European Programs of Co-operation in Engineering Education

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Abstract

In connection with the position and size of the Netherlands, it is important that students obtain a broad orientation within Europe. Because of the absence of sufficient resources, the Netherlands are dependent on the export of knowledge and not of products to remain a positive economy. Therefore our educational institute is practical y oriented. An important aspect for prospective employers is to work with basic tools in a creative and innovative way, and solve more complicated problems in a systematic and conceptual way. Life and impact on the society and environment is also important. Finally an important point are the communica-tive skills of the prospective engineer, who has to communicate with specialists from different disciplines and has to be able to sale the final product to interested costumers. In conclusion, the benefits for all partners, students, universities and business world, are presented.

Introduction

The Netherlands is a small country (16,000 square miles) which is situated on the edge of the continent of Europe. It has important seaports (Amsterdam and Rotterdam), which constitute the gateway to Europe, certainly also in view of the developments in Eastern Europe. The Netherlands is densely populated (1,060 inhabitants per square mile) and has few resources of its own. The main part of the national income depends on trade, especially international (transit) trade. Inevitably, The Netherlands therefore is oriented towards the world market, and towards the European market in particular.

The majority of young people in The Netherlands study at a high level, the size of the national Education budget for this type of education and the private contribution which is still low prove that the Netherlands seriously deals with investing in a high-quality future, being a part of a united Europe. The Netherlands has about 100 universities, which means that there is one university to every 170,000 inhabitants. In total, 850,000 students go to university, amounting to an average of 8,500 students per university, which means a higher education ratio of 5 % of the total population of The Netherlands. For higher education this implies that, apart from the usual components, foreign languages should remain heavily stressed. On average, people in The Netherlands learned three languages in secondary education, thereby facilitating a broad orientation towards Europe. For university education, this implies the need to keep up the knowledge of languages.

Engineering students are no exception to this rule. Since The Netherlands is small, these graduates too should be able to find work all over Europe. Whether it concerns working abroad for a foreign company or working abroad for a Dutch company, international orientation is a necessity and the knowledge of languages is an essential part of this. In the engineering curriculum, time is allocated

for this purpose. But since the teaching of engineering knowledge and skills takes up much time, an industrial placement abroad and/or graduating abroad was chosen, in addition to the regular teaching. The European Union has set up a number of funds that support and stimulate students to orient themselves towards Europe. As an engineering university, we use these funds, as it allows to link practical experience in engineering with increasing the practical skills, in order to communicate in a foreign language.

The players

Engineering universities in The Netherlands can be divided into two categories. One type of education is focused on research, the other category on applications. Universities of Professional Education are engineering universities of the latter category. It is therefore of vital importance for this group to have close ties with the business world.

The co-operation with **the business world** takes shape at various engineering levels. The business world has an advisory role at the highest level, and at lower level the business world and the engineering university guide and support each other. By forming a group of experts - from the bigger companies - the business world's advisory role has been guaranteed. Together with professors the curricula are discussed and, wherever necessary, adapted to the needs and developments of the business world. Changes and adaptations are constantly tested for their educational opportunities and principles. The other role of the business world and the engineering universities is a far more direct one, which does not mean that it is less important. By making industrial placements and final projects available, interaction of knowledge and skills between the two parties takes place.

Ever since the establishment of the engineering *hogescholen* it was customary to co-operate with the business world by means of industrial placements. The curriculum of all engineering courses includes a third year that is spent entirely in industry in order to gain practical experience and to obtain a clear picture of the opportunities within the field, thereby facilitating the choice of a specialization in the final year of the studies. The final projects were carried out within the institute under the supervision of the professors. In the years 1975-1980 the number of graduates was limited, about 40 students a year. After these years, a spectacular increase in the number of engineering students started. In ten years the number of students quadrupled and therefore also the number of graduates. In order to control this process, about 150 final projects had to be started and supervised. A mission impossible!

