MicroElectronics Cloud Alliance (MECA) – Presentation of a New Erasmus+ Project

Zsolt Illyefalvi-Vitez[1),2)], Oliver Krammer[2)], and Slavka Tzanova[3)]

[1)] Lightware Visual Engineering, Budapest, Hungary,
[2)] Department of Electronics Technology,
Budapest University of Technology and Economics, Budapest, Hungary,
[3)] Department of Microelectronics,
Technical University of Sofia, Sofia, Bulgaria,
illye@ett.bme.hu

***Abstract**: The MicroElectronics Cloud Alliance (MECA) Erasmus+ project (562206-EPP-1-2015-1-BG-EPPKA2-KA, 2016-18) brings together 18 partners from higher education institutions (HEIs) and enterprises (SMEs) to develop cloud-based European infrastructure and organisation for education in micro- and nanoelectronics providing a range of Open Educational Resources (OERs); remote access and sharing of educational and professional software; remote and practice-based learning facilities. Eight European HEIs and eight SMEs develop e-learning courses on: CAD systems, microelectronics technologies, test, characterisation and application of integrated circuits and systems; and they are to be provided as open educational resources to promote virtual mobility. Each university will provide remote access to its facilities, laboratory experiments or software systems for the partners in a cloud teaching system, giving them access to new resources. By providing accessibility of all developed e-learning materials as OERs, the university-business alliance will have impact on the education to be more responsive to labour market needs, thus the graduated students will be better prepared for the jobs, and the enterprises will be satisfied by the knowledge and skills of young specialists.*

1. INTRODUCTION

The access to a highly skilled workforce of engineers and technicians and to high quality graduates is essential for attracting private investments in electronics. In particular, micro- and nanoelectronics is suffering from an increasing skills gap and a mismatch between supply and demand of skills [1]. For micro- and nanoelectronics the engagement of industry to attract the young generation early in its education is critical. In addition to industrial efforts and relevant initiatives at regional and national level, the Commission continues the promotion of projects to develop and disseminate training and teaching materials on the latest technology in micro- and nanoelectronics as well as support awareness campaigns targeting young entrepreneurs.

The following most important motivation challenges have been identified and addressed:

- New partnership is needed between education and industry to create synergy between their needs, to foster the development of competencies, technological and entrepreneurial skills.
- It is necessary to find the balance between the needs of labour market of trained personnel and the need of mobility of the workforce in the sector.
- The use of cloud computing, the most modern Information Technology (IT) infrastructure in the learning environment, makes possible a higher level cooperation and distribution of lab sessions, CAD tools and teaching experiences.

2. OBJECTIVES OF THE MECA PROJECT

The MECA project addresses the needs of business and HE for training of new skills for new jobs and the needs of sharing open educational resources, IT infrastructure and expertise.

These needs especially arose in the highly interdisciplinary science of microelectronics where no university or SME can afford the necessary infrastructure, clean rooms, equipment, technology and experts. For the knowledge and cognitive skills, training the learning materials will be ICT-based with remote access to laboratories in the other countries, and the content will be based on the last research results and business practices in the most rapidly developing science. The e-learning will allow virtual mobility of students and an easy update of the contents which should be innovated every year.

The aim of the MECA project is the definition and development of cloud-based European infrastructure and organization for education in micro- and nanoelectronics providing a range of open educational resources, remote access and sharing of educational and professional software, remote and practice-based learning facilities. Its specific objectives are:

1. Analysis of institutional, teachers' and students' needs in shared IT infrastructure, teaching materials and learning resources, meeting the requirement of the enterprises in micro- nanoelectronics and translation into functional specifications of the clouds.

2. Networking of project partners from HE institutions and SMEs, to share ideas, methodologies and experiences in order to improve the HE programmes to face the rapid technological change in the sector and joint development of job-specific training modules.

3. Development of the mClouds microelectronics clouds system and realization of a shared server infrastructure, shared e-learning resources and the remote access to the CAD tools.

4. Pilot test of the virtual services and training teachers and technical staff in their use.

5. Implementation of jointly developed cloud-based open educational resources in micro-nanoelectronics in the partners' educational contexts.

The key benefits of the proposed project are that the specific capabilities will be shared between the partners in the mClouds teaching system, giving to the others access to new resources, and from the other side the common ones will be optimized, reducing the singular cost per institute and increasing the computational and structural power that is available for each partner.

