EuroTraining develops the Nanoelectronics Training Roadmap

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ABSTRACT

The ultimate goal of the EuroTraining Project is to enhance European industrial competitiveness in the global marketplace mainly by providing easy access to European training courses and by stimulating the development of new courses in the field of micro- and nanoelectronics. Training and university education roadmaps are being developed to support these activities. The nanoelectronics training roadmap will reach conclusions from the analyses of the needs of industry with a special focus on SMEs; of EU's new Member States; and of the broader public.

1. INTRODUCTION

EuroTraining – as one of the five basic services of Europractice – is the European Commission's initiative which aims to stimulate the wider exploitation of state-of-the-art micro- and nanoelectronics technologies by European industry. The ultimate goal is to enhance European industrial competitiveness in the global marketplace.

The EuroTraining project is offering a two-fold programme addressing both students and course providers.

- Students benefit from EuroTraining courses presented via the EuroTraining Course Directory and EuroTraining News.

- Course Providers can freely publicize their courses and include a hyperlink to their own web sites in the EuroTraining Course Directory. They can take advantage of the European Quality Labelling Service and the exciting new opportunities for course promotion as well.

EuroTraining has got support from the ICT programme under FP7 for a three year continuation with workpackages shown in Figure 1.

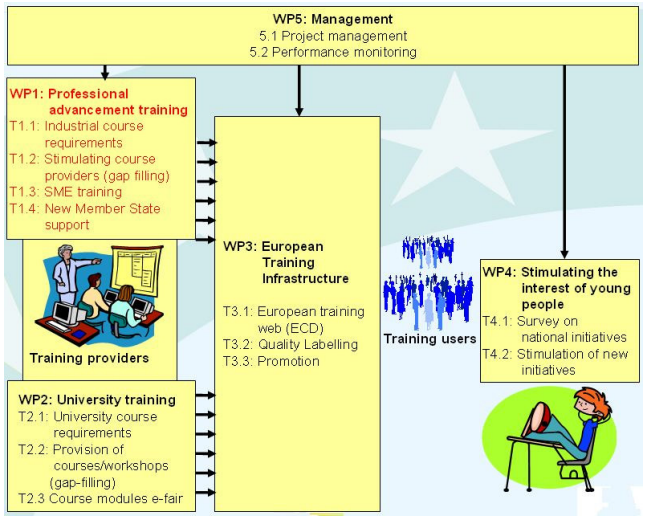

Fig.1: Workpackages of the EuroTraining Project

The new EuroTraining Project should have a stronger focus on:

- stimulating the development of new courses supporting the CMOS technology targeting digital components and complex digital SoCs (System on Chips) ("More Moore");

- to master diversification targeting non-digital applications, heterogeneous integration in SoCs or SiPs (System in Package) ("More than Moore") and

- to prepare for the technology generation beyond the CMOS scaling limits ("beyond CMOS").

To support these activities, training and education roadmaps are being developed, taking into consideration EC's policy, including the role of technology platforms.

2. EC'S POLICY TOWARDS NANOTECHNOLOGY

European Commission's views and recommendations regarding Nanoscience and Nanotechnology have been posted to the EC's Nanotechnology research portal at http://ec.europa.eu/nanotechnology/ .

The Communication from the Commission "*Towards a European Strategy for Nanotechnology*" [1] defines nanoscience and nanotechnology which "refer to science and technology at the nanoscale of atoms and molecules, and to the scientific principles and new properties … for the development of materials and devices with novel functions and performance".

Nanoscience benefits from an **interdisciplinary** or "converging" approach. In accordance with this, in EC's policy **nanoelectronics is treated as an inherent part of nanotechnology** as a whole, however electrical and electronics **applications** appear in many of the beneficiary areas, in particular as follows:

- Information technologies, including data storage media and flexible plastic display technologies. In the long-term, the realization of molecular or biomolecular nano-electronics, spintronics and quantum computing;

- Energy production and storage including low-cost photovoltaic solar cells (e.g. solar "paint") and improved insulation, transport and efficient lighting;

- Materials science developments and surface nano-structuring, that are expected to impact upon the fabrication of biosensors and molecular electronics devices;

- Manufacturing at the nanoscale, that requires a new interdisciplinary approach along one of the two main routes: the first starts from micro-systems and miniaturizes them ("top-down") and the second builds structures starting at atomic and molecular level ("bottom-up");

- Instrumentation for the study of the properties of matter at the nanoscale.

The Commission calls upon Member States for actions in connection with investing in human resources, to contribute to

(a) identifying the educational needs of nanotechnology and provide examples of best practice and pilot studies;

(b) encouraging the definition and implementation of new courses and curricula, teacher training and educational materials for both school and graduate level education;

(c) integrate complementary skills into post-graduate and life-long training, e.g. entrepreneurship, health and safety issues at work, patenting, "spin-off" mechanisms, communication, etc.

