Impact of FET Research Initiatives

Final report
Management Summary

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Management Summary

The European Commission has requested a consortium consisting of TNO (NL), CWTS (NL) Technopolis (NL) and VDI (DE) to develop a methodology that enables assessing the scientific impact of the FET Research Initiatives. It also requested to trial the methodology on two FET-clusters: Bio-inspired ICT and Quantum Information Processing and Communication (QIPC).

The Commission explicitly asked to address the added value of FET funding in terms of scientific and technological breakthroughs, changes in the research landscape and environment, (re)structuring of scientific communities and changes in national or international research programmes. In assessing the added value the methodology takes explicitly notice of the main characteristics of the FET programme, being foundational, transformative, purpose-driven, high-risk, collaborative and multi-disciplinary. The characteristics have been operationalised in order to study them empirically.

The resulting Impact Assessment Methodology identifies a set of twelve research questions. The research questions can be clustered around the following four dimensions of impact:
- quality and quantity of scientific results (e.g. number of publications, position of research efforts in European and global context)
- quality and quantity of human resources (e.g. mobility of scientists, effect of FET on personal careers)
- breakthrough and societal consequences (e.g. promising results, industrial interests)
- impact on scientific landscape (e.g. network formation, public–private linkages)

As with all impact approaches, these four dimensions are investigated on direct effects of inputs (output, such as number of publications), indirect effects (outcome, such as impact on research agendas’ and longer term indirect effects (impact, such as impact on research and innovation systems).

All research questions were studied in the assessment of the two FET-clusters. The composition of the FET-clusters was pre-defined by the Commission, on the basis of projects that either had already finished or were on-going. The clusters represented different combinations of scientific effort, Bio-ICT consisting of a relatively limited set of projects (six, of which three recently had started) and QIPC consisting of a larger set of eleven projects.

1.1 Assessing the clusters – empirical tools:

In order to assess the FET clusters a variety of empirical tools have been used. Key instruments were delivered by fine-tuning bibliometric approaches. These instruments enabled quantifying scientific output including various relevant parameters (delineation of scientific fields, identifying emerging topics, mapping scientific activity, mapping collaboration and networking effects). We tested different approaches for both clusters, producing a robust methodology that can cover various clusters.

Structured interview templates have been developed and used when interviewing a range of stakeholders. This delivered rich and in-depth insights in how stakeholders perceive the added value of FET-activities, being principal scientist, industrialist or policy makers. A survey focusing on human capital issues and directed at young
scientists showed to be very helpful in receiving additional information on mobility patterns and impact on scientific careers.

Desk research and patent analysis (the latter lonely in limited form using European Patent Classification keywords directly related to QIPC) complemented the tool box.

1.2 Case-studie Bio-ICT

Knowledge and technologies from both the ICT and the biological domain are paving the way for an increased convergence between the two (Bio-ICT), leading to systems with integrated biological and technological components and to innovations, for instance in computer architectures, bidirectional interfaces, prosthesis and implants. Bio-ICT is a very broad field of research and application. The FET-Research Initiative ‘Bio-inspired ICT’ was represented in FP6 and FP7, with predecessors in FP5. For this case study six FET-projects have been studied.

The FET programme has six main characteristics (foundational, transformative, high-risk, purpose-driven, collaborative and multidisciplinary). Each of these characteristics is reflected in a number of different effects that are addressed in the twelve research questions dealing with the outputs, outcomes and impacts of the FET-funded projects. Conclusions are drawn by summarising the results for each of the research questions along the lines of the six FET-characteristics.

Foundational refers to the potential radical character of FET research: ‘blue sky’ research that might lead to new insights, concept and theories that might change the view on certain natural processes (and even create new scientific paradigms). These breakthroughs can lead to innovations that improve the competitiveness of the European industry in the field of Bio-ICT. Transformative refers to the same, and focuses on the first part: new ideas. The results of the study confirm the foundational character of the research being financed; several breakthroughs were reported. Also the industry’s interest so far confirms the foundational and translational character in terms of newness of the field: at the moment a few specialised companies are involved, and the interest of larger companies is now slowly increasing.

The FET-characteristics of high-risks and purpose-driven refer to the uncertain character (risk), but in case it happens (the breakthroughs) the high impact character for industry (purpose) and refer to the same phenomena as the previous set of FET characteristics, but using different dimensions. An additional aspect mentioned here is the impact on the industries’ research agendas. This has been measured through a number of research questions, both in the output and the impact parts, but the findings only measure some very thin effects.

