

## Reference to the Safety Engineering Undergraduate Courses to Improve the Subjects and Contents of the Certified Safety Engineer Qualification and Examination System of China

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**Abstract:** The aim of this paper is to recommend that the subjects and contents of certified safety engineers use safety engineering undergraduate curriculum system for reference. Human resources play an important role in accident prevention and loss control. Education on safety engineering develops quickly in China. Moreover, the State Administration of Work Safety and the National Human Resources and Social Security Ministry have implemented a certified safety engineer qualification and examination system. The content of the four core curriculum of safety engineering-1) principles of safety science, 2) system safety engineering, 3) ergonomics and 4) safety management- can be clearly delineated. However, the content division of four examination subjects of certified safety engineers examination-1) production safety law and related legal knowledge, 2) safety production management knowledge, 3) safety production technology and 4) case studies of safety production accidents- has a lot of crossover. There is no conflict between the fundamental purposes of professional safety education and certified safety engineers qualification and examination system. Safety engineering undergraduate curriculum covers the content of a certified safety engineer examination.

**Keywords:** Courses, examination, certified safety engineers, safety engineering,

### INTRODUCTION

In recent years, Chinese people's recognition of the value of their own safety and health is growing due to the economic development and social progress. The government of China also puts more and more emphasis on accident prevention and loss control during the industrial production process. The lack of safety management capital and gap of skilled human resources caused by the inadequate technical capacity of workers which results from the deficiencies of traditional education and training affects the check of potential hazards objectively and becomes one of the main obstacles to enterprise safety production (Ahmad, 2004). Therefore, human resources for accident prevention and loss control are crucial (Mock *et al.*, 2005) which can be embodied in two important aspects: credential education of safety engineering (Farwell *et al.*, 1995) and personnel management of safety engineering practitioners.

Recently, education on safety engineering discipline develops quickly in China. Moreover, the State Administration of Work Safety and the National Hu-

man Resources and Social Security Ministry have implemented the Certified Safety Engineer Qualification and Examination System (CSEQES). This paper analyses and points out recommendations for improvement in order to provide a reference for safety engineering educators and management decision makers of CSEQES.

### CURRICULUM SETTING AND TEACHING FOR SAFETY ENGINEERING UNDERGRADUATE

The capacity and quality of safety practitioners are very important for accident prevention and loss control in the industrial production process (Mattila and Kiviniitty, 1993; Vincoli, 1994; Wilson *et al.*, 2004). Undergraduate education of safety engineering is an important power to cultivate future safety engineering practitioners. We must vigorously develop the safety engineering education and focus on enhancing the quality of undergraduate teaching of safety engineering to improve safety production management in China comprehensively. The rationalization improvement of safety engineering undergraduate curriculum (SEUC) is a major aspect among them.

**Development of SEUC:** Chinese universities were authorized to setup majors from 1949 to 1962. The State Council issued the first catalogue of disciplines and specialities for undergraduate education, namely General Program Catalogue for Colleges and Universities in 1963. When Ministry of Education started to modify the catalogue in 1982, the degree programs were totally different from the ones in 1963, which made the General Program Catalogue for Colleges and Universities completely meaningless. Therefore, to modify the program catalogue for undergraduates, Ministry of Education started the investigation which showed that the only subject related to safety discipline was mine ventilation and safety (or environment protection). The Ministry of Education released the second catalogue of disciplines and specialities for undergraduate education-Engineering Undergraduate Program Catalogue for Colleges and Universities. Safety engineering was the last pilot one among the 32 prototypes. Mine ventilation and safety were still included in mining fields. In 1993, the State Education Commission issued the third catalogue of disciplines and specialities for undergraduate education-Undergraduate Program Catalogue for Colleges and Universities-in which safety engineering became sub-discipline of Management Engineering and mine ventilation and safety became sub-discipline of mining. Three specialities similar or related to safety engineering were included in the catalogue, namely Aircraft Environment Control and Rescue, Image Technology for Public Security and Safety Precaution. In 1998, the Ministry of Education promulgated the Undergraduate Program Catalogue for Colleges and Universities to further integrate undergraduate programs. Mine ventilation and safety were cancelled. Disciplinary affiliation of safety issues in all industries covered by the safety engineering was also revised. It was changed to belong to sub-disciplines of safety environment but safety precaution remained the same. In this discipline classification, safety appeared in the first class discipline and safety issues contained in every industry were covered by safety engineering. This was a bigger step forward compared to graduate programs. The research objects of safety engineering are basically limited to accidents and occupational diseases in the professional activities. However, the solutions to safety problems are not only about engineering. The name safety engineering does not reflect its own current research properly. Safety science and engineering has officially become a first class discipline in the graduate admission with the efforts of people from all walks of life.

