

# Modular Design of Curriculum System in Cost Engineering of Application-oriented Undergraduate Based on Competence Structure

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**Key words:** cost engineering; competence structure; modular curriculum

**Abstract:** There are some problems in application-oriented undergraduate cost engineering teaching system. For example, correlation among platform courses is not closely, course content is set to repeat, mutilation and other issues. While building modular curriculum that corresponding to requirements of professional competence is effective way to solve the above problems. Taking cost engineering modular curriculum construction of application-oriented undergraduate in China as an example. Firstly, clear competence structure of professional training, including three competence levels from low to high, that is, map-reading and calculation and valuation competence, bidding and contract management competence and project financing and feasibility evaluation competence. Then, reconstruct and optimize cost engineering curriculum on the basis of three professional competence requirements, building modular curriculum system that response to three professional ability requests.

## Introduction

The professional objective of cost engineering is to cultivate applied and compound engineering professionals who are engaged in the project decision-making and the whole process cost management. In cost engineering professional training scheme, curriculum system including public basic courses, subject basic courses and specialized courses. And can also be divided into four platform courses, such as architectural engineering and information technology, management, economics and law. However, curriculum system for personnel training show a professional curriculum scattered, curriculum setting multiple, links among different courses of professional platform is not strong, professional core curriculum pieces, theory courses and practice courses divorce. It is difficult to achieve requirements of cost engineering compound professional training [1,2].

In order to break this dilemma, researchers made two paths. The one was from the perspective of knowledge integration to research the curriculum. Connecting associated knowledge together through curriculum integration, so that each platform course formed a whole [3,4,5]. Although knowledge-based curriculum design emphasized students have the ability to achieve mastery through a comprehensive study for knowledge. But it overemphasized on the system and integrity of knowledge, could not provide critical knowledge and basic practical work experience. So that it is not conducive to students' application ability, and trained graduates often reach out competence requirements of industry associations and enterprises [6]. The other was from the perspective of cultivating students' professional ability to promote curriculum integration. Xiong Wei, Wang Hui

proposed that the design of curriculum system should be in line with requirements of engineer qualification examination, and curriculum should be aimed at the whole process of cost engineering [7]. Yuan Jingfeng, Li Qiming put forward the new training concept that was "capability-oriented". They presented core competence structure which defined engineering technology as the basis, the entire process of project management as the main, and cost engineering management and contract management as brace. And also summed up Southeast University undergraduate cultivating approaches of core ability and teaching reform implementation plan [8]. Yan Ling built cost engineering studio practice teaching program based on the standards of cost engineering professional ability [9].

In summary, domestic scholars have emphasized undergraduate education should be guided to design theoretical courses and practical teaching system on the basis of professional ability. That is to say, on the basis of clearing the relationship between industry development and professional ability, emphasizing curriculum system of colleges and universities should be responsive to professional ability standard to integrate professional core courses, and form modular curriculum. In view of this, take application-oriented undergraduate cost engineering as an example, exploring the integration path of curriculum modular on the basis of professional competence. So as to provide reference and reform measures for the design and improvement of domestic application oriented undergraduate curriculum.

### Cost Engineering Professional Competence Structure

Core courses modularization of Cost Engineering should be required to build new curriculum system on the basis of the ability standards of industry association and the market demand. The first step of this study is to establish the cost engineering competence structure, in order to guide the modular set of professional core courses.

In this paper, according to competence demand of Chinese cost consulting firms, and combined with foreign competence level hierarchical management thought, professional competence of cost engineering was divided into three core competencies on the basis of engineering and information technology platform, including map-reading and calculation and valuation competence, bidding and contract management competence and project financing and feasibility evaluation competence [8,9]. Relationship among the three applied undergraduate cost engineering professional core competencies as shown in Fig 1.

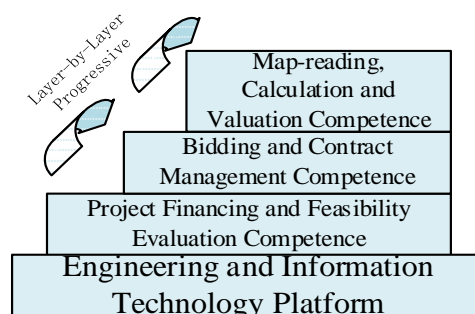


Fig 1 Application-oriented undergraduate cost engineering three core competencies

Three core competencies of cost engineering basically cover professional personnel competence requirements of the industry associations and enterprises. In order to further develop cost engineering professional three core competencies, three core competencies are divided into several specific competence elements. The core professional competencies list of cost engineering

as shown in table 1.

