Chapter XIV
Software Engineering at Full Scale:
A Unique Curriculum

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ABSTRACT

In 1996, a new Software Engineering curriculum was launched at Universität Stuttgart. It was based on many years of practical experience teaching computer science and also on experience in industry where most of our graduates will find jobs. While the topics of this curriculum are not very different from those of computer science, there is much more emphasis on problem solving, software construction, and project work. In 2009, our traditional curriculum leading to the so-called diploma (equivalent to a master's degree) will be replaced by a new curriculum according to the bachelor and master concept. This chapter describes both the old and the new curriculum, and discusses problems and achievements.

INTRODUCTION

Software engineering is usually taught as a special course for students studying computer science or engineering. But software engineering is not just a set of topics, as the SWEBOK (SWEBOK, 2004) suggests, but also, or primarily, a particular mindset, a way of thinking, very similar to the mindset engineers tend to have. One might say that you get a software engineer if you combine a computer science graduate's knowledge with the mental structure, the way of thinking, reasoning, and solving problems, of an engineer.

In order to educate such people, it is not enough to modify our CS programs by some cosmetic changes, a new lecture or a nice little project. We need a radical change. And we cannot pretend that our knowledge should be good enough for our students; we have to teach them what they need rather than teaching them what we like, because

most people like to teach what they have taught all the time (Ludewig, Reißing, 1998). This paper describes such a new curriculum that was launched in 1996, and discusses our experience.

BACKGROUND

Traditionally, students of science and engineering in Germany finally receive a *diploma*, which is equivalent to a master's degree. Since there is no formal level below the diploma, there is no equivalent to the Bachelor's degree and, hence, no straightforward mapping between a curriculum in Germany and a curriculum in Great Britain or in the United States.

The Diploma curriculum is similar to what is called an integrated master's degree program in Great Britain, India and some other countries.

Though space does not allow for a detailed comparison, here are some significant differences:

- In Germany, three levels of school education are available, differing in their requirements and in their duration. The highest level leads to a final examination, the so-called "Abitur". One out of three young people actually pass this examination, usually at an age around 19. In most of the engineering studies including computer science and software engineering, those who hold an Abitur may enrol without entrance examinations. But many of them underestimate the difficulties they encounter at university. That is one of the reasons why many students fail soon after beginning.
- A complete curriculum consists of 9 semesters: 4 semesters for the "basic studies", another 4 for the "advanced studies", and one for the diploma thesis. Most students take more time, resulting in an average of some 12 semesters. Many students have a part-time job in industry, or even run a small business.

- Both written and oral examinations are offered once in every semester; there are no mid-term exams. Students may attend a lecture this year and take the examination next year or even later. If they fail, they are required to repeat the examination after another semester. If they do not pass in the second attempt, they have to leave.
- The curriculum of the basic studies (semesters 1 through 4) is fairly rigid because there is little choice for the students. Still, they may postpone lectures and examinations. Therefore, only a minority has actually finished all the examinations that constitute the so-called "Pre-diploma" (*Diplomvorprüfung*) after two years. The Pre-diploma is not a degree but only the entrance condition for the advanced studies. Though the Pre-diploma may at first sight resemble a bachelor's degree, it is in fact very different because it covers mainly fundamental topics like mathematics and theory.
- In the advanced studies, the students can arrange their schedule as they like. When they have met all requirements, they can start their diploma thesis, which is strictly limited to six months.

The effect of these differences is that our students must take full responsibility for themselves. If they fail to work continuously, they will drop out sooner or later, as more than 50 % actually do. Those who survive can usually handle common problems fairly well. Colleagues from abroad who come to Germany and teach at our university tend to find that the system is strange for them but works well for those who succeed.

Faculty members in Germany enjoy a constitutional freedom of teaching: While we have to teach, *we* decide *what* we teach. This freedom has a subtle influence on curricula: There are no standardized components like in the US, because any professor teaching e.g. the basic course "introduction to CS" can (and often will) change the

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