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COVER NOTE

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date of receipt:	29 May 2017
To:	Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council of the European Union
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Subject:	COMMISSION STAFF WORKING DOCUMENT IN-DEPTH INTERIM EVALUATION of HORIZON 2020

Delegations will find attached document SWD(2017) 220 final PART 2/4.

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Brussels, 29.5.2017
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PART 2/4

COMMISSION STAFF WORKING DOCUMENT

IN-DEPTH INTERIM EVALUATION
of
HORIZON 2020

{SWD(2017) 221 final}
{SWD(2017) 222 final}

6. HOW RELEVANT HAS HORIZON 2020 BEEN SO FAR?

This question aims to determine whether the original objectives of Horizon 2020 as defined in its impact assessment are still relevant and how well they still match the current needs and problems of stakeholders. It also addresses the question of the flexibility of the programme against new scientific and socio-economic developments.

Expectations from Horizon 2020 in terms of relevance

Based on the Horizon 2020 impact assessment - compared to FP7 - Horizon 2020 is expected to focus on a limited number of mutually consistent and concrete higher-level objectives that are closely related to Europe 2020 (i.e. on growth and the resolution of six societal challenges through research, innovation, and the training and skills development of researchers). Horizon 2020 is expected to have the support of all types of stakeholders, who agree on the need to orient EU research and innovation funding towards the resolution of societal challenges and the achievement of ambitious EU policy objectives in areas such as climate change, resource efficiency, energy security and efficiency, demographic ageing, etc., and who support the centring of EU research and innovation funding around three objectives: tackling societal challenges, strengthening competitiveness, and raising the excellence of the science base. By strengthening bottom-up schemes and making work programmes less prescriptive Horizon 2020 is also expected to provide for more programme flexibility than FP7, being also more open with both curiosity-driven and agenda-driven activities working in tandem.

Summary box: Key findings on the relevance of Horizon 2020

- ✓ Horizon 2020's original rationale for intervention and objectives remain largely valid.
- ✓ Further strengthening the EU's science base is as necessary as ever and remains a valid Horizon 2020 objective.
- ✓ Closing the innovation gap and boosting industrial leadership remains a valid key objective for the EU and Horizon 2020, although the importance of supporting breakthrough, market-creating innovation is now more clearly recognised than when designing Horizon 2020.
- ✓ The societal challenges identified when conceiving Horizon 2020 still exist and are valid continued priorities for the EU and Horizon 2020.
- ✓ The continued relevance of Horizon 2020 also lies in its contribution to the achievement of a wide range of EU and global objectives such as the Sustainable Development Goals.
- ✓ Horizon 2020 has been flexible enough to support research on urgent new needs (e.g. Ebola and Zika outbreaks, migration) as well as new, promising science and research.
- ✓ Emerging priorities and new developments need to be scouted continuously and the right balance has to be found between being too prescriptive or not prescriptive enough.
- ✓ The strategic programming process improved the intelligence-base underpinning programming choices and helped better define the focus in line with stakeholder needs.
- ✓ Horizon 2020 is broadly in line with stakeholders' needs and is attractive for newcomers.
- ✓ The 2-year programming is at times seen as too rigid to swiftly respond to emerging needs dictated by disruptive and counter-intuitive technologies and business models.
- ✓ The translation of high level challenges and objectives into specific calls and topics is not always clear.
- ✓ The wider public's understanding of the benefits of publicly supported research and innovation and the involvement of civil society in Horizon 2020 can be further improved.

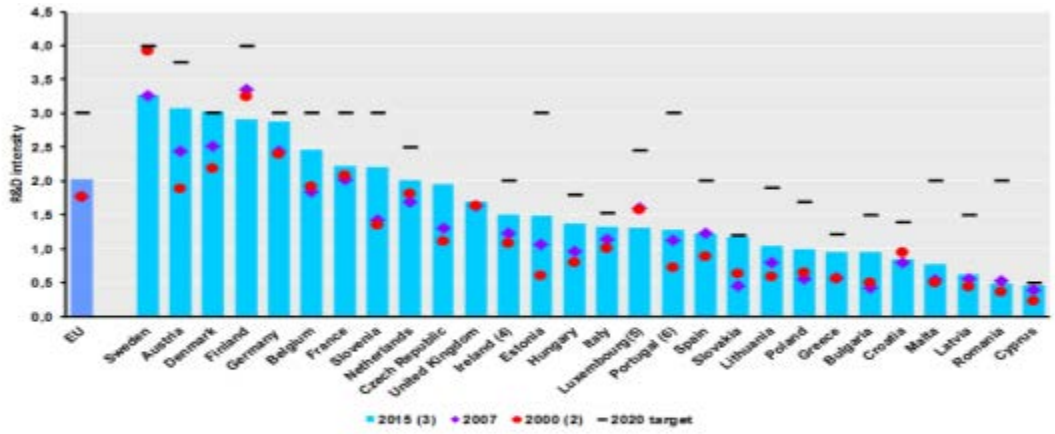
6.1. Is Horizon 2020 tackling the right issues?

6.1.1. The relevance of Horizon 2020 given the challenges to address

When Horizon 2020 was conceived Europe suffered from a number of critical weaknesses in its R&I system, which contributed to the problems of low productivity, declining competitiveness, inadequate response to societal challenges and the inability to move to a new sustainable economic model[1]. Europe's innovation gap was identified as the key problem driver, with the following structural problem drivers underpinning it: the need to strengthen the science base; insufficient technological leadership and innovation capability in the private sector; insufficient contribution of research and innovation to tackling societal challenges; and insufficient trans-national coordination. Horizon 2020 was adopted to tackle those problem drivers and improve Europe's competitiveness.

These (structural) problems still persist. The EU has not yet overcome the effects of the economic crisis – for the first time in almost a decade, all 28 EU economies are expected to grow over the next two years. High unemployment, especially amongst young people, remains the biggest socioeconomic concern and challenge in many Member States in 2016. At the same time, **the EU has to respond to new emerging challenges**, such as armed conflicts, rising migration flows or global health emergencies. The EU still faces strong productivity and innovation challenges, as emerging from the most recent economic forecasts.[2] Actions in the area of research and innovation are a central element in a coherent response to these overarching challenges.[3] In terms of investments in research and development (R&D), **overall EU-28 progress towards the Europe 2020 target (gross expenditures on R&D representing 3% of GDP by 2020) has so far been limited, reaching 2.03% in 2015** (Figure 1).

Figure 1 R&D intensity, 2000, 2007, 2015 and 2020 target



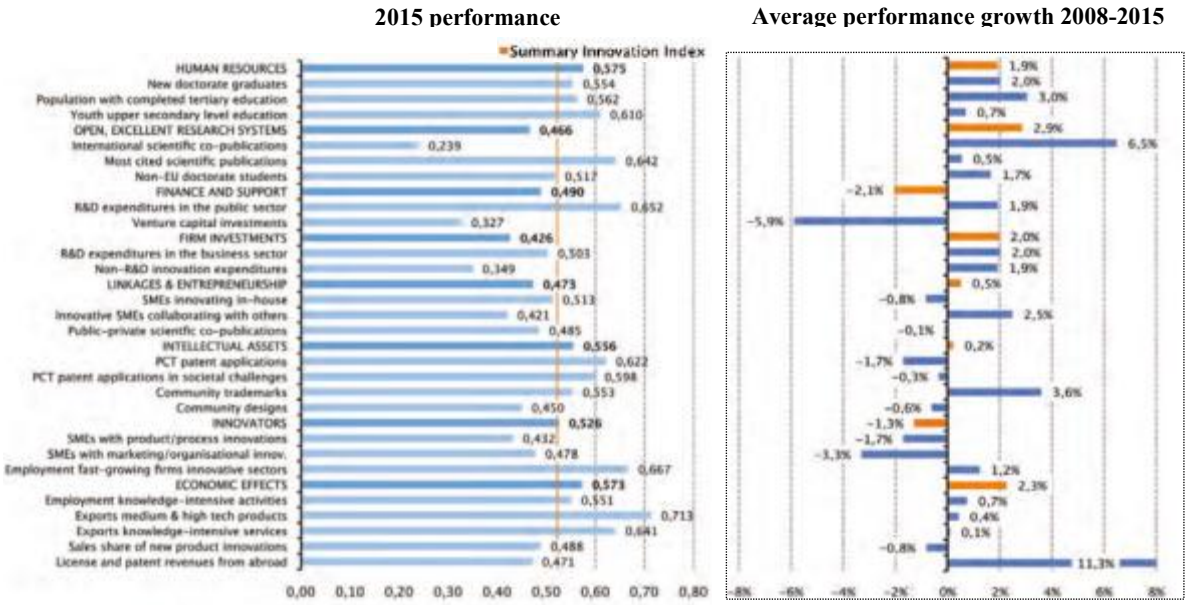
Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: Eurostat
Notes: (1)CZ, UK: R&D intensity targets are not available. (2)EL, SE: 2001; HR: 2002; MT: 2004. (3)IE: 2014. (4)IE: The R&D intensity target is 2.5% of GNP which is estimated to be equivalent to 2.0% of GDP. (5)LU: The R&D intensity target is between 2.30% and 2.60% (2.45% was assumed). (6)PT: The R&D intensity target is between 2.70% and 3.30% (3.00% was assumed). (7)DK, EL, FR, HU, NL, PT, RO, SI, SE, UK: Breaks in series occur between 2000 and 2015.

Figure 2 provides a snapshot of the European research and innovation performance in 2015 as well as the evolution over 2008-2015. Overall **EU research and innovation performance has been increasing** at an average annual rate of 0.7% between 2008 and 2015, but growth

[1] European Commission, SEC(2011) 1427, Impact Assessment Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation' (COM(2011) 808)
[2] European Commission (2016), European Economic Forecast Autumn 2016. Institutional Paper 038
[3] European Commission (2016), European Economic Forecast Autumn 2016. Institutional Paper 038

has not been equally strong across all R&I performance dimensions and indicators. In spite of some improvement, the EU is still lagging behind main international competitors, such as the USA, Canada and Australia.[4] The EU has been strengthening its educational knowledge base turning Europe into a more knowledge-based economy whereas the EU innovation system has become more networked both between Member States and at the global scale. However despite improvements the EU still displays **weaknesses in terms of firm-level investments and the share of innovative SMEs collaborating with others, international scientific co-publications and public-private co-publications**. Noteworthy is the negative growth of the average EU performance in the 'Finance and support' dimension which is due to a **strong decline in Venture capital investments** from an already low level (-5.9%), a declining performance in SMEs that introduced product or process innovations, and SMEs that introduced marketing or organisational innovations.

