

# An International Project/Internship Course

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## Summary

Students can benefit from projects/internship courses in many ways. They can acquire many skills that are wanted by employers such as communication skills and interpersonal skills, and it can be very motivating to apply the theory in a realistic context. Many things can be learnt more in depth when students are working on projects, and students learn to learn which is important today because engineers have to adapt to changes that come quicker than ever.

Denmark has a long tradition for project based learning (PBL) and project organised learning (POL). An interesting result of this tradition is “European Project Semester” or EPS. Since 1995, there has been a European Project Semester in Denmark, and it has been very successful with 1473 students enrolled so far. EPS is a mixture of formally taught courses (30 %) and project work in international, interdisciplinary teams. An important benefit is that students also acquire international competences from EPS.

Sometimes when students are working and studying in teams, some team members don't contribute to and don't learn from the project work and get credit from the work of the other students. EPS has an assessment system that hopefully prevents this.

*Keywords: practical learning, teamwork, international competences, assessment.*

Introduction.

Engineering education is usually a mixture of theory and various practical elements such as laboratory work, internships and projects. It reflects the way engineers work, and the practical aspects are important for many students.

WHY PROJECT/INTERNSHIP COURSES?

Many subjects can be difficult and too theoretical for engineering students. Many will understand the theory better when it is linked to something practical, and it can also be motivating to see how the theory is applied in a real-life situation. Usually, students learn more in depth when they do a project and have to apply the theory in a concrete situation.

Many students will get tired and bored if they only are taught theory. An internship can be a good change for those students.

Internships and projects done in cooperation with companies are important for students. Students come to know the culture of the companies and can establish good relations to the companies. It can help them to find jobs, and many find inspiration for their final projects.

Internships and student projects are also important for companies. They get an opportunity to influence the students, and it can help them to find the right employees. Hopefully, they can also benefit from the work of the students.

Universities and engineering schools can also benefit from internships and projects done in cooperation with industry. The cooperation can be a very valuable link to industry.

## **DIFFERENT TYPES OF PI-COURSES.**

Internships and project courses are very diverse. Consequently, it can be difficult to distinguish and systematise all variants. However, there is an attempt to a classification below:

### **INTERNSHIPS.**

In an internship, the student works as an employee in a company. However, the tasks of the student must be relevant for the study programme and usually they should be approved by the university or school. In many cases it will also be assessed by the school/university to secure a good outcome.

### **PROJECTS.**

There are many different kinds of projects, and they can be classified in many ways:

#### **WHERE ARE PROJECTS DONE?**

Some projects are done at the educational institutions; others are done in companies. They can also be done in cooperation between institutions and companies. Company projects are usually practical, and institutional projects are often theoretical, but many projects combine theory and practice.

#### **WHO DEFINE THE PROJECTS?**

Projects can be defined by companies, professors/teachers or students. Many find that it is important that students take ownership of their learning and their projects, so very often the projects are defined by students. Another reason is that a project defined by the students often is more motivating. By the way, it can also be difficult for professors/teachers to get new ideas for projects every semester, and when the same projects are repeated several times, students will often find old reports and benefit from those! However, it is important that supervisors can help students when they define the projects. Some students try to define projects that exclude the difficult parts they really could learn from.

#### **RELATIONS BETWEEN PROJECTS AND CURRICULUMS.**

Projects are used in many different ways. They can be part of one single subject or they can be interdisciplinary and combine several subjects; usually subjects taught in the same semester. They can be a small part of a semester or in some cases a whole semester. An important project example is the final project (or thesis).

#### **INTERDISCIPLINARY PROJECTS.**

Many projects are interdisciplinary. First of all, it reflects the way engineers work today. Thanks to progress in science and technology, things are so complicated that engineers usually no longer are able to work alone. Today, to meet the demands, there is usually a need of interdisciplinary teams of people with different specialisations. With the harsh international competition, it is also important that e.g. engineers can cooperate with sales people and marketing people at all stages when developing a new product.

For students, an important aspect of interdisciplinary projects is that they can see the coherence between the subjects and get a more holistic understanding of the syllabus.

### **TEAM PROJECTS.**

Some projects are done in teams, others by a single student. When done in teams, they can be bigger and, hopefully, more complex and interesting. Team projects reflect the way many people work today after graduation, and in most cases the students can benefit from the cooperation with the other team members. Many students will also improve their communication skills and interpersonal skills from the teamwork, and they learn to learn. However, it is a well-known fact that some students don't contribute effectively to the teamwork, maybe because they are unmotivated, maybe because they are lazy. Consequently, they create problems for the other team members, they can cause conflicts and they don't learn from the project work.

