"Strategic impact, no revolution."

Executive summary from Ex-post evaluation of NMP (FP6) – Strategic level

In June 2009 the "Strategic Level Ex-post Evaluation of NMP in Framework Programme 6" was assigned to Oxford Research and The Austrian Institute for SME Research by the European Commission, Research Directorate-General – Industrial technologies.

The purpose of the evaluation has been to study the strategic value and impact of NMP in its wider European and international context, with special focus on the ERA dimension, against the general policy objectives of FP6 and against the specific objectives of NMP.

Full version of the report may be found at:

http://www.oxford.no/nyheter/2010/ex-post-evaluering-av-nmp6

The title of this report refers to the general finding that the third thematic priority (NMP) in FP6 strategically affected Europe's competitive position and was an important programme which also influenced Member States' policies and research agendas. However, it cannot be directly linked to a revolution with regard to creating substantial scientific or industrial breakthroughs although these were among the explicitly targeted objectives. The programme strengthened Europe's position as one of the world leaders in the respective scientific and industrial fields, but did not enable Europe to outperform other key actors such as the United States or Japan.

Aim of the study

This study is evaluating the strategic value and impact of thematic priority "Nano-technologies and nano-sciences, knowledge-based multifunctional materials, and new production processes and devices" (NMP) in Framework Programme 6 (FP6) in its wider European and international context. The former includes a special emphasis on the Lisbon Agenda, the European Research Area (ERA) dimension as well as the general policy objectives of FP6 and the specific objectives of NMP itself. The comprehension of the context differentiates this study from the classic evaluation exercises measuring effectiveness and efficiency on the project level such as the simultaneously commissioned project evaluation of NMP FP6, which is conducted by another consortium and supposed to be completed in 2011. Being an ex-post evaluation it primarily refers in all its analyses and respective conclusions to the past. However, we believe that the conclusions drawn and the recommendations developed by all means are for their better part relevant for both the understanding of present developments and future plans.

The study provides recommendations from the overall lessons learnt and, where appropriate, from the comparison made between EU NMP activities and similar activities in Member States. Although this strategic evaluation cannot be a fully developed impact assessment on the level of individual projects or measure the actual outcomes of those, it was necessary to analyse the programme outputs and outcomes but on a higher, more aggregated level. However, this cannot

be completed without an understanding of the 'physical' impacts, which are in many cases not created yet due to the fact that part of FP6 projects are still running and eventual scientific impact or commercialization of scientific products coming from those projects in most of the cases will be continued in the years to come.

Nanoscience and Nanotechnologies are an important part of the entire research priority; they also appear as a stand-alone research field in many national programmes. Therefore a special attention to this field was intended, while simultaneously all data were presented and analysed within the context of the N, M and P split as defined in Work Programmes.

Methods

This evaluation was developed with use of both qualitative and quantitative methods. Apart from the desk work covering available documents and databases, the survey instruments were deployed both for the individual project co-ordinators and also to facilitate the collection of data on relevant national measures in Member States.

The research team conducted a series of 48 in-depth, semi-structured interviews with experts from business, research and policy-makers' groups following a pre-defined geographical coverage. Questions from the survey were also addressed in the interviews so as to get more qualitative, reflective answers to such issues as priorities in NMP FP6, the monitoring process and the funding schemes. This was also to assure necessary triangulation of data gathered.

Another important step of the study was the collection and verification of data about country measures financing research similar to NMP priority. Subcontracted members of European Network for Social and Economic Research conducted verification of information in different European countries, contacting relevant country experts and studying publicly available programme information. Data about 89 relevant measures were gathered and analysed, showing a large variety of approaches and dimensions all over Europe. These data allowed the evaluators to distinguish three categories of countries: "the front-runners", "the second-movers" and "the followers", which were later used in the analysis.

