ASSESSMENT OF EUROPEAN UNIVERSITIES

AND RESEARCH ORGANISATIONS

IN EUROPE

Executive Summary

MEDEA+ Scientific Committee

September 2002

EXECUTIVE SUMMARY

The Scientific Committee -- installed in 2001 by MEDEA+ -- presented to the MEDEA+ Board the results of its comparative analysis on the role and the efficiency of the academic research in microelectronics in Europe and in the United States. This assessment was conducted by a group of European Professors involved in microelectronics research, led by Gilbert Declerck, President and CEO of IMEC.

The findings and conclusions of this qualitative study address five dimensions: human resources, financing, organisation, cultural and behavioural aspects, and partnership with the microelectronics industry. Certain considerations in the report apply to research at large in Europe and thus extend beyond the specific domain of microelectronics.

1. With respect to human resources, the Committee is of the opinion that competencies are comparable, but that the critical mass in the microelectronics sector is larger and better focused in the US. Universities like Stanford, Berkeley, Harvard, MIT have a real “flagship” role, and act as “brain magnets” for researchers from the US and from other regions, including Europe, with the consequence that they publish more breakthrough research results.

2. In the US, the variety of funding sources from agencies (like DARPA, NSF, SRC, …) and from states that put R&D in microelectronics high on their agenda (such as New York), as well as private funds (see e.g. $500M-donation from Gordon Moore to Caltech) allow a better mixture of both very advanced and close-to-the-market research. In Europe, on the contrary, funding still appears rather scattered and below a critical threshold. The search for excellence is not the main criterion for decision makers, even if some programmes like MEDEA+ offer the opportunity for the best universities to team-play with best-in-class companies. As a matter of fact, “cross-border” funding is very difficult in Europe and it appears that to a large extent, despite laudable efforts from the European Commission, Europe is still a “patchwork” of nations with often uncoordinated efforts.

3. The organisation of education and research activities is very different in the US as compared to Europe. In the US, the most prominent Universities are “graduate schools” with students quite advanced in their curriculum. The professors can therefore concentrate their teaching on topics closely related to their research subjects. In Europe, all Universities have both graduate and undergraduate students; as a consequence, the administrative burden is higher, and the content of courses more general and rather de-coupled from state-of-the-art research topics. The situation for Europe could, however, improve in the future with the implementation of the Bologna Agreement creating “Bachelors” and “Masters” degrees. But the lack of flexibility in the administrative and investment decisions is such that European Universities lag behind their US counterparts in terms of efficiency. Despite some efforts from the European Commission (related to Networks of Excellence) the discrepancies between the various national academic systems make co-operations between Universities quite difficult.

4. It is therefore not surprising to find quite some differences between the attitudes and behaviour in Universities on both sides of the Atlantic. In the US, professors can directly negotiate their contracts with funding agencies or companies, while in Europe they have to apply through local and national intermediary bodies, following heavy and lengthy administrative procedures. This implies more dynamism in the American universities that are also more inclined to take risks. The public authorities in the US are more responsive to the needs of the research community in terms of more easily adapting laws and regulations: for example, the Bayh-Dole Act of 1980 authorised Universities to hold the patents and licence rights to inventions resulting from research supported by federal funding. The number of patent applications by US Universities is therefore much higher than by their European counterparts, this being also the consequence of a more "business-oriented" attitude in American Universities. Another constraint in Europe is that, due to the organisation in departments, it is more difficult to set up multidisciplinary teams. The boundaries between the American academic research teams are much more flexible and can be removed if needed. Finally, research and high-tech developments in general receive more interest from the press and from the public in the US than in Europe.

