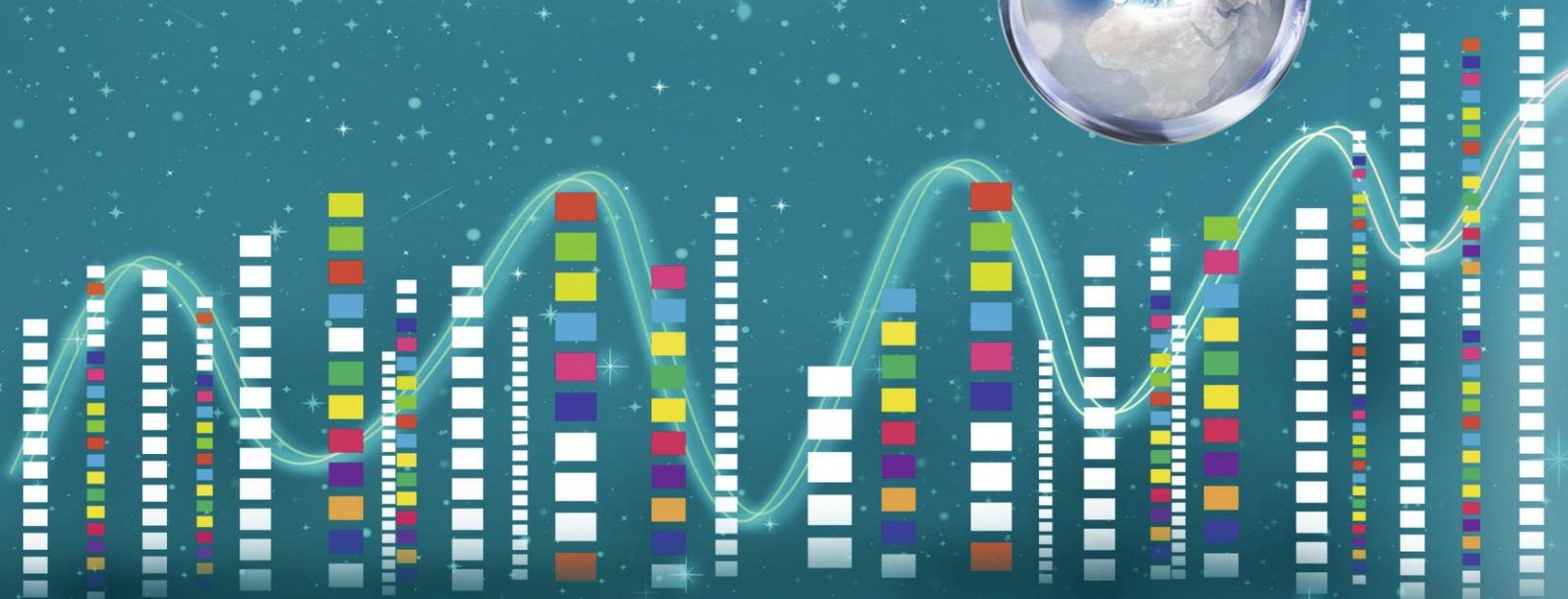




Evaluation study on the relevance and internal coherence of Horizon 2020 and its policy mix

Final Report

Independent
Expert
Report



Research and
Innovation

Evaluation study on the relevance and internal coherence of Horizon 2020 and its policy mix – Final Report

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Final Report

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ABSTRACT

The purpose of the 'Evaluation study on the relevance and internal coherence of Horizon 2020 and its policy mix' is to provide the European Commission with the specific data and analyses needed to support the ex-post evaluation of Horizon 2020 regarding the evaluation criteria 'relevance' and 'internal coherence'. Evidence has been gathered during the period August 2021 to September 2022 using a mix of quantitative and qualitative methods. Next to the Horizon 2020 policy mix, the study focuses on processes related to the strategic programming and work programme development. The findings overall show high levels of relevance and internal coherence of Horizon 2020. It proved to be more than its predecessors, which addressed industrial competitiveness, innovation and societal challenges, while continuing to invest in the excellence of the science base. The policy mix was adequate to address the objectives, without major overlaps or duplication. Overall, Horizon 2020 demonstrated flexibility in reacting to emerging needs, and in particular, to the COVID-19 crisis. Improvements made regarding the strategic programming process are acknowledged to support relevance and internal coherence, while the strategic approach to the prioritisation of topics needs strengthening. The strategic use of foresight and policy feedback (i.e. interactions of funded research projects with policy) were not yet systematically institutionalised at the end of Horizon 2020, despite having significant potential to inject some longer-term thinking into the Commission's efforts to orientate the framework programme.

KEY DEFINITIONS, ACRONYMS AND GLOSSARY

Definition of key terms

Term	Definition
Applicant	Legal entity submitting an application for a call for proposals.
Application	The act of involvement of a legal entity in a proposal. A single applicant can apply in different proposals.
Associated Country	Third Countries that are party to an association agreement with the European Union. They participate in Horizon 2020 under the same conditions as EU Member States. As of 1 January 2017 16 countries were associated.
Excellent proposals	Eligible proposals above threshold (proposals evaluated positively)
High quality proposal	A proposal that scores above set evaluation threshold, making it eligible for funding.
Instrument	The main connecting tool to bring Actions users together: a meeting, a conference grant, a training school, or a short-term scientific mission.
Interservice groups	Commission mechanism to ensure internal coherence of policy interventions.
Intervention logic	The links between a proposal's objectives, the planned inputs and activities and the intended results and impact.
Intervention	Any planned effort that is designed to produce specific changes in peoples' thoughts, feelings or behaviours.
Location-based Innovation	'Location-based innovation' (LBI) denotes innovations that result from deep interaction of diverse players in one (physical) location. LBI builds on the concept of a local value networks and therefore requires involving a wider range of actors including non-research related actors such as public administration, organisations and citizens. (see also multi-actor approach. The discussion on LBI as a concept to be used in EU R&I policies addresses the multi-level governance challenge, explicitly linking regional policies with mission-orientation for sustainable development in the context of the Green Deal. It has gained speed in 2020 with the publication of McCann & Soete (2020) and the work of the JRC (Rissola & Haberleiter 2020). ¹
Multi-actor approach	A concept introduced Horizon 2020. A multi-actor approach (MAA) involves including different types of knowledge – scientific and practical- in a research project. In particular non-research related stakeholder (end users but also concerned thirds) should be involved in the research process. MAA project are usually applied research projects that aim at producing solutions for real-world problems.
Newcomer	A Horizon 2020 Participant who was not involved in a FP7 Project (not a FP7 participant).
Openness of calls	Openness denotes a focus on expected impacts of the R&I activity as well as identifying a challenge or problem to be solved, but leaving the call or topic open as to the possible solutions, technologies, research methods, and approaches to be used.
Oversubscription rate	Excellent proposals but not funded/Excellent proposals*100.
Participant	Any legal entity carrying out an action or part of an action under Horizon 2020.
Participation	The act of involvement of a legal entity in a Project. A single Participant can be involved in multiple Projects.
Policy mix	The set of activities, instruments, and types of actions used to implement Horizon 2020.
Prescriptiveness of calls	Describing which technologies, research methods, and/or research approaches are to be used in response to the call or topic.
Stakeholder consultation	Stakeholder consultation is a formal process, by which the Commission collects information and views from stakeholders about its planned policies.

¹ The idea to better link EU research funding with structural funds has already been broad up by the FAB-LAB-APP report (Lamy et al (2017).

Term	Definition
Stakeholder groups	Those that have, or may have an interest (a stake) at the intervention or activity or its consequences – the main/prioritised and minority stakeholders, which according to Better Regulation Guidelines must be identified, broadly consulted and transparently considered.
Strategic intelligence	Intelligence that supports EU's role as a global player. It comprises Intelligence required for developing plans, policies and strategies and for the decision making of Member States.
Strategic programming process	The strategic programming approach takes into account new intelligence on scientific, technological, economic, market, and social trends and foresight, as well as emerging policy needs. It involves extensive consultations, notably through the Horizon 2020 Programme Committee and advisory structures.
Success rate	The share of proposals that are retained for funding out of the total number of eligible proposals. (Funded proposals/Eligible proposals)*100.
Target groups	Those, at whom the activity or a policy intervention is targeted and intended: the anticipated users, participants, co-contributors or beneficiaries.
Technology readiness level (TRL)	Technology readiness levels are indicators of the maturity level of particular technologies. This measurement system provides a common understanding of technology status and addresses the entire innovation chain: TRL 1 – basic principles observed; TRL 2 – technology concept formulate; TRL 3 – experimental proof of concept; TRL 4 – technology validated in lab; TRL 5 – technology validated in relevant environment; TRL 6 – technology demonstrated in relevant environment; TRL 7 – system prototype demonstration in operational environment; TRL 8 – system complete and qualified; TRL 9 – actual system proven in operational environment.

Acronyms

AC	Associated Country
AGRI	Agriculture and Rural Development
AI	Artificial Intelligence
AIT	Austrian Institute of Technology
ATI	Advanced Technologies for Industry
BBI	Bio-Based Industries
BOHEMIA	Beyond the Horizon: Foresight in support of future EU research and innovation policy
BUDG	Budget
CIMULACT	Citizen and Multi-Actor Consultation on Horizon 2020
CIP	Competitiveness and Innovation Framework Programme
CNECT	Communications Networks, Content and Technology
CORDA	Common Research Datawarehouse
COSME	Competitiveness of Enterprises and Small and Medium-sized Enterprises
CPPP	Contractual Public-Private Partnership
CSA	Coordination and Support Action
CSO	Civil Society Organisation
DG	Directorate General
DG ENER	Directorate-General for Energy
DG ENTR	Directorate-General Enterprise and Industry
DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
DG MOVE	Directorate-General for Mobility and Transport
DG RTD	Directorate-General for Research and Innovation
EC	European Commission

AC	Associated Country
ECORDA	External CORDA
EIC	European Innovation Council
EIS	European Innovation Scoreboard
EIT	European Institute of Technology and Innovation
EJP	European Joint Programme
EP	European Parliament
EQ	Evaluation Question
ERA	European Research Area
ERC	European Research Council
EU	European Union
EU-13	BG – Bulgaria, LT – Lithuania, SK – Slovakia, CY – Cyprus, LV – Latvia, CZ – Czech Republic, MT – Malta, EE – Estonia, PL – Poland, HR – Croatia, RO – Romania, HU – Hungary, and SI – Slovenia.
EU-15	AT – Austria, BE – Belgium, DE – Germany, DK – Denmark, EL – Greece, ES – Spain, FI – Finland, FR – France, IE – Ireland, IT – Italy, LU – Luxembourg, NL – Netherlands, PT – Portugal, SE – Sweden, and UK – United Kingdom.
EURATOM	European Atomic Energy Community
FCN	Foresight Correspondents Network
FET	Future and Emerging Technologies
FP	Framework Programme
FP7	Seventh Framework Programme
GDP	Gross Domestic Product
GHIT	Global Health Innovative Technology Fund
H2020	Horizon 2020
HEI	Higher Education Institution
HES	Higher education Sector
HoU	Head of Unit
IA	Innovation Action
ICT	Information and Communications Technology
IOI	Innovation Output Indicator
IoT	Internet of Things
ISI	Fraunhofer Institute for Systems and Innovation Research
JPI	Joint Programming Initiatives
JRC	Joint Research Centre
KET	Key Enabling Technology
KNOWMAK	Knowledge in the Making in the European Society
LEIT	Leadership in Enabling and Industrial Technologies
MFF	Multiannual Financial Framework
MS	Member State
MSCA	Marie Skłodowska-Curie Action
NCP	National Contact Point
NGO	Non-Governmental Organisation
No.	Number

AC	Associated Country
P2P	Public to Public
PCP	Pre-Commercial Procurement
PCT	Patent Cooperation Treaty
PHEIC	Public Health Emergency of International Concern
PIC	Participant Identification Code
PPI	Public Procurement of Innovation
PPP	Public-Private-Partnership
PRC	Private for Profit Company
R&D	Research and Development
R&I	Research and Innovation
RDI	EU Industrial R&D Investment Scoreboard
REA	Research Executive Agency
REC	Research Organisations
RI	Research Infrastructure
RIA	Research and Innovation Action
RTO	Research and Technology Organisation
SC	Societal Challenge
SC1	Societal Challenge 1: Health, demographic change and wellbeing
SC2	Societal Challenge 2: Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy
SC3	Societal Challenge 3: Secure, clean and efficient energy
SC4	Societal Challenge 4: Smart, green and integrated transport
SC5	Societal Challenge 5: Climate action, environment, resource efficiency and raw materials
SC6	Societal Challenge 6: Europe in a changing world – inclusive, innovative and reflective societies
SC7	Societal Challenge 7: Secure societies protecting freedom and security of Europe and its citizens
SCAR	Standing Committee on Agricultural Research
SecGen	Secretariat-General of the European Commission
SME	Small and Medium-sized Enterprises
SRIP	Science, Research and Innovation Performance of the EU
StC	Steering Committee
SWAFS	Science with and for Society
SWOT	Strengths Weakness Opportunities Threats
T	Tasks
TG	Technopolis Group
ToR	Terms of Reference
TRL	Technology Readiness Level
UK	United Kingdom
US	United States
WP	Work Programme

Horizon 2020 Actions

Action	Definition
Research and Innovation Action (RIA)	Action primarily consisting of activities aiming to establish new knowledge and/or to explore the feasibility of a new or improved technology, product, process, service or solution. It may include basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory or simulated environment.
Innovation Action (AI)	An action primarily consisting of activities directly aimed at producing plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose they may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication.
Coordination and Support Action	An action consisting primarily of accompanying measures such as standardisation, dissemination, awareness-raising and communication, networking, coordination or support services, policy dialogues and mutual learning exercises and studies, including design studies for new infrastructure. It may also include complementary activities of networking and coordination between programmes in different countries.
Programme COFUND action	Action funded through a grant. The main purpose is supplementing individual calls or programmes funded by entities, other than Union funding bodies, that are managing research and innovation programmes. A programme co-fund action may also include complementary activities of networking and coordination between programmes in different countries.
Dissemination' action	The public disclosure of the results by any appropriate means (other than resulting from protecting or exploiting the results), including by scientific publications in any medium.
Exploitation action	The use of results in further research activities, or in developing, creating and marketing a product or process, or in creating and providing a service, or in standardisation activities.
Close-to-market action	Type of action funding activities intended to produce plans, arrangements or designs for new, altered or improved products, processes or services, including: prototyping, testing, demonstrations, piloting, large-scale product validation, market replication.
FET (future and emerging technologies) action	Type of action funding projects on future and emerging technologies (such as biotechnology, global system science, green technology, medical and neuro-technology, nanotechnology, quantum technology, robotics, and new materials).
FTI (Fast track to innovation) action	Type of action funding close-to-market innovation activities.

Horizon 2020 Activities

Activity	Definition
Excellent Science	Science-driven and largely 'bottom-up' activities which are forward-looking, building skills in the long term, focusing on the next generation of science, technology, researchers and innovations and providing support for emerging talent from across the EU and associated countries, as well as worldwide
Industrial Leadership	Activities following a business- and SME-driven agenda, based on a demand-driven, bottom-up logic (SME instrument). Budgets complemented by use of financial instruments. LEIT following a technology-driven approach to develop enabling technologies that can be used in multiple areas, industries and services.
Societal Challenges	Activities covering the even societal challenges. Activities covering from basic research to market, with a focus on innovation-related activities, such as piloting, demonstration activities, test-beds, support for public procurement, design, end-user-driven innovation, social innovation, knowledge transfer and market take-up of innovations and standardisation. Non-technological, organisational & systems innovation as well as public sector innovation and technology-driven solutions. Bringing together critical mass of resources and knowledge across different fields, technologies and scientific disciplines and research infrastructures in order to address the challenges.

Activity	Definition
Spreading Excellence & Widening Participation	Teaming, twinning, ERA-Chairs, Policy Support Facility, better access of researchers & innovators to international networks (support to COST), NCPs; synergies with other policies and programmes
Science with and for Society	Attractiveness of scientific careers, gender equality, integration of citizens' interests and values in R&I, science education, accessibility and use of research results, governance for the advancement of responsible R&I and promotion of an ethics framework for R&I, anticipation of potential environmental, health & safety impacts, and improved knowledge on science communication.
Fast Track to Innovation (pilot)	Bottom-up measure for close-to-market innovation activities.
Cross-cutting support to specific issues	Gender equality, responsible research and innovation, international cooperation, social sciences and humanities, SME participation, sustainable development, biodiversity and fight against climate change, Digital Agenda.
Non-nuclear direct actions of JRC	Provision of evidence for EU policies – driven by customer needs, complemented by forward-looking activities.
European Institute of Innovation and Technology	Knowledge and Innovation Communities bringing together the knowledge triangle.

Horizon 2020 Instruments

Instrument	Definition
COLLABORATION-BASED GRANTS	
Fast track to innovation (IA)	Continuously open, innovator-driven calls will target innovation projects addressing any technology or societal challenge field
European Joint Programme COFUND (COFUND-EJP)	Support to coordinated national research and innovation programmes in implementing a joint programme of activities (ranging from research and innovation activities to coordination activities, training activities, dissemination activities and financial support to third parties).
ERA-NET-Cofund	Support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as Union topping-up of a trans-national call for proposals.
Pre-Commercial Procurement (PCP)	PCP actions aim to encourage public procurement of research, development and validation of new solutions that can bring significant quality and efficiency improvements in areas of public interest, whilst opening market opportunities for industry and researchers active in Europe.
Public Procurement of Innovative solutions (PPI)	PPI actions enable groups of procurers to share the risks of acting as early adopters of innovative solutions, whilst opening market opportunities for industry.
MSCA ITN	Marie Skłodowska-Curie Innovative Training Networks support competitively selected doctoral(-level) programmes, implemented by partnerships of universities, business and other RPOs across Europe and beyond. Partnerships take the form of collaborative European Training Networks (ETN), European Industrial Doctorates (EID) or European Joint Doctorates (EJD).
MSCA RISE	Marie Skłodowska-Curie Research and Innovation Staff Exchanges (RISE) support international and inter-sectoral collaboration through research and innovation staff exchanges, and sharing of knowledge and ideas from research to market (and vice-versa).
MONOBENEFICIARY GRANTS	
Marie Skłodowska-Curie Actions (MSCA)	Individual Fellowships (IF)) support experienced researchers undertaking mobility between countries.
MSCA COFUND	Aims at stimulating regional, national or international programmes (fellowship or doctoral programmes) to foster excellence in researchers' training, mobility and career development, spreading the best practices of MSCA.

Instrument	Definition
ERC Frontier Research	Funding for projects evaluated on the sole criterion of scientific excellence in any field of research, carried out by a single national or multinational research team led by a 'principal investigator'.
SME Instrument (IA)	The SME Instrument is targeted at all types of innovative SMEs showing a strong ambition to develop, grow and internationalise. It provides staged support covering the whole innovation cycle in three phases complemented by a mentoring and coaching service. Phase 1 – feasibility study verifying the technological/practical as well as economic viability of an innovation idea/concept. Phase 2– innovation projects that address a specific challenge and demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan.
Specific Grant Agreement (SGA)	The Financial Regulation provides the possibility of Framework Partnership Agreements for long term partnerships and associated specific grant agreements. Framework Partnership Agreements and Specific Grant Agreements have been used in a limited way when in line with the objectives of the programme parts.
Prizes	Financial contribution (lump-sum) given as reward following a contest.
NON-GRANT ACTIONS	
Public Procurement	Purchase of work, goods or services by public entities.
Financial instruments	Equity or quasi-equity investments; loans; guarantees; other risk-sharing instruments. Main form of funding for close to market activities. Horizon 2020's financial instruments operate in conjunction with those of the COSME programme. Expected strong synergies with the European Fund for Strategic Investments (EFSI).

Horizon 2020 Partnerships

Forms of Partnerships	Definition
Public-Public Partnerships	Article 185 of the TFEU allows the integration of national efforts into a programme undertaken jointly by several Member States, with the participation of the EU, including participation in the structures created for the execution of the joint programme.
Public-Private Partnerships (PPP)	Based on Article 187 TFEU they support the development and implementation of research and innovation activities of strategic importance to the Union's competitiveness and industrial leadership or to address specific societal challenges. They take the form of Joint Undertakings and organise their own research agenda.
Contractual public-private partnership (cPPP)	Structured public-private partnerships that have direct input into the preparation of work programmes in areas of major industrial significance. They develop strategic roadmaps for research & innovation activities.
European innovation partnerships (EIPs)	Public-private partnerships that bring together actors at EU, national and regional level to: boost research & development, coordinate investment in demonstration and pilots, anticipate and fast-track any necessary regulations or standards, increase demand, in particular through better coordinated public procurement to ensure that any breakthroughs are quickly brought to market.
European technology platforms (ETPs)	Public-private partnerships in the form of industry-led stakeholder forums to develop research & innovation agendas and roadmaps for action at EU and national level (private and public funding), mobilise stakeholders to deliver on agreed priorities and share information across the EU.
FET flagships	Large-scale European public-private partnerships that are science-driven at the start but gradually increase industrial participation over their ten-year duration.
Joint programming initiatives (JPIs)	Public-public partnerships with EU Member State authorities to increase joint programming of national research programmes in a specific area – by developing a shared vision for the area, defining a Strategic Research Agenda (SRA) and SMART objectives (specific, measurable, achievable, relevant and time-bound) and preparing the implementation.

Joint technology initiatives (JTIs) (also: joint undertakings (JUs))	Public-private partnerships with industry and stakeholders for joint funding and implementation of strategic research & innovation agendas (via a joint undertaking under Article 187 of the EU Treaty, co-owned by the EU).
Knowledge and innovation communities (KICs)	Partnership between stakeholders in the innovation process (higher education institutions, research organisations, companies, etc.). It takes the form of a strategic network, encouraged and funded by the European Institute of Innovation and Technology (EIT). The network can have various legal forms, and carries out joint innovation planning (mid- to long-term), to develop innovative products and services, start new companies and train entrepreneurs.

1. Introduction

1.1. Purpose of the evaluation study

The purpose of this study is to provide the Commission with the necessary evidence supporting the ex-post evaluation of Horizon 2020 concerning the evaluation criteria 'relevance' and 'internal coherence', as well as its policy mix. Furthermore, the study's conclusions and recommendations shall inform the implementation of Horizon Europe, and potentially future framework programmes (FP).

1.2. Scope of the evaluation

The study covers the whole Horizon 2020 programme (2014-2020). It is performed in line with the [Better Regulation guidelines](#) as applicable to all EU expenditure programmes.

The focus of the evaluation is on the relevance and internal coherence evaluation criteria. We note that the 'coherence' criterion splits broadly into internal and external coherence, and it is **internal** coherence that is considered in this study. Evaluating 'effectiveness', 'efficiency' or 'EU added value' is not part of this assignment and will be addressed in related Horizon 2020 impact area studies.

According to the Better Regulation toolbox², the two criteria are defined as follows:

***Relevance** looks at the relationship between the needs and problems in society and the objectives of the intervention and hence touches on aspects of design. Relevance analysis also requires a consideration of how the objectives of an EU intervention (legislative or spending measure) correspond to wider EU policy goals and priorities. Analysis should identify if there is any mismatch between the objectives of the intervention and the (current) needs or problems. (...)*

*'The evaluation of coherence involves looking at how well or not different actions work together. (...) Checking **internal coherence** means looking at how the various components of the same EU intervention operate together to achieve its objectives e.g. the different articles of a piece of legislation, different actions under an action plan. (...)*

In the context of this specific study, and building on the corresponding baseline definitions in the Better Regulation toolbox, 'relevance' and 'internal coherence' of the policy mix and the corresponding processes established are defined as follows:

Relevance of the design: The programme's relevance to the needs, priorities, problems and issues for R&I to be addressed at the European level; the relevance of Horizon 2020 to the European political priorities; the responsiveness to emerging needs and priorities;

Relevance of the policy mix: The degree to which the policy mix addresses the Horizon 2020 objectives; the adequacy in addressing the needs of target groups.

Relevance of processes: The extent to which processes supported relevance, for example different types of consultation and evidence used in Horizon 2020 programming.

Internal coherence of the policy mix: The translation of Horizon 2020 objectives into work programmes and calls, and coherence across the programme parts; the complementarity and consistency of established and new instruments, activities, or actions within the policy mix.

Internal coherence of processes: A set of process characteristics, expected to support the successful design of the programme.

² Tool #47: https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-47_en_0.pdf

2. Background to the initiative

2.1. Horizon 2020

Horizon 2020 brought together EU-level research and innovation funding into a single programme. It includes a portfolio of instruments, actions and activities that address a wide range of the needs of Europe's research and innovation system. It included bottom-up actions directed to individual researchers such as the Marie Skłodowska Curie Actions (MSCA) and the European Research Council (ERC), as well as thematic actions stretching from discovery science to application, entrepreneurship and scale-up. For the first time, it included the innovation activities from the former Competitiveness and Innovation Framework Programme (CIP), as well as the European Institute of Innovation and Technology (EIT). It was designed expressly to improve synergies among these previously separate EU interventions and this newly integrated model, coupled with a larger budget, was intended to drive economic growth, create jobs, and address societal challenges by coupling research and innovation more determinedly and more effectively than had been achieved before.

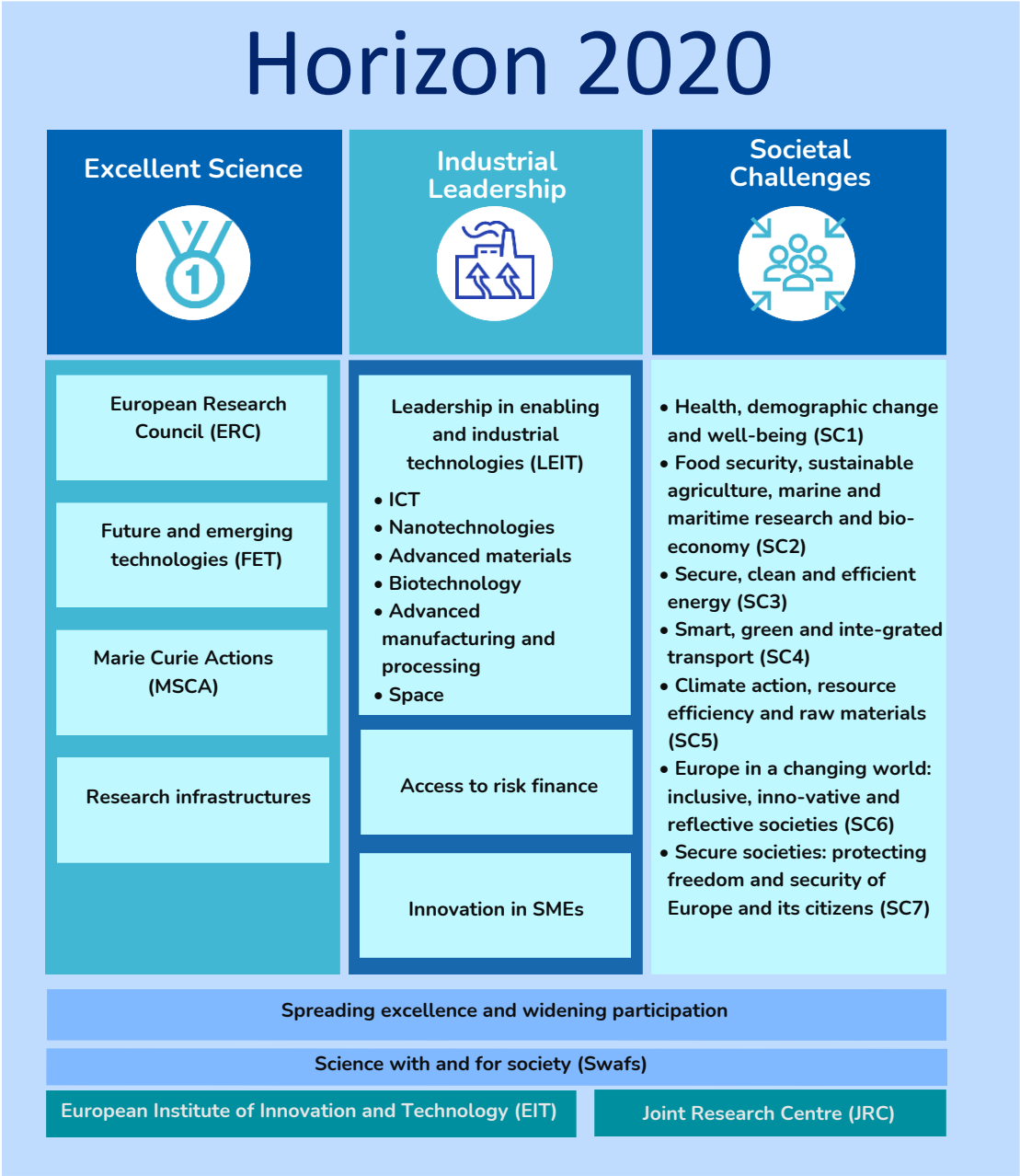
Horizon 2020 was structured around three mutually reinforcing pillars, each having its own specific objectives and broad lines of actions:

- The Excellent Science pillar
- The Industrial Leadership pillar
- The Societal Challenges pillar

It also included two horizontal lines – Spreading Excellence and Widening Participation, and Science with and for society – and several focus areas: four areas for targeted R&D investment (these varied for each multiannual work programme, and in 2018-2020 covered 'Boosting the effectiveness of the Security Union', 'Connecting economic and environmental gains – the circular economy', 'Digitising and transforming European industry and services', 'Building a low-carbon, climate resilient future'), the 'Fast-track to innovation' pilot, as well as cross-cutting issues (e.g. 'Gender equality', 'Responsible research and innovation', 'International cooperation', 'Social sciences and humanities' (SSH), 'SME participation', 'Sustainable development', 'Biodiversity', 'Fight against climate change', and 'Digital agenda'), the JRC's Euratom programme (non-nuclear direct actions), and the European Institute of Innovation and Technology (EIT).