The widest quantitative data set that was analysed in this evaluation resulted from a web based survey which covered co-ordinators of projects funded under NMP FP6 with a response rate of 56%. A fully representative coverage with regards to essential project characteristics such as type of instrument and NMP-subarea (nanotechnology, materials, production processes etc.) was reached. It should be noted that not all co-ordinators were familiar with all the different objectives and dimensions or have a sense of their project's contribution to different strategic goals. Nevertheless, they did have insights into the context of their research and they were capable of assessing issues of the European R&D policy context, both linked to their R&D projects and apart from their own activities, on a more abstract level. Another important issue in this context is that 71% of the projects covered by the survey were finished before the survey was launched in September 2009.

In the final stage of the project, case studies have been prepared, covering national policies that were relevant to the evaluation questions. The evaluation team has not been limiting this part of research only to best practices, but tried to identify and describe novel, specific approaches and solutions implemented in different countries.

The whole evaluation process was assisted by comments and recommendations from a Guidance Group of external independent experts in the NMP field and in evaluation methodology, both with regards to the tools used and their implementation, as well as deliverables and their content. Another feedback input has been provided by the European Commission evaluation project officers responsible for the evaluation at hand.

Findings

Full information about the findings can be found in respective chapters of this evaluation report. In this paragraph a short summary of findings is presented within the framework of main evaluations questions:

1) To what extent were the **objectives** assigned to NMP FP6 met or reached?

A large part of this evaluation report is dedicated to the analysis of the objectives and the extent to what they were met or reached. The reason for that lies in the way these objectives were designed and formulated, as no quantifiable target parameters of success were defined at programme, area, or topic level. In addition, the set of objectives – directly or indirectly linked to NMP FP6 – covers a substantial range of targets, making it impossible to find easy answers to this question.

The strategic evaluation at hand aimed at understanding the impact NMP had in terms of changing Europe in different desirable directions, including the wider context of the European Union such as its established goal to become the world's most competitive knowledge-based economy (the Lisbon Agenda), an increased international co-operation of researchers including the reduction of barriers for researchers' mobility (the European Research Area, ERA) and general objectives regarding all sorts of developments towards an increased sustainability of production, consumption, transport etc. Apart from these wider objectives, NMP was of course endowed with its own rather specific goals and objectives. Naturally, these do not only have to be seen as having derived from overall European goals but as actual distillations. Therefore, the overlaps are manifold and sometimes blur the boundaries between different agendas, objectives etc.

In sum, the objectives assigned to NMP FP6 have been achieved to different extents in different areas and by different instruments. NMP FP6 was quite successful with regard to the production and strengthening of excellent and new knowledge (but not necessarily 1st class knowledge), critical mass, shifts in research, and education/career chances/mobility of/for researchers. The interviews revealed that the impact on environmental sustainability was positive and substantial. In contrast, project coordinators judged the impact linked to commercialisation issues and especially to sustainability and environment issues (Gothenburg objectives) as not that important. This different result refers to project coordinators considering the immediate, more visible impact of their projects, which they considered were more visible for other areas than environmental sustainability. Most of the project results did not reach the commercialisation phase until the end of NMP FP6, it would have been difficult for them to estimate the impact on environmental sustainability in the long run.

A more general increase in the market-orientation of R&D was achieved, as well as an increasing cooperation between academia and industry. However, the programme showed significant difficulties involving SMEs, which partially were inherent in the complex design of the programme, and lack of knowledge in companies. It also appears that NMP FP6-funded projects contributed more to the creation of new knowledge (i.e. "creation of excellent knowledge", "strengthening of existing scientific and technological excellence") as well as to shifts in research towards exploitation and industrial utilisation than to commercialisation, yet.

One of the main objectives of NMP FP6 was to create '**critical mass**' without any notion of what this might be. Since the term itself is not defined (neither on programme nor project level) and is not connected to any quantitative target measure, the analyses have to remain on a purely qualitative level. However, interviews revealed that experts' and

participants' **assessed that NMP FP6 supported** the achievement of critical mass by means of **providing sufficient resources** for individual projects and therefore, the programme as such, especially in the nanotechnology and nanoscience area.

