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FET Flagships: A novel partnering approach to address grand scientific challenges and to boost innovation in Europe

1 INTRODUCTION AND POLICY CONTEXT

In October 2013, after a preparatory period of three years, the Commission launched through its FET scheme[1] two FET Flagships, Graphene[2] and the Human Brain Project[3] (HBP). Each of them is implemented initially as an FP7 project preparing the ground for what will be a new kind of partnership. In complement to these two projects, the Commission has also launched a coordination action bringing together Member States (MS) to jointly define and implement activities and finance projects in support of the Flagships.

These two Flagships are the result of a Communication adopted in April 2009[4], in which the Commission stressed the need for Europe to address grand scientific challenges through sufficiently long-term multi-disciplinary research initiatives, termed FET Flagships (hereafter, Flagships). In July 2009, an ISTAG report[5] confirmed the need for Europe to act and further elaborate on the principles of such Flagships. In December 2009, the Competitiveness Council welcomed this Communication and invited the Commission to propose Europe-wide Flagship initiatives.[6]

Although the Flagships are at a very early stage of implementation, the objective of this Staff Working Document is to take stock of progress so far and, most importantly, to present the Flagship model and its implementation in the Union's Research Framework Programmes, in particular within the current Horizon 2020 (H2020).

The Commission will undertake an interim evaluation of the Flagships in 2017.

This document does not address the launch of further Flagships.

Flagships are long-term, very large scale research initiatives aiming to solve an ambitious challenge such as understanding the human brain or exploiting the potential of graphene, the newly discovered revolutionary material.[7] With Flagships, the Commission proposes a new partnering model for long-term European co-operative research in the European Research Area (ERA)[8], demonstrating the potential for common research efforts. This model is based on the combination of a large Core Project playing a leading role for the whole duration of the initiative and a set of Partnering Projects. In this model, the research community drives the process of defining and selecting the grand challenge of the Flagship, and developing the related research roadmap. Half of the Flagship budget will be invested by the Commission

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1 FET, Future and Emerging Technologies, is the Commission's scheme that was supporting long-term ICT programmes in FP7 and is now in the Excellence Science part of Horizon 2020.

2 www.graphene-flagship.eu

3 www.humanbrainproject.eu

4 COM(2009) 184, 'Moving the ICT frontiers – a strategy for research on future and emerging technologies in Europe'.

5 ISTAG was the Advisory Group of the ICT Theme in FP7. Their report on FET Flagships "European Challenges and Flagships – 2020 and beyond" is available at ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/fet-proactive/press-17_en.pdf

6 http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/intm/111719.pdf

7 Both Graphene and HBP Flagships are research initiatives of the order of 1 billion Euros over a 10-year time scale.

8 http://ec.europa.eu/research/era/pdf/era-communication/era-communication_en.pdf

into the Core Project, while the Commission expects that the other half will be invested by the MS and private funding sources into Partnering Projects.

The European Union is investing in Flagships that will bring future growth and competitiveness: new ideas, new knowledge, new technologies, and skilled people. The Flagships will bring together the best scientists, creating a basis of fundamental research across different disciplines which can connect to applied research and deliver the innovations that will improve peoples' lives. The Flagships will establish Europe as a global leader in their domain and will become an attraction pole for international cooperation.

This Staff Working Document is structured as follows: Section 2 describes the Flagship concept and compares it to other large-scale initiatives; Section 3 briefly recalls the selection process which has led to the launch of the two Flagships and provides a short overview of these Flagships; Section 4 presents the model of the Flagships that is now being put in place; Section 5 describes the key features of the Flagships' action plans; Section 6 outlines the Flagship monitoring process; and, Section 7 draws some first lessons from the efforts carried out so far and summarises some key aspects for the successful implementation of Flagships.

2 WHAT ARE THE FET FLAGSHIPS AND WHAT ARE THEIR GOALS?

2.1 Key features and expected impacts

Flagships are visionary, science-driven, large-scale research initiatives addressing grand scientific and technological (S&T) challenges. They are long-term initiatives bringing together excellent research teams across various disciplines, sharing a unifying goal and an ambitious research roadmap on how to achieve it. Flagships aim at transformational impacts on science and technology, delivering a key competitive advantage for European industry and substantial benefits for society.

Flagships are expected to run for about 10 years, with a budget of around 100 million Euros per year per Flagship.[9] They require:

(i) Setting up large-scale partnerships that closely coordinate and integrate the contributions from a large number of research organisations, including academia, large industry and SMEs;

(ii) Commitment to a strong science investment over a long time period that cannot be carried out alone by the Commission or any single MS. This requires establishing a close link between related activities at European, national and regional level and ensuring a mutual reinforcement from the Commission and the MS of their research activities that contribute to the Flagship.

With Flagships, the Commission proposes a new type of partnership that is expected to deliver value on many different dimensions:

– ***Establish Europe as a global leader in their domain and an attraction pole for international cooperation:*** Flagships build on existing European S&T excellence, which will further develop and expand given the sustained and coordinated research

[9] The budget and duration of a Flagship are defined in accordance with its research roadmap.

collaborations between the best teams in Europe. Flagships are expected to become globally leading initiatives and poles of attraction for other initiatives, research organisations and teams, within Europe and beyond. They will create opportunities for intense international cooperation and for regularly communicating, at global level, the European achievements in the field.

– ***Develop new talents, new skills:*** Flagships will nurture creativity and talent. They will attract the best minds, and educate hundreds of young researchers from various disciplines, within Europe and beyond, and help educate and train a new generation of skilful researchers both in academia and industry.

– ***Create a long-lasting structuring effect on research efforts in Europe:*** By fostering and sustaining collaboration amongst hundreds of European research teams across disciplines and across academia and industry, Flagships will achieve a lasting integration of efforts and resources beyond their duration. Also, by creating synergies and a coordinated planning between European, national and regional activities, Flagships will help reduce fragmentation and optimise complementarities between EU and national research programmes[10], in the spirit of ERA completion.

– ***Deliver a large impact on competitiveness and society***: Flagships are designed from the outset to bridge the gap between fundamental research and innovation. They provide a long-term collaboration framework for academia and industry to jointly develop and implement a strategy for the efficient translation of scientific advances into concrete innovation opportunities. They will also contribute to addressing some of the major societal challenges Europe is facing.

2.2 Comparison with other large-scale partnerships at European level

As part of the Europe 2020 strategy, the Innovation Union policy[11] highlights the importance of partnering in European research and innovation (R&I) as a means for addressing Europe's insufficient and fragmented R&I efforts. Several large-scale partnering activities were developed in the course of FP7[12] and more recently, in the context of H2020.[13]

– *Public-Private Partnerships* are industry-driven research and innovation initiatives of strategic importance to the Union's competitiveness and industrial leadership or addressing specific societal challenges.[14]

– *Public-Public Partnerships* are led by MS. They mainly address the coordination and joint implementation of national research programmes. The Union finances the MS coordination activities and partly co-funds their joint research activities.

– *European Innovation Partnerships*[15] bring together stakeholders across policy areas, sectors and borders to integrate or initiate supply and demand side measures across the

[10] COM(2012) 392

[11] COM(2010) 546

[12] COM(2011) 572

[13] COM(2013) 494

[14] http://europa.eu/rapid/press-release_IP-13-668_en.htm

[15] http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=eip

whole R&I chain and aim to speed up market deployment of innovations addressing major societal challenges.

– *Knowledge and Innovation Communities* (KICs)[16] are partnerships launched by the European Institute of Innovation and Technology (EIT). KICs are integrating higher education, research and business actors to speed up innovation in Europe. Three KICs have already been launched. They focus on climate change, sustainable energy and ICT. Under H2020, the EIT will launch five more KICs of which two in 2014 focussing on 'healthy living and active ageing' and on 'raw materials'.

FET Flagships differ from all the above initiatives in that they are science-driven research initiatives that are led by scientific communities, while the industrial participation will build up over the duration of the Flagships. Further distinguishing factors are provided in Annex 2.