The collaborative aspect is especially addressed in the Integrated Projects and Networks of Excellence as these involve consortia with large numbers of research teams from all over Europe. The results show that there have been considerable changes in the scientific communities due to the FET-programme. New partners (from research organisations and industry) have been included in the project consortia and cooperation with them will be continued after the project is finished. The collaborative character is not a FET-specific aspect; it applies for many other EC funded projects. What is rather typical for FET and is also an important added value of FET is the multidisciplinary character of this collaboration. This is a rather unique aspect of the programme by which FET distinguishes itself from most other EC research programmes. This effect was measured through a number of research questions, both dealing with the characteristics of the research and the networks that are created. The results confirm the
multidisciplinary character: new links have been created between researchers from different disciplinary backgrounds. This applies especially for the cooperation between research organisations; less for cooperation with industry.

1.3 Case-study QIPC

Quantum Information Processing & Communication (QIPC) uses the possibility of control at the atomic level in an effort to build a quantum computer that would exploit quantum phenomena such as entanglement. Quantum computers hold the promise for solving efficiently some computationally hard problems, such as large integer factorisation or the simulation of quantum systems.

In the Fourth Framework Programme (FP4, 1995 – 1998) research on quantum phenomena gradually evolved towards the objective of “quantum information processing”. In FP5 (1999–2002) FET launched QIPC as a Proactive Initiative (PI). For the case study on QIPC the European Commission selected the following eleven FET-projects: three IPs (SCALA, QAP, EuroSQIP) and eight STREPs (COVAQIAL, QUELE, RSFQUBIT – RSFQ, OLAQUI, ACDET, MICROTRAP, QICS, EQUIND). All projects have been financed under FP6. The three IPs were funded under the FET Proactive Scheme, while the eight STREPS were funded under the FET Open Scheme.

Both the project coordinators in the interviews and the project reviewers in their project reviews report numerous new and important results achieved in FET QIPC projects that they consider as scientific and technological breakthroughs. The methodology applied in this study does not measure or judge if and on what level these breakthroughs on the project level also are being acknowledged and regarded as such by the larger scientific community of the QIPC field.

With respect to changes in the scientific communities a majority of the interviewees underlined the importance of the FET-initiative and stated that without the FET-funding a co-operation of such a focused and intense manner would not have occurred or would have been quite unlikely at least. Hence, the FET-programme was widely seen as a trigger of comprehensive co-operation, partnering and networking. Furthermore, the bibliometric network analysis has shown that there is a set of FET/related organizations which play an important, central role within the field as a whole. With respect to networks including industry it is found that equipment providers might play a crucial role in professionalising the lab equipment and thus in speeding up the research progress.

We did not find any hard evidence for FET-programmes having an impact on other international of national research programs. The evidence rather points in the direction that the influence of FET-programming on national programming might be better described as a co-evolution. It is conceivable, though, that additional interviews might uncover cases, where a direct impact of FET-programmes on national schemes is acknowledged. The mere existence of CHIST-ERA itself might be considered as evidence for a direct impact of FET on the agendas of national funding agencies.

The case study on QIPC provides good evidence that the QIPC project cluster overall has lived up to the ambitions of a FET Research Initiative.
1.4 Lessons learned

The confrontation of the cases and the methodology enabled drawing lessons on different levels.

1. For sake of completeness research questions on societal and economic impact have been inserted in the methodological framework. These impacts are out of reach when assessing impact of FET clusters which relate to on-going research. These research questions can be skipped for future assessments.

2. The combination of quantitative (bibliometrics) and qualitative (interviews, surveys) research tools lends robustness to the method. Quantitative research enables comparison between fields and activities. Qualitative research enables discovering perceptions, motives and attitudes with regard to FET research and the institutional context of FET.

3. The combination of empirical research tools enables assessing finalised and on-going research. Bibliometrics needs scientific publications. This requires projects to be in final stages or already ended. Interviews/Surveys are better suited for on-going projects, ensuring commitment and having unhindered and direct access to those involved.

4. The quality of the assessment is dependent on the availability of resources. Clusters need to have critical mass in terms of people and projects involved. This increases reliability and robustness of results. The methodology developed can be used to assess sub-critical clusters as well, when results are carefully monitored.

5. Expert involvement is obligatory. They are able to validate the delineation produced (which is key to the quantitative assessment) and they are able to validate the findings.

Conceptual problems that are hard to solve are:

1. Additionality of FET research. Subjective validity of additionality can be assessed (how do involved scientists assess the added value of FET compared to other instruments they use?). Objective validity of additionality (how to assess the added value of FET as stand alone instrument) is almost impossible to assess. Research activities and instruments are too much interconnected to singling out just one of them.

2. Control group. Though principally possible, it is very time and resource consuming to create an un-biased control group that would allow checking additionality. Methodological problems (such as mobility of scientists and changes of research groups/institutions over time) prevent establishing a control group in a straightforward manner.

Only when a global assessment and comparison of FET research is requested it seems relevant to address additionality and control group more in-depth than the method developed enables to do.