Horizon 2020 Advisory Group on international Cooperation

Report for the Work Programme 2018-20

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Table of contents

International Cooperation mainstreamed in H2020

General openness to the world is a unique feature and a "unique selling point" of H2020 and one of the priorities of the European Research Area (ERA). Europe is still leading in scientific publications. However, its general position in the global science and technology landscape is challenged on the one hand by emerging S&T powers. On the other hand, the economic crisis, and conflicts such as the refugee challenge are reducing Europe's perceived attractiveness as a location to do research and also as a partner for research collaboration.

Therefore, a joint effort is necessary towards effectively utilizing the potential of Horizon 2020 for international cooperation to strengthen Europe's S&T position in the world. [In other words: Europe's leadership position is in danger unless we cooperate much more internationally.

The new strategic approach to international cooperation launched by the European Commission in 2012[1]defines the policy framework and Horizon 2020 (H2020) provides the appropriate main instruments for implementation. The general openness to the world is still the baseline characteristic of the programme. However, there are three new aspects of H2020 compared with previous framework programmes:

- International partners from BRICMs[2] are not automatically eligible for funding by the EC anymore,
- International partner countries provide matching funds for the H2020 participations from their countries for most[3] or all or selected[4] thematic areas, or for specific regions[5];
- Roadmaps and substantive flagship initiatives negotiated and agreed between the European Commission and international partner countries[6]have been made explicitly to serve as a basis for priority-setting in H2020 programming.

Different country groupings call for different approaches and priorities of cooperation:

- The EFTA countries and the EU enlargement countries and countries covered by the European Neighbourhood Policy;
- Industrialised countries;
- Emerging economies;
- Developing countries.

The first phase of H2020 resulted in a dramatic reduction in international cooperation which can be only partially explained by the new funding rules for the BRICMs, but is also due to

[1] European Commission: Enhancing and focusing EU international cooperation in research and innovation: A strategic approach. COM(2012) 497, Brussels, 14.9.2012
[2]Brazil, Russia, India, China, Mexico
[3] Russia, China, Taiwan, Hong Kong, Macau,Mexico, Republic of Korea
[4] Australia (SC1), Japan (power electronics, critical raw materials), India
[5]Canada (Quebec), Brazil (Sao Paulo, Santa Caterina, Golás, Minas Gerais, and Amparo à Pesquisa)
[6]See:2014 and 2016 reports on the implementation ofthe strategy for international cooperation in research and innovation

turmoil in Europe's neighbourhood. In addition, in contrast to FP7, there is no dedicated international cooperation scheme,there are no specific International Cooperation Actions (SICAs) in H2020, and there is the decrease in the number of WP topics that mandate international participation.

In that situation, it is important to recall the main objectives and drivers for international cooperation and the crucial role it should have in H2020:

- To enhance scientific excellence and strengthen leadership while promoting the visibility of Europe's research and innovation capacities at a global scale;
- To access and attract talent and knowledge;
- To access infrastructures and resources as well as special environments;
- To strengthen Europe's scientific and economic competitiveness and innovation capacities;
- To participate in global value chains and markets and to enter and develop new markets;
- To develop cutting edge or emerging technologies together with international partners;
- To tackle global societal challenges in the most efficient way, building capacities and exchanging best practices
- To address issues that by their nature can only (or best) be solved through international cooperation;
- To support a Common Knowledge and Innovation Spacewith the EU's neighbouring countries;
- To identify hotspots of excellence in developing countries and establish long-term collaboration;
- To use Science diplomacy as "avant-garde" and support for cooperation in other policy areas

The foremost drivers for international cooperation in H2020 remain scientific excellence and international exchange of the best. However, in many cases also synergies with other EU policies and instruments should be sought and utilized. In general, international cooperation should have a long-term orientation building on what has been achieved and allow long-term capacity and partnership building to tackle scientific, societal and economic challenges.

The Advisory Group agrees with the view of the previous Advisory Group that a "Master Plan" for the systematic integration and implementation of a coherent and consistent international cooperation strategy in Horizon 2020 is necessary. The Advisory Group welcomes the advances with regards to the development of roadmaps and the definition of flagship initiatives with third countries as moves in the right direction.

The AG puts forward three key recommendations:

- To integrate the roadmaps and flagship initiatives into one coherent overarching Plan for International Cooperation under the Work Programme 2018-2020 that is binding for the different members of the Research Family;

- To define an overall coordinating, facilitating, supporting and monitoring function in the Commission with a clear cross-cutting mandate for the efficient implementation of the international cooperation strategy 2018-2020;
- To strengthen the resources for strategic intelligence and foresight for international cooperation providing the information and knowledge base for the planning and implementation of the international strategy. The Science Counsellors at the EU delegations play an important role in that area. The close cooperation with Member States' science counsellors should be strengthened in joining forces exchanging information and dividing labour in that area for mutual benefit. In addition, establishing closer collaboration with the various regional and international bodies involved in science policy should be considered and supported by appropriate means.

In addition, the AG recommends:

- To devote special attention towards increasing the mobility of European researchers to third countries. Immersion into those research and innovation systems is the basis for building trustful and sustainable personal and institutional relationships as a basis for long-term cooperation;
- To foster the cooperation with EUREKA in order to strengthen SME involvement and the focus on innovation. A specific Horizon2020/EUREKA scheme for supporting international cooperation of research intensive SMEs should be established;
- To strengthen the international dimension of public-public and public-private partnerships: For public-public partnership ensuring cooperation between Member States towards achieving critical mass as attractive partner for strong emerging international partner countries; for public-private partnerships *considering the need to balance engagement in international cooperation with safeguarding the interests of European companies*]
- To align Member States and EU policies and programmes for international cooperation as well as rules and procedures for launching joint activities and evaluating proposals. This would put Europe as a whole in a strong position when working with funding bodies from third countries in ERA-NETs, JPIs of Global Multilateral Initiatives.

The international dimension in H2020 can and should also be used towards supporting crosscutting integration. Developing country specific strategies across H2020 will help to identify synergies between the different pillars and schemes of the programme and support an integrated approach in the relations between the EU and third countries especially in cases of flagship initiatives of an interdisciplinary nature. Some Societal Challenges such as tackling climate change would require targeting countries of different groupings

Future and Emerging Technologies and SC5: Climate action and Environment

This contribution covers an EU strategy for International Cooperation in R&I for both FET and SC5 (never forgetting that R&D&I international cooperation can be used as a political instrument for peace, when the main objectives are to achieve well-being and socio-economic development):

- To explore the potential of FET for sustainable development and improve environmental sustainability and encourage the creation of suitable facilities to recycle and dispose e-waste
- To align policies to support the development, adoption, adaptation and diffusion of FET to take advantage of the technological leapfrogging opportunities created by such technologies, taking into account the socioeconomic and political context of countries
- To raise awareness and facilitate networking and partnerships between various technology foresight organizations and networks, in collaboration with other stakeholders
- To discuss and explore innovative financing models as a means to attract new stakeholders , and sources of investment capital for science, technology, engineering and innovation-based solutions, in collaboration with other organizations, where appropriate, within a multi-stakeholder approach
- Equal-footing **multi-stakeholder** (governments, academic and technical communities, private sector and civil society) partnerships based on the principles of co-ownership, mutual interest, shared benefit and co-financing, creating a stable long-term and sustainable framework
- To continue to use article 185 TFUE as a very useful real basis to engage both the Commission, Member States and third countries to handle a long term strategic cooperation in creation geographical zones, on certain scientific areas
- Maintain an EU leading position on clean-tech solutions and markets – to become the world role model for sustainable production and consumption – however, we still live in silos with no interactions between economic sectors and policies – international cooperation could be the driven force to EU to take the lead
- Systemic eco-innovation is about change and impacts – it should encourage strategic **multi-stakeholder** agendas to collaborate
- International cooperation to empower citizens, creating new jobs, like a grand coalition for digital jobs on an international cooperation basis.

Marie Sklodowska Curie Actions

General openness to the world is a unique feature and a "unique selling point" of H2020 and one of the priorities of the European Research Area (ERA). MSCA has a key role to play in that direction. Therefore, the global scope of MSCA should be maintained and strengthened. MSCA fellows have a role to play as "ambassadors" of European research and support later institutional collaboration between the host and the home institutions.

