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COUNCIL REGULATION

Setting up the "ENIAC Joint Undertaking"

IMPACT ASSESSMENT

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Analysis of the effects of a Joint Technology Initiative (JTI)

in the area of Nanoelectronics

European Commission, Information Society & Media DG

Nanoelectronics (G1)

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CONTENTS

1. EXECUTIVE SUMMARY 5

2. Procedural Issues and Consultation of Interested Parties 11

3. Problem Definition 13

3.1. What is the Issue or Problem that may require Action? 13

3.2. What are the Underlying Drivers of the Problem? 16

3.3. What are the Risks in the Current Situation? 18

3.4. Who is Affected, in What Ways, and to What Extent? 19

3.5. How would the Problem Evolve, All Things Being Equal? Is an intervention at Community level justified? 21

3.6. What are the Overall Policy Objectives and What are the Expected Effects? 23

3.6.1. Policy Objectives 23

3.6.2. Expected Effects 24

4. Policy Options 29

4.1. Approach to reach the objectives 29

4.2. Options discarded 32

4.3. Conclusions of the different approaches 33

4.4. Option Scenarios 34

5. Structure and Governance of the ENIAC Joint Undertaking 35

5.1. Participation and Legal Form 35

5.2. Governance Structure 35

5.3. Operations and Funding Model 36

5.4. Appropriateness of Governance Model of the Joint Undertaking 38

6. Analysis of Impacts 39

6.1. Economic Impact 39

6.1.1. Impact of Strengthening and Coordinating R&D 39

6.1.2. Impact of Achieving the Technological and Economic Objectives 45

6.1.3. General Economic Impacts 52

6.2. Social and Environmental Impact 54

6.2.1. Social Impact 54

6.2.2. Environmental Impact 55

7. Benefits and Risks 59
7.1. What if no action? 59
7.2. Benefits and Risks for Stakeholders 59
7.3. Relation of the JTI research with Community Programmes and EUREKA research 64
8. Meeting the Evaluation Criteria for JTIs 68
9. Monitoring and Evaluation 71
10. Annex I The importance of Nanoelectronics 72
11. Annex II The European Technology Platform in Nanoelectronics 79

1. EXECUTIVE SUMMARY

Introduction

A Joint Technology Initiative (JTI), a public-private partnership between industry, Member States and the Commission, is planned for nanoelectronics, with as major objectives:

- to increase and coordinate in a single programme the resources needed for industrially-driven cooperative R&D in Europe and to transfer results in major application sectors;

- to increase the level of strategic partnerships and initiatives among European partners and to provide European industry with the critical mass in terms of resources and competencies to play a significant role at global level;

- to experiment a new way of executing industrial R&D in order to efficiently anticipate the changing business and research models, more adapted to industrial needs in particular for SMEs, combining for the first time national, EU and private funding.

This document focuses on the impact analysis of such a JTI, based on the results of extensive consultations of the Commission with stakeholders in the nanoelectronics domain.

Problems and challenges

Nanoelectronics is pervasive and the motor for innovation in many areas today including mobile communications, transport, computing, consumer products, and manufacturing automation. This gives it a large economic impact or a high socio-economic relevance as for security, healthcare, aging, energy saving, and environmental monitoring. Europe must safeguard its capability to design and produce its products following its own standards of high quality, sustainability and environmental friendliness.

Nanoelectronics is a global market ($265bn in 2005) directly stimulating a larger electronics industry ($1340bn) but Europe is not gaining market share. Europe is a net importer of nanoelectronics: 12% of the worldwide semiconductor production capacity is located in Europe, while 20% of the worldwide semiconductor products are consumed in Europe. The global competition is fierce, especially by countries like Taiwan, Korea, China and the USA.

Business models are changing. Nanoelectronics becomes a global activity. Integrated Design and Manufacturing (IDM) companies are increasingly relying on foundries (third-party fabs) and go fab-lite for their added-value operations or even fab-less, cooperating in ecosystems of knowledge for their R&D and in strategic alliances for their access to the most advanced technologies. This is the result of the growing capital investments (e.g. 5.5 B€ for a typical mega fab) required to research and manufacture the new generations of components. This goes above what individual companies can afford (except Intel) in terms of return on investment and rate (18%) of research. Consequently, generic nanoelectronics technology research is executed in a few major alliances, while manufacturing of advanced commodity products is done in a few mega fabs. Europe must assure that its companies can play a strategic role in these global alliances and can keep added-value operations including advanced manufacturing in Europe, accessible to European partners (including SME's active in equipment, support, systems integration and design). One of the main competitive risks is a 'technological lockout'. European suppliers might fall so far behind their competitors that they are unable to catch up.

Research models are changing. Europe must further assure that the research can be executed on European soil in order to maintain high added-value jobs in Europe. This requires a shift from the linear model where research results are transferred from universities to institutes and industry, into a model where research is done in cooperation, deeply embedded in the industrial web supporting the knowledge ecosystems. Moreover the research must produce sufficient critical mass and allow for sharing access to expensive state-of-the-art infrastructures, supporting the European industry and its researchers in acting globally.

Delocalisation of nanoelectronics manufacturing holds a real risk of migrating also added-value activities toother parts of the world. Some countries have developed special incentives to attract and retain foreign semiconductor investment, whereas the EU lacks a dedicated sectoral approach to support this key industry. Europe must react with comparable measures.

Product performance and functionality is growing. Advances in miniaturisation allow ICT to be embedded everywhere, providing enhanced functionality, more intelligence and more personalised products and services. These added-value operations are key elements for product diversification and a strong European competence. They form the basis for a European Strategic Research Agenda combining miniaturisation with other system integration elements aimed at key European lead markets. This holds a huge economic potential in the knowledge-based society. Europe can just not afford to miss this future and become dependent for its social progress and well-being on other regions of the world. The semiconductor industry will also have to face the challenge of combining the shortening of the product life cycles with the increasing complexity of those products. In fact, only a significant investment in advanced R&D allows keeping up the pace of innovation in this sector.

Technological challenges are manifold. As technologies shrink in the nano domain, research is becoming increasingly multi-disciplinary. Bringing European competencies together is essential for future progress. The rising complexity to overcome the technological roadblocks requires increased human effort and an expensive infrastructure. Mobilisation of all resources and worldwide cooperation is required to realise the milestones. It is also expected that traditional miniaturisation will reach its limits in 10-15 years. Activities have to be started to prepare for beyond the traditional scaling of devices. Part of the R&D will have to focus on improving the efficiency of production. The capabilities to design new products are lagging behind the technological progress. The European research fabric will need to redirect itself to take better account of the technological opportunities and will need to invest more in applied research. This requires a fundamental shift from single science, technology thinking into multi-disciplinary system thinking.

Europe's public research investments in nanoelectronics are fragmented: Eureka, the Framework Programme (FP), national/regional initiatives (including various 'pôles de compétitivité'). Consequently, Europe's research landscape is in the need of a convincing, efficient coordinated approach in the area of nanoelectronics.

Market failures justify a public intervention in the nanoelectronics domain. Basic knowledge, developments of new equipment, materials and design tools are cross-cutting many applications, are difficult to protect, create many knowledge spillovers and are to be considered as "public good". Research is speculative and exploitation of the results uncertain with fierce global competition which creates imperfect and asymmetric information. SMEs engaged in high-tech innovative projects may find it difficult to reach critical mass to compete at worldwide level. The pervasiveness of nanoelectronics across a wide range of industries, public sector tasks and societal applications makes it impossible for R&D actors to reap the full return of their efforts. This creates major R&D spillovers and positive externalities. Coordination and networking problems among market actors, public sector, and cross-sectoral application domains also justify public intervention in pre-competitive R&D.

Policy

Stakeholders have recognised the critical nature of the problems and have gathered in the ENIAC European Technology Platform (ETP), in which all players work together to reinforce the EU's leading position in the design, integration and supply of nanoelectronics. The platform has published a Strategic Research Agenda (SRA) outlining the evolution of the field from a medium- to long-term perspective and identifying a number of important technological and regulatory challenges for Europe.

The proposed ENIAC JTI will be one of the pillars for implementing the **technological and economic objectives** of the ENIAC ETP. The JTI is to contribute to sharing the escalating costs of the R&D activities and infrastructures; take or maintain leadership in diversifying applications of semiconductor technologies; manage breakthroughs in technology and in design in order to fill the ever-widening gap between technologically achievable and economically feasible; provide SMEs with effective tools to support them in their innovation process and to act at global level.

Several options to implement the JTI were evaluated and discarded. These vary from doing nothing (business as usual) to participation in joint actions by Member States (with various legal models). Only a new action at Community level can develop an approach that combines the benefits of European integration with fast alignment of goals and industrial policies and with flexibility in participation and national commitment by Member States.

The analysis of the potential implementation options for the ENIAC JTI concluded that **a 'Joint Undertaking' model** on basis of Article 171 of the Treaty **is the only option that satisfies the constraints and requirements to achieve the objectives.** It's a structure durable over time with legal personality that (a) provides a legal framework for the collaboration of all public and private stakeholders, (b) is capable of receiving funding from different sources, and (c) is capable of launching major initiatives of longer duration.

It is further expected that the JTI will create **additionality** in terms of extra R&D expenditure thanks to the foreseen EC investment of €450m leveraging a €3bn programme with additional national support and greater industry funding (1 euro of the EC contribution to leverage an expected 6 to 7 euros of R&D effort). More importantly the JTI will create **'behaviour additionality'** in terms of European collaborative projects launched, acceleration of R&D results, expanded scale, scope and complexity of the projects.

Structure and governance

The founding members of the ENIAC Joint Undertaking (JU) would be Member States, the European Community and R&D performers. Other members can join the JU at a later stage. The R&D performers, i.e. industry and research organisations, are represented in the JU via an association called AENEAS. The statutes of this association have to follow the general principles of fairness, transparency and openness for accession.

The Governance Structure of the Joint Undertaking is made of a Governing Board, an Industry and Research Committee, a Public Authorities Board (PAB) and an Executive Director with a Secretariat.

The JU will elaborate a multi-annual work programme based on the SRA, under which R&D activities will be implemented through open calls for proposals. Participation to these calls will be open to all organisations and not only to the members of the association. State members of the JU will annually commit resources that will be mainly spent to fund their respective national participants. The EC will also commit a budget (contributed by the FP). Industry will cover more than 50% of its R&D cost for the JU through in-kind contributions. In addition, industry will cover approximately two thirds of the operational and non-R&D costs of the JU through cash contributions.

Economic Impact

European public funds act as a magnet for further private and national investments. Many national policies are being aligned with the European ones. Several new strategic initiatives are launched by Member States to support these technologies.

The total nanoelectronics value chain is concerned by this initiative. It is therefore of vital importance to build anchors for European top companies to stay here. Such anchors will be made of pools of competence and will be created through the fostering of networking between companies and research institutes. Furthermore, strategic alliances between nanoelectronics component suppliers and system designers will provide more incentives to keep knowledge in Europe and to create diversified products with a European flavour.

The impact of achieving the JTI technical objectives will bring Europe at par with other players worldwide for being considered a strategically important partner in global alliances in view of the diversification and integration of complex systems.

The JTI will remove uncertainty by creating the stability for investing in a long lasting initiative. Especially for SMEs, the new arrangements will offer a more attractive regime. A further benefit of the JTI compared to the current co-existence of various schemes is the increased efficiency of EU-level disbursements, the savings expected from avoiding preparation of proposals in different languages, the streamlined project reporting procedures and an increased success rate due to guaranteed harmonised funding procedures.