3 THE FIRST TWO FLAGSHIPS: GRAPHENE AND THE HUMAN BRAIN PROJECT

The Commission selected the first two Flagships, Graphene and HBP, in January 2013. They started operating in October 2013. This section presents the steps that led to their selection and briefly introduces their objectives.

3.1 The selection process of the Flagships

A study on large-scale Flagship-like initiatives, launched by the Commission in 2010, identified as a key success factor the involvement of the research communities in shaping the programmes of such initiatives.[17] The Commission therefore decided to set up an open and bottom-up process led by researchers and their scientific communities for the elaboration of candidate Flagships.

The Commission started this new selection process in early 2010 with an open consultation with the scientific community to share and discuss initial ideas for potential Flagships. Following this, in July 2010 the Commission published a call for preparatory actions, or 'pilots'. Each pilot aimed to develop, over a year, the full blueprint for a Flagship through broad interactions with the relevant scientific communities, industry and other stakeholders. Out of 21 eligible proposals received, the Commission selected six proposals and launched them as pilots in June 2011.[18] Each of the six pilots published a draft blueprint of their proposed Flagship in May 2012.

In July 2012 the Commission opened a second call for proposals for selecting two proposals out of the six pilot topics to be launched as Flagships.

In both these evaluations, a panel of high-level experts including leading scientists, industrialists and specialists from a broad range of disciplines, science and policy advisors evaluated the Flagship proposals. The evaluation was based on S&T excellence, sound implementation plans, and creation of the greatest value for Europe in terms of impact on

[16] http://eit.europa.eu/kics/

[17] FET Flagship study: http://cordis.europa.eu/fp7/ict/programme/fet/flagship/doc/flagshipstudy_en.pdf

[18] The selected proposals were Graphene (2-D materials), HBP (modelling the human brain), Robocom (robot companions for citizens), FuturICT (understanding and managing socially interactive systems), Guardian Angels (zero power sensor systems) and ITFoM (individualised medicine).

science, technology, society and economy.

Subsequent to this, in January 2013 the Commission selected "Graphene" (Graphene-based Revolutions in ICT and Beyond) and "The Human Brain Project", which were announced and hailed in the press as "*winning the largest research excellence award in history*".[19]

Throughout the selection process (May 2010 to March 2013) the Commission received advice from an Experts' Advisory Group consisting of high-level experts with experience in science and technology policy. At the same time, a continuous dialogue was taking place with the MS and AC, through a dedicated working group of their representatives in charge of ICT research.[20]

The main milestones of the Flagship selection process are presented in Annex 3.

3.2 The Graphene Flagship

Graphene, a form of carbon in a one-atom-thick layer, has a great potential to underpin new disruptive technologies, substituting materials used in existing applications and also leading to radically new markets and applications. The Flagship aims to take graphene and related layered materials from the realm of fundamental science to industrial and societal applications in the space of ten years. It will establish a new technology platform that will leverage the advantages of these materials as compared to established materials such as silicon.

Major technological impacts are expected in flexible electronics, high-frequency electronics, novel logic devices, novel spintronic devices but also in domains far beyond ICT. Novel composites, more efficient batteries and new types of sensors are examples of technologies that will benefit from graphene and related materials in a variety of fields of deployment, from energy to automotive technologies, and from chemical processes to aerospace.

The initial Graphene consortium brings together 76 academic and industrial organisations from 17 European countries.[21] Four European Nobel Laureates are participating in the Flagship. The consortium covers areas from quantum physics, material science and chemistry to electronics, engineering and device production.

More information on the Graphene Flagship can be found in Annex 4.

3.3 The Human Brain Project Flagship

Understanding the human brain is one of the key challenges of the 21st century. The Human Brain Project (HBP) aims to combine all existing knowledge and data about the human brain for building a realistic computer model of the brain by 2023. Such model will help researchers understand how the human brain works and the diseases affecting it.

HBP will have a potentially massive impact in areas such as neuroscience, new treatments for brain disease and future brain-inspired neuromorphic computing and robotics technologies.

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[19] http://europa.eu/rapid/press-release_IP-13-54_en.htm

[20] Further information about the Experts' Advisory Group and the group of representatives from the MS and AC (the *National ICT Directors' Working Group*) is available at http://cordis.europa.eu/fp7/ict/programme/fet/flagship/wg_en.html

[21] Following a competitive call, these numbers are expected to increase to 142 partners from 23 countries.

HBP gathers a large consortium of 112 partner organisations from 24 countries, mostly from Europe but also from the USA, Japan, and China and involves world leading experts.[22] It is a multidisciplinary consortium which includes experts in computer science, neuroscience, robotics, micro-electronics, and also in innovation and exploitation, ethics, education, programme management and communication.

More information on HBP can be found in Annex 5.

It is to be noted that each of the specific S&T areas covered by Graphene and HBP is also receiving Commission funding from several other parts of the Union's Research Framework Programmes. In H2020 for example, related research may also be funded from the European Research Council (ERC)[23], NMBP or ICT-Photonics in the LEIT[24] part of H2020, and the Health or the Transport Societal Challenges.[25]

4 THE FLAGSHIP MODEL AND ITS IMPLEMENTATION

4.1 The main features of the model

The model of a FET Flagship is shown in Figure 1 and includes:

- A large ***Core Project*** (CP) serving as the leading project for the initiative.
- ***Partnering Projects*** (PPs), also essential for achieving the Flagship's objectives, and being an integral part of the initiative.

The CP is funded by the Commission. Most of the PPs will be funded by the MS, Associated Countries (AC)[26], and where appropriate, third countries, at national, regional or transnational level. They may also be funded by private funding sources. The CP and the PPs work closely together to realise the Flagship's research roadmap. The general principles of the association between the CP and PPs are described in Section 4.2.3 below. The specific modalities of collaboration between the CP and an individual PP are to be worked out by the involved organisations.

This model serves as a flexible partnering instrument enabling the participation of the key actors in Europe in the Flagship's S&T areas. It is based on a strong commitment of the Commission which attracts matching contributions from the MS, AC and third countries (shortly, *participating countries*).

[22] The coordinator of the FP7 HBP is a Swiss organisation. In FP7, Switzerland is an associated country. In H2020 Switzerland currently is a third country. At the moment of publishing this Staff Working Document, an agreement was under preparation for the association of Switzerland in the Excellent Science part of H2020, which includes Flagships.

[23] http://erc.europa.eu/

[24] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/leadership-enabling-and-industrial-technologies

[25] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges

[26] These are the countries that are associated to the Union's Research Framework Programmes.

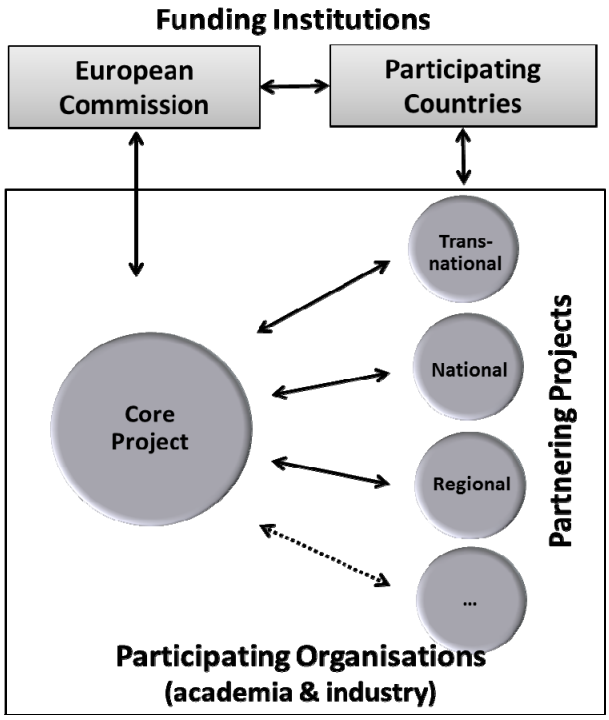

***Figure 1**: The Model of FET Flagships*

4.2 The implementation modalities

Flagships require a dedicated implementation that brings together the main stakeholders involved in a Flagship, namely, the participating organisations (academia and industry), and the funding institutions (the participating countries and the Commission).