The main aim of MSCA is to equip researchers with the necessary skills and international experience for a successful career, either in the public or the private sector. Therefore, the programme offers excellent training opportunities and host organisations to facilitate the career development of researchers. The programme is fully horizontal and interdisciplinary by its nature. MSCA provide grants for all stages of researchers' careers.

In principle, MSCA offers excellent opportunities reinforcing the international dimension of the career of European researchers by enrolling them in organisations in third countries and providing them with transferable competences, capabilities and skills like research cooperation and communication in different cultural settings but also insights in research and innovation system in international partner countries.

However, there are imbalances between different target countries. While the USA remain a preferred target country newly emerging countries such as China, Brazil, or India attract only extremely small numbers of outgoing European researchers. Personal experience and insider knowledge of European researchers that have been working in those countries will be important for establishing collaborations and partnerships with institutions in these non-European research areas that will play an important role in the development of research on a global scale. European researcher can and should act as "ambassadors" of European research and contribute to safeguarding the leading position of Europe in the global research and innovation community. Therefore, specific supporting measures should be considered such as

- Preparatory schemes introducing outgoing researchers with regard to culture and language as well as specific features of the research and innovation systems. As an example, the S&T Fellowship Programme China that combined half a year of language training with 18 months of research stay in China was very successful. In such schemes also specific attention should be paid on gender related aspects and barriers of mobility.
- Detailed studies about the international dimension of MSCA with regard to specific target third countries with a special focus of international outgoing fellows.
- Information activities with regard to cooperation with selected third countries especially those that are partners of the EU on the basis of agreements for S&T cooperation. In that context, the information about roadmaps and flagship initiatives should be more widely spread to European researchers.

- National Contact Points (NCPs) for International Cooperation should be re-established supporting the other NCPs and providing tailor-made information and assistance to researchers with regard to the mobility to specific third countries.

In addition, MSCA can attract the most outstanding researchers from third countries. Special attention should be paid on addressing the scientific diaspora. Specific activities, for example in the form of vouchers, targeting diaspora researchers can facilitate the transfer of knowledge and information between EU and 3rd countries.

Through the MSCA Alumni Association, networks of researchers can serve the benefit of ERA even beyond the duration of the grant and can help to contribute to sustainable development in the given research sector. Tracking researchers' career paths can provide important information with regard to training needs and thus support the further development of the MSCA scheme.

The European Research Area opening to the world will need European researchers that have insight and understanding of research and innovation in and with institutions in third countries based on practical experience and established personal contacts. MSCA is a key H2020 scheme that can and should substantially contribute towards achieving that ERA priority goal.

It is of outmost importance to ensure the sustainability of successful international collaborative projects and activities. Often, information and networks, together with valuable opportunities having been developed are wasted after the project end. In many cases it would be very useful to take up the findings of such projects and exploit them in future actions where applicable. In many international actions, it would be most valuable to move away from learning to action, from stand-alone pilots to sustainable collaborative initiatives.

Research Infrastructures

Research Infrastructures (RIs) play an ever growing role in scientific research. They are actively developed and used in most scientific domains, and allow for many new and breakthrough research discoveries. These facilities are not only dedicated to basic scientific research but many of them have been built recently to provide direct scientific support for the resolution of major societal and environmental challenges.

A majority of new research infrastructures have an international dimension. This is a growing necessity not only due to their increasing cost and complexity that require international partnerships and support, but also because of the added value provided by the cooperation between multiple partners. However, there are a number of challenges to this internationalisation.

RIs often require a long process of strategic priority setting, planning and design – typically at national level, but increasingly also at regional and even global level. The potentially participating countries have major differences in R&D funding systems, decision making process, strategic planning and evaluation procedures. Political, cultural and legal barriers have to be overcome and common methodologies and processes have to be developed to plan, construct and operate jointly international RIs.

Issues that might benefit from international cooperation include in particular:

- Increased scientific impact through shared competencies and broader access to user communities: international collaboration allows RIs to expand their user base.
- Capacity building in areas with lower scientific expertise: international RIs can constitute regional catalysers for developing scientific excellence ;
- Involving new countries in RI through international cooperation can increase science excellence and broaden the international coverage of data especially in environment, energy and life sciences. The involvement of more countries can bring in new skills, knowledge and resources but the right tools to improve and facilitate this involvement have to be developed.

Concrete recommendations on facilitating International cooperation

- Develop options for international RIs in terms of governance, management, funding, legal aspects including issues like know-how and data protection, public security, corporate and tax law;
- Develop tools to increase collaboration with new countries;
- Set up measures to assist interested countries in developing procedures for strategic planning and evaluation processes (partnership processes);
- Provide funding schemes to support international RIs beyond the initial developmental phase and into operation on specific aspects, for instance for data management and sharing, for open access and for access to users and training;

LEIT Information and Communication Technologies (ICT)

It is suggested that Open Innovation 2.0 should be at the centre of international cooperation on R&I. Open Innovation 2.0 is a new mode of innovation which blurs the lines between government, industry, academia and citizens. A core goal is the enabling the vision of sustainable living, where technology enabled innovations provide improved quality of life and improved wealth creation, while reducing unit resource consumption and lowering environment impact. For more details on OI2 see
http://www.nature.com/news/twelve-principles-for-open-innovation-2-0-1.19911

If we can collectively align around an agreed end state vision of our research and innovation efforts OI2 could be a powerful aligning force. Creating a series of shared visions for the different major societal challenges such as Climate Change and Sustainable energy, as compelling as JFK's statement of 'putting a man on the moon this decade and bringing him back safely' would help drive alignment.

However, OI2 is not a panacea. Open Innovation can even be dangerous where there is a substantial difference in the level of knowledge, contributions and resourcing of different players. In OI2 the principle of shared value is crucial so there should be a reasonably equitable distribution of the wealth generated from research and innovation. It has been noted by the high level reports on KETS that the ratio of basic research to applied research is much higher in Europe than it is in the US and other countries. This might position other countries to better exploit basic knowledge created in the EU. A recent EU report stated that the only Innovation indicator that the EU was leading on was scientific publications. This is a matter for concern although a subsequent report identified that the Innovation gap with the US was narrowing.

Trust is another key issue. Karl Eric Sveiby has written that 'Trust is the bandwidth of communication' and trust can only be built through continued engagement and shared results. While openness is great when there is high trust, the EU also cannot be naïve.

LEIT Nanotechnologies, materials, biotechnology, manufacturing

Opportunities & Considerations for International Cooperation

INTRODUCTION

The NMPB LEIT programme supports research and innovation (R&I) in the manufacturing of speciality high functionality materials and fabricated devices. First and foremost, it is a major industrial sector in its own right. Its' customer / supplier relationships are "business-to-business" (B2B). The sector has annual sales of ~ €trillions. It is fast moving, high added-value and supports a large number of SMEs and jobs. Europe's NMPB manufacturers are globally competitive and trade globally. International cooperation in this sector must balance both protection of Europe's IP and collaborations to extend markets and business.