To sum up the onjectives: within the MECA project we will strengthen the virtual mobility by providing open educational resources for virtual campuses; and by integrating the access to virtual learning resources and to the practices of online communities with traditional courses.

3. THE KNOWLEDGE ALLIANCE CONSORTIUM

The consortium involves higher education (HE) and small and medium size enterprise (SME) business partners: 8 HE institutions teaching engineering and sciences, including an expert in education technology, quality assurance (QA) and evaluation; 8 SMEs with expertise in the sector of microelectronics, including an SME specialized in ICT. It encompasses members from 9 countries from different application domains, including microelectronics and microsystems physics, design and fabrication, electronics packaging technology, nanotechnologies, information technology and experts in educational technology as well. (See Table 1 for the list and Figure 1 for the logos.)

Table 1. Partners of the MECA consortium.

Partner/Country	A-P	HEI	SME
TUS/Bulgaria	A	x	
INSA-Toulouse/France	P	x	
POLITO/Italy	P	x	
UNED/Spain	P	x	
UKIM/FYR of Macedonia	P	x	
AMG Technology/Bulgaria	P		x
INES/France	P		x
Astel/Italy	P		x
UPB-CETTI/Romania	P	x	
Giga Electronic International /Romania	P		x
eWorks/Germany	P		x
OUN/The Netherland	P	x	
BME/Hungary	P	x	
TU-Berlin/Germany	P	x	
Lightware Visual Engineering /Hungary	P		x
IGFOTON group (represented by INOMA Renovables SL)/Spain	P		x
ATRONICA/FYR of Macedonia	P		x
MASHO/Bulgaria	P		x
Total	**18**	**9**	**9**

A: Applicant; P: Partner; AP: Associate Partner

Fig. 1. Logos of the MECA Project, the Erasmus+ Programme and all Partners.

4. Work Plan and Work Packages

4.1. Project management

The aim is to ensure the quality of the project development: overall planning, monitoring the progress and the use of budget, reporting, co-ordination and communication within the consortium and with the Education, Audiovisual and Culture Executive Agency (EACEA).

The Project Steering Committee (PSC) including the contact persons of partner institutions monitors the project progress with respect to the main objectives. The coordinator is responsible for the concrete executive actions and financial management. Each PSC member acts as Local Project Coordinator and is responsible of carrying out the tasks and performing proper actions on a local level. The Work Package Leader is responsible for the timing, implementation and reporting of activities in the corresponding WP.

4.2. Need analysis

Analysis of user needs for shared IT infrastructure, teaching materials, learning resources in micro- nano-electronics relevant for the labour market. The need analysis of the following groups will be performed:

1. Representatives of the business, with regard to the knowledge and skills of their future employees and the most important disciplines to be taught at HE institutions;

2. Students, about their good/bad experiences with the CAD systems and the e-learning resources, their needs in specific learning resources;

3. Teachers, regarding their needs of sharing regularly updated teaching resources, the techniques and the curricula applied in each institution, the existing e-learning courses, access to remote laboratories, and their opinion of the applicability of the novel teaching methods for different disciplines.

4. Institutions, about the preliminary needs of the virtualization of their hardware and software infrastructure, the specific needs for the virtualization of learning environment in microelectronics design and technology;

4.3. Specification of the Cloud system

The aim is to design the functional specifications of mClouds system to satisfy the institutional, teachers' and students' needs, specification of remote labs access: design considerations, architecture, software and hardware solutions, human resources decisions.

4.4. Development of job-specific training modules

The needs for some training courses have been already defined and their design and development is planned (Table 2).

Table 2. Preliminarily planned e-learning courses.

