

PLACIS: International Inter-University Collaborative Training Platform in Systems Engineering

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Conference Key Areas: Engineering education research, Internationalisation, New learning concepts for engineering education, Novel education tools for engineering programs

Keywords: Collaborative, International, PBL, Outcomes

INTRODUCTION

“Systems engineering” is one of the most requested profiles for engineers.

Systems engineers master a variety of technical and human-centered disciplines. They are members or managers of international teams in charge of complex engineering projects.

SUPMECA is a French Engineering School in the fields of Mechanical and Industrial Engineering, with a consolidated experience in Systems engineering and in Problem Based Learning (PBL). In 2011 emerged the idea of a new training scheme to prepare future graduates to working as systems engineers in a changing globalized world, in which working in international teams, distributed over many locations, composed of members having different cultures and working habits, becomes the norm.

SUPMECA is a component of Collegium Ile-de-France, an Institute composed of SUPMECA, EISTI (Computer science engineering) and ENSEA (Electronic engineering). In 2011, the Collegium answered a call for innovative learning schemes from the French Ministry for Higher Education and Research and was awarded in 2012 a special funding to develop PLACIS. SUPMECA is the coordinator of PLACIS.

1 PLACIS IN A FEW WORDS

PLACIS is an innovative training scheme for future Systems engineers.

PLACIS is a collaborative platform between French and foreign universities, promoted by the Collegium Ile-de-France, Based on the concept of Problem Based Learning (PBL), a “pedagogy in which students learn about subjects by solving complex, multidisciplinary, realistic design problems” (Ward, 2013), PLACIS purports to train future systems engineers as realistically as possible: PLACIS projects - preferably requiring expertise from different engineering fields - are proposed by industrial companies and are carried out by a team composed of students from two universities in two countries.

The format of PLACIS projects is flexible and depends on the stakeholders involved in the projects. They are part of the curriculum and generally placed in the fifth year of higher studies - second year of the master - and correspond to an amount of 4 to 15 ECTS credits.

Concretely, the steps of a PLACIS project (or more precisely of each a phase of a PLACIS project) are as follows:

- A company proposes a project requiring expertise from different engineering fields.
- This project is discussed, adjusted and validated by both universities and the industrial partners.
- Voluntary Students are recruited in both universities and a team is formed.
- A kick-off meeting (in-person or via video-conference) is organised with all the people involved in the project.
- Students carry out their project while staying in their home university and using the tools of collaborative engineering. They are tutored by their teachers and by the industrial company providing the subject.
- A final presentation of the results is organised and the performance of the students is assessed.

Most of the projects are composed of several phases. In that case, the subject can be adjusted between two phases, depending on previous results, and successive teams of students carry out the different phases. It is obvious that the accuracy of the documentation elaborated by each team of students is of utmost importance for the successive teams.

As an example, we can quote the following subject given by one of the industrial partners: “Modelling of a test bench for electric or hybrid vehicle”.

PLACIS projects offer most of the elements cited by Ward [1] in his paper “Common elements of capstone projects in the world’s top ranked engineering universities”, in particular a strong group project emphasis, an emphasis on applied design projects, an active involvement of an industry stakeholder. In addition, for each project, the student team is international and based in two different locations.

2 LEARNING OUTCOMES AND ASSESSMENT METHODS

As PLACIS is also pedagogical research project, learning outcomes and assessment methods are key elements of the project.

2.1 Intended learning outcomes

The intended learning outcomes - LO’s - are both technical and non-technical, both generic and subject-specific. They are in line with those listed in the EUR-ACE

Framework Standards and with the standards of the French Accreditation Agency CTI - Commission des Titres d'Ingénieur.

Let us quote from EUR-ACE Framework Standards [2]:

“Ability to identify, locate and obtain required data; ability to design and conduct analytic, modelling and experimental investigations, critically evaluate data and draw conclusions; ability to investigate the application of new and emerging technologies in their specialisation.

Practical skills for solving problems design and realize engineering products, processes and systems,

(Ability to) function effectively as leader of a team that may be composed of different disciplines and levels; work and communicate effectively in national and international contexts.”