### **“EUROPEAN PROJECT SEMESTER”, EPS, - AN INTERNATIONAL PROJECT COURSE.**

#### **BACKGROUND.**

There is a 50 year old tradition for problem-based learning (PBL) and project-organised learning (POL) in Denmark. The present author experienced it at high school in 1962/1963 and found it very motivating and inspiring. In 1994, Professor Arvid Andersen at Elsinore Engineering College created a project semester in the field of thermodynamics for students in mechanical engineering. Thermodynamics is a very important subject for mechanical engineers, but many students find it difficult and too theoretical. Thanks to a well-organised semester with emphasis on a big project, the students learned thermodynamics better than usually. The present author was external examiner for this project semester and concluded that it worked well. The students were well-motivated and they had learnt in depth.

Based on this project semester, Arvid Andersen added the topic internationalisation and, in 1995, he created a “European Project Semester”, EPS, which became international in scope and integrated more fields of engineering.

EPS started in Elsinore Engineering College in 1995 with 6 students. When this college closed in 1997, EPS was transferred to the Department of Export Engineering at Copenhagen University College of Engineering (IHK). This department has a very international ambience and project-based learning, with interdisciplinary projects and students in teams, has been the default modus operandi for many years. EPS became very successful, to the extent that in the 2012 autumn semester EPS-student number 1473 was enrolled.

#### **THE AIM OF EPS.**

The aim of EPS is partly known from other problem-based learning: to make students active, motivated and creative, to give them team-working competences and to enhance their communication and interpersonal skills. However, the most important aspect of EPS is that students study in international teams and acquire teamwork and communication skills in an international context. In short, students acquire international competences, which are now very important.

#### **WHAT IS EPS?**

EPS is a semester for international students who have completed at least other four semesters. It is not only for engineering students, but also for other students who can contribute to an engineering project. As in real life, for example, marketing people often have to cooperate with engineers, and in some projects civil engineering students have cooperated with architect students. EPS consists of a formally taught course programme (9 ECTS) and a large, usually interdisciplinary project (21 ECTS). All project groups are put together according to the students' fields of study, the demands of the projects, the students' preferences, the group size (usually 4 or 5) and the international mix: all teams should be international.

The overall aim of the courses is to help students to work in international teams and to carry out the project work: the principal courses cover Teambuilding, Communication, Project Management and Systematic Innovation. Other courses are more specific and EPS-students can now choose three specialisations: Sustainability, Electronics & IT and Business & Technology. Language - that is English and basic Danish - are also part of the study programme.

The major part of EPS is the projects, most of which are interdisciplinary, although a few are narrower and explore topics in greater depth. The majority are real-life projects, carried out in cooperation with industry; but some of them are academic with no involvement of a company. In that context, it is to be noted that students are generally highly motivated in doing a "real" project for a company that awaits their findings. Most companies are Danish, but some projects have been done in cooperation with companies and institutions in Spain.

## **WHERE AND WHEN?**

Thanks to its significant success, EPS has spread from Denmark to many other countries and it is now also offered at:

Avans Hogeschool in 's-Hertogenbosch, The Netherlands.

Høgskolen i Oslo, Norway.

The Technical University of Lodz, Poland.

La Universidad Politécnica de Valencia, Spain.

Universitat Politècnica de Catalunya in Vilanova i la Geltrú, Spain.

Novia University of Applied Science in Vaasa, Finland.

École Nationale d'Ingénieurs de Tarbes, ENIT, France.

Artesis Hogeschool Antwerpen, Belgium.

Instituto Superior de Engenharia do Porto, Portugal.

Some EPS-providers offer an EPS in spring semesters, some in autumn semesters, and others in both: see [www.europeanprojectsemester.eu](http://www.europeanprojectsemester.eu) for full details.

EPS at all other institutions have been started with help from EPS in Denmark. It could be considered as a help to the competitors, but the aim is to secure a good level of EPS at all institutions. For EPS in Copenhagen, the other EPS-providers are not competitors, but good collaborators, and there is a good cooperation between the EPS-providers e.g. about student exchange. The EPS-providers have an annual meeting with the aim of finding inspiration, discussion joint concerns and new ideas.