- *Assembling and Inspection Technologies (BME)*
- *Computer Modeling and Simulation of Electronic Circuits & VISIR Lab Practice (UNED)*
- *Design and realisation of Micro-NanoBioSensors (POLITO)*
- *Design for Manufacturing of Microsystems, Electronic Packaging and Assembling Technologies of Microsystems (UPB)*
- *eLearning Courses CAD in Microelectronics and in Nanomaterials Using CADENCE (TUS)*
- *Electromagnetic Compatibility of Integrated Circuits (INSA)*
- *Electronic Maintenance in Renewable Energies (Igfoton)*
- *Fabrication & Application of Solar Cells (INES)*
- *Job-Oriented Courses (GEI, UPB)*
- *Micro- and Nano Sensors and Actuators (UKIM)*
- *Microsystems Design and Fabrication (AMG)*
- *Modelling and Design of ULSI circuits and systems (POLITO)*
- *Multi-Media Enhancement of Teaching Sensors and MEMS (BME)*
- *Semiconductor Device Modelling (UKIM)*
- *Superconductive materials (TUB)*
- *Technology of Electronics Products (BME)*
- *Virtual Laboratory Support for Microelectronics Packaging Education (BME)*

Depending on the results of the need analyses in WP2, changes in the topics of the courses might be done. To meet the needs of the labour market, the corresponding courses will be updated for the defined learning outcomes. The changes in the contents will be done in collaboration with experts/practitioners from the enterprises. Job-specific training modules will be jointly developed and implemented as e-learning modules for the mClouds system.

4.5. Development of the mClouds system

The aim is to implement the mClouds system and the shared server infrastructure, shared e-learning resources and the remote access to the CAD tools shared between institutions.

In WP5 of the MECA project we will implement the following three schemes designed in WP3:

1. Infrastructure as a Service model: private Cloud of each partner institution for sharing institutional IT infrastructure. Then a hybridization or federation of several Clouds will be applied to support temporary peak requirements, eliminating the need to oversize the private infrastructure.

2. Platform as a Service: Cloud-based WEB based e-learning applications in micro- nanoelectronics to share contents at European level, related to the deployment of WEB based e-learning applications.

3. Software as a Service model: mClouds for sharing CAD software, remote access to the partners' CAD laboratories. Expensive software will be shared between academic institutions and infrastructure costs can be shared accordingly.

4.6. Pilot test

Pilot test are to be carried out to test the developed (in WP4) cloud-based open educational resources in micro- nano-electronics in partners' educational contexts and training teachers in their use.

Four months are planned for training of teachers and trainers in the use of mClouds system and two training seminars – on the on job-linked education and on the use of mClouds. These four months will be devoted to the pilot test of the three scenarios and the shared infrastructure and educational resources.

As a result of the pilot test and after improvements and changes in the architectures, if they are needed, a plan for exploitation during the field trial will be done in WP9 Exploitation.

4.7. Quality assurance

Quality assessment (QA) will be based on a careful procedure of self-evaluation by the institutions involved in the project and coordinated by the Project Evaluator. The aim is to reassure that the products of the project are well documented and support project goals; that the activities carried out correspond to the activities that were defined in the original plan; that the project goals are met.

On the basis of conclusions and recommendations of the self-evaluations the management (PSC) of the project will make the necessary decisions and plan activities for their implementation. The EACEA experts will test through the interim and final reports whether the self-evaluation has been done carefully.

4.8. Evaluation

The purpose of the evaluation is to serve decision making within the project, but its main goal is to help developers in the improvement of the product and development process. It will be more oriented to the end users, i.e. to obtain feedback to help developers to improve the products and services, to reveal unforeseen circumstances in the learning environment, to insure better communication in the development team, to measure whether objectives are achieved and learners' needs are met.

The evaluation will be conducted during the whole project lifetime, starting with needs analysis, through mClouds architectures design and implementation, IT administrators and tutors training, to the implementation stage - the pilot test and the field trial.

4.9. Dissemination

The aim is multiply the effect of the project results and to ensure their sustainability, to increase the project impact by transferring them to different contexts, to promote new practices in new skills education.

The dissemination will begin with the start of the project with a design of a project web page and first publications on the on-going activities.. Information about the forthcoming activities, workshops, all reports and deliverables will be published on the web for dissemination, transparent management and monitoring by the Executive Agency. The abstracts, some prototypes of courses and tests will be published for two purposes, dissemination and evaluation by a larger audience.

The on-going activities and intermediate results will be reported on conferences in education and technology, in order to obtain feedback, to improve the processes and products of the project, and to extend the project network with new potential users.

Facebook is currently the biggest social media on the Web. This prolongs its usage as an advertising medium – allowing the access to thousands of potential users. The outcomes of this project can be promoted through Facebook, YouTube and/or other social webs.

By the end of the project a video will be produced and a leaflet in the languages of participating countries and in English. The last month of the project an open workshop/conference for dissemination of project results will be organized.