Figure 1 depicts the structure of Horizon 2020, including its three pillars, the horizontal parts aimed at widening participation, and science with and for society (SWAFS), as well as the JRC and EIT activities.

Figure 1: Structure of Horizon 2020

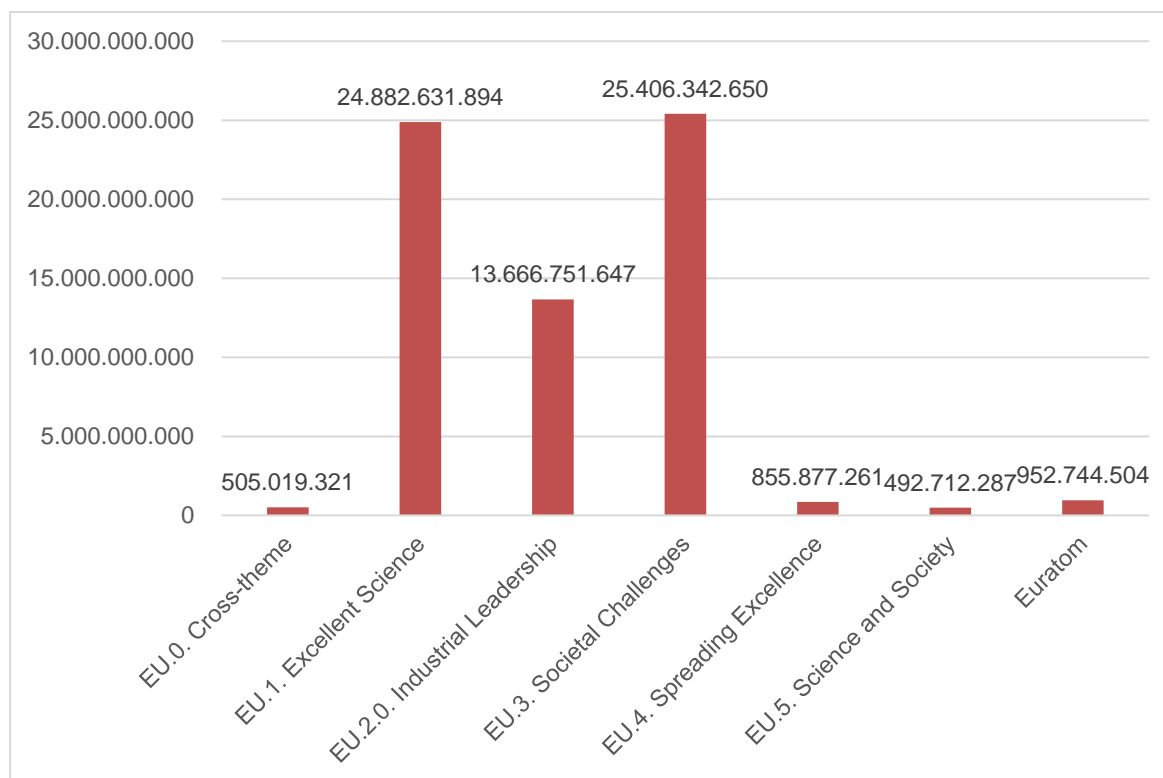


Source: EC.

A total of EUR 66.8 billion was allocated in Horizon 2020.³ Based on budget allocation, the largest pillar is Societal Challenges with 38% (EUR 25.4 billion) of funding (see figure 2). Pillar 1 with the highest share of projects, follows closely with more than EUR 24.8 billion (37%). A total of EUR 13.6 billion (20%) are allocated to Industrial Leadership. The programme parts Cross-theme, Spreading Excellence, Science with and for Society, and Euratom constitute a relatively small share of the programme budget.

³ Based on eCORDA data provided to the study team on 7 September 2021. Smaller deviations of the results from other analyses of Horizon 2020 performed later with an updated data set are possible.

Figure 2: Budget allocation in Horizon 2020 (in EUR)



Source: eCORDA, cut-off date 7 Sept. 2021.

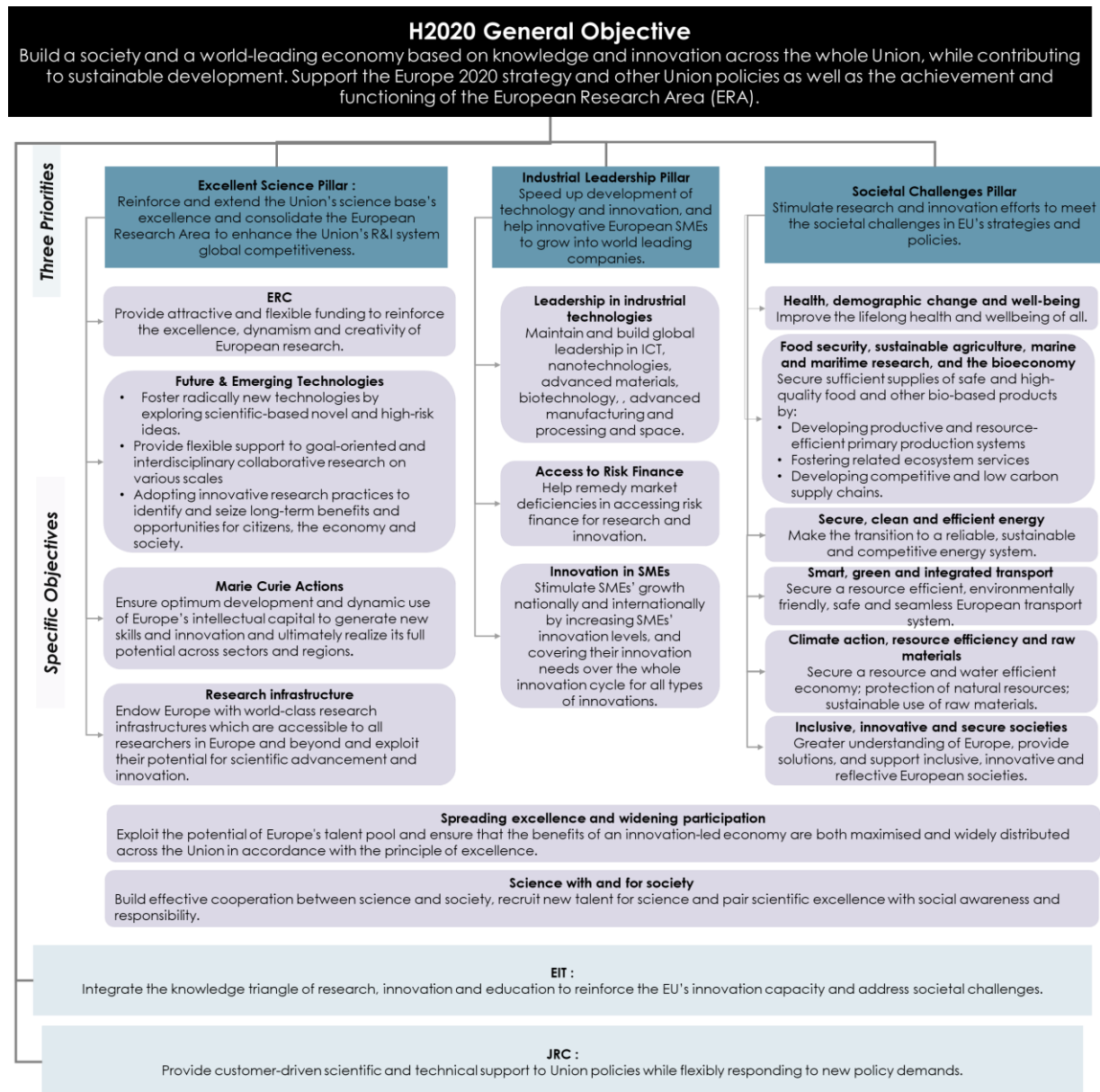
2.1.1. The Horizon 2020 objectives and the intervention logic

The rationale and objectives of Horizon 2020 are set out in Regulation (EU) No 1290/2013. The programme was to contribute to the creation of industrial leadership, growth, employment and citizens' welfare. Furthermore, it should reflect the strategic vision of the 'Europe 2020' strategy of 2010 and contribute to the European Research Area. In Council Decision 2013/743/EU, the structure and the rules for participation are laid out. The general objective of the programme is reflected in the three priorities Excellent Science, Industrial Leadership, Societal Challenges, and their respective specific objectives (see **figure 3**). The general objective should equally be pursued through the specific objectives of the two horizontal priorities, the JRC's Euratom programme (non-nuclear direct actions), and the European Institute of Innovation and Technology.

A detailed logical framework of Horizon 2020 was developed during the interim evaluation of Horizon 2020. Up to then, a basic narrative form of an intervention logic was provided, for example by the Communication associated with the ex-ante impact assessment of Horizon 2020.⁴ The detailed graphic version of the [Horizon 2020 intervention logic](#) gave a comprehensive picture of the needs and problems of the R&I system to be tackled, and the political objectives to be achieved, the activities and the expected impacts. It distinguished between outputs (the direct products from the activities, such as reports, trained researchers, demonstrators, prototypes, new infrastructures), outcomes that relate to benefits (direct from participation) and impacts (wider effects of Horizon 2020), which are categorised into three main types: scientific, economic, and societal impacts. While the condensed version for the whole of Horizon 2020 did not establish links between individual activities and actions to intended outputs, outcomes and impacts, detailed intervention logics were developed for each programme part.

⁴ European Commission (2011): COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: 'Horizon 2020 – The Framework Programme for Research and Innovation', COM(2011) 808, pp. 4-5.

Figure 3: General and specific objectives of Horizon 2020



Source: Own compilation based on Annex 1 of Regulation 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020.

These intervention logics provide for ideal programme developments. Furthermore, they reflect the thinking of the time of the interim evaluation and, thus, already incorporate a degree of development compared to the initial Legal Basis of Horizon 2020. The logic of the individual programmes show some variety in their set-up. Most provide comprehensive information on the overarching needs, objectives and specific objectives (not all of them) and a comprehensive overview on the activities. Yet, several give a very general view of the input side but largely avoid specifically linking objectives to activities. Further, the intervention 'logics' did not capture external intervening factors that may determine whether an impact will be achieved or not. This meant they could not adequately guide analysis on how Horizon 2020 interventions might have contributed to observed outcomes.

2.1.2. Horizon 2020 policy mix

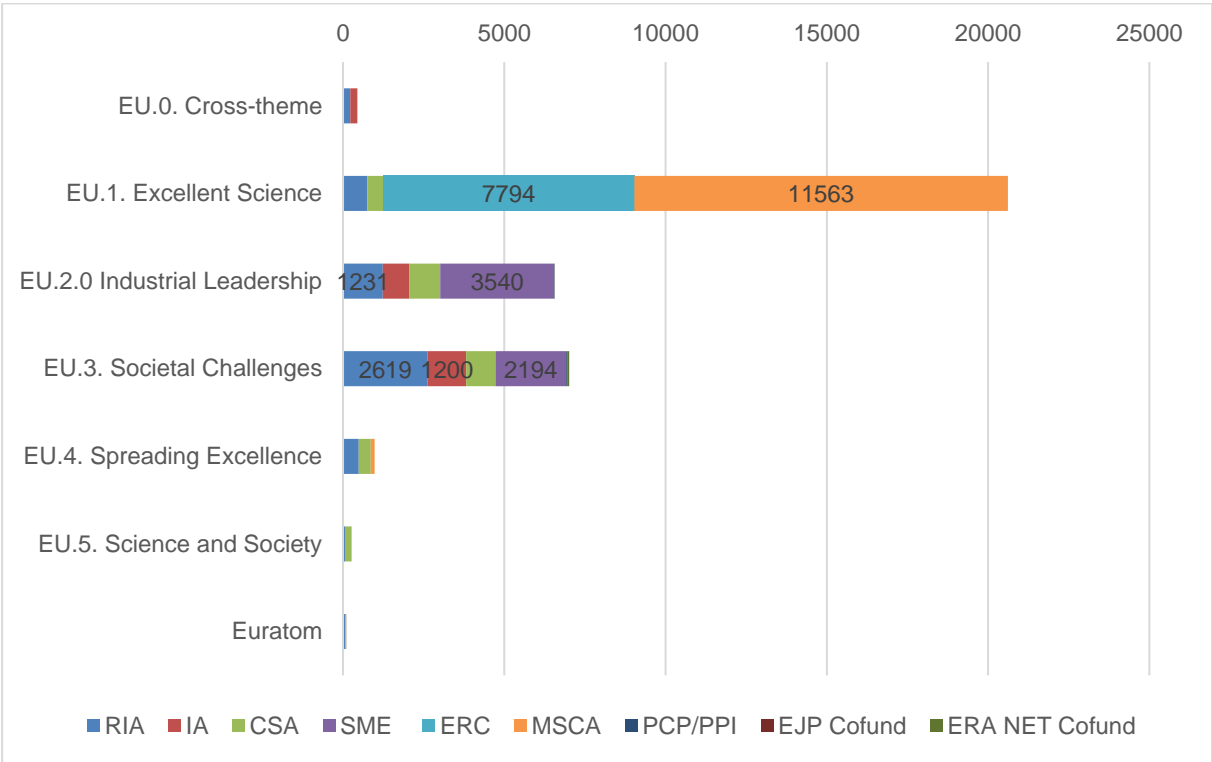
The Horizon 2020 policy mix is defined as the set of activities, instruments and types of actions used to implement Horizon 2020 (cf. key terms and glossary of this study).

Horizon 2020 was designed as an evolution following the experience of the previous framework programme (FP7). Some new and some 'refurbished' elements were added. The new programme was expected to cover the full cycle from fundamental research to the market. As such, Horizon 2020 was

directed at innovation-related activities, impact orientation, and included a 'challenge-based approach'. This new focus was not limited to the development of new products and services based on scientific and technological results, but also incorporated the use of existing technologies in novel applications, continuous improvement, both non-technological and social innovation. It included activities closer to the market and to end-users (e.g. prototyping, testing, demonstrating, piloting, product validation, and market replication) as well as demand-side approaches (such as public procurement of innovation). To this end, it expanded activities such as the SME Instrument, with an orientation towards higher Technology Readiness Levels (TRLs), innovation procurement, inducement prizes and – possibly a key distinguishing feature for Horizon 2020 – the pilot that led to the creation of the European Innovation Council (EIC). Horizon 2020 also encompassed a larger number of different types of partnerships, several as a legacy from FP7. They aimed to intensify public-private and public-public collaboration and coordination, and to create systemic impact while increasing the competitiveness of the R&I system (for different types of partnerships).

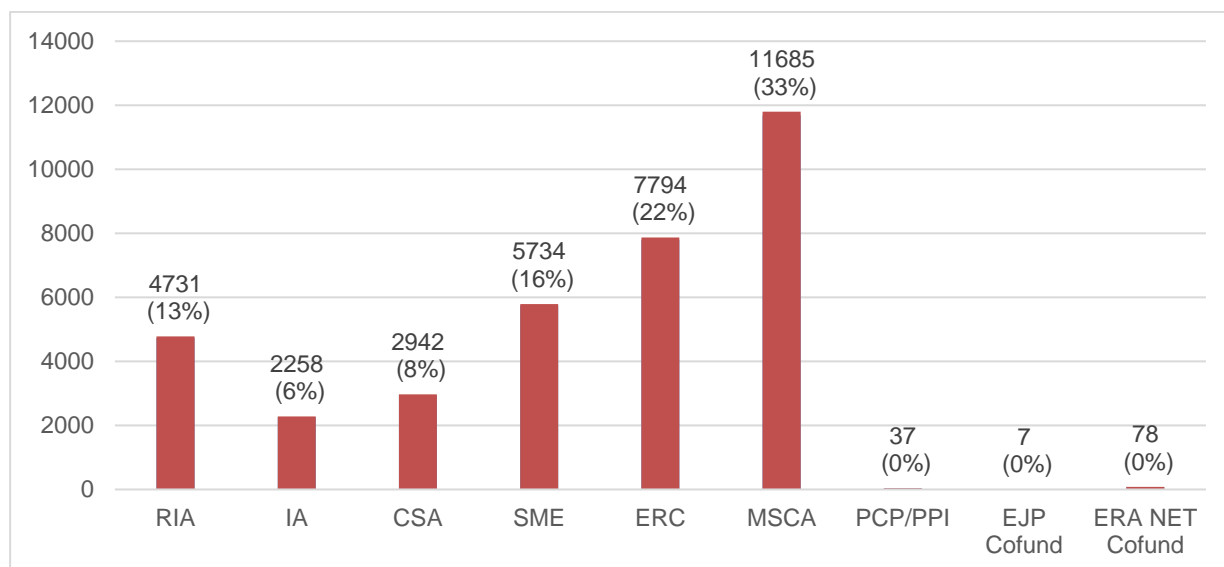
Horizon 2020 included more than 20 different types of actions (cf. see key terms and glossary of this study and the [intervention logic](#)), which varied by targeted beneficiaries, type and rate of financial support, scope, TRL, etc. Dominant actions in terms of numbers and budget allocated were in Horizon 2020 the ERC Frontier research grants and MSCA grants in the Excellent Science pillar, the SME Instrument, and Research and Innovation Actions (RIA) in the Industrial Leadership part. In the Societal challenges (SC) programmes, RIAs dominated, followed by the SME Instrument. Innovation Actions (IA) and Coordination and Support Actions (CSA) were also quite frequent in both the Industrial Leadership and SC pillars. Other types of actions such as procurement (PCP, PPI) played a marginal role in terms of projects and budget (cf. [figure 4](#) and [figure 5](#)).

Figure 4: Distribution of instruments and type of actions across programme parts (in numbers of projects)



Source: eCORDA as of 7 Sept. 2021.

Figure 5: Number of projects per type of action (simplified)



Source: eCORDA, as of 07/09/2021.

2.1.3. Strategic programming process and work programme elaboration

The terms of references of this study call for an evaluation of the strategic programming process and related processes of Horizon 2020. It is the only study among the set of Horizon 2020 ex-post evaluation reports asked to study Horizon 2020 processes. As these processes are only partially documented, the following description shall provide a basic understanding. It builds on desk research and interviews⁵ performed for this study. Thus, the description is part of the findings of this study, however, due to its descriptive nature, it is presented in this background chapter instead of the analytical chapters.

In this study, **processes are generally described in terms of how they worked at the end of Horizon 2020** and in the transition to Horizon Europe. For many processes we give an account of how they developed over time – as far as this was traceable, given that only a few interview partners were available who could cover the early phase of the programme.

The programming up to FP7 was by and large responding to the needs and interests of the research communities. Yet, in cases of crises and new political priorities the responses were *reactive*. With Horizon 2020, strategic programming evolved into a tool that allowed policymakers to shape and direct political priorities.

The development of the programming process towards a 'strategic programming process' included the identification of focus areas. They reflected the politically important themes of various directorates-general (DG). The process included a switch to two-year programming cycles (three years for the last cycle), writing of the work programme (WP) texts from a problem perspective, and a more targeted and orchestrated EC-internal and external consultation process. Over the course of the three programming phases, this process was further refined, as were different approaches to consultation and the gathering of evidence in the process.

Two key elements were introduced in Horizon 2020, which mark this development: First, **scoping papers** were developed by the various DGs involved, which summarised different sources of evidence and sketched the directions and main ambitions of the thematic programme parts (step 0 in **figure 6**). Second, an **overarching strategic programming document** guiding the first work programme was developed by DG RTD jointly with other implementing services after consulting Member States in programme com-

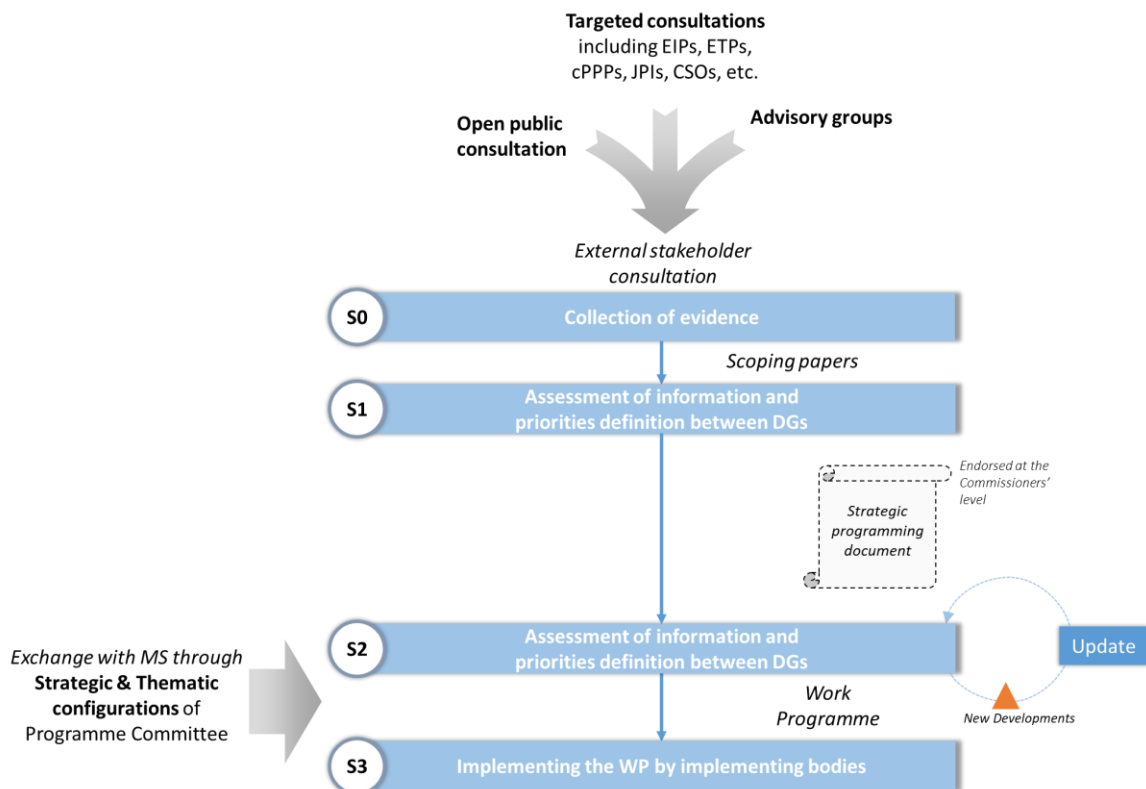
⁵ Cf. Policy mix case studies no. 1, 4 and 5.

mittees (step 1). This document was then developed for each programming period. The second overarching document was a sort of political offering,⁶ specifying how the different pillars supported the political priorities of the EC. In the third strategic programming document, the focus areas, which had played a less prominent role in the first two documents, were re-defined in response to the recommendations of the High Level Group on maximising the impact of EU Research & Innovation Programmes ('Lamy Report').⁷

While the first strategic programming document was neither formally approved, adopted, nor published, the second and third were published. During Horizon 2020, there was no procedure available while for Horizon Europe, the strategic programming plan formed part of a Commission Decision.

These newly established processes came on top of others, which had been in place within the framework programme history, most importantly the annual updating of the work programmes (step 2 in figure 6).

Figure 6: The strategic programming process as developed under Horizon 2020



Source: Fraunhofer ISI.

Various analytical inputs were used to inform the development and adjustment of the framework programme, ranging from the ex-ante impact assessments and regular monitoring flashes to the interim evaluation of Horizon 2020. The latter played an important role in adjusting Horizon 2020 ahead of the third programming period and for preparing Horizon Europe.

Horizon 2020 made a clear commitment to include the views of external stakeholders. These were introduced in the programming through the following mechanisms:

⁶ European Commission (sent to Commission President Barroso on 28 January 2013). Horizon 2020 Strategic Programming Document. Guidance for the development of the Work Programme 2016-2017.

⁷ European Commission (adopted on 27 October 2017). Horizon 2020 Work Programme 2018-2020. Strategic Programme Overarching Document.

- Expert Advisory Groups: One of the novelties in Horizon 2020 was the establishment of 19 thematic groups of EC external experts. The groups became operational for the second round of work programme development. Each group issued periodic reports (one for each work programming period).
- Open consultation (Green Paper): The ex-ante impact assessment for Horizon 2020 and the interim evaluation of Horizon 2020 have been subject to two open consultations in 2011 and 2016. Next to standardised questions that stakeholders (either organisations' representatives or individuals) took via an online survey, the consultation process also included the gathering of position papers.
- Further (informal) consultation mechanisms and meeting arenas: Beside the two main consultation mechanisms, several other interactions between the EC and external stakeholders existed, which were more ad-hoc and less institutionalised, and less frequently used.

A key Commission internal decision-making process based on coordination was introduced with Horizon 2020 to produce the overarching strategic programming document, for which (later) the term 'co-creation' was established as a consequence of systematic budget integration realised for the first time in the framework programme. Almost all the research funding of the different DGs became a part of the framework programme and thus of the (strategic) programming process managed largely by DG RTD, whereas under former FPs, the 'research' DGs had strategic responsibility for their own research budgets and developed 'own approaches' to programming (and administering) their FP parts (Andrée 2008: 10). Prior to Horizon 2020, 'policy' DGs looking to carry out research activities but lacking their own research budget had to submit their requests to 'research' DGs. Co-creation brought about new mechanisms of exchange, involving both the political and the operational level. Some top-down decisions remained, but the co-creation novelty also led to some collective decisions involving many services. The Horizon 2020 priorities were not decided by a single entity (or board of directors).

Formally, the work programme and its update were adopted by the different configurations of the programme committees, and thus jointly by Member States and the EC.

2.2. Evaluation questions and methodology

Table 1 presents the nine guiding evaluation questions. Two of them focus on the relevance of the Horizon 2020 design (understood as the set of objectives, the three-pillar structure and further activities as defined by the Legal Basis of Horizon 2020), another three are dealing with the relevance and internal coherence of the strategic programming process and the final four areas are dedicated to the 'relevance' and 'internal coherence' of the Horizon 2020 policy mix. Chapter 3 summarises the evidence related to the relevance, while chapter 4 is dedicated to the questions of internal coherence.

