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FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V.

POSITION PAPER FOR THE HIGH-LEVEL ROUND TABLE ON PREPARING FUTURE FET-FLAGSHIPS

Main Challenges and Candidate Proposals

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Content

1
General Remarks

- FET flagships dispose of an extraordinary financial budget, have high visibility in the scientific community and public and are supposed to have a high strategic impact.
- Eligible flagship topics should therefore directly contribute to Europe's technological sovereignty. In this context, we understand sovereignty as a measure of independence to remain capable of acting and making decisions.
- The limited number of proposals, as well as the fact that quite a few were submitted by individuals, suggest that the bottom-up online consultation process had not been sufficiently noticed by the scientific community of the EU.
- We regret that essential topics, in which Europe could gain technological leadership, are not (or only marginally) present, such as smart industry, renewable energies, energy storage and energy grids and cyber-security.

Having stated this, we recommend the following proposals being taken into closer consideration for the next FET flagship initiatives.

2
Supported Proposals

2.1
Individualised Organ Substitution - Plea for a Synthesis of the Proposals »Hope (Human Organ Printing Era)« and »European Initiative for Regenerative Medicine«

What is the grand S&T challenge that a candidate FET-Flagship should address?

Shortage of replacement organs is a major medical problem in an ageing society. Already at present, supply is insufficient due to low numbers of organ donors.
The idea of organ printing circumvents a lack of donors as well as difficulties arising from incompatibility after allotransplantations. However, great interdisciplinary efforts are necessary. Large scientific and technological progress is needed in many areas, since the present limitations are not restricted to regulation and administration.

Why is a FET-Flagship necessary to address this challenge?

This goal can only be achieved through interdisciplinary and transnational efforts and pooling of competences. The various biological (cell and tissue engineering, nerve fiber growth, …) and technological aspects (materials, ICT, automation,…) overcharge smaller consortia. Standardisation as well is a success factor and should be addressed to in a multinational alliance.

Why is it good for Europe?

Technological leadership in this scientifically ambitious and economically relevant new field of medicine and health management would certainly be a locational advantage for Europe.

What would it take to do it?

Supply with compatible organs is a serious limitation of medical care and should be tackled with an effort as technologically broad as possible. Therefore, not only organ printing but all directions of regenerative medicine should be considered. Consequently, we strongly suggest to form a joint initiative between the two proposals »Hope (Human Organ Printing Era)« and »European Initiative for Regenerative Medicine«.
The consortium should include all relevant European competence centers. Fraunhofer-Institutes have made significant progress in manufacturing vascularised tissue using 3D-printing techniques during one of the first EU-projects on this topic (»ArtiVasc 3D«; www.artivasc.eu). Fraunhofer IST contributes to Horizon 2020 project »FAST« which is amont the existing European research initiatives linked to this proposal.

What could be the role of ICT in addressing this challenge?

Any kind of additive manufacturing is based on digital construction data as well as software for process control. ICT therefore is essential and characteristic for this approach.
Standardisation and smart data approaches for individualisation and optimisation represent further ICT aspects.

2.2
The Future of Health Care: Deep Data, Smart Sensors, Virtual Patients and The Internet-of-Humans

What is the grand S&T challenge that a candidate FET-Flagship should address?

The goal of the project is to lift the health care system to a new level by individualizing the therapy of the main illnesses of the European population. Diagnoses and therapy will be based on latest scientific knowledge due to a fast transformation of research results into medical applications. This should be achieved via the development of novel -omics, imaging and multi-level advanced smart sensor technologies and big data/deep data analytics.

Why is a FET-Flagship necessary to address this challenge?

Changing the health care system in the proposed way to prevent diseases and to create individual therapy will require huge efforts and a joined initiative based on technological developments. Main obstacles for »The Future of Heath Care« project, as for many technological innovations in the health care sector, are legal and economic questions, as well as a delay in transferring scientific knowledge to applications. Only a European wide initiative on the scale of a flagship can address these aspects and revolutionize the existing infrastructure.

Why is it good for Europe?

The health care sector is one of the most important growing business areas in industry countries and thus in Europe. The proposal would help to build up and keep knowledge and companies in Europe. The digitisation of the health care sector is frequently targeted by US companies (start-ups as well as major IT-companies such as Alphabet). Here, Europe needs to react to keep a lead over the sensible data on health information. For Fraunhofer, the ownership and secure handling of sensitive data in the health care sector and in industry, as well as individuals' data, is of very high value and Europe should ensure its sovereignty in this field.

What would it take to do it?