4.2.1 The Core Project

The EU-funded CP acts as the driving force of the whole Flagship initiative and ensures its scientific leadership and cohesion. The CP is a 10-year research project that brings together and integrates the efforts of the key participating organisations which commit themselves to establish, maintain and implement the research roadmap of the Flagship.

The CP elaborates and proposes a collaboration framework with the PPs (see section 4.2.2) and is also responsible for defining and implementing some additional key features of the Flagship: the innovation strategy and collaboration with industry; the communication strategy and the contribution to education and training; the progress monitoring mechanisms; and, the responsible research and innovation agenda, including the citizens' engagement. All these features are part of the so-called *Flagship Action Plan*.

In order for the Flagship to realise its ambitious research roadmap, the CP requires:

- A stable financial framework for the whole duration of the Flagship, well beyond the 3-year average of standard EU-funded projects;
- A consortium composition which remains fairly stable over the lifetime of the initiative.

The Commission will provide this stable environment for the CP by establishing a Framework

Partnership Agreement (FPA)[27] with the organisations which form the CP consortium. The FPA covers the full duration of H2020, formalises the long-term commitment, roles and responsibilities between the CP consortium and the Commission and describes in detail the Flagship Action Plan. It is however not possible for the Commission to provide a single budgetary commitment for the whole duration of a Flagship initiative. This is one of the main challenges of supporting such long lasting initiatives with the available tools. To make its FPA commitments compatible with the budgetary programming constraints of H2020, the Commission will invite the CP consortium approximately every 2 years to submit a new proposal for funding the implementation of the next phase of the Flagship Action Plan. The scope and specific activities that such proposals need to address are defined in the H2020 work programmes. While this will necessitate additional efforts both for the CP consortium to submit such proposals and for the Commission to evaluate them, it provides at the same time the opportunity for the CP consortium to:

(i) Update and revise the research roadmap, which has to be a living document to ensure that maximum possible benefits are drawn from new ideas and S&T progress, as these emerge both outside and inside the Flagship;

(ii) Partially evolve its composition and structure to cope with the evolving implementation needs. The evolution of the CP consortium needs to follow open, transparent and fair criteria. The Commission will invite the CP consortium to put in place provisions for openness and evolution.

4.2.2 The Partnering Projects

The PPs are an integral part of the Flagship and contribute to the implementation of its research roadmap. Their role may vary from executing research in specific S&T areas of the research roadmap, by complementing or extending the ones covered by the CP, to focusing on technology transfer activities and to creating new innovation opportunities. PPs are essential for the success of the Flagship: they bring new knowledge, competencies, ideas and resources to the Flagship and will reinforce its scientific directions and leverage its innovation and exploitation potential. By connecting to the Flagships, researchers will benefit from outstanding scientific collaborations and participating countries will reinforce their own technological excellence and expertise over time.

Candidate PPs may be regional or national projects funded by the participating countries or other projects supported by private funds that are addressing S&T areas relevant to the Flagship. They may also come from dedicated transnational calls the scope of which is agreed between the CP and the participating countries. PPs can also originate from individual organisations that demonstrate their potential for concrete contributions to the Flagship. Projects funded in other areas of the EU research programmes, such as in the Industrial Leadership or Societal Challenges parts of H2020 or the ERC, may also become PPs.

Participation mechanisms of PPs in the Flagship: The CP needs to ensure the participation of external projects and their integration as PPs in the Flagship.

[27] See H2020 FET work programme 2014-15, http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-fet_en.pdf

The CP will elaborate the general modalities of its association with PPs and highlight the benefits of partnering. Such modalities will address, in particular:

- The PP selection process and selection criteria that are clear, open, fair and transparent;
- The respective roles and responsibilities of the CP and PPs that ensure an effective integration of the PPs in the Flagship. The aim is to create reciprocal value while preserving the coherence of the Flagship and building a sense of community.

The Commission and the participating countries will approve these modalities before they are widely published.

Projects selected through dedicated transnational calls are de facto candidate PPs. Other candidate PPs will submit directly to the CP their applications to join the Flagship. The final acceptance is to be done by the CP consortium. Once selected, the exact modalities and conditions for the collaboration between each PP and the CP are then to be jointly elaborated by the relevant stakeholders.

The Commission and the participating countries will monitor both the outcome of the PP selection process and the integration of the PPs in the Flagship.

4.2.3 Integration of efforts

Flagships involve hundreds of research groups from the participating countries and beyond. Their coordination is a major challenge for the Flagships and will very much depend on the effective integration of efforts both within the CP and between the CP and the PPs:

– ***Integration of efforts in the CP:*** Each CP involves the participation of dozens of different CP partners calling for an efficient and effective integration of their efforts. This is being addressed by setting up a management framework that: (i) allows the project leaders to constantly check the work plan execution, be informed of any potential deviations and evaluate the Flagship positioning with respect to the state of the art; (ii) uses project collaboration platforms that enable efficient team development and sharing of results, including both the CP and PP partners; and (iii) allows the project management team to continuously assess progress achieved through a well-defined project monitoring scheme based on Key Performance Indicators (KPIs).

– ***Modalities of association between the CP and PPs*** need to be developed to ensure that all partners are integrated in the initiative in a meaningful way. The exact modalities, terms and conditions of such collaboration, including the rights and obligations and the management of jointly developed intellectual property, between the PP and CP partners are to be jointly elaborated by the relevant stakeholders.[28] Their principles will be: (a) to preserve the coherence of the initiative and build a sense of community; (b) to allow for collaborations that bring reciprocal value to the parties and truly contribute to the Flagship implementation; and, (c) to reinforce the interest, alignment and contributions of national/regional programmes to the Flagship. In addition, the management framework of the CP will include representatives from the PPs so that they can contribute to the

[28] This may result in the signature of an agreement between the relevant partners of the CP and the PP involved in such collaboration.

evolution of the research roadmap of the Flagship and to an effective integration of PPs in the Flagship.

External advisory groups may provide additional assistance on the above.

4.3 The roles of the different stakeholders

The roles and responsibilities of the main stakeholders involved in a Flagship, namely the participating organisations (academia and industry), the Commission and the participating countries are as follows:

- ***The participating organisations in a Flagship:*** By becoming part of a Flagship, research organisations and industry endorse the overall goals of the initiative and commit to work together to realise the Flagship Action Plan. By setting up collaborations between research teams, sharing resources and exchanging results, they create the conditions for fostering and bringing together research talent across Europe. In addition to the funds they receive from the Commission and/or the participating countries, the participating organisations co-finance their activities and provide in-kind contributions to the Flagship, e.g. in the form of access to infrastructure, experimental facilities and equipment, etc.

- ***The Commission*** will sign an FPA to formalise its long term commitment to work with the CP consortium along the agreed Flagship Action Plan. The FPA will create a stable and structured environment, enabling (i) the funding of the implementation of the successive phases of the Flagship Action Plan and (ii) the collaboration frameworks between the CP and the PPs throughout the lifetime of the Flagship.

  The Commission expects to invest half of the Flagship's budget, i.e., around half a billion Euros over the entire duration of a Flagship. In H2020, the Commission funding is subject to several factors such as: budget availability; quality of the proposals submitted by the CP consortium every two years; and, performance of the Flagship.

  The Commission will work closely with the participating organisations and countries to create the conditions for the Flagships to be successful and maximise their benefits and impact, in particular an appropriate governance structure (cf. Section 4.4 below). The Commission will also monitor the progress of the Flagships, and ensure that they are in line with other EU policies where appropriate (e.g. open data strategy, responsible research and innovation, gender equality, citizens' engagement, etc.).

- ***The participating countries*** *(MS, AC and where appropriate, third countries)* coordinate their activities and foster participation and association with the Flagships of individual researchers, organisations or projects that they support through their national or regional programmes and/or through dedicated transnational calls.

