



Developing a New Total Quality Engineering Degree Program

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Total quality engineering (TQE) refers to the design, analysis and improvement of a manufacturing system in customer interface, product design, process design and control, supply management and product assurance. Its objective is to maximize the quality, reliability, safety and environmental performance of the system itself and the products involved.

The demand for TQE will increase in years to come. In 2008, the U.S. Congress passed the Consumer Product Safety Improvement Act (CPSIA), which requires a mandatory third-party testing program for children's products. In 2009, the CPSIA instituted a mandate that reduces the limit of lead content in children's toys and products from 600 parts per million (ppm) to 90 ppm in toy paint and to 300 ppm in total substrates.¹ These growing concerns, along with increasingly stringent national and international requirements on quality, reliability, safety, health and environmental concerns represent promising current and future demand for professional quality engineers with integrated safety, health and environmental knowledge and skill sets to cope with the aforementioned challenges.

The City University of Hong Kong (CityUHK) has developed a new bachelor of engineering program in Total Quality Engineering (BETQE) as a proactive and timely response, fulfilling the need for multiskilled quality engineering professionals in Hong Kong, China, Asia and beyond.^{2,3}

Community needs

In the last three years, numerous products were recalled throughout the world. Each year, about 20 million manufactured products—ranging from pet food to toys to automobile components—are recalled, which reveals the importance of having good quality, reliability, safety and environmental performance in manufactured goods as well as the complexities of the problems involved. For instance, in 2008, 65 toy recalls were issued by the Consumer Product Safety Commission (CSPC). Some examples:

- Microsoft recalled its Hot Wheels toys due to power supply failure.⁴
- Wal-Mart announced a DVD player recall due to fire hazards.⁵
- Target Corp. recalled children's toys that violated the lead paint standard and paid \$600,000 as a civil penalty.⁶

Inez Tenenbaum, CSPC chairperson, said products made to strict performance specifications based on mandatory standards and independently tested to ensure conformance



are more likely to be safe and of high quality.⁷ The U.S. Congress will further look at current production and supply chain practices, as well as products' level of conformity assurance, and put in place additional safeguards for imported goods. Because of these developments, professional engineers with integrated knowledge and skills in achieving national and international standards in product design and manufacturing are in greater demand.

The need for Hong Kong, Chinese and Asian manufacturers to switch from original equipment manufacturers (OEM) to original design manufacturer (ODM) requires professional engineers with integrated knowledge and skills in quality, reliability, safety and environmental aspects in product design, production process and supply management.⁸

To tackle the problem generated from the wave of product recalls in 2007, the Chinese government has taken actions to close noncompliant factories; institute more rigorous product testing of raw materials, components and finished products' and publish a set of best practices guidelines for ensuring product safety in the manufacturing chain. As a result, there is increased demand for quality engineering-related posts in the industry. In fact, in the last two years, the job vacancies concerning quality are among the highest in the engineering discipline.

There is a niche to fill in quality engineering programs at the undergraduate level in Hong Kong, China and Asia Pacific. A search of the universities and institutions in the Asia Pacific region shows there is no independent quality engineering undergraduate program available. The quality engineering courses are only offered in industrial or manufacturing engineering programs. The industrial or manufacturing graduates can only study one or two quality-related courses, and they don't provide sufficient knowledge and skill to handle the current problems.

Program aim, design principles

The BETQE proposes to fulfill the impending and growing demand for quality engineers in Hong Kong and Chinese manufacturing industries. It aims to equip students with sufficient analytical, technical and managerial knowledge and skills in contemporary quality and reliability engineering, product safety and environmental compliance and related technology in manufacturing areas of product design, production process and supply management. It is designed to prepare the students to play key professional roles in manufacturing amid increasing global challenges.

Students will acquire a broad understanding of the concepts, techniques and tools in the subject domain and a sound foundation in the relevant disciplines through practical



hands-on projects and extensive exposure to real-life scenarios in the industry, with the goal of attaining the dynamic levels and standards required by the global market.⁹

CityUHK emphasizes value-added educational programs for total development, professional competencies and skills, while maintaining strong links with business, industry, professional sectors, employers and the community. The program is designed with these criteria in mind, offering a number of unique features, such as:

- Taking a holistic view of quality, reliability, environmental, product safety and health issues in contemporary manufacturing industries.
- Having an integrated approach of engineering quality throughout the entire product lifecycle of product design, process design and control, product compliance and assurance, customer and supply management.
- Emphasizing experience-based learning with the provision of industrial attachment, cooperative education positions and industry-based projects.

Upon successful completion of this program, students should be able to:

- Apply the concepts, techniques and modeling tools used by quality engineering and related fields.
- Demonstrate multidisciplinary knowledge and skills in contemporary quality and reliability engineering, product safety, health and environmental compliance, as well as related technology, that is needed to cope with the dynamic nature of the manufacturing industry.
- Demonstrate required problem-solving ability and skills in quality and reliability engineering, and product safety, health and environmental compliance.
- Meet the required levels and standards of potential employers with experience acquired through practical hands-on projects and exposure to industry.
- Have some exposure to real-life industrial environments if the student opted for a cooperative education scheme.
- Develop the attitude of lifetime learning and take part in continuing education opportunities.
- Meet the core competency required for corporate membership in professional bodies, such as the Hong Kong Institute of Engineers, Hong Kong Society for Quality, ASQ and Chartered Quality Institute.