Figure 2 EU-28 research and innovation performance per dimension, 2015 and average performance growth over 2008-2015



Source: European Innovation Scoreboard 2016, European Commission

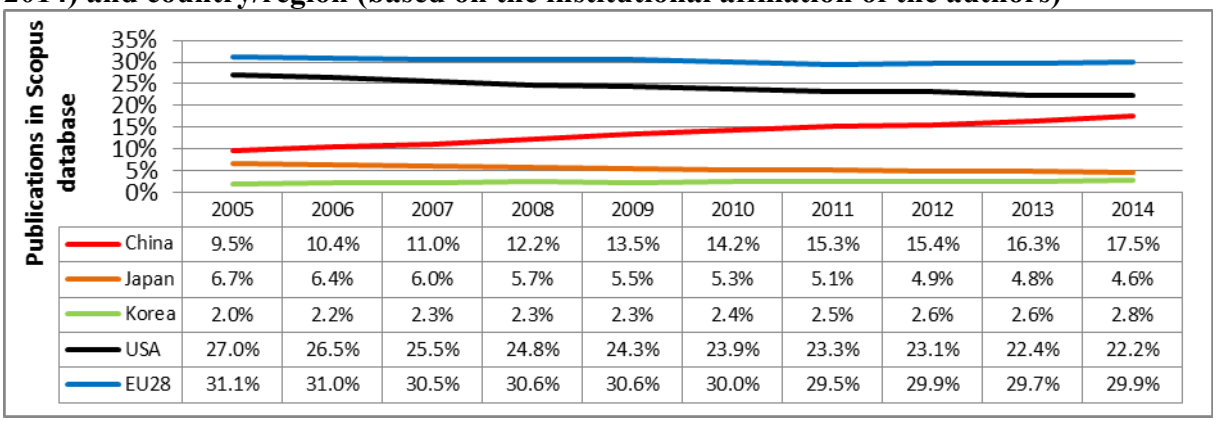
Furthermore, within the EU, there is substantially **unequal R&I performance amongst European Member States**[5]. The need for trans-national coordination was identified as a need to be addressed through Horizon 2020. Optimal circulation and transfer of knowledge (across countries, sectors and disciplines) is one of the key prerequisites for relevant research with societal or economic impact[6] and is addressed throughout Horizon 2020 through trans-national activities. Also, the specific programme Spreading Excellence and Widening Participation (SEWP) aims specifically to fully exploit the potential of Europe's talent pool and to ensure that the benefits of an innovation-led economy are both maximised and widely distributed across the Union in accordance with the principle of excellence. The thematic assessment validates the objectives of the SEWP programme highlighting however that widening countries are not all affected by the same problems and to different extents showing that the current dichotomy widening-non-widening and EU-13 versus EU-15, can be considered as a simplification of the reality.

[4] European Commission (2016), European Innovation Scoreboard 2016
[5] European Commission (2016), European Innovation Scoreboard 2016
[6] European Commission (2016), Science, Research and Innovation Performance of the EU, 2016

The need to strengthen the science base

In terms of scientific publications, the **EU is a world leader in terms of quantity, but still lags behind the USA in top quality output** as measured by bibliometric indicators[7] - even if improving in recent years - or by tracking major scientific recognitions such as the Nobel Prize awards. Other regions have been expanding their scientific profile, and emerging countries such as China have become large producers of scientific knowledge. However looking at the share of top 1% most highly cited publications (Figure 3) **the EU-28 has caught up with the USA in 2014, each accounting for about 40% of the world's top-cited publications**. In 2014 EU –based authors appeared on more top 1% cited publications (14,172) than USA-based authors based (14,093) in absolute numbers for the first time.

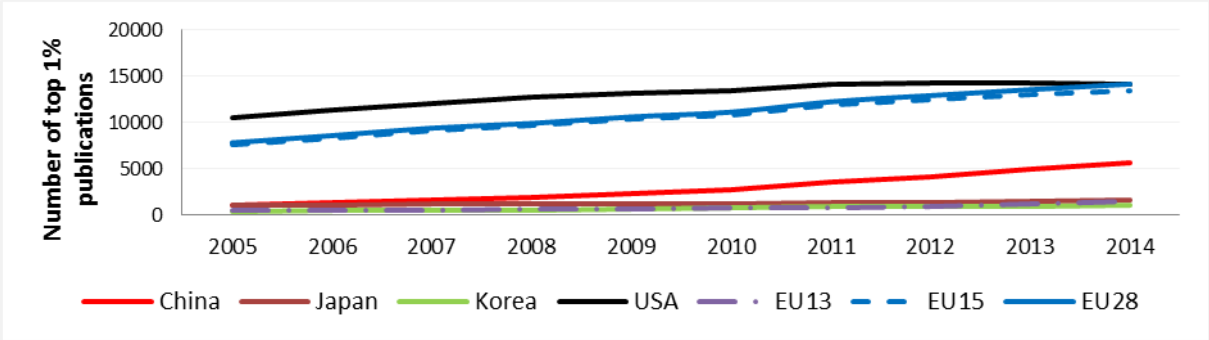
Figure 3 Percentage of publications indexed in Elsevier's Scopus database by year (2005-2014) and country/region (based on the institutional affiliation of the authors)



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
China	9.5%	10.4%	11.0%	12.2%	13.5%	14.2%	15.3%	15.4%	16.3%	17.5%
Japan	6.7%	6.4%	6.0%	5.7%	5.5%	5.3%	5.1%	4.9%	4.8%	4.6%
Korea	2.0%	2.2%	2.3%	2.3%	2.3%	2.4%	2.5%	2.6%	2.6%	2.8%
USA	27.0%	26.5%	25.5%	24.8%	24.3%	23.9%	23.3%	23.1%	22.4%	22.2%
EU28	31.1%	31.0%	30.5%	30.6%	30.6%	30.0%	29.5%	29.9%	29.7%	29.9%

Source: Scopus database, ERCEA elaboration

Figure 4 Evolution of number of top 1% most highly cited publications, selected countries and regions



Source: Scopus database, ERCEA elaboration

Worldwide, the EU is however lagging behind in university rankings. In the 2016 Leiden rankings,[8] only two EU universities are in the top 25 (US has 19) and seven in the top 50 (all from the UK, US has 38).[9] Within the EU, **scientific quality is concentrated in a group of leading countries** predominantly in North-West Europe while Southern, Eastern and Baltic

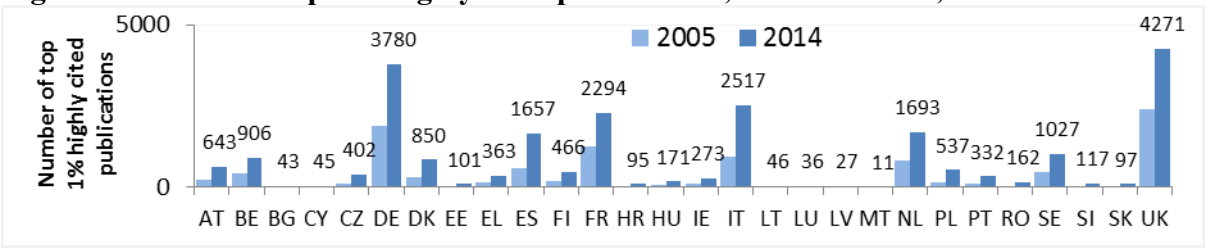
[7] OECD (2015), Science, Technology and Industry Scoreboard 2015: Innovation for Growth and Society

[8] http://www.leidenranking.com/, based on proportion of a university's publications that, compared with other publications in the same field and in the same year belong to the top 10% most frequently cited

[9] The US has 58 universities in the top 100 while the EU has 30 (including 17 from the UK, 7 from the Netherlands) with another seven from Switzerland and Israel combined

countries still rank at the bottom despite progress in recent years. Figure 10 shows the evolution of the number of top 1% highly cited publications by EU country.

Figure 5 Number of top 1% highly cited publications, 2005 and 2014, EU countries



Source: Scopus database, ERCEA elaboration

Evidence also shows a positive correlation between the level of science-business collaboration and the quality of research and frequency of innovation. Public-private co-publications per million-population stand at 50.03 in the EU, around 5 points lower than in Japan and over 35 points lower than in the USA.[10] The number or researchers increased in the EU in the last decade (from 1.4 million in 2005, to 1.7 million in 2013 and 1.8 million in 2015 in full time equivalents), but there are still large differences between EU Member States in how researcher careers are structured and how professional development and career planning is supported at the institutional level[11]. A growing share of PhD candidates in the EU is finding career opportunities outside traditional academic research careers[12].

Overall, the EU's public sector research system is large and diverse and remains the largest producer of knowledge in the world. However, it is essentially a "mass producer" with, relative to its size, comparatively few centres of excellence that standout at the world level and with large differences between European countries. Underlying the Horizon 2020 Excellent Science pillar, **the need to strengthen the EU's science base and support excellent research to improve the quality, relevance and impact of its scientific output remains valid** at a time when non-EU countries are investing massively in science and engaging in strategies to attract the top researchers.[13] Horizon 2020 allocates a budget of EUR 24.4 billion (31% of Horizon 2020 budget) for actions to raise the excellence of Europe's science base, in particular through actions which proven to be a massive success, including the European Research Council, with the view to generate the ground breaking research and innovation needed to sustain Europe's competitiveness in the long term.

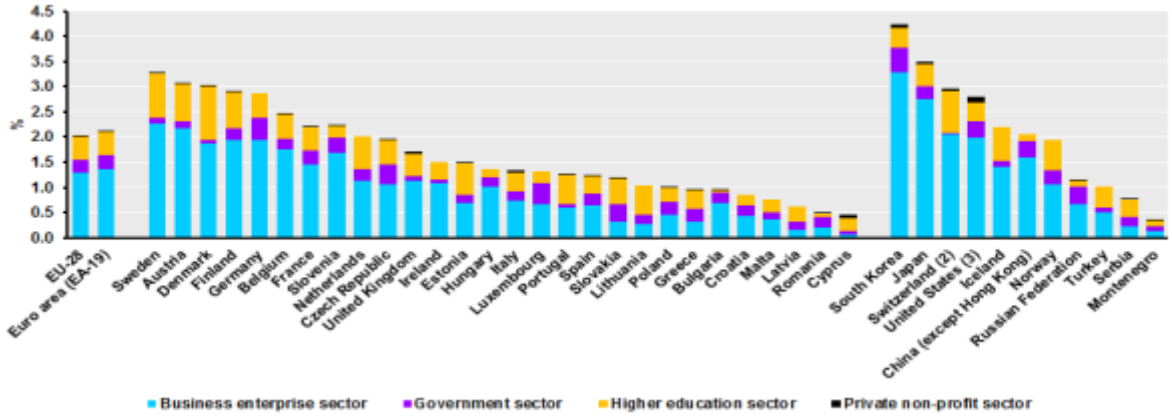
The need for a reinforced technological leadership and innovation capability in the private sector

Low consumer demand in Europe, uncertainties about the economic outlook, relatively high prices of raw materials and energy prices, as well as difficulties in access to finance for SMEs, were weighing down on business confidence when Horizon 2020 was designed[14] [15]. **Europe still shows a structural gap in private R&D investments, compared for instance to the USA, together with lower productivity growth**, which puts competitiveness at risk.