Table 1: Guiding evaluation questions

Guiding evaluation questions	Sub-questions	Report chapter
Relevance of H2020 design		
How relevant is Horizon 2020 intervention given the needs, priorities, problems and issues?		3.1.1 3.1.3
Relevance of H2020 R&I Investments		
Has H2020 prioritised its R&I investments rightly?	Mapping H2020 investments in relation to the relative competitive positioning of the EU; <ul style="list-style-type: none"> • What are the strengths, weaknesses, opportunities and threats shaping EU R&I investments since Horizon 2020 started? • Where does the EU have comparative advantages in terms of scientific knowledge production and circulation, technology areas, exports, value-added, sectors, or scientific disciplines? • Where is the EU a leading player? • What are the critical technological areas in which the EU is under-/ overperforming? Process characteristics: <ul style="list-style-type: none"> • Which rationales guided budgetary decisions? • What changes have occurred during the H2020 implementation? 	3.1.1 3.1.2

Guiding evaluation questions	Sub-questions	Report chapter
Relevance of the H2020 policy mix		
Was the H2020 policy mix effectively designed to meet the H2020 objectives?	<p>Criteria for the assessment of relevance of the overall policy mix or policy mixes of specific programme parts:</p> <ul style="list-style-type: none"> • Are H2020 scientific, economic and/or societal objectives exhaustively reflected in the policy mixes of the pillars or programme parts, without gaps or overlaps? • Do the policy mixes allow not only to address market failures, but also system failures, and/or transformational failures? • How appropriate was the level of granularity or prescriptiveness of the calls and/or topics? 	3.2.1
Relevance of the H2020 policy mix to address target group needs		
Did the H2020 policy mix address the needs of target groups especially the needs of new participants?	<p>Does the policy mix address the needs of applicants and beneficiaries, in terms of</p> <ul style="list-style-type: none"> • type of support offered (e.g. are funding opportunities transparent and clear?), • implementation modalities, • funding rates, • reporting requirements? <p>How well have new participants been mobilised</p> <ul style="list-style-type: none"> • in general, • as a result of the introduction of new instruments? <p>Do the interventions allow for increased intensity, understood as structuring (systemic) effects on the target groups?</p> <p>Does the growing impact orientation set the right incentives?</p>	3.2.2
Relevance of the H2020 policy mix in terms of flexibility		
To what extent was the Horizon 2020 policy mix flexible enough to react swiftly and appropriately to socio-economic, technological and scientific developments, including emergency situations and external crisis?	<p>How did the H2020 policy mix come into play in ensuring a swift reaction to crisis situations in terms of</p> <ul style="list-style-type: none"> • funding mechanisms and funding instruments, types of actions and R&I focus, • reaction time, • internal operational processes including delegation to implementing bodies? <p>What role did the Open Science policy promoted by Horizon 2020 play to react to external shocks?</p>	3.2.3
Relevance of the different programming processes in terms of flexibility		
Do the different H2020 processes contribute to a balance between long-term strategic orientation and flexibility needed?	<p>Reflection of challenges and priorities, which have been evolving after H2020 was conceived in WPs, call, projects:</p> <ul style="list-style-type: none"> • To what extent does the H2020 strategic programming process, esp. the second and third cycle, reinforce EU research and innovation strengths, building on opportunities, limiting weaknesses and allow to react/adapt to external threats in strategic areas for the EU? <p>Characteristics of the strategic programming process:</p> <ul style="list-style-type: none"> • Did the process for the second and third programming cycle incorporate specific mechanisms or sources of evidence to account for changes in the broader context? <p>Did the emergency procedure work swiftly to allocate funds to crises, e.g. to activities addressing the COVID-19-crisis?</p> <p>Characteristics of the WP drafting processes:</p> <ul style="list-style-type: none"> • To which extent were programme committees aware of the relevance of changes in the broader context? • Was there experimentation with the openness and prescriptiveness of calls? • Was there continuous communication established between programme committees and partnerships related to necessary updates of the strategic approach in light of new developments? 	3.3

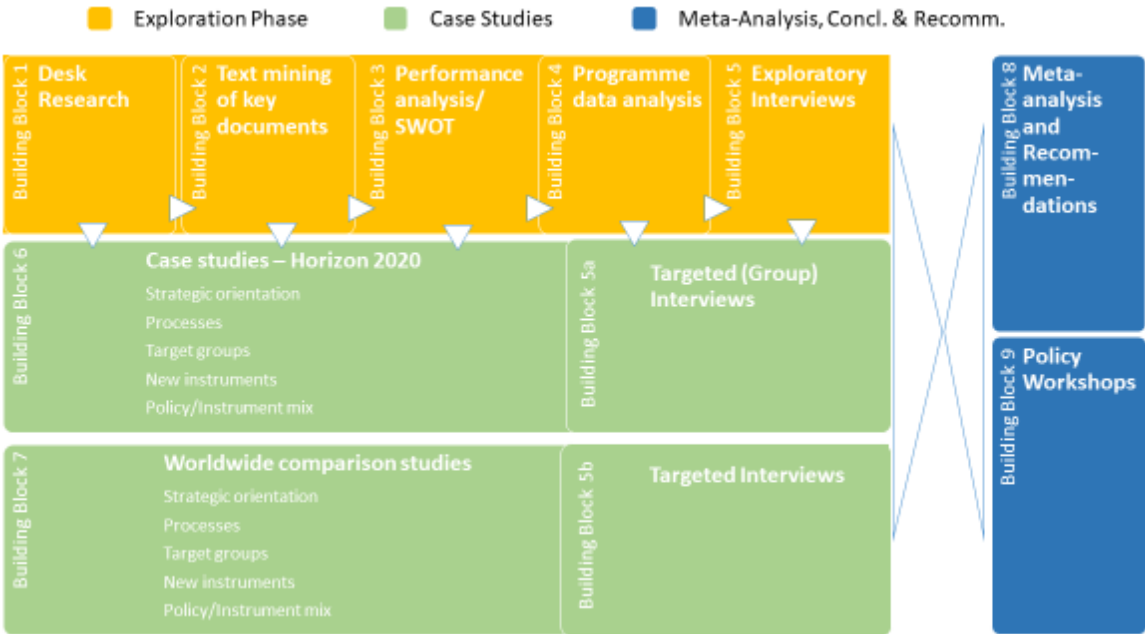
Guiding evaluation questions	Sub-questions	Report chapter
Relevance of the strategic intelligence used in the programming processes		
Have the H2020 programming processes sufficiently and effectively used different sources of strategic intelligence?	<p>Have the programming processes sufficiently and effectively used evidence and information sources, such as</p> <ul style="list-style-type: none"> • strategic foresight and road-mapping, including in the context of R&I partnerships, • evaluation and monitoring, • feedback from projects and research results, • stakeholder consultation and co-creation processes? <p>Process characteristics (focusing on consultation processes):</p> <ul style="list-style-type: none"> • Does the process reflect citizens' needs adequately? • Whose stakes were considered to be the most relevant? • How transparent were those processes for the stakeholders? 	3.4
Internal coherence of the programming processes		
Do the strategic programming process and the subsequent WP elaboration processes ensure a coherent translation of H2020 objectives into work programmes and calls?	<p>Reflection of H2020 objectives in practice in the work programmes, calls and projects:</p> <ul style="list-style-type: none"> • How well (transparent and exhaustively) have the H2020 objectives been translated into work programmes and calls? How do the projects selected align with the call text? • Are they strictly translated to those pillars where 'they belong to' or are there additional references to objectives across pillars? <p>Characteristics of the strategic programming process:</p> <ul style="list-style-type: none"> • What characterised the strategic programming process with focus on how WP objectives have been elaborated? • Did the process support policy learning? • What mechanisms were in place to prioritise or solve inconsistencies between (operational) objectives? <p>Characteristics of the WP elaboration processes:</p> <ul style="list-style-type: none"> • What characterised the WP elaboration process under H2020? • How did the strengthening of focus areas with the third WP change the strategic programming process? 	4.1 4.3
Coherence of the H2020 policy mix		
Was the H2020 policy mix designed in a way to foster effective implementation in light of the objectives?	<p>Criteria for the assessment of internal coherence of the policy mix (set of activities, instruments, types actions):</p> <ul style="list-style-type: none"> • Can complementary interaction outcomes of the policy mixes (e.g. for a pillar or programme part) be expected? • Do policy mixes for parts of H2020 (e.g. the pillars or programme parts) turn out to represent consistent intervention logics? <p>Criteria for the assessment of new elements of the policy mix (new activities, instruments, types of actions):</p> <ul style="list-style-type: none"> • How ambitious or risk averse are these new elements? Do they support incremental change or are they set to change the intervention logic in a way that disruptive change can be expected? • Are new elements of the policy mix duplicating existing ones? • Is the volume of R&I investments for the new element adequate given the level of ambition? 	4.2

Figure 7 shows the main methodological building blocks of the project. Evidence has been gathered during the period between August 2021 and September 2022 using a mix of quantitative and qualitative methods. Data collection and analysis was structured in five phases.

In the exploration phase, a cross-cutting basis of relevant data was developed using European Commission sources (e.g. extracts from eCORDA database, call texts, etc.), as well as compiled through the analysis of documents (Horizon 2020 programming documents, policy documents, evaluation studies, expert advice, etc.). Subsequently, the first qualitative (performance and SWOT analysis, exploratory interviews) and quantitative analyses (programme data analysis, text mining) were performed, which guided the subsequent steps of the study. In the third phase, 20 Horizon 2020 policy mix case studies were complemented by ten worldwide comparison case studies. These latter case studies provided

inspirational knowledge on leading practices, but were not used as benchmarks because the contexts of these programmes were not directly comparable to Horizon 2020. For both the Horizon 2020 policy mix case studies and worldwide comparison case studies 75 targeted interviews were conducted to support the 'sense-making' and analysis process. In the synthesis phase, insights and conclusions from the study were assessed and validated in two policy workshops, which included targeted stakeholder consultations of altogether 63 participants. The concluding meta-analysis was dedicated to deriving lessons learnt, areas for improvement, and operational recommendations for Horizon Europe.

Figure 7: Building blocks of the methodological approach



Source: Own compilation.

Overall, 138 external experts participated in the study, among them 80 stakeholders⁸ from seven different stakeholder groups and 58 EC officials.

Table 2: Number of experts and stakeholders involved in study

	TOTAL	Stakeholders	EC
Interviews	75	45	30
Policy Workshop 1 (May 2022)	28	15	13
Policy Workshop 2 (November 2022)	35	20	15
TOTAL	138	80	58

2.3. Limitations and data needs for further studies

With a view to its initial ambitions, this study is characterised by two major limitations that are due to lack of data and knowledge gaps. Most noteworthy is the **short historic memory of Horizon 2020's design and strategic programming development process**. Not only are there very few documented

⁸ In addition to the group of EC officials, seven different groups of external stakeholders took part in the study: (1) MS and AC staff involved in 14 programme committees and other groups involved in the development of the Horizon 2020 Work Programmes and calls, (2) Experts (non-EC staff) involved in the development of the Horizon 2020 work programmes and calls, e.g. chairs and members of Advisory Groups, foresight experts, (3) Senior officers of national and regional research and innovation funding agencies, (4) Senior officers of EU research and innovation representative bodies, including umbrella organisations representing applicant groups of Horizon 2020, incl. organisations representing societal actors, (5) Senior officers of the national contact points and related network and information services, (6) Policy officers representing programme parts of Horizon 2020 and project officers from organisations involved in the implementation, e.g., from the ERC, EIT, JRC, REA etc., and (7) Representatives of partnerships funded under Horizon 2020 (PPPs, P2Ps and KICs).

sources on the processes (apart from the interim evaluation), but many of the people involved in the design of Horizon 2020 and in the first two programming periods now work in different directorates of the EC or they have retired.

Furthermore, the interviews for the different case studies allowed the evaluation team to elicit some of the EC-internal processes and learnings from the various evolution stages of Horizon 2020. At best they represent a partial reconstruction of how and why Horizon 2020 was undergoing changes in the course of its lifetime, but the evidence shows that there is a lot to learn on how processes foster (or not) relevance and internal coherence. A formative evaluation approach – set up as an accompanying activity to the programme implementation – could offer the opportunity to analyse processes related to programme design and the development of work programmes in future FPs. This would promote iterative developments during the programming periods reflecting the intended design, intervention logic, and policy mix. This evaluation study on Horizon 2020 points to the need for new forms of embedding evaluations into policy learning processes involving a much wider range of Commission actors as well as external experts and stakeholders than before. This results from the need for increased collaboration between DGs and directorates as well as external experts and stakeholders to foster the development of comprehensive and (rather) complex programming processes. Although the relevance of evaluation for policy learning for subsequent framework programmes has grown immensely over the past years, a formative approach and hence change in evaluation culture might further support this process in the future.

Moreover, the **ambition to cover partnerships** as a cross-cutting issue in the various studies commissioned for the ex-post evaluation of Horizon 2020 posed a challenge for this study, which is asked to draw conclusions at the meta-level of the whole programme. Partnerships were covered by three case studies in this study, which give an account of their diversity by using illustrative examples.⁹ Drawing overall conclusions on the partnership approach was often limited by the observation that partnerships vary in their design, approach, and performance. Thus, it is recommended to cover partnerships in future evaluations of the framework programme by specific in-depth studies.

3. Findings on the relevance of Horizon 2020

3.1. Response to the needs and political priorities

This chapter summarises findings on the relevance of Horizon 2020's design, in particular whether it has responded to needs, priorities, problems and issues for research and innovation at European level and thereby addressed the focus of the European Research Area and further political priorities of the EU. According to the Better Regulation framework, 'relevance' analysis also needs to assess the extent to which an intervention responds to societal needs.

3.1.1. Needs, priorities, problems and issues for research and innovation at European level

As per the interim evaluation of Horizon 2020¹⁰, the original rationales for intervention and objectives of Horizon 2020 remain valid. With a view to R&I needs at European level, the interim evaluation stressed that the EU still needs to invest more to reach its 3% GDP target and requires more effort to strengthen the excellence of its science base and industrial leadership. It found that a persistent innovation gap remained in the EU, lagging in breakthrough and market-creating innovation. Accordingly, addressing this innovation gap was more clearly recognised in the interim evaluation than when designing Horizon 2020.

In order to assess whether the needs, priorities, problems and issues that shaped Horizon 2020 were and still are relevant, an analysis of EU performance in key areas of scientific and technological competitiveness and innovation dynamics in the European Union was performed for this study.¹¹ Building on its results, a SWOT analysis summarised the major strengths, weaknesses, opportunities and threats for R&I in Europe. The performance and SWOT analysis provided an understanding of the factual situation of the EU's relative competitive positioning at the time when programming decisions for Horizon

⁹ Cf. Policy mix cases no. 6, 15 and 16.

¹⁰ European Commission. 2017. 'Commission Staff Working Document. In-depth Interim Evaluation of Horizon 2020', p. 46.

¹¹ See for the detailed results Annex A 'Performance Analysis' to this study.

2020 had been made, both at the programme's inception and continuously throughout its implementation.

The following table displays the SWOT of the EU's relative competitive positioning:¹²

Table 3: SWOT of EU's relative competitive positioning relevant for Horizon 2020 setup

<p>Strengths</p> <ul style="list-style-type: none"> • Even after Brexit, the EU remains one of the world's three main scientific players, in quantitative terms, on par with the US and China. • Several Member States feature some of the highest R&D investment rates per GDP worldwide (e.g. Sweden and Belgium). A substantially greater number have at least reached the 3% objective. • With a view to innovation, the EU features a strong basis in corporate R&D investment: <ul style="list-style-type: none"> – a very relevant share of the world's leading corporate R&D investors (Scoreboard firms) are headquartered in the EU, – the EU is home to a substantial number of subsidiaries of Scoreboard firms outside in non-EU countries, – the EU continues to excel in the advanced manufacturing and, in particular, the automotive domain, despite a somewhat late start in e-mobility. • In addition, the EU features strengths in the areas of (industrial) biotechnology and advanced materials – and in some areas of renewable energies. • In a more general sense, the EU remains strong in integrating technological components into complex final products. 	<p>Opportunities</p> <ul style="list-style-type: none"> • R&D intensity among Europe's leading firms (those in the Innovation Scoreboard) has increased significantly; they now have a higher R&D intensity than Japanese firms. • The EU's scientific contribution is particularly strong, and of high quality, in the crucial area of climate research. • Europe retains global leadership in the modernisation of its traditional areas of strength and, given that framework conditions continue to develop favourably, industry is likely to further benefit from developments in the internet of things (IoT), while the automotive sector will see gains thanks to digital technologies aimed at cleaner, greener and more efficient mobility. • While no longer leading in absolute terms from a global perspective, Europe has witnessed a strong relative increase in scientific and technological output in many topical areas. • While Europe's European venture capital market cannot yet match that of the US, Singapore, Israel or China in terms of either volume or professionalism, European VC spending and progress in some key actors/sectors have increased and improved significantly since the early 2010s.
<p>Weaknesses</p> <ul style="list-style-type: none"> • The EU shows long-standing growth and productivity gap compared to the US. • Following Brexit, the EU now only ranks third in terms of overall R&D investment (GERD)¹³, well behind the US and China respectively. • In terms of average quality, the EU's scientific output continues to lag behind that of the US and the UK, although some MS still outperform these countries. • Business investment remains very concentrated, and almost half of all EU R&D investment goes to the automotive and transport sectors: <ul style="list-style-type: none"> – In particular, the EU lags behind with a view to venture and growth capital; as a result, there is a pronounced scaling-up gap to the US and China. The European Union is lagging with a view to an environment 	<p>Threats</p> <ul style="list-style-type: none"> • European companies' investments in R&D increase at a slower rate than the US and China. • EU investment in ICT, ICT services as well as in the health sector has remained below that of its competitors for a number of years. • Despite the achievements of the Green Deal, Europe has arguably not yet put sufficient emphasis on the energy and decarbonisation challenge. • With the continuous rise of China, the EU and the US are no longer in a natural position to shape the world's technological markets, for example in ICT industries. • At the same time, the EU's long-standing dependence on key electronic components, which have since the 1990s been primarily developed and produced in Asia (JP, TW, KR), continues to impair technological sovereignty.

¹² The annex to this report provides more evidence supporting the SWOT analysis presented above.

¹³ Gross domestic expenditure on R&D (GERD), 2021, Eurostat ([rd_e_gerdtot](#)) and [OECD database](#).

<p>that facilitates investment in relevant intangibles and scale-up funding.</p> <ul style="list-style-type: none"> - There is too little private risk finance for innovative investments since the European economy still mainly relies on bank financing. 	<ul style="list-style-type: none"> • The EU's share in global transnational patent applications has gradually diminished, as well in its established core areas of strengths: <ul style="list-style-type: none"> - European AI development – arguably the core future competence – does not keep pace with the US and China, at least not in absolute terms. - The EU's role in robotics has diminished, its established role as leading provider of future manufacturing technology is in jeopardy, as a lack of digital capacities may 'hollow out' manufacturing competences.
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Source: Own analysis based on Elsevier SCOPUS, EPO PATSTAT, Eurostat and OECD data, EU Industrial R&D Investment Scoreboard, broad-based review of further studies, see References in Annex A.

The performance analysis¹⁴ showed that several of the findings of the interim evaluation are still valid:

- In 2020, the average EU-27 research and development expenditure relative to GDP stood at 2.32%, hence despite some growth reported in recent years, still below the 3% target. Yet, the SWOT noted as a strength that several Member States achieved some of the highest R&D investment rates per GDP worldwide (e.g. Sweden and Belgium), and a substantially larger number of countries have reached the 3% objective.
- The EU shows a long-standing growth and productivity gap against the US, which has so far not been attenuated. Following Brexit, the EU now only ranks third in terms of overall R&D investment (GERD), well behind the US and China.
- With a view to innovation, the EU features a strong basis in corporate R&D investment: a relevant share of the world's leading corporate R&D investors (Scoreboard firms) are headquartered in the EU. However, business investment remains highly concentrated: almost half of the EU R&D investment is concentrated in the automotive and transport sectors.
- The 2020 'Science, Research and Innovation performance of the EU' (SRIP) report rightly describes the European Union as a powerhouse in science, [...] a champion in scientific production¹⁵, which continues to rank among the world's major players in scientific excellence that – even after Brexit – remains ahead of the US in terms of scientific output and the number of researchers. In terms of quality, the average, field-normalised citation rate on Europe's publications exceeds the world average but continues to lag behind that of the United Kingdom and the United States. Some of the Union's larger Member States, like Germany and France, achieve above average levels, although the gap with the UK and the US has widened, rather than closed in recent years.
- As confirmed by the most recent patent and publication data available, the EU is comparatively strong in advanced manufacturing technologies, the internet of things and digital technologies for mobility. In these areas, the EU is taking a clear lead ahead of the main competitors China and the US. The EU contributes a large share to the global publications on climate-relevant research.
- The EU is outperformed by its competitors in relevant fields and technologies. While in the field of energy it outperforms the United States in terms of publications, China has taken the numerical lead. The EU achieves about one-fifth of the shares of patents in digital security, advanced materials and photonics – yet, it is outperformed by the US and Japan respectively.
- Despite being behind the US and China, the EU is in a strong position regarding the number of start-ups and scale-ups, especially in the field of advanced manufacturing.

¹⁴ Compare for sources Annex A.

¹⁵ European Commission. 2020. 'Science, Research and Innovation performance of the EU', p. 25.

Drawing from the evidence, continuous investment in R&I through the framework programme is encouraged to further leverage Member State and private investment in R&I by way of co-funding collaborations at European level, and to invest in a broad scientific knowledge foundation at the European level, particularly for spreading excellence across Member States that exhibit comparatively lower scientific achievements. Securing a strong knowledge base in key technologies and further investment in companies' R&I activities – in particular SMEs – remains equally important.

There are a number of gaps in terms of sectors, technologies, and research areas, **where the EU is currently underperforming or investing less**. Supported by evidence gathered in the performance analysis¹⁶ for this study, the following areas were identified:

- The EU is no longer favourably positioned with a view to the production of the most advanced technologies' fundamental components, predominantly in the digital field where most production has been outsourced to Asia since the mid-1990s.
- The EU's scientific and technological performance (as measured in publications and patent applications) lags behind the US in health and behind both China and the US in ICT industries; also, the EU underperforms in industrial biotechnology vis-a-vis the US.
- Since the 1990s, the EU has put less emphasis on digital technologies than its competitors; the EU's core ICT sector has remained smaller than that of the US or Japan, as reflected in its share of respective patents.
- The EU shows lower contributions in terms of patenting for robotics and is also lagging behind in patenting for micro- and nanotechnologies.
- The EU is beginning to catch up with regards to artificial intelligence – which is one of the most dynamic technology fields with regard to patenting and start-up activity in the EU, but it is notably behind the US and China. While the EU remains one of the global leaders in AI science, it still lags in AI innovation, among others, due to a lack of available big data sources.¹⁷
- The European Union's share of patents relevant for addressing Societal Challenges ranks below average for health and food, agriculture, and bioeconomy.
- Overall, the EU's industrial R&D investment in ICT, ICT services as well as in the health sector (in particular biotechnology) remains below that of its competitors.

The acknowledgement of societal needs

Addressing societal needs through research and innovation became an increasingly urgent political priority (cf. the following section), and gained at the same time more prominence among scientific communities, as noted in the 2009 Lund Declaration¹⁸, which stated that research, development and innovation should increasingly address the societal challenges of our time. The Lund Declaration, issued in the context of a meeting of the European Council, reflected the view that R&I should aim for more societal and environmental impact in addition to scientific and economic impact.

Thus, all three rationales, which eventually became the cornerstones of Horizon 2020 – (i) the reinforcement of scientific excellence, (ii) the turn towards innovation, and (iii) the more political and impact-oriented framing of the thematic top-down funding programmes – were anticipated and brought forward by the STI community. In that way, the three-pillar structure of Horizon 2020 represented and catered to the major needs for R&I in Europe at the time when the programme was designed, while responding more than before to political priorities (see next section).

¹⁶ Cf. Annex A Performance analysis. There, we also identified the sectors, technologies and scientific fields, where the EU is currently overperforming.

¹⁷ European Commission. 2020. 'Science, Research and Innovation performance of the EU'; and European Commission 2021. '[Advanced technology landscape and related policies in China](#)'.

¹⁸ To be found for example here: [ERA Portal Austria – The Lund Declaration](#).

3.1.2. Political priorities of the EU

The interim evaluation concluded that Horizon 2020 is an important mechanism for supporting and delivering on the current set of EU policy objectives as well as international priorities.¹⁹ According to evidence from interviews²⁰ for this study, **competitiveness and growth** were among the primary objectives for the whole FP intervention. This is included in the legal base and a reflection of the period following the financial crisis in 2007/2008. Horizon 2020 was adopted in the context of the 'Innovation Union' and 'Europe 2020 Strategy' (2010), which promoted smart, sustainable and inclusive growth in Europe, and reinforced among others the 3% spending target for R&I by 2020. As interview partners confirmed, there was a clear intention to address the innovation gap and, overall, (re)orient the framework programme towards activities closer to the market.

This intention was the right direction to choose, and it remained valid for the whole of Horizon 2020. It was reflected not only in the Industrial Leadership pillar, but also in the Societal Challenges pillar.

Integrating several thematic programmes under the headline of Societal Challenges meant first and foremost defining thematic research programmes from a more political point of view, and addressing current challenges and priorities facing health, food production, energy and transport systems as well as the environment, society and civil security. The interim evaluation of Horizon 2020 acknowledged that these Societal Challenges were becoming more important with the formal adoption of the United Nations' Sustainable Development Goals (SDGs) in 2015.

So, also from an ex-post perspective, we can confirm Horizon 2020 was highly relevant in the sense that it has addressed the right objectives from the beginning, and that these remained valid (or even grew more important – see for a discussion on Horizon 2020 addressed emerging needs and priorities the next section).

In retrospect, there is one **challenge to the relevance of Horizon 2020**. Societal Challenges are in essence truly cross-cutting topics, requiring the exploration and generation of new knowledge, a dedicated industrial basis and capacity, and a research community engaged with the application, diffusion and communication of the resulting solutions. Thus, expectation grew that the whole framework programme should address these topics. For example, one of the key EU 2020 targets was a massive spending spree on sustainable development and climate action. Horizon 2020 was expected to spend at least 35% of its total budget related to climate action and at least 60% to sustainable development. The Horizon 2020 Legal Basis required the tracking of and reporting on sustainability and climate-related expenditure. As key Horizon 2020 objectives, climate action and sustainable development were expected to be relevant to all areas of the programme. As the analysis in Annex C shows, the three pillars met these spending targets to different degrees.²¹

- Expenditure on sustainable development is well above target at 64.4% of total budget. The Societal Challenges pillar in particular performs well above target, with 84.7% of all expenditure going towards projects contributing to sustainable development. Euratom and SWAFS expenditures are also above the 60% target. In comparison, all other programme parts are below target, particularly the EIC-Pilot (EU.0 Cross-theme), Spreading Excellence, and the Excellent Science and Industrial Leadership pillars.
- Horizon 2020 did not meet its expenditure target on climate action – 31.6% of total budget (3.4% below target). Again, the Societal Challenges pillar dedicated around half of its budget to climate action. Other programme parts such as Excellent Science and Industrial Leadership stayed well below the 35% target.

¹⁹ European Commission. 2017. 'Commission Staff Working Document. In-depth Interim Evaluation of Horizon 2020', p. 33.

²⁰ Cf. Policy mix case study no. 2 and exploratory interviews.

²¹ Cf. Annex C Analysis of eCORDA data. Calculated on the basis of RIO marker methodology developed by the OECD. Projects are assigned a 0% (not targeted), 40% (significant objective), 100% (principal objective) score, which is then applied to the EU budget contribution. Data available for eCORDA analysis in this project deviate slightly from the data set used to calculate the official EC values. According to the results from the EC, the climate relevant budget reached 32%, thus slightly higher than the results of 31.6% reported in our analysis.

The tension illustrated by this example comes from the expectation that programme parts, which aim to promote excellence and competitiveness in the R&I system, should also address political priorities regarding Societal Challenges. In particular, the ERC is generally not geared towards specific thematic needs, but provides a bottom-up funding mechanism open to all thematic domains. It is nevertheless important from a responsiveness and preparedness perspective, as it aims to explore a wide range of novel research paths and thus represents a reservoir of possible response options to a variety of emerging needs. While the ERC and Excellent Science pillar were broadly accepted, framework programme-related communication does not address explicitly the potential tension between specific objectives and overarching/cross-cutting objectives (and how to deal with them).