4.10. Exploitation

The objective of the exploitation is to maximize the impact of project results by optimizing their value, strengthening their impact, integrating them in a sustainable way and using them actively in systems and practices at national and European levels.

The last year of the project is devoted to the implementation of the shared IT infrastructure, educational software and e-learning materials. With the experiences gained and lessons learned during the pilot test, the consortium will plan the exploitation during the field trial.

The field trial will be performed with the students from the MSc degrees who follow courses in microelectronics: MEMS, electronics, micro- and nano-electronics at the participating universities with the use of all three scenarios for sharing e-learning resources, IT infrastructure and CAD software. From each university at least 20 students will be involved in the field trial.

After the end of the project, the services and training modules developed will be integrated in the regular MSc degrees in micro- nano-electronics of the partner institutions and with this purpose, they will be developed. The possibilities for collaboration at PhD level will be examined as well.

With the experiences gained and lessons learned during the field trial we will collaborate with the other faculties and the university management for mainstreaming and multiplication of project results in the HE in other engineering sectors.

5. ROLE OF THE HUNGARIAN PARTNERS

5.1. Role of BME-ETT in the project

- Work Package Leader of WP9 Dissemination. Planning and coordination of dissemination activities, enlargement of the project network with other higher education providers in the sector from EuroTraining initiative.
- Developing the project's web site in Hungarian on the server of BME, dissemination of the project results to EuroTraining users, contacts with Hungarian National Agency for project results dissemination, presenting the project activities and results in forums in micro- nanoelectronics education and lifelong learning.
- Publishing project results in reviews and presenting on conferences.
- Organisation of a workshop for dissemination of project results in Budapest.
- Planning and organisation of job and need analysis activities in Hungary.
- Development of the "Technology of Electronics Products" web-based course and adaptation of the "Assembling and Inspection Technologies" course to the mClouds system
- Three different innovative contents/results of the above mentioned projects/activities will also be transferred to cloud-based e-learning system: ETT-VLAB "Virtual Laboratory Support for Microelectronics Packaging Education", and SENSEDU - MEMSEDU "Multi-Media Enhancement of Teaching Sensors and MEMS" will be considered.
- Performing the pilot test in Hungary.
- Planning and organisation of the field trial in Hungary.

5.1. Role of LIGHTWARE in the project

LIGHTWARE will collaborate with the HEIs, especially with BME in learning outcomes definition for engineers in microelectronic, in course contents update and will be involved in tutoring of students. The company will be involved in:

- Coordination of university-business collaboration in Hungary.
- Analyses of needs for the business sector in Hungary (WP2); Peer review (WP3); QA procedures for the activities related to the business with regard to the criteria determined in the QA Plan in Hungary.
- Development of job-related course modules (WP4).
- Peer review of course contents, of e-learning materials, of practical virtual assignments (WP7).
- Peer review and feedback for the business sector for the implemented OERs (WP9).
- Peer review of the local project web-site, publications, leaflets and brochures.
- Dissemination of e-learning materials to Hungarian industrial companies.
- Dissemination and valorisation based on scientific/technical papers at seminars, symposia and conferences in the field of electronics, assembling/packaging and technologies.

6. CONCLUSION – EXPECTED IMPACT

Expected impact will be on the

- students – the highest quality of the specialised courses developed by the best departments in the field, the opportunity to train practical skills and competences with remote access to laboratories with advanced equipment and facilities;
- teachers – rich infrastructure and new shared teaching materials;
- universities – the European dimensions in HE: curricular development, virtual mobility of students and academic staff, integrated programmes of study, training and research;
- university-business alliance – the education responsive to the labour market needs, graduated students prepared for the job, enterprises satisfied by the knowledge and skills of young specialists.

7. ACKNOWLEDGEMENT

The MicroElectronics Cloud Alliance Erasmus+ project is sponsored by the EC grant agreement, number: 562206-EPP-1-2015-1-BG-EPPKA2-KA.

REFERENCES

[1] Communication from the Commission: "A European Strategy for Micro- and Nanoelectronic Components and Systems (COM_2013_298)", Published on 23/05/2013, Access: https://ec.europa.eu/digital-agenda/en/news/communication-european-strategy-micro-and-nanoelectronic-components-and-systems.