Let us quote also from CTI's standards [3]:

“Understanding of engineering methods and tools: identification and resolution of problems, even those that are not familiar and not fully defined, possibly using experimentation, innovation and research, the collection and interpretation of data, the use of computing tools, the analysis and design of systems,

Capacity to join an organization, to lead it and drive it forward: self-awareness, team spirit, commitment and leadership, project management, project coordination, communication with specialists and non-specialists alike,

Aptitude to work in an international context”

More specifically, PLACIS projects are expected to contribute to the acquisition of the following skills: intercultural communication and language skills, ability to plan, to work in teams, to collect, interpret and use data, practical experience in conceiving and designing a system for a client with the help of simulation tools and of the most novel tools of systems engineering (CATIA V6, Dymola, Artisan Studio, ANSYS, Matlab Simulink, Modelica...), experience with the tools of collaborative engineering (3DSwYm, Sharepoint, Webex, Skype). Of course, the students also gain experience in interdisciplinary communication as well as scientific and technical knowledge in the area of their specific project.

For sure, these and other skills and competences are acquired by the students throughout their entire curriculum in their home university, and PLACIS projects are only a part of it. However it is worth mentioning that the PLACIS projects are for the participating students a learning experience that meets some of the CDIO standards [4], they cover the Conceiving, Designing, Implementing steps and meet in particular the standards 5 - Design-build experience, 7 - Integrated learning experiences - and 8 - Active learning.

2.2 Assessment methods

Developing, testing and using a variety of direct and indirect assessment methods of the achievement of the intended LOs is one of the objective of PLACIS.

For the moment the assessment methods include:

- Assessment by the teaching staff and by the supervisor of the industrial partner of the commitment, motivation, autonomy, organization skills and project management skills of the team members.

- Direct assessment of the deliverables by teaching staff and by the supervisor of the industrial partner:
 - Written Technical report
 - Final oral presentation
 - Models developed
 - Gantt diagrams
 - Minutes of intermediate meetings
 - Posters

Although the direct assessment of the deliverables seems straightforward and looks familiar for the assessors, there are discussions among the PLACIS promoters and their partners, for instance on how to assess the quality of the models designed by the students and on how to do this in a consistent manner across projects. Moreover, for some projects, the quality of end-results produced by the team may be poor while nevertheless the learning objectives are met and the acquisition of competencies is satisfactory.

In addition, surveys of the stakeholders are carried out at the end of each phase of a project. In the first students' survey, the students quoted the following benefits:

- An opportunity to develop autonomous-learning,
- An opportunity to work with foreign partners having different approaches,
- An opportunity to learn and take advice from foreign students, teachers and industrial partners.

Moreover it was observed that teams composed of students with different backgrounds (for instance a team in which the French students had a background in Mechanical Engineering and the foreign students in Industrial engineering and management) worked very well, if not better than more "homogeneous" teams.

3 ONGOING AND FUTURE PROJECTS AND KEY FIGURES

Six PLACIS projects are now - June 2013 - in progress, involving students from Collegium Ile-de-France and from four foreign universities, two in Italy, one in Germany, one in the United States. A new foreign academic partner is ready to join.

These PLACIS projects also involve six companies, one for each project, two in the field of aeronautics, two in the field of automotive industry, one at the crossroads of aeronautics and renewable energies, one in the field of automation.

From its inception, a total number of 70 students, 12 teaching staff and 9 supervisors from the industry were involved in PLACIS projects.

4 DIFFICULTIES, KEY ISSUES AND CHALLENGES

Of course, it is not always easy to set up PLACIS projects and, once started, some projects meet some difficulties. Typical difficulties are the following:

- The academic calendars in the two partner university do not coincide and students are not available for projects at the same time during the academic year.

- In some universities, there is little window in the curriculum for project work and local or national regulations limit the number of ECTS credits that can be allocated to them and this can be a deterrent to the students.
- The information systems of the partner universities and of the industrial companies are not fully compatible. Even when they are compatible, some companies completely prohibit exchange of data between their information system and external information systems.
- The versions of the technical software tools used by the partners are not the same.

The academic partners work to overcome the difficulties connected to the differences in the curricula, but, whenever possible, when other difficulties arise, the PLACIS team will try to share them with the student teams and ask them to contribute to a solution.

Discussions and trials are in progress regarding in particular the integration of the projects in the curricula, the development of new assessment methods for the achievement of the LO's, including assessment by the participating students themselves of their personal performance, of the performance of their fellow team members and of the performance of the entire team.

Through systematic surveys of all stakeholders, returns on experience are being collected and will be used in order to improve, if needed, the format of PLACIS projects and to identify the "good practices".

Also, new academic and industrial partners are approached to join PLACIS in order to continue the development of this new platform and training scheme.

5 ACKNOWLEDGMENTS

PLACIS is supported by the French Agence Nationale de la Recherche under « Investments for the future » program with the reference ANR-11-IDFI-0029.

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