3. EUROPEAN TECHNOLOGY PLATFORMS

On the encouragement of the Commission, European Technology Platforms (ETPs) have been established. Technology Platform is a new partnership for building the knowledge society and leveraging knowledge and innovation for growth and employment. ETPs are industry led forums involving main public and private stakeholders (member states, industry, research, finance, public bodies) to address technological and related challenges.

Nanotechnology related European Technology Platforms are as follows:

- Nanomedicine for nanotechnology for health - http://cordis.europa.eu/nanotechnology/nanomedicine.htm;
- ENIAC (http://cordis.europa.eu/ist/eniac/) for nano-electronics;
- Sustainable Chemistry (http://www.suschem.org/) SusChem for nanomaterials;
- Industrial Safety (http://www.industrialsafety-tp.org/) ETPIS for nanosafety;
- Innovative Medicine for the development of new medicines, including nanotechnology approaches (http://cordis.europa.eu/lifescihealth/innovativemedicines.htm).

Nine of the ETPs are in the area of Information and Communication Technology (ICT) (Figure 2) [2].

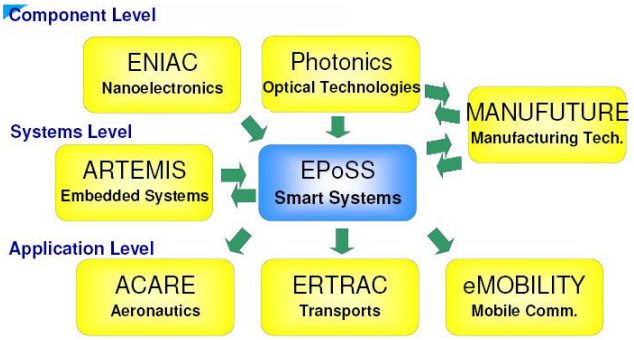

Fig.2: The links of ENIAC and EPoSS to other ETPs

4. VISION – 2020 AND ENIAC'S SRA

The European Commission published the report of the High Level Group "Vision 2020 – Nanoelectronics at the centre of change: A far-sighted strategy for Europe" in June 2004, and set the objectives for the European R&D related activities in this field [3]. The report verifies that micro-electronics has become a foremost driver of social and economic progress worldwide. The move to nanoscale devices, called nanoelectronics, will further revolutionize applications while demanding increasingly heavy investment in research and production to remain competitive.

This document proposes the development of a European Technology Platform (ETP) and a Strategic Research Agenda (SRA) for Nanoelectronics that fosters collaboration and makes best use of European talent and infrastructures.

The European Nanoelectronics Initiative Advisory Council - in short ENIAC (and also the name of the world's first electronic computer) - was established to materialize the proposals in Vision–2020. ENIAC's mission is to make the 2020 Information Society technologically feasible and economically affordable. To achieve these goals Europe must provide:

- A competitive supply chain with no major missing links;
- A research environment and infrastructures capable of supporting visionary and industrially relevant research activities;
- Strategic public-private partnerships in which strong user industries share their long-term visions with research partners and mobilize a critical mass of resources;
- A favourable legal and financial environment; and
- **An education system delivering a skilled, multidisciplinary research, design and production workforce.**

Multidisciplinarity brings new challenges in education and training [4], since engineers and researchers working in different fields should be prepared to understand one another's language, working paradigms and way of thinking. In order to interact efficiently across radically different domains, they need broad knowledge on basic as well as on highly experienced levels (Figure 3).

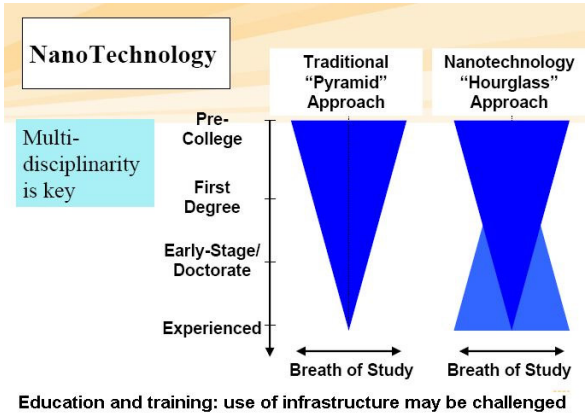

Fig.3: Broad knowledge is required by nanotechnology

5. CONCLUSIONS

Training activities should increase the **public awareness** of nanoelectronics, considering the following key aspects:

- Improve the training activity and effectiveness of the collaborative research programmes and the Technology Platforms, in particular that of ENIAC;
- Open the research infrastructure for the interested people, in particular teachers and undergraduate students;
- Initiate training programs for secondary school teachers of the natural sciences;
- Establish mobile courses with hands-on experiment possibilities (see a good practice at www.nanotruck.net);
- EC and local governments take measures to increase the number of students in nanoelectronics-related fields.

REFERENCES

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