[10] European Commission (2016), Science, Research and Innovation Performance of the EU, 2016
[11] IDEA Consult (2013), MORE2 study final report
[12] The non-academic sector here does not necessarily focus on industry, but could encompass public sector organisations, the voluntary sector and non-profit organisations.
[13] See Annexes Part 3 for in-depth assessments of each Horizon 2020 specific objective.
[14] European Commission, Industrial Policy Communication and Staff Working Document No 297, 2012
[15] Impact Assessment. Commission Staff Working Paper. SEC(2011) 1427 final

In 2015, just under 23 million SMEs generated EUR 3.9 trillion in value added (slightly less than three fifths of EU value added in the non-financial business sector) and employed 90 million people in Europe (two thirds of EU business sector employment). While business expenditure on R&D (BERD) in the EU-28 increased from 1.13% GDP in 2007 to 1.30% GDP in 2014[16], the EU is not on track to meet its 2% business R&D expenditure target by 2020. The gap in business R&D expenditure between the EU and some of its main competitors is mainly caused by a **lower weight of high-tech sectors in the EU's economy**. One source of Europe's lagging business innovation deficit relative to the US is seen in the **lack of "yollies**", i.e. young companies that have grown into world-leading innovators, in new innovation-based growth sectors.[17] It has been estimated that there could be up to 1 million new jobs created and up to EUR 2,000 billion added to GDP in the EU over the next 20 years if the share of scale-ups would match that of the USA.[18] Access to finance, in particular **venture capital availability**, for SMEs, seed and start-up companies is crucial for innovative firms to grow, increasing their revenue levels, market shares, and employment opportunities.[19] [20] Whereas the volumes of venture capital investment in the USA have suffered a slight decrease of around 3% in terms of GDP from 2007 to 2013, **the drop in the EU reached nearly 10% in the same period**. The size of the gap between the USA and the EU is 6:1, in terms of GDP.

Figure 6 Gross domestic expenditure on R&D by sector, 2015 (% of GDP)



Source: European Commission, Data: Eurostat, OECD. Notes: (1)Switzerland: 2012; Ireland, Turkey, Serbia, Montenegro: 2014. (2) Switzerland: Government expenditure on R&D refers to federal or central government only.(3)United States: Most or all capital expenditure is not included.

In comparison to the USA, the EU is strongly specialised in medium-high-tech sectors such as automobiles and parts as well as in electronics and electrical equipment. However, **the EU is lagging far behind the USA in high tech sectors** such as software and technical hardware and equipment, and has a similar share of companies in pharmaceuticals and biotech, while aerospace and defence are more present in the EU (Figure 7).

[16] The group of EU companies within the World's top 2500 increased their R&D in last year by 7.5%, above the rate of the US companies at 5.9% and the Japanese companies at 3.3%.

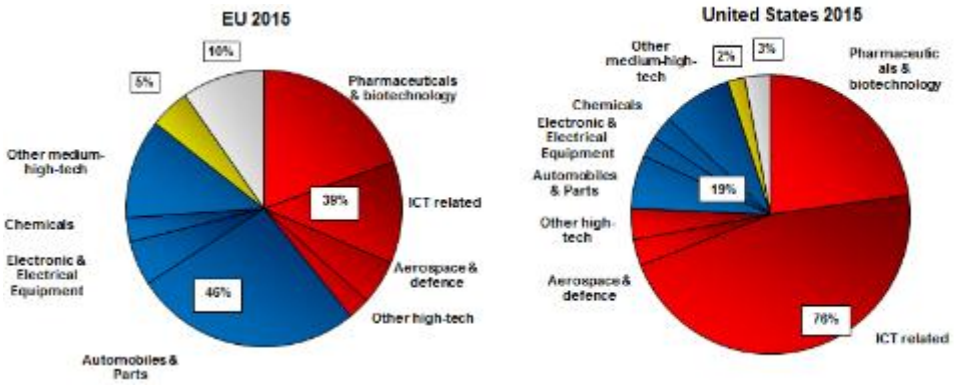
[17] High growth enterprises tend to be younger than the average enterprises (Innova, TNO, Framework Conditions for High Growth Innovative Enterprises, 2016). Among the USA leading innovators in the Industrial R&D Scoreboard, more than half are "young" (i.e. born after 1975), qualifying them as yollies whereas in the EU this share is one out of five. Yollies account for 35 % of total business R&D in the USA, while in Europe they represent 7%, (Veugelers R. Cincera M., How to Turn on the Innovation Growth Machine in Europe, 2015). High growth enterprises in the USA have on average twice as many employees as the European ones. The OECD concludes that 'a small set of high-growth enterprises drives a disproportionate large amount of employment creation'(OECD, Entrepreneurship at a glance 2016).

[18] Europe's next leaders: the Start-up and Scale-up Initiative, COM(2016) 733 final

[19] EIB (2015). Investment and Investment Finance in Europe 2015: Investing in Competitiveness

[20] European Commission (2016), Science Research and Innovation Performance of the EU, 2016

Figure 7 Sectoral composition of R&D intensive enterprises in the EU and United States, 2015



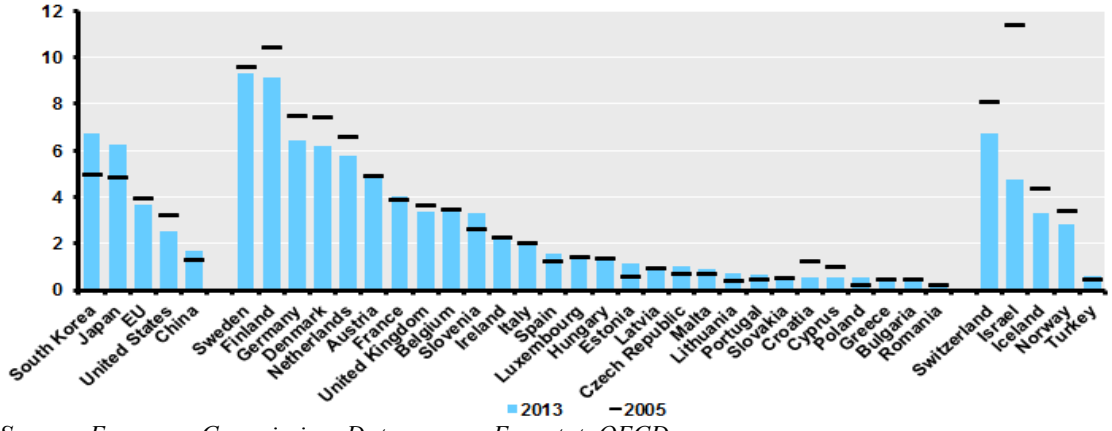
Source: EU Industrial Scoreboard, 2016

Box: Key data on the role of European industry in Europe

Industry accounts for the largest contributions to the economy's R&D intensity and trade balance (64%[21] of manufacturing on private R&D investments and over 80% of all exported goods). The strongest sectors also being technology and knowledge intensive are machinery and vehicles which represent 42% of exported goods, while other manufactured goods and chemical products represent 23% and 16% respectively.[22] More than 19% of the production volume of the EU-28 is highly dependent on key enabling technologies.[23] [24] The ICT sector also plays a key role for Europe's global competitiveness and growth. In 2014 (latest available data), the sector generated a value added of EUR 593 billion (4.2 % of EU GDP), employed 6.3 million people (2.8 % of EU total employment) and generated 16% of total business expenditure in R&D; ICT contributed 19-28% to the EU Innovation output indicator, highlighting the key trends in the digitalisation of industry.

As regards patenting activities, the EU performs on a similar level in international patent applications as the USA, but is outperformed by Japan and South Korea.[25] In many European countries, **the number of international and national patent applications has declined in the recent past**, while patenting is expanding quickly in East Asian countries. As a result, Asian countries, especially China, are catching up in world patent shares, while EU's share is declining and that of the USA, long in decline, has stabilised.

Figure 8 Patent applications (WIPO-PCT) per billion GDP (PPS€), 2005 and 2013



Source: European Commission, Data source: Eurostat, OECD

[21] Latest Eurostat data, October 2016
[22] EU Industrial Structure Report 2013
[23] Eurostat based figures from 2015.
[24] KETs Observatory, European Commission, December 2015.
[25] European Commission, Science Research and Innovation performance of the EU, 2016

Against this overall background, the second priority of Horizon 2020 is to foster Industrial Leadership with the aims to speed up the development of the technologies and innovations that will underpin tomorrow's new technology, keep leading industries at the forefront of global competition and help innovative European SMEs to grow into world-leading companies. **The technology-driven approach adopted under the Leadership in Enabling and Industrial Technologies (LEIT) programme, the provision of risk finance and the support of innovation in SMEs based on a demand-driven, bottom-up logic are all assessed as still relevant** given current challenges.[26]

The added value of Horizon 2020 programme is the focus on business-oriented research & innovation and exploitation opportunities. In effect, the current programme allows industries, and especially SMEs, to develop first concepts, then prototypes and patents for new products and services which can actually arrive to the market.

D'Appolonia SpA, Italy

Horizon 2020 allocates € 17.0 billion ((21.6 % of Horizon 2020 budget) for actions to directly support Europe's industrial base and to make Europe a more attractive place to invest in R&D. These are all actions which aim at leveraging significant private sector investment, including through a larger use of financial instruments (equity and debt) and through funding specifically for SMEs, so in effect the total funding invested in R&I through this priority is expected to be a multiple of what Horizon 2020 invests.