Social and environmental impact

The JTI will contribute to maintain and create more and better quality jobs, in line with the re-launched Lisbon strategy. Mainly the greater use of nanoelectronics-based products and services will lead to the creation of several thousands of jobs in Europe.

The JTI is oriented towards the vision of 'ambient intelligence': environments that are aware of our presence and responsive to our needs. The JTI targets such environments with six application domains: healthcare, energy, mobility & transport, security & safety, communication and education & environment. All have a high social relevance and contribute to improving the quality of life and well being in our society. Unless the public sector intervenes with adequate support, it is clear that individual firms cannot expect sufficient returns to justify the level of R&D investments that would be socially optimal. For instance, this applies to environmental monitoring and management which is a key application area for the JTI.

All electronic systems use electricity and are part of a general trend towards the 'electrification' of society. However, use of electronic systems also allows better management and control of energy efficiency. For example, nanoelectronics will be essential in the intelligent portable systems needed to reduce energy consumptions in the house, in the plants and in the transport systems that will be a key factor for the protection of the environment. In many applications this is their primary purpose. Moreover, reduced power consumption for electronic devices is an important and ongoing technical objective.

Nanoelectronics must be developed in a safe and responsible manner, in line with the European Commission's safe, integrated and responsible strategy for nanosciences and nanotechnologies for Europe in its Communications "Towards a European Strategy for Nanotechnology" COM(2004) 338 and "Nanosciences and nanotechnologies: An action plan for Europe 2005-2009" (COM(2005) 243). The strategy confirms that nanotechnology and nanoparticle developments should address any potential public health, safety, environmental and consumer risks upfront by generating the data needed for risk assessment, integrating risk assessment into every step of the life cycle of nanotechnology-based products, and adapting existing methodologies and, as necessary, developing novel ones. The establishment of the Nanoelectronics Joint Undertaking will bring all stakeholders together to discuss these important issues, to agree on common ways to address any potential risks and more specifically to call on common measures to support environmentally sound management of nanoelectronics life-cycle.

Benefits and Risks

The overall financial support from the EC in the area of nanoelectronics will increase during FP7.

The risks for the FP are very low. The EC contribution is conditional on the contributions of the Member States and will be made in annual commitments/disbursements depending on the progress of the JTI.

It is expected that part of the activities in the area of nanoelectronics currently supported within the Eureka clusters will be progressively integrated in the ENIAC JTI.

What if no action? Europe may run the risk that the competence to integrate new functionalities into smart systems will follow the off-shoring trend of commodity manufacturing, weakening in the long run the capability to produce in Europe added-value in electronic systems. This would result in a dramatic decrease in competitiveness in general, particularly as nanoelectronics is at the bottom of a wide food-chain forming the basis of the knowledge society and a motor for the future economy at large. This would also have major consequences for the number of high quality jobs, not only in the hardware sector but for all other activities dependent on hardware innovation. In order to avoid such a doom scenario, there is a political will to safeguard more European competence on European soil while encouraging strategic alliances to form knowledge-based ecosystems as well as to strengthen European presence in global alliances.

Monitoring

The JTI will be concurrent with FP7 and will be subject to similar procedures of monitoring and evaluation. The ENIAC SRA provides the baseline for assessments, of which the criteria could include increase in investment, efficiency in procedures, technological progress, non-technological activities and involvement of SMEs and new players. Two monitoring assessments are foreseen: one at the mid-term and one at the end of the life of the Joint Undertaking.

Conclusion

A JTI on nanoelectronics is proposed to help safeguard European competitiveness in nanoelectronics. An integrated European initiative of longer duration designed to link the different required competences together will deepen the strategic alliances between European partners providing for sufficient critical mass in terms of resources, access to infrastructure and competences to compete or cooperate at worldwide level.

2. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

This document focuses on the impact analysis and ex-ante evaluation of a Joint Technology Initiative (JTI) in the area of nanoelectronics and on a review of the potential governance arrangements. The procedures followed reflect the Commission's guidelines for ex-ante impact assessments[1]. Parts of the impact assessment were subject to contracts with external consultants awarded after tendering procedures.

The impact assessment drew on the results of extensive consultations of the Commission with stakeholders in the nanoelectronics domain following the development of the ENIAC Technology Platform[2] established in June 2003. More than 30 meetings were held with the industrial Forum of Stakeholders, the Steering Committee[3] and several Working Groups (in particular the Strategic Research Agenda (SRA) and Governance groups), and the national public authorities represented in the "Mirror Group[4]" gathering representatives from 21 Member States and Associated Countries. The relevant topics for this impact assessment such as the Strategic Research Agenda and the Joint Technology Initiative have been publicly presented and discussed in major events such as the ENIAC annual meetings (Brussels 2004, Leuven 2005, Monaco 2006), the Information Society Technologies Conference IST-2006 (Helsinki) and the public presentations of the ENIAC SRA in November 2005 and November 2006.

In the final step of this consultation process, representatives of the ENIAC Steering Committee and the Mirror Group met with an external consultant on three occasions over the period July-September 2006. These meetings focused specifically on the contents of this report and involved wide-ranging discussions to compile previous results, provide further inputs and to review the results. The study also undertook an in-depth assessment of the proposed governance structure of the Joint Undertaking implementing the Joint Technology Initiative.

For economic analyses the assessment has drawn primarily on public domain market data, but also on studies that provide a detailed picture of R&D and market trends in nanoelectronics-related areas: *Effectiveness of R&D to increase the competitiveness of European industry in the sector of micro/nanoelectronics* by Inno Group (resulting from an open tendering procedure by the INFSO Nanoelectronics Unit) and *The European semiconductor industry 2005 competitiveness report* by ESIA, both published in end 2005. The Inno study presents an assessment of the current R&D activities in nanoelectronics as a whole that takes into account technological, sectoral, market-related and funding aspects. The ESIA study presents the status of the semiconductor sector in a global market, analyzes the main challenges ahead for Europe and makes a number of recommendations for maintaining and enhancing the competitiveness of the European semiconductor industry.

Finally, the interim drafts of the present paper were reviewed by the ENIAC Support Group, the Mirror Group and an ad-hoc inter-service group[5]. The recommendations from the

[1] *Impact Assessment Guidelines*, SEC(2005) 791, European Commission, 2005 with March 2006 update.
[2] ENIAC Technology Platform, http://www.eniac.eu
[3] Summarized in a written contribution by Pasquale Pistorio, Honorary Chairman STMicroelectronics, 12 September 2006
[4] Members of the Mirror Group are AT, BE, BG, CH, DE, DK, ES, FI, FR, GR, IE, IL, IT, LT, LV, MT, NL, NO, PT, SE, UK
[5] Representatives of DG BUDG, ECFIN, ENTR, LS, RTD, SG were invited

Commission's Impact Assessment Board[6] have also been adopted, leading to more focus in the main text and the addition of annexes for further background information.

The methodologies used in the present report, including rechecking original data sources, are satisfactory and represent a sound basis for assessing the economic impacts of the JTI.

[6]Opinion delivered on 30th May 2007

3. PROBLEM DEFINITION

3.1. What is the Issue or Problem that may require Action?

Europe's future success as a dynamic and competitive knowledge-based economy depends crucially on our ability to master developments in nanoelectronics and to foster a strong and competitive nanoelectronics-based industry. The importance of nanoelectronics as an enabler for innovation, its technological challenges and the worldwide competition are described in Annex I.

In a context of fierce competition and high innovation rate, Europe will be a strong actor if it is able to address the following problems:

- The **exploding R&D and manufacturing costs** for the next generations of components;
- The need to mobilize **more and different competences** in a multi-disciplinary and more coordinated manner to address the growing variety of the technology;
- The **high risks** associated with the technical challenges and the financial perspectives;
- The necessity to **react in a flexible and timely manner**, given the cyclical and rapidly changing nature of the industry involved;
- The need for a **holistic approach** to research, through strategic partnerships and large initiatives between the manufacturers and their customers, linking technology, manufacturing, design and application development;
- The capacity to efficiently exploit the opportunity offered by a vibrant **network of European SMEs** and the emerging "regions of knowledge".

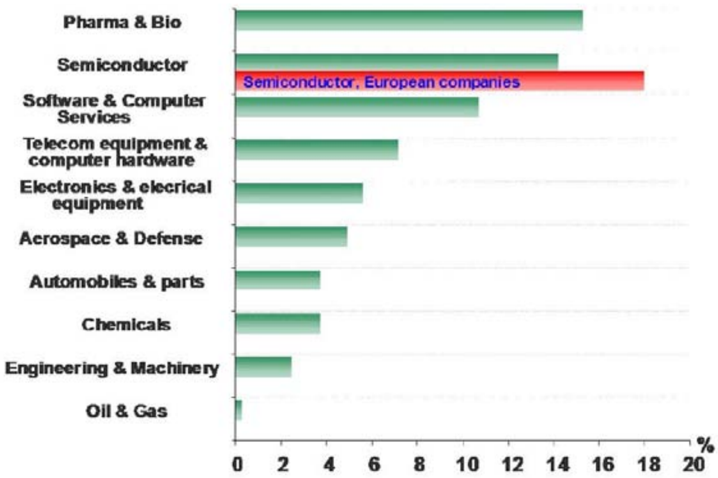
To reap the benefits of the upcoming technological progress, Europe needs to be able to turn multi-disciplinary scientific knowledge into industrial advances. Therefore, it is essential that a strong collaboration takes place at all levels: research organisations with industry, application drivers with technology pushes, public sector with private initiatives. This would allow the combination of technology-driven development with market-led research in one integrated effort.

Large Research Efforts for Nanoelectronics

The complexity of developing nanoelectronics components, both in designing and manufacturing the chips, requires a very high investment in R&D. In fact, the semiconductor industry is one of the most dependant sectors on its R&D intensity. In Europe, the semiconductor manufacturers have invested more than 18% of their annual sales in R&D over the last years (Figure 3-1).

While such an effort was necessary in order to take part and keep up in the global race, it is unlikely that the semiconductor manufacturers will keep increasing their total R&D expenditures in the next years. Their R&D investments have reached a ratio that would no longer be bearable if the up-going trend would continue. It is even predicted that, in order to stay competitive, the European R&D efforts will decrease in the next years and come closer to the worldwide average value of 14-15%.

Figure 3-1 : Research intensity (source: EC and MEDEA+)



However, the need for intense R&D is more than ever recognized as a key to success in making the next generations of components and integrated systems. In fact, only a visionary and significant project investing in advanced R&D and transfer into innovation will allow Europe to keep up with the pace of innovation in this sector. Hence, the future research landscape in nanoelectronics will most likely show a shift of some of the private R&D investments towards collaborative research inside strategic alliances allowing them to address the above problems. This should happen in a pre-competitive environment in which public intervention can help coordinate and leverage the required investments from all parties involved: industry, research organisations, universities and public bodies.

The Fragmentation of Research Funding in the EU

Europe's research investments in nanoelectronics are split across several initiatives: the EU's research Framework Programme, EUREKA, and national/regional initiatives, as well as industry's own proprietary R&D (Table 3-1). Total 'pre-competitive R&D' – that is carried out under public programmes - is estimated at around €1300m, which is roughly covering the sum of fundamental and applied research today. However, the required investments in fundamental and applied research are likely to increase in the future while the costs of product development will need to be strictly kept under control considering the shortening life cycles and the competition from other regions of the world. This shows that more public/private sources of financing the R&D activities may shift towards more advanced cooperative research efforts in Europe, targeting towards a ratio of public/private investments closer to 1/3-2/3 as in the Barcelona objectives.

