European Nanoelectronics Forum 2011

Downturn calls for greater cross-border research collaboration to ensure competitiveness

Some 250 representatives from industry, research organisations, academia and public authorities took part in the 2011 European Nanoelectronics Forum in Dublin on 15 and 16 November. The event provided an opportunity to review the mid-term progress of the EUREKA CATRENE nanoelectronics Cluster and the ENIAC Joint Undertaking (JU). It also provided a showcase for a large number of running and completed projects in a major poster and demonstration session. An intense programme of presentations provided an outlook for the semiconductor industry in uncertain times, looked at advances in process technologies and demonstrated a range of applications in the automotive industry.

The 2011 event reflected the cyclical nature of the semiconductor industry. "We were happy last year, less happy this year," said CATRENE Chairman Enrico Villa. "Yet microelectronics remains the key for the wellbeing of Europe." Microelectronics continue to drive the economy, growth and productivity while being responsible for 10% of global gross domestic product (GDP), he added. "Innovation is crucial to keep moving ahead. Moreover nano- and microelectronics are pervasive with new segments continuing to emerge."

Villa pointed to globalisation as still the rule overall with markets and industry moving east. "The Far East is the largest market," he said. "But the USA and Europe are more innovative. Industry in Europe is focusing on its strengths with a range of manufacturing alternatives – integrated device manufacture, fablight, fabless and foundries – and different strategies which are equally valid. To be mentioned as well, Europe's strength in delivering worldwide equipment and materials."

From the technological point of view, Europe's strength lies in More than Moore. "Europe is not totally self-sustainable in the More Moore sector but we need both and must ideally manufacture here to master innovation," he insisted. Moreover, innovation in equipment, materials, processes and products continues to accelerate.

Enrico Villa

Research collaboration a major asset

Research collaboration at European level is major asset with both horizontal and vertical co-operation. "The European capacity for working together is unique," said Villa. Moreover, individual countries are increasingly recognising the importance of supporting the nano- and microelectronics sector to attract industry.

CATRENE ended its first phase in 2011. To date, there have been 34 projects with 341 partners from 20 participating countries. France has played a key role with strong participation from Germany and the Netherlands. Many other countries are very committed, including Austria, Belgium and Spain. The important network of contacts established across Europe is also a real asset.

"CATRENE has continued the MEDEA+ success," concluded Villa. "Our bottom-up approach has been a precondition for success." The Cluster is highly flexible and tuned to rapid market changes.

CATRENE launches exploitation award

"Research is not a final objective but a tool to transfer ideas into marketable products," Enrico Villa pointed out. "Europe has to strengthen its exploitation." For this reason and to increase visibility for the Cluster and the companies involved, CATRENE is launching a new award for exploitation. This can involve a new standard, new product, new business, new company or increased market share. As exploitation can only be demonstrated several years after the project ends, projects finishing during the previous five years will be taken into consideration – exploitation can be derived from one or several projects. The process for the award is almost defined and will start in 2012.

Maintaining key competences

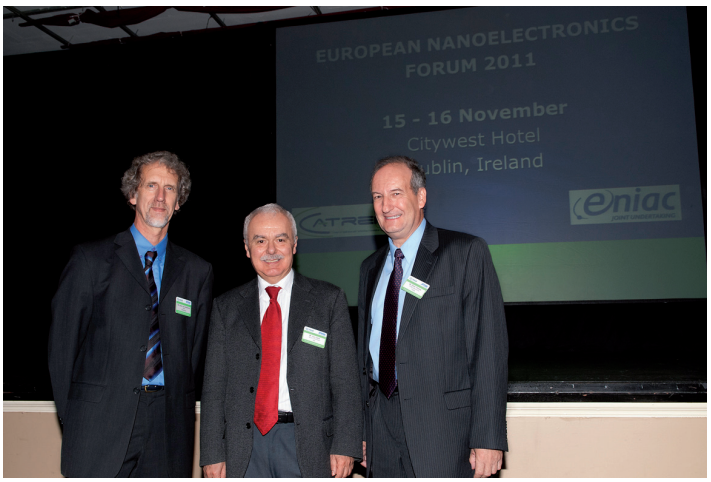
Gérard Matheron of STMicroelectronics provided an overview of the first technical session on process advances and chaired a panel session with the presenters involved in the DECISIF, EXEPT and LENS projects. "Such projects help companies to consolidate their market positions, maintain and increase R&D investment and jobs in Europe and keep research centres at the leading edge of technology," he emphasised.

Matheron believed it was important to keep key competences in Europe and continue to master leading-edge silicon-based technologies for both More Moore and More than Moore as well as developing the necessary equipment and materials. It is also important to maintain and develop local ecosystems and to give access to prototyping and volume capacity for systems companies developing societal applications.