  The Commission expects that the participating countries together with private funding sources will contribute the other half of the Flagship's supporting funds. The contribution of the participating countries to the Flagships will come mostly through regional or national programmes and dedicated transnational calls. The Commission may facilitate the participation and engagement of the participating countries in the Flagships through a dedicated activity that can be supported under the H2020 work programmes (in the form

of an ERANET action[29] or similar) for bringing together participating countries to support the Flagships. Such activity will further help the participating countries to:

- Identify or fund key projects at national or regional level that can become PPs of the Flagship;
- Prepare the launch of transnational calls or any other joint funding activity related to the S&T areas of the Flagships that could result in selecting PPs for the Flagships. The scope of such transnational calls is to be defined by the participating countries in close cooperation with the CP consortia.

The participating countries can also support the creation of national antennas and dedicated mechanisms[30] to increase awareness about the Flagships, and facilitate the creation of cooperation opportunities between the national players and the CP consortia. Finally, by linking to support mechanisms of the structural and investment funds[31], MS and Regions have another means to strengthen their support to the Flagships including through their Regional Smart Specialisation Strategies.[32]

4.4 The governance structure of the Flagships

A governance structure that reflects the multi-faceted multi-stakeholder character of the Flagships is necessary to implement them in a well-coordinated manner. The governance will allow for efficiently making decisions, both strategic and operational, for assessing the overall progress of Flagships and for making optimal use of funding and resources. The governance structure is illustrated in Figure 2 and includes:

- A *Framework Partnership Board (FPB),* linking the Commission and each of the EU-funded CP consortia. FPB provides the mechanisms to discuss the commitments of the participating organisations and the Commission to the Flagship. It will mainly contribute to maintaining relations of mutual co-operation and regular and transparent exchange of information between the CP consortium and the Commission on the planning, implementation and follow-up of the Flagship activities funded by the Commission and on any other matter of common interest. Representatives of the PPs who participate in the management framework of the CP will also be invited to attend the FPBs.

  Examples of subjects that FPB meetings will be addressing include: planning and implementation of the Flagship and execution of its activities as defined in the Flagship Action Plan; identifying new relevant H2020 work programme activities; discussing the collaboration framework, selection and integration of PPs within the CP; international collaboration aspects, etc.

  Two FPBs will be set up, one for Graphene and one for HBP.

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[29] For ERANETs under FP7, see http://ec.europa.eu/research/fp7/index_en.cfm?pg=eranet-projects-home. Their continuation in H2020 is the ERANET Cofund actions.

[30] Examples are the Knowledge Transfer Networks in the UK, the "Groupement de Recherche du CNRS" in France, etc.

[31] See "Financial instruments in ESIF programmes 2014-2020 – A short reference guide for Managing Authorities", http://ec.europa.eu/regional_policy/thefunds/fin_inst/pdf/fi_esif_2014_2020.pdf

[32] http://ec.europa.eu/research/regions/index_en.cfm?pg=smart_specialisation

- A *Board of Funders,* bringing together representatives from the participating countries and the Commission with the purpose of programming of activities in support of the Flagships.

  The role of this Board is essential for defining and planning the financial support to the Flagships for their whole duration. The Board Members will discuss the overall progress of the Flagships and will exchange information on European, national and regional activities in the areas of the Flagships. They will address the orientation and funding possibilities of their respective programmes and their synchronisation with the aim to maximise synergies and help Flagships meet their objectives. They may also focus on the selection and integration mechanisms of PPs within the Flagships. Representatives of the CP and PP Consortia will be invited to participate to the Board meetings, as appropriate.

  The Board will help to promote an environment that stimulates innovation by linking the S&T developments to innovation policies at national and European level.

  The Board is to be co-chaired by the Commission and the participating countries, which need to be represented at the right policy level where decisions about national programmes and budgets are planned.

- A *Flagship Governance Forum* (FGF), linking the Commission, the participating countries and representatives from the CP and PP consortia. The FGF has the form of a non-binding discussion forum which aims at achieving an efficient inter-working and synchronisation of the main stakeholders involved in the implementation of the Flagships and their respective activities. The FGF contributes to the development of a common European effort around the Flagships. It supports their further development, stimulates synergies between the CPs, PPs and related activities funded at regional, national, transnational or European level and promotes their innovation potential. Examples of subjects that FGF meetings may be addressing include:
  - Overall progress of the Flagships and their positioning with regards to the advancement of research in related S&T areas and to relevant international initiatives;
  - Hosting discussions (in the form of open forums) that are related to scientific, governance, or other aspects of relevance to the Flagships. Such discussions will be open to all, whether or not they are part of the Flagships.
  - Education and training activities, international cooperation aspects, etc.

  The FGF will cover both the Graphene and the HBP Flagships, and may meet in different configurations according to the agenda topics under discussion.

  The stakeholders will nominate their representatives at the appropriate level for best representing themselves in the FGF. The FGF is to be co-chaired by the Commission and the participating countries.

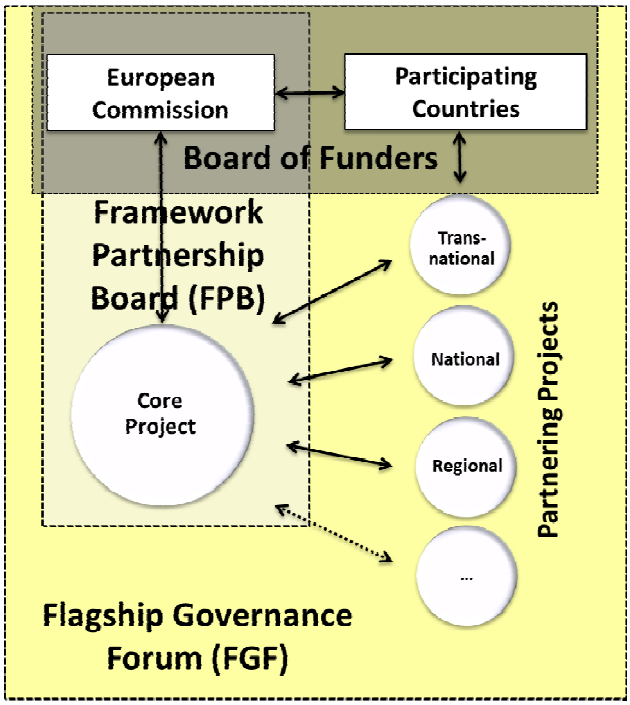

***Figure 2**: The Governance structure of Flagships*

The specific terms of reference that describe in detail the mandates of these governance structures will be defined in due course and in close collaboration with the stakeholders.

Status of the implementation of the two Flagships, Graphene and HBP

The implementation is at an initial stage. So far, the Flagships consist of two FP7 projects, which undertake the ramp-up phase of the Core Projects.

In addition, an FP7 ERANET action, FLAG-ERA[33], has been launched, bringing together funding agencies from more than 20 participating countries in support of the two Flagships. Its objective is to enhance complementarities and synergies of national and regional research programmes, create a discussion forum between these funding agencies and launch joint calls that address the research roadmaps of the Flagships. Within FLAG-ERA, the participating countries are about to launch a transnational call covering the areas of the two Flagships. The FLAG-ERA project will end in 2016. A new action in the form of an ERANET Co-fund instrument or other may then be included in the H2020 work programme 2016-2017 for continuing MS support to the Flagships.

Following an H2020 call for proposals for FPAs, the Commission expects to sign partnership agreements with the two CP consortia by the first quarter of 2015. Then, as detailed in the H2020 work programme 2014-15[34], the Commission will invite the selected consortia to submit their proposals for continuing the support for the CP in the second quarter of 2015. It is planned that the renewed contracts of the two CPs will be signed early 2016, just before the completion of the two FP7 projects, to ensure continuity in the implementation of the research roadmaps. Invitations to submit proposals for the next funding round of the CP will be made

[33] http://flagera.eu/

[34] See http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-fet_en.pdf, under "Other Actions, FET Flagship Core Projects, pp 30-32.

in the context of the H2020 work programme 2017-2018.

