Collaborative research and e-learning platform for a distributed project

Eleonora Bilotta\textsuperscript{w}, Pietro Pantano\textsuperscript{\textcopyright}, Jose Sepulveda\textsuperscript{\textcopyright}, Rocco Servidio\textsuperscript{w}

\textsuperscript{w}Linguistics Department
\textsuperscript{\textcopyright}Mathematics Department
University of Calabria
Ponte Pietro Bucci, 87036, Arcavacata di Rende
ITALY

Abstract: - The CoMSON project is a distributed European research project that combines research efforts from both academia and industry. This project is distributed among eight institutions across Europe. The aim of this project is to implement an experimental simulation platform (in software code) for devices in micro and nano-electronics with an integrated e-learning system. This project has two main goals. First, to train graduate students and post-docs in mathematical modelling, through the creation of this simulation platform, and second the delivery of this simulation platform to be used as a training tool for new recruits. In this paper we describe the information system architecture created to provide the partners with a strong collaborative and development research environment. This architecture provides a framework with three main goals: information sharing, collaboration in research and, training. This scheme easily allows users to access, update and interact with information and with other researchers within all the stages of the project.

Key-Words: - Microelectronics, Nano-electronics, E-learning system, Constructivism, Information system architecture.

1 Introduction

The European project CoMSON (Coupled Multiscale Simulation and Optimization in Nano-electronics) is a Marie Curie RTN (Research Training Network) project. It involves five partners from academia (Bergische Universität of Wuppertal, Politehnica University of Bucharest, Technical University of Eindhoven, University of Calabria, University of Catania) and three partners from industry (NXP, Qimonda AG, STMicroelectronics). The main goal of CoMSON is to implement a simulation software platform Demonstrator Platform (DP) and with an integrated e-learning platform. The simulation software platform comprises coupled simulation of devices, interconnects, circuits, EM fields and thermal effects in one single framework. To create this platform implies the development and validation of appropriate mathematical models to describe the coupling of different physical effects, their analysis (well-posedness) and related numerical schemes [2, 3]. This Demonstrator Platform (DP) will be used for training young researchers in microelectronics in academia and industry. Using this framework, the students learn to develop software, through developing the DP environment, and get familiar with concepts and problems of testing and diagnostics in the microelectronics field. When the DP is finished it will be used with the integrated e-learning system to train new personnel.

To coordinate all efforts the CoMSON project operates a collaboration and information-sharing system. This system comprises the DP the e-learning platform and an information-sharing system. In the next section, we review the method that led to the adoption of this scheme and describe the architecture of the collaboration and information sharing system within CoMSON. The third section offers a review of the innovative aspects of our platform approach and highlights the successes in use of the main capabilities. The last section provides conclusions and an overview of future work.

2 Information system architecture

In order to design the CoMSON platform we analyzed the project needs placing a strong emphasis in the user during the project and after the completion of the project. The design of the platform is based on the analysis carried out using a questionnaire. The aim of this questionnaire was to gather information about the general architecture of the platform (DP, e-learning platform and information system). We collected this information in order to design a system able to satisfy the request both researchers that will work within of project and students that will use this platform for training. The questionnaire was composed of two sections. The first section analyzed the needs for the learning and training system. The second section analyzes the general architecture of the information system. The questionnaire was sent to the group leaders in the different nodes of the consortium. The reason for this choice was that the group leader was the best candidate to make an informed decision about the needs of the final users. After the analysis of the questionnaire results, the results were presented to the project management board with a proposal for the design and implementation of the CoMSON information and collaboration platform. The platform can be divided in three main elements that are interconnected. The elements are the information sharing, the DP and the e-learning.

2.1 Information sharing

The Information-Sharing Element (ISE) of the CoMSON platform provides three main macro functionalities: web-supported documentation authoring and distribution, exchange of knowledge and communication environment.
This set of functions is intended to enable interaction and knowledge exchange during the duration of the project and after its completion. This set of tools provides a channel for communication between students and instructors as well as among researchers. Eventually this group will be enlarged including different academic and corporate institutions, cooperating on research or developing new methodologies. Furthermore, the ISE of the platform is the place where seamless knowledge exchange processes operate between academia and industry.

Its architecture, based on web technologies, enhances accessibility, ease of use and ease of integration with the other elements of the system. The ISE has been developed as an enabler for the above functions, comprising a set of interconnected tools. These tools are: web services including streaming server for content distribution; a forum and a mailing list system, for communication; and a documentation environment, which is used as a central information and document repository.

We used Plone Content Management System (CMS) to implement the ISE of the CoMSON project. Plone is an open source CMS built on Zope application server. “Zope includes an Internet server, a transactional object database, a search engine, a web page templating system, a through the web development and management tool, and comprehensive extension support”. Plone already has a large user base and multitude of developers, usability experts, translators, technical writers, and graphic designers who are able to work on Plone.

An important aspect of Plone is the workflow component (Figure 1). Workflow is collaborative and cooperative systems that allow the management of the documents. Each object can be assume different states. The objects state define whether an object can be accessible by others users. The Plone workflow includes four states: visible, pending, public, and private (Figure 1).

Figure 1. The default workflow for content that comes with Plone.

Another important aspect is that Plone is easy for end users. The Plone team includes usability experts who have made Plone easy and attractive for content managers to add, and maintain content. Plone interface is easy and intuitive. Several mailing lists provide a channel to exchange information between participants. The mailing lists facilitates the communication among the researchers of the project that work to develop both of the DP and e-learning platform [2]. Another objective of the mailing lists is to share information about the general and more administrative aspects of the project.