The role of the European population in accepting new technologies in the medical sector should not be underestimated for the success of this FET Flagship idea. Thus, a participation of relevant representatives and suitable communicators is necessary. The technical expertise involves deep -omics, smart sensing, imaging technologies, data analysis and integration competences, big data analytics, virtual patient models. The above aspects, especially sensors and data handling, are core competences of Fraunhofer. Technical solutions for data storage, handling and organisation are addressed in the »Medial Data Space« as part of the »Industrial Data Space«, a European wide association of more than 40 members. We recommend that besides the technical, legal, regulatory and educational aspects also ethical questions should be considered in such a large project and thus relevant protagonists should participate.

What could be the role of ICT in addressing this challenge?

The FET Flagship proposal wants to increase the role of ICT in the health care system. It is not about continuing current pathways, but creating a whole new way of integrating ICT in the health care systems. This is achieved through a completely synergetic approach: integration of countless heterogenic systems / sensors, big data analysis, data storage and data protection, cybersecurity, data visualisation et cetera.

2.3 Direct Conversion of Solar Energy: Renewables and More Technologies

What is the grand S&T challenge that a candidate FET-Flagship should address?

Energy and matter supply from renewable resources is a core prerequisite for sustainable economy. Direct conversion of solar energy to feedstock chemicals and biofuels following the natural principle of photosynthesis is the most radical and challenging approach. It shortcuts alternative methods like using excess of renewable electricity or biomass production. A significant progress in efficiency and stability of processes and devices is crucial. The central technologies to be addressed are direct conversion technologies addressing the development of new catalysts, semiconductors and nanostructures.

Why is a FET-Flagship necessary to address this challenge?

This goal can only be achieved through interdisciplinary and transnational efforts and pooling of competences. Numerous advances in many aspects have to be achieved and diverging disciplines and excellence centers have to co-operate if this purpose is to succeed.

Why is it good for Europe?

Independence from petrol is an ambitious vision of the EU, whose members predominantly have no petroleum occurrence.
As the authors state, "the frontier research […] requires addressing a number of interrelated topics in the coming decade, which would enable […] a more mature stage of technological development." The proposal clearly has basic research character.
Due to current low crude oil prices, profitability of biofuels is not to be expected soon. Nonetheless, already the replacement of petrol as a major part of raw material input to polymer production and chemical industry in general would mean a great progress and would lead to a higher degree of European independence for one of its largest economic sectors.
The proposal exhibits the character of a unifying idea and is suitable as European technological vision bonding the member states.

What would it take to do it?

Main focus of attention should be on robustness and efficiency of the developed process as well as on upscaling to achieve a large impact. Existing consortia in relevant research fields should contribute, such as the German "Carbon2Chem" initiative (Fraunhofer and Max Planck institutes together with industrial partners).

What could be the role of ICT in addressing this challenge?

ICT has no central role, but its development will be indispensable for the modeling of chemical processes and reactions and for molecule and materials design.

2.4 Nanoarchitectronics

What is the grand S&T challenge that a candidate FET-Flagship should address?

The proposal Nanoarchitectronics addresses an interdisciplinary and transnational approach to create a technological platform to unify the interactions between humans or systems with the surrounding environment. Nanoarchitectronics refers to a new technology aimed at conceiving, designing and developing reconfigurable, adaptive and cognitive structures, sensorial surfaces and functional "skins" with unique physical properties and engineering applications in the whole electromagnetic spectrum through assembling building blocks at nanoscale in hierarchical architectures.

Why is a FET-Flagship necessary to address this challenge?

Developments concerning sensors and smart interfaces nowadays are mainly driven by approaches of smaller consortia or in specific business fields. To finally form a framework on Nanoarchitectronics a joined initiative like the FET Flagship is necessary. Only common and parallelised research and development in the different sectors on nanoparticles, material engineering, signal processing and transmission will successfully systematise, homogenise and broaden the connectivity and sensing of this technology.

Why is it good for Europe?

The vision of Nanoarchitectronics has disruptive potential. Due to the broad approach the technology will influence many industries and thus will create jobs in Europe: in the field of high data-rate communications, aircraft and space systems, in the security and semiconductor industry, to name only the most prominent. Furthermore standardisation will be of utmost importance once new sensors based on this technology development become reality. Europe can influence the international discussion due to a united and far advanced technology.

What would it take to do it?

The Nanoarchitectronics idea is proposed by a large consortium. Due to the broad approach of the idea it has to be stressed that experienced management should be implemented and that intensive exchange to existing large scale initiatives like the "next generation internet" and "industry 4.0" should be targeted. European key player in the field of micro- and nanoelectronics such as Imec, CEA and Fraunhofer, not only due to their experience in standardisation procedures, should be involved, too.

What could be the role of ICT in addressing this challenge?

Nanoarchitectronics is all about ICT: It addresses the interaction of humans or systems with the surrounding environment through the whole electromagnetic spectrum. All key aspects address ICT: electronic architectures, embedded systems in nanoscale, signal transmission and processing, cyber-security.