Both Flagships are now working on defining the modalities of association of the CP with the PPs, which will soon be published. The Flagships are also working on identifying the first PPs whose integration in the Flagship will serve as an example for other candidate PPs. The FPAs of both Flagships will include a number of rules and procedures for selecting PPs and working in synergy with them.

As for the **governance structure**, so far only the internal governance of the two FP7 projects is in place and a first instantiation of the Board of Funders implemented via the FLAG-ERA project.[35] The FPB and the FGF are under discussion with the involved stakeholders: The FPB is agreed and will be established and start operating within 2015, soon after the signature of the FPAs. As for the Board of Funders and the FGF, they are now being defined with the participating countries and the Flagship Consortia and are also expected to become operational within 2015.

5 KEY FEATURES OF THE FLAGSHIP ACTION PLAN

This section describes the key features of the Flagship Action Plan: the innovation strategy and collaboration with industry; the communication and dissemination strategy; the education and training agenda; the responsible research and innovation agenda; and, the collaboration mechanisms with other related European and international initiatives.

The CP is expected to play a leading role in implementing all these features, given its critical mass of resources and the long-term perspective and stability it brings to the whole initiative. PPs will bring a substantial contribution to all these features, e.g. in creating concrete innovation opportunities.

5.1 Engaging with industry – Boosting innovation in Europe

While Flagships are part of the FET programme and are science-driven, they have also been designed, from the outset, as initiatives that contribute to Europe's innovation and growth. Consequently, Flagships will develop and implement an effective strategy to seize exploitation opportunities and generate increasing economic and societal returns in Europe. Such an innovation strategy is an integral part of the Flagships and will be put in place from their early development stages. The strategy has to encompass all those activities which capture and transfer knowledge (in the form of patents or know-how), skills and competencies so that these move swiftly from research labs to industry in Europe and from there to new market products and services. The innovation strategy of the Flagships builds around three main strands of activity:

(i) ***Identifying innovation together with an IPR and data management policy***. Flagships will have mechanisms for systematically identifying early innovative ideas (e.g. screening for ideas, assessing their value, enabling their use), and for protecting this knowledge and taking these ideas efficiently through the necessary steps until their further uptake and exploitation.

Flagships will develop a plan for IP management, including patents, to properly protect all those inventions and assets susceptible of industrial application. Their IPR policy will

[35] In Flag-ERA, this Forum is now called Flag-ERA National representative Board.

cater for collaboration needs with industry, by allowing combining different IPRs through suitable licencing policies. Flagships will also provide incentives for participating organisations and individual researchers to either disclose or protect their inventions, based on an exploitation strategy that takes into account the relative benefits of these options.

A data management plan is another essential component for the Flagships in line with the Open Access rules of H2020.[36] It needs to strike a balance between protecting innovative ideas (respecting the rights of those who own IPR) and opening access to data and results that stimulate the creativity of a much wider group of researchers and technologists.

(ii) ***Seeding innovation***: Flagships will put in place action plans for stimulating the entrepreneurial skills of individual researchers and give them incentives to innovate in Europe.[37] They can help them negotiate licencing agreements with industry or create their own start-ups, for example by linking to technology transfer offices and venture capitalists. Creating novel types of incentives for researchers is crucial for creating new dynamics between academia and market opportunities.

(iii)***Attracting industry and stimulating collaboration and technology transfer*** through appropriate schemes such as: Industrial liaison mechanisms for attracting the interest of Europe's industries and in particular SMEs in innovative results; joint collaboration structures for knowledge exchange and coordination[38]; collaboration platforms based on open innovation models, stimulating joint project development as a means for effective technology transfer helping external industry actors to design new products and processes through their interaction with Flagships; etc. A key element for each of these schemes is to ensure that those companies in Europe are engaged which have both the capacity and commitment to exploit the Flagship's results.

Innovation Strategy: examples from Graphene

Graphene organises *Graphene Connect*, a series of industry workshops aiming to help companies understand the potential for products with the goal of initiating future collaborative innovation projects within the flagship frame. Graphene also actively engages with SMEs and spin-offs. A database of IP (in particular patents) generated in the Flagship will be used to focus research efforts better and identify licensing opportunities. There is also a structured engagement with venture capitalists and technology transfer offices of the participating institutions to foster exploitation of results.

Innovation Strategy: examples from HBP

HBP is establishing different strategies: (i) PPs with industries on advancing or using the platforms for novel R&D; (ii) an Internet site that aggregates IP owned by HBP partners and semantically matches them to a database of European industries related to neuroscience, medicine, computing and ICT in general, triggers automatic alerts informing industry about

[36] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

[37] Researchers of the Flagships could also apply for specific H2020 Marie Skłodowska-Curie research training actions which cover such aspects.

[38] For example, such activities could also be supported by H2020 Marie Skłodowska-Curie actions that finance short term exchanges of staff between industry and academia.

HBP's IP basket and explains the process and models for licencing the IP; (iii) An on-line service centre where industry can apply to use the HBP Platforms or access HBP expertise to meet specific needs; (iv) Thematic and national *Technology Innovation & Prototyping Hubs* for young entrepreneurial scientists, clinicians and engineers formed in collaboration with national governments; and (v) Dedicated VC funds to drive start-up company formation. HBP brings the full spectrum of expertise and initial IP, serves as incubators to develop products and services, and prepares business concepts, strategies, and plans, In addition, HBP will work with WIPO[39] to increase IP awareness and strategy amongst researchers and hold regular industry information days.

5.2 Communication and dissemination strategy

An effective communication and dissemination strategy is essential for Flagships. It needs to involve a broad range of stakeholders, particularly researchers, industry, policy makers and the general public. Such strategy can also support the achievement of other Flagship activities, like innovation, education and training or responsible research and innovation.

The participating organisations, the Commission and the participating countries have a shared responsibility to the Flagship's communication strategy. This includes developing their own communication strategies and coordinating with each other to make sure messages are coherent and to obtain an amplification effect.

All Flagship communication channels need to be used to create and promote a strong EU identity and branding name for the Flagship. These channels will have to go well beyond the traditional scientific dissemination means. They will include dedicated web sites; scientific workshops and conferences (including a yearly open conference where all stakeholders are invited to attend); targeted workshops for industry and policy makers; demonstrations and exhibitions, etc. In order to address the general public, in particular those with a certain scientific education or interest, Flagships need also to put in place tangible examples about the S&T challenges they address and how their solution can improve the daily life of European citizens. Flagships activities will also have to target the science and technology section in newspapers and popular science magazines, traditional and social media (including targeted newsletters, press releases, blogs and videos), and presence at large technology fairs and public conferences and lectures organised by museums.

Overall, the Flagships will greatly benefit from engaging prestigious ambassadors, such as Commissioners, Members of the European Parliament, high-level politicians or other emblematic persons in the participating countries, with the role of championing the potential of the Flagship for European, national and regional economy and society.

Communication: examples from Graphene

Graphene uses traditional, digital and social media to communicate and engage with its stakeholders. Its web portal will cover publications and patents for the flagship community and a newsroom for the general public. In addition to the organisation of an annual conference, winter schools and industrial workshops, Graphene has a series of activities developed by scientific and industrial partners for broader and more illustrative presentation

[39] World Intellectual Property Organisation, www.wipo.int/

of up-to-date graphene research and its future applications. It includes interactive graphene activities for children and adults, education tools for school children, public lectures as well as exhibitions at museums.

Communication: examples from HBP

HBP results are largely oriented towards the use of HBP's innovative IT platforms by European and wider communities of scientists, industrialists and healthcare providers. Such results will be communicated and discussed with these stakeholders mainly through scientific publications and conferences (e.g., during the annual thematic HBP conference), but also through the information capabilities of the integrated web-portal of these IT platforms. HBP will also communicate to policy makers via specific conferences and to the general public using online, TV and paper media (including special material for children), science museums, and a specific programme of activities for education and ethics.

5.3 Education and training

Flagships will develop dedicated educational and training programmes with the objective to attract new talents and secure, over the years, the knowledge, competencies and skills needed within the initiative in all its dimensions: S&T, innovation, dissemination of knowledge, responsible research and innovation, etc.

