FET Flagships
Lessons learned from the first 30 months of their operation

The European Commission (DG Connect) and
the GRAPHENE and the HUMAN BRAIN PROJECT FET Flagships

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1. About this report

This report presents the main lessons learned by both the European Commission and the two FET Flagship Consortia, Graphene Flagship and the Human Brain Project, when implementing the ramp-up phase of the two Flagships (October 2013 to April 2016).

FET Flagships are a new partnering model between the European Commission (EC) and the Member States (MS) for long-term European collaborative research in the context of the European Reseach Area (ERA).[1] Two FET Flagships were launched in October 2013, the ***GRAPHENE Flagship***[2] and the ***HUMAN BRAIN PROJECT*** (HBP)[3]. They have completed their 30-month ramp-up phase and have been granted additional EU funding for the next 2 years of their 10-year roadmap.

The EC has published recently a blogpost[4] summarising the progress and main S&T breakthroughs of the two Flagships and their main outputs (in terms of major Key Performance Indicators – KPIs).[5] These were based on the findings of a technical review that the EC held in mid-2016 with the help of independent external experts.

This report complements the technical review findings of the two Flagships and presents the main lessons learned so far in implementing the Flagships. It reflects the collective experience of both the EC and the two Flagship consortia.

The EC has also launched an evaluation of the FET Flagship instrument that is being carried out by an independent panel of high-level experts[6] as part of the Horizon 2020 interim evaluation. The scope of the evaluation panel is to capture the wider views of how Flagships are perceived and utilised by the scientific communities in Europe and beyond and provide an independent view of the Flagships' impacts so far. The conclusions and recommendations of the evaluation panel, to be published early 2017, will also address the potential capability of the two Flagships in delivering their long-term objectives, and the implementation and the governance model of the Flagships, three years after their start.

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[1] A comprehensive overview of what FET Flagships are, their governance and how they are implemented can be found in the EC Staff Working Document "FET Flagships: A novel partnering approach to address grand scientific challenges and to boost innovation in Europe": SWD(2014) 283, 16 September 2014.

[2] http://graphene-flagship.eu/

[3] https://www.humanbrainproject.eu/

[4] https://ec.europa.eu/digital-single-market/en/blog/human-brain-project-and-graphene-flagships-are-moving-ahead-next-stage-their-10-year-voyage;

[5] **GRAPHENE Flagship review and highlights of technical achievements**:
http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=17006
HBP Flagship review and highlights of technical achievements:
http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=17075

[6] https://ec.europa.eu/digital-single-market/en/blog/fet-flagships-interim-evaluation-best-yet-come-0

The EC will use the lessons drawn in this report as well as the conclusions and recommendations of the independent evaluation panel to further improve the implementation of the two current FET Flagships as well as any others that may be launched in the future.

2. Main Lessons Learned from the Ramp-Up Phase

The lessons learned have been separated into three sections: enabling effects of the Flagship instrument, governance and implementation, and partnering.

2.1. The enabling effects of the Flagship Instrument

To achieve their ambitious objectives and technology development targets, each of the two FET Flagships mobilised synergies and established collaboration across 100+ partnering organisations.

By bringing together researchers from different scientific disciplines and technology fields, the Flagships started creating *an unprecedented level of collaboration and community building in Europe*. For example, in March 2016, HBP released its six ICT Platforms, which are the core of the emerging HBP research infrastructure for brain research. This was the result of an extensive multidisciplinary effort involving more than 750 scientific collaborators and engineers from 114 institutions in 24 European countries. The Platforms have now been opened to a very large number of users from all over Europe and beyond and *will enable new kinds of collaborative research* to be performed in brain research, cognitive neuroscience and brain-inspired computing.

Through their long duration, Flagships *enable the participating research groups* to *build up expertise and create durable links between academia and industry*. For example, in the GRAPHENE Flagship, this is key for advancing technology through different Technology Readiness Levels and for completing value chains needed to achieving tangible societal and industrial impact.