"Our main challenges are the need to build long term sustainable partnerships, the lack of research integration throughout Europe and the requirement for better alignment of national and European priorities," he said. Better cross-border co-operation is a must with more European clusters.

There has been a drop in semiconductor production in Europe with no sign of improvement in the near future. "There are few 300-mm fabs and laboratories in Europe," he pointed out. "We need to do more." However he saw new hope at the policy level in Europe with the flagship initiatives in Europe 2020: innovation union, the digital agenda, industrial policy in a globalisation era and, particularly, smart specialisation.

"Europe is well awake in nano- and microelectronics with plenty of opportunities for successful development of equipment, materials and silicon technologies," he concluded. "Designing and manufacturing advanced semiconductors in Europe is not a dead end. Let's just do it!"



A. van Dijsseldonk, L. Baldi, G. Thomas

Developing thin film transistor architecture on SOI

The MEDEA+ DECISIF project integrated various performance boosters in Partially Depleted (PD) and Fully Depleted Silicon on Insulator (SOI) devices for low power and high performance applications to overcome the current scaling limitations of CMOS technologies. The project focused on new gate structures and developed thin-film architecture for industrial applications with 28 nm demonstrators; FDSOI architecture is scalable to 20 nm. Engineered substrates with ultrathin silicon and insulator films for such technology are industrially available. "Performance improvements included 30% lower dynamic power at same speed or 20% increase in operational speed at same voltage and a 50% reduction in standby power at the same speed," said project leader Gilles Thomas of STMicroelectronics.

Making EUV lithography a reality

The CATRENE EXEPT project has developed entry-point technology for extreme UV (EUV) lithography. "Lithography is the key mechanism behind More Moore," said project leader Anton van Dijsseldonk of ASML. "EUV simplifies the process and reduces costs as cutting the number of process steps boosts yields." EXEPT developed the infrastructure to function under vacuum with suitable resists and mask technology, including successful mask repair. Two alpha tools are operational since 2006 and six pre-production machines have been shipped to customers, five are already operational. By the summer of 2012 the source power, and thus throughput will be upgraded considerably.

Pushing optical lithography to the limit

The ENIAC JU LENS project has pushed optical lithography to the limit for 32 and 22 nm processing through double patterning and pitch doubling according to project leader Livio Baldi of Micron Semiconductors. Both 32 and 28 nm technologies are available at the pilot lines of STMicroelectronics for logic and at Micron for memories. The development of 22 nm process technology has been made possible and Europe is on track for More Moore with the International Technology Roadmap for Semiconductors. European equipment manufacturers have also consolidated leadership in optical lithography.

Continuing investment in Ireland

Holding the European Nanoelectronics Forum 2011 in Ireland reflected the emergence of the sector in this region, according to Eamon Gilmore, Irish Deputy Prime Minister and Minister for Foreign Affairs and Trade. "Ireland is still a dynamic place for business," he stated. "This is a critical time for our economy. Yet, despite circumstances, foreign investment in Ireland remains high. And our single greatest resource is our people. All this has allowed us to grow as a knowledge-based economy."

The Deputy Prime Minister welcomed the recent EU High Level Group report on Key Enabling Technologies (KETs) for ICT. He saw CATRENE and the ENIAC JU as of major importance for the state of art in innovation in this sector and urged event participants to continue to work together to stay at the cutting edge of ICT technology.

Ireland will continue to invest in research and development and growth in nanotechnology. This is supported by companies such as Intel, Hewlett Packard, Analog Devices, IBM, Google and Facebook which are established in the country. Ireland also has specific ICT institutes such as the Tyndall National Institute in Cork, one of

A. Wild, E. Villa, E. Gilmore - Deputy Prime Minister Ireland, L. Hobbs

Europe's leading centres in hardware research and commercialisation – supported by Enterprise Ireland and the Irish Development Authority.

Eamon Sinnott, Vice President, Technology and Manufacturing Group and General Manager of Intel Ireland, underlined the importance of Ireland and Europe to the world's leading semiconductor manufacturer. "We have had 20 years of successful manufacturing here with $7.5 billion invested to date and 4,000 direct and indirect employees."

Intel employs some 12,000 people in Europe in 30 or so locations with 1,500 in R&D and is a keen follower of Moore's law – Moore was one of the founders of Intel. The company specialises in advanced manufacture. "Advanced manufacturing can generate economic growth and is a key engine for innovation as shown in the USA," said Sinnott. "We need this in Europe for the same reason."

