Implementation for a US-European Trans-national Degree in Real-Time Software Engineering

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***Abstract*— Programs in software engineering are challenged by the dynamic nature of software technology and by the universal public interest and need for computing systems. This is particularly true for real-time, embedded safety critical system. This paper describes the development of an international curriculum in real-time software engineering. It focuses on some technical issues related to how such an international engineering program would be managed.**

I. Introduction

The analysis, design, implementation, administration, and assessment of international curricula will become increasingly important in the global community of the 21st century. In support of this critical issue, the European Commission and the US Department of Education have funded the ATLANTIS initiative to promote collaboration in higher education between European and American universities. One American (Embry-Riddle Aeronautical University, Daytona Beach, FL) and three European Universities (AGH University of Science and Technology, Krakow, Poland; Brno University of Technology, Czech Republic; and Grenoble Université, France) are presently working on the framework of a new common curriculum in real time-software systems. This two-year project "Toward International Learning Environment for Real-Time Software Intensive Control Systems" was launched in January 2007 (EC grant: 2006-4563/006 001, US grant: P116J060005, http://www.ilert.agh.edu.pl). Project work is concerned with program objectives and outcomes, curriculum content and pedagogy, program administration (academic credit, course schedules, exchange of students and staff, etc.), and program assessment and accreditation.

II. Academic Credits

In order to develop international or common curriculum, the way to measure credits should be agreed between partners.

A credit system may have two objectives:

1. To validate the fact that a module, or a course, has been successfully passed thus measuring whether the student has acquired the minimum knowledge, skills and competencies relative to the course. This value is strategic for the student if the attribution of the final diploma is based on the validation of all program modules. Such a system can be used also as an accumulation system for life-long learning. Another application of a system based on this objective is to support a student's mobility:
   a) Student may transfer between universities for personal reasons or for a specialization (permanent mobility or transfer student),
   b) Student may spend part of her/his program in another institution during her/his studies (visiting student in the U.S. or ERASMUS exchange in Europe) to achieve a specialization or to improve multi-linguistic inter-cultural competences.
2. To grade the student either within a category (e.g. [A,..,E] or [2,..,6]) or as a percentage of a maximum possible (e.g. 70 %, 14/20) to assess her/his level of the subject competence. This approach does not by itself validate the course or module, except when some official passing thresholds are used (e.g. as a percentage of the maximum possible). A system based on this objective can provide a ranking or classification of the student. Such system, under certain rules, allows that a lower grade in one course can be compensated by a good grade in another, resulting in total average qualifying for graduation.

Another aspect is the amount of credit given to a course or module. This amount will have consequence when a compensation system is used for the final acknowledgment of the diploma, or when the final diploma is given only if a certain amount of credits are successfully accumulated.

Two criteria can be used to define the amount of credit:

1. The actual number of hours the students spent in pedagogical sequences i.e. contact hours (course, exercises, labs, conferences) where their participation can be objectively measured. This system is also used to quantify the time spent by a teacher in the class. The disadvantage of this system is that it is difficult to measure the actual student workload which deals with individual work, projects, etc.
2. The actual workload for the student considering all the time dedicated to work on the course including not only the contact hours but also personal work, study hall, academic projects, etc.

III. Synthesis on the credit transfer in the US and Europe

Both in Europe and in the U.S., credit systems are designed to evaluate students and to provide for student mobility between institutions.

When credits are used for the evaluation of students, the situation is the similar in USA and in the European countries (note that at this stage European countries generally use their own national or local grading systems). The credits are given after an academic term (semester, trimester) to justify continuation in the academic progress, or after the completion of a complete curriculum program to justify receiving the final diploma.

When credits are used for permanent mobility, appropriate "equivalences" must be found. The rules of equivalence could vary depending on institutions or programs, but generally the student will keep a record of his/her results in the origin university and will go to the new university through an admission procedure. This admission procedure will be based on the type and content outcomes of the “transfer” courses.

In Europe, ERASMUS introduced a transient mobility to encourage students to spend part of their studies abroad, to work in multinational, muti-lingual, and multicultural environment and also to appreciate the European dimension. A student going abroad, for a semester or for a year, pursues courses which are considered equivalent by the origin university. Typically, the student receives the diploma from the origin institution.

The same situation exists in the US, with the transfer credits earned from the host institution, allowing the students to attend another institution in another state or abroad. Bi-national degrees and diplomas exist both in U.S.A and Europe.

IV. Assessment and Accreditation

Current requirements prescribe that a transatlantic curriculum should be accredited both in the U.S. and each of the European partners.

In the U.S., ABET and the EAC manage accreditation of engineering programs. In Europe, despite the existing European project EUR-ACE, there exists no single European accreditation agency or mechanism responsible for accreditation of engineering programs. Although the accreditation process is the responsibility of the member states in Europe, accreditation criteria and processes proposed at the European level are being integrated into national accreditation systems. One could imagine that, in the future, procedures in the member states will be based on a common set of European accreditation principles and methods.

V. Comparing ABET-EAC and EUR-ACE

Both EUR-ACE and ABET-EAC prescribe an accreditation process that is focused on program objectives and outcomes. An analysis of the common features of the objectives and outcomes shows a great deal of similarity between the two. However, EUR-ACE puts greater emphasis on engineering analysis, project management and business practices, while the ABET-EAC highlights an understanding of contemporary issues, and professional and ethical responsibility. Both accreditation processes require periodic self-assessment, external review and they make judgments about accreditation in a similar manner.

It is clear the two approaches are similar in their goals, requirements and processes. The main area of difference is in the curriculum requirements and the required length of study. The EAC requires specific subject areas (math, science, engineering, general education, design experience), over a four year period, while the EUR-ACE first cycle specifies at least 180 ECTS credits (about three years) and does not specify subject areas. It certainly seems possible to develop an engineering curriculum that could satisfy both sets of requirements – a three year program for Europe and an additional year of general education added for a USA program.

VI. Discussion and Summary

The organization of an engineering transatlantic program, which could be accredited and recognized on both coasts of the Atlantic Ocean, requires one to precisely define the expected learning outcomes. Subsequently, the content of the syllabus should be defined. The setting of credits, taking into account the various pedagogical sequences (courses, exercises, labs, personal works, projects…) should be defined as a function of the workload of students to fit appropriately with the learning outcomes.

The accreditation of an academic program, especially an engineering program, is essential in order to verify its relevance, quality and currency. Both Europe and the United States have viable accreditation processes in place. Although the European processes are more diverse, the EUR-ACE project holds hope for a common process that could be quite easily integrated with the ABET-EAC process, in order to develop a transatlantic accreditation system that would serve the best interests of their universities, their faculty, their student and the public in general.

The final paper will present a deeper analysis of credit and accreditation, and some other aspects of the project.

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