Flagships contribute to *create and spread an innovation mind-set in Europe*. For example the GRAPHENE Flagship is providing lectures for young researchers in winter schools on how to innovate; innovation support to partners that have valuable technology but lack the experience to exploit it; and is helping industry to become aware of opportunities offered by new technologies. By doing so, the GRAPHENE Flagship becomes a natural hub for bringing together market pull and technology push, up to the point where industry adopts new technologies. The HBP has set up a pilot national industry-led innovation hub.

Flagships help *educate, keep and develop research talents in Europe*: in their ramp-up phase, each Flagship mobilised ~300-350 young and enthusiastic researchers (PhDs or post-doc level) from all over Europe and beyond. For example the GRAPHENE Flagship, with its focus on pushing forward new technologies and innovation, and its internal education activities, not only helps creating a culture of entrepreneurship, but also is serving as a training platform for supplying the skilled researchers European high-tech industry needs. The HBP trains a new generation of neuroscientists capable of harnessing the power of high performance computing and data analytics.

Flagships open the door for *international collaboration* by shaping the role Europe has on the global landscape in terms of science, technology and innovation, and forming a natural anchoring point. For example, the GRAPHENE Flagship has already held several international collaboration workshops with the USA, Japan and Korea, and has now put in place mobility funding grants for

young researchers, in close collaboration with the US-NSF.[7] Such international collaboration is essential to establish in a young and quickly evolving research field such as two-dimensional materials (graphene being the most well-known case).[8] The HBP Flagship has also engaged in similar activities and participated in several international workshops. It is now launching concrete collaboration activities notably with the US BRAIN[9] and the Canadian brain initiatives.

Flagships give *high visibility to the EU investments in science and technology, and attract a lot of attention* from both public and scientific media. This visibility rightly puts demands in terms of transparency and communication from all the stakeholders involved in the Flagships so as to provide realistic expectations and accurate information about the progress, the expected outcomes and the impact of a given Flagship. This transparency is however limited in certain cases by the rules defined in the Horizon 2020 regulation[10] which protect for instance the anonymity of the experts involved in the evaluation and monitoring of an initiative.

2.2. The governance and the implementation of the Flagships

The experience from the GRAPHENE Flagship and most importantly from the controversy of the HBP Flagship with the neuroscience research community[11] shows that FET Flagships must rely on an effective and efficient *governance structure*: it is critical for a Flagship to have a balanced system of decision powers and accountability, ensuring a clear separation of powers between scientific steering, strategic and financial decision-making and the day-to-day implementation of research activities. Senior researchers, research institutions and other stakeholders must be appropriately represented in the governance structure; the leadership of a FET Flagship must be able to inspire individual researchers in each of the research groups; and the Flagship must be able to have recourse to good external advice in critical decision making moments, by setting up for example, an external and independent high-level S&T advisory body. Ethical questions play an increasing role – both with respect to the inner functioning of the Flagships and their relationship to society.

Apart from the governance, a FET Flagship is also critically dependent on a *professional management* capacity led by an experienced and highly effective coordinator and an efficient admininistration team. Decisions must be taken smoothly and timely despite the high number of organisations involved. The documents associated with a Flagship are also bulky and need proper document handling and quality control procedures. Equally important is to find the right balance between centralised and decentralised efforts for implementing Flagship activities related to innovation, education and training, and communication, dissemination and outreach.

The optimal size that a FET Flagship consortium should have, depends among others, on the strategic research agenda and the disciplines involved. For example, in the GRAPHENE Flagship

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[7] https://ec.europa.eu/digital-single-market/en/blog/graphene-flagship-reaches-us-first-steps-joint-collaboration-eu-us-are-set-0

[8] Such international collaboration is essential for the following reasons: European and US research teams have complementary expertise and can benefit enormously from each other; technology roadmaps play a vital role in the take-up of graphene-based technologies, but need to take into account developments across the world; and, standardisation and the characterisation of the performance of two-dimensional materials for applications are other examples where global contacts can help achieve further progress.

