

Education Venturing Abroad with Industry: Exploration and Practice, Taking EMU Mechanic Training of Jakarta-Bandung High-Speed Railway as an Example

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Abstract

Based on the “Going Global” development strategy of China’s high-speed railway, the paper anchors the practical needs brought by the successful practice of Jakarta-Bandung high-speed railway for railway vocational education going global, the main difficulties faced by “Education venturing abroad with industry” are analyzed, such as single training capacity, lack of international trainers, lack of training resources, limited training time and space. The exploration and practice of Guangzhou Railway Polytechnic in EMU mechanic training of Jakarta-Bandung High-Speed Railway is introduced. Through the vocational education alliance to form a joint force for vocational education going global. Through four steps, selection, education, utilization and retention, the ability of training staff is reinforced. By strengthening the cooperation between colleges and enterprises, the training resources are developed jointly. Via dual teachers and “online + offline” model, the time and space barriers on class are broken. Guangzhou Railway Polytechnic has completed the localized skilled talents training task for EMU mechanic training of Jakarta-Bandung High-Speed Railway, with high quality. The Guangzhou Railway Polytechnic Solution of China’s high-speed railway “Education venturing abroad with industry” is exported.

Keywords

Vocational Education Going Abroad, Jakarta-Bandung High-Speed Railway, EMU Mechanic, Localized Skilled Talents, Vocational Education Alliance

1. Introduction

On 12 October 2021, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the Opinions on Promoting High-Quality Development of Modern Vocational Education, explicitly stating the need to explore an internationalized development model of “Chinese language plus vocational skills” to serve international capacity cooperation and facilitate vocational schools accompanying Chinese enterprises in their global expansion. In 2022, the General Offices of the CPC Central Committee and the State Council issued the Opinions on Deepening the Reform of the Modern Vocational Education System. This document proposed aligning education with industrial output and fostering industry-education collaboration, promoting the “Chinese language + vocational skills” program to serve international capacity cooperation and the global expansion of Chinese enterprises. It aimed to cultivate international talent and locally skilled personnel urgently needed by Chinese-funded enterprises, thereby enhancing the international influence of China’s vocational education (Zong, 2024). On 11 July 2023, the “Notice of the General Office of the Ministry of Education on Accelerating Key Tasks in Reforming the Modern Vocational Education System” outlined eleven priority tasks. The eleventh task, “Establishing Vocational Schools with High International Standards,” emphasized that all regions and institutions must adhere to the principle of “education following industry development and industry-education collaboration,” systematically develop overseas vocational education programs with Chinese characteristics, cultivate a cohort of vocational educators equipped for international teaching, train localized technical and skilled personnel to support Chinese enterprises’ overseas expansion, and comprehensively elevate the international standing of vocational institutions. Recent national policy documents reveal that internationalization is a defining feature of modern vocational education, rendering it an imperative rather than an optional component of higher vocational institutions’ operations. A key pathway for vocational education internationalization is “teaching follows production, industry and education advance together” (Tran & Dempsey, 2017; Sadykova et al., 2025). This approach enhances the institutions’ international influence while serving global industrial capacity and supporting Chinese enterprises going global. “Vocational Education Going Global” refers to China’s international development strategy for vocational education, aiming to enhance its global influence and voice through opening up and international cooperation.

2. Education Should Follow the Practical Demands of Production

The Jakarta-Bandung High-Speed Railway, as a flagship project under the China-Indonesia Belt and Road cooperation, stands as the first successful instance of China’s high-speed rail technology being exported overseas in its entirety-encompassing the full system, all elements, and the entire industrial chain. Construction

commenced in January 2016, with the line officially opening for service on 17 October 2023. Spanning 142.3 kilometers, it connects Indonesia's capital Jakarta with the renowned tourist city of Bandung, operating at a design speed of 350 kilometers per hour. Following its opening, the journey time between Jakarta and Bandung has been reduced from three hours to 40 minutes. The project represents a successful practice of "going global collectively" by a consortium of state-owned enterprises led by China Railway International Limited. Construction and operations are managed by Kereta Cepat Indonesia China (KCIC), a joint venture between Chinese and Indonesian enterprises, whose organizational structure is illustrated in **Figure 1**. The contractor consortium is led by China Railway International Co., Ltd., with members including China Railway Engineering Corporation Limited (CREC), China Energy Engineering Group Co., Ltd. (CEEC), China National Railway Design Group Co., Ltd. (CRDC), CRRC Qingdao Sifang Co., Ltd. (CRRC Sifang), China Railway Signal & Communication Group Co., Ltd. (CRSC) (Ju, 2023).