3.1.3. The responsiveness to emerging needs and new priorities

Horizon 2020 fell into a period of dynamic global change, having been conceived during the aftermath of the 2008/09 financial crisis and extending into a period of increasing geopolitical uncertainty, a more acute awareness of the unfolding climate crisis and, finally, the first major pandemic of the 21st century.

As the set of objectives for Horizon 2020 and the three-pillar structure were codified in the Horizon 2020 Legal Basis, this set-up remained unchanged throughout the life span of the programme. Adaptations were possible through the three programming cycles, with the third cycle responding to the interim evaluation not only regarding thematic priorities, but also by way of adapting the policy mix, as the EIC Pilot was launched. Further adaptations were possible through the annual updating of work programmes and the annual budgeting (which allowed primarily for shifts within programme parts).

Overall, we find in a qualitative analysis of the introductory chapters of work programmes, Horizon 2020 addressed these upcoming political priorities²² well by adding them to the work programmes, calls and funded projects. Likewise, issues and needs emerging from within the research and innovation (policy) arena during the Horizon 2020 implementation were picked up in work programmes. As **table 4** shows, these new and emerging discourses covered scientific, economic, societal and environmental topics at different levels of granularity, ranging from specific topics such as 'science diplomacy' to broad political agendas like the Green Deal.²³

We find in particular the themes like 'economic transformation' and 'Green Deal', 'sustainable transition' or 'just transition' as well as 'digitalisation' and 'climate change' were prominently addressed by work programmes.²⁴ It becomes clear from the analysis that Horizon 2020 used the third programming phase to readjust priorities in response to the new policy priorities of the new European Commission after 2019.

Table 4: List of topics emerging after 2015 as identified from documents

Challenge dimension	Topics
Economic	Corporate Social Responsibility
	Disruptive innovations
	Economic system transformation (Circular economy; new business models; Green Deal)
	Entrepreneurship
Environmental	Biodiversity
	Environmental degradation
	Pollution
Scientific	Citizens participation (Citizen science; Co-creation; Experimentation)
	Open science

²² External developments like the refugee crisis in 2015, the COVID pandemic in 2020 and/or political developments like the European elections and the subsequent appointment of a new European Commission in 2019 were expected to induce changes to Horizon 2020. Likewise, strategic intelligence like the interim evaluation of the previous framework programme and stakeholder consultation are assumed to have provided impulses for adaptation of a running FP in general. Thus, we took documents related to these events as a relevant data base to identify emerging topics. Overall, we analysed 22 documents describing the external space of Horizon 2020, global trends and developments as well relevant strategic intelligence produced for Horizon 2020.

²³ They have been processed and operationalised for further analysis, cf. Annex B Text mining.

²⁴ The more specific terms were found in calls and topics, cf. section 4.1, which analyses how overarching objectives have been translated in work programmes, calls and projects.

Challenge dimension	Topics
	Responsible Research and Innovation
	Science diplomacy
Societal	Brexit
	Climate change
	Digital transformation
	Impact of research
	Knowledge society
	Migration
	Mission-oriented research
	Pandemic
	Sustainable Development Goals
	Sustainable transition, just transition

Source: Own compilation, based on documents describing global trends and developments as well as relevant strategic intelligence produced for Horizon 2020.

As quantitative text analysis shows, most of the upcoming themes analysed display the highest prevalence in calls and project descriptions of the Societal Challenges programmes. This suggests and confirms that the SC pillar is the most prominent domain under which upcoming themes are addressed directly, through textual references. This is plausible since many of the upcoming themes relate to wider conceptions of innovation policy emphasising social and environmental dimensions. Almost all upcoming themes are covered by SC calls and projects, with the exception of open science, entrepreneurship, disruptive innovation, and software driven IT domains, which are more prominent in Excellent Science or Industrial Leadership calls. The SC programmes have responded to climate change and other, partly related environmental challenges, such as pollution and biodiversity. Notably, the topics of societal embeddedness and 'security union' appear in the calls. For societal embeddedness, this is not backed up by the findings for concepts that would indicate a practical implementation, hence there is only low prevalence in the calls for terms like 'citizen participation' or 'responsible research and innovation'.²⁵

The quantitative analysis of calls over time again clearly showed how most of the themes considered in the analysis gained more prevalence in 2020, towards the end of the framework programme. The themes of climate change, digital transformation and mission-oriented research feature most prominently, as a reflection of the European Green Deal and the de facto ever-increasing digital challenge.

There is further evidence linking Horizon 2020 to emerging priorities and themes:

Strategic intelligence for Horizon 2020

Firstly, interviews indicated that relevant changes, such as the reformulation of focus areas and their reduction in number, and the request to implement the new EIC Pilot, were introduced mainly in reaction to the Horizon 2020 interim evaluation and the lessons from the 'Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes' (also called the 'Lamy Report') following the interim evaluation of Horizon 2020 in 2017. They addressed areas of strategic importance, although the focus areas did not take off as originally expected (cf. section 4.1.2).

Changes in the taxonomy of Key Enabling Technologies

Secondly, in order to acknowledge the ever-greater role of the digital revolution, the taxonomy of Key Enabling Technologies, after it had become a key reference point (post-2010), was complemented by a number of specific digital, i.e. software-driven domains: artificial intelligence, big data, IoT, digital technologies for mobility, digital security and robotics.²⁶ Investment in ICT in the Leadership in Enabling Industrial Technologies (LEIT) programme had been high from the beginning of Horizon 2020 with approximately 10-11% of budget share of the whole Horizon 2020 and around 60% of the share of the

²⁵ Cf. Annex B on text-mining results. In the text mining we have used a wider list of key words for this analysis compared to the list used for the qualitative analysis of the introductory parts of work programmes.

²⁶ Once introduced in the context of the broader debate on general purpose technologies, Horizon 2020 conceived of the KETs as technologies that are required to remain competitive and address Societal Challenges. The six 'classic' KETs comprise industrial biotechnology, nanotechnology, micro- and nanoelectronics, photonics, advanced materials, and advanced manufacturing technologies.

LEIT budget. In particular, with a view to artificial intelligence, the European Union had clearly missed the first wave of development in the early 2010s. Up to today, there is a notable gap between the European Union's capacities and that of the United States or China that will be ambitious to close. The lack of availability of relevant big data sources remains a key weakness of the European Union, in particular as big data is required both for developing and for deploying AI technologies. Currently, only one in ten European enterprises performs big data analytics. Consequently, the EU accounts for a mere 8% of global private investments in artificial intelligence. While it remains one of the global leaders in AI science, it continues to lag in AI innovation, as most relevant companies with new business models prefer to set up shop elsewhere. In line with this, private investments in AI are rising dynamically in the US and China, whereas they remain insufficient in Europe.²⁷

Budget allocation over time

Thirdly, the way the budget is allocated can offer a limited indication of how the priorities developed during Horizon 2020. The prescriptions by the Multi-annual Financial Framework (MFF) for the different programme lines, as the outcome of a political negotiation between the EC, the European Parliament and the Member States (the Council), offered some room to shift between priorities. By and large, only the contributions by third countries were not prescribed to one of the programme lines.

- Within the prescriptions for each programme, programme committees had the freedom to decide how to allocate the budget to the topics. As quantitative text analysis suggests, upcoming topics were addressed by work programmes, while none of the existing topics disappeared from the agenda. This reportedly led to a dispersal of financial resources, without any apparent priority setting.²⁸
- Major observable shifts²⁹ were the COVID-19 reaction (when emergency procedures were activated and more than EUR 1 billion was mobilised by drawing on third country credits) and the Green Deal calls (when the whole non-spent budget of the programme was dedicated to this new priority).
- Some budgetary shifts were visible in between programmes: the Societal Challenges pillar saw a slightly increased share in the third programming period (41% compared to 38% in the previous two periods). Corresponding to the launch of the EIC Pilot, budgets for FET and innovation in SMEs went up considerably in the period 2018-2020.³⁰ Likewise, the Spreading Excellence and Widening Participation programme increased its budget share and absolute funding more than most other programmes, although with roughly half a billion euros of funding, it was still a small part of the programme (approximately 1.5% of the Horizon 2020 budget in the period 2018-2020).

3.2. Relevance of the Horizon 2020 policy mix

3.2.1. Policy mixes of pillars and programmes addressing Horizon 2020 objectives

The relevance of the Horizon 2020 policy mix is assessed by the extent to which it addressed the Horizon 2020 scientific, economic, and societal objectives.

Figure 8 visualises key elements of the Horizon 2020 policy mix, in particular the combination of bottom-up and top-down approaches across the pillars, the foci on different TRLs, and the dominant types of action. This figure illustrates a shift towards innovation, seen in programs like FET, and across all sections of the Industrial Leadership pillar. These programs aimed for higher technology readiness levels (TRLs) compared to earlier Framework Programmes. The Excellent Science pillar constituted the major part of bottom-up funding actions and basic science at the lower end of the TRL. The Societal Challenges pillar was made up of the former thematic programmes, which were then meant to address the

²⁷ European Commission. 2020. 'Science, Research and Innovation Performance of the EU'. See also Annex A Performance analysis.

²⁸ A budget monitoring at the level of topics or political priorities could give a more definite answer. Currently, this is only performed for some cross-cutting spending targets.

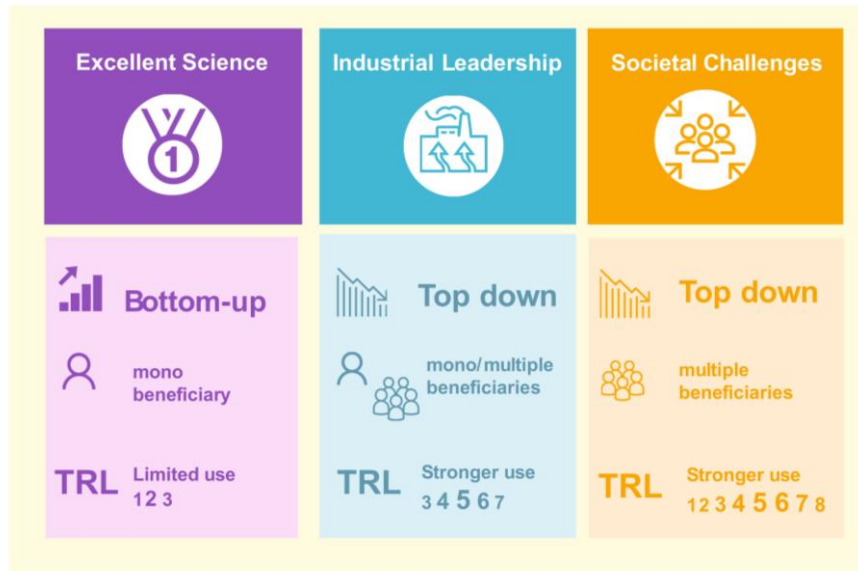
²⁹ Also, the EFSI (European Fund for Strategic Investments) needs to be mentioned, which required to withdraw EUR 2.2 billion from Horizon 2020 in 2015.

³⁰ European Commission, Directorate-General for Research and Innovation, Evaluation study on the European Innovation Council (EIC) Pilot: final report, Publications Office of the European Union, 2022, p. 13.

needs and challenges faced by society. As a whole, these three components addressed Horizon 2020's general and specific objectives. They were supported by further activities, such as the non-nuclear research of the JRC, the EIT, and the programmes 'Spreading Excellence and Widening Participation' and 'Science with and for Society'.

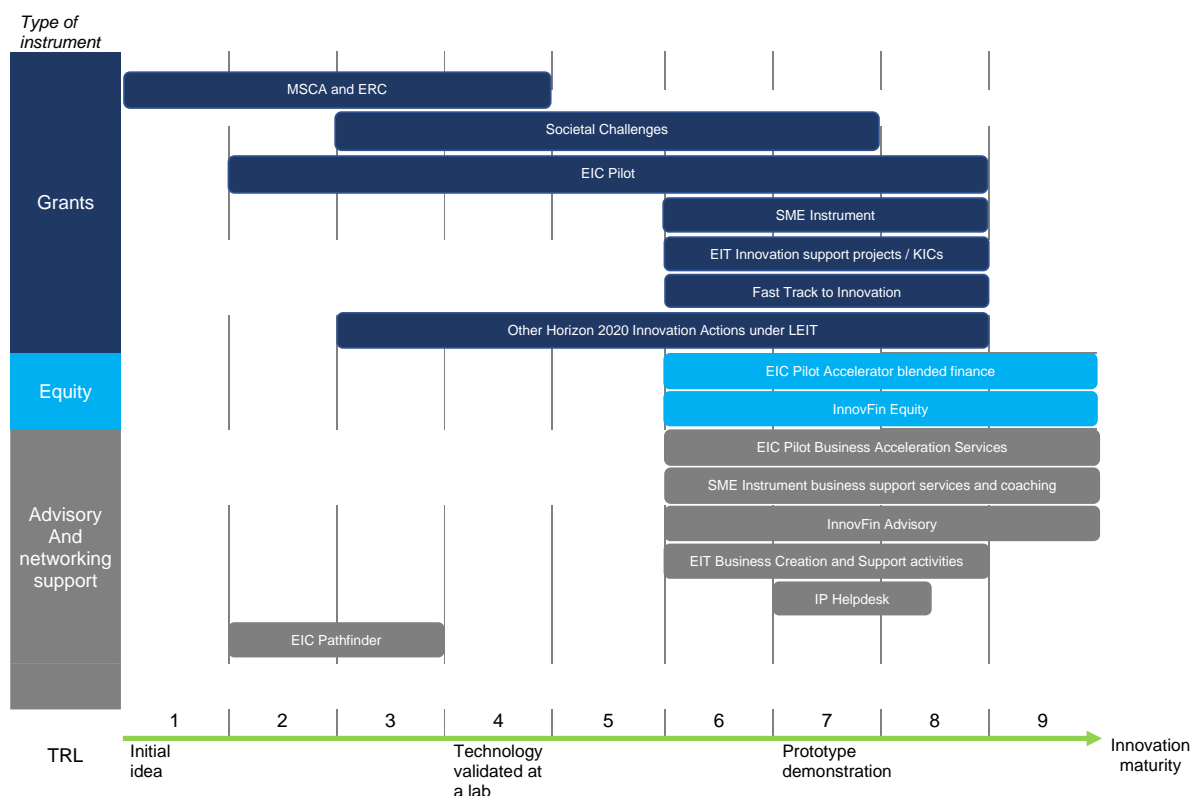
Figure 9 displays how the policy mix was designed to address all TRLs after the launch of the EIC Pilot in the last programme phase (2018-2020).

Figure 8: Key elements of the Horizon 2020 policy mix



Source: Technopolis, based on Horizon 2020 calls data, cf. Policy Mix case study no. 14.

Figure 9: Horizon 2020 support across the TRL scale



Source: Innovative Europe evaluation study, 2023, updated by the European Commission. ³¹

Case study analysis and stakeholder consultation in this study showed that specific policy mixes were brought to bear in the three programme parts (Excellent Science, Industrial Leadership, Societal Challenges), which supported the specific objectives of each part. In many programme parts, specific types of action clearly dominated.

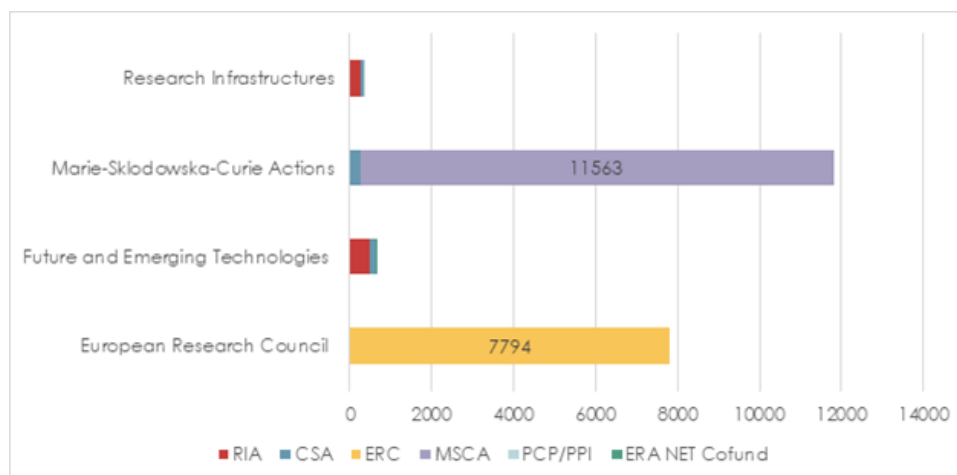
The Excellent Science policy mix

Pillar 1, especially ERC, is regarded as a crucial building block of European scientific excellence and fulfils that objective. The ERC was integrated into the policy mix of FP7, and those design elements were kept for Horizon 2020, and again for Horizon Europe. ERC grants and Marie Skłodowska-Curie Actions (MSCA) were the most prominent types of action in the whole FP, which aimed to reinforce and extend the excellence of the Union's science base, and to consolidate the European Research Area in order to make European science more competitive on a global scale.

In terms of action types, the picture was as expected: almost the entire budgets of the Excellence Science basket were spent on ERC-grants and MSCA-grants respectively. In the case of Research Infrastructures and the FET programme, the picture was mixed, with a relevant share of Coordination and Support Actions (CSA) next to the dominant Research and innovation action (RIA).

³¹ European Commission, Directorate-General for Research and Innovation, Evaluation study on the European Innovation Council (EIC) Pilot: final report, Publications Office of the European Union, 2022, p. 60, <https://data.europa.eu/doi/10.2777/261324> – updated by PPMI for the Innovative Europe evaluation study (2023).

Figure 10: Funding instruments and type of actions in Excellent Science (in number of projects)



Source: eCORDA, cut-off date 7 Sept. 2021.

Table 5: Number of projects and budget allocation in Excellent Science (in EUR)

	Number of projects	Share of projects	Budget allocation	Budget share
European Research Council	7,806	37.88%	13,363,522,436.64	53.71%
Future and Emerging Technologies	640	3.11%	2,601,222,469.68	10.45%
Marie-Sklodowska-Curie Actions	11,813	57.33%	6,514,799,682.79	26.18%
Research Infrastructures	347	1.68%	2,403,087,304.76	9.66%
Total	20,606	100%	24,882,631,894	100%

Source: eCORDA, cut-off date 7 Sept. 2021.

Publication analyses, which are important ex-post measures for the effects and impacts of research funding, can also serve to indicate relevance. Publication analysis performed for this study confirms the EU's scientific competitiveness over the past decade.³²

- The EU remains a key actor with regard to scientific output and the number of researchers, European researchers contribute about 24-25% of all global publications.
- The EU holds a leading position with regard to scientific excellence (impact measured by citation rates), some of the larger Member States perform at similar levels to the US.

Funding from European (excellence) programmes clearly supported these achievements, which indicates a relevant contribution also from Horizon 2020 and the Excellence Science programme part, in particular.

With the turn to impact and policy orientation after the interim evaluation and the Lamy Report, a somewhat biased picture of Horizon 2020 appeared, giving the impression that all programme parts were expected to contribute *equally* to the overarching policy objectives. The Excellence Science pillar cannot be assessed against policy objectives in the same way as the other programme parts defined expressly to address them. Nevertheless, the ERC has focused in recent years on demonstrating its relevance to policy objectives, for example with studies demonstrating how the ERC research addressed climate change. Further, as evidenced by the adaptations to the original formula, pillar 1 sought to develop new impact pathways with a similar but parallel intervention logic to pillars 2 and 3.

In spite of the structural differences between the principal-investigator-driven funding approach of ERC and the collaborative approach underpinning pillars 2 and 3 of Horizon 2020, its role also needs to be seen from a portfolio perspective, where frontier research plays a key role in providing a rich source of novel insights – the application of which may not be immediately obvious but becomes apparent years

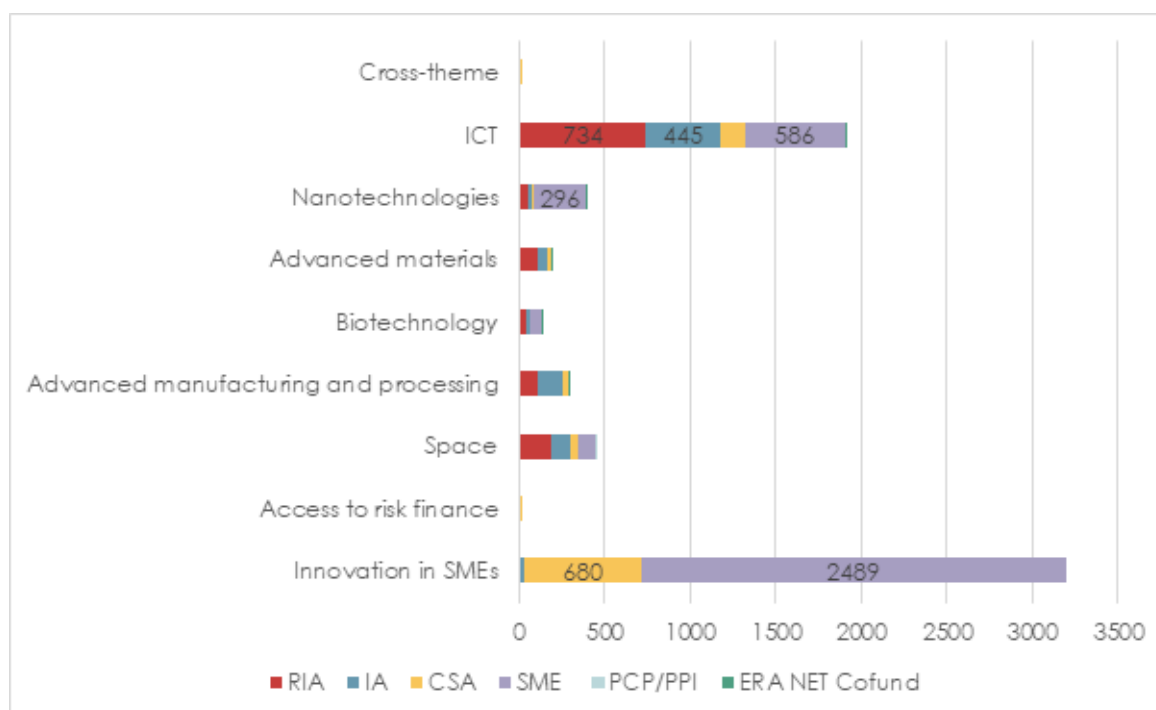
³² Cf. Annex A Performance Analysis.

after the initial discovery. As highlighted also in interviews³³ and policy workshops, the 'serendipity' of frontier and basic research was quite effective in the search for vaccines against COVID-19. Basic research funded from both EU and national sources could be brought to bear on developing a new vaccine against the global pandemic, even though the mechanisms identified and methods developed were initially meant to become effective in the fight against cancer.

The policy mix in Industrial Leadership

As outlined previously, the Industrial Leadership pillar is one of Horizon 2020's three main pillars, and it consisted of three specific objectives: Leadership in Enabling and Industrial Technology (LEIT), Access to Risk Finance, and Innovation in SMEs. In terms of budget allocation, pillar 2 can be characterised as highly concentrated (**table 6**): the area Information and Communication Technologies was allocated more than half of the total funding in pillar 2 with 51.4% (EUR 7.03 billion), despite representing only 29% of projects. In addition, 12.6% of funding was allocated to Advanced Manufacturing and Processing (EUR 1.7 billion) and 12.4% to Innovation in SMEs (EUR 1.69 billion), which had the highest number of projects. A further 9% of funding was granted to projects in the area of Advanced Materials (EUR 1.2 billion). All other areas received less than EUR 1 billion in funding: Space with 7% or EUR 967 million, Nanotechnologies with 4% or EUR 592 million, Biotechnology with 3% or EUR 426 million, Access to Risk Finance with EUR 10 million, and cross-themed funding worth EUR 2 million.

Figure 11: Funding instruments and type of actions in Industrial Leadership (in numbers of projects)



Source: eCORDA, cut-off date 7 Sept. 2021.

Table 6: Number of projects and budget allocation in Industrial Leadership (in EUR)

	Number of projects	Share of projects	Budget allocation	Budget share
Cross-theme	2	0.03%	2,046,589.78	0.01%
ICT	1911	29.09%	7,033,278,988.61	51.46%
Nanotechnologies	386	5.88%	592,516,858.74	4.34%
Advanced Materials	184	2.80%	1,218,155,579.05	8.91%
Biotechnology	130	1.98%	425,881,766.05	3.12%

³³ Cf the deep dive case study on COVID.

	Number of projects	Share of projects	Budget allocation	Budget share
Advanced Manufacturing and Processing	290	4.41%	1,722,233,895.07	12.60%
Space	453	6.90%	967,450,902.92	7.08%
Access to Risk Finance	13	0.20%	9,720,733.00	0.07%
Innovation in SMEs	3202	48.74%	1,695,466,333.50	12.41%
Total	6571	100%	13,666,751,646.72	100%

Source: eCORDA, cut-off date 7 Sept. 2021.

The primary activities supporting the three objectives of the pillar were:

The SME Instrument work programme calls in 2014-15 and 2016-17 related to specific LEIT areas (e.g. bio- and nanotechnology and space) and offered a potential for open, disruptive applications. In the last SME work programme for 2018-2020, the focus moved to SME innovation support (INNOSUP) based on the recommendation given by the Horizon 2020 interim evaluation. With the new format, the SME Instrument Phase 1 was discontinued, and SME Instrument Phase 2 became the EIC Accelerator with the opportunity for support and equity investments.

INNOSUP's goal was to strengthen the dynamism and resilience of the SME innovation ecosystem in Europe, with INNOSUP Actions generally operating as pilots to test particular approaches. They consisted of innovation-support measures designed to enhance services to SMEs through collaboration, peer-learning, and the testing of new approaches that facilitate SME access to customers, capital, and competencies. By August 2022, EUR 160 million had been invested in over 200 INNOSUP projects with some 550 participants.

Access to finance instruments constituted an important support mechanism, especially for SMEs, by funding financial intermediaries. The European Investment Bank (EIB) and the European Investment Fund (EIF) implement financial instruments on behalf of and in partnership with the European Commission. By the end of June 2019, funding through risk finance instruments totalled EUR 22.3 billion. In most cases, the beneficiaries were SMEs.

The policy mix of the Industrial Leadership pillar placed a strong focus on SMEs. Further, all programmes of the Societal Challenges pillar adopted the cross-cutting policy of strengthening SMEs, although the SME instrument was used with variable intensity; analysis of call texts revealed frequent mentions of 'SMEs' and 'technological innovation' in the Excellent Science pillar, which indicate a certain degree of relevance to (and of course coherence with) the Industrial Leadership pillar's objective of fostering industrial competitiveness, not the least because of the ERC's proof-of-concept scheme.³⁴

The evidence suggests that strengthening the competence of firms in key technologies was and still is one of the key challenges for the competitiveness of Europe, and hence highlighting it as one of the three main pillars was well justified and relevant. Also, based on the findings of the case study, the themes within Industrial Leadership pillar appeared highly relevant regarding the needs of European industry.

Access to Risk Financing was broadly recognised as one of the main bottlenecks for the European innovation ecosystem, and the objective of opening up risk financing for leading innovation-driven companies was a highly relevant addition to the framework programme. Approaching this primarily through pilots and experiments, in collaboration with EIB and the COSME programme, seemed well justified given that the topic was relatively new and novel models were needed.