Ambitious research agenda for Flanders

Leo van de Loock of IWT, the agency for Innovation by Science and Technology in Flanders, Belgium, outlined the region's ambitious agenda for R&D but called for more direct European-level funding for its research institutes as their results are used widely outside the region. "Flanders spends 2.12% of its GDP on R&D, slightly above the EU average, and ICT is the most important sector," he said. The region is keen to be more active but has limited funds. It has had a long participation in EUREKA ICT Clusters and was involved before that in JESSI. "Cross-border research co-operation has been well demonstrated, particularly in semiconductors, but a question lies over funding for research institutions such as IMEC," he said. "We support IMEC directly and it is also funded through EUREKA and EU Framework Programme projects but it needs more funding that Flanders cannot provide alone. Joint Technology Initiative funding gives large institutes in small countries a disadvantage as it relies on local top-up funding".

Market volatility set to level out

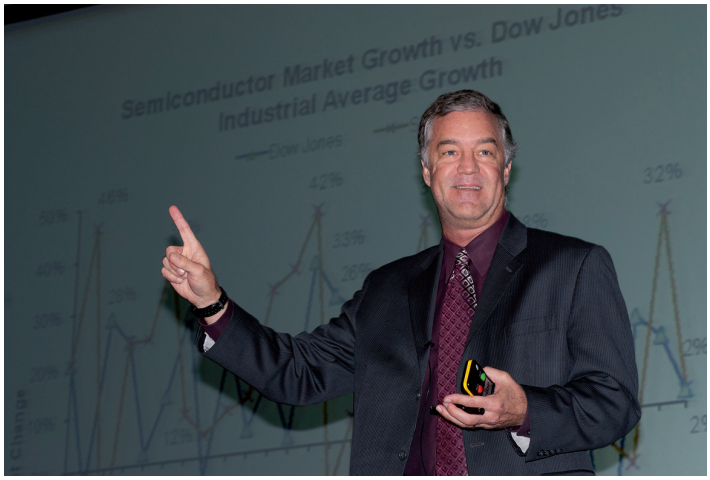
Bill McClean, president of market research organisation IC Insights, provided a stimulating overview of the current volatile semiconductor market. He identified the strong correlation between fluctuations in global GDP and the worldwide semiconductor market. At the same time, he pointed out that, while the value of worldwide GDP is $59 trillion, that for systems is only $1.3 trillion – leaving lots of room for expansion.

"Emerging markets are driving with China now even larger than Japan and growing at 9% a year," said McClean. "China has impressive world rankings and will be the largest consumer of PCs, mobile phones, automotive electronics and digital TVs." However he believed that India is likely to become the highest growth.

2009 was a bad year for GDP and semiconductors, while austerity measures and stimulus spending boosted 2010 figures. Economic head winds have affected 2011 with uncertainty hitting markets although the news has been slightly better outside the USA. Capital spending has been restricted which should avoid overcapacity and firm up semiconductor prices. McClean also sees the Japanese market on the road to recovery.

"Over the long term, IC Asia Pacific markets are

forecast to stabilise and lead to a compound annual growth rate of 8 to 10% for the IC market," he concluded.



Bill McClean

Cleaner, safer and more comfortable driving

Microelectronics is the major element in innovation for the automotive market, making driving cleaner, safer and more comfortable. Nowhere is this truer than in driving-assistance features which are no longer limited to luxury vehicles but are finding their way increasingly into mid-level mass-market cars.

Automotive technology group Valeo is playing a leading role in developing the systems required for this market as Patrice Reilhac, Research & Product Marketing Director for the Valeo Comfort and Driving Assistance Systems Business Group explained.

Extensive market research based on methodologies such as focus groups, car clinics and face-to-face discussions has been carried out to understand motorists' real needs. This identified three key demands:

1. Visibility enhancements with non-glaring high beam headlights;
2. Emergency braking using new laser scanner technology that enables active safety; and
3. Remote parking with smart phones – such systems make use of existing sensors and do not need a PC. They are already available le on mid-market vehicles, including models from Volkswagen.

Peter van Staa of Bosch provided an overview of the automotive technical session which featured the ENIAC JU projects E^{3}Car and SE2A as well as automotive applications in CATRENE projects. He focused on future societal challenges such as the need to save energy and the environment. "Automotive is expected to be the innovation driver for universal eMobility," he pointed out. "This offers a huge market perspective."

Safety and reliability on the road are other key requirements. The societal impact of microelectronics can be proven, for example by dynamic drive stability control systems. Highly integrated and thus relatively cheap systems were developed in the 1990s and have been recognised by the assurance enterprises as an effective method of reducing the number and severeness of accidents. This has now led to them being made mandatory by law for all new cars manufactured in both the United States and the European Union from 2011 onwards..

Europe has a dominant position in the automotive electronics market worldwide, van Staa emphasised. European companies are market leaders in automotive along the whole value chain. More than Moore technologies are the key enablers for innovation in cars – a modern vehicle can have up to a hundred microelectronic systems.