The need for R&I to contribute to tackling societal challenges

The third pillar of Horizon 2020 "Societal Challenges" responds to the policy priorities and societal challenges that were identified in the Europe 2020 strategy. Since the adoption of Horizon 2020, **the role of R&I to contribute to tackling societal challenges has further increased with the adoption of the UN's Sustainable Development Goals[27] and the Paris Climate Change Agreement (COP21)**[28] in 2015, providing a global framework to European action. The post 2015 Sustainable Development Agenda calls on all countries to enhance research, upgrade technological capabilities, encourage innovation, increase the number of R&D workers per 1 million people and increase public and private R&D investment in line with the universal 17 SDGs[29]. In 2016, the Commission published its Communication on the Sustainable Development Goals ("Next Steps for a Sustainable European Future[30]") which ensures that all EU policy measures take on board SDGs at the outset. Research and innovation are mentioned as crucial means to implement certain SDG targets, with a particular reference to FOOD 2030.[31]

The thematic assessments suggest that **the challenges remain valid for R&I investment and are even reinforced by the SDGs framework and the socio-economic context**. However, Horizon 2020's objectives in the societal challenges pillar as currently articulated in the legal basis are in several cases regarded as very broad and "all inclusive" - not providing an optimal basis for programme priority setting, monitoring progress or evaluating programme performance. Based on results from the thematic assessment **the Science with and for Society programme is also regarded as highly relevant to the overarching challenges facing Europe in transversal areas of Horizon 2020 in particular the need for greater support for citi-**

[26] See Annexes Part 2 for in-depth assessments of Horizon 2020 specific objective including each Societal Challenge.
[27] Available at: http://www.un.org/sustainabledevelopment/sustainable-development-goals/
[28] Available at: http://unfccc.int/paris_agreement/items/9485.php
[29] As highlighted in the report of the High Level Expert Group on the "Role of science, technology and innovation policies to foster the implementation of the SDGs", European Commission, 2015
[30] Available at: http://europa.eu/rapid/press-release_MEMO-16-3886_en.htm
[31] European Commission, Staff Working Document (2016)319, European Research and Innovation for Food and Nutrition Security, 2016.

zen science and user-led innovation. The European Economic and Social Committee (EESC), however, questioned whether the programme sufficiently involved real "societal" stakeholders and requested clarification about whether all societal groups can and should participate in SWAFS[32].

Horizon 2020 allocates the highest share of its budget for tackling societal challenges (€ 29.7 billion, i.e. 37.8% of Horizon 2020 budget). These correspond to the key policy objectives of Europe 2020 and to concerns shared by all Europe's citizens. A stronger focus is put on close to the market activities and radical technological breakthroughs. The underlying rationale is that big opportunities exist to turn the challenges of today into the business opportunities of tomorrow and investing public money on research and innovation can make the EU exit the crisis successfully while addressing citizens' concerns. These amounts are complemented by those dedicated to support the EIT (€ 2.7 billion), which gets an important budget increase compared to FP7, and the JRC, which continues its role in contributing scientific expertise to the Union's policy making process. Additional funding for nuclear energy research activities is also available through the Euratom programme.

6.1.2. The relevance of Horizon 2020 to address European objectives

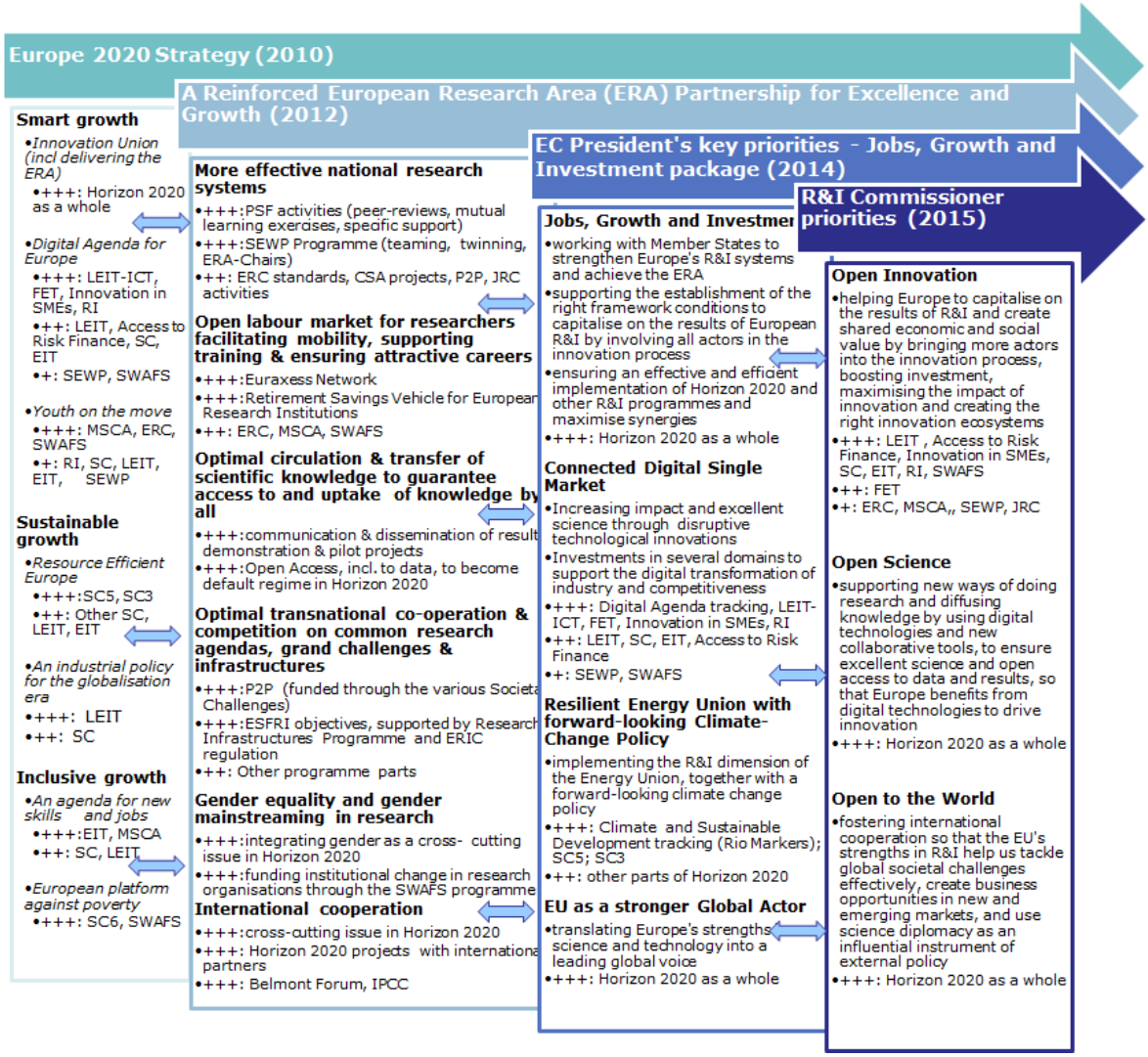
Strengthening the Union's scientific and technological bases, notably in support of its industrial competitiveness, is enshrined as an objective in the EU Treaty[33]. While Horizon 2020 was adopted in late 2013, before the 2014 new European Commission came into office, it is the EU's main funding programme for R&I until 2020 and thus is an important mechanism for supporting and delivering on the current (and future) set of EU policy objectives. Horizon 2020 was adopted in the context of the Europe 2020 Strategy[34]. This strategy seeks to achieve smart, sustainable and inclusive growth in Europe, including by devoting 3% of EU's GDP to R&D by 2020. The Juncker Commission 10 priorities[35] provided an update and focus to these goals whereas the "3 Os", put forward by the R&I Commissioner, which call for open science, open innovation and openness to the world[36] complement the research-policy objectives since 2015.

Evidence collected within the thematic assessments as well as the work of an Expert Group[37] shows that **Horizon 2020 remains an important mechanism for supporting and delivering on the current set of EU policy objectives as well as international priorities**[38]**.** Horizon 2020 directly addresses the long-term objectives of Europe 2020 and, in particular, many of the commitments of the 'Innovation Union'. Even if not initially developed according to these priorities, Horizon 2020 in its current setting is also assessed by European Commission services as relevant to contribute delivering on the current priorities, in particular to Jobs, Growth and Investment, the Digital Single Market, a Resilient Energy Union, and the EU as a

[32] European Economic and Social Committee, Information report on Interim evaluation of Horizon 2020, 2016.
[33] http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12012M/TXT&from=en
[34] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF
[35] https://ec.europa.eu/priorities/publications/president-junckers-political-guidelines_en
[36] More information on the Open Innovation, Open Science and Open to the World (3 O's) approach available at: http://ec.europa.eu/research/openvision/index.cfm
[37] European Commission Expert group on evaluation methodologies for the interim and ex-post evaluations of Horizon 2020, Applying relevance-assessement methodologies to Horizon 2020 (forthcoming report). A text mining approach was developed to investigate whether keywords from key EU and international documents are present in Horizon 2020 Regulation and the first Work Programmes. This approach was not applicable in the case of the Excellent Science pillar because of its bottom-up nature.
[38] Investment in R&I is also recognised as an important aspect of EU's comprehensive response to harnessing globalisation, COM(2017) 240.

Stronger Global Actor (see Figure 9 for a detailed overview of how Horizon 2020 aligns to each of the key EU priorities).

Figure 9 Relevance of Horizon 2020 in the framework of evolving EU priorities 2010-2015



Note : +++ : very relevant to address these priorities, ++ : partially relevant, + : slightly relevant
Source: European Commission, DG RTD A5, based on thematic assessments

Stakeholder position papers: Horizon 2020 is addressing policy priorities of Europe.

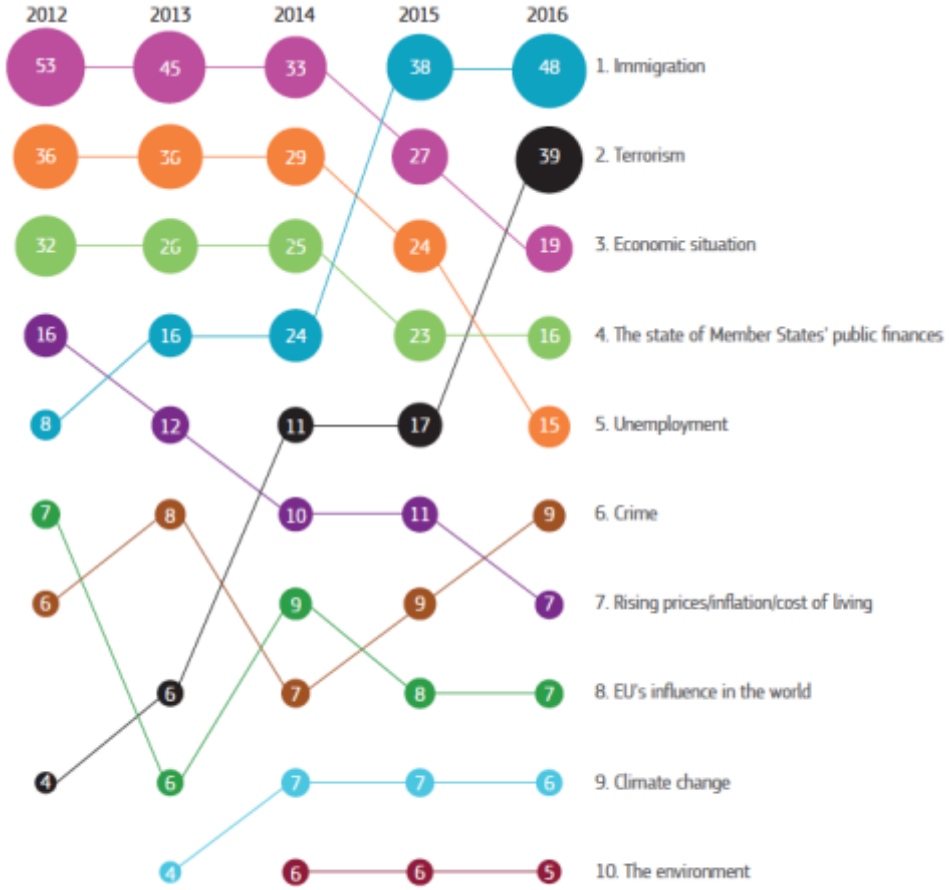
The majority of position papers from stakeholders representing different stakeholder groups commented on the role of Horizon 2020 in policy priorities. More than half of those who commented depict a positive view of the contribution of Horizon 2020 to current policy priorities.

