

Improving access to high-tech **nanoelectronics** design tools and technologies

Carl Das provides some insights into his work building the academic capacity of state-of-the-art nanoelectronics technologies, and the benefits that European companies will ultimately gain from this

What are the main issues that you are looking to address within the semiconductor industry?

In order to ensure that Europe remains competitive in new product design and to prevent all aspects of design being outsourced to other regions such as Asia, it is absolutely necessary that European industry has enough high quality well-trained System on a Chip (SoC) design engineers. Consequently, universities must continue to have access to state-of-the-art CAD tools and prototype fabrication for integrated circuits (IC), micro-electro mechanical systems (MEMS) and

heterogeneous technologies. EUROPRACTICE provides 650 European academia with access to the same CAD tools, design kits and IC processes that are used in industry.

What advantages are offered to industry and academia through this service?

This common platform ensures that the skilled graduates being produced are far more immediately useful to industry, and that collaborative projects between universities and industry have a common basis on which to work. EUROPRACTICE allows SMEs to access the IC technologies from tier-1 foundries, allowing them to design and produce application specific integrated circuits (ASIC), which again leads to innovative products. Through the access to the most advanced CAD tools and IC processes, European academia is able to engage in state-of-the-art research which leads to innovation, proven by its many papers at conferences such as the International Solid-State Circuits Conference. It has been proven during the last two decades that EUROPRACTICE has been offering a very valuable service to academia. European universities and research institutes have affordable, one-stop access to the best design tools, design flows and processes normally only available to the largest multi-national corporations. Graduates entering industry from European universities are more appropriately trained and are more able to meet future challenges of industry. As the requirements of European academia have evolved, so have the offerings of the scheme. The areas of study have diversified, and the EUROPRACTICE user community of today is far broader both geographically and thematically than could have been envisaged at the beginning of EUROCHIP.

What technology trends is this sector currently witnessing?

Over the last 20 years we have noticed that the technology portfolio offered by EUROPRACTICE has followed the International Technology Roadmap for Semiconductors. As soon as an ASIC technology became

available in the industry and was considered as a mature technology, EUROPRACTICE was able to agree with the foundry to offer this technology also to the academia. One of the main concerns of EUROPRACTICE and of the European Commission was that it should be a pan-European service available and affordable for all 650 European Academia. We could offer ASIC prototype fabrication affordable through the MPW principle. However, with the introduction of the more advanced nanometre technologies some 10 years ago, the mask set was so expensive that reducing the prototyping cost with a factor 10 to 20 times the amount was not enough to make it 'affordable' for students. It was then that we started to offer MEMS technologies. MEMS technologies are less advanced in dimension, less expensive in masks, and thus more affordable for student designs. Moreover, MEMS can be designed as part of a system. With the latest integrated complementary metal oxide semiconductor (CMOS)-MEMS technologies (CMOS being not the most expensive nanometre generation), it is possible to design complex and advanced heterogeneous systems. This means that well-trained system engineers are available to industry. We are looking to other non-CMOS technologies becoming available on the market – such as silicon photonics, microfluidics, optofluidics, etc. When these technologies are mature, supported by foundries and supported by CAD tools, EUROPRACTICE starts to evaluate and make them available to academia, as and when appropriate.

How are you supporting companies to improve their competitiveness in the marketplace on a global scale?

European fabless design companies have easy access to prototype and small volume fabrication, packaging and testing. We have seen that more than 200 fabless companies in Europe have made use of the EUROPRACTICE service in order to access nanometre technologies for their new product innovations. Without EUROPRACTICE the access to nanometre technologies would certainly have been very difficult, if not impossible.



Building European capability in nanoelectronics

Since its creation in 1995, **EUROPRACTICE** has been supporting succession in Europe's ICT technology sector. Along the way, it has effectively bridged the gap between academia and industry in this high-tech world

As a result of the programme's recent efforts, members are now able to prototype heterogeneous systems in a number of specially-selected MEMS technologies, including some integrated CMOS/MEMS technologies



THE WORLD OF ICT is rapidly changing. Technologies are quickly becoming obsolete and costs are being driven down by global markets. In order for the EU to stay at the forefront of this industry, European businesses and academia involved in the sector must work closely together to ensure there is a rapid succession of highly trained students moving into the workforce. Funded by the EC's Seventh Framework Programme (FP7), EUROPRACTICE has been focused on building links between industry and academia in the microtechnology sector. The project is essentially about facilitating cooperation as a common European microelectronics-based design infrastructure. Where this service really offers a point of difference is that it is a complete package, bringing together the academic world with industry in a very streamlined manner. It is a one-stop shop of solutions, backed up by some of the best CAD vendors and foundries in the world.

EXTENDING THE OFFERING

Now just completing its fourth phase, this project has extended its activities to include selected micro-electro mechanical systems

(MEMS) technologies and some complementary metal oxide semiconductor (CMOS)-MEMS technologies. Project Coordinator, Carl Das, who is based at world-leading nanoelectronics research company imec's headquarters in Belgium, explains that EUROPRACTICE acts as a very important intermediary between integrated circuit (IC) tools and technologies suppliers on one side and the European academia and SMEs on the other: "As it is very difficult, if not impossible, for SMEs in Europe to access application-specific IC technologies from foundries for small volumes, the EUROPRACTICE offering is very well-suited".