5. The Industry-Science relationship is facilitated in the US as a consequence of the well-accepted role of Universities in advanced domains such as microelectronics. They are not considered as the mere suppliers of the labour force, but rather as a cornerstone in the economic "food chain" of this industry. The start-up phenomenon originated in Silicon Valley from University Professors pioneering this business with the help of dynamic venture capital. Europe has recently also started moving in this direction, but it will take some time before a certain aversion from entrepreneurship on the Professors' side is mitigated. The US industry itself is very much concerned about the working conditions in the Universities, as evidenced by the recent report of the Semiconductor Industry Association (SIA), calling for a significant increase in the federal funding of advanced research in microelectronics. In Europe, on the contrary, companies and Universities compete in order to gain access to scarce R&D funds. A positive consequence of that situation is, however, the incentive for Universities and the Industry to team up and jointly carry out research projects -- like in most MEDEA+ projects, and in some EC projects as well. With such an approach, it is, however, almost impossible to finance fundamental research which has not yet reached the pre-competitive stage (i.e. with no immediate potential for applications). In the US also, the mobility of staff between University and Industry is quite high, while in Europe it almost never occurs that a senior scientist moves from a company to a Professor chair.

   And last but not least, the combined revenue of microelectronics companies being 4 times larger in the US than in Europe, more links are possible between more actors with larger resources and less structural or ideological obstacles.

RECOMMENDATIONS

The main conclusions and recommendations of this report to the funding and program Organisations and to the Public Authorities are therefore:

1. To think in terms of efficiency when distributing money to academic research teams in the domain; to authorise "cross-border" public funding whenever necessary; to concentrate resources on Excellence Centres having (i) reached a critical size in terms of skills, infrastructure and importance of projects, and (ii) demonstrated the ability to work with Industry.

2. To emphasize that investments have to be made at two levels: (1) at the institutional level (= creating the so-called "infrastructure"), which attracts top-level people and supports them in their local environment (i.e. the basis); and (2) ample operational funds must be made available, for which researchers can compete with ambitious plans and ideas. In such a two-level competitive system, concentration of talent in world-class places will automatically take place, not because it is organized that way, but because competition based on quality (rather than on side issues) will favor the best and most dynamic groups (creating *de facto* centers-of-excellence).

3. To also allocate budgets for risky projects without an immediate impact, with reduced application procedures and less administrative burden. This might require a specific organization, comparable to the SRC or DARPA in the US.

4. To enhance with appropriate means and funding (incl. alignment of patent regulations, …) both the number of patented results and the rate of their actual transfer to and exploitation by industry.

5. To strengthen structures allowing a cheap access for University to silicon processing and to CAD tools. This access, actually provided on a short-term basis only (e.g. via EUROPRACTICE IST-1999-12057), should be organized as a permanent service for education and research with appropriate means, comparable to the corresponding services existing in the US and in Japan.

6. To facilitate the organisation in Europe of elite workshops, attended "by invitation only", to cultivate the networking spirit; to promote and sponsor the existing European conferences such as ESSCIRC, ESSDERC, DATE …; to encourage by all means the "brain circulation" and the return of Europe's best talent working abroad.

7. To ensure that in the current global situation -- where the actors fight for rare human resources, esp. in microelectronics -- Europe becomes a point of attraction for the brightest students and researchers. Policies and resources have to be implemented to advertise and organize fluxes towards and within Europe. The urgent action, aiming at the creation of a European ‘market’ for individual talent in order to increase mobility and to allow individuals to choose freely their place of work, is to implement the common rules and curricula as defined in the Bologna Agreement.

8. To pay sufficient attention to the evolution of microelectronics towards the limits of the International Technology Roadmap for Semiconductors (ITRS), which will require the development and implementation of radically new technologies that need much more interdisciplinary research. This will require a different allocation of resources, and new organisational schemes such as interdisciplinary research centres, …to conduct research in fields such as molecular electronics, ultra-low power electronics, new materials and interfaces, heterogeneous systems on chip, etc. . This will generate the need to build-up efficient linkages between researchers from a wide range of disciplines such as Electrical, Mechanical and Chemical Engineering, Materials Sciences, Physics, Biology and Chemistry, Mathematics and Computer Sciences, a.s.o.

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