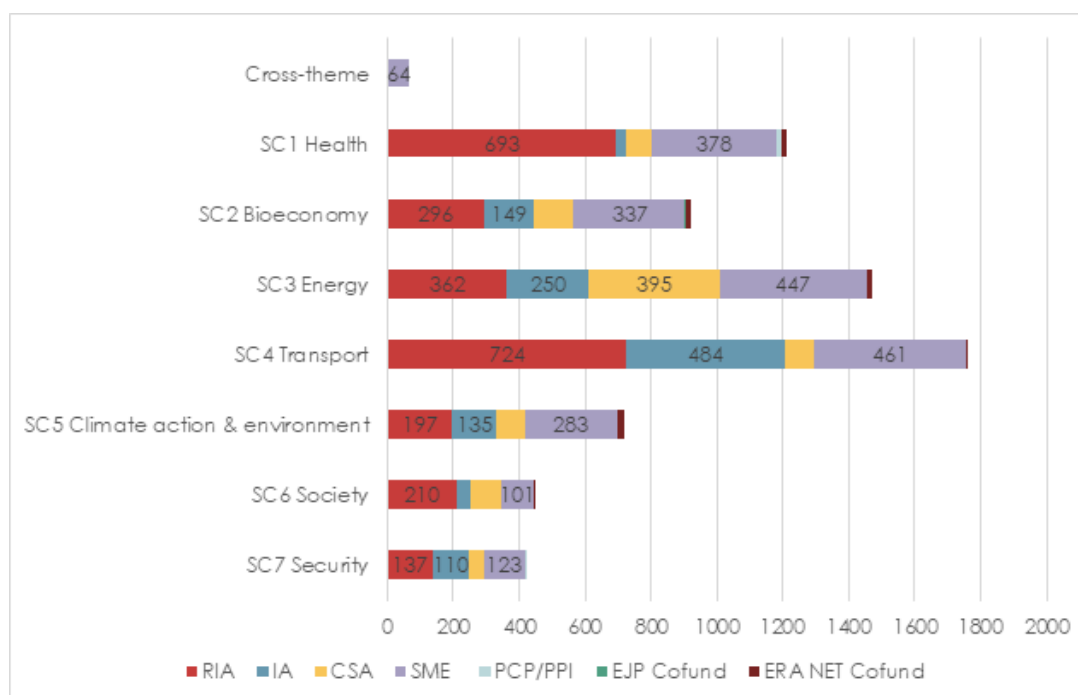
However, since the volume and model of implementation in Access to Risk Finance was very different to other parts of the Industrial Leadership pillar, it raises a question whether it was internally coherent and in balance with other parts of the Industrial Leadership pillar. From this perspective, the findings suggest that the **introduction of the European Innovation Council** helped to improve the internal coherence of the programme.

³⁴ Cf. Annex B Text Mining.

Policy mixes in Societal Challenges programmes

In terms of the distribution of types of action in Societal Challenges (figure 12), the analysis shows that, overall, Research and Innovation Actions were the most frequent type in pillar 3, typically found in SC1, where two-thirds of projects are Research and Innovation Actions, and SC4 Transport, where almost half of the projects were Research and Innovation Actions. The SME Instrument also played a key role in pillar 3, particularly in the areas SC2 Bioeconomy, SC3 Energy, and SC5 Climate Action and Environment, where SME Instrument projects occurred more frequently than other types of action. Innovation Actions were most often found in SC4 Transport, SC3 Energy, and SC2 Bioeconomy. Furthermore, Coordination and Support Actions played a large role in SC3 Energy, where the number of CSA projects was higher than RIA or IA.

Figure 12: Funding instruments and type of actions in Societal Challenges (in numbers of projects)



Source: eCORDA, cut-off date 7 Sept. 2021.

Table 7: Number of projects and budget allocation in Societal Challenges (in EUR)

	Number of projects	Share of projects	Budget allocation	Budget share
Cross-theme	67	0.96%	127,039,210.67	0.50%
SC1 Health	1,210	17.25%	6,039,482,872.88	23.77%
SC2 Bioeconomy	920	13.12%	3,458,758,766.59	13.61%
SC3 Energy	1,469	20.94%	4,890,665,300.82	19.25%
SC4 Transport	1,758	25.06%	5,566,060,191.32	21.91%
SC5 Climate Action and Environment	717	10.22%	2,763,600,013.10	10.88%
SC6 Society	452	6.44%	990,130,688.69	3.90%
SC7 Security	421	6.00%	1,570,605,606.04	6.18%
Total	7,014	100%	25,406,342,650.11	100%

Source: eCORDA, cut-off date 7 Sept. 2021.

In terms of budget allocation, the analysis shows a slightly different picture: 23.8% of funding was allocated to SC1 Health (see table 7). SC4 Transport, the largest area in terms of the number of projects, received 21.9% of funding. SC3 Energy was allocated 19.3% of the budget, and SC2 Bioeconomy received 13.6% of funding. SC6 Society had a slightly higher number of projects than SC7 Security, however budget allocation to SC7 was significantly higher than to SC6 (6.2% or EUR 1.57 billion in SC7 compared to 1.9% or EUR 990 million to SC6).

Comparing all SC programmes (cf. the **figure 12** above), they have adopted the cross-cutting policy of strengthening SMEs, although the SME Instrument was used with varying intensity. As compared to FP7, these formerly strongly research-oriented programmes evolved under Horizon 2020 towards more innovation and market orientation.

- Over the course of Horizon 2020, Societal Challenges programmes evolved towards more innovation and market orientation, which is shown by the importance of the SME Instrument and of Innovation Actions in the Societal Challenges programmes' policy mix. With the growing urgency of challenges like climate change, the level of ambition and expected impact of innovation policy was raised. Policy interventions were expected to contribute to sustainability transitions by fostering industrial and societal transformation. Towards the end of Horizon 2020, the expert reports of P. Lamy and M. Mazzucato respectively (both in 2017), and the 'Green Deal' priorities of the new von der Leyen Commission (2018) provided a narrative that supported policy interventions addressing transformative change.³⁵ Nevertheless, the policy approach continued to focus on technological innovation and market-based solutions. In response to these new impulses, some very first steps were taken in this direction and Horizon 2020 was thus compared in latter stages to the new policy practices taking shape in Sweden, the Netherlands, Germany, and the UK:³⁶ the Green Deal call and some calls in SC6 (Environment) were experimenting with 'location-based' innovation.³⁷
- As sustainability transitions are embedded in socio-economic and cultural context and require social change, they require knowledge from Social Sciences and Humanities (SSH). Although SSH were embedded throughout the FP via SSH liaison officers for all Societal Challenges and LEIT parts, recent data shows that the participation of disciplines within SSH decreased both quantitatively and qualitatively over the lifetime of the FP. SSH were addressed by calls in the last phase of Horizon 2020, but their integration into multidisciplinary projects remained challenging, as they were often perceived as an add-on element in the research design.³⁸

Case studies on three of the seven SCs performed in this study show that they responded to the changing policy discourse and developed a problem-orientation approach over the course of Horizon 2020. For example, SC1 Health increasingly addressed the impact of the climate crisis on health. By looking at the example of SC4 Transport, the following paragraphs demonstrate how the changing rationales were framing the programme:

Example of SC4 Transport: from technology push to problem-solving

The EU funded transport research and innovation aimed at moving from a 'technology push' to a 'problem-solving and challenge-based' approach, with increased emphasis on impact rather than on individual outputs from research projects and programmes.³⁹ This could be seen in terms of:

- A thorough coverage of the whole research-and-innovation chain;
- Strong ambitions regarding cross-modal and cross-cutting activities (an integrated, holistic, and systemic approach highly relevant to the increasing challenges faced by transport);
- Further shift from project- to programme-level cooperation (systemic approach requiring a higher level of coordination to design the work programme and support cross-fertilisation of results between projects);

³⁵ In particular the mission-oriented approach to Horizon Europe, which was developed at that time, builds on this narrative.

³⁶ Challenge driven innovation policy in Sweden (since 2011), Mission-oriented top sector policy in the Netherlands (since 2018), the UK Strategic Priorities Fund (since 2018) and the German Hightech Strategy (2018), Cf. Annex E Worldwide comparison studies.

³⁷ Cf. Policy mix case study no. 7.

³⁸ Cf. Policy mix case study no. 18.

³⁹ Cf. Policy mix case study no. 10.

- Renewed effort to reconcile policy requirements, societal challenges, and industrial needs, with significant repercussions on architecture and priorities (in line with the policy orientations, a strong new emphasis on decarbonisation and the integration of advanced technologies towards an integrated transport system).

The Horizon 2020 work programmes helped to develop the cross-cutting nature of transport, as demonstrated by the close links with other work programmes within Horizon 2020 such as projects addressing climate change and energy. This became clear also in the overlapping nature of the Joint Undertaking Fuel Cells and Hydrogen 2 that covered both SC3 and SC4.

From 2014 onwards, a total budget of EUR 5.7 billion was allocated by the EC to SC4 projects under Horizon 2020. About half of the EC contribution was dedicated to Article 187 Partnerships (EUR 2.8 billion). Four partnerships were financed (Shift2Rail, Fuel Cell and Hydrogen, Clean Sky 2, SESAR). Projects inside these partnerships accounted for 48% of all SC4 projects. Additionally, establishing the contractual public-private partnership on Green Vehicles meant an important change towards emphasising green transition.

With this strong emphasis on partnerships in the SC4 budget, an explicit effort was made to mobilise industrial partners to buy into the ambitions pursued within Horizon 2020. The design of the strategic roadmaps of the Joint Undertakings were driven by industry, with limited involvement of representatives outside the consortium. While this ensured that the main industrial players were represented at EU level and that R&I activities were aligned with the technological development needs of industry, it risked creating silo-thinking with limited potential to facilitate the required transformation processes. As already expressed in the interim evaluation, the inclusion of a wider range of stakeholders either in the governance structures or in submitted proposals remained a key challenge for the partnerships looking to apply a more challenge-driven approach that better addressed the needs of stakeholder groups and society at large.

Looking at the types of action, innovation actions predominated in the largest partnership formed in the transport sector (Clean Sky 2: 84.8% of EC contribution), while research and innovation actions dominated outside partnerships in the SC4 WP. This corresponded with the need to further develop technological solutions in sectors such as aviation, waterborne transport, logistics, etc., with a view to deploying them through prototyping, testing and demonstrations up to large-scale product validation and market replication activities.

The use of TRL and systemic intervention

One prescriptive element, which evolved over time in Horizon 2020 calls, was the specification of TRL scale. While at the beginning there was no systematic use of the TRLs in the calls, this gradually spread to encompass the majority of the Horizon 2020 programmes (except actions such as MSCA, ERC funding, and Access to Finance) and was used in about 20% of the calls. In addition, according to interviewees,⁴⁰ the practice further evolved by introducing clearer specifications of the levels at which projects should start, and the expected levels that the projects should reach.

In cases where a systemic approach is expected, and societal engagement is considered key for advancing the solution towards higher adoption levels, interviewees mentioned that TRLs should not be considered as the only reference. For example, for topics in Societal Challenge 5, which were partly technology focused, but rather related to technology adoption or diffusion, the approach that needed to be taken was more holistic or systemic: the measures needed in projects of 'higher TRLs' were also targeting, for instance, 'behavioural change'. In these cases, the definition of the TRLs (e.g. for TRL 5-8) was not considered fully appropriate.

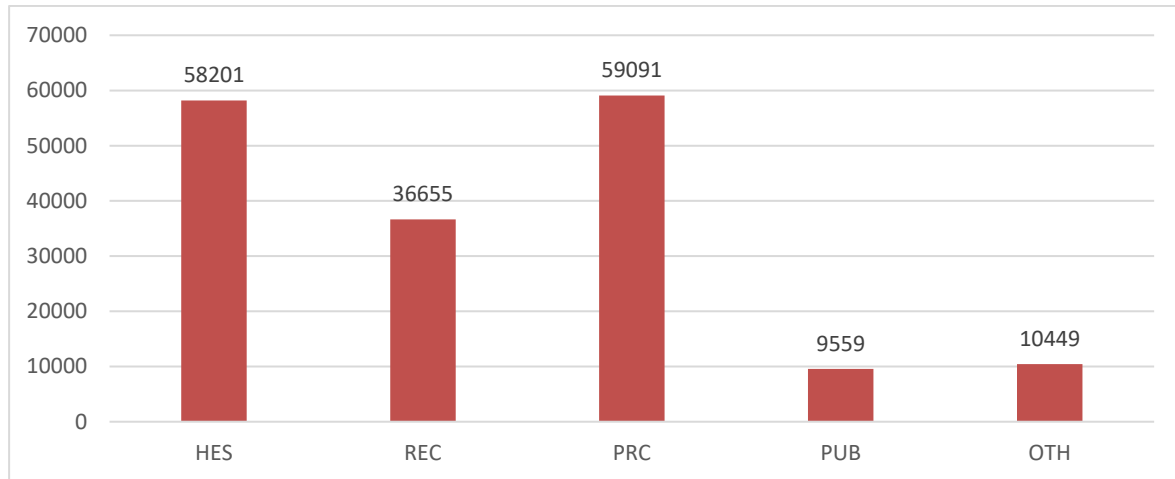
Furthermore, stakeholders highlighted that the TRL level was often considered insufficient to do justice to the notion of innovation, and recommended moving away from the linear framework of TRL to ensure that innovation is funded from a cyclical or systemic point of view.

⁴⁰ Cf. Policy mix case study no. 14.

3.2.2. Aptitude to address the needs of target groups and attract newcomers

In terms of participation patterns by beneficiary type (**figure 13**), private-for-profit companies (PRC) had the highest share of participations (34%), closely followed by higher education institutions (HES, 33.5%), and research organisations (REC, 21%). Public bodies and other organisation types represented a relatively small share (5.5% and 6%).

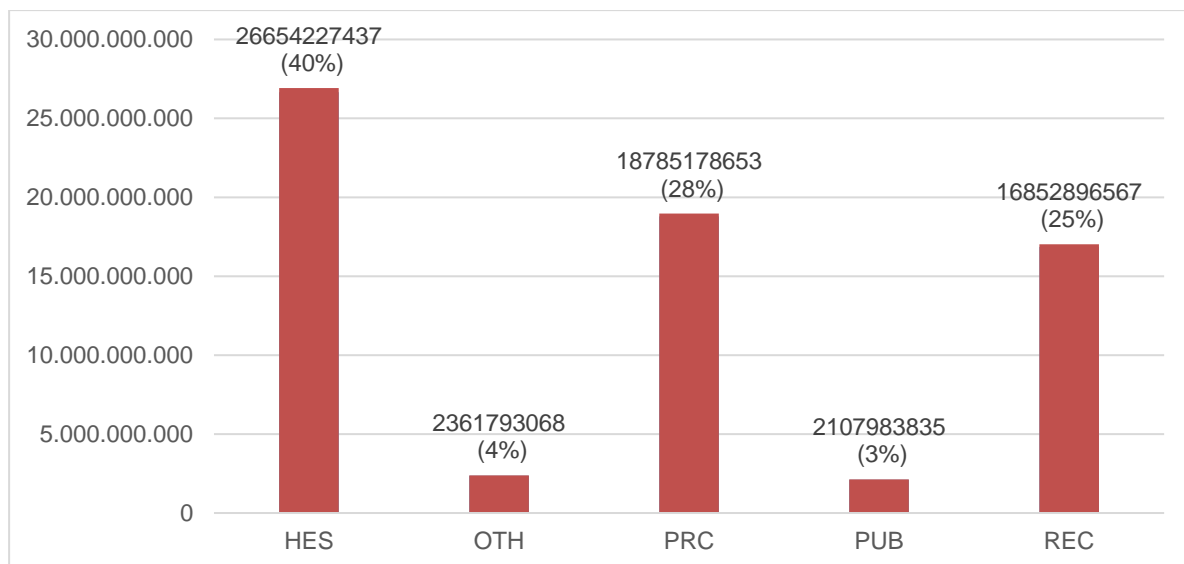
Figure 13: Total number of participations by beneficiary type



Source: eCORDA, cut-off date 7 Sept. 2021.

As **figure 14** shows, HES were allocated the highest share of funding (40%), while companies, due to the different funding rates, received 28% of the total. A quarter of the budget was allocated to research organisations. Public bodies (3% of total budget) and other participants (4% of total budget) were the smallest beneficiary groups also in terms of funding.

Figure 14: Budget allocation by beneficiary type (in EUR and %)



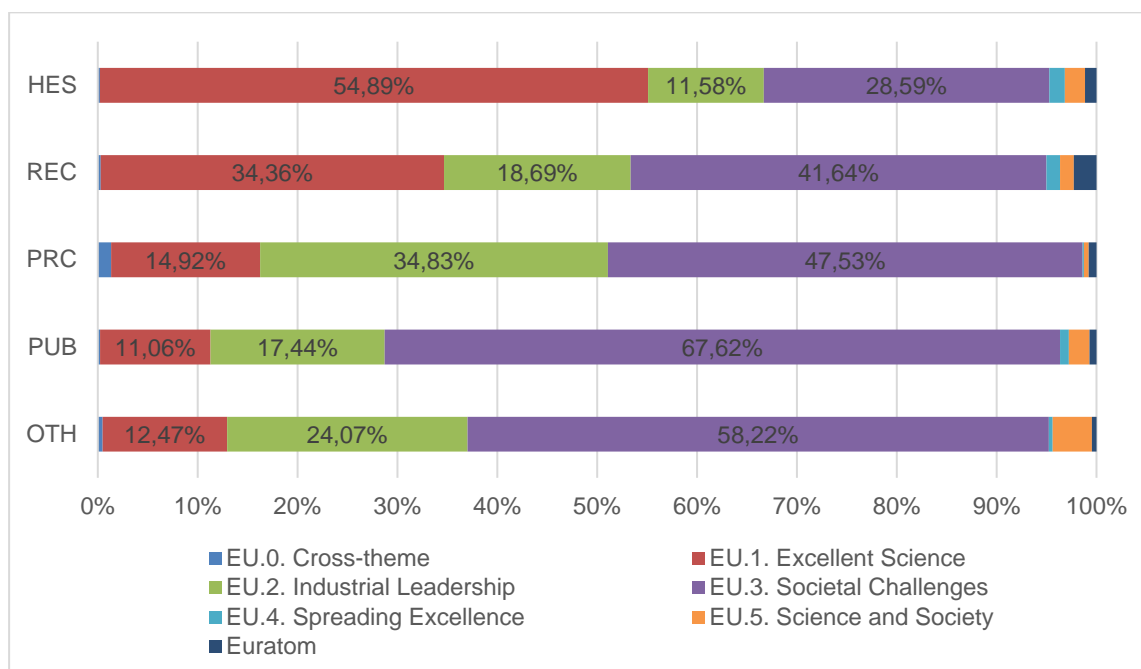
Source: eCORDA, cut-off date 7 Sept. 2021.

There are significant differences in participation patterns across the beneficiary types (see **figure 15**):

- HEI participation concentrated, to a large extent, on pillar 1 (Excellent Science). Slightly less than three in ten participations by HEIs occurred in Societal Challenges, and approximately one in ten in Industrial Leadership.
- Some 42% of participations by RECs were in Societal Challenges, approximately a third of participations occurred in Excellent Science, and 19% in Industrial Leadership.

- Roughly a third of participations by PRCs occurred in Industrial Leadership, and a further 48% in Societal Challenges.
- Participations by public bodies were most heavily concentrated on Societal Challenges, where more than two-thirds of participations occurred.
- Other organisations also participated mostly in Societal Challenges (58% of participations), and a slightly larger share of participations under Industrial Leadership, as compared to public bodies.

Figure 15: Distribution of participations by beneficiary type and programme part



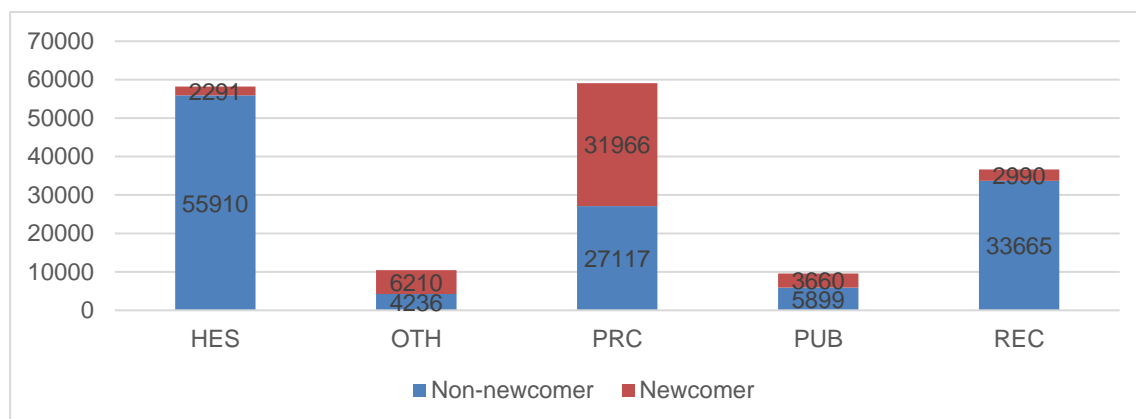
Source: eCORDA, cut-off date 7 Sept. 2021.

Overall, Horizon 2020 managed to mobilise newcomers⁴¹ relatively well, however there were large differences between beneficiary types. Across all, 27% of participations were carried out by newcomers. In more detail (see **figure 16**):

- Newcomer mobilisation in companies was particularly successful, where 54% of participations were newcomers to Horizon 2020.
- It was also very successful in mobilising newcomers in the 'Other' participant group, where 59% of participations were by newcomers, and 38% of participations by public bodies were carried out by newcomers.
- Newcomers were less frequent among higher education institutions (3.94%) and research organisations (8.16%). However, one has to take into consideration that the overall potential for newcomers was much larger among companies due to the overall size of the beneficiary group compared to HEIs and RECs.

⁴¹ A newcomer is a Horizon 2020 participant who was not involved in a FP7 project (not a FP7 participant, see also glossary). The analysis was done on level of Participant PIC In Use. Within this study, the analysis based on eCORDA data refers to data submitted to the project team by EC by 7 September 2021. In contrast to this, the Monitoring Flash 'Newcomers in EU R&I programmes – Main trends in Horizon 2020, first evidence from Horizon Europe' by the European Commission indicates 2 August 2022 as the reference date. While the definition of 'newcomers' is the same, there are a few differences in methodology between our work and the EC Monitoring Flash. Unlike our study, the EC report focuses on unique participants and on funding received, rather than on participations, meaning that ratios are not directly comparable between the two reports. Furthermore, as explained in its methodological note, the EC report focuses on beneficiaries only, while our analysis also includes partner organisations and third parties.

Figure 16: Number of 'newcomer' participations by organisation type



Source: eCORDA, cut-off date 7 Sept. 2021.

Perspectives from stakeholder groups

Both **HEIs** and **RECs** saw the FP as an important resource to support multidisciplinary cross-border collaboration between a wide range of R&I stakeholders across and beyond Europe. It responded to their needs by supporting research throughout the innovation cycle – from discovery research to applied research – with a variety of actions. This diversity ranged from the fellowships such as the MSCA training for young researchers to multidisciplinary collaborative research projects to address societal challenges. As such, the FP promoted excellence, enables researchers' mobility, and provided funds for large research infrastructure. However, further challenges to Horizon 2020 remained, according to the research stakeholders, in relation to: (1) the overall FP budget (oversubscription), (2) widening participation of EU-13 countries, (3) better inclusion and integration of social sciences and humanities (SSH), (4) funding collaborative discovery research, and (5) enabling trust-based cost-accounting simplifications.

Widening participation: The number of participants and the net EU contributions requested by the research institutions showed a very uneven distribution between EU-13 and EU-15 countries.⁴² The largest recipients of funds were still the EU-15 countries with a share of 79% of the requested EU net contribution, followed by the EU-13 countries with 7%. The two most important barriers to widening participation within public research, according to the interviews partners, were: 1) oversubscription, which often led to self-exclusion, and 2) missing support mechanisms (both nationally and institutionally). A couple of activities and actions were considered relevant by interview partners to address these obstacles: 1) actions under Spreading Excellence and Widening Participation, such as twinning, teaming, and ERA Chairs, 2) as part of MSCA, it was suggested by interviewees that return fellowships be made available to support outward and return mobility. In addition, interview respondents suggested a mobility scheme should be made available to young researchers, enabling them to participate in joint, international doctoral programmes and summer schools so that they have the opportunity to train in more than one institution, 3) to further strengthen links between EU-13 and EU-15 countries, the importance of transnational bottom-up networks, such as Cooperation in Science and Technology (COST), was raised by REC representatives.⁴³

Adequate participation of SMEs was rightly placed among the key objectives of Horizon 2020. It was very popular with SMEs:⁴⁴ With the start of the third work programme, **SME participation** had already surpassed its target of 20%, with almost 24% of the total budget for LEIT and SC going to SMEs. For the whole programme duration, the participation rate of SMEs was calculated to be at 20% (cf. eCORDA data analysis), so it went down slightly since the interim evaluation, but still reached the targeted level.

A 2021 study on the effectiveness of public innovation support for SMEs in Europe indicated that the SMEs' level of satisfaction had considerably improved. As part of the study, six of the INNOSUP Actions were evaluated. The study concluded that the actions correspond to the needs of beneficiaries and the

⁴² Cf. Policy mix case study no. 18 on research stakeholders.

⁴³ Cf. Policy mix case study no. 18.

⁴⁴ Cf. Policy mix case study no. 19.

innovation barriers they face. It was also highlighted that the actions were 'relevant in all EU Member States since the needs of SMEs are somewhat comparable'. It should be noted, however, that relatively little emphasis was paid to the availability of skilled staff and talent attraction (recognised as the most important challenge for many start-ups and growth-oriented SMEs across the EU). The topic was addressed directly by the Innovation Associate programme (INNOSUP-02-2019-2020), which aimed to support SMEs and start-ups by recruiting post-doctoral researchers from other countries. Instruments and actions supporting training, capacity building and access to talent, such as the Marie Skłodowska-Curie Actions (about 10% of companies' participations in Horizon 2020, about 6,500 in total, was in MSCA⁴⁵) in the Excellent Science part and the Enterprise Europe Network and INNOSUP Actions in the Industrial Leadership pillar, were appreciated and expected to generate positive effects on the participants.

The aim of Horizon 2020 to increase the participation of **Civil Society Organisations (CSOs)**, in particular in the Societal Challenges pillar, proved difficult to meet. Although their participation increased as compared to FP7, CSOs often faced obstacles⁴⁶ when participating in research projects: (1) assessment criteria in research funding were regarded as too focused on key performance indicators concerning scientific excellence, whereas societal impacts remained difficult to operationalise and assess. Consequently, (2) research projects and questions appeared highly research-driven and designed toward the needs and interests of the research community. The share of funding was lower (4%) than their numerical share of participation (6%), which indicates that CSOs seemed to generally take on non-core roles in research⁴⁷ project consortia and participate in other parts of the research process, such as communication, coordination, and dissemination/uptake of research results.

In JPI areas, which tackled grand societal challenges, the process predominantly focused on opening up space for new actors – in particular so-called '**need owners**'. For example, **cities** were not only engaged in the development of the research agenda, but were empowered thanks to the decision to place their needs at the centre of the process. For example, in **JPI Urban Europe**, while developing the Strategic Research and Innovation Agenda (SRIA), a co-creation process was established that involved different stakeholders – including scientists, funding agencies, cities, companies, and civil society – and it followed an iterative approach. Specific reasons for updating the SRIA included new policy agendas and reconsideration of experiences collected through joint activities. The update of the SRIA process focused on systemic urban transition, impacts on cities, national urban policies, and R&I policies. In its vision, JPI Urban Europe defined its ambition to support cities in their transition efforts and create robust evidence according to their needs.

Partnerships: According to evidence from interviews⁴⁸ and policy workshops (and despite the clear distinction between the individual partnerships), the main challenges were still perceived in terms of openness and entry levels for newcomers. Small countries found it difficult to participate in co-funded collaborations. There was a concern regarding large country dominance and that specific topics were only covered by a partnership, but not through 'normal' calls.

3.2.3. Usefulness of the policy mix in crisis situations – the case of the COVID-19 pandemic

In response to the COVID-19 crisis, the Commission mobilised a wide range of instruments and actions under Horizon 2020 during its last work programme.⁴⁹ These included grants to collaborative R&I projects through RIAs IAs, and CSAs, support to public-public partnerships and public-private partnerships, and financial instruments, such as equity or quasi-equity investments, loans, guarantees and other risk-sharing instruments. As evident in the [ERAvsCorona Action Plan](#), the mobilisation of these instruments and actions was part of a coordinated response, which acted as an important precursor for tackling COVID-19-related issues.

The option to award grants without a call for proposals, together with a set of emergency funds, enabled the programme to respond even faster to the COVID-19 crisis, as compared to previous Ebola and Zika

⁴⁵ Cf. Annex C eCORDA analysis.

⁴⁶ Cf. Policy mix case study no. 20.

⁴⁷ Cf. Policy mix case study no. 20.

⁴⁸ Cf. Policy mix case studies no. 15 and 6.