[9] See for example the *Joint Statement of the 14th EU-U.S. Information Society Dialogue* on BRAIN Initiative /HBP, https://ec.europa.eu/digital-single-market/en/news/joint-statement-14th-eu-us-information-society-dialogue

[10] COM(2011) 809 final and REGULATION (EU) No 1290/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 L 347/84 (20.12.2013)

[11] https://ec.europa.eu/digital-single-market/en/blog/no-single-roadmap-understanding-human-brain

the number of partners has increased from 75, at the start of the Flagship, to more than 150 now, which is considered to be very large. The size of the Consortium should not be so large that the funding per partner becomes marginal. If this happens and partners obtain most of the funding from other sources, there is a danger that the Flagship will have little leverage to promote common policies. If the Consortium is however too small, it may be perceived as elitist, providing resources only to a small privileged group.

While keeping the size of the Consortium reasonable, the progress along the research roadmap requires *the consortium composition to gradually evolve* over its 10 year lifetime to match the needs and priorities of the Flagship as it progresses towards its ultimate goal of converting scientific advances into concrete innovations. For example, one of the lessons learned from the controversy that HBP faced[11] is that upfront agreement on the Flaghip goals and *the implementation of open and transparent mechanisms* for the Consortium evolution (i.e., for terminating the participation of partners and for selecting new partners) are essential for the Consortium to evolve successfully over the different implementation phases of its research roadmap.

Measuring the outputs, results and impact of the FET Flagships during their lifetime and afterwards is also of utmost importance. *Key Performance Indicators* (KPIs) need to be built-in from the start of the project, and tools to monitor/measure them should be put in place. These should cover the technical progress of each work package, outcomes of the initiative (e.g. number of publications, number of patents, number of PhD students, etc.), and measures that aim to establish the longer term impact (e.g., number of new products and processes produced, spin-offs created, jobs created in industry, etc.). Both Flagships have now managed to put in place such a reasonable set of KPIs.[5]

2.3. Partnering

Partnering is a cornerstone of the Flagships and in an initiative of this scale it relates to a large number of stakeholders involved.

[Partnering with research communities] By setting up priorities for 10 year periods at the European level, the two Flagships have triggered *strategic discussions and collaborations amongst interested stakeholders* on new technology development and innovation opportunities for Europe. Depending on the scope of collaboration, Flagships developed different partnering models to work with research communities and industry. Two such examples include the *associate members* (Graphene Flagship)[12] or the *user groups* (HBP).

The *research roadmaps of the Flagships impact at different degrees on activities planned in national and trans-national research programmes across Europe*. A partnering approach was thus defined during the ramp-up phase for associating to the EC-funded *core Flagship project* MS-funded transnational or national projects. These are so-called *Partnering Projects*[13] to the Flagships. Partnering Projects help formalise collaboration across a set of projects that are contributing to the Flagship research agenda. The first such projects were associated to the Flagships in April 2016[14] under their Horizon 2020 phase, and they are mainly funded through the

[12] http://graphene-flagship.eu/graphene-flagship-welcomes-first-associated-members-(2)

[13] https://ec.europa.eu/digital-single-market/en/news/fet-flagship-model-implementation-and-governance-model-horizon-2020-short-overview-and

[14] In April 2016, 19 research projects have been selected through the first FLAG-ERA Joint Transnational Call and joined the two Flagships as Partnering Projects.

FLAG-ERA ERANET.[15] The experience gained so far from this new partnering approach shows some difficulties in the integration of many different and rather small-size partnering projects in the Flagships' activities. For example, one lesson learned is that good solutions need to be put in place from the very beginning for defining and managing the related complex confidentiality and IPR issues between partners of the core and the partnering projects. This is a dimension of the partnering model to monitor and assess as it scales up in the future.

[Partnering with the EC] Flagships required putting in place an *open and collaborative interaction between their management and the EC*, much beyond what is done in other EC-funded research initiatives. This regular and close collaboration allowed both sides identifying challenges and finding solutions for a smooth implementation of the Flagships. Experience gained so far shows that such implementation would need to be furter streamlined. For example, funding of Flagships is operated through a phased approach of typically 2-3 years duration and requires regular proposal evaluation and project reviewing cycles of the successive Flagship grants. While this permits regularly assessing the progress of the Flagships against their roadmap, it also necessitates putting in place quite early, i.e., at least 12-15 months in advance, the detailed planning of the next phase of the Flagship activities. From the perspective of many researchers in the Flagships longer phases would better support achieving their goals.