For instance, in their position papers stakeholders note that: Horizon 2020 is tackling current challenges of Europe by contributing directly to Europe's competitiveness which leads to jobs and growth; a few position papers highlighted contribution of Horizon 2020 to the realisation of the European Research Area (ERA) by funding collaborative research, trans-national infrastructure and mobility; position papers from businesses that addressed this point specifically noted that the (societal) "challenge driven" research and innovation approach of Horizon 2020 and the fact that the programme covers the whole innovation chain is crucial for a competitive European industry; position papers received from international stakeholders that addressed this point also mention that Horizon 2020 plays a role in addressing challenges that are of global nature.

6.2. Does Horizon 2020 allow adapting to new scientific and socio-economic developments?

Whereas high (youth) unemployment remains the biggest socio-economic concern and challenge in many Member States in 2016 associated to slow economic growth, **the EU has to respond to new emerging challenges, such as armed conflicts, rising migration flows or global health emergencies and terrorism** (see Figure 10).[39] More specifically, the increase in the threat of terrorism, with major incidents occurring in several Member States, the increase of the sharing economy and bottom up citizen centred innovative solutions, and huge step-change progress in some areas of technological developments (examples include 3D printing, smart phone applications, 5G) are some of the developments impacting the context of the programme.

Figure 10 What issues are Europeans most concerned about?



Note: Data are in percentage of EU-total respondents. Respondents were asked to select two issues within a pre-defined list.
Source: Eurobarometer.

Source: Eurobarometer data, cited in European Policy Strategy Centre (2016), EU2016: From trends to policies- Key trends

Horizon 2020 has built-in flexibility[40] to tackle new and unexpected challenges and thus allows for a more flexible approach to respond to the new emerging challenges compared to

[39] This shift is observed across the Union with the exception of Portugal, where fears around public finances and unemployment rank second and third after immigration, and Romania, where crime comes third.
[40] See Article 12 and 15 of Horizon 2020 Regulation.

FP7.[41] The strategic programming approach (see previous section) involving advice, evidence and foresight aims to support flexibility in its implementation[42].

So far, **the Horizon 2020 Work Programmes have responded to some pressing new challenges.** The possibility afforded by the financial regulation to award grants without a call for proposals in exceptional and duly substantiated emergencies, is indeed an option that can increase the flexibility of the 'Societal Challenges' pillar, as demonstrated by the swift research response to the recent Ebola outbreak (see box below). Also the SC6 Work Programme 2016-2017 reflects the increasing awareness of the topic of migration. Thematic assessments under Societal Challenges however point out that **two-year programming is at times too rigid to integrate swiftly new and "urgent" topics dictated by external events or disruptive and counter-intuitive technologies and business models**. The FET assessment confirms that in its current design FET has the potential to keep closing the gap between research and innovation, but also highlights the **scope for better coordinating the various stakeholders so as to ensure a stronger alignment of basic/fundamental research with future needs**. In the SC6 assessment, it appears that there are also emerging needs that the SC6 programme does not fully cover yet such as the Refugee crisis and the future of the EU after the "Brexit".

Box: Horizon 2020 reacting to the outbreaks of Ebola and Zika

The outbreak of Ebola in West Africa was the major international public health emergency of the past few years. SC1 promptly supported urgent research on Ebola by launching – for the first time – two fast-track procedures completed in a very short timeframe.[43] EUR 24.4 million from Horizon 2020 were mobilised despite not being foreseen in the Work Programme. In parallel, the IMI-Ebola+ call (a PPP between EU and EFPIA) was launched in record time taking into consideration the dual nature of IMI. This Horizon 2020 SC1 research response, very significant in scale, with a total of EUR 140 million, in turn, leveraged a further EUR 101 million from the European pharmaceutical industry.

Horizon 2020-funded Ebola actions have already delivered significant results: supported the R&D of all 3 leading Ebola vaccine candidates, provided evidence that the initially proposed treatments of antiviral favipiravir and plasma from survivors are not effective, developed diagnostic tests and produced critical new knowledge about the virus itself. Most significantly, in spite of the enormous challenges, the research was done timely and with due respect to all H2020 and international ethical standards[44]. These actions have placed the Commission second only to the US Government in terms of commitments made[45]. The Commission has also strived to coordinate other Ebola research funders by establishing frameworks for cooperation to enable a swift and effective global research response in future outbreaks.

SC1 has taken the lead in establishing the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R) that links together research funders, the scientific community, industry, patient groups and public health actors. Its goal is build up the research capacity so that an effective research response can be launched within 48 hours of an outbreak. It was tested with the **Zika outbreak** in Latin America in 2015, when the Work Programme was updated to include in emergency a call on Zika research, in coordination with other funders of preparedness research. Through this call, EUR 30 million were allocated to address the urgent Zika research gaps. Additionally, from other Work Programme 2016 calls, EUR 15 million were allocated for research on Zika vaccines and for infrastructures for mosquito research.

[41] The FP7 ex-post evaluation concluded that even though FP7 responded to the economic crisis it was not flexible enough to respond to new emerging challenges.
[42] As an illustration the European Commission 2015 paper on 'Strategic Foresight: Towards the 3rd Strategic Programme of Horizon 2020' identifies potentially important emerging issues and disruptions for Horizon 2020 to feed into the discussion for the upcoming Work Programmes.
[43] While following all Horizon 2020 rules as the Financial Regulation foresees the possibility to award grants without a call for proposals in exceptional and duly substantiated emergencies. This procedure was planned during September 2014, with results announced and projects launched in October. The IMI-Ebola+ call was launched on 6 November, with results announced mid-January 2015.
[44] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5240928/
[45] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5112007/

The bottom-up, open and non-prescriptive nature of most of the actions supported under the Excellent Science pillar[46] **allowed adapting flexibly as needs arose, channelling funds to new and promising research areas, including on multidisciplinary research** and integrating effectively the European Open Science Cloud into the forward vision for e-infrastructures. For example, MSCA have demonstrated a certain level of flexibility by responding to the emerging challenge of migration flows through initiatives aimed at welcoming researchers to Europe. This is also the case beyond the Excellence pillar: funding for 'Science4Refugees' projects has been introduced into the Science with and for Society programme. Similarly, FET-funded interdisciplinary research has responded quickly to evolving economic and societal needs, such as those arising from privacy and security concerns, complexity of socio-economic (e.g. financial) and socio-technological systems, or in extremely competitive emerging industry areas such as graphene, quantum technologies and biotechnology. FET-Open is explicitly non-topical and non-prescriptive in order to allow for new ideas, within the broadest spectrum of themes and disciplines.

As highlighted in the thematic assessments, **new socio-technological developments call for a constant review of Horizon 2020 priorities and scouting of developments**. Evolutions since the adoption of Horizon 2020 of the socio-technological framework include an increased importance and visibility of **digitisation and the new role of consumers**. For example, technological developments are dramatically increasing the capacity of research infrastructures to collect and produce data and the developments in distributed computing, overall computer power and high-volume data transmission have combined to produce an **explosion of data-driven science**, giving scientists in many disciplines inter-operable access to research data of a hitherto-unimagined scale and diversity.[47] [48] The 2016/2017 work plan for European research infrastructures included the European Open Science Cloud pilot, which has delivered a further leg to the European structure to deliver the open data and research agenda and underpin the digital single market.

The manufacturing industry has become more service focused, by the **increasingly blurring product-service boundaries**. Firms previously focussed on straight manufacturing are positioning themselves as "solution providers", often based on using advanced technologies in their products and digital and data based services. Customisation or after-sales services are examples. While this approach has been taken up in the LEIT-NMBP Work Programme, selected projects do not reflect yet the importance of these developments in terms of their planned activities.

Based mostly on a keyword text mining approach (also containing phrases and topics), which compares the degree of matching between keywords extracted from the Horizon 2020 establishing act (Council Decision 2013/743/EU) and Work Programmes (2014-15 and 2016-17) against keywords extracted from international and EU policy documents, social media, and patents and publications, an expert group concluded that Horizon 2020 takes into account subsequent technological and scientific advances to a high degree.[49] Moreover, an external study looking at the keywords of the FET projects abstracts, highlight the high number of **FET projects that focus on technologies that are expected to have significant potential to drive economic im-**

[46] Under this pillar, research proposals tend to be less constrained by policy objectives set out in a Work Programme established years earlier, and as such can target topical issues using the latest scientific and technological approaches.
[47] See thematic assessment of Research Infrastructures
[48] Riding the wave. How Europe can gain from the rising tide of scientific data. 2010
[49] European Commission Expert group on evaluation methodologies for the interim and ex-post evaluations of Horizon 2020, Applying relevance-assessement methodologies to Horizon 2020 (forthcoming report)

pact and disruption by 2025[50]. Also **the ERC is reinforcing 25 of 28 key fronts of research** (Figure 11).