Table 1 The core professional competencies list of Cost Engineering

Professional competence	Competence elements
B01 Map-reading and Calculation and Valuation Competence	C01Map-reading competence C02Quota-applied competence C03Calculate quantity valuation competence C04Bills of quantities compiled competence C05Tender sum limit compiled competence C06Tendering sum compiled competence
B02 Bidding and Contract Management Competence	C07Bidding process management competence C08 Bidding program planning competence C09Bidding documents compiled competence C10Contract price management competence C11Termination of contract and payment competence
B03 Project Financing and Feasibility Evaluation Competence	C12Project economic evaluation competence C13Financing scheme selection competence C14Project proposal preparation competence C15Feasibility research report competence C16Investment estimation competence

### Curriculum Setting of Cost Engineering Based on Professional Competence

In order to solve the problem of fragment among professional platform courses of cost engineering, on the basis of the professional ability standard “map-reading, calculation and valuation competence, bidding and contract management competence and project financing and feasibility evaluation competence”, formed three core course modules, including measurement and valuation course module, bidding and contract management course module and project feasibility evaluation course module. cost engineering curriculum integration in application-oriented undergraduate as shown in table 2.

Table 2 Curriculum integration of cost engineering in application-oriented undergraduate

Core competence	Competence elements	Corresponding core courses	Curriculum integration	Course Modules	Studio
Map-reading and Calculation and Valuation Competence	Map-reading competence	Construction project quota principle and practice Construction project measurement and valuation Computer aided cost engineering	Module 1: Map-reading Module 2 : Measurement Module 3 : Valuation Module 4 : Practice	Measurement and valuation course module	Map-reading and quantity calculation studio
	Quota-applied competence				
	Calculate quantity valuation competence				
	Bills of quantities compiled competence				
	Tender sum limit compiled competence				

	Tendering sum compiled competence				
Bidding and Contract Management Competence	Bidding process management competence	Project bidding and contract management FIDIC conditions of contract Construction regulations Construction contract law system Cost engineering management	Module 1: Basic law Module 2: Bidding management Module 3: contract management Module 4: Practice of contract management	Bidding and contract management course module	Bidding and contract management studio
	Bidding program planning competence				
	Bidding documents compiled competence				
	Contract price management competence				
	Termination of contract and payment competence				
Project Financing and Feasibility Evaluation Competence	Project economic evaluation competence	Project feasibility research and evaluation Project Financial Management Cost engineering management Project investment and financing Engineering economics Project management	Module 1: Economic evaluation Module 2: Investment estimation Module 3: Feasibility research Module4: Whole-process cost consultation	Project feasibility evaluation course module	Project financing studio
	Financing scheme selection competence				
	Project proposal preparation competence				
	Feasibility research report competence				
	Investment estimation competence				

As shown in Table 2, measurement and valuation course has four modules. Module 1 mainly introduces the basic principle of drawing, the composition, content, and image recognition methods of construction drawing. Module 2 mainly introduces the basis of quantity calculation, calculation standard and calculation method. Module 3 mainly introduces the composition of cost engineering, valuation basis, basic knowledge of the engineering quota, the method bills of quantities valuation, etc. Module 4 mainly introduces engineering price and valuation, preparation of bills of quantities, tender sum limit compilation, tendering sum compilation, and with the aid of the application of computer to measure and value. Bidding and contract management module includes four modules, among of them, module 1 introduces all kinds of construction laws, regulations and department

rules and regulations, etc. Module 2 mainly introduces engineering bidding basic procedure and related laws and regulations, etc. Module 3 mainly introduces the basic theory of contract law and method, the main content of FIDIC conditions of contract, etc. Module 4 mainly introduces contract management planning, risk management, project price adjustment problems in-depth. Project evaluation course module also includes four modules. Module 1 introduces the basic key elements, index and method of economic evaluation, evaluation criterion of investment scheme, financial analysis, uncertainty analysis, value engineering, etc. Module 2 mainly introduces content, procedures, methods of investment estimation. Module 3 introduces the basic principle of feasibility research and the basic content of project evaluation. Module 4 introduces the whole process cost consultation, focuses on the content of the decision phase and design phase.

It is an important guarantee for technology application competence and the formation of comprehensive quality to establish practical courses. Due to cost engineering is committed to cultivate applied professionals, cultivating competence of analyzing and solving practical problems, so practical teaching is very important to cost engineering. Application-oriented undergraduate cost engineering constructs three studios that corresponding to three theoretical curriculum modules on the basis of three core competence requirements, that is, map-reading and quantity calculation studio, bidding and contract management studio, project financing studio. Studios is conducive to the integration of economics, management, law, engineering, and students can experience in the real environment of measurement and valuation, bidding management, contract management, investment and financing management.

## Summary

Cost engineering core courses modular setting that based on competence structure is closely combined with the actual work of students in the future. And effectively increasing courses targeted, avoiding the blindness and randomness of curriculum. Breaking the original subject-oriented curriculum system, changing the form of a single course teaching, focusing on exchanges between various branches of curriculum, ensure the cultivation of students' knowledge learning and ability. In addition, studio practice teaching system that corresponding to three core curriculum modules breaks original unit of knowledge, makes theoretical study and practice link closely to solve the problem that theoretical teaching and practice teaching divorce.

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