Table 3-1 : European Expenditures on Nanoelectronics Research

Type of R&D	€M/yr	R&D Financing	€M/yr
Fundamental Research	300	EC Framework Programme	140
Applied Research	1100	EUREKA	260
Product Development	2200	National Programmes	500
Prototyping	1000	Regional Support	400
		Total Public Funding	1300
		Industry (proprietary)	3300
Total	**4600**		**4600**

Source: Inno Group, 2005

Europe has made **major investments in ICT research over a number of years under the Research Framework Programmes**. Concentrating on high-quality, the EU's ICT research programmes both focus and integrate Europe's ICT-based science and research and were the first to include the new Member States in collaborative projects. This effort is being renewed and expanded under the forthcoming Seventh Framework Programme (FP7). It includes a number of innovations to ensure research meets the needs of the European economy and society, including a seven-year timeframe for programme planning, increased budget and simpler procedures. Greater emphasis than in the past is given to the needs of European industry, to help the ICT sector compete internationally and develop its role as a world leader in key sectors. Nevertheless, the Framework Programme still has significant limitations: its contents reflect areas where EU25 can arrive to agreement for spending **a relatively small percentage of the EU's total public budget**. For example, FP6 amounted to only 5-6% of all public support for civilian research expenditure in the EU[7].

Moreover, the Framework Programme concentrates on pre-competitive innovation with a time horizon of 7+ years which is less suited for the time frame of industrially oriented nanoelectronics research. Despite putting emphasis on SMEs, the Framework Programme only reaches 20% participation when the nature of market-led research in nanoelectronics would benefit from 50 % participation.

Another funding mechanism is the **inter-governmental EUREKA scheme**. EUREKA has proved to be a valuable cooperation mechanism that complements the FP in important ways. In particular, it allows cross-national R&D cooperation in areas that this is a necessity but the FP budget would not be sufficient to sustain. The EUREKA framework has notched up some notable achievements over the years, most notably the longstanding collaborations in the form of "cluster projects" in the areas of microelectronics (the JESSI, MEDEA and MEDEA+, Eurimus, Pidea, Euripides clusters) and software-intensive systems (ITEA and ITEA2). These have been valuable cooperation mechanisms through which up to €260m of public funding are provided to R&D industrial projects every year. It is not a coincidence that all four current

[7] Cordis (Community Research and Development Information Service) database on Innovation articles

cluster projects of EUREKA concern the ICT domain; overall, around two-thirds of EUREKA project funds are estimated to be in the area of ICT.

However, EUREKA and its cluster projects also have well-recognised **shortcomings**. Its nature of an inter-governmental mechanism means that once a project has been accepted by EUREKA it often then needs to go through the national procedures of each partner for individual national grants just as any other national R&D project. On top of the duplication of evaluation and project monitoring procedures, the variable levels and predictability of public funding available have constantly weakened the effectiveness of the scheme. Up to date, EUREKA has not been able to correct or resolve these underlying problems[8]. Despite being capable to address industry-led research, the EUREKA set-up contributes to the fragmentation of the R&D landscape in nanoelectronics.

At **national level**[9], 14 out of 122 funding programmes in 23 EU Member States and Associated Countries are dedicated or have significant relevance for Nanoelectronics research. Similarly, 12 out of 30 Member and Associated States have identified Nanoelectronics as "a most important official ICT policy priority".

In front of the major challenges facing the European industry and economy, Europe's research landscape is fragmented and lacks in a convincing efficient approach in the area of nanoelectronics: the Framework Programme can define top-down priorities but requires broad agreement on priorities for budget allocation and its overall budget is severely limited compared to the overall public research budget in Europe; EUREKA is bottom-up but lacks efficiency and focus, and national efforts are scattered and not focused on common objectives.

Current Funding Instruments are Inadequate: The Need for Public and EU Intervention

Substantial added value can be realised by a European-level approach that draws together and intensifies some of the current research efforts (national, European or private) in order to address the needs of Europe in terms of industrial competitiveness. Europe has to step up its game, in quantity as well as quality, in nanoelectronics research in the face of fierce international competition. In such a fast-moving global market, Europe needs the ability of coherently focusing on common objectives, but also the ability to adapt the objectives to changing industrial and market circumstances. It must develop a European approach combining technology-driven and market-led research, building critical mass but also allowing flexibility at both strategic and operational levels without suffering all the drawbacks of inter-governmental schemes.

Current instruments do not provide the appropriate framework for mobilising European resources, on a large scale, around common objectives. They also lack the flexibility to allow Europe to go forward in a structured and organised way that allows a "variable geometry" in mobilising private, European and national funds while remaining effective and efficient.

3.2. What are the Underlying Drivers of the Problem?

Technological Complexity is Escalating R&D Expenses and Changing the R&D Landscape

[8]Annual Impact Report of EUREKA 2005 (May 2006)
[9]Cistrana survey. http://www.cistrana.org/, Cistrana is a project initiated by a European Research Area (ERA) working group of Member and Associated States.

In the last 30 years, the almost perpetual improvements in semiconductor performance coupled with cost reductions were achieved by miniaturisation technologies. These were following an empirical law, Moore's law dictating a doubling in density and performance every 2.5 to 3 years while it takes an average time of 6 years to develop one generation of technology. However the rising complexity, the required human capital and the investments in R&D and manufacturing are so huge now, that one can expect progress to slow down and that a more global cooperative effort will be required to take the next hurdles.

Research in manufacturing and technology that was so far undertaken at universities and institutes will need to be done in close collaboration with industrial entities. The linear model of transferring research from basic science to the manufacturing unit, involving different actors is no longer valid. Research will shift to a model where cooperation between all research actors in so-called competence clusters will become dominant. The European industry and research community has to follow these trends, and where possible to take the lead, in order to remain competitive.

Changing Business Models

Nanoelectronics becomes increasingly, because of its nature, a global activity. Offshore manufacturing in foundries is already practiced. Most new huge mega-fabs are being built in the Asian Pacific region (Taiwan, Japan, China, South Korea). Most of these plants are run by Alliances to share the risks and costs. Global cooperation becomes a must and is not any longer an option.

With costs of such plants approaching €5bn, Integrated Design and Manufacturing companies (so called IDMs) increasingly take the decision to work more closely with these foundries in order to keep up with the miniaturisation progress (Moore's Law). Progressively more IDMs allow the foundries to handle not only the traditional Integrated Circuit production but also R&D. Over time, the advantage from internal process technology for IDMs will become less a differentiator for many products.

Moreover the cost for research is growing at a faster pace compared to growth of the revenue. For instance European semiconductor companies spend between 16 and 18 % on research, which is higher than any other industry and above the worldwide level. Such a situation obviously calls for a further consolidation in bigger entities and for setting up more strategic alliances to deal with research as well as production and share the increasing risks.

Most of European semiconductor manufacturers are of the IDM type and plan to go into a "fab lighter" position covering system on chip design and, with respect to manufacturing, concentrate on more added value additional processes. In some cases the semiconductor part of their business is taken over by private equity. This change of business model calls for a deeper collaboration among the different actors. Moreover, the traditional value chain from manufacturer to systems designer becomes a value ecosystem, a cluster alliance, where research and developments are done in cooperation, and where all functions are individually optimised towards the total system level. In this changing landscape, many European companies offer excellence at system level in different application fields. They should maintain this position. Moreover, companies must also safeguard the possibility to design in their products societal, environmental and sustainability concerns specific to Europe.

Nanoelectronics have an immense potential for future applications but their research and industrialization need high levels of human, time, capital and competence resources. To make the required resources available in the short product cycles of the nanoelectronics industry will need strategic partnerships between all shareholders of the value-chain.

Impact and Limitations of Public Funding Policies

An important question in an industry as fast-moving as nanoelectronics is whether public R&D financing has a deep impact on the market. Some analysts consider support for near-market R&D projects not to be very efficient as they are subject to changes in company strategies[10]. On the other hand, other analysts have shown that large initiatives, such as the Japanese VLSI programme, the US Sematech programme, and the European JESSI, have played a critical role in allowing companies from those countries to stay at the forefront of competition. An appropriate conclusion would appear to be that a winning scenario is the convergence of public objectives with industry's strategic interests.

3.3. What are the Risks in the Current Situation?

The current situation in nanoelectronics development, which is characterised by increasing competitive pressures from globalisation, escalating investment costs, changing business and research models, and a fragmentation of research efforts, brings substantial threats and risks for Europe. ICT are not only crucial to the competitiveness of all industries, they also present opportunities to transform our economy and society in the face of major challenges such as population changes, climate change and sustainability. Nanoelectronics underpin the next generations of ICT systems that will facilitate this.

The current fragmented situation will lead to a **loss of competitiveness for Europe.** Electronics feed the whole economic food chain: the **opportunity to create jobs and innovate** new products and services **is at risk**. Nanoelectronics are so central to value creation in the modern world that an economy that fails to master nanoelectronics loses a significant part of its innovation capability. Europe must retain the high degree of flexibility and innovation necessary to adjust to the rapid pace of market change.

One of the main competitive risks is a '**technological lockout'**. Rising costs of capital investment and research as well as the increasing pace of technological change could lead to a situation where European suppliers fall so far behind their international competitors that they are unable to catch up. This situation would be made all the more risky by the industry's cyclical nature and above-average market volatility. If **loss of competitiveness** was to occur, it **would not be gradual but step-wise**, therefore creating huge knock-on effects for end-user industries and the EU's balance of trade.

From a technological point of view the risks are two-fold. In the short term, the development trajectory is well known – as set out in the ITRS roadmap; but without sustained and focused effort, Europe will be **unable to keep up with international competitors in realising the ITRS milestones** and ensure a distinctively European flavour in their interpretation. At the same time, we have to **intensify efforts to seek major breakthroughs in diversifying the technology for the long-term**, which will form the basis for future generations of electronic systems.

[10]For further discussion on these issues see *Effectiveness of R&D to Increase the Competitiveness of European Industry in the Sector of Micro/Nanoelectronics,* Inno Group, 2005

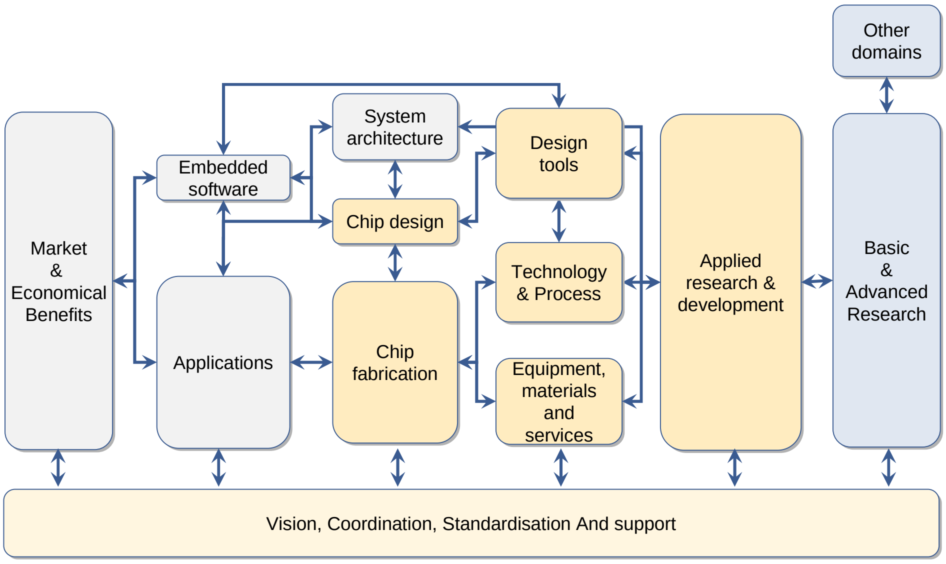
The European economy has benefited considerably from the success of its microelectronics industry. Over the last fifteen years, the sector has invested around $35bn in fabs, laboratories and R&D, thereby creating more than 50,000 highly qualified jobs and with a threefold 'trickledown effect' of locally created jobs[11]. So far, Europe has largely resisted the delocalisation trend that has affected other regions. **Delocalisation remains a threat, however, with a very real risk of first manufacturing and then higher added-value activities migrating to Asia**. Already we have seen the number of European designs stagnating.