⁴⁹ Cf. for further info the COVID-19 deep case study in Annex D.

outbreaks. On the same day that the World Health Organization (WHO) declared a Public Health Emergency of International Concern (PHEIC), the Commission granted EUR 10 million of Horizon 2020's emergency funds to support research into COVID-19.

The role of open science policy

Access to data and especially open data is critical in emergency public health responses. In this case, timely data facilitated the targeting of resources to control the spread of infection, promote the use of evidence-based interventions for treatment or prevention, avoid duplication of efforts, and ensure the efficiency of emergency responses.

In response to the data challenge, the European COVID-19 Data Platform was launched on 20 April 2020 under Horizon 2020 to accelerate research and discovery by enabling a rapid collection and sharing of available research data on COVID-19. The platform, provided a free-to-use, open, and scalable European and global digital environment. In less than two months, the platform included more than 35,000 raw viral sequence data sets, 200 protein structures, and 90,000 scientific publications that could be freely shared between researchers.

With the establishment of the European COVID-19 Data Platform the Commission reinforced its commitment to open research data and Open Science aimed at making science more efficient, reliable, and responsive to societal challenges. In this context, the platform was also a priority pilot.

Some shortcomings (rather related to effectiveness than to relevance) were identified by various experts interviewed. The COVID-19 crisis showed a need not only for open data policies but institutionalised frameworks and infrastructures to manage and share relevant data, as well as legal standards concerning the ethical use of patient data. In addition, according to some interviewees, the ad-hoc implementation of the European COVID-19 Data Platform, hosted by a newly established European Open Science Cloud (EOSC) , proved to be insufficient in the initial response.

3.3. Relevance of processes in Horizon 2020: flexibility to react to emerging needs and new priorities

A general introduction to processes established to support the relevance (and coherence) of Horizon 2020 – and developed further over the course of the programme – is given in chapter 2.

3.3.1. Integration of upcoming topics into work programmes and calls

EC officials interviewed for this study explained that a key Commission internal decision-making process based on coordination was introduced with Horizon 2020, for which (later) the term 'co-creation' was established.⁵⁰ This process was a consequence of the budget integration process – a first for a framework programme. Before Horizon 2020, the different 'research' DGs developed the work programmes for 'their' FP budgets in isolation.

At the end of Horizon 2020, the understanding and processes were established; in each cycle of the multi-annual programming a document had to be produced that identified the key priorities and 'focus areas'⁵¹ for integrating cross-programme activities around major challenges in the following work programme, while aligning with Horizon 2020 Legal Basis. Thus, it played a key role in translating the identified EU priorities and developing the content of the three consecutive Horizon 2020 work programmes with their 19 Specific Programmes.

This process developed over the course of the framework programme. For example, as learned from the interviews,⁵² the first strategic programming document was never approved officially, adopted, or published. There was no procedure for it, while nowadays they are published and become a Commission decision. A second, more political document was developed to show how the different pillars supported

⁵⁰ Cf. Policy mix case study no. 5.

⁵¹ Cf. Policy mix case study no. 3.

⁵² Cf. Policy mix case study no. 1.

the political priorities. In the third strategic programme, the focus areas became 'practical' and paved the way for mission orientation in Horizon Europe.

'Co-creation' not only involved different DGs' political (cabinet) level input, but also facilitated exchange at the operational level. There were some top-down decisions as well as some collective decisions involving many services. The Horizon 2020 priorities were not decided by a single entity (or board of directors). Seven services were involved in Horizon 2020.

Framework programme elaboration is unique in the European Commission: no other process includes as many DGs and stretches over such a long time period. Although formal decision-making structures are in place, power dynamics between DGs is very relevant in setting the work programme-related decisions, as explained by interview partners.

Interviewees and input from policy workshops suggest that the strategic programming process led to the inclusion of many varied topics in order to reach a compromise. Moreover, the multi-annual cycles were not flexible enough to react to upcoming topics. Thus, the annual updating of work programmes was an opportunity to redress this, with often more than one update in a year (although some of them were rather editorial in nature). Also in the annual updating process, new topics were constantly added to the work but there was no mechanism to delete topics deemed to be less effective, which resulted in increasingly complex and convoluted programming.

As the budget was mandated by legislation to specific programme parts, its flexibility was limited to priority setting within the 'budget envelope' for each of the programmes, and to the contributions of the third countries (which were not pre-assigned).⁵³

3.3.2. Adaptations of strategic approaches of partnerships

The partnership SRIAs fulfil important roles, helping to orient partners and guide their strategies. The examples of the public-public and public-private partnerships analysed in the case study on strategy building⁵⁴ underlined that co-creative and participatory processes – to develop a joint vision and research strategy between all relevant stakeholders – were increasingly used throughout the partnerships.

With a focus on aligning EU MS strategies and building user and stakeholder communities, JPI initiatives such as Urban Europe managed to evolve into intermediary organisations with a brokerage function for developing joint visions and innovation communities sharing a common mindset.

Stronger use co-creation approaches was also detected for the public-private partnerships under consideration, which to some extent based their core processes on technical working groups made up of core industry members. Evidence showed that there was also a response to the recommendations outlined in the Interim Evaluation of the Contractual public-private partnerships (cPPPs). This included, in particular, stronger integration of related vertical industries and neighbouring sectors, teaming up in the context of regional Smart Specialisation Strategies (3S), engaging with EU Member States policymakers more actively and increasing transparency through wider use of targeted and open consultations on the definition of R&I priority areas and roadmaps.

Overall, the case study showed that the then SRIA process contributed to a process-inherent, 'dynamic' selection of relevant stakeholders. Interviews⁵⁵ point to the fact that ensuring openness and participation in these design processes remained a relevant task for all partnerships to encourage continuous reflection and appropriate development/adaptation of the stakeholder environment. Interviews confirmed that the use of collaborative methods also raises the legitimacy level – and thus relevance – which helped to balance different interests between various stakeholder groups.

No formal process between partnerships and programme committees existed. Informal exchange and coordination happened through the dual role assigned to programme committee members as part of their partnership governance and programming responsibilities.

⁵³ Cf. Policy mix case study no. 2.

⁵⁴ Cf. Policy mix case study no. 6.

⁵⁵ Cf. Policy mix case study no. 6.

For public-public partnerships, the JPI's strategic processes were evidence of improvements during the framework programme. At the same time, we find the process of ERA-NET Cofund application was to some extent an action to ensure complementarity between the partnerships and Horizon 2020. In addition, the SET Plan is the key R&I and technology strategy for the energy area, guiding particularly the development of new energy technologies and providing a forum for coordination (including cross-DG coordination) and exchange.⁵⁶ For the SC2 Food programme, back-to-back meetings of the programme committee (operational, programmatic focus) and the Standing Committee on Agricultural Research (SCAR) (strategic focus) were particularly constructive in aligning agendas and coordinating activities. The SCAR had continuous communication with some of the JPIs, e.g. Healthy Diets, Healthy Life.⁵⁷

3.3.3. Emergency procedure to react to crises and reaction to COVID-19 in particular

On 30 January 2020, as the WHO declared a PHEIC, COVID-19 had spread to 19 countries outside China, and 7,824 laboratory-confirmed cases were reported, including 170 deaths. That same day, the Commission announced that it would grant EUR 10 million of Horizon 2020's emergency funds to support research into COVID-19. The Commission launched an emergency request for expressions of interest for research projects that would advance the understanding of COVID-19 and its impact on infected persons, possibly making it the first call worldwide. Grants were also subject to rapid data-sharing clauses to ensure that authorities would be able to apply research findings immediately in their response. This rapid reaction was made possible by the standing budget line for emergency research funds that the Commission had introduced as part of the Horizon 2020 annual work programme for SC1 in 2018.

Scaling up the EUR 10 million emergency call launched in January, the Commission announced that it had secured an additional EUR 37.5 million from Horizon 2020 for research on COVID-19 vaccine development, treatment and diagnostics, on 6 March 2020. In total, EUR 48.2 million was awarded to 18 projects, which involved 151 research teams from across the EU and beyond.

The emergency procedure meant the relevant authorities (under the Financial Regulation) could award grants without a call for proposals, and the work programme could be updated if necessary, thus enabling Horizon 2020 to respond swiftly to exceptional and duly substantiated emergencies. This was first demonstrated by the swift research response to the outbreaks of Ebola and Zika. However, the response to COVID-19 showed an even quicker reaction time. For instance, when WHO declared a Public Health Emergency of International Concern (PHEIC) due to Ebola, the first research projects were initiated within a mere two months..

The multi-annual approach of the strategic programming also allowed a certain level of flexibility in the redefinition of priorities and the response to new developments, as evident by the introduction of a standing budget line in 2018 of EUR 10 million per year for emergency research funds in the SC1 work programme, following the experience of the Ebola and Zika outbreaks. In interviews⁵⁸ and the policy workshops it was said that although the emergency funds were not always easy for the Commission to justify to the Member States, it was very important that they existed, as it can be quite difficult to make larger reallocations of framework programme budgets.

The possibility to award grants without a call for proposals, together with the newly introduced emergency funds, did enable the programme to respond even faster to the COVID-19 crisis compared to previous Ebola and Zika outbreaks. All the interviewees in this study emphasised the speed with which Horizon 2020 was mobilised to respond to the pandemic.

Although the emergency funds proved to be very useful in ensuring a swift reaction to the COVID-19 crisis, the amount of financing provided by the funds soon turned out to be insufficient given the development of the pandemic. Additional funds were therefore secured during the amendment procedure of the Horizon 2020 work programme. According to interview statements,⁵⁹ these additional funds were secured through a flexible mechanism in the budgeting of the Horizon 2020 work programmes allowing budget increases of up to 20%. No adjustments could be made to the budget that was already allocated

⁵⁶ Cf. Policy mix case study no. 15.

⁵⁷ See for more policy mix case study no. 11.

⁵⁸ Cf. COVID-19 deep dive case study.

⁵⁹ Cf. Policy mix case study no. 2.

to actions and instruments unrelated to COVID-19. This proved to be a challenge towards the end of 2020, as there was no additional funding available from Horizon 2020.

During the Ebola and Zika outbreaks, there were only a few funding instruments mobilised under Horizon 2020. As the nature of the COVID-19 pandemic was fundamentally different from those outbreaks, the inter-institutional arrangements and decisions that needed to be taken were much more complex in the COVID-19 response, which affected the EU and its Member States on a systemic level, going beyond the institutional framework and the mandate, as well as the competence of individual Directorate-Generals. Several interviewees highlighted the fragmentation and gaps between the DGs and the challenges of cross-sectoral coordination that the pandemic revealed, where different committees were working on different aspects with different pieces of information.⁶⁰

3.4. Relevance: types of consultation and evidence used in Horizon 2020 programming

3.4.1. Advisory groups

In the strategic programming process (cf. section 2.1.3), expert advisory groups (AG) played a major role in the synopsis of the evidence collected, as they provided their reports with recommendations for strategic programming – an important source for the scoping papers. For almost all programme parts of Horizon 2020 and some cross-cutting issues, 19 advisory groups were established to support, in particular, the second and third phases of implementation. The advisory groups played a major role in co-shaping the content of the work programmes based on a combination of retrospective evidence and future intelligence.

Interviews⁶¹ and the document review showed that work practices varied significantly across advisory groups, indicating that there was no common standard for their role and their relationship with the European Commission. Nevertheless, across some of the groups, the following two observations were made by the evaluation team:

- At the policy workshop for this study, it was discussed that the importance of inputs from advisory groups widely varied across work programmes. For example, information from the inclusive and innovative society AG was essential, especially in the third work programme. The main reason behind that is the lack of in-house capacities and thus the need for external support. In other instances, AG inputs were incorporated upon request, relating to specific issues.
- Statements in interviews and at the policy workshop pointed to the fact that the extent to which advisory groups used foresight approaches (compared to conventional retrospective evidence) varied significantly. At the same time, some AG members tended to have too narrow a perspective on what fields of research, beyond their core expertise, might be relevant to a programme.

The advisory groups of Horizon 2020 were set up as a bottom-up mechanism to feed expert knowledge into the work programme development process. In general, however, a missing link was found between the 'top-down' initiatives of the EC and the 'bottom-up' advice they sought. Although the actual contributions of the AGs were appreciated, their inputs were not used to the extent possible. The problem, according to interviews and discussions at the policy workshop, resided in the lack of appropriate mechanisms to bridge top-down political guidance and bottom-up scientific input. But also, in some cases, experts were not willing to engage with the truly strategic dimensions of the programming process, which in the end hampered the quality of strategic programming and work programmes.

Another (underexploited) potential of the advisory groups was the cross-fertilisation between the 19 groups to identify redundancies and opportunities for synergies concerning interdisciplinary research and innovation challenges. Interview partners and participants in policy workshops reported that joint meetings between the chairs of the advisory groups were organised, but it would have required more than two actual meetings to be effective.

⁶⁰ Cf. COVID-19 deep dive case study.

⁶¹ Cf. Policy mix case studies no. 4 and 5.

3.4.2. Strategic foresight and roadmapping⁶²

In the FP7 and Horizon 2020 work programmes, individual foresight projects were funded in a range of areas. While the results of some of these projects were used selectively on a case-by-case basis to inform work programme development, there was neither an overview of foresight-related FP projects nor of their use in work programme development. Under Horizon 2020, strategic foresight was understood as systematic foresight activities geared towards the anticipation of future challenges, opportunities and options.⁶³

Foresight acquired a more prominent role in strategic and work programme development in the course of Horizon 2020, and even more so with the preparation of Horizon Europe. Thanks to the [BOHEMIA](#) project⁶⁴, for the first time a dedicated foresight project was implemented to help prepare the Horizon Europe framework programme in a more anticipatory manner and as a building block alongside the Horizon 2020 interim evaluation and the modelling of economic impacts resulting from the new framework programme. But already from the second wave of Horizon 2020 work programmes onwards, a foresight-inspired strategic document⁶⁵ played a relevant and influential role in the preparation of work programmes, with variations in the level of influence across programmes.

The current study revealed that there was clear scope to more systematically tie foresight activities to the strategic programming process, as part of a longer journey starting in the 2010s when uncertainty and volatility in Europe was showing signs of increasing. Foresight can inject some longer-term thinking into the Commission's efforts to orient the framework programmes towards equally longer-term policy objectives and strategies, such as those related to the notion of 'system transitions'.

That approach has started to gain ground in various Commission policies. For example, the Foresight Correspondents' Network was an important contribution to strengthening futures literacy in DG RTD and other services, and it still serves as a vital horizontal interface on emerging R&I and policy challenges. In line with the growing importance attached to foresight more generally, this initiative was carried on as the Horizon Europe Foresight Network.

3.4.3. Evaluation and monitoring

The EC uses various data sources to monitor implementation of the framework programmes and make continuous adjustments. For example, the analysis of submission data provides information on high or low interest and this feeds into the planning of new (or updates of existing) WPs and calls, along with other information.

At the halfway mark of Horizon 2020, the results of the interim evaluation and ex-post evaluation of the previous FP were both available as a reference. These informed changes in the third WP, in particular in response to the recommendations brought forward by the High Level Group⁶⁶, which had been established after the Lamy Report. The interim evaluation of Horizon 2020 differed from the previous one as big parts of the evaluation were conducted in-house by different EC services⁶⁷. Interviewees⁶⁸ explained that this allowed the analysis of more and different data, and mobilised a range of people and units in DG RTD and other EC directorates, engaging them in discussion on how Horizon 2020 was progressing and what needed to change. Moreover, the midterm evaluation (and again the ex-post evaluation) were approached in a more horizontal manner across themes and pillars, and not by programme. This process allowed greater common understanding of the short-term needs (that could already be

⁶² See for roadmapping in partnerships section 3.3.2.

⁶³ Cf. Policy mix case study no. 4 on foresight.

⁶⁴ Cf. final report of the EC-funded project BOHEMIA (Beyond the Horizon: foresight in support of future EU research and innovation policy).

⁶⁵ It was published for the third programming cycle: SAMI (2016): Strategic Foresight: Towards the 3rd Strategic Programme of Horizon 2020, European Commission, Brussels.

⁶⁶ [Register of Commission expert groups and other similar entities \(europa.eu\)](#) and [Summary of High Level Group recommendations, introduced by Pascal Lamy – YouTube](#)

⁶⁷ Evaluation reports are published at the webpage of the Publications Office of the EU, [Search results – Publications Office of the EU \(europa.eu\)](#). Key documents can also be found at: [Horizon 2020 – Programme Analysis \(europa.eu\)](#).

⁶⁸ Cf. Policy mix case study no. 5.

tackled in the work programme of Horizon 2020). For example, the more selective approach to focus areas in the third work programme paved the way for the mission-oriented approach taken for Horizon Europe.

Other examples of influential studies were the reports of the [CIMULACT](#) and the [BOHEMIA](#) projects. Interview partners⁶⁹ see those studies as suitable mechanisms to introduce new topics to the framework programmes. They took place in the last trimester of Horizon 2020, influencing mainly Horizon Europe developments, but also led to minor changes to the third programming phase of Horizon 2020.

3.4.4. Policy feedback

With Horizon 2020, the outsourcing of programme management to agencies for some parts of the programme became fully effective. Consequently, the Commission services had less direct contact with ongoing FP projects which had been taken over largely by the agencies. In this context, policy feedback mechanisms gained greater significance.

Nevertheless, when the management of the framework programme was still handled by the EC itself, several directorates put in place a clear division of labour between the project officers in charge of managing FP projects and the policy officers responsible for R&I policy matters, with limited interaction between the two groups. However, it needs to be stressed that this was not handled in a uniform manner across all services, in particular in the early years of Horizon 2020. The analysis led to the conclusion that the outsourcing of programme implementation to the agencies deepened the gap between knowledge creation in FP projects and policy processes that could benefit from that knowledge. As a consequence, new interaction processes needed to be established between agencies and Commission services.

The Research Executive Agency (REA) offers a good example of how a dedicated 'feedback to policy' mechanism could improve the planning and implementation of R&I policy. Interviewees said the introduction of such a mechanism helped to structure the inputs to European Commission services, including a Rapid Reaction Network. The Agile Network (AN, as it was called) was a pilot that ran successfully from 2018-2021,⁷⁰ and was aimed at gathering information from all units at REA each time an emergency happened. It was through the AN that relevant information was collected and analysed for major policy questions, regardless of their urgency, including the '1000 solutions' the 'COVID-19' crisis, 'citizens involvement', 'social innovation', etc.

Opportunities for policy feedback arise at different stages throughout the programme life cycle. During the Horizon 2020 programme implementation, REA 'project learning' was an important feature, requiring the submission of briefs at each reporting period, and organising roundtables and policy webinars. In addition, REA's efforts to bring policy officers closer to projects allowed for direct exchange opportunities during Horizon 2020. For example, policy officers were invited to join several Horizon 2020 project kick-off and review meetings. REA also put effort into producing reports based on the results from the projects or from cluster events where different stakeholders and projects were gathered to share their learnings, practices and strategies for better citizen engagement.

However, it was not possible to build a broader picture on policy relevant recommendations beyond individual project results or small clusters of projects. Organising policy relevant knowledge within the agency depended highly on informal communication between project officers, and also the transfer to Commission services worked mostly via informal communication channels. After some time and a drawn-out design process, a broader IT-based solution was adopted in May 2020. It aimed to go beyond simple 'policy monitoring' and 'flagging' by offering project portfolio analysis and clustering functionality.

3.4.5. Stakeholder consultation

Commission services expanded the mechanisms for consulting stakeholders in Horizon 2020, firstly through the introduction of thematic expert advisory groups. Stakeholder consultation and testing of new forms of interaction increased during the third programming phase in light of the forthcoming framework

⁶⁹ Cf. Policy mix case study no. 5.

⁷⁰ Cf. Policy mix case study no. 1.

programme, Horizon Europe. New consultation arenas opened up, such as the European R&I Days and the off-process consultation for the Green Deal calls.

Open consultations are a legal obligation of Horizon 2020. The impact assessment for Horizon 2020 and the interim evaluation of Horizon 2020 were subject to two open consultations in 2011 and 2016. Participation in open consultation is usually very high. Open consultation in Horizon 2020 helped to mobilise the FP communities, familiarising them with EC priorities and offering a formal possibility to react to them. According to interviews,⁷¹ the number of CSOs participating in these consultations increased during Horizon 2020,⁷² opening up the possibility to hear a more diverse range of views.

However, some interview partners doubt that the different and divergent perspectives received via these mechanisms were fully taken up in the work programme elaboration. For example, the [public consultation for the interim evaluation](#) included the following feedback: 'Among the issues listed as needed to further maximise the socio-economic impact of the EU framework programme for research and innovation, four items stood out (i.e. more than 30% of respondents strongly agreed): i) more room for bottom-up proposals; ii) more focus on the support for the exploitation of research results; iii) better access to the programme for newcomers, and iv) increased focus on fundamental research.' (p. 19).

While some of these issues required long-term change, such as budgetary shifts to assign more weight to one pillar than another, others could have been addressed under Horizon 2020. However, except for the fact that the actions of the newly established EIC were geared towards the exploitation and scale-up of results, interview partners did not notice other changes in response to the findings of the consultation.

Secondly, interview partners claim that the open consultation mechanisms were not designed in a way to include distinct views from external stakeholders. Its survey structure asking whether topics were relevant or important, which leaves no room for differentiated feedback. In its current structure, the survey is perceived as an instrument for **legitimising the current EC priorities**, not as an instrument that can open the discussion and bring in new aspects.

Another mechanism of open consultation was the **possibility for external stakeholders to hand in position papers**. Interviewees acknowledge the EC's efforts to integrate external stakeholders' feedback. This is especially true for issues around the management and implementation of the framework programme, but also the modes of research funded or the shaping of missions.

Ahead of the **elaboration of the Green Deal Call**, the EC engaged in a new and unusual consultation process. As a result of the COVID lockdown, scheduled stakeholder consultations during conferences and association meetings had to be cancelled. Instead, a survey was publicly launched, including a 'feedback' option. While the survey was framed in a traditional way, asking about the relevance of each proposed topic, the open question on design generated many responses that had to be processed using quantitative text analysis methods. As a result, this work programme consultation mobilised significant numbers of stakeholders, although it was only open for 16 days. The first-time use of quantitative text analysis revealed alliances of stakeholders mobilised around their specific interests. Furthermore, those topics that received high support from external stakeholders were set as Green Deal topics. There is no public information about the participation of CSOs in this consultation.

Moreover, **informal communication** and exchange with external stakeholders was a feature throughout Horizon 2020, especially with the umbrella organisation of the main R&I stakeholders (researchers, industry, SMEs and to a lesser extent CSOs). As interview partners⁷³ reported, the big umbrella organisations used (informal) channels to express their needs and the interests of their member organisations. They have built up considerable experience in the management and functioning of Horizon 2020 (and later Horizon Europe), and they have the resources to act. In 2019, a novel attempt to open up the

⁷¹ Cf. Policy mix case study no. 5.

⁷² To our knowledge, no data were gathered on the participation of CSOs, they were merged under 'other participants'.

⁷³ Cf. Policy mix case studies no. 5 and 18.

discussion and include a variety of different stakeholders (some maybe new to the framework programmes) was introduced: the European R&I Days. There are no conclusive insights from the interviews whether this approach really brought about a change.

3.4.6. Consultation of Member States and Associated Countries in Programme Committees

Work programme development follows a clearly articulated process. Once a first WP draft has been discussed with the services, it is shared with the Member States through the Programme Committees (PC). They provide an opinion, followed by a discussion in the interservice groups. Then it is finalised and adopted.

Member State representatives interviewed⁷⁴ for this evaluation report highlighted that the change from FP7 to Horizon 2020, along with the shift from the annual WP to multi-annual WP was advantageous. They found it made the adoption of the WP to be 'less hectic'. In addition, it made it easier for the Commission to engage with Member States during iterations of the programme. Another significant change from FP7 to Horizon 2020 was to offer broader outlines of the various topics (less detailed), which allowed more room to integrate new (strategic) ideas. Typically, MS encounter difficulties when attempting to remove sections or proposed actions. Compared to that, as clarified through the interviews and the policy workshops, the hurdle to introduce new elements to the document is rather low. Often, just a handful of countries supporting a proposed idea are adequate for its inclusion in the documents, notably during the scoping paper stage or early drafts of the work plan.

Member State policies to staff the PCs were quite different, which led to very heterogeneous PCs. Because of this, MS representatives found it difficult to agree on joint positions. PC meetings were not geared towards consensus and clear recommendations. According to some PC members, in some cases DG RTD decided according to its own preferences in light of a broad range of MS opinions. '

While the Horizon 2020 legislation sets out the broad lines of action and the budget envelope, and the strategic programming document sets out the overall strategic priorities and focus areas, the work programmes define the priorities for each year as well as the details of the calls for proposals, including the modes of implementation. As the budget was adopted on a yearly basis, the WP had to be constantly updated, resulting in several Commission decisions on WP documents per year. However, the process leading to WP updates did not include room for discussions, as updates were often very explicitly advised by the EC and were raised in response to strategic needs.

This means that the multi-annual work programmes came on top of the existing process for annually updating the work programmes. They were meant to change the established process as the consultation of stakeholders and advisory groups (which assembled experts and stakeholders) could take place in preparation for the multi-annual programme, while for the annual updating a Commission-internal process ('co-creation') and Member State consultation in PCs was foreseen. In fact, due to regular (and quite systematic) leaking of the annual update drafts, this process was – and still is – subject to informal interventions by stakeholders, particularly 'a group of privileged research organisations and universities', among which the drafts are circulated.⁷⁵

4. Findings on the internal coherence of Horizon 2020

4.1. Internal Coherence: translation of Horizon 2020 objectives into work programmes and calls

4.1.1. The 'three-pillar-logic'

Horizon 2020 objectives were well translated into work programmes and calls. As the objectives were very broad, we developed a set of key words specifying the objectives. This was used as a dictionary in

⁷⁴ Cf. Policy mix case study no. 1.

⁷⁵ Science Business, 17 March 2022 'The Horizon Papers: Draft work programmes leak again'. Fisch, Peter (2015): Some critical reflections on the role of Work Programmes in Horizon 2020. Think Pieces 3/2015. Peter.fisch.eu.

the semantic text analysis performed in this study. That way it could be tested more reliably whether work programmes, calls and projects addressed the objectives. It was found that in the calls for each of the three pillars, the objectives pertaining to the respective pillar were frequently mentioned, pointing to a high level of congruence between the wording of the calls and the general objective of Horizon 2020, as stated in the Legal Base.⁷⁶

4.1.2. Cross-pillar references and Focus Areas

Altogether, the findings from text mining and case studies provide evidence that various key objectives of Horizon 2020 were supported by activities in different pillars in parallel, in particular the policy focus on SMEs and on Societal Challenges. This supports their cross-cutting nature and thus internal coherence. However, there were challenges to establishing cross-cutting linkages and synergies within Horizon 2020, as the example of the **Focus Areas**, which were a new structural activity in Horizon 2020, showed.⁷⁷

Focus Areas were those of high political relevance and societal concern. In order to maximise impacts, research and innovation activities across several work programme parts would be needed to address a particular challenge. Ideally, the Focus Areas would cut across thematic boundaries and bring together contributions from various programme parts to pursue a common objective. The Focus Areas provided the means to 'promote' a call from two angles (two work programmes), thus increasing its visibility.⁷⁸

The Focus Areas were conceived internally without consulting external stakeholders. Their functions for internal coherence were to: (1) link different DGs in charge of work programmes, (2) limit the 'working in (EC internal) silos', (3) think and act beyond immediate DG's needs, and (4) consider synergies with areas dealt with by other DGs.

As indicated by interviewees,⁷⁹ the Focus Areas were entirely perceived within the EC – led by DG RTD and aimed at providing a means to become more policy relevant and obtain more buy-in from other DGs. This worked well to some extent, but there were no processes established to maintain interest from a higher level in the hierarchy. Further, the case study found that budget rigidities prevented a true cross-over between work programmes. Lastly, the selected portfolios were not systematically followed, and linking between projects only developed in the last WP.