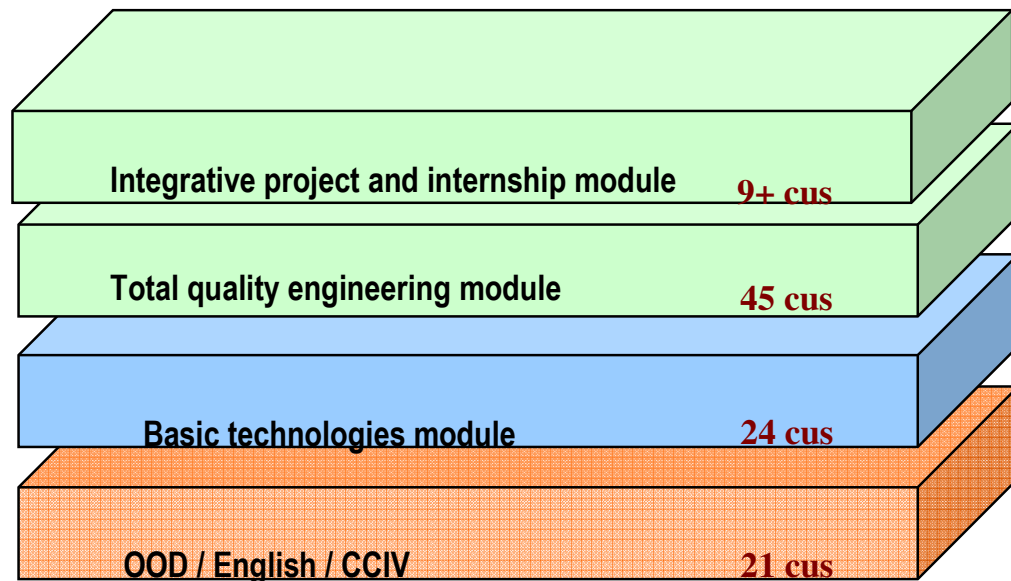
Program structure and curriculum

In addition to the general university requirements, the basic program curriculum consists of three modules (see Figure 1):

1. Basic technologies.
2. TQE.
3. Integrative project and internship (IPI).

The TQE and IPI modules form the core competency of this program. There are 15 TQE courses covering design and process quality, reliability engineering quality, quality systems and management, material and chemical testing, product safety regulations and international standards. The IPI provides a platform for the students to apply the principles and theories learned in a real-life environment.

Figure 1: Program structure



Total: 99+ credit units (cus)

Optional practical training (8 credits) in the form of the one-year internship through the cooperative education scheme in the third-year provides students with the opportunities to acquire more hands-on experience in and exposure to the industry.

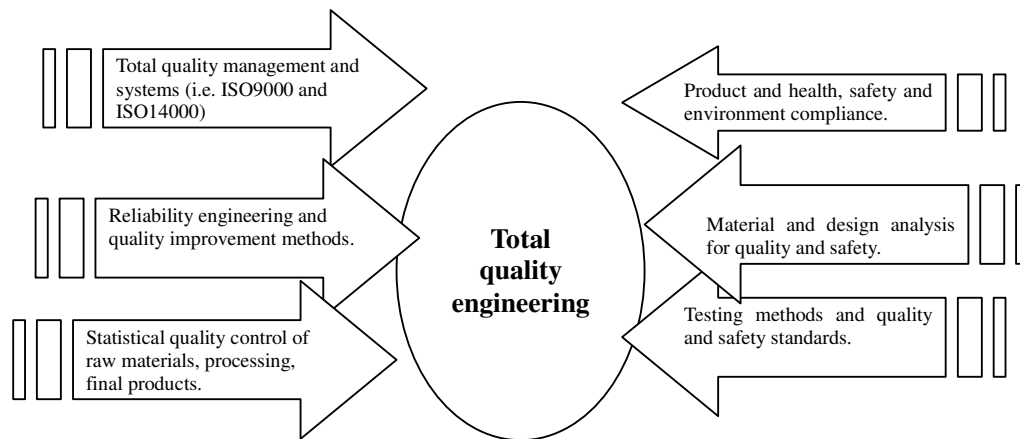
The choice of electives will provide students with opportunities to enhance their



interests and confidence in applying what they have learned. Appropriate quality assurance processes and guidelines will be adopted to ensure the new program will be managed and delivered with the same quality of standards as other undergraduate programs offered by the department. Some unique design features are:

- A balanced emphasis on theories and practices in quality, reliability, product safety and health. Environmental engineering is fundamental and pivotal to the design of this program (see Figure 2), thus, innovative teaching approaches will be adopted in the delivery of the curriculum to integrate theories with industrial practices. Problem and student-centered activities and experience-based learning, as well as the provision for industrial attachment, cooperative education and industry-based projects, are typical means to achieve the program objectives.
- External quality certification bodies and testing houses that indicate their willingness to support the program, particularly in industrial standards and product-testing courses involved in various product sectors.
- International exchange arrangements established between the department and other universities in mainland China and overseas.

Figure 2: Total quality engineering core study



The BETQE graduates will be highly trained specialists to safeguard product quality and ensure smooth export to global markets. They will have knowledge in:

- Developing process controls to improve quality.
- Designing product sampling and testing to ensure quality.
- Creating a system of procedures and controls to guarantee total quality.
- Designing products and services for reliability and health, safety and environment



(HSE) performance.

- Managing supplier and customer relationships.
- Tracing chemical analysis for toxicity.
- Understanding the latest quality standards and specifications of various countries.
- Certifying compliance to HSE regulations.
- Providing international leadership and communication skills.

This new TQE program addresses the issue of quality control and product assurance in the international trade, focusing on the safety, health and environmental consequences of products. The total quality engineer—armed with the traditional skills of process design, control and engineering knowledge, with additional training in supply chain management, trace element analysis, international standards and conformity, and compliance knowledge and skills—will be a key leader in ensuring product quality, to meet the needs of customer specifications and international standards. It is a proactive and timely response that fulfills the need for multi-skilled quality engineering professionals in Hong Kong, China, Asia and beyond.

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