By their very nature NMPB technologies can provide breakthrough technical solutions for addressing the societal challenges (E.g. Health, Energy, Climate Change, Bio-economy etc. Thus NMPB R&I and manufacturing businesses play a pivotal role in translating excellence in research translating over "death valley" to market application. NMPB's businesses by being major players in resulting global value- chains, have the potential to provide the best solutions for Europe's societal challenges. NMPB has carried out a simple analysis of INCO EU/individual country bilateral cooperation road maps. In order, the most frequent collaborations are:

I. Nano EHS Environment, Health & Safety risk research
II. Materials, devices and standards 5G telecoms, Internet of things, superfast broad band. (CONNECT & NMPB to jointly lead?)
III. Scarce materials substitution
IV. Components of the circular economy e.g. the 4xRs, (reduce, reuse, remanufacture & recycle) and life cycle analysis (LCA)

The above are incorporated into our proposals below:

1. **Technical Opportunities:**
   a. **Energy:** NMPB Technologies are at the heart of new paradigms in energy generation, storage and transmission. Examples include catalysts for generation and storage, new materials for renewable energy generation. Also graphene structures for low energy loss transmission.

   b. **Water Supply Security**: Potable water is energy intensive in high-temperature countries. NMPB chemical and biotechnology industries are large users of water. These industries are at risk in periods of water shortage, as citizens' needs take priority. Thus NMPB cooperationscould contribute to blue technology and clean oceans objectives.

   c. **Circular Economy (CE)**: NMPB Technologies and actors have the most comprehensive set of practical tools of all technology sectors for delivering CE's circularity goals of minimising energy use and eliminating waste materials to environmental sinks (air, land and water). They include:" safe & "green by design" multi-scale modelling, catalysts (chemical - and bio-), on-line EHS monitoring, technology substitution, (LCA) and the 4xRs**.**

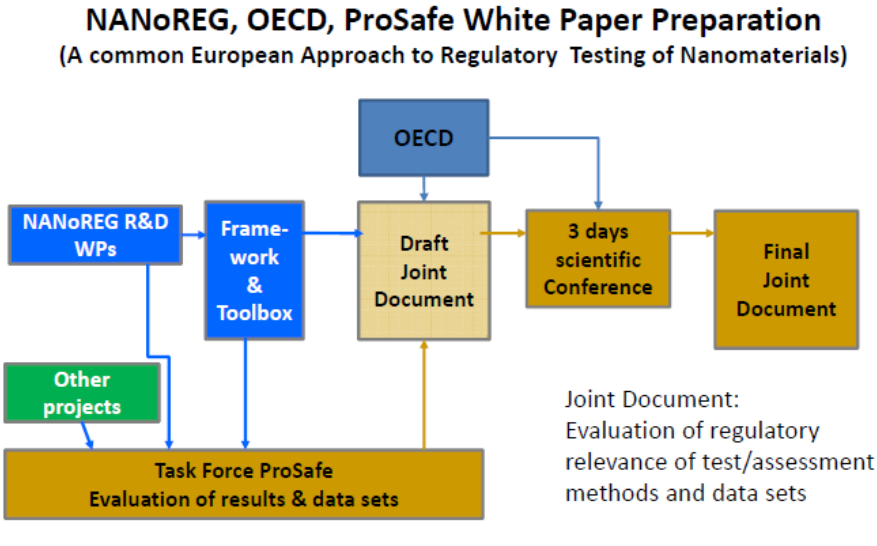
   d. **Climate Change:** NMPB Circular economy manufacturing techniques have good track records here (e.g. EU R&I for HFC refrigerants replacement of CFCs has led to the UN (2015) confirming the "hole in the ozone layer is now healing. New NMPB technology is now needed for low energy refrigeration and reduction of 'green house' gases.Thereis a general need for NMPB technology to recycle CO_2 into useful product to replace CCS.Through

international cooperation, Europe's CE approaches could be used in collaborations to address these challenges.

e. **"Internet (Smartphone?) of Things":** NMPB technologies, such as smart materials and devices which include sensors, actuators and data transmission protocols, lie at the critical interfaces between intelligent products, wireless technologies and internet based ICT systems. International cooperation within ISO, CEN, CENELEC, with the US, JN, KR will be essential for development of coherent technology standards for European manufacturers.

f. **Nanotechnology – Progress towards cost-effective and evidence-based Global regulation:** Nanotechnology is now through its 10-year Gartner "Hype to reality" cycle and is finding commercial applications in all other industrial sectors (e.g. Health , ICT etc) and for the grand challenges (Energy, Water, CE, clean technologies etc). Full market realisation however is held back by diffidence amongst decision makers in governments, investors and large industry, because of fear of environment, health and safety (EHS) risks for engineered nanoparticles. In the last 10 years Europe and the US have invested ~€500M and $750M on nano EHS research. There is an urgent need, initiated in Europe but in cooperation with the OECD, US, JP, CN, CA and AU to migrate the most relevant research to innovation in:i) regulation (ECHA and REACH), ii) EHS testing to support and iii) Control of labelling and packaging (CLP).

g. Two important initiatives are progressing that will enable acceleration and harmonisation of international cooperation. The first is a root and branch review of all previous EU nano EHS projects by the pan European FP7 NANOREG project to extract the best practice and data for regulatory development. The second is the ongoing sharing of EU scientific results and best practice internationally through the *Communities of Research* (CoR). The dominant partner in global nano EHS research is the US's National Nanotechnology Initiative (NNI) through its Coordinating Office (NNCO). The FP7 NANOREG and H2020 PROSAFE Projects, together with the OECD with input from the US NNCO, is writing a *White Paper* to be published in March 2017, to chart the future direction of nano EHS research and innovation for informing global regulation of nanotechnology(See Figure below):



h. The proposal is to create an *axis of virtue* inter alia the US and EU for a harmonised forward programme of nano EHS R&I based on the 2017 *White Paper's* recommendations. Early joint activities should include:

(i) Creation of international reference materials and standards
(ii) International laboratory proficiency testing schemes
(iii) Joint mesocosm studies to study environmental impact.
(iv) Standardised high-throughput testing, nano-QSARs and toxogenomics research

i. These themes would subsequently be augmented by programmes from the strategic plan emerging from the 2017 *White Paper.* The current CoR programme already includes contributors from JP, CN, CA and AU. The proposal therefore recommends inviting all international bilateral cooperation to join the EU, US, JP, CN, CA and AU partners in this important long-term venture

j. Nanotechnology Public Perception: At the beginning of the "Gartner "hype to reality" cycle , public fears of EHS risks for engineered nanotechnology were heightened following concerns over GM products. This in turn led to the large investments in EHS research on both sides of the Atlantic and the development of tools to minimise hazard and exposure to human health and environmental impact. Recent studies by CEFIC across Europe comparing public perception of nanotechnology versus many other industrial sectors. Early indications from the US NNI suggest public opinion amongst American citizens is moving the same way. Cooperation in comparative sociological research could provide support for evidence-based global regulation and reduce risk concerns amongst governments, investors and large industry.

2. International Trade Opportunities:

a. Metrology and standardisation for EU competitivity in TTIP:NMPB is the lead programme coordinating the EU/MS funded €600M (EURAMET) European Metrology Innovation Programme (EMPIR). It involves the national metrology institutes of all 28 Member States (MS) and 16 International cooperations. Its new standards are developed for all industrial sectors and challenges from Health to ICT. EMPIR is a novel, powerful and can provide leadership for global industrial standards. This requires partnerships with the national metrology institutes in major trading blocs such US, CN, JP, CA, AU, IN etc.

b. Business Insurance risk modelling research for KETs manufacturing: This applies to all key enabling technologies (Nano, Bio, Materials, Production, Photonic and ICT). By coupling CE methods for multi-scale modelling techniques for "safe/green by design products and processes together with business insurance risk modelling it will be possible to increase investment in developing NMPB businesses for higher-added value chains and new global trading models along materials or device trading financial businesses. A global system for "track and trace" for advanced materials will enable lower supply chain costs for customer-supplier B2B in value chains

c. Asia: Cooperation with ASEAN countries using NMPB CE techniques could contribute to Circular Ocean Concept and provide future business opportunities for Europe.

d. **Africa and Middle East:** NMPB Technologies can contribute to cooperation in renewable energy, storage and transmission. Equally, cooperation in clean water production is also foreseen.

LEIT Space

1. Setting the scene

In recent months and years, Europe has obtained outstanding results in technically challenging fields, such as the Rosetta probe accompanying the comet Churyumov-Gerasimenko along its orbit, or the LISA pathfinder mission , in preparation for a future mission to detect gravitational waves from space, the sensitivity of which surpassed all expectations. With the combination of Ariane, Soyuz and Vega, many probes or satellites have been launched successfully. The first ExoMars mission, developed in collaboration with Russia, was launched by a Proton rocket from Baikonur in April 2016. In parallel, China and also India are progressing rapidly, in space endeavours in general and more particularly in exploration. The International Space Station has continued hosting European experiments in various fields, but is expected to last only until 2020. The worldwide launch market is in a state of flux with the advent of new private options offered, e.g. by Space X.