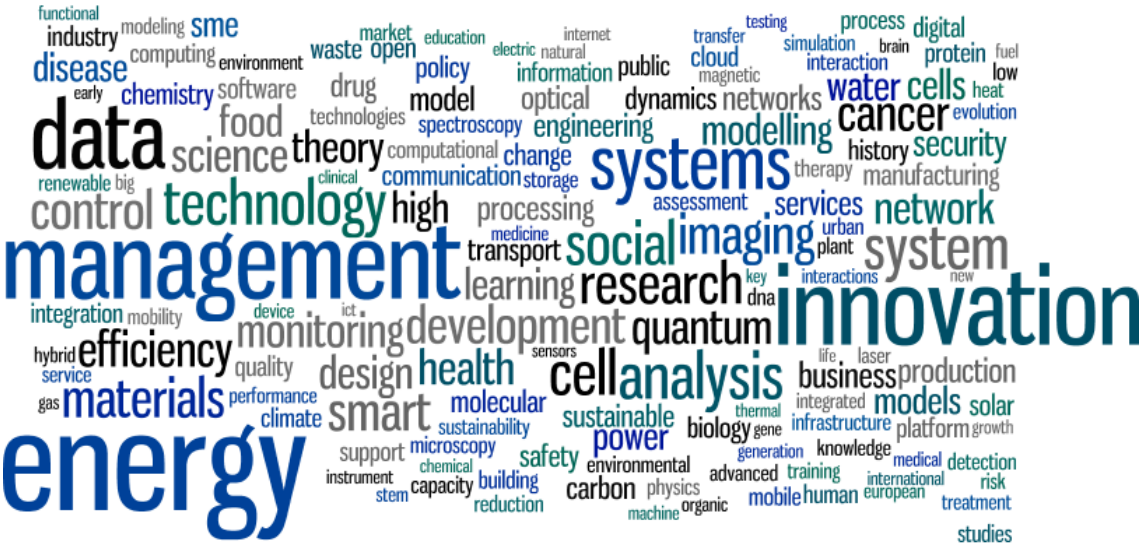
Figure 11 Key hot and emerging research fronts where ERC grantees are working

Hot research fronts where ERC grantees are working	
1. Outbreak, prevention and control of microbial contamination of fresh produce; 2. Mechanism of plant innate immunity; 3. Microplastic pollution in the marine environment; 4. Biodiversity loss and its impact on ecosystem functions and ecosystem services; 5. Global warming hiatus; 6. Carbon cycle of inland waters and the ocean; 7. Clinical trials of direct-acting antivirals (DAAs) for hepatitis C infections; 8. Immune checkpoint inhibitors anti-PD-1 antibodies in melanoma immunotherapy; 9. The molecular mechanism for origin, development and differentiation of macrophage; 10. Differentiation, function, and metabolism of T cells;	11. Phosphors for white LEDs; 12. Sodium-ion batteries; 13. Galactic center gamma-ray excess; 14. Property and application of monolayer/few-layer black phosphorus; 15. Observations of the cosmic microwave background (CMB) by Planck; 16. Baryon acoustic oscillation (BAO) related research based on sky survey missions like SDSS; 17. The internet of things, cloud manufacturing and related information technology services; 18. Research on measurement-device-independent quantum key distribution; 19. DEA (Data Envelopment Analysis) based assessment of environmental and energy efficiency.
Emerging research fronts where ERC grantees are working	
1. Effects of systemic insecticides (neonicotinoids and fipronil) on non- target organisms and environment; 2. Elemental composition of the North Atlantic Ocean and Southern Ocean; 3. Principles of chromatin looping and evolution of chromosomal domain architecture;	4. Research fronts on perovskite 5. Experimental realization of fractional Chern insulators; 6. Studies of Comet 67P/Churyumov-Gerasimenko by Rosetta.

Source: ERCEA, Thematic assessment of the European Research Council (see Annex 2), 2017

Figure 12 provides an indication of the current thematic coverage of projects based on the frequency of keywords used in all Horizon 2020 selected projects. This shows the current strong focus of the more than 11,000 selected projects on 'energy', 'data' and 'systems'.

Figure 12 Wordcloud of frequency of keywords from Horizon 2020 projects



Source: Horizon 2020 CORDA, date: 01/01/2017. The size of the word depends of its frequency in projects' keywords

[50]McKinsey (2013). Disruptive technologies: Advances that will transform life, business, and the global economy.

The flexibility of Horizon 2020 to adapt to new scientific and socio-economic developments is nuanced by the results of the stakeholder consultation. 36% of respondents agreed fully or to a large extent that Horizon 2020 thematic coverage is flexible enough to cope with changing circumstances, 41% agree only to some extent, and 12.4% fully disagree. NGOs tend to disagree more than the other categories of respondents (16% full disagreement rate). Also a high percentage of respondents agree, at least to some extent, that Horizon 2020 supports the latest developments in R&I at the national/ European and international level (93% of agreement rate). The most positive respondents are businesses and public authorities and the most negative are NGOs. When asked about whether Horizon 2020 priorities address the current challenges confronted by the European Union (e.g. migration, terrorism, ageing population), only 35% of the consultation respondents think the programme does fully or to a large extent, 42% to some extent and 8% judge that it is not the case at all. Academia and research organisations tend to be more positive (86-83% think it does at least to some extent) than business (71%).

Stakeholder position papers: Improvements are needed regarding Horizon 2020 flexibility to changing priorities

In their position papers a few stakeholders also commented on the programme flexibility and stated that improvements are needed mainly regarding Horizon 2020 flexibility to changing priorities but concrete examples substantiating such statements are not evident. However, one research organisation noted the rapid response to emerging areas such as migration, Ebola and Zika is a good practice example of flexibility of the programme that could be applied to other parts of the programme.

6.3. Is Horizon 2020 responding to stakeholder needs?

6.3.1. Involvement of stakeholders in programme design

Compared to FP7, stakeholders are much more closely involved in the programme design through the 19 Horizon 2020 Expert Advisory Groups[51] which have been set up as consultative bodies for the individual programme elements of Horizon 2020[52], targeted and open public consultations on future research themes,[53] European Technology Platforms (ETPs), which develop R&I roadmaps for action at EU and national level in some sectors, Programme Committees composed of representatives from Member-States and European Innovation Partnerships (EIP). The priorities and activities under Contractual Public-Private Partnerships build on an agreed relationship between the European Commission and the private sector in defined areas, and on specific roadmaps with Key Performance Indicators and a commitment to additional investments on the private side. In addition, the Citizen and Multi-Actor Consultation on Horizon 2020 ('CIMULACT') project[54] started in 2015 to improve the engagement of citizens and provide concrete input to the European R&I agenda.

> *"There has been significant improvement in Horizon 2020 in comparison to FP7. However, there is still some issue on transparency on how the work programmes and calls are set. There seems to be a lack of long term impact as call topics often lack continuity and are funded from different angles for the same topic, which fails to connect in a holistic, long term solution. The participant portal although highly simplified and unified, still pose a challenge for newcomers to navigate through."*
>
> Italy, European Academy of Bozen/ Bolzano

[51] The Expert Advisory Groups produce reports and recommendations that contribute towards defining the Work Programme. Full list and open call for expression of interest: http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020-experts. The mandate of the selected experts is for a period of 2 years with the possibility of renewal for a further maximum 2 years.

[52] http://europa.eu/rapid/press-release_IP-13-1026_en.htm When launched in 2013, nearly 40% of their members (20-30 per group) had not advised on previous EU research programmes, ensuring a 'fresh approach' in the new programme

[53] e.g Call for Ideas launched for Societal Challenge 5. This includes open public consultations as well as dedicated written consultations and events targeted at respective stakeholder groups.

From the thematic assessments, it appears that **the introduction of the strategic programming process has improved the intelligence base underpinning programming choices and has helped better define the focus of the programme in line with stakeholder needs.** The translation of high level challenges and objectives into specific call topics is however not always clear to external stakeholders. Moreover, it was found difficult to establish clear links between high-level policy objectives and the related quantitative targets and the specific contribution expected from some topics.[55] Room for improvement is also identified in reconciling the perspectives of short to mid-term legislative and specific policy making tasks of policy DGs with a long term and systemic view on R&I**.** The thematic assessment on SEWP also highlights that supporting world-class excellence requires long-term commitment, and continuity also on the public and policy side, e.g. through structural reforms.

More than 80% of the stakeholder consultation respondents agreed that the frequency of the calls of the Horizon 2020 Work Programmes and their clarity are either "good" or "very good". The majority of respondents have a positive opinion on the transparency in the process of formulating the Work programme (67%) and the ease of finding the right call for their proposal. There are however also high levels of dissatisfaction with 26% that found that these are "poor" or "very poor".

Stakeholder position papers: Stakeholders have different opinions on the degree and appropriateness of their involvement in Horizon 2020 design.

In their position papers, some stakeholders commented on the degree of their involvement in the design of Horizon 2020 and its activities, but their opinions differ. Of those commenting some have a positive view on the current level of involvement and see the agenda setting process contributing to a comprehensive and widely supported programme. Several others however noted the current design of the Work Programmes is not transparent. In general, organisations found lacking involvement of stakeholders from their particular field. For instance, among others, the following issues were highlighted: inadequate coordination with the Members States specifically mentioned by Germany and France but also by stakeholders in academia; Estonia as well as one SME noted that larger players seem to have more influence on the research programme and the call topics; and a few stakeholders that commented on this issue from the industry and the business community noted they are not well represented in the Horizon 2020 projects, working groups, advisory groups and committees (their representation is reportedly below 20%).

6.3.2. Programme attractiveness and take-up

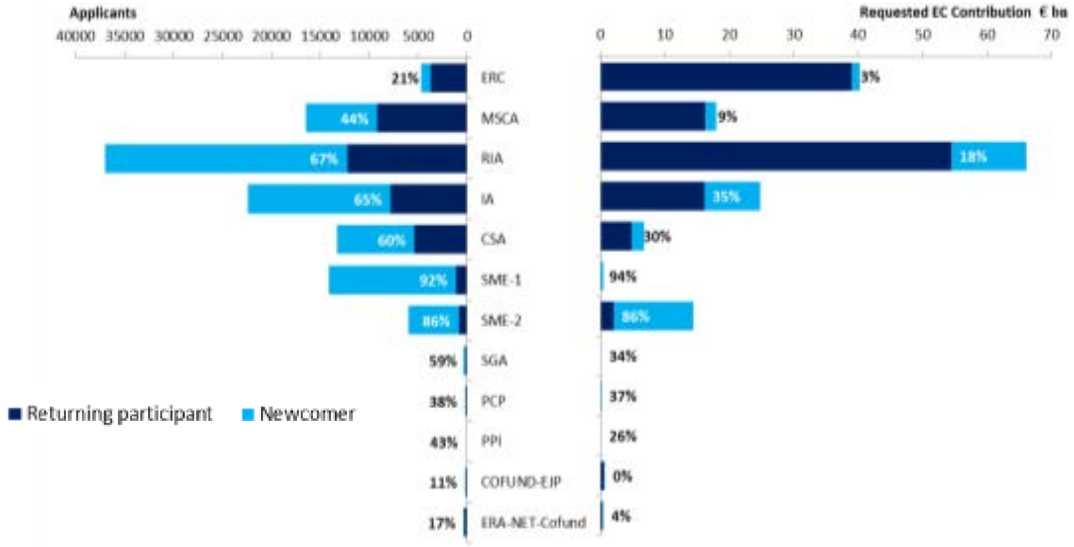
The **high demand for programming funds** is an indication of the value stakeholders attach to the programme. Compared to FP7, the number of proposals submitted to Horizon 2020 has increased significantly. Whereas FP7 generated around 135,000 proposals in the 7 years of its existence (around 20,000 per year), as of 1 January 2017 – after three years - more than 100,000 proposals had been submitted under Horizon 2020, which is an average of more than 33,000 per year. **The most attractive programme part in terms of proposals submitted is the SME instrument, followed by the ERC, MSCA, LEIT-ICT[56] and the Health Societal Challenge.[57] In FP7, the private sector submitted 25.4% of the applications; this share has increased to 37.4% in Horizon 2020.** Each higher or secondary education institution (HES) on average applies more often to Horizon 2020 compared to private companies. In the

[54] http://www.cimulact.eu/
[55] For instance, what will be the contribution to "an 80-95% decrease in greenhouse gas emissions by 2050" that will be provided by a certain project concentrating of improving powertrain efficiency in Societal Challenge 4.
[56] This includes Open Disruptive Innovation projects implemented through the SME instrument.
[57] An in-depth discussion on oversubscription is presented in Section 7 "Efficiency".

first three years of Horizon 2020 implementation, each HES applied 28 times on average compared to 2.6 times for private companies (1.2 times on average for SMEs).