## **GETTING OF TO A GOOD START.**

In reality, the time-period for a semester is short compared with the time that may be lost in the beginning with exchange students who come to a new location and have to deal, amongst others, with a new environment and new accommodation. It can be a particular problem for students who are not familiar with PBL and POL, because they may waste considerable time in the initial phase of a project period - which is when students have to find out what is important, what is not, and define the project. As a result, it is important that the projects start as efficiently as possible. All the students therefore receive descriptions of the projects they can choose, at least two months

before the semester starts, they return a prioritised list of three preferred projects and the project groups are formed on the basis of these lists. It is motivating for the students if their first priorities can be accommodated, but other factors are also important: the skills of the students should align with the demands of the projects. The group size should be 4 or 5 students, and all teams should be international. After the semester students have reported repeatedly that the international experience was for them the most motivating part of it all.

Once the groups have been formed, each student receives an e-mail informing them of their project and the names and e-mail addresses of the other team members. Students are asked to discuss with a professor or supervisor from their home university how they could and should contribute to the project work. This is important for many students, to secure credits for the semester when they return to their home universities, and it helps them to define and start the project work when they meet the other team members. Those initial discussions about the projects take place on the second day of EPS when the teams meet their supervisors from IHK and from the companies.

When the projects need to be defined, many students are reluctant to make decisions and prefer to be told what to do. However, it is important that students take ownership of the projects and responsibility for their learning. Companies will - of course - contribute with their expectations of the projects, and supervisors from IHK will help students to make realistic problem statements at a sufficiently high level. Courses such as Teambuilding, Communication, Systematic Innovation and Project Management will hopefully also help the students to start their project work well.

### **THE BELBIN TEST.**

Not only do EPS-students have different fields of study, different nationalities and different cultures, they also have different personalities! Consequently, they are required to do a Belbin test (Belbin, 1981) on-line before they start on EPS. The result of this test is important because different personalities with different qualities and skills are needed in teamwork. It is always comfortable to work with people like oneself; but in the long term the outcome of the teamwork will be better with different personalities being involved. The Belbin test and theory accommodates this and the hope is that the students will learn to appreciate diversity - although it has to be acknowledged that diversity can cause difficulties and perhaps even conflicts.

### **PROJECT WORK AND SUPERVISION.**

Often, when people are working in teams, the cooperation is not efficient and time can be wasted. This can arise if there are those who do not contribute effectively, perhaps because they are not motivated, or those who do not organise their work well. There is a course about project management at the start of the semester and during the semester supervisors help students to work in a well-structured and well-planned manner and to make use of what they learnt in the project management course.

A team cannot work efficiently without meetings; but many people have wasted a lot of time in meetings! So, students have to learn to prepare for meetings, to write agendas, to chair and to write minutes. All EPS teams have meetings at least once a week with their supervisors, for which the students are responsible, with all team members being required to have tried to write agendas, chair meetings and write minutes.

Supervisors should - of course - be able to help with technical questions from the students and give them good advice about the projects. However, they must also help students with the team process and follow the teamwork and the group performance closely. Sometimes students will feel that the project work is satisfactory and that everything is in order, and sometimes they will be frustrated and inclined to lose confidence and need to be given encouragement. Sometimes there are hidden conflicts, sometimes there are open conflicts. Misunderstandings arising because of different cultural backgrounds can generate many conflicts. When 60 - 70 students from perhaps 15 nationalities are working together in teams, many things can go wrong and problems and conflicts can occur. Communication is not only a matter of language: cultural background and context are also important factors. Different people with different backgrounds may interpret the same words

differently. Different working habits and cultures, direct or indirect communication, expressive or reserved culture, relation-focus or deal-focus and many other differences may give rise to misunderstandings and conflicts. Naturally, some conflicts will not be caused by misunderstandings, but rather by different opinion. This is valid: students are not clones of each other and may have different views about how the project should be designed and implemented. As a result, an important part of teamwork is learning how to negotiate.

Finally, although there is a need for different personalities in a well-functioning team, personal differences that are too big may also cause problems. Supervisors must therefore be aware of conflicts and other problems and be able and willing to help the students to deal with them. Equally, students must learn how to handle conflicts. Some students tend to avoid conflicts because they find it embarrassing; but hidden conflicts will usually become worse until the time comes when the matter becomes overwhelming, so it is important that supervisors are able to detect - and deal with - such matters.

In short, supervisors have several important roles in EPS; as technical teacher, advisor for the team process and as a person who can facilitate and nurture the team process. For example, if a student becomes demotivated, it is important to identify the reason for this: in some cases a simple change of the problem statement can be the solution.