Whereas China, Japan, Korea, Malaysia, Singapore, Taiwan and the US have developed special incentive schemes to attract and retain foreign semiconductor investment, **the EU lacks a dedicated sectoral approach to supporting this key industry**. Indeed, revisions to EU industrial policy over recent years have actually reduced the financial support for the large investments necessary for leading-edge semiconductor manufacturing facilities, leaving a void in large-scale future investment. Europe needs incentives to support the build-up of a competitive and distinctly European nanoelectronics industry.

3.4. Who is Affected, in What Ways, and to What Extent?

The nanoelectronics industry comprises of a complex value chain, running from basic research, technology and materials, through to design, manufacturing and applications (Figure 3-2).

Figure 3-2 : The Nanoelectronics Value Chain



Source: INNO Group. 2005

The European industry enjoys a good position, with three **integrated device manufacturers (IDMs)** among the world's top-ten nanoelectronics companies[12]. Europe also has more than ten much smaller IDMs, typically one or two generations behind in terms of technology and focusing on specific segments, like automotive, aerospace or telecommunications. In 2004, the total revenues of European IDMs were almost $28bn, of which $25bn was accounted for by 'the big three'.

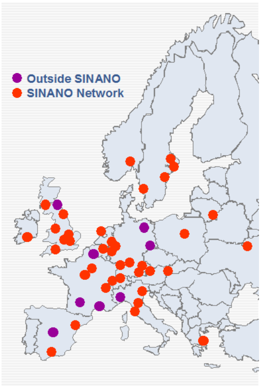
[11] *The Future of the European Microelectronics Industry,* MEDEA, 2003
[12] The 'big three' are: Infineon-Qimonda, STMicroelectronics and NXP Semiconductors (ex- Philips Semiconductors)

The last 20 years have seen a process of 'deverticalization', whereby it has become more and more difficult for a single company to master efficiently the whole value chain. The most recent manifestations of this have been the creation of **'fab-lite'** companies, who develop strategic niches in-house and partner with pure manufacturing fabs for 'standard' products, and **'fab-less' companies**, who choose to invest in design and marketing and to subcontract manufacturing to 'foundries'. Those companies require reduced capital investment, are in close contact with the market through application developers, and are not limited by the internal manufacturing technologies. To succeed, however, they need clear product differentiation, design expertise, strong controls over intellectual property and subcontracting. Europe has an array of fab-lite and fab-less companies as well as **innovative SMEs** specialising in areas such as Intellectual Property (IP-blocks) and application design.

Europe has been less strong in **semiconductor equipment**. Although it acquired a leading position in lithography, today's majority of equipment vendors are American or Japanese. Europe has no main player in the design automation tool market, although there are some promising start-ups. Indeed, the increased complexity, the number of materials used, the growing number of different processes and equipments open new opportunities for new entrants in this field.

There is a large array of **academic laboratories** throughout Europe involved in the nanoelectronics sector. Many of the laboratories are also focused on several other sectors, such as nanotechnology, microsystems, or solid-state physics. SINANO, a Network of Excellence in Silicon-based Nanoelectronics devices launched under FP6, groups 43 laboratories from 16 European countries. In addition, Europe has a strong base of **non-academic laboratories** including three major state-of-the-art laboratories mostly focused on applied R&D[13] (Figure 3-3).

Figure 3-3 : Research Laboratories involved in Nanoelectronics (source: SINANO, 2005)

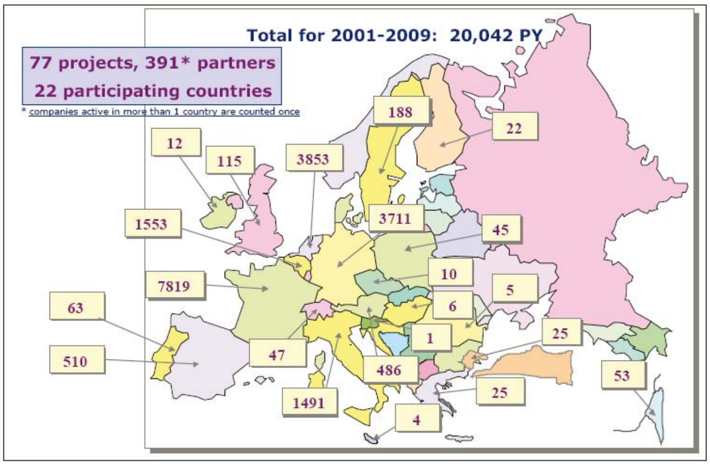


To illustrate the wide geographical spread of the industrial nanoelectronics sector in Europe, the following figure shows the location of the research partners involved in MEDEA+ (Figure 3-4). All those organisations are directly affected by any initiative touching upon the R&D investments in nanoelectronics, not just the 3 main semiconductor manufacturers. Their future is at stake, while the innovation capability in Europe would be seriously hindered by the lack of a strong, leading-edge nanoelectronics sector. This would impact many thousands of

[13] These laboratories are: Fraunhofer MicroElec Alliance, Germany (1600 staff, budget €170m per year); IMEC, Belgium (1300 staff, €160m/yr); and CEA-LETI (1430 staff, €157m/yr). Ref: *Inno Group, 2005*

companies throughout Europe, who rely heavily on advanced IT components for developing their own innovative products and services.

Figure 3-4 : Participants in MEDEA+ (source MEDEA+, 2006)



Public authorities are interested in the nanoelectronics arena as policy makers, regulators and funding bodies. They are looking to leverage their own research efforts, avoid duplication and develop synergies between national and European programmes and policies. Public authorities also have to be alert to the regulatory and policy issues arising from new applications, concerning aspects such as safety, security, digital trust and the environment.

Finally, European **citizens** are affected by nanoelectronics in a variety of ways: through lower cost products and services; through improved safety, security and quality of life arising from innovative applications; and through improved access and choice.

3.5. How would the Problem Evolve, All Things Being Equal? Is an intervention at Community level justified?

Hence, the nanoelectronics field in Europe has reached a turning point. It has the potential to drive innovation and growth and contribute significantly to European competitiveness and economic and social change. But it also faces a fragmented research landscape, escalating technological complexity and research costs, and increasing international competition. All of these factors are set to be exacerbated over the coming years, making the current approach unsustainable. **Europe must increase and make better use of its investments in this strategic area**.

Two major factors, underlined by ENIAC, highlight the necessity for the European Union to act:

- Welfare of the European nanoelectronics sector is strongly related to the establishment of a strong network of various competencies. No European state can claim to possess all of these top competencies.

- Huge R&D infrastructure investments are required in order to stay in the race driven by the ITRS roadmap. Today no European manufacturer has the ability to invest alone in such infrastructures. The sharing of infrastructures together with cooperative research on processes between industries and academia is therefore of prime importance. Moreover, it is widely recognised that local incentive schemes are the main contributors to the net cumulative income of the fab, even more so than the huge wages differences between developed and developing countries.

Setting up a limited number of megaprojects relevant to the semiconductor community is essential for its future presence in Europe. Such partnerships are a unique source for enhancing Europe's competitive edge across all sectors of the economy and for creating high-tech industry clusters as global poles of competitiveness of which Europe takes advantage. In addition to pre-competitive partnerships at a horizontal level, i.e. among semiconductor companies, increasing emphasis needs to be placed on encouraging vertical partnerships that integrate capabilities along the supply chain. The strategic objective here is to ensure competitiveness throughout the development and production chain and establish the links between semiconductor suppliers, manufacturers and end-user enterprises that are as synergistic as possible.

Source: The European Semiconductor Industry: 2005 Competitiveness Report

The above demonstrates the **necessity** to set up Europe-wide initiatives to support European competitiveness in the field of nanoelectronics. Moreover, synchronising the efforts to manage the portfolio of European competencies and infrastructures would enable Member States to achieve greater efficiency than would be made individually.

Market Failure and European Value Added of Community Intervention

A recent report on innovation market failures and state aid[14] has identified four major market failures that may have a significant impact on the innovation process and its exploitation:

- **R&D spillovers**: the process of undertaking innovation, or the end result of the innovation process (e.g., a product), often generates wider benefits (positive externalities). Left to the market, projects that, from a private perspective, are not directly profitable, but would generate large social benefits for instance, may not be taken forward.

- **Appropriability** : knowledge and ideas are often *non-excludable*: it can be difficult to exclude others from using the innovation and to make them pay individually for the benefit they receive. Again, firms may give up projects as a result.

- **Coordination**: firms rarely innovate alone. However, problems may exist that have an adverse impact on the ability of companies to coordinate or at least interact, and so deliver innovation. A wide range of problems may arise, including difficulties in coordinating R&D and inadequate access by smaller firms to the innovation system.

- **Imperfect and asymmetric information**: this affects, in particular, financial markets. Due to information problems, SMEs engaged in high-tech innovative projects with good prospects may find it difficult to obtain financial investments.

If an innovative sector is likely to be affected by one of these market failures, there is an indication that innovation is sub-optimal and that a public intervention has the possibility to increase the level of innovation and associated exploitation. Nanoelectronics is affected by all these factors.

[14] Innovation market failures and state aid: developing criteria – November 2005

Market failure in nanoelectronics would lead to a situation where the market is dominated by a few non-European players, which brings along the risk of tying European high-tech companies to the "good will" of a few market leaders in nanoelectronics technology.

Unless ambitious and concerted action is urgently taken, there is a risk that Asia and the US become the sole bastions of industrial excellence in this field, leveraging their strong investments and skills in nanoelectronics. This would have serious consequences for the competitiveness of the high-tech European companies. In addition, it could lead to organisations outside the EU creating an anti-competitive scenario in Europe. Indeed, considering that several non-European semiconductor manufacturers are vertically integrated with final products (e.g. Samsung), the European system companies would be forced to rely on competitors for the supply of critical components with the risk of losing ground in the race for innovation. The intervention of Public Authorities at European level is needed to create the necessary innovation environment for high-tech industry to thrive, as well as providing a state of the art research infrastructure.

It is clear that **only an action coordinated at Community level** can **develop an approach which combines the benefits of European integration with fast alignment of goals and industrial policies and with flexibility in participation and national commitment by Member States**.

3.6. What are the Overall Policy Objectives and What are the Expected Effects?

3.6.1. Policy Objectives

The overarching objective is to help **realise Europe's potential in the future markets for intelligent products, processes and services by strengthening and coordinating innovation and investment in nanoelectronics R&D**. This is fully in line with the Commission initiative[15] "i2010" (European Information society in 2010) in the context of the Lisbon strategy and the Barcelona objectives. The aim is to achieve world excellence in nanoelectronics, allowing the development of future generations of electronic components and their use in virtually any high-tech product and service offered to the citizens.