**Overview on the SEUC and existed problems:** The basic thought about setting safety discipline curriculum is to set up courses with engineering back-ground and engineering safety courses widely or with particular

emphasis, to arrange a minority of curriculum of safety science methodology, a few courses like medical science or psychology or even cancel them. This aims to enable the students to master or focus on engineering and corresponding safety technology. Together with common knowledge on safety science, safety problems can be solved mainly with engineering techniques rather than management. Based on the fact that it's a main target to foster an engineering bachelor degree, the teaching plan has certain focuses, which leads to poor commonality. The education on safety engineering should centre on the research objects, a range of common courses which will benefit accident precaution and loss control should be opened generally such as safety management, industrial psychology, engineering psychology, applied statistics, science of law, complex systems and so on. Students' ability to apply safety science theory into practice should be cultivated.

**CSEQES and its examinations:** This section discusses the CSEQES and the existed problems of examination and possible improvement methods.

**Overview of CSEQES:** The qualification is a necessary standard of knowledge, skills, ability and professional ethics that professionals and technical personnel engaging in specific profession should have. It's also a common practice for professionals and technical personnel administration in market-oriented countries (Wilson *et al.*, 2004; Cheetham and Chivers, 2001). CSEQES is an important part of national human resources development. It is a strategic mean to promote safe production and economic development which is also a mainstay mechanism to support safety production. Management for CSEQES is established in many countries and regions like United States, the United Kingdom, Canada, Japan and Hong Kong (Blair, 1997; Charehsazan, 1994; Adams *et al.*, 2004; Gorbell, 2006; Brauer, 2008). The earliest existence can date from nearly one hundred years ago. Post admission control can be implemented on various professionals in safety production with the establishment of CSEQES. The quality of professionals and technical personnel in safety engineering can be improved as well as safety production and management quality. The State Administration of Work Safety and the National Human Resources and Social Security Ministry have established a series of supporting documents of staff identification, the qualifying examination, registration and continuing education to carry forward qualification system positively. The director of the personnel training department of the State Administration of Worker Safety points out that as the qualification system has just started, there are some existed problems need to be further studied and solved, such as:

- The legal validity of CSEQES should be further improved

- The certified safety engineers may not really play its due role very well
- CSEs are insufficient and distribute unevenly
- Scientificity and rationality of examination need further enhancement

Reference points out that problems existed during the implementation of CSE are as follows:

- The CSEQES is not fully recognized in some enterprises
- Government's propaganda of implementation of the system is not enough
- Relevant laws and regulations are not well-established
- There is inconsistency between certified categories and actual professional competence
- Relevant payment standards are imperfect
- The powers and responsibilities are not uniform
- The methods to obtain knowledge which doesn't update timely lack of diversity

Existed problems in the examinations and possible suggestions for improvement four subjects are required for CSE examinations by the syllabus. They are as following:

- Production safety law and related legal knowledge
- Safety production management knowledge
- Safety production technology
- Case studies of safety production accidents

In terms of examination proposition, it remains to be more scientific and rational. The reliability and validity of CSE examination proposition should be enhanced intensively based on the theory and methods of testing. A candidate of good proficiency in Chinese and logical thinking ability can solve many questions in recent CSE examinations depending upon the relationship between language and logic. They don't have to fully grasp the safety science what affects the validity of the test to some extent. The examination should test safety science theory and candidates' ability to put theory into practice, rather than their language skills and logical reasoning ability. Therefore, more consideration should be taken into this factor that affects test validity on the details. Some knowledge which may be used in specific equipment safety technology of a particular industry is not suitable for written papers of CSE examinations. Practical experience of safety professionals is difficult to be examined by an answer sheet. Therefore, the paper recommends that more attention should be paid to theory in CSE examinations. On-site safety personnel and safety and health practitioners can be guided to attach more importance to the theoretical study of safety science and the awareness of combining theory with safety management practices. For better