4.2. Internal coherence of the Horizon 2020 policy mix

4.2.1. Complementarity and consistency

The internal coherence of the policy mixes is defined by the complementarity of the instruments, types of action and activities, and by consistent intervention logics. As such, the internal coherence is closely related to the relevance, discussed in the previous chapter. While the perspective of relevance analysis is to ask whether the policy mix addresses all objectives, the coherence analysis asks whether the elements of policy mixes are interacting in a synergetic way without major interferences.

Examples from different parts of Horizon 2020 called upon in the following paragraphs underline on the one hand how the different approaches to grants (mono-beneficiary and collaborative, more research- vs. more innovation-oriented etc.) interact in a complimentary way – from the perspective of the programme parts and the whole Horizon 2020 programme.

From the perspective of the whole programme, there was some interest in the EC's steering committee of this study to understand whether any time-wise coherence is traceable in Horizon 2020, with projects/ideas 'moving up the innovation ladder' by being funded from different parts of the programme consecutively. Several interview partners and statements from the steering committee point towards the fact

⁷⁶ Cf. Annex B Text Mining.

⁷⁷ Further, a separate study on cross-cutting issues has been commissioned as part of the Horizon 2020 ex-post evaluation.

⁷⁸ Under WP2-18-2020, four Focus Areas were supported with: 'Building a low-carbon, climate resilient future (LC)', 'Connecting economic and environmental gains – the Circular Economy (CE)', 'Digitising and transforming European industry and services (DT)', and 'Boosting the effectiveness of the Security Union (SU)'.

⁷⁹ Cf. Policy mix case study no. 3.

that such an 'innovation pipeline' approach was not intended by Horizon 2020. Also, the introduction of TRLs was not meant to support such an idea, but rather to visualise how the overall policy mix of Horizon 2020 aimed to target more innovation and close-to-market activities than FPs ever before. This ambition of Horizon 2020 was clearly realised, although datasets on the use of the TRL concept across the programme are not systematically available, and thus the judgement has to rely more on qualitative information.

Linkages of the Excellence Science pillar with others

Under pillar 1, MSCA and FET, ERC and Research Infrastructures complemented each other to produce 'excellent science'. MSCA and ERC formed the most coherent set of actions. The MSCA programme complemented other Horizon 2020 activities, particularly FET, ERC and Research Infrastructures, to produce excellent science. Furthermore, the age profile of the MSCA fellows was complementary to ERC grantees, i.e. the MSCA fellows were younger. FET and Research Infrastructures were complementary, as well as FET and LEIT ICT. FET and ERC overlapped both at strategic and implementation levels. The technologies coming from interdisciplinary research carried out within FET were exploited in a wide range of applications beyond Societal Challenges ICT.⁸⁰

With the re-integration of the ERC into FP7 and solidified in Horizon 2020/Horizon Europe, expectations regarding coherence and synergies with other parts of the framework programme have been rising. In the course of the years, additional elements were added to the set of ERC funding schemes, in particular from 2012 onwards the 'Proof of Concept' scheme, aiming to support the commercial or societal exploitation of ERC project results, and the Synergy Grants allowing for collaboration between Principal Investigators (PI) from different organisations. These two additions were compatible with the PI-driven funding model, typical of the ERC, but the bulk of project funding (> 90% between 2014 and 2020) continues to be fed into grants to individual PIs – as was the case of MSCA grants. Overall, excellence-driven collaborative research played a rather minor role in the first pillar of Horizon 2020, and was largely confined to selected areas of S&T in the FET programmes.

With the growing impact and application orientation of the Societal Challenges pillar, in particular towards the end of Horizon 2020, the room for more fundamental collaborative research in pillar 2 became more limited, and thus also the possibility to seek funding for follow-ups to ERC grants through pillar 2 funding. Systemic linkages between ERC and EIC started to be built in 2021, following a joint declaration and series of joint activities to specify the EIC Transition schemes, which were 'designed to help results from ERC Proof of Concept projects get closer to the market'.⁸¹ Comparable initiatives do not yet seem to exist between ERC and EIT.

Linkages of Industrial Leadership pillar with others

Evidence collected in the case study⁸² implies with the SME Instrument and Risk Finance Instruments, a path had been created to cross the 'valley of death' – the gap many European ventures face in obtaining growth capital. In addition, on the basis of recommendations in the interim evaluation, innovation support measures for SMEs were increased in the third WP.

Findings from the interviews⁸³ also support the overall internal coherence of the Horizon 2020 policy mix (in pillar 2). Especially the fact that SME Instruments (and EIC) were primarily mono-beneficiary compared to the emphasis on collaborative projects in other Horizon 2020 parts, which prompted the introduction of equity financing as part of the EIC Accelerator. The importance of non-financial support (most notably INNOSUP actions and Enterprise Europe Network (EEN)) accompanying financial instruments was also highlighted in the interviews.

Pillar 2, together with many other parts of Horizon 2020 (with the exception of pillar 1 – Excellence Science), focused on research and innovation at higher TRLs. Under LEIT, research and innovation activities accounted for EUR 5.4 billion (45%) and innovation activities for EUR 4.2 billion (35%). Thus, when looking at the pillar as a whole, funding concentrated more on research-focused projects than on

⁸⁰ Cf. Policy mix case study no. 8 on 'Excellent Science'.

⁸¹ See <https://erc.europa.eu/news/statement-eic-advisory-board-and-erc-scientific-council>

⁸² Cf. Policy mix case study no. 12

⁸³ Cf. Policy mix case study no. 12.

innovation-focused ones. There were, however, differences in emphasis between different thematic areas. Emphasis on science-driven activities was the most evident in the case of biotechnology: RIA accounts for EUR 238 million and IA 46 million. Space follows biotechnology with EUR 485 million invested in RIA and EUR 226 million in IA. Only in Advanced Manufacturing and Processing do investments in innovation outweigh those in research activities (RIA: EUR 632 million, IA: EUR 1.1 billion).

Cooperation with other parts of Horizon 2020 was financially implemented through cross-cutting calls. In the area of KETs there were altogether four cross-cutting calls in the fields of circular economy and industries, batteries and low-carbon future. It should be noted here that, thematically, many calls – especially in the third WP – reflected the themes under the Societal Challenges pillar.

As mentioned earlier, pillar 2 accounted for 35% of all the Horizon 2020 private-sector participants. This amount was higher than in pillar 1 (15%) but lower than in the Societal Challenges pillar (48%). This might be an indication that the themes responding to Societal Challenges showed high potential for competitiveness and growth, in addition to themes related to key industrial technologies covered in pillar 2.

Linkages of Societal Challenges programmes: example of SC1 Health

Interviewees⁸⁴ gave evidence that the Health SC encountered a substantial shift from earlier programmes: while it had been a medical programme up until FP7, thereafter it aimed to become a programme that addresses real societal issues. This priority was linked to a second priority – namely to use all available types of actions and instruments. These were, by and large, focused on pillar 2, yet, under pillar 1 MSCA and the ERC, health research was performed. The health area was the only one which was not categorised according to TRLs. This was due to the rather long-term effects of fundamental biomedical research and the dependency on this research for applied research. While the ERC funded the fundamental research, SC1 aimed to fund 'translational research', i.e. research with an impact on patients.

Overall, about 60% of the budget was distributed through individual project grants. About 40% was channelled through different public-private and public-public partnerships:

- To boost pharmaceutical innovation in Europe, the Innovative Medicines Initiative (IMI2) supported in its second phase collaborative research projects predominantly with industrial partners.
- The Active and Assisted Living Programme (AAL JP2) supported market-oriented research and SMEs. It worked together with the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA).
- Several MS were participating in the Joint Programming Initiative on Antimicrobial Resistance and in the Joint Programming Initiative on Demographic Change, and in the European and Developing Countries Clinical Trials Partnership (EDCTP2).

The SC1 is implemented by DG RTD and DG CNECT and both had their own calls. Yet, in order to provide for a more visible joint effort, WP3 for example included both DGs' call topics under one WP. Based on a number of interviews with EC colleagues, they pointed out that the effort was to achieve more coherence among the DGs and to design a joint FP with more interlinkages and less individual thinking and acting. To the outside, this achievement was much less visible: in SC1, coherence between the two DGs' calls and topics was not seen.

Furthermore, SC1 supported a number of international activities in the areas of cancer, neuroscience, and systems medicine. Activities included the European Innovation Partnership on Active and Healthy Ageing (managed by DG CNECT), the Global Alliance for Chronic Diseases, the Joint Programming Initiative 'More Years, Better Lives – the Challenges and Opportunities of Demographic Change' and the Joint Programming on Neurodegenerative Diseases Research.

⁸⁴ Cf. Policy mix case study no. 9.

4.2.2. New instruments and types of action: expected complementarities

A couple of new actions were introduced in Horizon 2020 to broaden the innovation and impact orientation: the SME Instrument, which was followed up in the last work programme phase by the newly designed EIC Pilot, innovation actions and complementing RIAs with a focus on application, and prizes.

In particular, the SME Instrument was in terms of numbers of projects granted and allocated budget the most important new type of action. The mono-beneficiary SME Instrument showed good complementarity with other types of action and contributed to realising the turn towards more innovation orientation. Because of this, some stakeholders at the policy workshop criticised it for favouring the new EIC Pilot.

As part of the work programme for 2018-2020, the EIC Pilot was launched to foster breakthrough innovations. The main novelties of the EIC Pilot included: 1) reformed and simplified funding instruments, 2) a more flexible and proactive approach to management (needed for high-risk projects and fast-moving technologies and markets), and 3) new governance model with an EIC Pilot Advisory Board. The EIC Pilot consisted of two funding schemes introduced to build on and deepen the previous Horizon 2020 instruments. The EIC Pathfinder pilot, encompassing FET-Open and FET-Proactive, was introduced to target 'high-risk cutting-edge projects exploring new territories aiming at developing radical and innovative technologies'. The EIC Accelerator Pilot, which encompassed the previous SME Instrument (grants) as well as an optional blended finance component (equity), was targeted to 'SMEs with a radically new highly risky, and thus, non-bankable idea underpinned by a business plan for rolling out marketable innovation solutions and with a potential to scale up'.

An evaluation of the EIC Pilot concluded that 'within Horizon 2020, the EIC Pilot has a unique target and configuration that allows the programme to respond to needs not addressed by other programme parts'. The evaluation highlighted that the EIC Pilot was the only instrument covering almost the entire TRL spectrum, and it supported the commercialisation of innovations across all sectors and technology domains. According to the evaluation, the EIC Pilot also complemented other parts of Horizon 2020, most notably the 'Innovation in SMEs'. In addition, it pointed out that the EIC Pilot's introduction also helped clarify the objectives and roles of the SME Instrument and INNOSUP actions as they were separated into different programme parts. However, the coherence between the EIC and EIT actions was considered inadequate. Yet it was anticipated that the new structure in Horizon Europe would help further clarify the synergies between EIC, EIT and INNOSUP actions.

Innovation actions were introduced for Horizon 2020 and mainly target activities directly aiming at producing plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose, IAs can include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication. For pillar 2, these actions focused on higher TRLs were highly important, and 87% of all IA projects were funded by pillar 2.

Regarding the **FTI pilot scheme** and the **Eurostars** programme, the aim and the scope were very similar to the SME Instrument, but the target groups were different. They focused on consortia and partnerships while the SME Instrument on individual firms. The fact that the SME Instrument was oriented towards higher TRLs was a strength as it helped bring innovation closer to the market. This, combined with the research collaboration and demand-side instruments⁸⁵ – according to the interim evaluation – made sure that Horizon 2020 could support SMEs throughout the innovation cycle.

Besides the SME Instrument, 'Innovation in SMEs' included actions related to enhancing SME innovation capacity by providing better support (**INNOSUP Actions**). The actions included various measures for the Member States and regions (typically implemented by intermediaries such as innovation agencies, industrial clusters, or associations) to improve and develop new services for SMEs. Other actions in 'Innovation in SMEs' included, for example, the contributions and support to the Enterprise Europe Network and the EUREKA – Eurostars programme.

The interim evaluation concluded that due to the cross-sectoral and systemic nature of the challenges, INNOSUP activities 'are best implemented in the context of Innovation in SMEs'. It was also concluded

⁸⁵ Although, there were some limitations to demand-side instruments under Horizon 2020, as policy mix case study no. 17 underlines.

that the coherence between INNOSUP Actions, Enterprise Europe Network, and the SME Instrument was very good, and the actions 'clearly strengthen each other'.

Innovation procurement added a strategically important diversity to the Horizon 2020 policy mix as it focused on innovation used to solve problems and allowed high-end research to play into the needs of the public sector. However, as a counterpart to the framework programmes' overall supply-side approach, the lack of capacity among interested procurers was seen as the main reason for a rather tentative uptake. In practice, supply-side measures dwarfed demand-side efforts in Horizon 2020.⁸⁶

4.3. Internal Coherence: process characteristics

4.3.1. Knowledge management and policy learning

Large organisations face challenges when trying to embed longer-term learning processes internally, and the EC is not an exception in this regard. This tendency is visible in the history of FPs. The Kinnock reforms in the early 2000s made it difficult to ensure the continuity of knowledge and experience at management levels, because managers (from Heads of Unit upwards) need to change positions every five years. Beyond management, EC Contract Agents⁸⁷, who coordinate and implement programme activities, have a maximum total contract of six years. Qualified and trained people are lost in this way – only a fraction of them stays if they manage to pass a 'concours' or secure a position in another institution. As a result, Commission services cannot sufficiently accumulate knowledge. Interviewees⁸⁸ argue in favour of horizontal mobility to avoid silo-thinking and enable learning and cross-fertilisation across domains. While there is no easy solution to this challenge, the various interviews indicate that the balance between continuity and mobility of staff – both at managerial and operational levels – is an issue of concern.

More specifically, many of the process elements involving Horizon 2020 were newly established: the strategic programming was not uniform (consultation of stakeholders and experts was handled differently compared to former FPs) and invested in a broad EC-internal 'co-creation' process across DGs in order to arrive at an overarching strategic document. Also, for the first time, multi-annual programmes were set up to allow for a better (and more prospective) response to new developments and challenges from the R&I side, while contributing significantly to the EU's overall policy objectives. These approaches were developed during Horizon 2020. For example, after the first WP was adopted a 'lessons learned' catalogue was elaborated: more than 50 lessons were collected and fed back into the discussion and processes for the following WP.

The role of the advisory groups also changed during the implementation, giving increasing recognition to the advice of the expert groups (and hence the views of external stakeholders). Thus, the links between the advisory groups and further programming steps were sometimes intertwined. For example, the chairs and co-chairs of the AGs were part of the workshops helping to prepare the third strategic programming document. In return, the chairs also channelled the information back from these workshops to the thematic expert groups; some of them found their way into the advisory group reports.

The establishment of the Foresight Correspondents' Network or FCN (now Horizon Europe Foresight Network HEFN) as a cross-DG and cross-EU institutional network of strategic 'foresighters' combined elements of future-oriented learning and empowerment. The FCN was established in 2014, in response to the recommendations by the European Forum on Forward-Looking Activities (EFFLA). Initially, the interest and momentum of the network was limited – foresight was considered too marginal and it was possibly underestimated in terms of its longer-term influence on strategic agendas. This changed with the growing prominence of foresight and Commissioner Sevkovic's annual 'foresight report' and other foresight experiences within DG RTD. It has also led to higher-ranking officials attending network meetings, and they also tend to be more outspoken than earlier participants. Interviewees and policy workshop participants agree, the foresight-gathering is still more about individual than organisational learning; much of its influence thus depends on the individuals participating.

⁸⁶ Cf. Policy mix case study no. 17.

⁸⁷ In DG RTD, 27% of the people are contract staff (Source [Statistical Bulletin Oct 2022](#)).

⁸⁸ Cf. Policy mix case studies no. 4 and 1.

4.3.2. Transparency of processes

A common feature of all consultation mechanisms used by the EC in the (strategic) programming process of Horizon 2020 was, according to interviews⁸⁹ and discussions at policy workshops, the lack of transparency on how the input from EC external stakeholders is used. This was especially true for the open consultations and the AGs, but also opinions stemming from strategic intelligence sources (evaluation and prospective studies). As per insights gathered from interviews and stakeholder perspectives shared during the policy workshops, two prominent weaknesses were identified: 1) poor organisational setup that hindered the effective incorporation of expert knowledge into strategic programming processes, particularly evident in the scoping papers and 2) a break in the policy feedback loop. For external stakeholders, even those well acquainted with the framework programmes, there was little clarity on what sources were ultimately used in the work programme elaboration and how the decisions were made.

In addition, the fact the work programme was updated quite frequent made this situation more complex – all the more as the annual updating was also found to be non-transparent and resource-intensive.⁹⁰

4.3.3. 'Experimentation' with openness/prescriptiveness

In Horizon 2020, the concepts of 'openness' and 'prescriptiveness' were used for the thematic programmes, where the EC identified specific objectives, policy goals, and societal impacts to be addressed. Thus, these concepts became particularly relevant for pillars 2 and 3.

According to interviews,⁹¹ the drive for more openness compared to earlier framework programmes resulted in a shift in programming logic based on a guideline for EC units and representatives responsible for drafting the work programmes. The aim was to put a focus on the elaborating 'expected outcomes and impacts', while at the same time reducing prescriptiveness in terms of which technologies, research methods and approaches a project proposes. The internal guidance specified that the focus should be put on impact-orientation, i.e. the specification of the 'expected impact' section of the call text, whereas the 'scope' section of the call text was to be left more open. It remained unclear how broadly the guideline had actually been followed.

Those with knowledge about the guideline also report that this shift also had an effect on the programming process itself. As a result of the new programming logic, the Horizon 2020 call and topic drafting process shifted towards identifying challenges or problems to be addressed instead of starting from the state-of-the-art of a technology and identifying possible development paths and applications for this technology.

Experiences and lessons learned in some Societal Challenges programmes (SC3 Energy, SC4 Transport, SC5 Climate Action) showed that the initiative to increase openness in call and topic formulation taken at the beginning of Horizon 2020 was successful. There was unanimous agreement among interviewees that Horizon 2020 as a whole was much less prescriptive in terms of approaches and methods to be used than previous FPs. All interviewees ascribe this to the coordinated drive at the start of Horizon 2020 from DG RTD. According to interviews, the quality of proposals and projects was high thanks to the shift to more open calls and topic descriptions

The Green Deal call: As interviewees explained, the Green Deal call was in many aspects an unusual call for Horizon 2020. It was very much an experiment towards the end of the framework programme, where the budgets and types of calls were also markedly different from 'typical' calls in terms of size and ambition. The Green Deal call was also characterised by more prescriptiveness than usual where the topics aimed at and prescribed concrete solution paths. Much of the prescriptiveness was introduced indirectly, by aiming to deliver results in the short- to medium-term, which can only be achieved with existing/quite mature technologies. However, there were also some Green Deal calls that were intentionally kept broad and very open in terms of approaches to be used. These open topics were ones that

⁸⁹ Cf. Policy mix case studies no. 5 and 1.

⁹⁰ Fisch, Peter (2015): Some critical reflections on the role of Work Programmes in Horizon 2020. Think Pieces 3/2015. Peter.fisch.eu.

⁹¹ Cf. Policy mix case study no. 13.

integrated different domains and SCs and where the co-creation group(s) involved DGs new to work programme drafting without established approaches.

Several factors and arguments calling for relatively more prescriptive calls and topics were drawn from interviews and policy workshop discussions:

- Systemic and holistic approaches: A key argument for more prescriptive calls is when the call aims at systemic and holistic approaches and solutions needed to contribute to cross-cutting challenges such as reaching sustainability goals. Such systemic and holistic approaches require more explanation, targeting cross-cutting objectives and activities, and typically require the inclusion of new actor and stakeholder groups.⁹²
- 'Novelty' of subject: Similarly, persons drafting work programmes often described calls and topics in a more prescriptive manner when the call addressed concepts and subjects new to the FP and the R&I community and/or was an experimental topic in this area. For some SCs, this might be when the call targeted systemic and holistic approaches, as this was relatively new to the particular area at that time.
- Maturity of technology/solution: Interviewees and participants at the policy workshop confirmed a clear link between the maturity of the technology in question, thus linking to TRL levels and the prescriptiveness required. In areas where R&I is more advanced, i.e. solutions have already reached higher TRLs, and the challenges now lie in demonstration, implementation, upscaling, and market rollout, higher prescriptiveness was needed.⁹³

5. Conclusions on key ambitions and challenges for the relevance and internal coherence of Horizon 2020

5.1. Conclusions on relevance

The relevance of the design of Horizon 2020

- Horizon 2020 intervention was highly relevant given the needs, priorities, problems and issues for R&I to be addressed at the European level. All three rationales, which eventually became the cornerstones of Horizon 2020, namely i) the reinforcement of scientific excellence, ii) the turn towards innovation, and iii) the more political and impact-oriented framing of the thematic top-down funding programmes, were anticipated and brought forward by research communities. In that way, the three-pillar structure of Horizon 2020 covered the major needs for R&I in Europe at the time when the programme was designed, while responding at the same time (more than ever) to political priorities.
- Horizon 2020 took place in an era of dynamic global change, having been conceived during the aftermath of the 2008/09 financial crisis and extending into a period of increasing geopolitical uncertainty, a more acute awareness of the unfolding climate crisis and, finally, the first major pandemic of the 21st century. Overall, Horizon 2020 addressed these political priorities by adding them to the work programmes, calls and funded projects. Likewise, issues and needs emerging from within the research and innovation (policy) arena during the Horizon 2020 implementation phases, such as open science and societal impacts of research, were picked up in work programmes.
- A limitation on the relevance of Horizon 2020 design was that the inclusion of emerging themes as additional topics in the work programmes was not carried out on the basis of a strategic (refocusing, redirecting) approach. However, emerging topics – coming either from new political priorities or bottom-up emerging needs from the research communities – could be addressed by the budget, mostly by reallocating portions within the same programme heading. As these budget envelopes tended to

⁹² An essential element of a more holistic approach is not only to seek a more prescriptive approach to R&I funding but also to include other types of policies outside the R&I spectrum (e.g. regulation, public procurement), and to include the problem owners in the process of implementation (cf. recommendations).

⁹³ Cf. for more policy mix case study no. 13.

be based on political priorities, the budgetary discretion of the EC was largely limited to shifts within the programme headings.

- Two major events brought about new impulses to re-orient the last programming period of Horizon 2020 and give directions for Horizon Europe. These were the 'Report of the Independent High Level Group on Maximising the Impact of EU Research & Innovation Programmes' (also called the 'Lamy Report') following the interim evaluation of Horizon 2020 in 2017 and the arrival of a new European Commission along with new priorities, in particular the European Green Deal, in 2019. The transformative change called for by the Green Deal was addressed by dedicated calls in the last year of Horizon 2020.
- The EU is beginning to catch up in artificial intelligence – which is one of the most dynamic technology fields with regard to patenting and start-up activity in the EU – yet, there still is a significant gap between itself and the US/China. While the EU remains one of the global leaders in AI science, it still lags in AI innovation, among other areas, due to a lack of available big data sources.
- Overall, the EU's industrial R&D investment in ICT, ICT services as well as in the health sector (in particular in biotechnology) has remained below that of its competitors for a number of years.

The relevance of the Horizon 2020 policy mix

- Overall, the Horizon 2020 set of instruments, activities and types of action (the 'policy mix') proved well matched to its expected outputs and impacts, and thus found to be 'relevant'. In each of the three main programme parts (Excellent Science, Industrial Leadership, Societal Challenges), a specific policy mix was brought to bear, which corresponded to their specific objectives.

More specifically:

- The ERC is regarded as a crucial building block of European scientific excellence. ERC and other bottom-up schemes supporting frontier research were important during the Horizon 2020 timeframe, from a responsiveness and preparedness perspective, as they sought to explore a wide range of novel research paths and thus a reservoir of possible response options to a variety of emerging needs. The development of the COVID-19 vaccine by BioNtech/Pfizer was one of the most remarkable recent examples of this preparedness: an ERC grant to Ugur Sahin and his team was one among other grants, which provided the relevant knowledge.
- The policy mix of the Industrial Leadership pillar put a strong focus on SMEs and was thus highly relevant for the specific objectives of strengthening SME innovation performance and growth. Further, all programmes of the Societal Challenges pillar adopted the cross-cutting policy of strengthening SMEs, although the SME Instrument was used with varying intensity. The analysis of call texts reveals in this regard frequent mentions of 'SMEs' and 'technological innovation' in the Excellent Science pillar, which indicate a certain degree of relevance to (and of course coherence with) the Industrial Leadership pillar's objective of fostering industrial competitiveness, not the least because of the ERC's Proof of Concept scheme.
- The availability of skilled staff and the ability to attract talent was the most important challenge for many start-ups and growth-oriented SMEs across the EU during the framework programme. Actions supporting training, capacity building and access to talent proved to be particularly relevant to these needs, including the Marie Skłodowska-Curie Actions in the Excellent Science part and the Enterprise Europe Network and INNOSUP Actions in the Industrial Leadership pillar (About 10% of companies' participations in Horizon 2020, equivalent to 6.500 in total numbers, was in MSCA).
- The slow uptake of mission-oriented and transformative policy approaches in the Societal Challenge programmes was identified as a limitation in Horizon 2020 – slow compared to some leading Member States such as Sweden (which has included such policies since 2011), Germany, the Netherlands and UK (all since 2018). Over the course of Horizon 2020, Societal Challenges programmes have developed towards more innovation and market orientation, which is shown by the importance of the SME Instrument and Innovation Actions in the SC policy mix. Nevertheless, the policy approach remained traditional, as it continued to focus on technological innovation and market-based solutions. This hampered, for example, the participation of 'practice partners' such as public authorities and CSOs (see also below). Changes in the direction of transformative approaches in research and innovation activities started only in the last year of Horizon 2020 in response to the European

Green Deal and calls, and included (i) the acknowledgement that research and innovation activities should aim to support processes of social change, (ii) a more open understanding of different types of generalisation processes allowing for 'location-based innovation' among other examples, and (iii) a more explicit call for multi-disciplinarity (strengthening the role of SSH) and trans-disciplinarity (strengthened role for 'practice partners' due to greater focus on research supporting the implementation of solutions).

- Throughout Horizon 2020, the integration of SSH in multidisciplinary projects remained challenging, as they focused primarily on technological change.
- The aim of Horizon 2020 to increase the participation of CSOs especially in the Societal Challenges pillar proved difficult to meet. Although their participation increased as compared to FP7, CSOs often faced obstacles meeting participation rules and assessment criteria for project research funding. The share of funding was even lower (4%) than their numerical share of participation (6%), which indicates that CSOs seemed to generally take on non-core roles in research project consortia and, rather, participating more in research communication, coordination, and results dissemination/uptake activities. Although the participation of CSOs showed signs of increasing from work programme 1 to 3, the generally low numbers indicate that Horizon 2020 lacked coherence and understanding on how exactly they should be involved. The Green Deal calls, which gave more weight to implementation, generalisation and uptake, started to fill this gap, by for example requiring 'practice partners' to take on the responsibility of local experimentation.
- The number of participants and the net EU contributions requested by the research institutions show a very uneven distribution between EU-13 and EU-15 countries. The largest recipients of funds were still the EU-15 countries with a share of 79% of the requested EU net contribution, followed by the EU-13 countries with 7%. The two most significant barriers to widening participation within public research were: 1) oversubscription, which often led to self-exclusion, and 2) missing support mechanisms (both nationally and institutionally).
- The current study has identified challenges in terms of openness and entry levels for newcomers in partnerships, especially if coming from small countries, although a clear distinction must be made between the individual partnerships. This was a concern as specific topics were only covered by partnership activities, but not by Horizon 2020 work programmes.
- The introduction of a reference to the TRL classification gradually spread to encompass the majority of the Horizon 2020 programmes (except actions such as MSCA, ERC funding, Access to Finance), and was used in about 20% of the calls. It spawned two interrelated shortcomings: as the practice evolved to introduce clearer specifications of the levels at which projects should start, and the expected levels that the projects should reach, this tended to support a linear intervention mode, which does not fit all programme parts and intervention logics. Second, in cases where a systemic or holistic approach was expected, and societal engagement considered key for advancing the solution towards higher adoption levels (for example, topics in Societal Challenge 5), TRLs limited the solution scope at the technology adoption/diffusion end.
- Several instruments and actions under Horizon 2020 proved to be very useful in responding to the COVID-19 pandemic, for example, the InnovFin Infectious Diseases action and the IMI partnership. The possibility to award grants without a call for proposals, together with newly introduced emergency funds, enabled the programme to respond even faster to the COVID-19 crisis compared to the previous Ebola and Zika outbreaks.

