

# Construction and Reflection of Software Engineering Major Based on Accreditation Board for Engineering and Technology (ABET) Certification

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**Abstract:** With the rapid development of information technology, the demand for talents in the field of software engineering is growing. In order to cultivate high-quality software engineering talents who meet the market demand, universities have continuously carried out the construction of software engineering majors. Accreditation Board for Engineering and Technology (ABET) certification, as an internationally recognized higher education quality assurance system, provides important reference and guidance for the construction of software engineering majors. Guided by student learning outcomes and core competencies, combined with the characteristics of software engineering talent cultivation, the innovation of talent cultivation mode takes industry-education integration and school-enterprise cooperation as the main development paths and explores comprehensive reform of the major in terms of professional positioning and goals, curriculum system, teaching conditions, and teachers. This comprehensive reform model has effectively promoted the development of major construction and improved the quality of talent cultivation.

**Keywords:** ABET certification; Software engineering; Major construction; Talent cultivation

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## 1. Introduction

With the continuous innovation of software development technology and the improvement of social and local enterprises' requirements for the professional quality of software engineering talents, it has become an important task for universities to cultivate software engineering talents with innovative spirit and practical skills.

However, there are still some problems in the talent cultivation of software engineering majors at present. The lack of rigorous and scientific argumentation and reference in the setting of the curriculum system and training objectives leads to unclear core competencies of the major and difficulty in ensuring the long-term and effective quality of applied talent cultivation <sup>[1]</sup>.

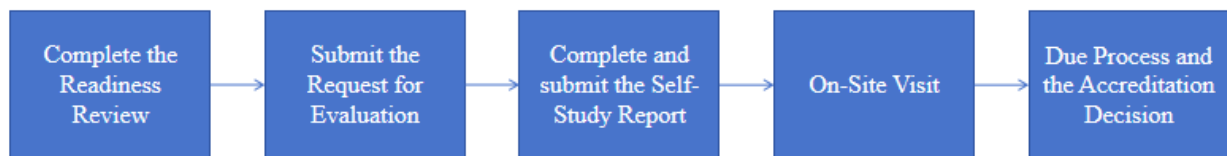
Accreditation Board for Engineering and Technology (ABET) certification, as an internationally recognized higher education quality assurance system, provides important reference and guidance for the construction of software engineering majors in universities.

## 2. Introduction to ABET certification

In 1932, the ABET was established in the United States, with its predecessor being the Engineers Council for Professional Development (ECPD). Initially formed by the union of five societies and associations, ABET has since grown to include over 30 engineering or technology professional societies and associations<sup>[2]</sup>. Over nearly 90 years of development, the ABET engineering education certification system has become the most developed engineering education professional certification system in the United States and one of the most globally recognized engineering education assessment and certification systems. Currently, more than 800 universities worldwide, including Carnegie Mellon University, Princeton University, Harvard University, and others, have received ABET certification for their relevant undergraduate programs.

The purpose of ABET certification is to ensure that the accredited program meets professional quality standards. It conducts certification through a peer review process, which includes steps such as self-evaluation, on-site visits, evaluation reports, and certification conclusions. During the self-evaluation phase, universities are required to prepare various data and draft self-evaluation reports in accordance with relevant formats to conduct professional self-evaluation. On-site visits are conducted by evaluation teams composed of experts from both the engineering industry and academia to assess whether the university meets the certification standards.

The philosophy of ABET certification has three main components: (1) focusing on student learning outcomes as the core and goal-oriented abilities; (2) requiring universities to emphasize the integration of theoretical knowledge and practice in student training; and (3) emphasizing the continuous self-improvement and enhancement mechanism of training programs. **Figure 1** illustrates the ABET certification process<sup>[3]</sup>.



**Figure 1.** ABET certification process

## 3. Reform and practice of software engineering major construction based on ABET certification

### 3.1. Formulation of training objectives

Training objectives serve as the top-level design of a major, occupying a crucial position in major construction. They play a guiding role in the entire education process, determining the direction, content, methods, and evaluation of educational activities. They also determine the institutional characteristics of a university, serving as both the starting point and ultimate destination of major construction<sup>[4]</sup>.

ABET certification requires that training objectives align with the positioning of the university and department, and the talent needs of the industry and academia should also be considered<sup>[5]</sup>. Additionally, they must meet the student ability standards set by ABET. Therefore, the parties involved in setting training objectives include not only the academic committee of teachers but also alumni and industry advisory committees, to balance the suggestions of teachers and industry representatives.