understanding of candidates' actual ability, the ratio of the subjective questions should be raised. The answers should be judged by experts or strictly trained personnel in order to guarantee a fair result. On the syllabus, it is recommended to further refine the contents of CSE examinations and specify the range especially the common knowledge and skills that on-site safety practitioners should generally acquire, such as safety management, accident-causing theory and accidents prevention, safety laws and regulations, system safety engineering and safety assessment, accident modeling and simulation of complex systems and so on. Specificity of technical knowledge and engineering experience that different industries own should be unapparent. The knowledge and points of view which some questions intend to check are obviously not accurate in recent exams. Test contents should be the general consensus and findings that have been reached in the international science and engineering field, rather than words that are universally accepted or even the assertion that have been proven wrong or incomplete and inaccurate. On the whole, discrepancy still exists between the recent CSE examinations and teaching contents of current undergraduate education. It can be concluded that its overall proposition falls behind domestic undergraduate education. In order to improve the level of the examination proposition, it is suggested that the achieved results of domestic safety engineering undergraduate education can be referred to on one hand and overseas proposition experience of developed countries can be learned on the other hand.

#### **THE BUTT JOINT BETWEEN SAFETY ENGINEERING UNDERGRADUATE COURSES AND CSE EXAMINATIONS**

Human resources for accidents prevention and loss control is crucial. It is embodied in two important aspects: credential education of safety engineering and personnel management of safety engineering practitioners. Considering from theoretical aspects of human resources management, credential education of safety engineering is the basis of training future safety professionals. Continuing education is necessary for safety practitioners to maintain and improve their theoretical level and abilities to integrate theory with practice for long. Estimation about whether they have the requisite competence to achieve the intermediate certificate in these areas is also needed. Thus, credential education of safety engineering and the CSE examinations are successively connected: the former is the base and the premise of the latter, while the latter is continuation and development of the former.

The fundamental goals of credential education of safety engineering and the CSE examinations are consistent and successively close relationship exists between them logically. Therefore the contents of the examination and safety engineering education should

be highly relevant. However, for some reasons, there still exist problems in the butt joint between them. The joint between Safety Engineering Undergraduate Curriculum and Teaching (SEUCT) and CSE examination contents and proposition is absolutely essential.

Most colleges and universities generally adopt at least four common core courses when they offer Safety Engineering Undergraduate Programs (SEUP), namely Principles of safety science, system safety engineering, safety ergonomics and safety management. The research objects of safety science are accidents and the goals are accident prevention and loss control. These four subjects are set according to the accidents theory, main factors that lead to accidents and accident prevention methods derived from them. They are highly scientific, systematic and complete. Furthermore, their teaching contents can be clearly divided. Therefore, it can be said that they are the soul and core of the SEUC, based on which the other professional courses of safety engineering are to be expanded and concrete. Although the four examination subjects are also set in accordance with knowledge required for safety practice, apparently they are less scientific and precise than the four core courses. So there are intersections and ambiguities in the division of examination contents, which are not conducive to designate proposition scope scientifically and affect the depth of the examination as well. Suggestions are proposed that the valuable experience of Safety Engineering Undergraduate Teaching (SEUT) should be used as reference for courses setting and examination subjects and contents of CSE examinations are consistent with Safety Engineering Undergraduate Curriculum (SEUC) and its contents. From another perspective, curriculum setting is easy to be systematic and complete due to the long cycle of SEUT, so we can see that the contents of the examination are contained in safety engineering undergraduate courses.

### CONCLUSION AND LIMITATIONS

The four common core courses namely principles of safety science, system safety, ergonomics and safety management are set according to the accidents theory, main factors that lead to accidents and accident prevention methods derived from them. They are highly scientific, systematic and complete. They are the soul and core of the SEUC and their teaching contents can be clearly divided. Although the four examination subjects:

- Production safety law and related legal knowledge
- Safety production management knowledge
- Safety production technology
- Case studies of safety production accidents- are also in accordance with knowledge required for safety work practice, there are plenty intersections among the division of examination contents, which are not conducive to designate proposition scope

scientifically and affect the depth of the examination as well.

From another perspective, curriculum setting is easy to be systematic and complete due to the long cycle of SEUT, so we can see that the contents of the CSE examinations are contained in safety engineering undergraduate courses. Suggestions are proposed that the valuable experience of SEUT should be used as reference for courses setting and examination subjects and contents of CSE examinations are consistent with SEUC and its contents.

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