The main role of this collaboration has been to facilitate access to a wide range of industry-standard microelectronic and nanoelectronic tools for training and research at the European universities and research institutes who are members of EUROPRACTICE. Das points out that the initiative has been highly successful, as it now provides a pan-European service offering CAD tools and prototype fabrication to 650 academic institutes from more than 40 countries. The collaboration is also manufacturing over 500 designs annually, with a large portion in advanced nanometre technologies. "Of

course it is nice when managers of new start-up companies contact us and ask to use our services. Many of these callers worked with us when they were students and have positive memories," reflects Das.

ACCESSING THE LATEST CAD TOOLS AND TECHNOLOGIES

The collaboration acts as both a broker and an advisor. Universities and technical institutions are able to purchase CAD tools as well as IC/MEMS/SIP prototype fabrication, and access technical support on how to use and install these advanced tools and technologies. The idea behind the broker role is that the programme is able to work closely with industry as a bulk purchaser to negotiate the best possible deals; in this way, they can access standard industrial CAD vendors for academia licences that are cost effective. To do this, they coordinate all purchase orders from members each month, and renew each university's CAD licence annually. This means academia can now access some of the most advanced CAD tools and technologies for prototype fabrication that only the largest companies can normally afford to work with.

INTELLIGENCE

EUROPRACTICE

OBJECTIVES

To offer 650 European universities and research institutes affordable access to industry standard, state-of-the-art IC design (CAD) tools for training and research, and access to affordable prototyping in advanced deep-submicron IC CMOS (down to 40 nm), MEMS and heterogeneous technologies. It acts as an intermediary between CAD vendors, foundries and European academia.

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CARL DAS graduated from KU Leuven, Belgium with a Master's and PhD in Electrical Engineering. In 1984 he joined imec, Belgium to start up a MPW service for IC prototyping for the local universities. In 1989 he became responsible for the Foundry Working Group in the EUROCHIP project. Since 1995 he has been Chairman of the EUROPRACTICE project. In 2010 he became Director of ASIC Services, offering services to 650 European academia institutes, 200 non-European academia and around 350 companies worldwide.

As a result of the programme's recent efforts, members are now able to prototype heterogeneous systems in a number of specially-selected MEMS technologies, including some integrated CMOS/MEMS technologies. This means that academia are able to develop both CMOS and MEMS solutions and fully-blown SoC solutions. Das describes how EUROPRACTICE was created with the initial idea of offering European universities CAD tools and prototype fabrication for ASIC designs. This means that they now also support a range of heterogeneous technologies for system design, such as MEMS and photonics technologies.

REDUCING PROTOTYPE FABRICATION COSTS

EUROPRACTICE is also involved in multi-project wafer (MPW) technology. Das explains that the MPW technology processes are actually very simple: "In a MPW run, several ASIC designs are merged together on the same mask set and hence fabricated together on the same wafer. This technique is used for fabrication of prototypes of the ASIC designs and allows splitting of the high mask cost over different ASIC designs, typically reducing prototype fabrication cost by a factor of up to 10 or 20". The challenge has always been that this type of technology is generally used exclusively by large foundries for some of their biggest customers; hence access to the technology for universities and smaller companies is restricted as the costs and support efforts are too large. This is where EUROPRACTICE has made a major contribution, since it coordinates with a number of different ASIC foundries to buy, or share, the MPW runs. They then offer low-cost prototype options to their 650 European members, as well as around 550 non-European academia and companies worldwide. It is a win-win situation, as the foundries enjoy dealing with and supporting just one client (being EUROPRACTICE), while academia and companies are able to use technology from which they would otherwise be restricted.

To overcome some of the challenges associated with the costs of technologies in the

semiconductor industry and to help remove some of the barriers to universities and research institutions accessing these, the collaboration has introduced a programme called mini@sic. One of the ideas behind this is that they will be able to stimulate knowledge and awareness in design and developments among academic institutions. Each year, EUROPRACTICE buys a design area on a few selected MPW runs (known as mini@sic runs) and breaks it into smaller blocks to sell to universities. "The mini@sic programme offers universities an affordable solution and stimulates them to take up these new nanometre technologies," explains Das. Another way they are motivating and encouraging involvement is to provide the right training in the advanced ASIC and MEMS technologies. "We noticed several years ago that take-up of new technologies was very difficult for universities without proper training. That is when we started the EC-funded IDESA and STIMESI projects and, as a result of these courses, we have seen academia take up new technologies much faster."

Dissemination is a really important part of achieving good outcomes for EUROPRACTICE. Awareness-building is carried out through a number of different channels that are targeting European universities and the wider research community. These include: the development of two separate CAD and IC websites; preparation of annual activity reports that are available on the website for downloading; provision of information days; hosting booths at exhibitions; preparation of flyers; and the development of a wall calendar with the dates of the available MPW runs. The niche that this programme fills is critical in supporting the progression of well-trained engineers to help European companies compete in what are now highly competitive global markets. From Das's perspective, all their hard work means that industry, and in particular SMEs, have better access to highly-skilled staff and the latest technologies: "Ultimately, this will enable them to innovate effectively; this is the basis for more cost-effective development, and will help to ensure that new products enter the market," Das reflects.



EUROPRACTICE
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