This is also in line with the vision of the European Technology Platform on Nanoelectronics (ENIAC ETP - see Annex II for further details), as set out in their Strategic Research Agenda[16] (SRA): to contribute to European competitiveness through pre-competitive, collaborative R&D on nanoelectronics. The SRA aims at securing global leadership, creating competitive products, sustaining high levels of innovation, and maintaining world-class skills within the EU.

That objective implies ambitious technological and economic objectives in response to the problems identified in the preceding sections:

(1) Share the escalating costs of the R&D activities and infrastructures in order to maintain Europe in line with the international industrial roadmap (30% cost reduction of elementary logical functions achieved by semiconductor components per year), and thus increase (or at least maintain) for the next 10 years the European market share for semiconductors from the current 18%.

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[15] Communication from the Commission COM(2005) 229 - The "i2010" initiative provides an integrated approach to information society and audio-visual policies in the EU

[16] ENIAC Strategic Research Agenda, First update, November 2006

(2) Take or maintain leadership in diversifying applications of semiconductor technologies and applying them to innovative markets, holding at least 30% of the worldwide nanoelectronics market share in at least 3 application domains.

(3) Manage breakthroughs in nanoelectronics design, in order to fill the ever-widening gap between what is achievable by the technology and what can economically be designed and tested. A step increase of the design productivity should be targeted within 5 years.

(4) Provide European SMEs with effective and efficient tools to support them in their innovation process by linking them to industrial technology leaders and state-of-the-art research organisations. Research projects should involve at least 40% of SMEs beside large industry and research organisations.

3.6.2. Expected Effects

By strengthening and coordinating innovation and investment in nanoelectronics R&D, Europe will contribute to the intense R&D effort that is required for the industrial and research organisations to take part in the global race, while overcoming the current fragmented R&D landscape. This will lead to more efficient and focused research efforts concentrating on key technologies and knowledge of importance to European players throughout the ICT value chain.

The technological and economic objectives address market failures for which public intervention is justified (Table 3-2).

Table 3-2 : Addressing Market Failures in R&D Domains

	R&D Spillover	Appropriability	Coordination	Information
1. Sharing costs	✓ New processes and technologies ✓ Exploitation of materials and technologies in other domains	✓ Agreed IPR arrangements	✓ Access to fabs for SMEs and R&D institutes ✓ Linking academic research with industrial priorities ✓ Close cooperation among fabs	✓ State-of-the-Art infrastructures ✓ Access to investors and advanced technological and critical market knowledge
2. Diversifying applications	✓ Further exploit core technology in different application fields	✓ Agreed IPR arrangements	✓ Access to fabs for SMEs and R&D institutes (R&D on alternative uses) ✓ Close relationships with "alternative" markets ✓ Wide variety of required competencies	✓ Access to investors and advanced system knowledge
3. Design breakthroughs	✓ IP libraries for wide uptake	✓ Get access to design rules for a particular technology	✓ Access to tools for SMEs and R&D institutes	✓ Access to investors
4. Involving SMEs	✓ Develop niche application markets	✓ Privileged relationship with large companies	✓ Access to fabs and close cooperation with large manufacturers	✓ Access to investors

- **R&D Spillovers** are more likely to happen in the technology domains where results such as new processes and new equipments may be further used and applied to other domains through components not being part of the international roadmap.

- The **coordination failures** are primarily in getting access to state-of-the-art process facilities and equipment (both R&D and production) to R&D institutes and SMEs, and in adequately forecasting the future research and development needs on the basis of critical activities going on elsewhere. These are not able to invest in such developments or equipment but need access to them in order to innovate and demonstrate proofs of concept. Initiatives such as Multi-project Circuits (CMP[17]) or Europractice[18] are good examples of coordination activities that can be set up in this domain. Moreover, the European nanoelectronics industry is currently sponsoring research in universities and research centres with more than €70m per year[19]. If those large companies would leave Europe, the financial support for the corresponding scientific research would be lost as well.

- Similar considerations can be made with the *design breakthroughs*. A particular set of players within this domain is composed of IP and fab-less companies. Despite many success stories and opportunities, these companies are facing increasing design costs and coordination is required in order to have access to shared, standardised and interoperable libraries (Table 3-3), thus reducing **appropriability failures**.

Table 3-3 : Failure Reasons for Fab-less Companies

✓ The lack of reusable and genuinely pre-qualified design IP: a major reason for purchasing a pre-designed function block is to reduce both cost and risk. If there is a large effort required to integrate the block into a larger design, the purpose/benefit of IP is reduced;
✓ The lack of interconnect standards between functional blocks;
✓ The lack of growth in some of the target markets over the last three years;
✓ The challenges IP companies have in achieving revenue scale purely on royalties;
✓ The reluctance of semiconductor companies to share upside potential through royalties;
✓ The desire of in-house development teams to defend and develop skills. Additional to this is the likelihood that semiconductor companies will only outsource the lower value-add parts of the design leaving the higher value parts for themselves;
✓ Modules and packaging technologies allow many of the cost advantages thought possible by large scale system-on-chip designs; and
✓ Long term, open source design libraries may emerge for standard components.

- **Information failures** mainly correspond to the huge investments to be made for building and maintaining state of the art production facilities but also to highly risky investments to be made to support prospective research beyond the current technologies. Also the information flow between the actors in the total value chain is not always optimal although essential to adequately forecast the future technology ad market needs. Finally, small companies and start-ups in the nanoelectronics sector are facing difficulties to access Venture Capital funding.

Market failure has also a geographical component. The increasing costs and resources for R&D and investment in production, the growing complexity of the processes, the multi-disciplinary nature of the developments all require **coordination at worldwide level**. As a consequence, deverticalization is a global phenomenon. Companies such as AMD, TI, Freescale, etc… follow a similar trend as most European companies (NXP, ST, Infineon,

[17] The key idea of the multiproject chip system is that sharing a chip or a wafer among several projects makes it possible to greatly reduce manufacturing costs, which allows users at universities to fabricate chips at an extremely low cost – http://cmp.imag.fr

[18] EUROPRACTICE is a European Commission initiative, funded by the Information Society Technologies (IST) Programme. The aim is to improve the competitiveness of European industry by the adoption of advanced electronics technologies - http://www.te.rl.ac.uk/europractice_com/

[19] estimation derived from discussions with major European semiconductor companies

Qimonda,…), with the notable exception of Intel who can still afford to progress on its own scale and paste thanks to its unique strength on the market. Deverticalization at worldwide level is a key tool for major private companies for correcting market failures by building alliances. However, this mainly holds for companies already operating globally. Many market failures still exist for smaller companies and between research institutes and industry that justify public intervention.

Looking closer at **coordination in the nanoelectronics value chain** (Figure 2-2), advanced chip fabrication is located in a few regions in Europe (France, Germany, Ireland, Italy), and technology & process R&D in a few innovation ecosystems (Dresden, Grenoble, Leuven-Eindhoven). Basic and advanced R&D is spread widely over Europe (Figure 2-3). However, their efforts need to be linked with the industrial poles or innovation ecosystems to valorise their results in Europe.

In **equipment, materials and services**, Europe has some competencies in specific parts. Some are spread over various SMEs throughout Europe. In a few cases, Europe holds a key strategic position. For instance, Europe lags behind in several materials aspects - except for SOI where SOITEC, France is leading - because these materials are R&D spillovers of global supplier companies who have their main business in other industrial sectors. On the other hand, Europe is leading in photolithographic production equipment, due to a close cooperation between ASML located in the Netherlands, Zeiss in Germany some hundreds of SME suppliers mainly located in the Netherlands and a major research institute (IMEC, Belgium). The close relationship with some semiconductor companies (ST-Philips) in the context of a cooperation in MEDEA+ was considered an asset to guide the research. Europe has this unique position because the US failed to build up such a total competence chain to produce this complex equipment. This example underlines the need for coordination across borders even if sometimes the integration of the results is very focused in one specific region. The European position in equipment, materials and services is based on individual success stories of some SMEs or larger companies. These need access to the main innovation ecosystems and fabrication areas to acquire the critical mass in competence required to act at global level and to valorise their results.

In **chip technology and fabrication of components**, Europe is considered weak in production of memories and microprocessors and related advanced technology, despite the presence of some non European companies (Intel, AMD). Europe has a leading position in logic devices for several application-specific markets and power electronic components. In order to progress in these fields, Europe will need to maintain access to the most advanced miniaturisation technology developments going on at worldwide level. Many spillovers of developments in memories and processor technology are expected in the field of logic devices. European companies must ensure access and occupy a strategic position in global alliances addressing these generic developments in order to take the benefits of those spillovers. It is also expected that developments and knowledge for advanced logic components addressing one application field will create spillovers in other application fields. The need to act as a global ecosystem for generic developments and generic innovation at worldwide level and for specific applications at European or even at regional level justifies public funding at European level.

Design, system integration and application competencies are available to some extent in all regions in Europe and for many application sectors, with a notable exception for computing. The ability to coordinate and combine the system developments with the design and system architecture activities is considered to be a European asset enhanced by the close collaboration between system companies (Nokia, Siemens, Alcatel, …) and semiconductor companies (ST, Infineon, NXP), still capitalising on the past IDM nature of most European semiconductor suppliers. Generic design platforms are only weakly covered and Europe has very little presence in CAD. However, it needs access to such tools in order to cope with the increasing design complexity and costs. The cooperation between system and semiconductor companies creates an advantage for Europe in the **application and system architecture** domain with many spillovers between different application domains including societal applications of public interest.

Regional coordination and cooperation is very important between the major regions involved in the most advanced developments to increase critical mass and efficiency. However, cooperation is also required with less involved regions in order to provide their local companies and institutes with an access to state-of-the-art competencies to valorise their developments and to transfer nanoelectronics progress into innovative applications.

These geographical considerations demonstrate the need for access, coordination, cooperation and information sharing between different regions to overcome a 'regional' market failure and contribute to the globalisation of the field.

Europe as well as all other regions in the world must have a presence in, or access to all activities in the nanoelectronics value chain if it is to maintain competence in this strategic field and if it wants to maintain or enlarge its market position and reap the economic and social benefits related to the nanoelectronics based applications.

4. POLICY OPTIONS

4.1. Approach to reach the objectives

New Instrument in FP7

The Seventh Framework Programme (FP7) (2007-2013) is an important point of departure for Europe. It reflects a consensus that to equip itself as a competitive and dynamic knowledge-based economy Europe must redouble its efforts to increase and get better returns from its R&D investments. The FP7 co-decided by the European Parliament and Council has recognised the problems described in the previous section, and introduces the concept of **Joint Technology Initiatives (JTI)** as a major innovation to **give concrete answers** to the need for **greater strategic focus, for assembling a critical mass of research in key areas, for better coordination in research, and for tighter coupling between research and innovation**.