2. Main drivers for international cooperation

In space, main drivers for international cooperation are studies on subjects impacting humanity as a whole, such as: human space flight, earth observation and climate change, space weather, space debris, exploration of the solar system, astrophysics and fundamental science. COSPAR, the Committee on space research, has set global roadmaps for astronomy, for space exploration, for space weather and for observation and integrated earth system science, which are useful to assess existing and possible future areas for international cooperation in each of these fields.

Human space flight in Europe will be in a delicate position once the exploitation of the ISS ceases. New opportunities for human flights will have to be found through international cooperation. Meanwhile, H2020 can support the relevant technologies for enabling humans to spend long periods in flight or on other solar system bodies than the earth.

In Earth observations, CEOS (Committee of EO Satellites) and GEOSS (Global EO System of Systems) monitor the work done at the global level. The Copernicus satellites are part of this global effort, and they should be attentive to the needs of emerging and developing countries.

In space exploration, some ambitious goals, such as sending humans to Mars, are so challenging that they require wide global collaboration. The main agencies involved are coordinated informally bythe International Space Exploration Coordination Group, which have established and continue updating a Global Exploration Roadmap, which can be used as a basis to decide on future studies and missions.

On the innovation/technology side, an important aim of Europe in the coming years should be to develop technologies it does not own yet, in order not to be dependent for crucial elements of satellites or probes or launchers. International cooperation, with countries more advanced in the subject, could be extremely useful.

Another goal should be to take advantage of the numerous developments stemming from its successful missions to develop innovative applications to other areas. On a case by case basis, it should be possible to establish collaborations with emerging or developing countries that would be particularly interested in one or the other of these applications.

Access to Risk Finance

Growth oriented companies in search for funding is continuously having problems when it comes to attracting investors from outside their own country. There are many barriers for cross border investments, some are formal barriers connected to national legal framework and tax issues, others are of more cultural and institutional nature.
Others again are more practical like

- Which legal frame work shall govern an NDA: that of the discloser or that of the recipient?
  - Because of the risk of being exposed to a litigation under a foreign legal framework, many investors refuse to sign NDA from foreign entrepreneurs.
- Shareholder registers is a universal method used by private unlisted companies to track ownership of a company,
  - to create a shareholder register in compliance with standards across EU jurisdictions is a challenge for SME's.

Investors often benefit from special tax incentives, if they invest in national companies, which discourage cross border investments, where such incentive is not "part of the package". Smaller investors also refrain from making cross border investments because of uncertainty about foreign legislation. Closer cooperation in the form of cross border investments can remove all or a major part of the both real and perceived risk, because the local partner knows his national legal framework. However due to different national tax regimes capital gain/and losses are treated differently national legislation. This means that often in exit situations, the exit route of preference differs between investors adding to the perceived investment risk.

In order to facilitate a better cross border cooperation between investors, it could be useful in cooperation with e.g. The European Venture Capital Association (EVCA) and the European Business Angel Network /EBAN) to identify major barriers for cross border investment and international syndication. In particular, it could be relevant to identify those barriers, which can be removed via further transnational cooperation without changes in national or EU legislations, and those which requires more fundamental changes in legislation.

A comprehensive prioritized mapping of both perceived and real barriers for cross border investments in SME's would provide a good platform for political initiative to further enhance cross border investment. This would make more funding possibilities available for Europe's future growth companies. Many of which can already be identified from the groups of successful SME having received H2020 Instrument Phase 2 funding.

Innovation in SMEs

As the **2012 INCO S&I strategy claims,** "As more research and innovation is performed in third countries, the Union will need to access this knowledge. To remain a major global player, the Union must present itself as an attractive location for carrying out research and innovation and be successful in the global competition for talent, while at the same time preserving its economic interest." The overall objectives are to increase the EUs competitiveness and to strengthen demand lead innovation.

Innovation activities are becoming truly global. India and China are already larger than US in receiving R&D investments and both nations are becoming important sources of global innovation investments. Market structures in these new innovation power houses require new ways of innovation in order to provide affordable solutions to the many in those markets. Production of new knowledge and technology needs to be balanced with the initiatives to stimulate import and commercial utilization of research results regardless of where in the world it is produced.

Research and innovation and the role of SMEs are seen as major drivers of growth with open innovation and open science promoting the collaboration between stakeholders and the creation of value at the interface between sectors and industries where synergistic approaches can help address major societal and market needs. Support to innovative SMEs has a high priority in Horizon 2020.

The Innovation in SMEs Advisory Group proposed structural and financial support measures that:

- Support and help innovative SMEs to commercialize their innovations (commercialization objective)
- Stimulate sustainable growth in SMEs (growth objective) with the focus on long term growth and competitiveness rather than short term “exit” in the financial markets
- Address the financing needs of SMEs by combining multiple financing tools while respecting market practices

European SMEs are operating in a changing global environment that presents new kinds of challenges that necessitate agility, increased awareness and systematic innovation at multiple levels. The SMEI as a policy tool needs to reflect this environment and faces specific challenges of its own that it must address if it is to achieve its intended purpose.

Based on the report of the Innovation in SMEs Advisory Group version 1, June 6th 2016, , the following recommendations can be directly linked to the field of international cooperation:

- Improving skills of SMEs

In the area of improving skills of SMEs, the Innovation in SMEs Advisory Group has discussed the introduction of mentoring, besides current coaching activities. Mentoring services could be delivered by professionals from Europe and beyond with the added value of preparing European entrepreneurs to all the challenges related to internationalization and can lead to synergies to bridge gaps also with regard to trends in the non-European landscape, especially concerning emerging markets and their focus on crowd funding and thinking, their way to create networks and strategic alliances.

- Improve the processes and skills of the support system

In order to improve the processes and skills of the support system, in line with the EU Communication 'Small business, big world' one of the six fields of action is "promoting clusters and networks for SME internationalization", the Advisory Group proposes the formation and support of horizontal and vertical clusters i.e sector based or target market based. It is also underlined, that networks of intermediaries that help each other to improve skills and support learning should be considered.

- Open innovation in SMEs

New initiatives should also facilitate open innovation in SMEs. Open innovation is becoming an important tool in innovation development for SMEs, who must and will rely on external sources for technology and knowledge, and not force themselves to (re)invent R&D results. For research-intensive SMEs, open innovation processes provide new opportunities to license IPR instead of having to develop them into own products and services. Moreover, participation of SMEs in pre-competitive research collaborations is desirable. The value of 3rd country participation in such collaborations should be further supported. Better conditions for open innovations needs to include better linkages to innovation enabling contexts, to research institutions and to innovation clusters worldwide.

Global challenges present new business opportunities and create demand for new innovative solutions for society and industry. As the Innovation in SMEs Advisory Group explains, "production of new knowledge and technology need to be balanced with the initiatives to stimulate import and commercial utilization of research results regardless of where in the world it is produced." (page 56) Such initiatives could target the absorption capacities of SMEs and innovation services.

SC1: Health, demographic change and wellbeing

Many of the challenges addressed in this Societal Challenge are of global nature, requiring the development of global solutions in cooperation with third countries and relevant international organisations or initiatives. Strengthened international cooperation will provide opportunities for Europe at large, notably by learning from experiences acquired outside of Europe, by drawing from other sources of excellence in science and of innovation, and by building new markets. International cooperation will also uncover new approaches to address common health and wellbeing problems.

Issues that might benefit from International cooperation include in particular:

(i) Research and innovation solutions are needed to meet the challenges of an ageing population in Europe and the rising costs of health services. Countries outside Europe are facing the same challenges and intensified international cooperation will facilitate the development of effective and efficient new models of care.

(ii) Advancing technologies, ICT platforms, robotic and semantic interoperability of digital health framework will require international cooperation and global consensus on shared standards;

(iii) Research into improving health of the ethnic minorities and resident migrants is an important challenge, which will require international cooperation. In particular, health records for people in the move are lacking and it will be important to build a European network of health databases and Big data.

(iv) Innovation on environment and health, green solutions and sustainability (incl. climate change) will require international cooperation as environment-related issues are global and cannot be tackled within the European borders.