It was difficult to think of a solution which was didactically acceptable and which would mean a good supervision for the student, so that the level of education could be maintained. The solution in itself was obvious. During their placement the students had become very familiar with the business world and vice versa. Many companies indicated that they would like to see the students back, because the effort and knowledge of the students had an important, often innovative input for the company. For the engineering institutes too there were benefits: the positive introduction in the business world at a higher level, the technical reporting and the exchange of knowledge and skills between the business world and education. More advantages can be mentioned. The student provides the business world with new ideas, he can stress his distinctive features and at the same time settle in, while working on a problem which is truly important for the business world. Once the student is ready for graduation, the company has got a good impression of the student, who is also thoroughly familiar with a specific problem and therefore is a specialist. Should the company not be able to take on a new employee or if the employer and the student did not get on too well, no damage is done, neither for the business world nor for the student, and both parties can look for another man or another job.

The Tools

Within **the European Union** the idea of a united Europe is taking more and more shape, implicitly expecting the next generations to be able to operate all over Europe. In order to reach this goal, a number of programs were set up that brought together the two most important parties. Two of the programs that are most important to the universities will be amplified below.

The first program, **Erasmus,** offered a grant to the student that started studying at a foreign (engineering) university. The student's engineering university of origin then had to recognize the - learning modules that were passed. This not only was the start of a dialogue between the European universities with resulting forms of co-operation, but it also led to a kind of comparison of levels realized by students and a process of integration initiated for young people in Europe. So it is a relationship between engineering universities. Very specifically, there are also thematic forms of co-operation involved, in which engineering universities with a certain specialization co-operate.

The second program, **Comett,** offered a grant to the student that started increasing his working knowledge with a foreign company, the local engineering university (UETP = university enterprise technology partner) being responsible for the reception, supervision and the quality. A unique opportunity for student and company to acquaint themselves with the level of students and companies from other countries of the European Union. So a relationship between engineering university and (foreign) business world.

This program also contains a number of other possibilities.

Strand A, financing a co-ordinating center.

Strand B, not only the exchange of students, but also of professors.

Strand C, the spread of knowledge to companies by means of short courses.

Strand D, special projects, especially fact-finding missions to Eastern Europe and economically weaker countries in Southern Europe.

As a third program the building up of a **network of one's own** should be mentioned. For contacts outside The Netherlands and outside Europe there was the Stir scheme, a grant offered by the Ministry of Education, Culture and Science to support and stimulate studying outside the European Union.

Act one

Combining these elements resulted in the following philosophy for our institute:

"At least one Placement or Final Project should preferably be carried out abroad".

To give shape to this philosophy a number of steps had to be taken. In the first place, we had to take part in the European programs. In the second place, a network of engineering universities had to be set up. In the third place, both students and professors had to be convinced of the advantages.

Participating in the European programs Erasmus and Comett was possible because of the approval of a proposal which described setting up the co-ordinating center, the courses to be offered, the students to be exchanged, the co-operating universities and the participation of the business world in the region.

It was possible to build up a high-quality network of universities by actively searching the European network and carefully choosing new partners in addition to existing contacts based on specialization and quality, but also by creating a distinct profile for oneself in the field of quality and reliability.

Convincing students and professors was relatively easy. The students were interested in an adventure abroad which was supported financial y. The professors agreed to a transfer of knowledge in this way; besides it was also attractive to visit well-known foreign colleagues, and innovative developments could be transferred on a modest scale.

Act two

Preparing this adventure abroad had to be done thoroughly. The reason being the fact that students were placed abroad for at least six months, they had to be self-sufficient, since there was no Dutch supervision around. In order to form an image of the places abroad that could be visited, an extensive library was set up, which included not only literature on cultural aspects but also tourist and geographical information. The receiving universities were asked to help with this in order to complete the picture. In the years that followed, the experiences of students who participated in the program were used. A questionnaire with their experiences was added systematically to the existing literature.

In addition, after their period abroad, students had to talk extensively on their experiences using photographs or video tapes. This information had to include all aspects of their period abroad, such as housing, manners, opportunities for tourists, etc., but also the engineering level and their personal impressions. Second-year students will then be invited to attend, in order to be well-prepared when going abroad. Furthermore, the grant of the program allows the student to take extra language courses.

Act three

The above ingredients should enable us to realize of a number of basic philosophies. The following objectives are important to the future European citizen:

- international orientation
- development of practical skills
- development of communication skills
- development of systematic and conceptual thinking
- development of innovative skills

To what extent can these be realized?