Flagships will develop dedicated educational and training programmes in the S&T areas they address. Such programmes will result in new academic curricula or in complementing existing ones, with particular focus on multi-disciplinarity, and in the validation and deployment of these programmes in the participating countries. In doing so, Flagships will make use of all relevant resources, including those at EU level, such as the possibilities offered by the Marie Skłodowska-Curie actions and the European Institute of Innovation & Technology.

Flagships will also be working closely with industry for developing dedicated training programmes targeting industry players, helping them acquire new competencies and skills they need for turning Flagship results into successful market innovations.

The education and training agendas will be complemented by communication actions targeting young people (via e.g. schools, science museums and general and specialised media), in order to encourage them to take up an S&T career.

Education and Training: examples from Graphene

Graphene has a number of initiatives to address education and training at different levels. One of these is *Graphene Study*, a series of winter-schools that allow students to benefit from the knowledge of Europe's top researchers in a short amount of time. A second initiative is *Graphene Connect*, a series of training workshops aimed at engaging technologists and at helping company engineers understand the potential for new graphene-based products.

Education and Training: examples from HBP

HBP is organising a large-scale programme of multidisciplinary education, the *HBP curriculum*. HBP is developing knowledge streams across the disciplines to define the HBP Curriculum and guide young scientists through the many new avenues of multidisciplinary R&D. Using a spectrum of innovative forms of on-line education, the programme focuses on the convergence between ICT, biology and medicine and will prepare a new generation of

researchers capable of working in domains crossing neuroscience, medicine and computing. The programme also provides the specialist training for making effective use of the HBP IT Platforms. It includes detailed user material, mandatory lectures and workshops on innovation including responsible innovation for all PhD candidates participating in HBP-related research and similar training to more senior researchers. Formal on-line examinations and a multi-university certification process are foreseen. Recruitment of new HBP students will be based on on-line testing of performance on the HBP IT Platforms.

5.4 Responsible research and innovation

Dialogue with society, ethics and safety are of paramount importance for the Flagships. Flagships will make sure that their activities, their data, and the way such data are used, comply with applicable ethics and safety rules, and that, when necessary, appropriate contacts with local or national ethics and/or data protection authorities are established.

Monitoring and control will be complemented by awareness raising, communication, training and support activities towards all the participants of the Flagship. In addition, a high-level external monitoring will be set up, aiming at advising on potential broader issues, including the identification of areas where currently established rules do not adequately apply or where no rules yet exist.

The Flagships need to engage not only with specialists but also with the organised civil society and the public, through consultation and dialogue, in order to verify and support the Flagship goals and approach and, in particular, the related socio-economic and ethical dimensions. Dedicated campaigns could help increasing citizens' awareness, gain their support, obtain their feedback on research directions or even enable them to participate actively in the research. If this engagement reveals new issues, the project objectives will be revised and/or protective measures put in place regarding take-up and deployment.

An in-depth understanding of men and women’s needs, behaviours and attitudes contributes to the scientific quality and societal relevance of produced knowledge, technologies and innovations. Therefore, the Flagships will also consider and promote the gender dimension in research content, wherever relevant.

Flagships will also liaise with the responsible research and innovation efforts deployed in other large initiatives and resources developed via the Commission and MS funding, e.g. under the "Science with and for Society" programme of H2020.

Responsible Research and Innovation: examples from Graphene

Graphene has set up a dedicated work package "Health & Environment" to systematically identify any possible hazard to living organisms resulting from exposure to graphene and related layered materials. Partners are engaged in the activities of the European Nanosafety Cluster and the project abides to safety precautions referred to in existing guidelines, while ethics rules are followed for toxicity assessment with animals and human cells.

Responsible Research and Innovation: examples from HBP

HBP has established two levels of control, one addressing the wider prospective uses of the projects results and a second one, dealing with the activities carried out within the initiative:

- HBP has established a foresight lab for analysing industrial, economic and social consequences of foreseen results. It has also started a philosophical analysis on the implications of the research on our understanding of the mind and consciousness. HBP will run on-line debates and conventions for engaging with the general public, and set up dedicated fora for dialogue with specific stakeholders. An external advisory *Ethical, Legal and Social Aspects Committee* is supporting all these activities.
- Regarding its direct R&D activities, HBP has set up an independent team for ethics, reporting directly to all levels of the management structure, and which, as part of their monitoring, maintains a registry of tasks requiring ethics control and of their approval. This internal group is complemented by an external advisory *Research Ethics Committee*.

5.5 Collaboration with other European and international initiatives

Flagships are evolving in a wider research context where other European and international initiatives exist.

At Union level, relevant large scale initiatives exist mainly in the form of public-private and public-public partnerships. Wherever relevant, Flagships will establish collaborations with these initiatives to benefit from all possible synergies and to fully play their role of globally leading research initiatives. Such collaborations are expected to have a large leveraging effect in particular on the innovation and exploitation potential of the Flagships.

At international level, other Regions of the world have initiatives relevant to Flagships. Where there is strategic value and reciprocal benefits, the Commission will promote the establishment of international collaboration agreements with such Regions, within a context of creating wider coalitions for addressing the global scientific challenges of a Flagship. Agreements will be based on the prior identification by the scientific community of specific areas for S&T collaboration. Such agreements need to properly consider industrial competitiveness issues, especially when European industry participating in a Flagship is involved. The Commission will promote a collaboration scheme whereby each Region finances its own organisations. For reasons of industrial competitiveness, collaboration outside the Union is likely to focus mainly on advancing research components of the Flagships. There have been indications of a significant interest from third countries such as the USA, Japan, China, Korea, Canada and Singapore for the activities being developed by the two current Flagships.

European and international collaborations: examples from Graphene

In Europe, large-scale initiatives like ECSEL[40] or the photonics PPP[41], national programmes like GRAF-TECH in Poland[42] and projects including those funded through the NMBP LEIT part[43] of H2020 are being considered for collaborations by the Graphene Flagship.

Initial contacts are in place with international activities in the USA, Korea, China and

[40] http://ec.europa.eu/digital-agenda/en/time-ecsel

[41] http://www.photonics21.org/

[42] http://www.ncbir.pl/en/domestic-programmes/graf-tech/

[43] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/nanotechnologies-advanced-materials-advanced-manufacturing-and-processing-and

Singapore, mostly at the level of researchers. Collaborations with researchers in China are also developing rapidly. Options for collaboration with the US are being pursued, possibly following up on the Materials World Network action of the National Science Foundation in the USA.[44]

European and international collaborations: examples from HBP

HBP is considering collaborating with European initiatives like IMI[45], AHA[46], JPND[47] and the HPC PPP.[48]

HBP and the US BRAIN initiative[49] are in discussion for a joint cooperation programme. One or more workshops are to be held in 2015, with the aim to explore concrete areas of collaboration like scientific exchange of ideas, data and models, common use of infrastructures, and data and ethical standards. HBP will also investigate the potential of cooperation with Japan and China.

6 MONITORING THE PROGRESS OF THE FLAGSHIPS

Each Flagship will put in place an effective management and monitoring framework to regularly assess progress and achievements along its research roadmap and to monitor that the work is delivered on time, on budget and with the required quality. This framework is based on well-defined objectives, activities, milestones, risk assessment and adequate resources, as well as on a set of key performance indicators (KPIs):

- Monitoring includes quality assurance against specifications, analysis of validation results, and discussion on any relevant issues (e.g., level of integration of PPs in the Flagship). It is based on separation of roles, including peer-review mechanisms and external advice for discussing project global results, outcomes of the control and trajectory adjustments, wherever required.

- To facilitate the monitoring, independently verifiable KPIs will be defined for assessing all the activities of the Flagship Action Plan, i.e., research roadmap execution (progress in related work packages and tasks), innovation and communication strategies, etc. Examples of generic KPIs for such activities include: number of PPs participating in the Flagship and quality of their integration, number of PhDs engaged and delivered, number of patents or licenses granted; number of effective technology transfers to industry; number of research projects launched jointly with industry; number of new companies created; number of publications and their impact; number of trained specialists taking jobs in industry; number of collaboration agreements with other European or international initiatives, etc. These KPIs will be complemented by specific KPIs that relate to the technical area of each Flagship.