The allocated funds in NMP FP6 seem to have reached a critical mass in the nanotechnology area, due to, among others, the higher promotion and visibility of the 'nanotechnology' area, compared with the new materials, new production processes and devices areas. Although a high relevance of the priorities and the key scientific and technological challenges identified in NMP FP6, safety regulations, toxicity-, health risks and ethical issues related to NMP – were not promoted strongly enough either at the national level or in NMP FP6.

2) What have been the nature, relevance and value of the **results** produced?

In terms of the outcomes of NMP FP6, the promotion of nanotechnologies in Europe is considered to be strategically important. Through the promotion of nanotechnologies, development of an Action Plan and efforts towards a European Strategy for Nanotechnologies, which are major outcomes in their own rights, the NMP FP6 programme has contributed to mainstreaming national programmes and to facilitating the development of a European Research Area as well as triggering the member states to establish own agendas and strategies for nanotechnologies nationally. Key industrial challenges were faced within different research projects, but they were not declared to be finally dealt with. The knowledge was rather considered to be only "high class knowledge" rather than "first class" in many cases.

NMP FP6 not only brought NMP on the political agenda but supported the establishment of certain dynamics in the field, in terms of RTD cooperation and networks between a variety of actors, sectors and disciplines, through both enhancing the existing teams, but also encouraging new teams and approaches. Furthermore, the thematic priority facilitated processes that frequently include research that was initiated by already established research teams under previous FPs, developed in NMP FP6 and continue in FP7 and beyond, which extend into – and influence – other research fields and technologies beyond central NMP-fields.

Affecting research fields and technologies beyond NMP, the NMP FP6 has without a doubt contributed to the scientific advancement and integration of nanotechnology RTD in Europe, in terms of publications in high ranked journals, innovation related outputs, patents and spin-offs. Areas such as nanomedicine, forestry, energy, electronics, textiles, machine tools and robotics have been considered by the experts to have advanced considerably through the NMP FP6 projects. To what extent the knowledge related results constituted first class knowledge it was difficult to estimate, although the nanotechnology area seems to be the area which has come furthest in this respect in NMP FP6. Moreover, difficulties in attracting first class knowledge industry-driven research may have an implication upon the nature of the results in NMP FP6.

Generally, the NMP FP6 set-up allowed participation of new research teams and partnerships and constituted a favourable environment for developing sustainable collaborations in the field of NMP and beyond. Capacities to establish and maintain new cooperative relationships significantly improved for a majority of participants in NMP FP6. However, the tangible effect on sustainable co-operations among researchers appears to be somewhat limited.

In general, the new knowledge and know-how produced is considered as being not sufficiently disseminated and used by final users, especially by industry. Besides the access to (new) knowledge, which can be perceived as a preparatory effort for an actual

knowledge transfer, the analyses indicate a well developed access to, or actually joint usage of physical R&D-related infrastructure and furthermore a remarkable exchange of personnel within the projects reflecting actual knowledge and technology transfer. It also appears that the projects within NMP FP6 contributed to a large extent to an improvement of the programme-objective "knowledge and technology transfer", when assessed in a more general context among different other objectives.

Participating in NMP FP6 clearly had positive effects on research related investments and R&D expenditures, whether they originate in the research consortia's own budgets or private third-party funding. However, these results have been achieved to a different degree and the main reasons for the weaker mobilisation of private capital lie in the uncertainty of an economic utilisation of the research conducted, the risk of failure and difficulties in handling IPR.

3) How **relevant and effective** was the programme from its design to its implementation?

Among the general findings regarding the relevance and effectiveness of NMP FP6 was the conclusion that the design-related aspects were more effective than the administration-related implementation aspects of the programme. Opportunities to cooperate with international partners, the expected higher level of research and a better thematic adequacy offered by NMP FP6 have been found to be among the most important factors which triggered participation in the programme.