(v) Infectious diseases do not respect borders. The conduct of research on emerging infectious pathogens and antimicrobial resistance, as well as innovation in health technologies to tackle associated health threats will need cooperation beyond Europe;

(vi) Boosting EU's competitiveness in new areas such as personalized and precision medicine will benefit from international collaboration. Advancing early disease detection, prevention, and new clinical trial paradigms will require expanding existing data and biobanks beyond Europe.

Concrete recommendations on facilitating International cooperation

- Make participation on third parties a requirement for certain SC1 calls;
- Dedicate a portion of the budget for third countries;
- Simplify the bureaucratic aspects of applying for Horizon 2020 calls and make explanations on work programs more user-friendly;
- Advertise at international conferences about the possibility for third countries to participate;
- Organize coordinated and joint calls between the EC and third countries.

SC2: Food, agriculture and forestry, marine and maritime and inland water research and bioeconomy

i) International cooperation dimension

Many of the challenges in this area are of global nature, requiring the development of global solutions in cooperation with third countries and relevant international organisations or initiatives in particular view of solving common problems and meeting international commitments.

Main challenges are the following: to ensure safety of EU consumers at imported foods; reduction, valorisation of food waste and by-products; improving resource efficiency to reduce environmental impact of food chains; promoting and supporting healthy diet to improve public health; fostering innovation and exploitation of research results.

Main objectives for international cooperation

1. To participate in global value chains and markets
2. To tackle global societal challenges in the most efficient way
3. To access to talent, knowledge and resources

ii) Main drivers for international cooperation and recommendation

Priorities for 2018-2020 are the following:

- At *Sustainable Food Security*,

1. To participate in global value chains and markets

Ensuring safety of imported food for protection of the health of the European consumer

- Promoting the application of preventive approach and use of practical risk assessment methods by the food businesses, continuation of the support of the implementation of the, common priorities developed by the EU-China Task Force on FAB within the flagship initiatives with China.
- Implementation of the recommendations developed and agreed on improving the framework conditions for EU-China innovation cooperation based on a “Study supporting EU-China Innovation Cooperation Dialogue”, South-East Asia, Africa.
- Improving sustainability creating opportunities for EU knowledge and solution providers for prevention, reduction and valorisation of food waste, continuation of the support of the implementation of the, common priorities developed by the EU-China Task Force on FAB within the flagship initiatives with China.
- Improving the food safety, resource efficiency, reduction of waste of global fish and seafood supply chains with South-East Asia.

2. To tackle global societal challenges in the most efficient way

- Improving the resource efficiency and sustainability of transcontinental value chains with Latin-America;
- Promoting and supporting healthy diet to improve public health. Making the healthy choice the easy choice. Networks to validate the beneficial effect of bioactives and traditional medicine with natural constituents – with India, China, South-East Asia, Africa

- Sustainable food supply in large cities, urbanisation. Implementation of the recommendations developed and agreed on improving the framework conditions for EU-China innovation cooperation based on a "Study supporting EU-China Innovation Cooperation Dialogue" – Brazil, Mexico

3. Access to talent, knowledge and resources

- Fostering innovation and exploitation of research results, integrating the private initiatives on innovation. Cooperation visits New Zealand, Australia, Canada, USA. This includes cooperation on healthy and safe foods and healthy diet. Atlantic Ocean Research Collaboration in
- Access to young talents. Organising international food innovation awards based on the experiences of the Ecotrophelia. Implementation of the recommendations developed and agreed on improving the framework conditions for EU-China innovation cooperation based on a "Study supporting EU-China Innovation Cooperation Dialogue" – South-East Asia, India, North-America.
- Fostering cooperation of EU third parties innovation networks and joint best practice guides on food innovation sector specific measures and demonstration projects;

SC3 Secure, clean and efficient energy

Setting the Scene

International Cooperation for Energy – whether nuclear, energy efficiency, diversification "away from oil", system optimization or low carbon technologies - has a decades old tradition with key involvement by EU research and industry actors. More than 1000 international R&I cooperation agreements and partnerships are active at present. They involve all major research institutes and companies in both the developed and developing world. They cover both pre-competitive, energy R&D projects as well as demonstration and market launch initiatives. Thus, an announcement that Europe is "open to the world" will not necessarily translate into INCO activities in the energy sector. The EU sponsored Energy R&I INCO program must (i) offer a win-win situation for all partners; and (ii) deliver on either "Excellent Science", or "Industrial Leadership", or "Societal Challenge" goals.

Four factors will impact the demand for and the type of energy INCO projects during the Horizon 2020 period:

- First, the Mission Innovation initiative launched by the 20 largest industrial countries at the Paris Climate Summit in 2015 to double public, low carbon R&I funding by 2020 and mobilize private funding will make available substantial new funding to strengthen national research capabilities. INCO energy R&I will not be required for cost sharing purposes.
- Second, energy security or strategic energy independence remains one of the major objectives for nearly all countries. Thus, low carbon energy research is expected to create jobs at home (and hopefully export markets). The goal is NOT to substitute imported fossil fuel with imported low-carbon products/installations/systems or software.
- Third, demand for low carbon energy from emerging and developing countries will outpace demand in the OECD countries. These markets will offer opportunities for market ready AND competitive, European technologies. However, they require nimble industry actors that are able and willing to navigate the very different regulatory environment and energy systems of non-EU countries.
- Fourth ,while Europe has been a leader in low carbon R&I and deployment, it faces now strong competition and cost pressures from other OECD countries and China and to a lesser degree from India and Brazil.

Main Drivers and Specific Recommendations

Within this context the drivers of energy related International Cooperation under Horizon 2020are the need

(i) to address issues that by their nature can only (or best) be solved through international cooperation;
(ii) to develop/demonstrate specific low carbon technologies and systems and develop cutting edge or emerging energy technologies;
(iii) to build capacity and exchange best practices to meet societal challenges;
(iv) to develop new markets and support the EU's neighbouring economies;

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The foremost driver remains scientific excellence and international exchange of best practices as low-carbon technologies and systems advance along the R&I cycle. In addition, the EU INCO program

should be willing to "build on what has been achieved" and allow long-term capacity and partnership building to meet societal challenges.

International Cooperation "must do"

The absolute priority for international R&I cooperation is **cyber security for electricity systems**. While this issue is being addressed by security analysts and regulators, bringing together cutting edge international researchers and exchange of best experiences is urgent.

Further important collaboration needs related to **digitalization** are

- research on privacy of life data in the energy field;
- network and systems interoperability in a digitalized world, and
- regional stakeholder collaboration on DAMES (Digitalization and Modelling of Energy Systems)

Standardization of alternative fuel and transport systems from electric cars, hydrogen fuel stations to self driving cars is another "must" for INCO R&I.

INCO on nuclear safety, staff development and exchanges ought to be continued.

Specific Energy Technologies and Future Emerging Technologies

Scientific excellence or critical technology demonstration/ market launch ought to be the drivers for INCO involvement in this important area of energy R&I. The Advisory Group of Energy has no specific recommendation for a targeted call at this point in time.

Capacity building to meet societal challenges

INCO activities in the energy field must address climate change issues, energy poverty and sustainable urban and infrastructure development. he Advisory Group of Energy suggests INCO research platforms for

- smart and sustainable cities;
- sustainable infrastructure systems;
- optimization of distributed renewables in different settings and systems.

In this context it may be helpful to explore new business models such as Living Labs.

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The above areas of INCO activities may require simultaneous strengthening of the research infrastructure in the partners' country and the funding medium/long-term researcher exchanges.

Capacity building to develop new markets and support EU's neighbouring economies

As the major part of the future low carbon energy growth market is in Africa, Asia and neighbouring non-EU countries, it is in the interest of the EU Member States to strengthen ties with these important new markets well beyond the existing international collaboration agreements with OECD and BRICS countries.

Priority should be given under Horizon 2020 to building research infrastructures and much more intensive education and researcher exchange initiatives than in the past. Building on past programs with the EU's Eastern and Mediterranean neighbours is a clear priority. However, such program with neighbouring countries ought to be supplemented with new programs in African and Asian non-BRICS countries.