[Partnering with the MS] *MS support and contribution to the Flagships is essential for their success*. They are participating in the Flagship governance structure, notably through the Board of Funders[16], where they are discussing with the EC the state of progress of the Flagships and programming activities in support of the Flagships.

MS are expected to contribute up to 50% of the funding of a Flagship. These contributions can be direct or in-kind:

- *Direct MS contributions*: MS are supporting the Flagships either through relevant national programmes and/or through the FLAG-ERA ERANET joint calls. MS have or are planning to have national activities supporting the Flagship roadmaps.[17] So far however, their direct contributions to the Flagships proved to be lower than expected. FLAG-ERA I permitted to launch 19 transnational projects for a total of 13.5 M€ for both Flagships and the budget of FLAGERA II is ~15 M€ for launching new transnational projects in the period 2017-2018.

- *In-kind MS contributions*[18]: For the time being the MS are still discussing the methodology they should use for measuring and providing a living inventory of their in-kind contributions.

In summary, there is a strong evidence of the MS commitment to the success of the Flagships (for example, through their regular participation and involvement in the governance of the Flagships) but their direct financial contributions are, for the time being, lower than expected.

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[15] www.flag-era.eu: FLAGE-ERA is a network involving most of the regional and national funding organisations in Europe that offers a good platform to coordinate a wide range of sources of funding the Flagships.

[16] The Board of Funders brings together the main funders of FET-Flagships, namely representatives from the Member States (MS) and Associated Countries (AC) of Horizon 2020 and the Commission, with the purpose of programming activities in support of the FET-Flagships.

[17] See http://graphene-flagship.eu/Lists/Deliverables/D16.3%20Report%20on%20mapping%20of%20European%20graphene%20research.pdf

[18] Examples of in kind contributions include: access to infrastructure, experimental facilities and equipment, etc.

3. Conclusions

Flagships represent ***a unique model*** for long-term European co-operative research that pursues both scientific excellence and innovation objectives. ***Flagships are not the appropriate instrument for every type of research***. They should be considered particularly when goals such as pushing forward a technology over a longer time frame or enabling a new type of scientific exploration that requires a collective effort, can only be reached through a long-term, large scale coordinated effort. Such initiatives can be appropriate to secure the knowledge transfer between the different tiers of the value chain. ***A Flagship can only be envisaged in a field that has reached sufficient maturity***. There should be at least a core of industrial or societal partners who have entered the field and can motivate it from their long term interests. There should be also a large enough academic community that can take up the challenge and constructively interact with the industrial and societal stakeholders so as to deliver along the value chain (GRAPHENE Flagship); or to enable the creation of a major European service-based research infrastructure (HBP).

From the lessons learned so far, ***the overall Flagship concept proves to be valuable*** and the implementation mechanisms deliver on expectations even though improvements can be made on some aspects. The mechanisms to involve MS and to partner with relevant nationally funded activities are still at early stage of implementation and should be further monitored as they scale up in the future. Overall, ***the design of the partnering and implementation model of the Flagships would merit to be further evolved and improved***, in order to best fit the needs of the Flagships and their Consortium evolution, as well as those of the EC and the MS. Furthermore, for future Flagships, it may be better to look at options that can enable ***a more straightforward financial commitment of the MS to the Flagships***.

The findings and recommendations of the Interim Evaluation panel of the Flagships will further contribute to assess the Flagship concept and its implementation and will be essential in recommending potential improvements in the future. Preparations for the launch of further FET Flagships, towards the end of Horizon 2020, or in its successor programme, will take full account of the lessons learnt so far.

Further information:

Full details and references on the EU FET Flagships strategy, activities and project portfolio can be found at: http://ec.europa.eu/programmes/horizon2020/en/h2020-section/fet-flagships