The revision of the Work Programmes in NMP FP6 worked fine in general although transparency could be improved. The reaction and adaption to changes in the scientific and industrial scene affecting NMP technologies took place quite appropriately. Some ETPs' role in shaping the priorities has been positive and their importance was increasing. Although the priorities and the topics were relevant and actual in NMP FP6, the selection and the focus of priorities, among which the industry focus, improved towards the end of the programme.

In spite of NMP FP6 alignment with the Member States, the USA and Japan in addressing key scientific, technical and industrial challenges in terms of transforming their old industries, a greater market orientation of the research and closer co-operation with the industry stakeholders in Europe is considered to be a key European problem. However, it is important to add that NMP FP6 was the only programme worldwide which was implemented using the split of areas defined as N, M and P. Other national programmes use different layouts (in most of cases wide research programmes covering all disciplines, or industry/sector related programmes, where pure nanotechnology or pure materials-related programmes are listed as a separate discipline, or an enabling technology).

Analyses of existing measures and their results in Member States indicate three groups of countries – both in a technological and in political context: front runners, fast second movers and followers. Still in terms of selection of priorities all Member States tend to concentrate their funding in the topics, where they already have a competitive advantage of some kind (existing knowledge, research resources or industry base). To this point NMP FP6 managed to offer a wide variety of possibilities (relevant research topics) for all interested actors to participate, and was treated as a complementary and attractive source of funding for many research teams simultaneously operating in national programmes. European funding was considered to be very attractive also for new research teams, especially by the representatives from followers' and second movers' countries. Simultaneously, long and complicated procedures and low success rate for the newcomers appeared to be discouraging for this group of beneficiaries, especially including SME.

When comparing to Member States, their programmes' priorities are designed (especially those investing larger amounts into research) to make the best use of the existing country potential and to meet the interests of national research teams, political bodies and industry lobbyists. MS programmes' objectives have similar strategic dimensions, but the measurement of accomplishment of those strategic objectives is not undertaken. The evaluations are concentrated rather on direct results on project level and implementation issues, then on measuring the overall strategic impact.

To some extent, there was a connection between changes in the priorities and focus in national programmes (at least for some MS) and the outcomes of the revision process of the work programme in NMP FP6, through the consultation process which usually involved national delegates and experts active both at the national level and EU level. The choice of priorities and focus in NMP FP6 and those in national NMP-related programmes influenced each other in different ways and to a different extent. The hypothesis that NMP frontrunners, which also are the biggest countries in Europe, influenced the priorities and focus in NMP FP6, while an inverse influence being the case for the second-movers and follower countries, which include smaller countries and new MS, seems to have got some support in this evaluation.

4) What were the **impacts** with regard to the ERA and Lisbon objectives?

The overall contribution of NMP FP6 to the issue of transforming Europe into a more attractive working place for researchers from outside Europe (Lisbon Agenda) was assessed to be rather weak, while the contribution of NMP FP6 projects to an increased mobility *within* Europe and the attraction of skilled employees / researchers from EU countries was considered to be quite substantial.

Through a research agenda driven by industry, involving the ETPs and industry stakeholders, the multidisciplinary character and the efforts made to integrate actors, sectors and disciplines in NMP FP6, effects upon the increased orientation of European RTD towards the market are to be expected, although issues such as SME involvement and IPR exploitation were present and posed difficulties in this respect. By successfully integrating researchers both in academia and in businesses, by ensuring a multidisciplinary environment in the projects and opening for co-operation with countries beyond the EU and by providing increased career opportunities for young researchers, has NMP FP6 moved closer towards ERA objectives. There are aspects which still have to be improved such as reducing legal and practical barriers hampering mobility across institutions, better knowledge of and experience about IPR among the researchers and hesitance from the industry to bring in their cutting edge research into the FP financed RTD. ERA-NETs great potential for producing trans-national research collaborations plays an important role in improving the coherence of implementation of national and EU RTD activities and in the area of co-ordinated funding in NMP.

As requested, the evaluation team established a comprehensive matrix of indicators for possible future use by European Commission, based on analysis of correlations between various strategic documents (see Chapter **Feil! Fant ikke referansekilden.**).

