

Bachelor and Master in Engineering Education Fiction or Reality?

by Kurt R. Richter¹

In 1999 the so called Bologna Declaration initiated endless discussions and disputes in particular between the academic communities and politicians in most European countries. Sooner or later these discussions were followed by political decisions changing the educational systems at university level in all European countries in a radical way as never seen before. These changes were supported by politicians and industry while the academic community was rather sceptic and sometimes heavily opposing the changes. The academic community was afraid that the level in education would be reduced and would not be appropriate in particular for engineers.

Today the process has started in almost all European countries. Political decisions have set the issue in concrete and made the Bologna Declaration undisputable discussions and disputes are more or less stopped in many countries.

Nowadays in Austria which probably in this respect has the most restrictive laws within the European countries the transition from the old Diploma studies (5 years) to the 3 years undergraduate (Bachelor-) studies and the 2 years postgraduate Masters studies is almost completed for most curricula at the Universities of Technology in Graz and Vienna according to.

Since the traditional title "Dipl.-Ing." (diploma engineer), however, stands for highly qualified graduates, both Austrian Universities of Technology in Vienna and Graz decided to keep this title. Therefore the new formula is

BSc + MSc = Dipl.-Ing.

This shows that the idea of comparability of the degrees as demanded by the Bologna Declaration will be still difficult to achieve. Still titles will differ from country to country.

As far as the 3 + 2 years structure is concerned it should be mentioned that according to information received from students it can be expected that more than 90% of them intend to continue their studies in master programmes after they have

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graduated as Bachelors. This in fact makes the transition from 5 to 3+2 years programmes more than questionable.

In some countries this problem becomes even more transparent as soon as beside of the universities of technology (or technical universities) Polytechnical Institutes and/or Fachhochschulen educate engineers who are very much practice oriented. Like the bachelors at the universities their students graduate (also with the degree of a bachelor) after 3 or 3.5 years. The questions which arise are:

- Is the bachelor graduated from a universities a duplication of the bachelor graduated from a Fachhochschule?
- If not, is the bachelor from the university prepared for research and development in industry or
- are the universities aware of this dilemma preparing the students for the master courses which, however, is not within the interest of industry?

According to a study of the German VDE fig. 1 shows the requirements of industry with respect to Diploma Engineers (MSc) versus Fachhochschul- and University Bachelors.

The ratio between the two groups in various departments of industry is

$$\text{MSc (Dipl.-Ing.)} : \text{BSc (+ FH)} = 43.6 : 56.4$$

Can these requirement be satisfied by the institutions educating engineers?

I believe that in many European countries the answer is: Not at the present stage.

The reasons for this dilemma as I see it are:

Due to the *numerus clausus* and the entrance examinations the number of graduates from the Fachhochschulen is limited while in many countries the universities could provide the bachelors needed since they do not have a no *numerus clauses* and no entrance examinations. However, if most of the graduated bachelors continue to study for the master degree the number of bachelors leaving the university also will be limited. Even if the bachelor programmes at the universities are appropriate for industry requirements.

In my opinion the only chances to get more bachelors from the universities to industry are

- To introduce entrance examinations for the Master Programmes

- To select the best bachelors for the Master programmes or
- Industry is paying reasonable salaries attractive for graduates to leave the university voluntarily.

Another issue of the Bologna Declaration is the free mobility of students.

If the remaining obstacles to the free mobility of students are eliminated by the Bologna process, seems not quite obvious to me yet. In various discussions with Vice Deans for Education and a Vice Rectors for Education of the same university I received two inconsistent answers. The one stated that after the change of the programme structure a remarkable increase of incoming students from abroad could be recognized while according to the information received by the other the increase was because of a very active staff member of the faculty, who pushed and advertised mobility programs for students. The European Union provided such programs before the Bologna Declaration was signed.

Also quality assurance and accreditation is more or less independent of the 3 + 2 or 5 years structures as long as the curricula and courses are similar and comparable in particular for an international accreditation..

Critical self-evaluation is necessary. However, the real evaluation of engineering educational programmes is done by industry employing our students and integrating them into research and development and the production process as well. This kind of evaluation happened anyway since engineering programmes have existed. Industry ranks the universities and their programmes according to the quality of their students. Unfortunately, the delay time of the feed back is very long (6 years minimum). This delay plus the time necessary to provide appropriate changes will add up to at least 10 years.

Another concept to keep a high quality standard is to have an appropriate accreditation system. Such a system as the Accreditation Board for Engineering and Technology (ABET) in the United States would be ideal on a European level. These evaluations or accreditations of universities, however, are very costly and mostly can not be afforded. Another problem for such a centralized accreditation system is that very often the various governments who administer the governmental universities want to be independent and autonomous without too much interference from outside.

Questions not answered yet

In 2004 I presented a paper at the HATZ Colloquium in Zagreb in which I raised the following questions [k.richter (2004)]:

- Were the former educational systems as bad as sometimes stated?
- What are the industry requirements?
- Do our universities educate engineers to meet the requirements of industry and/or small and middle sized companies?
- Is the 3+2 structure the proper system for engineering education?
- Would the majority of graduates leave the universities after 3 years or continue for the Master?

However, I am afraid that most of them can not be answered yet. May be it is still too early the questions since I believe that in many countries neither the universities nor industry have enough experience yet.

Conclusions

In the conclusion I will try to underline some positive and/or promising aspects initiated by the Bologna Declaration.

- In the course of restructuring the educational programs rigid structures were broken, new courses were introduced and outdated were updated or eliminated. Unfortunately, sometimes programmes were straightened at the costs of basic and fundamental courses.
- New programs were organized and implemented
- BSc may decrease the “drop out” rate which in Austria still is rather high. However, most of the student drop out within the first two years of the curriculum.
- In Austria the number of examination units was reduced remarkably at least for the engineering education programmes
- Quality Assurance by self evaluation is a good start. It is a first step on the way to a European system of Quality Assurance and Accreditation.

I hope that through learning by doing the whole educational system will improve with or without Bologna Declaration.

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