The first objective is achieved without problems. Three programs are available. Students can uses these. In addition, private initiative is always possible and sometimes allows the university to build up new and interesting contacts. It should be stated, however, that as from 1 January 1996 the variety of European programs has been reduced to two large programs, **Leonardo** and **Socrates.** Broadly speaking, Leonardo is the successor of Comett, and Socrates replaces Erasmus.

The second objective, developing practical skills, is achieved in different ways. Firstly, within the regular curriculum and secondly by the practical training in the business world. An extra dimension to the objective is the availability of Comett, because international and practical experience are combined in it.

The third objective, the development of communication skills, is clearly present owing to the first two objectives. Without communication a stay in the domestic or foreign industry is inconceivable. It is completed by the presentation of the experiences, and within the institute, by simulated work environment projects, working as a team and giving talks.

The fourth objective is the development of systematic and conceptual thinking. This objective will be developed only to a small extent within the European programs and will therefore have to be taught by means of the right didactic methods and instructional formats. Tools for this are learning how to analyze problems, how to distinguish between parts of a solution, how to formulate limiting conditions, how to design in a structured way and how to design test-sets. Designing and testing digital integrated circuits is an excellent subject in this respect.

The fifth objective, the development of innovative skills, can partly be filled from foreign

experience, and partly by practical exercises within the curriculum. The foreign work experience can put the student in touch with methods of solving problems that are totally different from the ones he was taught. Other ideas, originating from different cultures, can stimulate and increase the students' innovative powers. Creatively dealing with the available tools can be very refreshing and can sometimes break through fixed patterns.
Through education new didactic teaching methods can be used that can lead to innovative impulses such as problem-based working in groups or individual y, or solving problems in groups with limiting conditions that are too strict or demands that are too high. In addition, the present-day student will increasingly have to be trained to work in multidisciplinary groups, which has the extra advantage of putting him in touch with different approaches and problem solving methods. Another important item institutes have to think of when training engineering students is the increasing complexity of the problems, in which, to a large extent, life cycle, energy consumption and impact on the social environment are important now and in the future.
A tentative conclusion could be that all ingredients are there for a successful Europe-wide education of the present student generation. All objectives were achieved: international orientation, development of practical skills, development of communication skills, development of systematic and conceptual thinking, and development of innovative skills.

Benefits

What are the advantages for the student in this whole process?

In the first place he gains a wealth of international experience. During his entire education he has learned to tackle problems systematically, he is now able to put his theory into practice and to gain further insight in a variety of problems. From time to time he is confronted with working under pressure. He gets to know people with other ideas and ways of thinking, founded on a different culture and therefore showing another approach to solving problems. He has the advantage of automatically learning a foreign language, which is a problem for technical people anyway. He learns how to solve problems by himself, not just at work, but especially in his personal life. He has to adapt to different customs and traditions, and he has to support himself. Besides all this he will get a number of connections that can be valuable to a future employer. And last but not least his Europe-wide thinking will be initiated.

What are the advantages for the university?

The first advantage is of course the transfer of knowledge between the various partners. International contacts are very important, from the point of view of cultural integration and reaching an understanding of different customs and traditions. Furthermore, learning from each other when solving problems or generating ideas is an important thing. Because of the close contacts with the business world a completely new curriculum has come about and all professors have become aware again of the fast changes in the business world and the need to follow up on these changes and adapting their subject matter consequent y. These contacts with the business world also led to application-oriented research projects, and know-how of the large companies could be translated by means of tailor-made short courses for small and medium-sized companies.

What are the advantages for the business world?

In the first place of course the transfer of knowledge between the companies and the universities at a national and international level. Both theoretical and practical knowledge is transferred by students into both directions and, if necessary, the level is increased by means of short courses from the

university. Of course, companies can benefit from the international contacts of the students and their proficiency in a foreign language, both verbally and in writing. Companies will have a new kind of employee who has learned to tackle problems in various ways, of course all based on a systematic approach. Apart from this, there is easy access to the university and its knowledge and the business world can always rely on this knowledge through its new employee. This also the case when dealing with new projects in fields unknown to the people involved. One can always consult the university, as a result of the good relationship with the university. One knows who to address!

L erature

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