[44] http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12820

[45] http://www.imi.europa.eu/

[46] http://ec.europa.eu/research/innovation-union/index_en.cfm?section=active-healthy-ageing

[47] http://www.neurodegenerationresearch.eu/

[48] http://www.etp4hpc.eu/

[49] http://www.nih.gov/science/brain/

The Commission will complement the internal monitoring of each Flagship by regular project reviews with the use of high-level experts who examine the outcomes of the internal monitoring and assess the strategic level achievements and bottlenecks for progress. These reviews will also assess the continued relevance of the research roadmap in the light of the development of the field. In addition, in 2017 the Commission will undertake an interim evaluation of the two Flagships, including their governance and implementation mechanisms as these are defined in this document.

7 FIRST LESSONS LEARNED AND NEXT STEPS

Flagships have been designed to be true European science partnerships that will cut across different national and European programmes and unite Europe's brightest researchers in the pursuit of ambitious goals at the frontiers of scientific knowledge. They have been designed as a new type of partnerships that jointly address the needs for the Union to increase investments in foundational research; make research and innovation funding across the Union more efficient by creating synergies and a coordinated planning between European, national and regional activities; and, bridge the gap between fundamental research and innovation, as a means to ultimately boost the innovation ability and competitiveness of Europe's industry.

The ***Flagship selection process*** was completely new and challenging for the Commission. It necessitated a lengthy consultation and preparation phase that lasted almost four years. Overall, however, it was justified by the scale of the ambition at stake and was implemented through an open and transparent way, in cooperation with the MS. It was based on a bottom-up approach that involved, during its preparation, many different scientific communities that developed the foundations of initiatives, including complete and detailed roadmaps, forming the basis for selecting and launching well-prepared Flagships. The Commission considers this selection process to be a success.

In order to realise the Flagship model and its implementation described in this document, the following aspects are essential:

- ***Support of the participating countries*** to realise the overall Flagship objectives. The Commission expects that the participating countries together with private funding sources will provide half of the Flagship budget, by financing the PPs of the Flagships. So far, the involvement of the participating countries is very encouraging. Representatives from more than 20 research ministries and national and regional funding agencies are participating in the ERANET action which the Commission is funding under FP7. They share information on relevant programmes and initiatives and are about to launch a transnational call covering the areas of the two Flagships. A new action in the form of an ERANET Co-fund instrument or other may then be included in the H2020 work programme 2016-2017 for continuing MS support to the Flagships.

- ***Stability and openness of the CP consortia over time***: At the very heart of the Flagship model is the selection of an excellent consortium able and committed to implement the CP and through it, the whole initiative. At the same time, such CP consortia need to partly evolve over time, as their research roadmap evolves and new needs arise.

  The FP7 ramp-up phase of the Flagships was designed with the possibility to add more project partners in well-defined S&T areas for strengthening the CP consortium's skills and expertise in those areas. The selection of new partners was done through competitive

calls for proposals, which attracted a large number of proposals: both in the case of Graphene and HBP, the selection rate was in the range of 1:10 to 1:15 in terms of proposals submitted versus retained. This shows the huge demand and expectations from interested academia and industry teams all over Europe to join the Flagships.

Although H2020 does not include provisions for competitive calls within ongoing projects[50], there are two main ways introduced in the Flagship model to create wider partner coalitions needed for the success of the Flagships.

- The CP consortia put in place their own provisions for openness and evolution. This is expected to be done every two years, when the Commission will invite the CP consortia to submit their proposal for implementing the next phase of their (revised) roadmap.
- The CP consortia build collaborations with Partnering Projects.

The ability of the Flagships to create such wider coalitions both with interested potential partners but also with industry to exploit the huge potential they will have created will be a critical dimension for their success.

- ***The innovation potential*** of the Flagships is very high as this is shown by the number of industry companies that are already CP partners (in Graphene, 25% of the partners) or by the targeted large industrial sectors (for example, pharmaceutical industry in HBP). It is expected that industry will play an increasing role in the Flagships as these further develop. This will be reflected in the evolution of the CP consortia and/or in the PPs, which are expected to increasingly focus on technology transfer activities as the flagships reach their final phase.

- ***The international collaboration potential*** of the Flagships is also very high. This is demonstrated by an increasing interest from the USA and many other industrialised countries to establish cooperation agreements with the Union in the S&T areas covered by the Flagships. The Commission expects that a number of such international collaborations will be initiated and launched in the next two years, covering both Flagships.

The overall Flagship implementation framework described in this document is only at a preliminary stage of establishment. The Commission expects to have the full framework in place in the course of 2015. This framework, and in particular its governance structure, will be regularly assessed by the Commission in close cooperation with all the involved stakeholders and may evolve so as to best achieve the Flagships' objectives.

In 2017 the Commission will undertake an interim evaluation of the two Flagships, including their implementation and governance framework. This evaluation will be carried out by an external Panel of high-level Experts. The results will be used to critically assess the Flagships model and their implementation but also to possibly help define new Flagships.

[50] If necessary to achieve the objectives of the project, the CP consortium may propose to provide financial support to third parties for specific types of activities. These are so-called cascading funds under H2020. Examples of specific activities that could be covered here include: mobility of PhD candidates, dedicated experiments, small-scale technology transfer actions, etc.

ANNEX 1: LIST OF MOST USED ACRONYMS IN THE STAFF WORKING DOCUMENT

AC: Associated Countries

CP: Core Project

FET: Future and Emerging Technologies

FGF: Flagship Governance Forum

FPA: Framework Partnership Agreement

FPB: Framework Partnership Board

H2020: Horizon 2020

KPIs: Key Performance Indicators

MS: Member States

PPs: Partnering Projects

R&I: Research and Innovation

S&T: Science and Technology

ANNEX 2 - COMPARISON BETWEEN EU PARTNERING INSTRUMENTS

Partnering instrument	Objective	Agenda setting	Implementation
FET Flagships	To address grand S&T challenges and to create the conditions for translating risky, exploratory research into innovation	Scientific community	- Long-term partnership between the EC and a specific consortium - Roadmap-based initiative led by a large EU funded project coordinated with national/regional programmes
Public-Private Partnerships (PPPs) *are undertaken* ***jointly*** *by the* ***EU*** *and other* ***public entities*** *together with* ***industrial and academic partners*** *to strengthen Europe's industrial leadership and leverage R&I investments in a specific area.*			
Joint Technology Initiatives (JTIs)	To strengthen European industrial leadership in key areas of industrial research	Industry-driven	- Joint Undertaking under Art. 187 TFEU, mainly implemented through open calls for proposals
Contractual PPPs	To strengthen European industrial leadership in key areas of industrial research	Industry-driven	- Contractual arrangement between the EC and (mainly) industrial partners implemented through open calls for proposals based on strategic research and innovation roadmaps
Public-Public Partnerships (P2Ps) *are undertaken* ***jointly*** *by the* ***EU*** *and national level public payers (****ministries & national/regional funding bodies****) to align national strategies, helping to overcome fragmentation of public research effort.*			
ERA-NET Cofund	To coordinate national research programmes and enable joint funding in agreed R&D areas by MS	MS	- Jointly defined trans-national call for proposals and coordination of national activities, with top-up funding from the EC
Art 185 initiatives	To integrate national and European research programmes in specific research areas	MS	- EC contributes matching funds to implement the joint programme agreed by the MS
Joint Programming Initiative (JPI)	Coordinate/integrate national research programmes to address a societal challenge	MS	- EC supports MS networking and Strategic Research Agendas when in line with H2020

Other types of partnerships			
EIT's Knowledge and Innovation Communities (KICs)	To boost innovation by fostering the integration of higher education, research and innovation to address societal challenges	Higher education, research and business actors	- Long-term partnership between higher education, research, and business actors - Long-term strategy, business plan and portfolio of activities approach
European Innovation Partnerships	To speed up innovation addressing societal challenges acting across the whole research and innovation chain	EC in collaboration with stakeholders	- Framework bringing all relevant stakeholders across the whole R&I cycle, integrating and coordinating existing initiatives and instruments.