5) What are the main **lessons learnt** and the possible recommended actions which could be derived from this evaluation?

A comprehensive list of recommendations is presented in the paragraph below, summarizing findings and recommendations described in full in **Feil! Fant ikke referansekilden.**.

Recommendations

An overview of the recommendations is presented below with a split corresponding to their possible application range.

NMP FP6-related recommendations

1. **NMP rationale:** Make the rationale behind NMP subareas integration more explicit, underline M and P subareas role in the programme. Perhaps incorporate M and P into Nanotechnology Action Plan.
2. **Use existing platforms:** Use existing mechanisms for stakeholders' involvement through current platforms within the planning processes. Cross link existing mutually relevant platforms.
3. **European Distinctiveness in a global marketplace:** Include quantitative and qualitative technology mapping and foresight studies in NMP to identify key fields of European expertise in the NMP area, and to adjust funding levels according to identified key development research fields.
4. **Simplification of Procedures:** Simplify application procedures aimed at enhancing participation of new research teams from "second movers" and "followers" countries. This must be associated with support measures for newcomers to receive necessary application support and with further simplification of project reporting and accounting procedure for all programme participants.
5. **Multi Disciplinary Projects:** The focus on encouraging and funding multi-disciplinary research projects should be maintained or intensified.
6. **Fine Tuning with Regard to Targets:** Make the targets of the different instruments applied in NMP FP6 clearer and more distinct. Consequently, the fine-tuning of the instruments with regards to their targets should be considered.
7. **Joint cross-thematic calls to meet user demand side:** Increase the number of joint calls of different thematic priorities in areas that are heavily interlinked and where such joint calls meet a respective demand on the user's side.
8. **Address Societal Challenges with public debate studies and regulatory works:** Intensify and target major societal challenges using NMP in such areas as: healthcare for the ageing population, issues related to energy, protection of the environment, sustainability in all production processes, reduction of waste in materials. Open a debate on the creation of a system of NMP-related regulations, assuring a safe and responsible approach to research in NMP areas in Europe.
9. **First Class Knowledge and Time-to-Contract:** Define "first class knowledge" in detail to be able to measure the degree of achieved first class knowledge. Time-to-contract indicators are to be lowered to assure more industry engagement and therefore generating first class knowledge and focusing on market orientation.
10. **Detailed and Coherent Commercialisation Strategy and Commercialisation Platform:** Create a new type of policy instrument with the primary aim of bringing European technologies to the market, e.g. a European NMP Commercialisation Platform

gathering stakeholders committed to commercialisation, should be set up to enable action upon the ECs wish to increase commercialisation.

11. **Communication of EC Pipeline:** Implement a direct action to let venture capitals access the EC project pipeline, and for researchers to hear about the market potential of their work.
12. **Transparency of Negotiations and Information Flow:** Increase the transparency of negotiations and assure information flow during planning and revision processes related to NMP

General recommendations with regard to implementation of Framework Programmes based on the findings from this evaluation:

13. **Support measures for research teams:** Consider additional funding for dedicated project preparation, awareness building and support measures for new research teams in MS. Continue simplification of the reporting and accounting procedures.
14. **Infrastructure:** Include infrastructure as an important planning dimension for shaping future research priorities in Europe. Coordinate with structural funds implementation.
15. **Dissemination of Knowledge:** Intensify dissemination activities towards industry and the broader public. Use PUDK/PUDF to larger extent.
16. **Support for Start-Up Companies:** Support start-up companies, for instance by provision of efficient incubator facilities.
17. **IPR Protection and Innovations to market:** Intensify investigation into the reasons behind the scarcity of inventions being transformed into innovations and eventually protected by means of IPR.
18. **SMART Targets and Long Term Monitoring:** Define future objectives for NMP with use of SMART targets. Develop a monitoring and evaluation indicators system that will allow comparing impact of the programme over a long time period (10 years at least), with estimated targets to be reached