A JTI is **a public-private partnership**, mainly resulting from the work of European Technology Platforms (ETP) to implement (parts of) their Strategic Research Agenda. JTIs have been identified by the Commission[20] as part of FP7 to support a limited number of European Technology Platforms in reaching their objectives[21]. As reflected in the FP7 text:

"*In a very limited number of cases, the scope of an RTD objective and the scale of the resources involved could justify setting up long-term public private partnerships in the form of Joint Technology Initiatives. These initiatives, mainly resulting from the work of European Technology Platforms and covering one or a small number of selected aspects of research in their field, will combine private sector investment and national and European public funding, including grant funding from the Seventh Framework Programme and loan and guarantee finance from the European Investment Bank.*"

JTIs are a new type of instrument to respond to the real needs of industry and other stakeholders, able to accommodate variable configurations of public authorities (Commission and Member and Associated States) in a way that is not possible under the 'traditional' FP7 instruments. The Community offers a legal and organisational framework that allows the effective pooling of resources from R&D undertakers, the Commission and also from national governments. In this way JTIs "transcends" the Framework Programme and national programmes, integrating both in an area where urgent action and industrial strategic focus is necessary**. Setting up the JTI as an integral instrument to run alongside the Framework Programme is an essential step in achieving the Framework Programme's overall objectives.**

As indicated by the FP7 impact assessment[22], the implementation of **Joint Technology Initiatives** will contribute to the achievement of the Lisbon competitiveness objective and the Barcelona targets for research spending, identifying areas critical for European competitiveness and supporting ambitious, research agendas which will be strategic and long-

[20] "Science and technology, the key to Europe's future – Guidelines for future European Union policy to support research", COM(2004) 353 of 16.06.2004

[21] *Report on European Technology Platforms and Joint Technology Initiatives: Fostering Public-Private R&D Partnerships to Boost Europe's Industrial competitiveness,* SEC(2005) 800, European Commission, 2005.

[22] "More Research and Innovation - Investing for Growth and Employment :A Common Approach" Impact Assessment {COM(2005) 488 final}

term in nature, while involving the commitment of massive financial, organisational and human resources through public-private partnerships.

Implementation of Joint Technology Initiatives

FP7 establishes[23] that a **“Joint Undertaking" model on the basis of Article 171 of the Treaty[24]** will be the specific legal instrument to implement the JTIs. Article 171 of the Treaty offers a wide range of possible implementation structures for Community research and development programmes, of which the most prominent is a Joint Undertaking. The main advantage of a Joint Undertaking is that it creates a strong and efficient coordination mechanism, able to structure and handle contributions coming from different fields and sectors. Although the application of Article 171 to the concept of the Joint Technology Initiative is novel, there are a number of examples where Article 171 has been used to set up joint undertakings in the research field, including, notably, Galileo under EC rules and JET in the framework of EURATOM.

The remainder of the document will refer to "**ENIAC JTI**" (or **JTI** in short) for the Joint Technology Initiative option, and in some cases as "**ENIAC Joint Undertaking**" (or **Joint Undertaking** in short) when dealing with the implementation details of the legal structure (legal, governance, funding schemes, etc.).

Why a JTI in the nanoelectronics field?

Nanoelectronics has been identified by the Commission as one of the potential areas for the establishment of a JTI (resulting from the work of the ENIAC Technology Platform) during the implementation of FP7[25], confirmed by the Competitiveness Council meeting on 4-5 December 2006[26].

The JTI in Nanoelectronics (**ENIAC JTI**) is a means of setting up and running a European Industrial R&D Programme in this area that runs alongside and is tightly coupled to the more foundational nanoelectronics research that is typically funded under the FP and to the MEDEA+ (EUREKA) programme aimed at some lead markets covering specific national priorities (Figure 4-1).

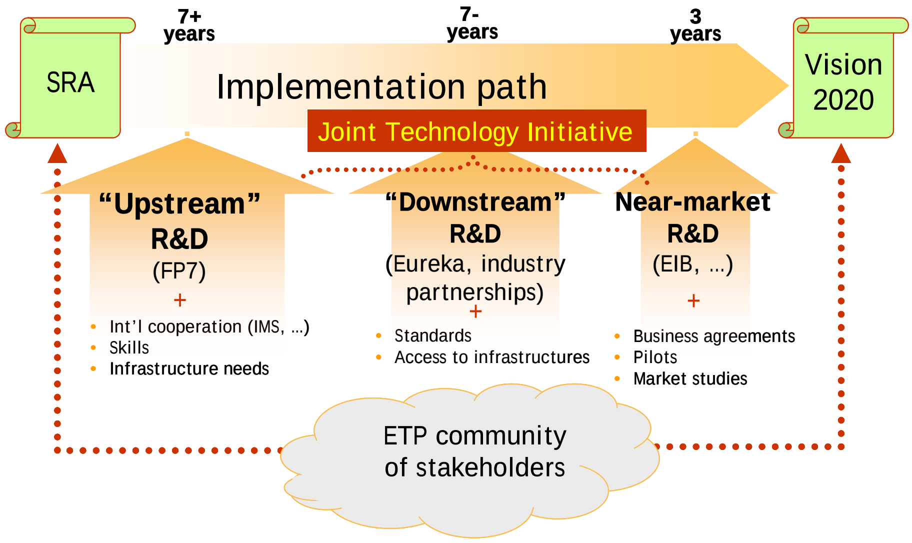
[23] FP7 text "Each Joint Technology Initiative will be decided upon individually, either on the basis of Article 171 of the Treaty (this may include the creation of a joint undertaking) or on the basis of Specific Programme Decisions in accordance with Article 166(3) of the Treaty.".

[24] Article 171: “The Community may set up joint undertakings or any other structure necessary for the efficient execution of Community RTD programmes”

[25] Proposal for a Council Decision concerning the Specific Programme “Cooperation” implementing the Seventh Framework Programme (2007-2013) of the European Community for research,-technological development and demonstration activities; COM(2005) 440, 21 September 2005

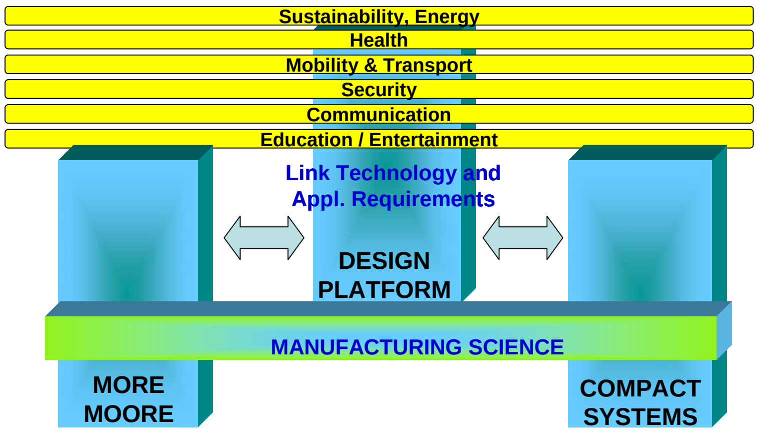
[26] 15717/06

Figure 4-1 : JTI scope



The technologies that would be addressed under the JTI R&D activities are a significant portion (~50%) of the ENIAC SRA objectives: parts of the domains More Moore, More than Moore and Heterogeneous Integration (called Compact Systems), Equipment and Materials (as manufacturing science), Design (Figure 4-2).

Figure 4-2 : JTI Contents



Those topics have a strong industrial drive for exploitation in key application sectors where Europe has a leading position. Research in these domains will contribute to achieving the technological and economic objectives highlighted in section 3.6.1.

The critical mass and greater flexibility and focus brought by the JTI instrument is especially relevant in the nanoelectronics field. The nanoelectronics sector has a strong industrial orientation and addresses the core of the Lisbon agenda by supporting innovation and competitiveness for key sectors in the EU. It has a broad constituency, much of it outside of the core ICT sector. The systemic nature of the technology, requiring close links between research, innovation and deployment; the high level of investments and risks involved; and the in-depth strategic alliances: all make the nanoelectronics field an excellent candidate for a Joint Technology Initiative.

4.2. Options discarded

Some options have been considered but discarded for the following reasons:

- Do-Nothing

The Do-Nothing option relates to a policy of no financial intervention at EU level in the field of nanoelectronics research and technological development (discontinuation of funding this area in FP7). As pointed out by the FP7 impact assessment[27], the Do-Nothing can be clearly ruled out as an option as it would go against the **need to invest more and better in research and innovation** and the **building of an integrated European Research Area** in a critical area for European competitiveness.

- Implementation of the JTI by alternative legal models

During the preparation of FP7, several options were considered by the Commission for setting up public-private partnerships to implement JTIs that could accommodate the participation of industry, the European Commission and Member States. An **extensive analysis** was carried out by a Commission Inter-Service Working Group[28] and the following is a summary of its conclusions with the most relevant alternatives considered for the legal entity form and a brief analysis of their implications for the Commission participation[29]:

- **The "European Economic Interest Grouping" (EEIG) model** (e.g. European and Developing countries Clinical Trial Partnership, EDCTP). Potentially light procedures as the legal form is already recognised and accepted in all Member States. The joint and several liability of the members is a major obstacle, especially in view of the participation of private organisations. The participation of the Community in such a legal structure has been discarded in general.

- **The "Non-Profit Organisation" model -** it could be an **Association** (e.g. asbl INTAS) or **Foundation** (e.g. European Energy Foundation), established under national law (non harmonised). The legal structure is subject to changes by national legislation. The principle of "one member, one vote" and majority voting would pose significant problems of control over the Community contribution. The participation of the Community in the legal structure is allowed only if the other members are Member States or third countries, and is strongly discouraged.

- **The "Commercial Private Company" model -** involves the formation of a profit-making enterprise, generally limited by guarantee. It is subject to changes by national legislation. There are restricted means of control for the Community (each member has a voting right in relation to his number of shares). Community participation can be accepted only in exceptional cases.

The above models are less efficient (various legal barriers), provide less critical mass (more adequate for a sole public or private membership but not both) and are less suited (lack of possibility to establish a dedicated regulation fitted for purpose) for achieving the objectives of a public-private partnership.

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[27] "More Research and Innovation - Investing for Growth and Employment :A Common Approach" Impact Assessment {COM(2005) 488 final}
[28] Commission inter-service Working Group (TP WG 3) in the "Options for establishing Joint Technology Initiatives" (24-11-04)
[29] The Commission participation in other legal structures is regulated by its guidelines C(2004)2958 of 4-8-2004

- Participation in joint actions by Member States

This option for achieving the ENIAC JTI objectives is based on Article 169 of the Treaty[30], which enables the Community to participate in research programmes undertaken jointly by several Member States[31] as part of the FP implementation. This option was discarded as it would present a number of difficulties:

(1) This option would address to a certain extent the fragmentation of research in Europe by bringing the Community into national R&D programmes undertaken by several Member States. However, the policy objective of strengthening and coordinating investment in nanoelectronics R&D is above all motivated by industrial competitiveness objectives. This is not necessarily achieved by participating in national R&D programmes/activities that may be geared towards specific interests. The Community would have to verify the adequacy of the national programmes with respect to the technological and economic objectives highlighted in section 3.6.1, without disposing of a serious lever on the participating Member States.

(2) Article 169 of the Treaty only covers the public sector and does not allow for private sector participation, which is essential to ensure industrial relevance and focus in such a fast-moving field. The markets and opportunities in nanoelectronics are of such a magnitude that an industry-driven approach is required. As the action focuses on industrial objectives that are important for economic competitiveness, industrial participation is necessary to guide the elaboration of the Research Agenda, ensuring consistency between industrial strategies and priorities and public funding policies. In addition, industry's participation is necessary to ensure their long term commitment to the objectives.

(3) The joint implementation of research programmes by several Member States would need the establishment of a private-law legal structure. The Commission guidelines32 indicate that in principle the Commission cannot participate in such bodies. Therefore, the Commission would have to contribute financially through a grant and have a limited influence but not actively lead the developments.