The increased interest is prominent thorough Horizon 2020, but especially for the SME Instrument, which has generated more than 30,000 proposals compared to around 5,000 in FP7 (under Research for the benefit of SMEs). Overall, in Horizon 2020, SMEs submitted 99,434 applications in eligible proposals, which is around 26.2% of the total for Horizon 2020 (against 23.7% in FP7).

Figure 13 Proposals submitted and funding requested per programme part



Source: Corda, cut-off date by 1/1/2017

Noticeably, **78% of all organisations that applied to Horizon 2020 funding in the first three years of programme implementation were newcomers** (i.e. have not received funding under FP7), the majority of them was from the private sector. More specifically, the programme generated interest of 35,288 new SMEs, representing more than half of the new applicants from the private sector (55,296) as well as 5,022 new higher or secondary education institutions, 5,150 new research organisations and 3,925 new public bodies, and 5,376 'Other' organisations (which include most of the civil society organisations) indicating the continued relevance of the programme for new players, including for organisations representing citizen's interests. In particular, the large majority of applicants (91.3%) to the SME Instrument are new to the Framework Programmes.

Figure 14 Number of distinct applicants and applications per type of organisation

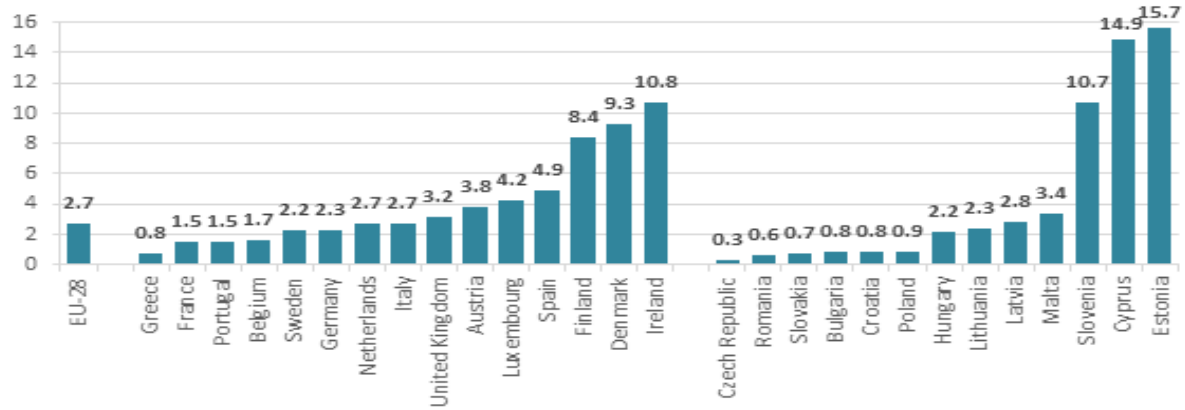
	Number of distinct applicants		**Number of applications**	
	Total	*Out of which from new players*	Total	*Out of which from new players*
Private Sector	55,296	*46,034*	141,880	*84,462*
out of which SMEs	*35,288*	*28,551*	*99,434*	*58,646*
Higher or secondary education institutions	5,022[58]	*3,024*	140,900	*7,973*
Research Organisations	5,150	*2,464*	68,346	*5,341*
Public Bodies	3,925	*2,815*	13,551	*5,480*
Other	5,376	*4,309*	14,492	*8,460*
Total	**74,769**	***58,646***	**379,169**	***111,716***

Source: Corda, cut-off date 1/1/2017 (success rate is calculated excluding grants to named beneficiaries)

[58] This covers e.g. universities, academies, colleges, technical schools and high schools.

The SME Instrument assessment looked at the number of excellent proposals as a percentage of the target group of innovative, growth ambitious SMEs per country. The reach-out to the target groups differs from country to country. **In some small and mid-sized Member States, such as Estonia, Cyprus, Slovenia, and Ireland, the SME Instrument persuades over 1% of the target group to submit competitive proposals.** The EU28 average is 0.27%[59].

Figure 15 Penetration rates of the SME Instrument per Member State (SMEs reached per 1,000 of the target population)



Source: Interim evaluation of 'Innovation in SMEs', Technopolis, based on CORDA data (July 2016).

6.3.3. Stakeholder views on the support offered

6.3.3.1.Reasons for participation and types of support

According to the stakeholder consultation, **the main reasons for participating in Horizon 2020 are financial support, access to new knowledge and know-how, and unique collaboration opportunities with existing or new European or international partners**. Interdisciplinary work and the opportunity to work with other types of actors also stand out[60]. Reasons for participation are also illustrated by the word cloud in Figure 16.

It follows from the stakeholder consultation that **grants are regarded as the most relevant forms of funding provided through Horizon 2020, followed by co-fund, prizes, financial instruments and public procurement.** [61] Collaborative grants and ERC stand out as being particularly relevant to respondents. Almost 7.5% of the respondents who did not participate in Horizon 2020 underline lacking adequate type of financial support for their work and 14.6% mentioned that the programme lacked a relevant area/ topic for their needs.

A dedicated survey asked SMEs and intermediaries organisations about their views on the design of the SME instrument. The most attractive features include the fact that this support is available to a single company, the size of the grant, the rate of funding and the openness of

[59] Calculated as the ratio between the total number of quality applications made to the SME instrument and the target number of SMEs (in thousands). It is understood as the number of SMEs reached per 1,000 of the target population.
[60] Respondents also refer to products, solutions development and commercialisation (mainly quoted by businesses); internationalisation, visibility and enhancement of the participants' research profile (mainly quoted by academia); the ability to advance global knowledge and solve societal challenges such as climate change and health; and the ability to perform or have access to high-profile research. Some business respondents also mention growth opportunities through activity development and a better or secured position on markets, as well as the ability to develop innovation faster.
[61] Very few beneficiaries of the Access to Risk Finance programme part replied to the stakeholder consultation on the interim evaluation (0.8% of respondents). Detailed consultation results per organisation type are provided in Annex Part 2.

topics. Especially SMEs are very positive about the possibility to resubmit proposals, as well as about the time period from application to grant.

Figure 16 Please share with us a short, telegraphic testimonial. What does Horizon 2020 mean to you? What is its main feature?

Wordle®, Source: Replies to stakeholder consultation questionnaire launched in the framework of the Interim Evaluation of Horizon 2020, October 2016-January 2017, N=1704

Stakeholder position papers: The transnational and multi-sectorial approach for excellent research and innovation is working well.

Some stakeholder position papers including academia, research organisations, public authorities and NGOs commented on the transnational and multi-sector collaborative approach for excellent research and innovation and perceive it as an "*attractive*" and "*successful*" method and "*the backbone*" of Horizon 2020. However, one SME was particularly critical noting there is already enough interdisciplinary and that insisting on it makes research lose its focus.

As regards the openness of the calls, the right balance has to be found between being too prescriptive and not sufficiently. Whereas the FET assessment points out that the open and non-prescriptive nature of the calls leads to a dispersal of approaches and solutions that may result in imbalances in the number of proposals across topics impeding the cross-fertilisation of experience, under the Industrial Leadership Pillar the LEIT-ICT assessment highlights that there is not enough room for openness in the calls for topics and ideas of the research community, creating the risk that quality research is not funded because it does not fit the calls or their timelines. For LEIT-Space a risk is identified of a focus in the programme design towards the specific needs of each segment, thus lacking the integrated approach needed for the longer-term creation of competitiveness by fostering the inclusion and strengthened position of European SMEs in the global supply chains. A number of respondents to the call for ideas for a European Innovation Council argued that call themes should not be pre-defined but rather be more open and bottom-up. In order to fill the gaps in EU support, many stakeholders called for dedicated calls for disruptive technologies and improved access to risk financing[62].

In general, **Horizon 2020 covers topics responding to the needs of stakeholders;** stakeholder only mentioned a few examples of topics not covered in Horizon 2020. However, a

[62] Available at: https://ec.europa.eu/research/eic/pdf//eic_call_for_ideas-overview.pdf#view=fit&pagemode=none

majority of stakeholders responding to the stakeholder consultation pointed out that Social sciences and Humanities are not sufficiently included in the calls.

Stakeholder position papers: Social sciences and humanities need to be better integrated in the programme design.

Some stakeholder position papers from different types of organisations mentioned that social sciences and humanities (SSH) are currently not adequately integrated in Horizon 2020 specifically in Pillar 2 and 3. Stakeholders stressed SSH have an equal capacity to solve the challenges of society today than natural sciences. In their opinion SSH needs to be better integrated from the design of work programmes, description of calls to project evaluation (i.e. ensure at least one evaluator has SSH expertise).

6.3.3.2. Addressing the needs of citizens

From the thematic assessments, it appears that **the innovations arising from Horizon 2020 are likely to benefit all types of stakeholders -including citizen-**, through an enhanced capacity to address several of Europe's most pressing societal challenges, from living with climate change to improved civil security. Moreover, these new applications and service areas are perceived as promising economic growth and employment opportunities. At different Technology Readiness Levels (TRLs), and depending on the specific challenges addressed, the projects are involving different types of partners from the 'triple helix', that is industry, academia and governments, and in less frequent cases society (e.g citizens, civil society organisations - CSO). Based mostly on a keyword text mining approach (also containing phrases and topics), which compares the degree of matching between keywords extracted from the Horizon 2020 establishing act (Council Decision 2013/743/EU) and Work Programmes (2014-15 and 2016-17) against keywords identified by the experts as pertaining to EU citizen needs, an expert group concluded that EU citizen needs are broadly covered in all pillars - revealing a 50 to 75% correspondence between keywords in both Work Programmes and the Horizon 2020 establishment act and keywords identified by the experts as pertaining to EU citizen needs.[63]

The area of citizen science often falls between the categories: It is science, but it is also education, culture and a science and society activity. It happens often that citizen science (especially citizen science initiated by the public) does not get funding because funders do not feel responsible for that subject area.