SC4: Smart, green and integrated transport

I. Challenges and International Cooperation context:

1. Challenges related to "Mobility and Access for All":
"Mobility for all" may be specified as a "right" to accessibility to services and opportunities. It is associated with freedom of movement, democracy and self-reported happiness. Countries with lesser mobility are found to feature less security, poorer governance, and more unequal opportunities.

2. Challenges related to "Sustainable Mobility and Transport":
Transport environmental impact and the environment impact on transport concern a large spectrum of research arenas. The transportation community faces extraordinary and diverse environmental challenges: establishing knowledge, developing new technologies and facilitating the transition to applications and commercialization, under updated and enabling policies and norms. Freight and air transport in particular, face the most complex technical challenges with longer term technology breakthrough yet with short term rewards expected from new business models. Climate change is a multiplier of risks for transport. It increases costs of investment and services, and it makes evaluation of costs more uncertain. The environmental dimension needs to be mainstreamed as part of the risks and the solutions throughout transportation activities.

3. Challenges related to "Competitiveness and Leadership in Transportation"
Keeping pace with skills development and the exponential growth of knowledge and technology is critical. There is a broad sense however, that "Europe is losing its competitiveness" because of its smaller scale, lesser investment in research and development, lesser vertical integration than its major competitors, and less supportive environment for new market entrants with innovative products and services. There is a need for cooperative research to identify and work on new challenges. There is also a need to adopt a strategy between preserving EU technological leadership, or whether to accept, selectively, the role of follower in areas where others, for example the USA, are more advanced. Imitation also supports growth and competitiveness, and in many ways imitation represents incremental innovation where there may be an advantage. In any event a clear strategy about leadership may be of value in core research areas.

4. Cross cutting Challenges Group" Knowledge and Governance"
There is a critical need to renew the evidence base with state of the art data analysis techniques, and studies relating to the socio economic mega trends, understanding them and building the knowledge to address its issues and respond to its needs with appropriate policies and incentives. The efficient sharing of knowledge, updating of the repository of data and promotion of its use in policy making, also constitutes a top priority research agenda.
Governance is a self-standing agenda:
In the many transitions phases through which the sector is evolving, a fundamental discussion needs to be held on the role of national, local and international governments, with respect to

ethics, privacy, safety, security, prevention of *de facto* quasi monopoles emergence, and on the social premises on which transport decisions are taken.
The development of intrusive products such as drones and the management of unchartered transitions (*especially regarding mixed road traffics of automated driverless and non-automated vehicles, on highways, and including pedestrians and two wheelers in urban areas*) raises governance issues. The same applies to the Data related to the mobility, identity, activity, security or safety of individuals, which are shared and controlled by third parties: research is needed to develop governance solutions for this issue.

II. International Cooperation Avenues and Priorities for the Transport Sector

A. Through the International Cooperation (INCO) programme, the EC has established the framework for R&I cooperation with international partner countries at both the regional and national level. Accordingly, joint R&I priorities have been identified in many areas including transport, and targeted transport themes (e.g. biofuels with South America) have been activated. This is to be maintained and further enhanced.

B. Accruing benefits at the EU level through international R&I cooperation however requires a stronger engagement on behalf of all concerned parties: the European dimension (in terms of both inputs and outputs) of international cooperation programmes and projects is not sufficiently visible, as individual Member States, as well as industry, often opt for bilateral approaches that do not allow to achieve the critical mass that is a prerequisite to successfully operate on global markets.

C. The European leadership in areas such as transport automation, safety, energy efficiency and greening in general can only be maintained and enhanced if the governance of international cooperation in R&I recognizes the need for novel instruments (incentives, standards, multilateral policy dialogue) to promote a truly integrated European strategy.

D. EU knowledge in transport technology, combined with its recognized leadership in sustainable mobility policies and practice, should be better and more systematically exploited to foster education programmes directed to the next generation of transport leaders in other regions of the world.

E. Cooperation with selected developing countries is an avenue whereby good governance practices are shared and exported in order to address security gaps and to ensure EU security. It is also necessary to have reciprocal and compatible regulations for trade, for example to export automated vehicles.

F. Rules for users of automated vehicles need to be standardized, in the same way as the UN oversaw the Traffic signal standardization through the Vienna Convention. WTO, International Telecom Union (ITU) need to be involved and ITU possibly reinforced. EU may serve as a catalyst for international governance since it has credibility. The new

governance allows a framework to be put in place smoothly, and serve to settle conflicts and differences.

G. It is necessary to remain aware of the global state of research: in particular regarding strategic areas of research among our larger partners US and China. To gain some measure of proximity to that unknown strategic research, there is scope for selected international cooperation and the Commission may facilitate rapid links and other engagement ways with China and US.

SC5 Climate action, resource efficiency and raw materials

The context Europe and the need for international cooperation

It is necessary to reflect and respond to the priorities of Europe. The Juncker Commission has outlined ten priorities, of which Climate Action and Energy is a key priority. Despite a political and economic defying context, the challenges and possibilities linked to climate change mitigation and adaptation in line with the Paris Agreement is growing among businesses, cities, nations and citizens. Green growth is an emerging and powerful trend in the EU economy, capturing the vision of enabling the growth of jobs and competitiveness in businesses in an economy and society that is sustainable, inclusive, and provides products and services supporting a clean environment and healthy lifestyles. This requires a changing trajectory linking growth with different social demands and lifestyles, and envisioning a vast and deep economic and technological transition. Europe, through its different tools, should capitalize on this opportunity and boost inclusive growth through targeted and effective research and innovation activities. By doing so, there is significant potential to both create new domestic markets and a basis for new exports.

At the policy level, the 7th Environment Action Programme (EAP) provides the guiding framework European environmental policy until 2020 through three key objectives8, four enablers: i) better implementation of legislation; ii) better information by improving the knowledge base; iii) more and wiser investment for environment and climate policy; iv) and full integration of environmental requirements and considerations into other policies and horizontal priority objectives: i) to make the Union's cities more sustainable; ii) and to help the Union address international environmental and climate challenges more effectively. It is a cross-cutting framework and builds on a number of initiatives, including the Resource Efficiency Roadmap and the 2020 Biodiversity Strategy, to name a few.

Closely linked are also the Energy Union and the Circular Economy Package introduced in 2015, the Raw Materials Initiative and the European Innovation Partnership on Raw Materials, the revision of Waste Directive, the Eco-design Directive, the integrated European Union policy for the Arctic and others. Finally, in advancing its innovation priorities and international cooperation, the EU needs to find a balance between protecting the intellectual property of its innovations to ensure that the incentive to innovate remains and deploying them more widely in the pursuit of collective, international goals.

Cities and rural territories play a crucial role in addressing climate change. Urbanization continues at a rapid pace with approximately 60 per cent of global population estimated to live in cities by 2030 and cities will be key implementing agents of national and international mandates, goals and agenda, such as the SDGs and the 2030 New Urban Agenda. However, urban areas need to be reconsidered as part of an integrated system with adjacent metropolitan, peri-urban and rural areas, which connect to cities by providing essential lifelines of food, water, other resources and crucial ecosystem services/ resources. In the

context of a low carbon and circular economy, there is a need to think about the resource flows between urban and rural areas – what developments in one have on the other (whether that is land use, mobility etc.) through integrated, participatory planning approaches. There is an emerging need for more integrated, participatory planning approaches to shape resilient and healthy urban and rural environments. Thus, cities and local rural territories are where climate action, from policy decisions to infrastructural changes can take place directly and immediately – giving rise to opportunities to efficiently and economically address climate change. International cooperation in this area is essential.