Taking our university's software engineering major as an example, the professional training objectives formulated in accordance with ABET certification requirements are as follows: To cultivate internationalized applied talents who have a global perspective, innovative thinking, and good professional literacy, and who master computer science theory, modern software engineering methods, and mainstream development technologies. These talents should be able to compete in the fields of software development, testing, and software technical services, meeting the demands of the global information technology and software industry. Within five years after graduation, through their own learning and industry experience, graduates should be able to achieve the expected training objectives as described below: (1) Possessing healthy physical and mental qualities, good humanities and professional literacy, and a sense of responsibility for serving society. They should be able to adapt to the development of the software industry and possess sustainable development capabilities. (2) Applying knowledge in areas such as software engineering to solve complex engineering problems encountered in the design, construction, implementation, quality assurance, and maintenance of software systems in the Internet field. (3) Possessing strong teamwork and organizational management skills, able to effectively play a core role in interdisciplinary teams to ensure the implementation of projects. (4) Having good reading, understanding, and writing skills, as well as international communication skills. They should be able to carry out exchanges, competition, and cooperation in a cross-cultural context, grasp the technical development trends of the global software industry, and adapt to modernization construction and future social development needs.

In terms of organizational structure, integrating the characteristics of the university, an enterprise advisory group is established within the curriculum committee of the secondary school, composed of industry leaders and enterprise technical experts related to the major. The school convenes the curriculum committee meeting twice a year to review the training objectives of each major and propose evaluation and revision opinions on the training objectives and course construction of each major based on the current talent needs of society.

### **3.2. Construction of curriculum system**

Based on the professional training objectives, the ability standards required for students to achieve upon graduation are established. These ability standards must meet the student ability requirements specified by ABET. Subsequently, the curriculum system is designed according to the standards of the abilities required for students. The training objectives and the curriculum system need to be reasonably matched and form an organic whole to achieve optimal results. The training objectives should clearly and specifically reflect the ability requirements that students need to meet upon graduation. Meanwhile, each training objective requires the support of multiple measurable and specific graduation ability requirements. Conversely, the same graduation ability requirements can also support the achievement of multiple training objectives. The corresponding relationship between them should be implemented and used to guide and review whether the curriculum process plan is reasonable. When building the curriculum system, attention should be paid to implementing the ability requirements into specific courses one by one. When modifying the curriculum system, decisions should be made by evaluating and considering its impact on training objectives and target abilities. When setting courses, focus should also be put on the vertical and horizontal connections between courses, so that students' abilities can be gradually improved in different stages of the learning process. **Figure 2** illustrates the relationship between the training objectives and the curriculum system of the software engineering major.

Concept	ABET accreditation philosophy and requirements: student-centered, outcomes-based education (OBE), and continuous improvement.	
Professional comprehensive ability	<ul style="list-style-type: none"> <li>• System analysis and design ability</li> <li>• Application software development ability</li> <li>• Software testing ability</li> <li>• Project management and operation and maintenance ability</li> </ul>	Specialized courses, comprehensive practical courses, graduation design
General professional ability	<ul style="list-style-type: none"> <li>• Basic programming ability,</li> <li>• Software design ability</li> </ul>	Professional foundation courses, engineering literacy courses
General knowledge and skills	Communication skills, self-learning ability, innovation ability, team collaboration ability	General courses in humanities and social sciences, general courses in natural science, and general courses in engineering literacy

Figure 2. Relationship between the training objectives and the curriculum system

### 3.3. Curriculum construction and implementation cases

Based on ABET certification and educational philosophy, our professional team has comprehensively carried out curriculum reform and construction on the basis of the established professional curriculum system. Taking “Python Programming” as an example, we have reformed the course from three aspects: content arrangement, teaching methods, and student evaluation. Firstly, based on the professional training objectives and student graduation ability requirements of the college, we have redefined the course ability objectives and made corresponding adjustments to the course content. Secondly, we have reformed the teaching mode, adopting an innovative model based on independent exploration and integrating learning and application as the approach, and carrying out a mixed online and offline, integrated in-class and out-of-class teaching mode. In terms of course assessment, we have broken the traditional evaluation model of determining grades through a single examination, and exercised and assessed students’ comprehensive abilities through homework, periodic tests, in-class and out-of-class projects, comprehensive projects, and other methods.

## 4. Conclusions

Drawing on the methods of American ABET certification for professional development, combined with the actual situation of Chinese universities, we can effectively promote the rapid development of engineering education in China, and play a positive role in cultivating practical software talents with solid professional skills and vocational qualifications.

This article discussed the problems in the cultivation of software engineering talents, ABET certification standards, and the professional development plan guided by ABET certification. It also introduced in detail the practical cases of curriculum construction. Using ABET’s ability standards to refine curriculum teaching objectives, a quantifiable student ability evaluation mechanism has been constructed, adopting various advanced teaching modes and achieving good results. In the future, we will continue to track the implementation of the training plan, promptly discover and address problems in the implementation process, continuously improve and optimize, and explore a practical system suitable for the cultivation of software engineering talents in applied undergraduate colleges and universities, in order to improve the quality of student training and future development.

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## Disclosure statement

The authors declare no conflict of interest.

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