"The three project presentations provide good examples of the possibilities," he said. "And power technologies – systems including packages and not just components – have a broader impact on industrial electronics, offering a large benefit for Europe." However he pointed to the need to improve design technologies as design costs have grown dramatically in the move from 250 to 65 nm technologies.

Sensor innovation and knowledge creation boost car performance

The ENIAC JU SE2A project is developing smart sensors and reliable electronics to enhance the safety and fuel efficiency of cars. Targets include improving reliability and lifetime predictability to a level of zero ppm and 95% accuracy. Examples of project advances include a true ground-speed sensor, an eHorizon, a CO2 tool and a reliability knowledge framework. "This is a European project with important partners," explained project leader Harry Thewissen of NXP Semiconductors. "While we would have done such R&D work ourselves anyway, a co-operative project means we can do more, better and faster."

Developing European technology for first industrial generation electric vehicles

The ENIAC JU E³Car project set out to build a solid nanoelectronics technology base for Europe, establishes reference designs and platforms for electric vehicles and develops semiconductor components with a 35% better efficiency for the first industrial generation of electric vehicles. "The need was to bring together electrical and automotive understanding," explained project leader Reiner John of Infineon Technologies. Highlights included a power conversion inverter roadmap, 400 and 600 V insulated gate bipolar transistor inverter technology and improvements in smart dynamic monitoring, power distribution, power management and battery management. 28 demonstrators allowed measuring the progress, and some of the innovative solutions will be included in industrial products as early as 2012.

Supporting cross-domain applications of automotive technology

Philips has long been involved in EUREKA microelectronics projects, starting in JESSI. "Its key strategic directions are now in healthcare, lifestyle and lighting. All three areas have been involved in CATRENE automotive-related projects", stated Paul Merkus. "These include Philips Healthcare in the current THOR power electronics projects, Philips Lifestyle in the completed Caring Cars project and Philips Lighting in the continuing SEEL project for the replacements of inefficient halogen lamps in general and automotive lighting. Such projects connect automotive to other application domains in a wider context – the value of CATRENE's bottom-up approach next to ENIAC's top-down approach".

R. John, P. Merkus

Increasing and leveraging investments in Europe

Executive Director Andreas Wild concluded the 2011 forum with an overview of the ENIAC JU which has now been autonomous for just over a year. "Our vision was that the Joint Undertaking should increase and leverage private and public investments in nanoelectronics and contribute to strengthening Europe's future growth, competitiveness and sustainability of the entire value chain," he said. This is a long-term activity as it

takes a decade for new leading-edge advances to become the baseline process for More-than-Moore diversification.

"Currently, Europe is focused on the traditional value chain," he pointed out. "European device manufacturers are looking for profitable niches and evolving towards fablight and fabless production. Europe is lagging in investments and now ranks last in the world in 300 mm capabilities." Since 2004, manufacturing investment has dropped from 12% to under 4% and there are notable gaps in the technology chain.

"Initially, there has been less growth in ENIAC JU investment than budgeted," Wild said. "This is now going the other way with a doubling of funding this year but is still below budget. We therefore plan to double funding again in 2012. However, this requires 'must-do' projects and strong support from the National Funding Authorities."

The High Level Group on KETs identified three pillars for investment. ENIAC JU is focusing in 2012 on the second pillar – pilot line projects – with expression of interest required before 19 January 2012. Conditions include execution by an industrial consortium, use of an innovative technology, development of an innovative product meeting a societal challenge, demonstration of its value and potential, establishing a realistic environment (a facility), and having a convincing deployment plan in a European manufacturing site.

Wild spelt out the actions now required in Europe. These include:

- Providing an advanced competitive fab;
- Supporting also the emerging value chain - including equipment and materials suppliers, foundries and fabless companies;
- Competing in the transition to 450 mm wafer production; and
- Filling the gaps in the European technology value chain, particularly in the move to high volume, low cost components and support for early adopters.

"If nanoelectronics is a Key Enabling Technology, the private sector and the public authorities – European, national and regional – must work together to strengthen growth, competitiveness and sustainability," he concluded

First poster and demonstration award

"The European Nanoelectronics Forum poster and demonstration exhibition has been the best ever," said ENIAC JU Executive Director Andreas Wild. "There were 61 projects in a 650 m² area involving €1.5 billion of research costs. They covered all eight work areas of the CATRENE / ENIAC JU vision, mission and strategy document presented to the European public authorities at the beginning of the year." The first prize for the most illustrative project went to the CATRENE COMCAS project which is developing low-power design solutions for data communication-centred heterogeneous multicore architectures targeting 45 and 32 nm CMOS technologies.

Voting process

A. Castillejo, Project Leader COMCAS