On water, food and energy, despite policy and research-driven efforts at the national, European and international levels, water resources are still under relevant pressure in numerous regions. Water crises have been

identified by the World Economic Forum as the Top 1 risk in terms of impacts on economy and society for the upcoming years28. According to the European Environment Agency (EEA), pressure will increase in the years to come. Immediate action is therefore necessary to address existing and emerging challenges in the field of water resources. Competition for water among different uses has turned this resource into a limiting factor for societal wellbeing, and in some areas for economic development (e.g. for the agriculture sector, including its energy production and contribution). Within the new post-2015 development agenda, the place of water-related issues has been further strengthened. Indeed, water is at stake not only in Goal 6 to “Ensure availability and sustainable management of water and sanitation for all”, divided into seven specific targets, but in almost all of the 17 SDGs. So far the "full" interactions between energy, food provision, water use and links to other important environmental and societal challenges are understood conceptually and are already captured in cross-compliance frameworks to EU policies and the UN SDGs. Changes in climate come with drastic changes in the system dynamics of biodiversity, water, and ecosystems that are essential to our food security. These are also inextricably linked to human health. However, there remains a significant knowledge gap on the dynamics of the interactions and they are not well quantified. One particular aspect is the response between the different elements of the nexus to economic incentives such as the price of water and energy. The water-food-and-energy nexus is a key nexus that fosters growth and jobs, and if capitalized on will play a crucial role in Europe’s leadership in integrated technologies. International consensus and cooperation in these areas is essential to progress towards sustainable and integrated global solutions.

Finally, international regional initiatives like PRIMA (Partnership for Research and Innovation in the Mediterranean Area) aiming at establishing long-term structured partnerships in research and innovation in certain areas can be core with a view to preparing the building blocks of a multi-year and integrated Research programme on food systems and production and water resources and provision to enhance knowledge and unlock its innovation potential for food security and water availability through end user-friendly solutions in a context of ecological, demographic and climatic change and to advance existing knowledge and innovations for water and food quality and safety.

SC6 Inclusive and Reflective Societies: Europe in the world and international collaboration

(extracted from the AG's recommendations)

Migration

Migration is an international and global issue which cannot be addressed only within Europe or by European policies alone. International collaboration with both governmental and nongovernmental bodies is thus essential for better understanding and therefore more effective policies and policy implementation. Geopolitical changes can often trigger migration movements, so it is important to study what geopolitical consequences follow from all aspects of migration, both in Europe and in the source locations of migrants. What does migration mean for Europe as a world actor and what does it mean for the external view of Europe?
Migration policy needs rapid, flexible and long-sighted measures starting with policy innovation, changes in governance (e.g. when does an immigrant get the right to vote?) and programmes to equip people and all institutions and companies to deal with the change.
Good practice examples in managing migration flows in singe EU or non-EU countries should be considered. Important governance and policy issues requiring a research and innovation focus include, but are not restricted to:

- Addressing the WEF8 risk analysis of high-level geopolitical and societal risks which includes profound social instability, large-scale involuntary migration, state collapse or crisis, interstate conflict and the failure of national governance. These require governance and policy responses at all levels, not least internationally.
- Although increasingly typified and regulated as a 'brain-drain' of highly skilled workforce, the skill sets of migrants into Europe that have historically been encouraged by European governments to offset local shortages in the labour market, have also included low-skilled or semi-skilled labour. The greater the encouragement and facilitation of the migration of high-skilled workers, the more likely it is that this will undermine the perception of Europe as a responsible global influence. These inter-relationships need to be understood in the context of the international agenda.
- For example, the need to rethink the EU's Africa policy. High growth rates in the last 15 years have led to the belief that Africa, the world's poorest continent, will become 'the China of the 21st Century'. At the same time, the African population will double by 2050, and this is likely to increase its migration potential. In a context marked both by an above average pace of economic expansion and a booming population, an ageing European Union (EU) will be directly confronted at its doorstep with all major developments, positive or negative, affecting the African continent. In view of such challenges, Europe needs to define an ambitious strategy, beyond its traditional role of main development aid donor, to contribute more effectively to African development and to create the conditions for it to become sustainable, whilst not denying the likelihood that some African migration might be beneficial for Europe. In contrast, China embarked at an early stage on large-scale economic cooperation with Africa. The proposed EU-EAC Network aims to promote a tripartite cooperation system

between the EU, Africa and China to create a favourable framework for sustainable development. It argues that the EU's and China's comparative advantages can complement each other for the mutual benefit of all three parties.
- Creeping restrictions on the free movement of EU citizens, such as the Roma deportations since 2010 onwards, as well the proposed restrictions of access to social welfare for EU migrants in EU member states, as in Germany and the UK.
- The role of Turkey in Europe's and the broader Middle East's refugee crisis.
- The destabilisation taking place in the Caucasus, Moldova and Ukraine.

The important actors also need to be considered when examining the governance of migration, not just the nation state and supranational institutions, but also for example:

- Civil actors (e.g. grassroots movements, local actors/societies, NGOs, etc.)
- Human rights agencies (local, transnational, etc.)
- Representatives of migrants.

The human and social dynamics of the Fourth Industrial Revolution

Research and innovation are needed to reconfigure European policy for the turbulent world described above. Over the past four decades, the political model, including its legal and regulatory frameworks that both facilitated the global spread of technology and provided some protection against its disruptive consequences, has come under attack. It is clear that welfare states have become less generous, levels of long-term unemployment are much higher, taxation has become less progressive, and many contend that politics has increasingly been dominated by money and special interests. Whether or not these trends are conducive to inclusive, innovative and reflective societies requires urgent research and innovation actions, particularly because they are global in extent, not confined to Europe alone and in fact many may be more significant outside Europe. Thus, strong international collaboration is required to successfully address them.

Europe does not lack talent and creativity for the Fourth Industrial Revolution but does lack a market for them. However, young entrepreneurs, especially the most creative, often need to migrate to large cities, and some move beyond Europe. At the same time, the most successful high tech creative companies are struggling to grow or are likely to be bought by non-European capital as, for example, Skype. There are almost no new multinational corporations in Europe, while the US has generated Apple, Google, Facebook, and Amazon, each of which has created new global markets, partially exploiting European talent, and dominating the European consumer market. An important research and innovation issue to be addressed is why has Europe failed to create the type of multinational corporations that will retain its best and brightest brains and what are the implications – both negative and positive -- for not doing so? This may be a question of whether the upside of adopting an American style high tech model outweighs the downside in terms of culture, values and social cohesion.

The predicted end of mass employment will also have an impact on governance and democracy as we know it. Reverting the meaning of the American revolutionaries' motto, "no representation without taxation", there might be temptations to question the right to vote of people who have never paid taxes. As a result of the new digital economy, greater numbers of young people do not fit neatly into traditional job markets, whilst the increasing incidence of mobile and trans-national work makes it difficult both to pay taxes and to vote. Most of these issues also have a considerable international dimension, for example in the context of the likely Transatlantic Trade and Investment Partnership (TTIP), as well as existing WTO arrangements.

Governance of the future

Increasingly, the existential societal challenges faced by Europe are shared with the rest of the world and cannot be contained within, or excluded from, European borders, whether these include climate change, pollution, terrorism or international law and treaties. Europe as a unit needs to exercise 'soft' power in such contexts, whether or not it develops its hard power capabilities in cooperation with NATO and other allies. Research and innovation are therefore needed to address issues relevant to the role of Europe in the world, much of which should involve international collaboration, with key questions such as:

- The role of Europe in a multi-level governance environment:
    - Cross-border dimensions.
    - Local including city-levels, as well as marginal and rural areas.
    - Multicultural/cultural diversity within countries (e.g. different levels of openness towards social and cultural integration of various societies).
    - Social/political interaction between the EU and incoming aspiring Member States, such as Georgia, Ukraine and Moldova.
    - The rise of Asia: challenges and opportunities for Europe.
    - Centralisation versus decentralisation trends, and the role played by the changing societal context within countries, for example the growing importance of cities ('smart' cities) in sub-national systems, as well as the 'brain drain' phenomenon and, as a possible consequence, residual 'retired societies' at national levels.
- Conflicts, crisis and the role of the EU and other inter-governmental and trans-national organisations like the UN, the WTO, the WB and IMF, the OECD, the International Court of Justice, etc.
- Diversities of societal contexts and the relation of these with European governance and the European dimension.
- How different inequalities are handled by the different forms of government.
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The pursuit of 'good governance' (see section 5.4) is, of course, relevant for the government actor, but also for corporates, civil organisations, and in fact, for all governance systems across society, including trade associations, international bodies like the UN, WTO, etc. The issue of 'fairness', tax and tax heavens, especially in the aftermath of the so-called Panama

papers, is also of high relevance in the good governance context. It can also be linked to the issue of ensuring risks and benefits are well distributed in the Fourth industrial Revolution theme, as well as to the cross-cutting issue of inequality, poverty and fairness. In turn, there are links to issues of justice, legal instruments, the rule of law and institutions like the European Court of Justice, and how these need to change to cope with the evolving Europe. One example might be the re-establishment of physical border controls in response to the migrant crisis.

