

Reforming and innovating the talent development model for international cooperation program in engineering management under the carbon peak and carbon neutrality goals in China

Siyue Zhu^{1,a,*}, Ziri Xu^{2,b}

¹School of Engineering and Architecture, Wuhan Polytechnic University, Wuhan, 430034, China

²School of Foreign Languages, Wuhan Huaxia University of Technology, 589 Guanshan Avenue, Wuhan, 430074, China

^azhusiyue@whpu.edu.cn, ^bxuzirui@whhxit.edu.cn

*Corresponding author: zhusiyue@whpu.edu.cn

Abstract: Against the backdrop of the national "dual carbon" strategy, the construction industry is undergoing a transformative shift towards green, "dual carbon", and intelligent development. In response, the training of talent in international cooperation programs in engineering management must evolve to meet contemporary demands. This paper examines the current landscape of domestic engineering management international cooperation talent training and delineates the specific attributes required by engineering management international cooperation professionals within the "dual carbon" framework. Furthermore, it delves into the development of a talent training model tailored to engineering management under the "dual carbon" paradigm, proposing a framework encompassing cultivation objectives, program formulation, and methodological approaches. This paper offers insight into comprehensively improving the quality of talent cultivation for international cooperation programs in engineering management.

Keywords: "dual carbon" goals, international cooperation program in engineering management, talent development model

1. Introduction

The carbon peak and carbon neutrality ("dual carbon" goals) strategy represents a pivotal strategic decision spearheaded by the Party Central Committee. In line with this initiative, the Ministry of Education has issued comprehensive guidelines, including the 'Action Plan for Carbon-Neutral and Scientific and Technological Innovation in Higher Education' and the 'Work Program for Strengthening the Carbon Peak Carbon-Neutral Higher Education Talent Cultivation System' for the years 2021 and 2022 [1-2]. These documents explicitly emphasize the role of universities in utilizing top-tier talent cultivation to support the national "dual carbon" strategy. The 'Research Report on Energy Consumption and Carbon Emission in China's Buildings' (2022) underscores a critical fact (as shown in Figure 1): the building sector in China is responsible for a substantial 50.9% of carbon emissions, signifying its pivotal role in the "dual carbon" strategy [3]. This makes the engineering management international cooperation program's students' integral participants and beneficiaries in the transformative journey of this industry. Their contributions will undoubtedly play a crucial role in shaping the future of the construction field across various industries.

To support the realization of the Dual Carbon Strategy, the International Cooperation in Engineering Management program should align with the inherent requirements of the national Dual Carbon Strategy and the industry's greening and intelligent transformation. It should strive to move towards cutting-edge, informatization, practicality, and innovation [4-5]. Therefore, from a practical perspective, there is an urgent need for the International Cooperation in Engineering Management program to reform and innovate the existing talent development model.

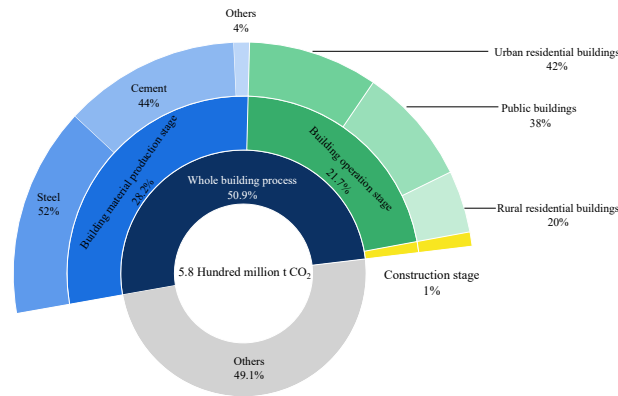


Figure 1: Total energy consumption and share of carbon emissions from the whole building process in China in 2021

2. Characteristics of the demand for specialized personnel for international cooperation in engineering management under the "dual carbon" strategy

2.1 Large gap in demand for talents

As green and low-carbon development has become one of the "keywords" in the development of China's construction industry, more and more practitioners in the traditional construction industry are joining the new green profession. Research shows that in 2022, the number of employees in the green building industry will be 8,543,400, with a talent gap of about 1,485,000 people, and an average annual growth rate of about 21%, and in 2024, the talent demand gap will reach 2,214,100 people [6]. Among them, there is a shortage of one million green building engineers, i.e. professionals who can be engaged in engineering management in various aspects of green building such as project initiation, planning, design, plan review, construction, supervision, inspection, completion, and acceptance, approval of sales, maintenance, and use.

2.2 New requirements for technical skill positions

Digitalization, informatization, and intelligence have become an important engine for the construction industry to promote the strategic goal of "double carbon". From the perspective of job capacity, with the continuous development of building intelligence, informatization, and industrialization, and the continuous application of BIM technology and assembly building construction technology, the corresponding job capacity requirements of different types of enterprises have also changed [7-8]. For example, in construction units, intelligent builders need to have the ability to prepare intelligent construction plans, intelligent construction organization designs, and guide intelligent construction. In real estate development enterprises, BIM engineers, need to have the ability of BIM modeling, BIM calculation, and BIM bidding. In architectural design units, assembly building deepening designers, need to have the ability to design assembly building programs.

2.3 New green careers bring new opportunities

In June 2022, the Ministry of Human Resources and Social Security will officially include "building energy conservation and emission reduction consultant" in the Occupational Classification Dictionary (2022 edition). This designation underscores the pivotal role of green building energy-saving and emission-reduction consultants in driving the construction industry towards sustainable development. Consequently, under the "dual carbon" strategy, professionals in engineering management are poised to access promising employment prospects, reflecting the growing demand for expertise in this crucial domain.

3. Analysis of the current situation of international cooperation talent cultivation in engineering management

As China's "Going Global" strategy and the high-quality construction of the "One Belt, One Road"

initiative progress, there's an escalating demand for international engineering management professionals, driving the evolution of international cooperation programs in engineering management [9]. According to the Ministry of Education of the People's Republic of China, data from the information platform for Chinese-foreign cooperative education indicates that Chinese colleges and universities have undertaken a total of 14 engineering management Chinese-foreign cooperative programs or institutions, as shown in Table 1. These programs collectively enroll approximately 2,000 students annually.

The educational objectives of each institution vary slightly, focusing on equipping students with fundamental knowledge in engineering technology and management, as well as economics and law pertinent to engineering management [10-12]. Additionally, emphasis is placed on providing basic engineering training, proficiency in foreign languages, and the capacity to engage in engineering management and related tasks with an international perspective. Graduates are envisioned to assume roles in construction units, design firms, building construction supervision agencies, real estate enterprises, and the investment and financial sectors. They are expected to emerge as seasoned engineering professionals with international acumen, robust humanities literacy, and a penchant for innovation.

However, it's worth noting that the cultivation objectives of these programs currently lack alignment with the "dual carbon" agenda, indicating a potential lag in addressing contemporary sustainability imperatives.

Table 1: Engineering Management sino-foreign cooperative education programs or institutions in China

Items	Program or Institution	Name
1	Cooperative Education Program	Tsinghua University and the University of North Carolina at Chapel Hill (U.S.) Collaborate to Offer a Master's Degree Program in Engineering Management (Global Supply Chain Leadership).
2	Collaborating institutions	SILC Business School and Shanghai University.
3	Cooperative Education Program	Tianjin University of Urban Construction and VIA University College of Denmark cooperate to organize an undergraduate education program in engineering management.
4	Collaborating institutions	Xi'an Jiaotong-Liverpool University.
5	Collaborating institutions	International Joint Audit Institute, Nanjing Audit University.
6	Collaborating institutions	International Joint Audit Institute, Nanjing Audit University.
7	Collaborating institutions	The Scotland Academy at Wuxi Taihu University.
8	Cooperative Education Program	Jiangsu University Cranfield Tech Futures Graduate Institute.
9	Collaborating institutions	Suzhou University of Science and Technology and the University of South Wales of the United Kingdom cooperated to organize an undergraduate education program in engineering management.
10	Cooperative Education Program	Shandong University of Architecture and North Dakota State University cooperate to organize the undergraduate education program of Engineering Management (Digitalization of Construction Projects).
11	Cooperative Education Program	East China Jiaotong University (ECTU) and Anglia Ruskin University (ARU) collaborate to organize an undergraduate education program in engineering management.
12	Cooperative Education Program	Wuhan Polytechnic University (WHPU) and Southern Utah University (SUU) cooperated to organize an undergraduate education program in engineering management.
13	Cooperative Education Program	Northeast Forestry University (NFU) and Aston University (UK) collaborated to organize an undergraduate education program in engineering management.
14	Cooperative Education Program	Jilin University of Architecture (formerly Jilin College of Architecture and Engineering) and Pacific State University of Russia cooperated in organizing the undergraduate education program of engineering management.

4. The construction path of talent cultivation mode for international cooperation program in engineering management under a "dual carbon" Strategy

Amidst the construction industry's shift towards green and low-carbon transformation, there arises a critical need for the international cooperation program in engineering management discipline to transcend its traditional paradigms. This transition mandates a reevaluation of training objectives to mirror the requirements and distinctiveness of the "dual carbon" initiative, thereby crafting training goals for professionals in international cooperation programs in engineering management that align with and bolster the national "dual carbon" strategy. In response to this, a specialized "dual carbon" oriented training framework for students pursuing international cooperation programs in engineering management will be developed. This initiative will enhance the existing curriculum by incorporating modules that emphasize sustainability, thus fostering curriculum innovation and reform aligned with the "dual carbon" strategy.

Simultaneously, guided by the practical exigencies of enterprise and industry development, we advocate for the fusion of academia and practical application, fostering both practical and innovative capacities among students. This entails the creation of an integrated practical teaching platform tailored to the international cooperation program in engineering management, all under the overarching goal of the "dual carbon" imperative. This endeavor aims to deliver high-caliber engineering management professionals capable of contributing to the national "dual carbon" strategy. Figure 2 illustrates the construction path of the "Dual carbon" demand-oriented talent cultivation model for the international cooperation program in engineering management.

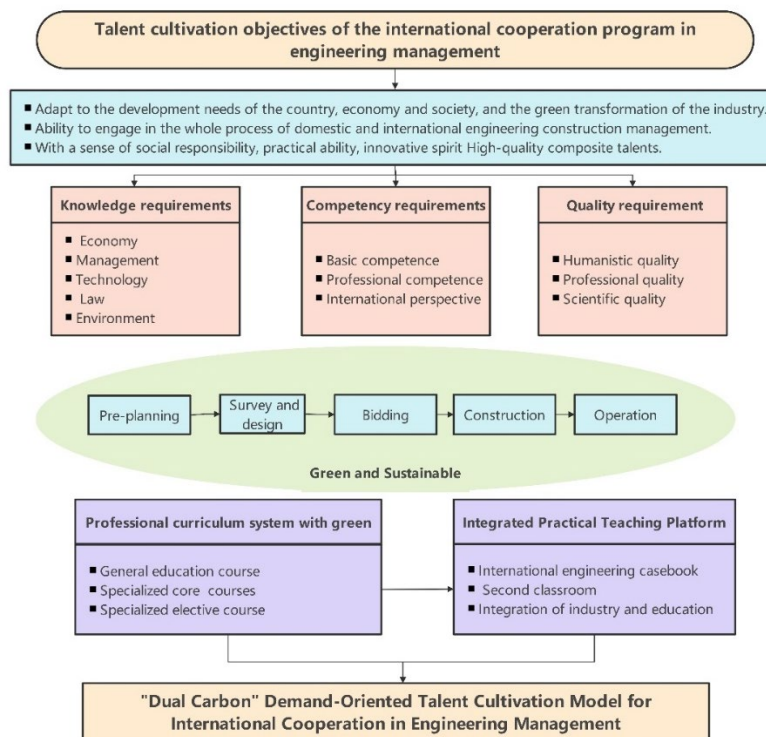


Figure 2: Construction path of "Dual Carbon" demand-oriented talent cultivation model for international cooperation in engineering management

4.1 Development of a talent training program for international cooperation program in engineering management to serve the national "Dual Carbon" strategy

In light of the current inadequacy of ecological civilization education in guiding international cooperation personnel training in engineering management, coupled with the limited alignment between traditional training programs and the "dual carbon" imperative, there emerges a series of common challenges. These challenges include the insufficiency of single-discipline knowledge to address the needs of engineering management international personnel within the "dual carbon" framework.

To address these challenges effectively, it is imperative to infuse green and low-carbon concepts into education and teaching within the engineering management international cooperation domain. This entails establishing a precise linkage between professional talent training objectives and industry demands, while also meeting the criteria for core occupational competencies. By formulating a professional talent training program tailored to international cooperation in engineering management that aligns with the national "dual carbon" strategy, we can bolster the profession's social adaptability and enhance its capacity to navigate contemporary sustainability imperatives.

(1) Development of "dual carbon" oriented talent cultivation objectives for the international cooperation program in engineering management

The green transformation and advancement across the entire construction industry chain directly correlate with the realization of the "dual carbon" objectives within the construction sector. In light of this, the formulation of training objectives for international engineering management professionals must address three key dimensions.

Firstly, it should be aligned with the developmental requisites of the nation, economy, and society, as well as the industry's green transformation. Secondly, it should equip individuals with the capability to oversee the entirety of domestic and international engineering construction management processes. Thirdly, it should cultivate high-caliber composite talents imbued with a sense of social responsibility, practical acumen, and innovative spirit.

By attending to these aspects comprehensively, we can ensure the effective preparation of international engineering management professionals who are not only adept at navigating the evolving landscape of the construction industry but also equipped to contribute meaningfully towards sustainable development and the attainment of "dual carbon" goals.

(2) Accelerating the innovation and reform of the curriculum system of international cooperation in engineering management under the "dual carbon" Goal

The "dual carbon" paradigm introduces a groundbreaking development concept and a novel construction approach for the construction industry, with green construction as its guiding principle and intelligent construction as its cornerstone. Therefore, in the construction of engineering management courses aligned with the "dual carbon" objective, adjustments should be made to revolve around green and smart methodologies.

For instance, intelligence and information technology courses such as BIM (Building Information Modeling), and Revit, among others, should be integrated into the core compulsory curriculum. Additionally, the concept of environmental protection and green development should be infused into traditional core courses in engineering construction and engineering project management.

Furthermore, elective courses should encompass topics such as intelligent building, smart cities, green building, sustainable development, introduction to sponge cities, building carbon modeling, and design for carbon reduction in buildings. By incorporating these elements into the curriculum, students can gain a comprehensive understanding of both the technological advancements and sustainability imperatives shaping the future of the construction industry under the "dual carbon" framework.

4.2 Constructing an integrated practical teaching platform for international cooperation program in engineering management under the "dual carbon" goal

The cultivation of talents in the engineering management international cooperation specialization under the "dual carbon" imperative is a multifaceted and intricate endeavor. Presently, there exists a dearth of platforms and insufficient emphasis on cultivating innovative practical abilities among engineering management international cooperation majors in colleges and universities. This gap results in a disconnect between talent training and the evolving needs of enterprises, hindering the realization of high-quality training for engineering management international cooperation professionals within the "dual carbon" framework. To address this challenge effectively, it is imperative to establish a robust alignment with the demands imposed by the "dual carbon" objectives, while continually tracking advancements in engineering management technology and innovative teaching methodologies. Key areas of focus include:

Firstly, establish a practical training platform utilizing "simulated reality". This platform will deeply integrate cutting-edge technologies such as BIM, 3D printing, Autodesk Revit, and Green Building Studio, fostering an innovative hands-on training environment.

Secondly, create an international engineering case database, with a focus on green building projects. Through this database, students can gain intuitive insights into the operational intricacies of international engineering processes, facilitating the incorporation of green environmental principles throughout the entire lifecycle of construction projects. This initiative will effectively amalgamate various professional knowledge domains.

Thirdly, implement an integrated approach to science education and competition. This entails hosting lectures conducted by international engineering management associations such as the Chartered Institute of Building (CIOB) enabling students to remain abreast of disciplinary frontiers. Furthermore, encourages student participation in collegiate research and competitions, reinforcing practical training and fostering comprehensive abilities through national competitions focused on the "dual carbon" domain, thereby enhancing their practical innovation capabilities.

4.3 Strengthening school-enterprise cooperation, industry-teaching integration and collaborative education

The engineering management professionals adapted to the "dual carbon" goal need to have the qualities of innovative thinking, green awareness, engineering practice ability, and other aspects to meet the requirements of occupational core competence. Through school-enterprise cooperation, with school-enterprise co-construction of internship bases, training bases, joint cultivation, etc., starting from the real problems faced by enterprises in the process of development, school-enterprise mentors jointly guide the cultivation process of international cooperation talents in engineering management and improve the engineering practice ability and engineering quality of students, to increase the adaptability of talent cultivation to the society.

5. Conclusion

In light of the national "dual carbon" strategy and the ongoing low carbon transformation within the construction industry, the training of engineering management international cooperation professionals must evolve in tandem with contemporary demands. Presently, the existing training mode for university engineering management international cooperation professionals lacks close alignment with the "dual carbon" imperative, rendering it challenging to meet the specialized requirements of this era. This paper has endeavored to explore the concept of constructing a talent cultivation model for engineering management professionals under the "dual carbon" framework, addressing aspects such as cultivation goals and program formulation. By proposing ideas for the scientific development of talent cultivation modes tailored to engineering management international cooperation under the "dual carbon" agenda. It provides ideas for scientifically formulating the talent cultivation mode of engineering management international cooperation majors under the "dual carbon" goal, to comprehensively improve the quality of talent cultivation of engineering management international cooperation majors.

Acknowledgments

The authors would like to express sincere thanks to the Teaching Research Project at Wuhan Polytechnic University (Grant number XM2023016).

References

- [1] Ministry of Education of the People's Republic of China. *Higher Education Carbon Neutral Science and Technology Innovation Action Plan*. 2021.07.
- [2] Ministry of Education of the People's Republic of China. *Work Program for Building a Strong Carbon Peak Carbon Neutral Higher Education Talent Training System*. 2022.04.
- [3] Specialized Committee on Building Energy Consumption and Carbon Emission Data, China Building Energy Efficiency Association. *2022 China's Buildings and Carbon Emission Research Report [R]*. Chongqing, 2022.
- [4] Bian Chunlei. *Research on the impact of environmental regulation on the productivity of the construction industry under the "dual carbon" background[D]*. Qingdao University of Technology, 2023. DOI:10.27263/d.cnki.gqudc.2023.000437.
- [5] M. K. Chen, W. Shen. *Research on the cost management of green building based on the background of the "dual carbon" target [J]*. *China Building Metal Structure*, 2023, 22(05):172-174. DOI:

10.20080/j.cnki.ISSN1671-3362.2023.05.058.

[6] Wang Shaojie, Zhang Shang. *Status quo and development suggestions of green building project management in China* [J]. *Construction Science and Technology*, 2022, (11):98-101. DOI: 10.16116/j.cnki.jskj.2022.11.023.

[7] Zhang P, Cao XY. *Research on the improvement of BIM talent training mode for engineering management majors in Western colleges and universities under the background of industry-teaching integration* [J]. *Industrial Technology and Vocational Education*, 2023, 21(03):33-39. DOI:10.16825/j.cnki.cn13-1400/tb.2023.03.024.

[8] Gao Yunli, Jiang Lei, Shi Feng. *Reform of Engineering Management "Dual Capability" Cultivation Curriculum System Based on Intelligent Construction* [J]. *Education and Teaching Forum*, 2022, (42):42-45.

[9] Rong Huaying, Yan Shensheng. *Research on the synergistic development of Hebei's science and technology innovation and engineering management internationalization talent cultivation under the background of "Belt and Road"* [J]. *Foreign trade and economic cooperation*, 2020,(12):44-48.

[10] Hou Xiangzhao. *Internationalization talent cultivation mode of interdisciplinary engineering management major* [J/OL]. *Journal of Huaqiao University (Natural Science Edition)*, 1-6, 2024. <http://kns.cnki.net/kcms/detail/35.1079.N.20240206.1046.002.html>.

[11] Wang Guan. *Research on Talent Cultivation of Engineering Management Professionals in Colleges and Universities Based on the Trinity of "Competition and Certificate Courses"* [J]. *Journal of Jilin College of Agricultural Science and Technology*, 2023, 32(05):79-83.

[12] Sun Guoshuai, Liu Xiaowei, Hu Guojie, et al. *Teaching Reform and Practice of Engineering Management Specialty for Applied Talent Cultivation--Taking Engineering Accident Analysis and Countermeasure Course as an Example* [J]. *Journal of Liaoning University of Technology (Social Science Edition)*, 2023, 25(03):139-142. DOI:10.15916/j.issn1674-327x.2023.03.035.