European Citizen Science Association, Switzerland

As part of MSCA, the European Researchers' Night attracts up to one million citizens every year, and has brought researchers closer to the general public, increased awareness of R&I activities and encouraged young people across the EU to embark on research careers. The thematic assessments however highlight the **gap in society in understanding of the benefits of publicly-funded research and overall room for improvement in bringing research closer to the general public and encourage young people to embark on research careers**. **The involvement of representatives of civil society still appears to be low (even in the Societal Challenge 6 dedicated to inclusive society) compared to the traditional R&I actors, like academia and industry.**[64] This is happening despite the efforts to open the programme to new players and to empower citizens, in particular through citizen science/citizens observatories (Societal Challenge 5).

[63] European Commission Expert group on evaluation methodologies for the interim and ex-post evaluations of Horizon 2020, Applying relevance-assessment methodologies to Horizon 2020 (forthcoming report)

[64] As an illustration, in the transport thematic assessment, the limited involvement of representatives from the softer transport modes is considered an issue. This may partially be due to the fact that stakeholders such as civil society organisations representing citizens at large, pedestrians, passengers of all transport modes and unions are not constituted in well-defined groups, as the majority of other more traditional transport modes are.

The Science with and for Society programme part is one key way Horizon 2020 responds to citizen needs[65]. Although there is strong support for the involvement of civil society in Horizon 2020 the vast majority of representatives of Civil Society Organisations (CSO) surveyed by the European Economic and Social Committee (EESC) (83%) agree or strongly agree that there is a **lack of knowledge exchange between the scientific community and civil society**. Responsible Research and Innovation (RRI)[66] is a cross-cutting issue in Horizon 2020, which aims to encourage societal actors to work together during the whole R&I process to better align R&I with the values, needs and expectations of society. However, an external study[67] found that **CSO participation in FP6, FP7 and Horizon 2020 was/is however marginal**. The share in funding of CSOs is even lower than the share in institution numbers and in project participations, even if - as of April 2015-, Horizon 2020 exhibited an increase on a low level (2.3% compared to 1.4% in FP7). This contrasts with the monitoring data suggesting that 11% of Horizon 2020 projects are RRI relevant. As such, it is currently not clear whether or how these RRI-relevant projects really are "*instances where citizens, CSOs and other societal actors contribute to the co-creation of scientific agendas and scientific contents*". Also the network analysis performed in this study points out that **CSOs that do participate generally take on non-core roles in project consortia**.

49% (1706) of the stakeholder consultation respondents agreed fully or to a large extent that Horizon 2020 priorities address the main citizens' needs, whereas 37% (1302) agree to some extent and 5% judge that it is not the case at all. The most negative respondents are NGOs. 48.5% (1698) of respondents agree that an increased involvement of citizen in priority setting is needed to further maximize the socio-economic impact of the EU framework programme for research and innovation whereas 37.9% (1320) disagree (13.6% (473) do not know). The most positive are NGO. Whereas business umbrella organisations are more negative, a slight majority of individual SME respondents agree together with individual research organisations, academia and public authorities.

Box: Examples of promotion of Responsible Research and Innovation across Horizon 2020

Under **SWAFS** the VOICES and CIMULACT projects have recently invited citizens to interact directly with EC services. These projects will harness the knowledge and views of citizens to help shape future Work Programmes. In 2016 two topics under SWAFS also invited stakeholders to reflect on the main science and society issues that should be tackled through Horizon 2020.

In 17.4% of **Societal Challenge 1**'s projects, citizens, CSOs and other societal actors contribute to the co-creation of scientific agendas and contents[68]. They are representatives of patients or users who provide useful, sometimes crucial, information on the needs and expectations of important stakeholders, thereby influencing the project's design. Such organisations are highly involved in the European Innovation Partnership for Active and Healthy Ageing initiative. They also play an active role in the definition of personalised medicine.

Under **Societal Challenge 2** a large number of projects implement the multi-actor approach. The multi-actor approach aims at more demand-driven innovation through the involvement of various actors all along the project. It includes existing knowledge into scientific work: end-users and practitioners are involved, not as a study-object, but in view of using their entrepreneurial skills and practical knowledge for developing innovative solutions. The multi-actor approach ensures the link between Research and Rural Development policies through the approach which implies the involvement of all concerned actors in all phases of project activities. The multiactor

[65] It has three specific objectives: the co-operation between science and society, the recruitment of new talent for science, and the pairing of scientific excellence with social awareness & responsibility

[66] Responsible research and innovation is promoted via: public engagement, open access, gender, ethics, science education, and integrated actions that for example promote institutional change.

[67] WU Vienna in collaboration with FAS Research and De Montfort University (forthcoming), data of April 2015

[68] Data on this cross-cutting issue is provided by EC Project Officers during grant agreement preparation.

approach is implemented as part of the European Innovation Partnership "Agricultural productivity and Sustainability"[69]

Under **Societal Challenge 3** a number of projects (e.g. Nobel Grid, Empower, Flexiciency, Flex4Grid) enable the active participation of citizens in the energy system, e.g. through the development and deployment of advanced ICT tools and services and promoting the role of prosumers (e.g. in smart grids). Under the 2014 and 2015 calls 16 projects are supported[70] targeting explicitly citizens, consumers and/or local stakeholders with the aim of raising awareness, building capacities and increasing their involvement for facilitating the uptake of innovative energy solutions.

A chapter dedicated to the societal dimension is included in the Work Programmes for **Societal Challenge 4** Smart, green and integrated transport since the start of Horizon 2020. Amongst the activities, the project MOBILITY4EU[71] brings together the civil society and the transport stakeholders to co-design transport solutions embedding societal needs.

Societal Challenge 5 continues to support citizens' science actions, capitalising on the results of FP7 projects (i.e. MyGeoss, Citizens Observatories). The goal is to empower citizens, providing them tools to measure and share, through apps, environmental parameters like air quality, noise, alien invasive species, etc. momentum, with a very active European Citizen Science Association (ECSA)[72].

Societal Challenge 6 projects make efforts to reach the specific stakeholders and the general audience with web-based platforms, social media and communication resources. For example the project DANDELION (Promoting EU funded projects of inclusive, innovative and reflective societies) aims to support the uptake and valorisation of Inclusive, Innovative and Reflective Societies research and improve its dissemination towards citizens, policy makers, academia and media. This will be achieved through a series of innovative and creative communication activities targeted at a range of audiences.

Under **Societal Challenge 7** a number of projects (CITYCoP, ICT4COP, INSPEC2T, TRILLION, Unity) share a common aim of engaging citizens in Community Policing and strengthening citizens-law enforcement relations. Overall, this enhanced collaboration between community and law enforcement agencies aims to maximise the safety and security of all citizens.

6.4. Key conclusions on the relevance of Horizon 2020

Horizon 2020's original **rationale for intervention** and objectives remain valid and the challenges identified at programme launch still exist. The level of R&D expenditure in the EU-28 lies at 2.03% in 2015, which is still below the 3% target of the Europe 2020 Strategy. In spite of some improvements, the 'innovation gap' identified at programme launch still exists. The EU-28 continues to be less innovative than key competitors, but performance differences have become smaller. In particular Europe still displays a structural gap in R&D investments (public and private) and in the uptake of innovation, together with lower productivity growth. It also lags far behind key competitors in high tech sectors. In addition, patent applications are declining in many EU countries and Europe displays a relative lack of young companies that have grown into world-leading innovators, in new innovation-based growth sectors and is home to fewer young companies that have grown into world-leading innovators. It is now more clearly recognised that such companies play a key role in bringing about the necessary breakthrough, market-creating innovation. The Societal challenges identified at programme launch remain valid and are even reinforced by the SDGs/COP 21 framework and the evolution of the socio-economic context. Strengthening Europe's science base, boosting industrial leadership, addressing societal challenges and cooperating internationally remain instrumental for achieving many of the key EU policy objectives. However, the translation of high-level objectives into work programmes, calls, and projects is not straightforward (lack of clear pre-

[69] http://ec.europa.eu/eip/agriculture/
[70] such as: FosterREG, TOPTEN ACT, SMART-UP, STEP_BY_STEP, DOMINO, Digi-Label, RESCOOP Plus
[71] Available at: http://www.mobility4eu.eu/
[72] Available at: http://ecsa.citizen-science.net/

defined intervention logic). The programme objectives as currently articulated in the legal basis are in several cases regarded as very broad and "all inclusive" - providing no indication of what success would look like on programme completion. As such, the current definition of objectives is assessed as not providing an optimal basis for programme priority setting, monitoring progress or evaluating programme performance.

Horizon 2020 has been **flexible** enough to adapt to new emerging needs (e.g. Ebola and Zika outbreaks, migration) and is in line with subsequent technological and scientific advances. The bottom-up, open and non-prescriptive nature of most of the actions supported under the Excellent Science pillar allowed adapting flexibly as needs arose, channelling funds to new and promising research and training areas, including on multidisciplinary research. The two-year work programming may however at times be too rigid to adapt to new and "urgent" topics dictated by disruptive and counter-intuitive technologies and business models. Evolutions of the socio-technological framework (incl. digitisation, servitisation, data revolution, social conflict, violence and security concerns, SDGs) are expected to profoundly impact the Horizon 2020 context in the coming years, calling for a constant review of priorities and scouting of developments. A right balance is also to be found between being too prescriptive or not enough, depending on the pillars and areas. There is also scope for ensuring a stronger strategic alignment of basic/fundamental research with future needs.

The programme is broadly **in line with stakeholders needs** and is attractive for newcomers, generating a high demand given funding available. Financial support, access to knowledge and expertise, and collaboration with European or international partners are the main reasons for participating. Grants for collaborative projects are perceived by stakeholders as the most relevant form of funding for their needs. Compared to FP7, the strategic programming process has improved the intelligence base underpinning programming choices and has helped better define the focus of the programme in line with stakeholder needs. However, the transparency in the Work Programme formulation process, the participation of stakeholders/citizens in the agenda-setting and the ease of finding the right call are areas for improvement. Horizon 2020 innovations are likely to benefit all types of stakeholders, including citizens- and have the capacity to address several of Europe's most pressing societal challenges, from climate change to improved civil security. There is however, a gap in society in understanding the benefits of publicly-funded research and overall room for improvement in bringing research closer to the general public.