Many things can go wrong, but the majority of students who choose EPS are aware of the importance of the international experience and are highly motivated. They usually have a positive attitude and they learn to appreciate diversity, in spite of the problems this can cause. An important part of the EPS concept is that students are responsible for their project work: they are treated as adults, not as children. It would simply be too time-consuming for supervisors to monitor the students continually - and such action would also be very tedious for the students as well for the supervisors! The intention is that students will behave in a mature and responsible manner if they are treated like grown-ups. For some students, however, this freedom may lead to temptations. There will always be - at all universities and colleges - students who try to complete their education with the minimum of effort, or even try to cheat. Such students - especially if they are used to more traditional teaching - may believe that EPS is an opportunity for "leaning back and enjoying life" instead of studying. It is important to be realistic and face this problem.

If all students in a team agree to be lazy, the supervisor must be able to detect this and explain to the students that such an attitude will not work. However, some teams may put a great deal of effort into concealing their indolence and try to make it look as if their poor results are simply due to a bad luck.

Supervisors must be aware of this: after many years of experience, with 1473 international students, I venture to suggest that we have learnt a great deal about how to deal with such situations. However, it rarely happens that a whole group agrees to be lazy. More often, one or perhaps two students in a team might be thus inclined. In such cases the overall performance will be poor, conflicts may occur and the good students may lose motivation. To overcome these problems and to make sure that lazy students do not pass the exam as a result of the work of the other team members, EPS uses a special assessment system.

## **EPS ASSESSMENTS.**

Twice during the semester, the students have to do a "self and peer assessment" in which their opinions about their own and the other team members' performances are compared. They are required to assess the quantity and quality of the technical contribution and the contribution to the team process. For some students, it can be a very useful experience to see that the assessment of themselves by the other team members is different to their own self-assessment. Whilst these assessments cannot be part of the marking system - as staff we need honest answers - it is very instructive for the students and it can help with the timely detection and solutions of problems. It is also a very good tool for supervisors to use to detect problems and appraise the overall condition of the team and its members.

In the exam, students are assessed individually. After a group presentation, during which all members contribute and are assessed individually, they are examined individually. However, the team process is very important and based on the supervisors' opinions each team receives an average mark for the teamwork. The students must then distribute this portion of the marks (35 %) individually according to individual performance. Some students do not like this system, but when it is explained why it is used, they tend to understand and accept it. They may divide the marks equally, but groups who have had teamwork problems caused by lazy team members know how to make use of the system!

It is to be hoped that this assessment system ensures that all students receive correct and individual marks. It dissuades some students from not participating in full because they know in advance that if they do not contribute effectively they will get bad marks, or will not pass the exam. Another important outcome is that many conflicts about who is lazy and who is not are avoided.

Of course, it is a challenge to award marks for teamwork in a well-defined way. Many different elements are assessed, such as quality and quantity of the work, how well-organised the work was, how well the students cooperated, how well they solved problems and conflicts and so on. It is difficult to give precise marks for all such elements - and the marks should not be based upon how "nice" a person the individual might be. To a certain extent, the teamwork marks are based upon intuition, but many years of experience have convinced the present author that intuition is more correct than people usually believe.

### **BENEFITS OF EPS.**

After engaging with 1473 students from 38 countries, the experience with EPS has been very positive. Many of the benefits of PBL and POL have been enjoyed and, because of the international context, these benefits have been enhanced. When the teamwork is good - which is usually the case - synergy takes effect; that is, the whole becomes greater than the sum of its parts. It becomes more "we" and less "you and I. Students become motivated, active and creative; they mature and assume responsibility for their project work and for their learning.

There is no doubt that the international experience is the most important part of EPS. Student diversity is a source of strength, but it can cause problems and conflicts. The majority of students learn to appreciate diversity and tell us that the international experience was the aspect they liked most. Through various social networks and emails it has been observed that they keep in touch and that EPS initiates their international network. After EPS, many have written to the present author to advise that they secured a job as a result of the international experience gained through EPS; and many EPS-students and professors who are well acquainted with EPS have given us very positive feedback.

### **CONCLUSION.**

The conclusion is that PBL and POL work well when properly applied, especially in an international context such as EPS. However, students have different learning styles, professors have different teaching styles, subjects are different and all learning/teaching will become boring if it is always done in the same way. Learning is nutrition for the brain and, like all other nutrition it should be a good mixture of good ingredients.

An important aspect of group work is that students - hopefully - improve their communication skills and interpersonal competences. The international competences will also be reinforced when the teams are international, as is the case with EPS, as will motivation.

Assessment is an important aspect: it should always be in harmony with the learning process. When teams are learning by PBL and POL, and especially when using interdisciplinary projects, matters can become complicated. It is important that the assessment system is able to cope with this challenge, and equally so for the EPS assessment system.

### **ACKNOWLEDGEMENT.**

I would like to thank Professor Arvid Andersen whose good idea it was and who started the first EPS in 1995.

## **REFERENCES**

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