2.2 Experimental server

The experimental platform is the core of the CoMSON project. This platform hosts the collaborative work for the main objective of the CoMSON project the implementation of the experimental Demonstrator Platform (DP). This software code platform is used to develop and validate mathematical models to describe the coupling of different physical effects, their analysis (well-posedness) and related numerical schemes [1, 2]. The main components of the DP (Figure 2) [5] are: (1) A library of test examples and experimental measurements to be used as benchmarks for any new method. (2) A set of modules consisting each of a collection of functions providing the basic functionality of the single domain simulators. (3) A control programming language (Octave), which enables to connect the aforementioned functions and form simulation algorithms.

Figure 2. The Demonstrator Platform architecture [5].

The DP is organized as a repository of code. The history of changes in files is synchronized to allow changes made by different users that work on the same project. This synchronization has been implemented using the Concurrent Versions System (CVS), which allows users to work on the same DP files simultaneously. Each user can edit the DP files within his copy of a repository, and later report the change to the central database server. The principal function of this server is to store the DP applications files, in order to collaborate at the realization of the experimental platform, and the documentation about the platform.

The DP is available as a collection of CVS modules, each containing one or more DP modules. To operate with the DP users should get an account for the CVS server. Once they have an account, the user can checkout the complete DP. After building the DP in his/her own environment, the DP can be used. All the contributions to the DP should have their corresponding description and test procedures to ensure quality and usability. In order to avoid developing code already available outside of COMSON, the DP offers the possibility to use external libraries. These
libraries are not part of DP but are connected to it by interfacing routines. Therefore, these external libraries are not included in the CV$S$ repository, and they have to be downloaded and installed separately. These libraries are available in the reference machine, including instructions how to build them.

In order to distribute the DP outside of COMSON, snapshots are created which can be downloaded from the webserver. These snapshots contain all publicly available DP Modules.

2.3 E-learning
The third element of the collaboration system is the e-Learning platform. This platform provides three kinds or learning resources. First, it is a repository for course notes, slide presentations, articles, book chapters, etc. Second, it hosts interactive courses that can be used as a stand-alone learning solution or blended with face-to-face lectures or seminars. Third, a simulation platform that interfaces with the DP to create educational simulations. In order to develop this simulation platform in microelectronics field, our goal is to implement a Graphical User Interface (GUI) able to interface the knowledge in the e-learning platform with DP [4]. This interface will be implemented in Java language and will allow the users to perform tests and simulations of electronic circuits. In particular, these simulations will allow to train young researchers in mathematics applied to modern technologies, both form a theoretical and a practical point of view. The aim of the e-learning platform is to create a flexible and innovative educational environment, which would actively engage students with the content in a meaningful and relevant way.

The e-learning platform includes constructivist methodologies based on a learning-by-doing approach [1]. Constructivism is a set of assumptions about learning that guide many learning theories and associated teaching methods. The active dimension of the constructivism learning is implemented by means of simulations. The simulations are presented as virtual laboratories, which allow to visualize (with animation) and to manipulate interactively, step by step, metaphoric representations of the functions, modules and coupling paradigms of DP. These characteristics give a deeper understanding of them. In our e-learning platform, learners and instructors can interact with different technologies, which support the students in the acquisition of skill on specific topics. The integration of different tools allows applying innovative e-learning methods and technologies. In particular, the e-learning environment foresees the development of a new generation of educational tools (e.g. 3D visualization, intelligent agents, etc.) [4]. This approach is supported by a full integration between virtual tools and remote simulation by the DP technology.

3 Innovative aspects
The main idea of the CoMSON project is to develop an integrated platform that contains simulation tools in order to link industrial and academic knowledge and necessity. To achieve this objective information has to flow and interaction among members and with materials should be rich. These interactions have to observe two aspects, first the accomplishment of the objectives of the project and second the use of the final product for learning and training. This environment will help students to acquire basic and advanced knowledge and skills in the microelectronics field through production and later training. The link between academic and industry helps students acquire creative and practical skills to apply during problem solving activities. The e-learning platform interfaced with an interactive environment composed of simulations, virtual repository, and so on, will allow to students to experiment and learn doing hands on projects. Learning through experimentation and practice is important for motivating students and to improve students’ problem-solving abilities.

In particular, our system is based on five ways in which new technologies can be used:
1. To work on real-world problem into the virtual environment.
2. The virtual environment provides the students scaffolds and tools to enhance learning.
3. Students and instructors have more opportunities to share ideas and to collaborate using technological tools in order to work on common projects.
4. To build virtual educational communities in order to expand learning opportunities in the microelectronics field.
5. Integration between collaboration, sharing tools and simulation environments embedded into the e-learning platform.

Each of these poses an opportunity for technology integration, and successful integration increasing both technology skills and content knowledge. From a methodological point of view, the informative system integrates a multidisciplinary approach in order to share both educational contents and tools. Academic partners and industrial companies participate to implement contents and tools to integrate within system.

The main goal of the information system architecture is to improve the integration between documents and tools for a better usage and collaboration by the consortium members and it’s future as a learning tool. This integration will ease collaboration and improve learning.

4 Conclusion
On-line learning has seen explosive growth in higher education over the past decade. CoMSON project is an important opportunity booth students and researchers that work in microelectronic field, because aims to integrate academic and industrial need, using the information and
communication technology. In this paper, we have given an overview of the informative system architecture that we have designed. We have showed the different tools of the informative system. In particular, to e-learning platform we have proposed the use constructivism approach, considering the nature of the learning processes using new technology. Constructivist framework and technology can be used to promote relationship among theory, practice, and technological skill. However, this system needs a thorough analysis in order to evaluate if informative system support the e-learning platform. In order to verify it, we have design some experimentation with university students.

References: