



Research Article

QUALITY ASSURANCE OF CIVIL ENGINEERING TRAINING PROGRAMS AT UNIVERSITIES THROUGH A TOTAL QUALITY MANAGEMENT APPROACH: THEORETICAL ISSUES AND IMPLEMENTATION CHALLENGES IN THE MEKONG DELTA REGION

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ABSTRACT

Civil Engineering programs at universities in the Mekong Delta region play a critical role in preparing qualified personnel for regional socioeconomic development. However, the quality of these programs has not fully met practical requirements and labor market demands. This study examines the theoretical foundations and challenges of implementing total quality management (TQM) to assure the quality of civil engineering programs at higher education institutions in the region. The study uses a qualitative approach combining a review of TQM literature with an analysis of program self-assessment reports from selected universities. The findings indicate that TQM is appropriate and feasible for managing program quality assurance through a learner-centered approach and continuous improvement based on the plan-do-check-act (PDCA) cycle. The study also identifies three key implementation challenges: limited training facilities and equipment; a shortage of highly qualified faculty members and construction industry experts; and inflexible curricula that are slow to incorporate technological advances and skills required by the labor market. Based on these findings, the study proposes strategic directions for enhancing the quality of civil engineering training programs through TQM.

Keywords: civil engineering; higher education; PDCA cycle; quality improvement; total quality management; training program

1. Introduction

The importance of the construction industry in Vietnam is increasing in tandem with the socioeconomic development of the country, especially the Mekong Delta region (MDR), where demand is increasing for infrastructure development and adaptive construction

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solutions suited to the region's unique natural conditions (Gorman, 2023). In this context, civil engineering (CE) training programs (TPs) at universities play a central role in preparing qualified personnel to support sustainable regional development. However, current findings suggest that the quality of CE TPs offered at higher education (HE) institutions in the MDR remains insufficient to meet the expectations of the labor market and the needs of the construction industry. Quality assurance (QA) of TPs is a mandatory responsibility of HE institutions to ensure compliance with national quality standards and progress toward international and regional standards. Total quality management (TQM), one of several quality management frameworks used in HE, has attracted considerable academic interest because it promotes learner-centeredness, stakeholder involvement, and continuous improvement through the PDCA cycle. Adoption of TQM has proven to improve teaching quality, learning quality, and management effectiveness in educational institutions. Empirical studies indicate that TQM can enhance management efficiency and the quality of teaching and learning, provided that it is adopted and implemented in accordance with local contexts and resources (Kigozi & Ko, 2019). Evidence from the MDR universities indicates that the ability to implement TQM is still limited, especially in terms of infrastructure and human resources. Nevertheless, successful applications at some institutions demonstrate the effectiveness of TQM in improving teaching practices and learning management (In'airat & Al-Kassem, 2014). Moreover, with increasing demands in the construction industry related to climate change and digitalization, the CE TPs of several institutions have not been sufficiently responsive to technological developments or industry-relevant skills.

2. Research methods

This study examines QA practices for CE TPs at selected representative universities in the MDR through a TQM approach. It focuses on the management and implementation of QA activities, including the relationships among input factors, training processes, and outcomes. The study combines theoretical analysis with empirical document analysis. Data were collected from self-assessment reports for four CE TPs at Can Tho University, Tien Giang University, Kien Giang University, and Mien Tay Construction University. These institutions offer CE programs and represent diverse stages of development and levels of QA implementation in the region. The reports primarily cover the first accreditation cycle and provide a broad overview of program implementation and QA practices. The universities were selected to reflect geographical variation and diverse resource conditions, providing a more comprehensive account of the challenges in implementing TQM. Document analysis was used to identify key constraints and recommend ways to improve the effectiveness of QA through TQM.

3. Content

3.1. Concepts of quality assurance and quality assurance of training programs

QA is a set of systematic plans, procedures, and activities designed to ensure and improve the quality of an organization or its products and services. It centers on prevention

and process management rather than on inspection of the end product (Deming, 1986). In HE, QA is recognized as a comprehensive set of activities carried out by HE institutions to ensure and improve the quality of training by achieving institutional objectives and learning outcomes and meeting the expectations of relevant stakeholders (D. C. Nguyen, 2002). QA of TPs plays a vital role at the program level within the HE QA systems as it centers on systematic control and continuous improvement of the program design, implementation, evaluation, and revision. From a TQM perspective, the quality of the program is created by managing input factors, training processes, and output quality in an integrated manner and by continual improvement using the PDCA cycle. This approach allows HE institutions to take proactive action to address challenges, make improvements in a timely manner, and sustainably improve the quality of their programs (Deming, 1986; T. H. Nguyen, 2014a).

3.2. Overview of TQM and its application in higher education

3.2.1. The concept and basic principles of TQM in education

TQM is a systematic management approach originating in industrial manufacturing and informed by seminal contributions from Deming (1986) and Juran and De Feo (2010). It has subsequently been adapted to service industries, including HE. TQM is an organization-wide management philosophy that seeks to improve quality by involving every function, activity, and individual in continuous process improvement and by meeting the needs of customers and society (Deming, 1986; Juran & De Feo, 2010; Oakland, 2014). In HE, TQM extends beyond output control to encompass the entire training system: institutional mission and objectives, curriculum design and implementation, teaching and learning activities, assessment of learning outcomes, and systematic continuous improvement. It emphasizes educational quality developed and assured through institutional processes (T. H. Nguyen, 2014b). Previous research identifies several basic principles of TQM in HE. *First*, learner-centeredness recognizes learners as the primary beneficiaries of educational activities. The fulfillment of learning needs, competency development, and employability serve as key indicators of educational quality (Juran & De Feo, 2010). *Second*, customer and stakeholder orientation recognizes learners, faculty members, administrators, employers, and society as stakeholders. Program quality is assessed in terms of the extent to which their expectations are met and they are satisfied (T. H. Nguyen, 2014a; Oakland, 2014). *Third*, organization-wide involvement makes quality a shared institutional responsibility rather than the sole responsibility of dedicated quality units. This principle seeks to create commitment and consensus around institutional quality enhancement (Deming, 1986; Oakland, 2014). *Fourth*, process-oriented management views educational activities as interrelated processes that are systematically designed, monitored, and improved. This perspective enables institutions to prevent deficiencies and improve the effectiveness of training (Juran & De Feo, 2010). *Fifth*, continuous improvement through the PDCA cycle is central to TQM. The cycle enables institutions to plan, execute, check, and improve their TPs systematically, flexibly, and sustainably (Deming, 1986; Oakland, 2014). In Vietnamese HE, the

PDCA cycle is regarded as a foundation for effective program QA (Tran & Nguyen, 2025). *Sixth*, evidence-based decision-making requires management and quality improvement activities to draw on reliable data and verifiable evidence rather than subjective judgments. Educational data management and analytics systems are essential to operationalizing this principle (Juran & De Feo, 2010; Tran & Nguyen, 2025). *Seventh*, a quality culture is a prerequisite for successful and sustainable TQM implementation. Such a culture develops when quality, continuous improvement, and accountability are promoted throughout the institution, supporting ongoing QA and program improvement (Nguyen, 2014a; Nguyen & Doan, 2025).

3.2.2. The role of TQM in quality assurance of Civil Engineering training programs

TQM is a holistic management approach that assures and improves training quality in HE through the integrated improvement of input factors, training processes, and outcomes. TQM is particularly relevant to CE TPs in the MDR, where demand for infrastructure supporting climate change adaptation is increasing and resources for program delivery remain limited (Hradesky, 1994; Nguyen, 2014b). Through the application of TQM, HE institutions can standardize and continually enhance CE TPs using the PDCA cycle for objective setting in teaching and learning; planning teaching and learning activities; and evaluating student learning outcomes. This process management can help institutions identify and address deficiencies in curricula, teaching methods, and practical training conditions proactively, so as to improve the training quality and meet regional labor market requirements (Deming, 1986; Juran & De Feo, 2010). Moreover, TQM encourages participation by institutional leaders, faculty members, learners, and industry partners. This strengthens the relationship between training and practical work, supports the integration of construction technologies suited to each country and region, and enhances learners' practical skills (Hradesky, 1994; Nguyen, 2014a). In this way, TQM, besides being an effective tool to assure the quality of CE TPs, is also a method that complies with the development orientation of Vietnamese HE; altogether, TQM plays a significant role in developing human resources in the construction sectors to serve sustainable socioeconomic development in the MDR.

3.3. Challenges in implementing TQM in the Mekong Delta region

3.3.1. Limitations in infrastructure and modern teaching equipment

Lack of adequate facilities and modern equipment is one of the principal challenges in implementing TQM in CE education in the MDR. To implement TQM effectively, infrastructure must be available to support both teaching and practical training (Kigozi & Ko, 2019). Lack of laboratories and modern equipment constrains the quality of construction education, where practical activities are a critical component. Nguyen and Dang (2021) report that HE institutions in the MDR have significant constraints on investment in laboratories, practical training facilities, and modern equipment for teaching and research. This study employs document analysis of self-assessment data of Can Tho University, Tien Giang University, Kien Giang University, and Mien Tay Construction University to analyze the current status of facilities and equipment supporting CE education. These data were

primarily derived from criterion 9 (facilities and equipment) of the self-assessment reports, which covers classrooms, laboratories, practical training equipment, learning resources, and information technology supporting educational activities. Table 1 was subsequently developed to summarize the key facilities and equipment issues that affect the quality of CE education in the MDR, based on a synthesis of institutional self-assessment findings, identified areas for improvement, and quality improvement plans.

Table 1. *Infrastructure and Equipment at Selected Universities Offering CE Programs in the MDR*

Institution/Source	Infrastructure and Equipment Limitations	Impact on Training Quality
Can Tho University (2022)	- Some laboratory and practical training equipment in CE programs have exceeded their depreciation period and require replacement or upgrading (sub-criterion 9.3).	- Limits hands-on practice and prevents students from accessing new CE technologies and standards. It also reduces motivation, creativity, and enthusiasm for learning, which are essential to becoming skilled engineers.
Tien Giang University (2022)	- The institutions have not yet established a dedicated software platform to support students' online learning activities (sub-criterion 9.4).	- Reduces flexibility in teaching and learning and limits students' ability to learn at any time or place and review content. This also limits preparation for digital working environments in modern CE.
Kien Giang University (2022)	- Laboratory and practical training equipment remains relatively basic and primarily meets the requirements of the core specializations (sub-criterion 9.3). - The availability of high-performance computers capable of supporting specialized CE software remains limited (sub-criterion 9.3).	- The scientific research activities of faculty members and students remain limited, making it difficult to publish valuable results in reputable international journals. The university also struggles to attract collaborative projects with businesses that require in-depth technical analysis. - Limited access to high-performance computers may prevent students from gaining adequate hands-on proficiency in essential professional tools, including BIM platforms and core structural design and simulation software such as Revit, ETABS, SAP2000, AutoCAD 3D, and PLAXIS.
Mien Tay Construction University (2021)	- The library has not yet been connected with the libraries of international universities. The number of foreign-language textbooks and reference materials in CE remains insufficient to meet academic needs (sub-criterion 9.2). - The IT infrastructure remains underdeveloped and insufficiently integrated due to financial constraints (sub-criterion 9.4).	- Knowledge may lag behind development trends and may fail to keep up with technological advances and international standards. In addition, foreign-language proficiency in the specialized field will be limited. - Limited ability to practice and use specialized CE software. Difficulty accessing new technologies such as BIM, digital simulation, and artificial intelligence in the construction industry.

(Source: Authors' compilation)

3.3.2. Lack of highly qualified faculty members and industry experts in Civil Engineering

The data in Table 2 indicate a shortage of highly qualified faculty members and CE experts at universities offering CE programs in the MDR. Although universities in this region have faculty members with a foundational academic background, the number of professors (Prof.), associate professors (Assoc. Prof.), doctoral degree holders (PhD), master's degree holders (MA), and CE experts remains limited. This shortage leads to several challenges regarding the quality of education and research in the field.

Table 2. Faculty Members Involved in CE TPs at Universities in the MDR

Institution/Source	Faculty members involved in CE TPs	Prof.	Assoc. Prof.	PhD	MA
Can Tho University (2022)	13	0	01	05	07
Tien Giang University (2022)	13	0	01	04	08
Kien Giang University (2022)	13	0	0	02	11
Mien Tay Construction University (2021)	67	01	01	14	51

(Source: Authors' compilation)

According to the self-assessment report for the CE TP at Can Tho University (2022), 13 lecturers participate in program delivery. During 2017–2022, the program had no full professors and included only one associate professor and five doctoral degree holders. The limited availability of senior academic staff and CE industry experts may constrain the delivery of advanced subject knowledge and the development of advanced research (Can Tho University, 2022). Kien Giang University has 13 lecturers involved in its CE TP, including two doctoral degree holders (Kien Giang University, 2022). During 2017–2022, the institution had no professors or associate professors. The limited number of highly qualified academic staff and CE industry experts may constrain research, the adoption of advanced and emerging technologies, and broader academic development. Nevertheless, the academic staff broadly meets the minimum requirements for undergraduate program provision under national regulations (Ministry of Education and Training, 2022). Increasing the number and qualifications of academic staff, particularly those in senior positions and with professional CE experience, is therefore critical to improving program quality. Tien Giang University has 13 lecturers involved in CE TPs, including one associate professor and four doctoral degree holders, and had no full professors during 2017–2022. Although a substantial proportion of its lecturers hold doctoral and master's degrees, the absence of full professors makes advanced training and specialized research difficult (Tien Giang University, 2022). The limited availability of professors, associate professors, and construction industry experts may also constrain the adoption of advanced knowledge and research leadership. Mien Tay Construction University has 67 faculty members involved in CE TPs, including one professor, one associate professor, and 14 doctoral degree holders. It has comparatively more lecturers with academic titles and degrees than other institutions offering CE programs in the MDR. However, the numbers of professors, associate professors, and construction industry experts remain insufficient to meet the needs of teaching, research, and technology transfer (Mien Tay Construction University, 2021).

Overall, limited availability of highly qualified academic staff and CE industry experts may constrain educational quality, research capacity, and the adoption of advanced teaching methods and emerging construction technologies.

3.3.3. Inflexible training programs not aligned with labor market needs

A significant challenge in implementing TQM in CE programs at universities in the MDR is the limited flexibility of training curricula and their inadequate alignment with labor market requirements. HE institutions are required to review, revise, and update undergraduate curricula at regular intervals, with a review cycle not exceeding two years. The CE programs examined in this study have complied with this requirement by conducting periodic curriculum reviews and updates. However, as construction technologies are rapidly changing and there is an increasing focus on digital transformation in the construction sector, there are discrepancies between what is taught in the curriculum and what the industry requires. The curricula have not fully responded to the evolving needs of employers or the labor market in terms of using new technologies and innovative ways of working. The primary challenge, therefore, is not the lack of a curriculum review and updating mechanism but the ability to promptly and comprehensively integrate new knowledge, technologies, and professional practices into educational programs. Delays in this integration limit students' access to emerging industry trends and create a gap between training and professional practice (Ministry of Education and Training, 2021; X. T. Nguyen, 2022). Systematic analysis of the four universities' CE program self-assessment reports identified common constraints on practical program implementation. Furthermore, key soft skills for CE (e.g., teamwork, project management, and communication) are not adequately covered in curricula, although they are increasingly sought after by employers in the construction field. This is a drawback that affects the graduates' capacity to effectively utilize their knowledge in professional contexts and their preparedness to meet the requirements of the labor market (Nguyen, 2022). The curriculum review and revision process at some universities in the region is still protracted and insufficiently adaptive, and it is difficult to meet the requirements of innovation and international integration of the curriculum, especially in relation to the QA standards of AUN-QA and ABET (Nguyen et al., 2025).

3.4. Solutions to enhance the quality of Civil Engineering training programs according to TQM

3.4.1. Improving infrastructure and modern equipment

To effectively implement TQM and enhance the quality of CE education in the MDR, investment in and development of facilities and equipment are essential. It has been demonstrated in previous studies that investment in laboratory facilities, practical training equipment, and instructional technology is one of the key factors that contribute positively to the improvement of educational quality and, consequently, students' educational outcomes (Juran & De Feo, 2010). Infrastructure should be viewed as an integral part of the QA system, supporting a favorable learning environment and continuous improvement of learning processes (Hradesky, 1994). The provision of modern equipment for laboratories and

practical facilities will enable the students to engage with advanced technology in CE. Juran and De Feo (2010) believe that the use of practical tools and simulation software will enable students to learn theory as well as the practical skills needed in the field. Modern infrastructure and equipment will also enable the students to work in a professional environment that is as close to the work environment as possible, thus improving their problem-solving skills when they enter the labor market.

3.4.2. Strengthening faculty training and development

Faculty members play a pivotal role in the implementation and sustainability of TQM in HE institutions, particularly in CE education. To ensure effective implementation of TQM, HE institutions in the MDR should prioritize enhancing faculty quality through professional development programs focusing on contemporary teaching methods and pedagogical competence. In addition to active learning approaches such as cooperative learning, case-based teaching, and problem-based learning, project-based learning is considered particularly suitable for the distinctive characteristics of CE education. Roesler et al. (2015) indicate that site visits to construction projects significantly enhance students' understanding of the professional roles and responsibilities of civil engineers. The integration of emerging technologies into teaching, including BIM, the Internet of Things, artificial intelligence, big data, automation, green construction technologies, and renewable energy, has become increasingly essential. Among these, BIM is widely regarded as an essential tool in contemporary CE education and practice. Accordingly, faculty development programs should enable instructors to effectively apply these technologies in instructional practice.

3.4.3. Developing a flexible training program aligned with practical needs

Training programs should incorporate modules on advanced construction technologies, project management tools, and soft skills, particularly teamwork and communication, to enhance graduates' professional adaptability (Dang, 2024). Several studies support flexible, practice-oriented curriculum development. Roure et al. (2018) emphasize collaboration among faculty members within disciplinary departments to update curriculum content. Roesler et al. (2015) recommend interdisciplinary faculty teams for curriculum development and greater coordination among academic units through professional forums. Students should also participate in internships at construction companies and authentic projects to strengthen their professional skills, gain experience with new technologies, and prepare for the labor market (Hradesky, 1994). Other research emphasizes institutional engagement with external stakeholders to ensure that curricula meet societal and industry needs (Sinnott & Thomas, 2012). CE TPs in the MDR should reflect regional conditions, including soft soils, salinity intrusion, flooding, and climate change. Programs should therefore pay particular attention to construction on soft ground, climate-adapted project management, and green construction technologies suited to the local context.

4. Conclusion

This study contributes to enhancing the management of QA activities for CE TPs at universities in the MDR through a TQM approach. The study demonstrates that the core

principles of TQM and the PDCA cycle can be systematized, and thus validates the use of this model in the optimization of input factors, training processes, and learning outcomes. The results also reveal some significant context-specific challenges in TQM implementation at regional universities, including availability of facilities and infrastructure, faculty capacity constraints, and insufficient curriculum flexibility to meet the changing needs of the construction industry and the labor market. The study proposes a set of strategic solutions based on the findings to enhance the effectiveness of program-level QA under the TQM framework. In order to advance the research further, several avenues for future research are suggested: quantitative analyses to explore the effect of the TQM factors on training results, development of a quality assessment framework based on TQM and in line with sustainability goals, comparative analysis of TQM and other quality management models, and empirical or case-based research to evaluate the implementation of TQM in selected HE institutions in the MDR.

❖ **Conflict of Interest:** Authors have no conflict of interest to declare.

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BẢO ĐẢM CHẤT LƯỢNG CHƯƠNG TRÌNH ĐÀO TẠO NGÀNH KỸ THUẬT XÂY DỰNG Ở CÁC TRƯỜNG ĐẠI HỌC THEO TIẾP CẬN TQM: NHỮNG VẤN ĐỀ LÝ LUẬN VÀ THÁCH THỨC TRONG TRIỂN KHAI TẠI KHU VỰC ĐỒNG BẰNG SÔNG CỬU LONG
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TÓM TẮT

Chương trình đào tạo ngành Kỹ thuật Xây dựng tại các trường đại học ở khu vực đồng bằng sông Cửu Long giữ vai trò quan trọng trong việc cung cấp nguồn nhân lực phục vụ phát triển kinh tế – xã hội của vùng, song chất lượng đào tạo hiện nay vẫn chưa đáp ứng đầy đủ yêu cầu thực tiễn. Nghiên cứu này nhằm phân tích cơ sở lý luận và làm rõ các thách thức trong việc triển khai mô hình quản lý chất lượng tổng thể vào bảo đảm chất lượng chương trình đào tạo ngành Kỹ thuật Xây dựng tại các trường đại học trong khu vực. Nghiên cứu được thực hiện trên cơ sở tổng quan lý thuyết về quản lý chất lượng tổng thể kết hợp với phân tích các báo cáo tự đánh giá chương trình đào tạo của một số trường đại học ở khu vực đồng bằng sông Cửu Long. Kết quả nghiên cứu cho thấy mô hình quản lý chất lượng tổng thể có tính phù hợp và khả thi khi vận dụng vào quản lý bảo đảm chất lượng chương trình đào tạo, thông qua việc lấy người học làm trung tâm và thực hiện cải tiến liên tục theo chu trình PDCA (Plan - Do - Check - Act). Đồng thời, nghiên cứu chỉ ra ba thách thức chủ yếu trong quá trình triển khai, bao gồm: hạn chế về cơ sở vật chất và trang thiết bị phục vụ đào tạo; thiếu hụt đội ngũ giảng viên có trình độ cao và chuyên gia ngành xây dựng; chương trình đào tạo còn thiếu linh hoạt, chậm cập nhật công nghệ và kỹ năng đáp ứng nhu cầu thị trường lao động. Trên cơ sở đó, nghiên cứu đề xuất một số định hướng giải pháp nhằm nâng cao chất lượng đào tạo ngành Kỹ thuật Xây dựng theo tiếp cận quản lý chất lượng tổng thể.

Từ khóa: cải tiến chất lượng; chương trình đào tạo; chu trình PDCA; giáo dục đại học; kỹ thuật xây dựng; quản lý chất lượng tổng thể