However, the participation of the Commission in the legal structure is of paramount importance. The EC must have a decisive strategic role in (a) the adoption and implementation of the Strategic Research Agenda and (b) the integration process, driving and balancing the different interests of the involved parties (Community, Member States and industry). The Commission is the only actor that can defend the Community's interests in this process. The direct participation of the Commission will also ensure the full control on its own contribution.

4.3. Conclusions of the different approaches

From the analysis in the previous sections, the **ENIAC JTI** implemented through a “Joint Undertaking" model on the basis of Article 171 of the Treaty as described in section 4.1 is the only option that satisfies the constraints and requirements to achieve the objectives of the

[30] Article 169: “In implementing the Framework Programme, the Community may participate in RTD programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes”

[31] In FP7, this approach will be tried amongst others in the proposed initiative on Ambient Assisted Living: www.aal169.org

[32] C(2004)2958 of 4.8.2004

action: the Joint Undertaking is a structure durable over time with legal personality that (a) provides a legal framework for the collaboration and direct participation of the public (Member/Associated States and the Commission) and private stakeholders, and (b) is capable of receiving funding from different sources (e.g. grant from the Community, loans from the EIB, others)

The options considered in section 4.2 cannot be considered appropriate for the proposed actions, as they do not satisfy the above constraints.

4.4. Option Scenarios

Following the conclusions above, only the following two policy options have been considered for further analysis:

(1) '**Business-as-usual**' option. This is basically a continuation of the current working arrangements. Parts of the ENIAC Strategic Research Agenda would then be implemented through the existing EU instruments and, separately, through national programmes including some intergovernmental cooperation under EUREKA (MEDEA+ and Euripides). Commission support would be through the regular instruments in the four Specific Programmes of FP7, in particular for collaborative research under the Cooperation Programme. This option will be considered as the baseline option.

(2) ENIAC JTI - "**Joint Undertaking**" on the basis of Art. 171 of the Treaty to implement a "Joint Technology Initiative" with the participation of industry, the European Commission and Member States, building on the existing ENIAC Technology Platform). In this model, the Community (represented by the Commission) would be a full member alongside other entities willing to commit funding or contributions in kind. It is created by a legislative procedure (Council Decision) that implies the definition of all the characteristics of the entity in a Council Regulation. A detailed description of proposed model for governance and operations of the Joint Undertaking can be found in the next section.

5. STRUCTURE AND GOVERNANCE OF THE ENIAC JOINT UNDERTAKING

5.1. Participation and Legal Form

The founding members of the Joint Undertaking (ENIAC Joint Undertaking) under Article 171 of the Treaty would be Member States, the European Commission and industry (grouped in an Industrial Association called AENEAS). Other members can join in at a later stage:

- **Member or Associated States** that are not part of the initial founding group can become members by a simple request to join, in which they commit to the obligations and rights of the members as described in the ENIAC Joint Undertaking Statutes included in the Council Regulation.

- **Private entities** will participate in the Joint Undertaking predominantly through membership of AENEAS. The statutes of AENEAS follow the general principles of fairness, openness and transparency for accession of new members, and include special provisions for participation and representation of SMEs and for ensuring overall that industrial involvement reflects a wide industrial constituency[33].

- **Third Countries** with active policies or programmes within the scope of the ENIAC JTI and **other entities** (e.g. European Investment Bank) capable of contributing substantially to the realisation of the objectives of the Joint Undertaking will be able to participate through special accession agreements that will be negotiated between the ENIAC Joint Undertaking and the candidate.

The participation of private entities (industry and academia) in the legal structure of the JTI could be done on an individual basis or through the vehicle of a non-profit association. However, the latter provides a flexible and elegant solution, in particular when the number of stakeholders is large: new companies and research organisations may join the association at any time with a very simple process, whereas if individual organisations were members of the JTI directly it is likely that the Council would need to be involved for the addition or removal of members.

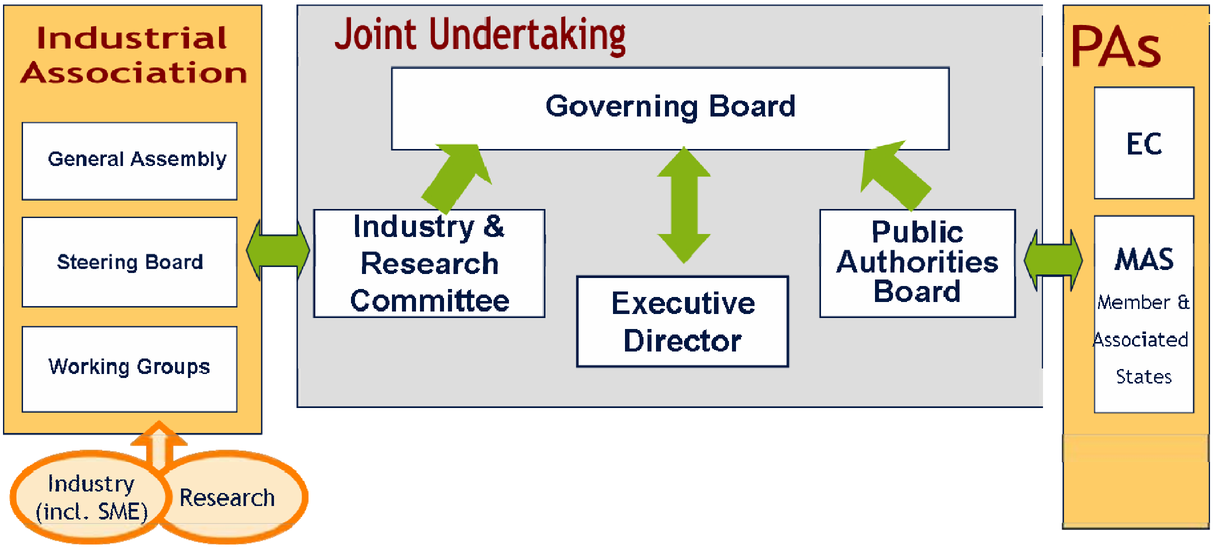
The participation of private entities through the association will ensure that industrial and academic involvement reflects a wide constituency rather than being a 'closed shop' of a few key players. The statutes of the association have to follow the general principles of fairness, openness and transparency for accession, and include special provisions for participation and representation of SMEs and academia. In addition, **the JTI's calls for proposals will be public and participation will be open to all organisations and not only to the members of the association**.

5.2. Governance Structure

The bodies of the Joint Undertaking will be the Governing Board, the Industry & Research Committee, the Public Authorities Board, and the Executive Director (Figure 5-1).

[33] AENEAS Statutes

Figure 5-1 – Governance structure



Governing Board: The Governing Board has overall responsibility for implementing and supervising the execution of the JTI programme and takes all decisions of a strategic nature. The balance of the voting rights will be 50% for the Industrial Association and 50% for public authorities (Commission and participating States). The distribution of the votes for the public authorities will be established annually in proportion to the funds committed to the JTI's activities.

Industry & Research Committee: It will be responsible for the definition of the JTI industrial policy regarding the technological and research strategy, dissemination, public relations and other activities.

Public Authorities Board (PAB): Composed of national public authorities and the Commission. It will be responsible for decisions involving allocation of public funds following JTI calls for proposals.

Executive Director: Is the legal representative of the Joint Undertaking and ensures its day-to-day management. A **Secretariat** will be established to support the Executive Director in all his/her tasks. Non-financial tasks of the Secretariat may be subcontracted by the ENIAC Joint Undertaking to an external service provider with relevant experience, such as the ITEA or MEDEA offices.

5.3. Operations and Funding Model

The Joint Undertaking will focus mainly on the downstream part of the SRA. Its core will be an industry-driven programme, complementary to the MEDEA+ cluster of EUREKA for collaborative R&D. The JTI will elaborate a multi-annual work programme based on the SRA, under which R&D activities would be implemented through open calls for proposals. States members of the JTI will annually commit resources that will be spent mainly to fund their respective national participants in projects selected under these calls. The Commission will also commit a budget (contributed by the Framework Programme) for the JTI that supplements the funds committed by participating states. Industry will commit matching in-kind contributions and funds – more than 50% of the total costs of the projects - to execute the

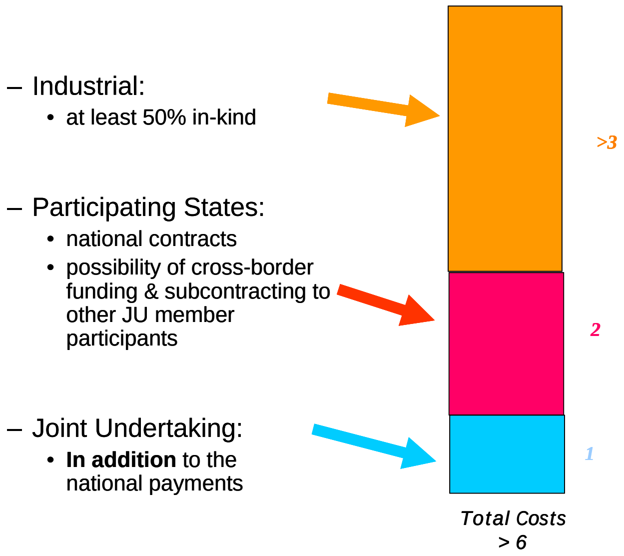
R&D work. In addition, industry will contribute to operating and non-R&D costs of the JTI through cash contributions.

One of the key benefits of the Joint Undertaking will be **the leverage effect of Community funds**. Projects selected following Calls for proposals will be financed through a three-tier system:

- The Joint Undertaking provides a flat rate funding percentage to all participants in selected projects of the calls launched by the ENIAC Joint Undertaking.
- Participating States provide an additional public funding to their national participants, which will complement the JU funding up to their national funding rate of projects or to a level specifically defined for this cooperative initiative by the State involved.
- Industry will commit matching in-kind contributions and funds – more than 50% of the total costs of the projects - to execute the R&D work.

As an example, a typical project could be financed 52% by industry, 32% by Member States contributions and 16% by the Commission's contribution to the ENIAC Joint Undertaking (Figure 5-2).

Figure 5-2: ENIAC Joint Undertaking Project Financing



Industry will contribute to the operating and non-R&D costs of the JTI through cash contributions. This is confirmed in a letter addressed to Commissioners Reding, Potocnik and Vice-President Verheugen[34], signed by 9 CEO's and senior executives of the main companies involved in the ENIAC Technology Platform. It is estimated that industry will provide funding of at least €24m during the initial 7 years of the JTI for the operating costs of running the Joint Undertaking.

The participants from countries that have not made commitments of funds for the Call will be eligible for the flat-rate funding percentage (anticipated at 16.7% of total participant costs) from the ENIAC Joint Undertaking.

[34] Letters of support from the main ENIAC industrial stakeholders on 31.01.06

These provisions ensure adequate flexibility of the ENIAC Joint Undertaking funding model. On the other hand, ENIAC Joint Undertaking funds that are *not* provided in combination with national funds will initially be capped at about 10% of the overall JTI budget spent on projects following a given call for proposals, so as to preserve the incentive for Member and Associated States to join the scheme and increase their annual commitments.

5.4. Appropriateness of Governance Model of the Joint Undertaking

An important question is whether in the proposed Joint Undertaking model the right members are involved and the governance model and legal structures foreseen are appropriate. The design of decision-making within the ENIAC Joint Undertaking is based on **five core governance principles**:

(1) The principle of **representation** according to the mobilisation of resources. Voting rights are split equally between the public and private parties, and for the public authorities votes are distributed according to the proportion of funds they commit to the ENIAC Joint Undertaking activities.