ANNEX 3
PREPARATION AND SELECTION OF THE FIRST TWO FLAGSHIPS – CHRONOLOGY OF MAIN EVENTS

April 2009	EC Communication 'Moving the ICT frontiers', COM(2009) 184
July 2009	Report of the ICT Advisory Group (ISTAG) on FET Flagships
December 2009	Endorsement of the FET Flagship Initiatives by the Competitiveness Council of the European Union; Opening of online consultation for ideas
January 2010	Start of the FET Flagship study exploring options for legal and operational frameworks
Early 2010	Open consultation with the scientific community on initial ideas, including a workshop event on 22 January 2010
2010	Set-up of the FET Flagships Science Forum and of a Working Group of the ICT Directors of the MS and AC
July 2010	Launch of a competitive call to support comprehensive FET-Flagship Pilots (6 preparatory actions, each focusing on a Flagship challenge)
May 2011	Official launch of six Flagship Pilots at fet11: The European Future Technologies Conference and Exhibition
June 2011 to May 2012	Implementation of the Flagship Pilots phase
July 2012	Launch of a competitive call for the selection of two Flagships
December 2012	Launch of a call for an ERA-NET, in support of the Flagships
January 2013	Selection of the HBP and Graphene Flagships
May 2013	Selection of the ERA-NET FLAG-ERA
October 2013	Launch of the HBP and Graphene Flagships and of FLAG-ERA

ANNEX 4 – THE GRAPHENE FLAGSHIP (HTTP://GRAPHENE-FLAGSHIP.EU/)

The challenge: Graphene, a form of carbon in a one-atom-thick layer, has the potential to underpin the next generation of disruptive technologies, substituting materials used in existing applications but also leading to radically new applications and markets. The Flagship aims to take graphene and related layered materials (GRM) from the realm of academic laboratories into to industrial and societal applications in the space of ten years. The Flagship will establish a new technology platform which will leverage the complementary advantages of carbon-based materials with respect to silicon or other materials. Research on graphene is already at an advanced stage, with significant scientific outcomes well demonstrated and reproduced by several research groups all over the world. However, most graphene-based applications are still several years in the future. There is time for Europe to play a major role in developing graphene-based technologies and bring their benefits to the European economy and society.

The initial Graphene FP7 Core Project consortium brings together 76 academic and industrial research groups from 17 countries, and is expected to expand to 142 partners from 23 countries during 2014, as a result of a competitive call. Among the participants there are four Nobel Laureates. The partners cover a large spectrum of disciplines from quantum physics, material science and chemistry to electronics, engineering and device production. The consortium also includes some of the key European suppliers and system integrators in the electronics sector.

The research roadmap: The Flagship focuses on three main areas: material technologies, new device concepts and their integration into new systems. In materials technologies, the aim is to identify, explore and characterise new layered materials and assess their technological potential; and, to develop reliable, reproducible, and safe, large-scale production technologies for GRM addressing the needs of different application domains. In component technologies, the aim is to identify new device concepts enabled by GRM, and to develop component technologies that utilize the potential of these new materials platforms with a focus on electronic technologies. Finally, in the area of systems integration, the Flagship will integrate graphene-based components and structures to systems that provide new functionalities and open new application areas. The Flagship will also develop integration routes for nanocomposites, flexible electronics and energy applications.

The international context: Major initiatives on graphene exist in particular in China, Japan, Korea and Singapore. The advisory council of the Flagship includes top experts from Asian and American research communities, and the consortium is collaborating actively with researchers on the global scene, e.g. by co-organising conferences in other parts of the world.

Impacts: Key technological impacts of Graphene are expected in flexible electronics; high-frequency electronics; novel logic devices; novel spintronic devices, but also in domains far beyond ICT including novel composites, more efficient batteries and supercapacitors and new types of sensors. Progress achieved in these areas will enable or enhance applications in a variety of industrial sectors: from energy to automotive, and from chemical to material and to aerospace. Graphene will also contribute to sustainable development by introducing new energy efficient and environment friendly products based on carbon and other abundant, safe and recyclable natural resources.

Major milestones: By spring 2016: first improved quality graphene targeting electronics, sensing and energy applications, and identification of the fundamental limits of graphene devices and components suitable for low-power flexible systems. By 2018: safe and

sustainable supply of graphene with the right quality, quantity and price. By 2023: integrated circuits and systems for applications in electronics, sensing, energy and health. The Graphene Flagship will also organise a yearly major conference (Graphene Week).

ANNEX 5 – THE HUMAN BRAIN PROJECT (HTTPS://WWW.HUMANBRAINPROJECT.EU)

The challenge: Understanding the human brain is one of the greatest and most ambitious challenges facing 21st century science. HBP will gather all the disperse neuroscience data and knowledge, and will use them to model the information processing at every scale of the brain, from genes to cognition, in sufficient detail so that useful predictions can be made.

The HBP FP7 Core Project consortium includes 112 institutions, mostly from Europe but also US, Japan, China and Israel involving hundreds of the world leading experts. HBP gathers expertise on and across the borders of disciplines: from computer science and neuroscience: bio-informatics, computer architectures, software engineering, databases, bio-hardware (neuromorphic), simulation, visualization, brain imaging, genetics, cognitive science, theoretical neuroscience and physiology, medical practice, and also experts in innovation, industrial exploitation, ethics, education, program management and communication.

The research roadmap: HBP will build an integrated system of six ICT-based research platforms, providing scientists anywhere in the world with access to highly innovative tools and services that can radically accelerate the pace of their research. The six ICT platforms are: (i) The Neuroinformatics Platform, bringing together data and knowledge from neuroscientists around the world and making it available to the scientific community. (ii) The Brain Simulation Platform, integrating this information in unifying computer models, making it possible to identify missing data, and allowing *in silico* experiments, impossible in the lab. (iii) The High Performance Computing Platform, providing the interactive supercomputing technology neuroscientists need for data-intensive modelling and simulations. (iv) The Medical Informatics Platform, federating clinical data from around the world, providing researchers with new mathematical tools to search for biological signatures of disease. (v) The Neuromorphic Computing Platform, translating brain models into a new class of hardware devices testing their applications. (vi) The Neurorobotics Platform, allowing neuroscience and industry researchers to experiment with virtual robots controlled by brain models.

The international context: Understanding the human brain is a global challenge. There are many other major brain initiatives in the world, mainly in the USA (US Brain initiative), Canada, Japan, China, Korea and Australia. The cooperation between HBP and the US-Brain initiative is under preparation. A Global Network of Brain Initiatives is being considered.

Impacts: The scientific, industrial, economic and societal impact of HBP is potentially enormous. The world spends billions of Euros to generate neuroscience data and hundreds of billions to diagnose patients. Integrating this data establishing a culture of sharing data and models and using simulations in supercomputers will change the way science and medicine is done; Chip, computer and robot manufactures will reap the benefits of brain-inspiration; Pharmaceutical companies will be able to design and test drugs on simulation; citizens will have a much cheaper personalised and scientifically ground treatment for their mental diseases, bringing huge savings.

Major milestones: By spring 2015: HBP will open the 6 ICT platforms to all consortium researchers; these will be open to all researchers in the world by 2016. By 2018, the platforms will be fully operational and start delivering on future neuroscience (first *in silico*

neuroscience experiments on parts of the mouse brain), future medicine (biologically-based classification of brain diseases), computing (neuromorphic chips and interactive visualization with supercomputers). By 2021, it is foreseen to have high fidelity model of the whole mouse brain for *in silico* behavioural experiments, while for 2023, the project will be ready to deliver a high fidelity model of the human brain for *in silico* science, medicine and technology implementation and a first map of major brain diseases. HBP will also organise a dedicated annual conference.