How Horizon 2020 processes support the relevance of the programme

- The programming up to FP7 by and large responded to the needs and interests of the research communities. Yet, in cases of crises and new political priorities the responses were reactive. With Horizon 2020, strategic programming evolved into a tool that allowed policymakers to shape and direct political priorities.
- Over the course of the three programming phases, this process was further refined, as were the different approaches to consultation and the gathering of evidence in the process. Advisory groups and the preparation of scoping papers was seen together with the coordination between EC services as the major elements contributing to the expected benefits of the strategic programming process.

These benefits included a better (and more prospective) response to new developments and challenges from the R&I side while contributing significantly to the EU's overall policy objectives.

- Coordination between the European Commission directorates general (DGs) has considerably improved in Horizon 2020 and can be characterised in particular in its last phase (and the transition to Horizon Europe) in the following ways: (1) It is one of few co-created EC programmes at the time and involved the highest number of DGs; (2) Before Horizon 2020, coordination of framework programmes within the Commission happened primarily at cabinet level, but with Horizon 2020, DG RTD managed to establish a more integrated programming approach that included operational-level coordination which enriched the programming process and supported increased coherence compared to FP7. The evaluation study notes as downsides of the co-creation process that (1) power dynamics between DGs were evident in setting the WP-related decisions, and hindered to some extent the benefits of widespread consultations, and (2) work programme development – especially the updating process – resembled a 'collection exercise', where new topics were added to the work programmes and little consideration given to refining down or removing topics deemed to be less effective. Co-creation was one of the major reasons the number of topics increased.
- Despite well noted approaches to improve the consultation among the stakeholder groups, several problematic issues remained. Most importantly, open consultation mechanisms were not designed in a way to include the distinct views of external stakeholders. The survey structure asked whether topics were relevant, but leaves no possibility for differentiated feedback. In its current structure, the survey is perceived as an instrument for legitimising the current EC priorities, not as one that can open the discussion and bring in new aspects. In addition, the stakeholder consultation, in particular the informal channels, favoured the dominant R&I stakeholders (who know the game and have the resources to act), which put newcomers at a disadvantage, especially those stakeholders representing the end-users of research and innovation processes, in particular civil society.
- With the orientation towards impacts and the consecutive opening up of new consultation arenas (European R&I Days, Green Deal public consultation), in its last phase, Horizon 2020 made notable improvements; introducing societal needs and societal interests more directly via consultation into the framework programme.
- Strategic use of foresight and policy feedback (i.e. interactions of funded research projects with policy) were not systematically institutionalised by the end of Horizon 2020, despite having significant potential to inject some longer-term thinking into the Commission's efforts to better orientate the framework programme.
- The SRIAs of partnerships fulfilled important roles during the FP, helping to orientate partners and guide their strategies. The increased use of collaborative methods also raised the level of legitimisation – and thus relevance – which helped balance different interests between various stakeholder groups. Although SRIAs followed different timelines to work programmes, some partnerships aligned more strategically with PCs than others because of overlapping memberships in partnership steering bodies and programme committees.
- The reaction to COVID-19 and the mobilisation of budget from the emergency funds in Societal Challenge 1 (Health) happened rapidly. It was concluded that the emergency procedure developed after Ebola and Zika outbreaks served the response to COVID-19 pandemic well.
- Although the amount of crisis funding mobilised in response to COVID-19 turned out to be too little, the existence of the emergency funds proved to be very useful in ensuring a swift reaction to the resulting crisis.

5.2. Conclusions on internal coherence

The internal coherence of the Horizon 2020 policy mix

- Horizon 2020 objectives were translated very well into work programmes and calls. Further, key objectives of Horizon 2020 were addressed across pillars, in particular the policy focus on SMEs and on Societal Challenges.
- Horizon 2020 integrated newly emerging themes exhaustively in the calls. Societal Challenges programmes were the most prominent domain under which new themes were addressed.

- The Excellent Science pillar featured a coherent policy mix. The mono-beneficiary grants of MSCA and ERC were the cornerstones of this policy mix. This is where the age profile of the MSCA fellows was complementary to ERC grantees, i.e. the MSCA fellows were all younger or at earlier stages in their career.
- At the same time, opportunities for collaborative basic research decreased with the Industrial Leadership and Societal Challenges programmes focusing on higher TRLs. The Future and Emerging Technologies (FET) programme could not fully compensate for this change, as it was too narrow in scope and low in volume.
- Among the new instruments and types of actions, in particular the SME Instrument and the EIC Accelerator Pilot, which encompassed the previous SME Instrument, showed complementarities with many other actions – in the Industrial Leadership and Societal Challenge pillar: (1) In terms of target groups, as a mono-beneficiary grant, it complemented the FTI pilot scheme and the Eurostars programme, the aim and the scope of which were very similar; (2) The EIC was the only instrument covering almost the entire TRL spectrum, and it supported the commercialisation of innovations across all sectors and technology domains. Thus, the introduction of European Innovation Council helped to improve the internal coherence of the framework programme.
- Innovation procurement added a strategically important diversity to the Horizon 2020 policy mix as it focused on innovation used to solve problems and allowed high-end research to play into the needs of the public sector. However, as a counterpart to the framework programmes' overall supply-side approach, a shortage of capacity on the part of interested procurers was deemed to be the main reason for poor uptake. In practice, supply-side measures dwarfed demand-side efforts in Horizon 2020.
- Focus areas as a means to establish cross-pillar linkages had very little structuring effect on the coherence of processes within the EC. Focus areas were entirely perceived within the EC – led by DG RTD and aimed at boosting policy relevance and obtaining more buy-in from other DGs. This worked to some extent well, but there were no processes established to maintain interest among higher levels in the hierarchy. Further, budget rigidities prevented a true cross-over between work programmes, the selected portfolios were not systematically followed up, and systematic linking between projects only developed in the last WP.

How Horizon 2020 processes support the internal coherence of the programme

- The strategic programming process was developed during Horizon 2020 and there was a constant ambition to learn and to improve, with the effect that by the time of the third programming cycle many of the process parts had taken shape, and were carried on into the governance of Horizon Europe.
- Because of staff mobility policy, contracts ending, and other staff moves, EC units responsible for framework programme governance could not sufficiently accumulate knowledge. Horizontal mobility was floated as an idea to avoid silo-thinking and enable learning and cross-fertilisation across domains. Today, the balance between continuity and mandated staff mobility – both at managerial and operational levels – remains an issue for knowledge management and policy learning in DG RTD.
- Scouting of emerging topics, upcoming needs and challenges was not fully/procedurally enshrined in the strategic programming process in Horizon 2020, which meant it lacked (systematic) approaches to deal with future uncertainties in highly volatile contexts and adequately cover societal needs and mechanisms.
- Consultation mechanisms used in the (strategic) programming process of Horizon 2020 were lacking transparency on how the input from EC external stakeholders is used; feedback from the various consulted groups needed to be integrated to improve the outcomes and justify the resource-intensive consultation procedures. This was especially true for the open consultations and the Advisory Groups. A positive development was observed – greater transparency and openness – as part of the consultation process for the Green Deal call; indeed, it was made public from the beginning and provided easier access for all stakeholders.
- The drive for more open calls compared to earlier framework programmes revealed different understandings of openness/prescriptiveness among those involved in programming. Evidence collected

for this study suggests that the dominant understanding of these terms turned out to be the following: calls should be prescriptive in specifying intended impacts, but open in defining approaches, methods or technologies. Against the backdrop of the worldwide comparison case studies performed for this study, it was found that this approach has been used for the UK Strategic Priorities Fund since 2018. Further evidence suggests that the approach started to become institutionalised in Horizon 2020.

6. Recommendations on key ambitions and challenges for the relevance and internal coherence of Horizon 2020 and future framework programmes

This chapter offers two sets of recommendations following from the findings of this study and in response to the requirement to draft recommendations with relevance for Horizon Europe: (1) 'quick wins': operational recommendations, which should be addressed in the short term in the implementation of Horizon Europe, and (2) areas for improvement requiring structural change. While acknowledging that structural change needs a mid- to long-term perspective for its implementation, the identified areas for improvement were highly relevant to Horizon Europe. We took into account the improvements already made during the first two years of HEU when formulating our proposal for the future. These recommendations have been discussed and were further substantiated in a policy workshop with stakeholders and DGs involved in the framework programme.

6.1. 'Quick wins': operational recommendations for the implementation of Horizon Europe in the short term

6.1.1. Relevance

Make processes of knowledge management and policy learning more relevant

The delegation of the FP implementation to Executive Agencies (EA) increased the need to organise feedback from research projects to policy (DG RTD shifted half of its employees to executive agencies). The Research Executive Agency has made an effort to learn from the first policy feedback exercises established under Horizon 2020, to spread good practices internally. For example, REA produced reports based on the results from the projects, and initiated an 'annotated catalogue of policy feedback options' to choose from. These actions were geared towards encouraging discussions between project officers and policy officers. Today, all EAs are now under the umbrella of the 'Feedback to policy framework' in Horizon Europe. However, interactions between FP-funded research and policy should be a two-way process with policy DGs actively engaging with the agencies to absorb the knowledge created in research projects and to communicate their needs. The established 'feedback to policy' framework in HEU should be evaluated in due time.

In the long run, organisational change needs to take place: more resources are needed for targeted policy feedback. Greater and easier mobility of staff to and from agencies could be systematically encouraged as part of a career path in the EC.

More transparent stakeholder engagement

Stakeholder engagement in democratic decision-making more generally is an important element to ensure that legitimate interests are voiced and heard. This naturally poses a challenge for policymakers trying to balance and be receptive to all interests and needs, regardless of their experience and size. Indeed, there is a well-organised landscape of interest groups active in Brussels, which promote the interests of the various research actors very efficiently.

Despite several changes to the programming process, in particular the invention of multi-annual work programmes and new approaches to stakeholder consultation in the scoping phase, existing ways of interest group communication have remained the same over the course of the past FPs. During the annual updating processes, draft work programmes do not stay within the EC and programme committees; instead, quite frequently stakeholders happen to see them and use their well-established informal links to the EC to interact on them. This creates some path dependencies, as only a limited number of Brussels-based liaison offices are well enough organised and connected to 'know the game' and to play it.

Stakeholder organisations do not have equal opportunities to get their voices heard. The consultation for the Green Deal call was different in this regard, as the draft work programme was made public from the beginning and provided easier access for all stakeholders. This open model could be the standard approach for organising consultations on draft work programmes in the future.

Aiming for transformative impact

Horizon 2020 had the ambition to be a very broad and inclusive programme, addressing at the same time persisting challenges and issues in the European R&I system, and becoming more responsive to European level policy priorities. With the financial and economic crisis preceding the design of the programme back in 2010 and 2011 and pushing it towards a meaningful contribution to competitiveness and economic growth, a narrative appeared that very much emphasised the economic impact of the framework programme. This was further reinforced and at the same time re-directed with the high-level Lamy Report in 2017, which asked for a clearer response of research to societal needs and challenges. While this reasoning has been present in the European R&I policy discourse – since the Lund Declaration in 2009 – Horizon 2020 set out to redefine this by replacing thematic programmes with Societal Challenges programmes. Thus, increasing attention on societal (and environmental) impact became prevalent in the last phase of Horizon 2020 only. Nevertheless, the policy mix and related implementation modalities remained largely the same, the target groups remained consistent, and there were no major attempts to fund a new mode of research. Such a new mode would have entailed multi- and trans-disciplinarity, put social change on equal footing with technological innovation, and recognise different generalisation patterns instead of aiming for one-size-fits-all solutions. In Horizon 2020, there were modest attempts to fund 'location-based' innovation or 'transformative research' in the SC Environment programme and the Green Deal call. Now, in Horizon Europe's cluster programmes and missions, there is room to call for transformative research. A general call for more involvement of SSH – although correct – will not be enough.

In contrast, Sweden has operated its Challenge-Driven Innovation Programme – as a slightly prescriptive approach to transformative research – for more than a decade.

In contrast to Horizon 2020's Societal Challenges pillar **Sweden's Challenge-Driven Innovation Programme (CDI)** is characterised by a much more bottom-up and flexible project development process that supports short-term flexibility while ensuring long-term orientation. Funded projects under the CDI must be related to challenges that address one of the global goals (and be long term in orientation) but problem formulation and solution proposals are designed by applicants in collaboration (short-term flexibility). This means that it is up to each project itself to clarify and present the impact logic of the project and to demonstrate its contribution to higher-level goals. Additionally, flexibility is achieved through the Stage Gate Model of the CDI which is a structured project progression framework by which the CDI organises, assesses and funds projects while also shaping the internal logic of a project and its priorities (e.g. from problem/solution scoping and ideation in stage 1 to commercial application and demonstration testing in stage 3). As a result, the project and the consortium are constantly adapting and the involvement of private-sector partners increases with each phase.⁹⁴

⁹⁴ See for further details on international comparison cases presented in this and the following boxes Annex E.

Valuing the contribution of bottom-up programme parts to political priorities differently

In retrospect, the prevalent orientation on societal challenges (mission in HEU) risked nurturing the expectation that all parts of Horizon 2020 should equally contribute to overarching policy objectives like sustainable development (SDGs) or combating climate change. This was, for example, supported by cross-cutting spending targets for SDGs and climate. Poorly specified intervention logics contributed to a situation where the excellence-oriented, bottom-up parts (in particular the ERC) risked no longer being judged against their original objectives. A learning that was drawn rightly for Horizon Europe was to continue the integration of the excellence-oriented parts in their own right. Another learning in HEU was to work with specific impact pathways from the beginning. The approach now implemented in Horizon Europe should be monitored and evaluated against the following questions: (1) Do these tools help programmers to map the specific characteristics of each part? (2) Are they useful in supporting the design of more transformative types of actions and activities? Further, for cross-cutting targets, like the spending targets related to SDGs or climate change, it should be made clear, that the different parts of the programme are expected to contribute to these targets to varying degrees.

6.1.2. Internal coherence

New collaborative grant scheme for the excellence programme part

The growing impact orientation reduced space for collaborative research at lower TRLs in the framework programme.

Building further on the relevance of investigator-driven science at lower TRLs, there is an unanswered question as to why the potential of excellent science through collaborative research involving several organisations from different countries is not leveraged more extensively, even in the current framework programme. It is recommended to reconsider the option of opening up the FP to more collaborative research opportunities at lower TRL. The approach of the UK Strategic Priorities Fund tries to combine discovery-led research with impact orientation. It is prescriptive in terms of overall objectives and open at the same time as regards technological (or other) approaches.

UK's **Strategic Priorities Fund** (SPF), launched in 2018, is part of a wider package of UK Research and Innovation (UKRI) measures for investment in multi- and interdisciplinary research across 34 programmes. It strengthens the discovery-led approach (in addition to challenge-oriented approaches) with a focus on large collaborative projects. The approach is not completely bottom-up, as the funded projects have to respond to key strategic government R&I priorities.

Coordination among different policy domains and broader policy mixes

Before Horizon 2020, coordination regarding the framework programme within the EC happened primarily at cabinet level, with the main aim to coordinate the individual budget parts assigned to different DGs. Programming was mainly in the hands of the family of 'research' DGs. With Horizon 2020, there was a change, as DG RTD managed to establish a more integrated programming style. As a consequence, a different approach to the coordination between services, whose research budgets were now under a joint umbrella, was set up. It included coordination at the operational level, and was found to be working well. 'Policy' DGs (those without their own research budgets) continued to give input to the 'research' DGs on their research needs. Also, the co-creation of Horizon 2020 resulted in multi-DG input. However, few other EC programmes were co-created, and thus limiting real synergy between programmes.

Now, with Horizon Europe taking a mission-oriented approach and aiming for broader societal transformation, there arises a need to coordinate the research and innovation missions with the sectoral policy approaches. A holistic approach requires 'systems thinking' to analyse mutual inter-relations between the policy mixes within the FP and to combine instruments beyond R&I funding (e.g. regulation, public procurement). Thus, cross-policy domain structures and processes should become part of the FP governance and policy cycle. The SET Plan is an example from Horizon 2020 which provides a good practice for the new type of coordination needed.

Rooted in sectoral approaches the Dutch mission-driven Top Sector Innovation Policy (MDTSIP) provides some inspirational knowledge for mission governance.

In 2018, the Top Sector policy was revised and became the **Mission-Driven Top Sector and Innovation Policy (MDTSIP)** with a stronger emphasis on societal challenges. The revision marked a shift from a sectoral approach to a challenge-oriented approach. Containing elements of mission-oriented innovation policy (MOIP), the Dutch approach informs the opportunities and challenges related to coordinating multi-stakeholder engagement across the design and implementation stages of the policy. The multi-stakeholder approach, mirrored in the governance model of MDTSIP, helps to ensure the relevance of the policy by incorporating the views of a wide array of stakeholders in the design and implementation processes. The MDTSIP also shows that building the intervention upon a detailed theory of change and structured around an integrated portfolio of projects, which limit inconsistencies and gaps between activities, can enhance its overall coherence.

Alignment of partnership strategies with work programme development

Partnerships have a special role in the FPs. They are regarded as important levers to contribute to framework programme objectives – and thus to internal coherence of the framework programme. They are at the same time important for the development of the European Research Area as a whole and are expected to contribute to external coherence by establishing fora where Member States can coordinate their policies (in particular in the public-public JPIs). Partnership strategies should therefore resonate with the strategic programming of the framework programme, however, they are also expected to act with a reference to ERA objectives.

Against this background (and the acknowledged differences of the different types of partnerships), mechanisms and processes to coordinate between agenda-setting by partnerships and strategic programming and thematic priorities in Horizon 2020 was handled differently by the partnerships. Some partnerships developed a structure for 'light' coordination by way of double memberships of delegates in programme committees and partnership governing boards. These have in some cases happened accidentally, but proved to be a good approach for coordination, in particular when the delegates were very much driven by a thematic interest and less so by sectoral or national interests. Thus, these overlapping or double memberships in partnership governing boards and programme committees should be further developed and adopted by more partnerships.

Although building on different rationales, the Global Health Innovative Technology Fund (GHIT) can provide some inspirational knowledge for the partnership approach.

What is unique and noteworthy in **GHIT** is its ability to leverage co-finance from private and philanthropic entities and engaging different stakeholders in R&D activities in risky and otherwise under-financed and under-researched sectors connected to neglected tropical diseases. Additionally, the partners have also agreed to share their compound libraries, which significantly speeds up identifications for pharmaceutical R&D. This way, GHIT is following the open science principles. The GHIT fund has also managed to develop an internally coherent pipeline of R&D product development platforms, which facilitates R&D throughout the TRLs, from early research to the launching of products. Moreover, GHIT has partnered up with UNDP to assist the late-stage candidates with the access and delivery strategies in developing markets.

6.2. Areas for improvement requiring structural change

6.2.1. Relevance

A true crises budget

Although the emergency funds (EUR 10 million) proved to be very useful in ensuring a swift reaction to the COVID-19 crisis, the amount of financing provided by the funds soon turned out to be insufficient given the development of the pandemic. Additional funds (almost EUR 40 million) were secured from the remaining 'free' money in Horizon 2020, which was still found to be too low to deal with the pandemic.

While the introduction of the 'crises budget' was a clear improvement during Horizon 2020, the additional amount mobilised from Horizon 2020 'free money' (mainly contributions from third countries) pointed to the fact that the overall amount of the emergency budget was limiting the response to the crises.

On top of that, as the Health programme is the only one with a standing budget line for emergency research, the EU might want to think about a 'crisis response budget line' for any future situations warranting an immediate response, including non-health related ones.

Such a FP crisis budget line should be anchored in the programme in a way that it can be purposed for other R&I priorities in case no major crisis happens. Further, an FP crisis budget should be part of a broader cross-policy domain crisis reaction mechanism and budget to react to emergencies/situations in a holistic manner, beyond the mere R&I needs that a crisis creates.

The example from the Singapore strategic programme shows that about one fifth of the programme budget is reserved for flexible reaction to emerging themes and crises. This should be read only as an inspirational example, not as a recommendation to follow this route, as the RIE2025 programme and the Singaporean situation are comparable to the FP only to a limited extent.

Singapore's Research, Innovation, and Enterprise 2025 (RIE2025) is a five-year plan developed by the National Research Foundation (NRF), which sets strategic goals and the direction for national R&D. Budget is allocated to four major objectives, however the structure allows for flexibility through so-called White Space funding, which is 21% of the overall budget. The White Space funding budget is primarily set aside to provide flexibility in responding to research areas that had not been identified at the start of the five-year funding tranche. These may be revealed in periodic strategy reviews or through engagements with stakeholders, including discussions with advisory panels. New areas funded through White Space include epidemic preparedness and response, space technology and increasing Singapore's capacity for sustainable urban food production.

Focus on 'need owners'

The increasing impact orientation of Horizon 2020' Societal Challenges programmes and to some extent the activities in the Industrial Leadership part continues under Horizon Europe, where these two components were merged in the cluster programmes, and where additionally R&I missions were (re)defined to reach policy targets.

Horizon 2020 opened itself up to new actors, in particular to civil society actors. It was found that the ambition to generally increase the participation of these actors in projects was successful only to a limited extent. Although their participation rose significantly, it was often hindered by the fact that research programmes and questions appeared highly research-driven and designed toward the needs and interests of the research community.

The Green Deal call worked differently in this regard, and had a mobilising effect on societal partners. In those cases, when there was no clear mandate or role in the implementation of the research results for 'practice partners', it seemed more straightforward to focus on those who have such a role (and thus an own research need). One way to approach this should have been to mobilise so-called 'need owners' (often cities, ministries and other public authorities next to civil society actors) for participation in these projects. Since needs owners usually seek solutions and not R&I funding, they should stay in their core competency area and therefore mainly participate and steer from the demand side, not necessarily driving R&I activities. The aim should be to strengthen their role the closer a project moves towards implementation. Thus, an 'expanded toolbox' would be needed to stimulate the participation of these actors.

Accordingly, participation and funding rules should be adapted in order to adequately support the participation of need owners. Non-research performing actors should receive compensation for their time and effort. Valuing implementation, upscaling and generalisation would need a whole different approach to the FP's participation rules and financial arrangements attached to that.

The approach of the Israelian R&D fund also points to needs owners, although somewhat differently from what has been discussed in this report for Horizon Europe.

The case study on the **R&D Fund Israel** provides inspirational knowledge about the swift financing process and attractive opportunities for specific target groups. In particular, the preferential financing offered for specific geographic areas and ethnic groups reveals the ability to reflect the underrepresented needs. More specifically, the R&D Fund provides financial support to Israeli corporations at more developed growth stages, SMEs and eligible large corporations – this can cover between 20% and 50% of the R&D expenditure. The R&D financing calls are not prescriptive. They neither define the technology readiness level nor the type of actions funded. However, the intensity of financing is tailored to the geographical location, gender and ethnic composition of the management team. With preferential financing, the R&D Fund aims to increase the diversity in the high-tech sector.

More selectivity and priority setting

In our analysis we come to the conclusion that the updating processes of the Horizon 2020 work programmes supported flexible reaction and adaptation of the work programmes and calls to emerging needs or trends and policy objectives. While having taken the step towards multi-annual work programmes of two (and respectively three) years in Horizon 2020, the EC kept the approach of annual updating of work programmes, which in fact also meant that more than one update was processed per year (including those of an editorial nature without changes to the content). Thus, a high degree of flexibility and adaptability was being ensured by these processes.

There were some downsides to this. First, and most importantly, the updating process resembled a collection exercise, where new topics were added to the work programmes, while the existing ones were not refined or adapted (kept in situ). Hence, co-creation effectively increased the number of topics; not decreased it, as it would have been expected. In particular, the annual updating demanded a lot of resources, even for simple editorial changes without any strategic impact. The Research Council Norway is an example of a leaner co-creation approach.

The **Research Council of Norway** is commissioned by 16 different ministries, and governed by the Ministry of Education and Research (MER). Through the preparation process of the long-term plan and the yearly 'Letters of Instructions' from different ministries, the voice of all ministries is effectively heard. MER is leading a common steering system of RCN, which aims to ease the alignment of instructions/priorities of the different sectoral ministries. Due to this specific governance and funding arrangement of RCN, most of its programmes are cross-ministerial.

Focus and selectivity on focal topics is needed. Selection criteria should be developed in the strategic programming process. They should be based on a good combination of external advice and the EC's internal strategic intelligence (e.g. building on an improved 'feedback to policy' scheme). External advice should not be additional, but could for example build on a more strategic use of foresight studies.

6.2.2. Internal coherence

Mandate to focus and (re)direct

A consequence of the adaptation of work programmes, as described in the previous section, was their 'inclusive' nature. New topics were being integrated into work programmes, leading to new calls or the revision of existing calls. Thus, regularly, there was some budget allocated to the emerging themes. As the existing topics were rarely abandoned completely, budgets were shifted within the programme headings, implying the risk of funding some topics with 'subcritical' amounts.

Thus, Horizon Europe should establish the practice of prioritising themes more clearly in work programmes. Formally, this requires Member State and EC agreement in PCs. Counter to the formal competencies of PCs, the role of the MS in PCs has, in practice, been downgraded to endorsing the agenda of the EC. Opinions differ on the role that the PCs should have in the future, as they work very differently; some being challenged by the different MS policies to choose representatives and lobby for their national interests. Experience from Horizon 2020 showed that some PCs work very well together with expert committees, and that this balances political bargaining. PCs working jointly with expert committees could thus become a decision structure for implementing focus and re-direction in work programmes. This would rebalance the current decision structures by upgrading the role of the Programme Committees and strengthening expert advice in strategic decision-making.

Examples from worldwide comparison studies show completely different approaches to focus and (re)direct the research activities. These tasks are delegated to programme managers or multi-stakeholder boards, thus a strong bottom-up-logic is inherent to these processes.

The **Bill and Melinda Gates Foundation** places significant trust in the autonomy of directors of programme strategies. This increases the flexibility of the foundation by reducing the administrative burden.

ARPA-E (US) enjoys considerable organisational flexibility at an administrative level. Programme directors have great autonomy to craft programmes and select and actively manage projects, also with regard to the reallocation of funds. This feature allows ARPA-E to make fast and non-bureaucratic decisions and to respond more quickly to changing technological conditions. In order to bring new technologies towards implementation, ARPA-E assembled a 'Tech to Market' team whose main tasks are to support the implementation as well as the commercial advances of the new technologies. Finally, the Department of Energy provides ARPA-E the option of calling on the so-called Other Transaction Authority (OTA), a procurement mechanism for goods and services that are not subject to the US Federal Acquisition Regulation. It can be used in cases where the terms of traditional agreements are not suitable for the potential performers. This flexible contracting option enables ARPA-E to quickly fund potential projects.

The **Research Council of Norway** operates multi-stakeholder portfolio boards that play a key role in prioritising key portfolio areas and providing a bottom-up perspective on priorities to be chosen. They oversee budget allocation and make decisions about the selection of funded projects. This approach differs from that generally used in similar organisations, where only representatives of one type of organisation usually participate in decision-making.

The mechanism to focus and re-direct should be accompanied by more budgetary flexibility. It should facilitate more coordinated linkages across programme parts (i.e. 'budget envelopes') and thus mitigate the barrier encountered by focus areas in Horizon 2020. It should also make sure there is sufficient non-pre-purposed budget. This is currently vastly depending on the contributions of countries associated to the FP. As the current experience with Horizon Europe showed, this can become limited in cases when one or two large countries drop out.

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The 'Evaluation study on the relevance and internal coherence of Horizon 2020 and its policy mix' shows high levels of relevance and internal coherence of Horizon 2020. Horizon 2020 was more than its predecessors which were geared towards industrial competitiveness, innovation and addressing societal challenges, while continuing to invest in the excellence of the science base. The policy mix was adequate to address the objectives, without major overlaps or duplication. Overall, Horizon 2020 proved to be flexible in reacting to emerging needs and in particular to the COVID-19 crisis. Improvements made regarding the strategic programming process are acknowledged to support relevance and internal coherence, while the strategic approach to the prioritisation of topics is in need of strengthening.

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