(2) The principle of **cooperation** between the public and private partners. The decision-making process relies on participation from both sides and neither party can make decisions on its own since each of the two sides has 50% of the voting rights.

(3) The principle of **separation** of public-private bodies. The Joint Undertaking makes a clear and formal separation between the roles of public and private entities. The Industry & Research Committee leads on the definition of the Research Agenda and on industrial policy and related activities. The Public Authorities Board leads in decisions on allocation of public funds. For instance, the PAB has sole responsibility for the final selection of projects following calls for proposals involving public funds, and also approves the content of these calls, thus avoiding any conflicts of interest of industry participants.

(4) The principle of **independence** of the Executive Director. The Director has no decision or voting rights within either the PAB or the R&IC and acts totally independently of outside interests. The Executive Director has overall responsibility for the evaluation and selection process and, overseen by the Governing Board, will take all reasonable measures to respect its independence and efficiency.

(5) The principle of **effectiveness**. The ENIAC Joint Undertaking will utilise and build on existing mechanisms as far as possible rather than set up some new mechanisms from scratch. It will make use of the valuable experience accumulated over the years under EUREKA in areas such as contract establishment and handling. Rolling work plans, regular calls, faster turnaround and common procedures for evaluation, review and monitoring: all will contribute to a more flexible approach compared to the current situation and make the JTI efficient to operate, both for participants and for the initiative itself.

6. ANALYSIS OF IMPACTS

6.1. Economic Impact

6.1.1. Impact of Strengthening and Coordinating R&D

6.1.1.1. Mobilisation of resources

For an EC contribution of **€450m** (for the duration of the Framework Programme), **the estimated mobilisation of funding for R&D activities in the ENIAC JTI is about €3bn** over seven years (Table 6-1), of which around 55% would come from industry, and the rest from public funding (European Commission and Member and Associated States involved).

Table 6-1: JTI Funding Scenario

	Total 2007 - 2013		
€, million	**Private**	**Public**	**Total**
FP	1050	1050	2100
E!	1500	810	2310
JTI - Industry	*1680*		*1680*
JTI - Community		*450*	*450*
JTI – Member States		*880*	*880*
JTI total	**1680**	**1330**	**3010**
National	5770	2880	8650
Total Co-funded	*10000*	*6070*	*16070*

In the baseline scenario (Table 6-2), for a similar additional EC contribution of €450m (for the duration of the Framework Programme), the total research efforts would be 13% lower.

Table 6-2: Baseline Scenario

	Total 2007 - 2013		
€, million	**Private**	**Public**	**Total**
FP	1500	1500	3000
E!	1500	810	2310
JTI	**0**	**0**	**0**
National	5770	2880	8650
Total Co-funded	*8770*	*5190*	*13960*

Leverage Effect

A main benefit of the ENIAC JTI for all stakeholders - industry, national public authorities and the Commission – is a better leverage effect than the "Business-as-usual" scenario (in the sense of a better mobilisation of resources by the Community contribution for nanoelectronics research in Europe).

Following the funding model detailed in section 5.3, the ENIAC JTI will allow to combine (add up) national and Community funding in such a way that 1 euro from the Community will leverage approx. 1.8 euros at national level. This funding will trigger private research efforts in a proportion depending on the funding rate (currently 50% in the FP and 35% on average in EUREKA). The incentive induced by the additional Community funding will increase the level of national funding which will in turn allow greater private research efforts. **Thus, the proposed mechanism enables one euro of the Commission's contribution to leverage an expected 7 to 8 euros of R&D effort.**

In the "Business-as-usual" Commission's contribution does not have any leverage effect at national level, and if invested through the current instruments of the Framework Programme one euro of the Commission's contribution would be matched by roughly one euro of private funds.

Additionality

There are several indications that the ENIAC JTI will be able to **attract additional funding** to R&D activities in nanoelectronics:

At national level: there is certainly no way to guarantee that any JTI would result in "fresh" money transferred to research from other national budgets. However, the additionality mechanism foreseen in the ENIAC Joint Undertaking actually provides a strong incentive to increase national funds in the targeted areas, and **precludes substitution of national funding** as higher commitments of funds by a State result in higher amounts of Joint Undertaking funds made available to participants from that State.

At industrial level: as pointed out in the Commission communication on Economic reforms and competitiveness[35], additionality at industrial level remains extremely difficult to define and monitor at an operational level. As outlined in section 3.2, it is unlikely that the semiconductor manufacturers will continue increasing their total R&D expenditures, but the JTI should rather trigger a shift of the private R&D investments towards collaborative research at European level allowing for better cost sharing of exploding R&D costs and help keeping the R&D activities in Europe.

Indeed, industry has clearly shown its commitment to increase its collaborative funding level: As stated in their support letter for the ENIAC JTI[36] and in the ENIAC Strategic Research Agenda, industry expects – and hopes – that the national public funding available would more than double, provided that the ENIAC JTI is launched with sufficient Commission support; in this case they commit to double their pre-competitive R&D through the JTI (currently channelled mainly through the EUREKA clusters MEDEA+ and Euripides) within 5 years from the JTI's launch.

The question then is how much of this doubling of pre-competitive R&D promised by industry would have taken place anyway. To make an educated guess on this requires looking at the specific research objectives of the ENIAC JTI. All of the technical domains expected to

[35] Commission communication "Economic reforms and competitiveness: key messages from the European Competitiveness Report 2006" COM(2006) 697, SEC(2006)1467

[36] Letter sent to Vice-President Verheugen and Commissioners Reding and Potocnik , 31.01.2006

be addressed in the JTI are essential for improving the long-term competitiveness of their products and services. However, without public intervention, industry has the tendency to focus on R&D projects that are short term and have a clear link to the business model of a particular product live rather than to more generic technologies (only those can be developed in a pre-competitive environment) that will not benefit just one company but the entire sector. The latter point is related to the **"behavioural additionality"** that is achieved by public grants; i.e. inciting companies to participate in joint developments that have a social or economic overall return that may be much larger than the return to any single organisation.

Another relevant consideration is that input additionality is of interest only when the industrial investment is made **in Europe**. Industry R&D is increasingly global and companies locate it wherever they get the best conditions. Public financial aid, in the form of an efficient R&D programme, with important networking effects can be an important determinant for a company's decision on where to spend its R&D money. By stimulating strategic alliances between the actors in the value chain and forming knowledge clusters, the JTI will safeguard that research in nanoelectronics is executed in a European context.

Overall, for Europe to intensify its investment in R&D – as foreseen under the Barcelona objectives –industry needs to be assured that its investment in Europe is well spent. **This assurance derives in large part from the policy context for research**: that the funding environment is sufficiently clear and stable over a longer duration to sustain industry investment; that public investments are being made in training and infrastructure; that there is no unnecessary red tape; and that regulatory issues are being anticipated and understood.

In the "Business-as-usual" scenario it is very unlikely that there will be additional money invested: the level of national funding through the EUREKA clusters tend to remain steady or even decline. On the other hand, the ENIAC JTI option provides a clear and stable framework that has received tangible national commitments and indications of likely budget increase for the areas covered by ENIAC in national programmes. The ENIAC Joint Undertaking also provides a mechanism for broadening industrial participation in R&D (achieving "behavioural additionality") and for industry to act together towards common goals and objectives that is not possible in the "Business-as-usual" scenario. As a result, competitors will be able to reduce costs by sharing enabling technologies.

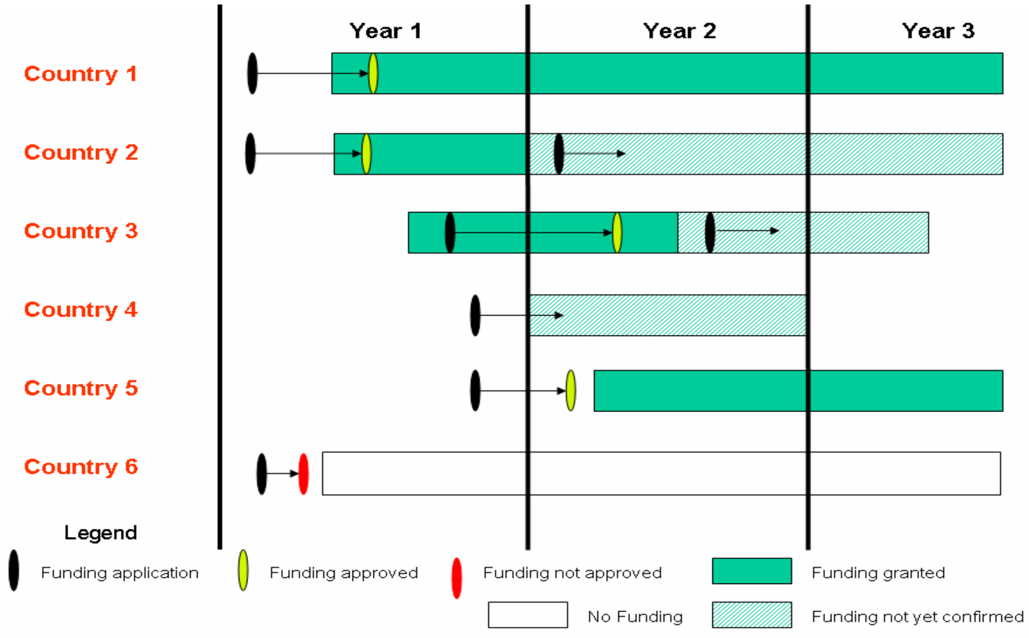
6.1.1.2. Impact of Removing Budget Uncertainty

Budget uncertainty is a key barrier in the current EUREKA approach. The funding schedule for potential participants in one (real) EUREKA project[37] is illustrated in Figure 6-1. As shown for this (typical) EUREKA project, two out of the six partners never obtained public funding; and for the other four there were just two or three whom funding periods coincided over time.

[37] Source: EUREKA Cluster presentation in CISTRANA workshop "Best practice in Multinational Programme Collaboration", Köln 18.01.06

Figure 6-1: Example of EUREKA Funding Schedule

(The horizontal bars show the time span of the activities in the project)



Firms are less reluctant to invest in preparing R&D projects if they know that funding will follow or can be assured for a longer period. The JTI will remove the funding uncertainty, providing a reliable framework with calls for proposals that have secured a budget allowing industrial stakeholders to plan their investments. Provided the Member States fulfil their financial commitments, and the JTI procedures are as efficient as planned especially regarding the one-step budget allocation/approval procedure, these new arrangements will offer a more attractive regime and should broaden the participation.

EU-level versus National Disbursements

A further benefit of the JTI is **the increased efficiency of EU-level disbursements compared to the same disbursements at national level**. Previous analysis made for the impact assessment of FP7[38] shows that in the long run (by 2030), FP-level disbursements will have 89% more impact on GDP per euro invested and a 20% greater impact on jobs than the same funding allocated at national level (Table 6-3). While it is not within the scope of this assessment to replicate such a detailed econometric analysis, it is reasonable to assume that similar benefits could apply between the ENIAC JTI and the "Business-as-usual" Scenario. Indeed, the expected €840m of national money spent through the ENIAC JTI can be assimilated to EU disbursements since they will be allocated though common European procedures and focused work plans as in the Framework Programme, whereas in the "Business-as-usual" this money is disbursed according to the different priorities of national programs.

[38] *Impact Assessment and Ex-Ante Evaluation of the 7th Framework Programme*, Commission Staff Working Paper, SEC(2005) 430, European Commission, 2005.