Over recent decades, the competences of EU governance have been considerably increased. In the same period many important global issues have been entrusted to specialised International Organisations (IOs). These two trends have produced a growing need for the EU to be well represented in the relevant IO in order to promote its objectives and work together to solve global challenges, including the migration and refugee crisis. Research and innovation in the context of governance in its global dimension should also examine the deep relationship between governance, migration and economic transformation. The migration and refugee crises are ultimately the product of governance failures in both EU and non-EU countries, whilst economic transformation is a global phenomenon ultimately led by markets so only indirectly within the scope of governance. In both cases, the EU needs to work with IOs such as the UN and WTO together with all the other non-state actors. Research and innovation could highlight the nature of this system of systems as 'global system science' to assist policy makers engaged with multi-level governance.

Cross-cutting issues and synergies

As history shows, Europe has often suffered due to the lack of sufficient in-depth knowledge concerning developments elsewhere in the world. This is necessary both to project European influence and soft power, but also for the sake of mutual learning when most societal challenges are global in extent and require international if not fully global collaboration. Some important challenges for research and innovation actions in this context might include:

- Examining how Europe can be fully 'open', both for participation from researchers and innovators outside Europe and because purely European responses to global challenges are unlikely to succeed. Diversity across Europe and transnational processes should be emphasised in many topics.
- Supporting strong partnerships with transnational actors, such as international organisations like the G8 and G20.
- A specific example might be social, cultural and economic cooperation between the EU and the Eastern Partnership countries, as this should be deepened in order to contribute to democratisation processes, to the development of markets for EU companies, and to strengthen European security. In this context, the role of Russia, for example on its border with the Ukraine, is causing unease. Other issues that could be considered in this context are sharing best practices in research, development and innovation management, as well as developing innovation strategies and the reform of research and innovation systems.

- Other countries which are very important for EU external policy include the USA, the Mediterranean countries, India and Asia, especially China. The 'rise of Asia' in particular poses challenges and provides opportunities for Europe.
- Given that Europe accounts for an increasingly smaller amount of global knowledge production, it is important to ask whether some projects in some domains can really be of excellent quality when no non-EU researchers and innovators are involved.
- For example, in China there is much effort in the domains of strategic intelligence and science policy, and in monitoring the activities of other countries in this area. This should be an area in which the EU could strengthen its efforts.
- How can Europe with its global partners increase the effectiveness of conflict prevention as well as of peace and stability measures?

SC7: Secure Societies

International cooperation in security R&D&I can provide opportunities and advantages for European practitioners, European industry, and European researchers in Academia, notably by allowing to draw from more sources of innovation, by opening new markets, by easing access to excellence outside Europe.

The Protection and Security Advisory Group (PASAG) set-up a working group on International Cooperation that will help identifying opportunities, threats, weaknesses and strengths that may result from cooperation with third countries, and recommend modalities for international cooperation within SC7 involving academics, practitioners and industry to the benefit of Europe.

1. General findings for Security Research

Issues that might benefit from international cooperation (INCO) in Security Research are:

(i) **Tackling global and inter-sectoral security and societal challenges** that cannot be addressed in isolation, but need global scenarios, knowledge and cooperation as well as practical cooperation such as exercises;

(ii) **Speeding-up development in past-conflict and less developed regions and mutual trust and relations** through science diplomacy and knowledge transfer leveraging EU development funds, its economic weight, and initiatives such as the "European Neighbourhood Policy".

(iii) **Boosting EU's competitiveness** through well-known positive effects of research collaboration, through expectations of neighbouring countries for the EU to bear responsibility and pay for security on the continent favouring technology transfer.

(iv) **Promoting customs control standards and CSI requirements** through agreed operating procedures for trusted countries.

(v) **Exporting the EU's understanding of security** such as focusing on the causes of insecurity and not just the effects; prioritizing prevention and anticipation; involving all sectors with a role to play in public protection (political, economic, social, etc.); respecting liberty and human rights

(vi) **Exploiting potential synergies that exist in areas of law enforcement cooperation, integrated border management and criminal justice systems.**

Major risks of INCO that have to be kept in mind (for further risks and more details cf. to the full document to be produced) include knowledge drainage, leaking of sensitive information, the lack of coordination as regards intelligence among MS leading to opportunities for third countries to exploit this, and the lack of intra-EU coordination on INCO leading to competitive disadvantages.

Concrete general recommendations independent from cooperation partner or scientific area

- Bilateral contracts with the EU for national co-funding by emerging and developed economies; the latter should include specialties of third country national rules and legislation for security research and export as well as IPR
- Possibly dedicated tasks for planning CSAs (as in DRS5) for in-depth insights into the issue (cf. 2015 AG INCO report): SRAs whose development involves third countries plus MS' visions; use cases of successful INCO; inertia to successful cooperation; mainstreaming with other parts of H2020 ; identification of target groups and areas
- For any cooperation bilateral preparation of funding schemes and roadmaps is recommended (cf. 2015 AG INCO report); harmonization of at least some MS' requirements is needed; strategic EU goals need to be defined; harmonization of national and EU funding schemes for INCO; utilize the experience and connections of members states with fruitful bilateral agreements with third countries as bridge.
- Flagship initiatives and respective roadmaps should be developed and key institutions at policy and program level should be identified and their agreements ensured for the co-funding for participation in H2020 projects and initiatives.
- Arrange larger conferences, like the Annual EU security Conference with a global partner; E.g. EU and North America in a Euro-Atlantic Security Research Conference, another year the EU and East Asian Partners, or Another year the EU and the BRICS in Partnership.
- Strive for coordinated and joint calls between the Union and the third country
- Involve the public and private sector as well as public-public cooperation.
- Assessment of the effectiveness and impact of cooperation activities with third countries. Possibly create small planning teams focused by country. Interagency and inter-nation objective setting. Specialised and knowledgeable people, no REA—selected evaluators.
- Devote special attention towards increasing the mobility of European researchers to third countries and vice versa. Immersion into those research and innovation systems is the basis for building trustful and sustainable personal and institutional relationships.
- In order to strengthen SME involvement and the focus on innovation, closer cooperation with EUREKA is recommended. A specific Horizon2020/EUREKA scheme for supporting international cooperation of research intensive SMEs should be established.
- Avoid EU jargon when drafting work program

More details are going to be recommended for specific thematic areas:

- Borders and External Security
- Fighting Crime and Terrorism
- Secure and Resilient Societies
- Cybersecurity and Privacy Technologies
- Promoting a Competitive Security Industry

Horizon 2020 Advisory Group International Cooperation

Members

Ana Cristina Amoroso Neves, FET

Manfred Horvat, MSCA (Chair)

Fredéric Sgard, Research Infrastructures

Martin Curley, LEIT Information and Communication Technologies (ICT)

Terence Wilkins, LEIT Nanotechnologies, materials, biotechnology, manufacturing (NMPB)

Catherine Cesarsky, LEIT Space

Uffe Bundgaard-Joergesen, Access to Risk Finance

Ágnes Márta Szmolenszky, Innovation in SMEs

Marie-Paule Kieny, SC1 Health, demographic change and wellbeing

Andrá Sebök, SC2 Food security, sustainable agriculture, marine and maritime research & the Bio-economy

Marianne Haug, SC3 Secure, clean and efficient energy

Alassane B. Ndiaye, SC4 Smart, green and integrated transport

Ana Cristina Amoroso Neves, SC5 Climate action, resource efficiency and raw materials

Barbara Ubaldi, SC6 Inclusive and reflective societies

Merle Missoweit, SC7 Secure societies