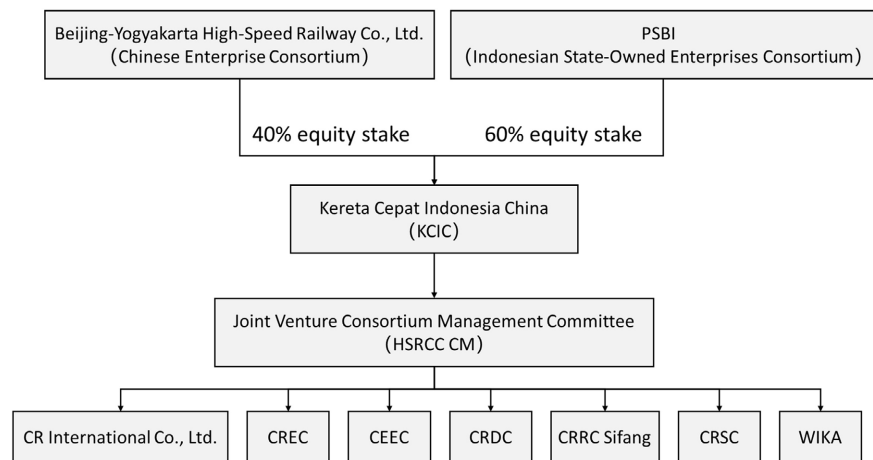


Figure 1. Organizational Structure of the Jakarta-Bandung High-Speed Rail Project (Wang, 2023).

This consortium covers the entire value chain of high-speed rail design, construction, operation, and maintenance, encompassing all technical domains including subgrade, track, overhead contact systems, rolling stock, signaling, and transport. The Jakarta-Bandung High-Speed Railway represents the comprehensive export of China's high-speed rail system, encompassing all elements and the entire production chain. This differs from previous engineering contracts or equipment exports, constituting a holistic transfer of technical standards, design consultancy, engineering construction, equipment manufacturing, personnel training, and operational maintenance. From the moment the Chinese consortium secured the Jakarta-Bandung High-Speed Railway project, efforts to cultivate localized high-speed rail technical talent in Indonesia commenced simultaneously. High-speed rail constitutes a systemic engineering endeavor, with training encompassing multiple disciplines including rolling stock, locomotives, engineer-

ing, electrical systems, and vehicles. As a leading institution in railway vocational education, Guangzhou Railway Polytechnic possesses a profound railway heritage and extensive experience in international education. It is an honored to undertake the training of mechanical engineers for the Jakarta-Bandung High-Speed Railway EMUs, thereby making a modest contribution to the global advancement of China's high-speed rail technology.

3. Challenges Faced in Industry-Education Collaboration

3.1. Training Capabilities Are Limited

Railways constitute a complex system engineering endeavor, wherein the seamless operation of trains necessitates the close coordination of various subsystems. China State Railway Group has established over 90 distinct technical positions, and the high-speed rail systems exported overseas similarly require corresponding training programs for over 90 roles. Over decades of development, China's railway talent education system has largely crystallized into a structured framework comprising "railway universities + railway vocational colleges + regional railway bureau training bases + railway technical schools", with each institution and unit fulfilling specific roles within this system. Moreover, in accordance with the original Ministry of Railways' arrangements, both undergraduate and vocational institutions possess distinct specializations. By combining their respective comparative advantages, they collectively fulfil the mission of cultivating talent for all railway positions. Following the restructuring of the railway system into a market-oriented operation, the inherent specialization of individual institutions makes it challenging for them to undertake training for all job types. Consequently, they are unable to independently undertake training programs for local employees overseas.

3.2. Shortage of International Teaching Staff

Vocational education, particularly railway vocational education, has for a considerable period confined its developmental scope to the domestic sphere, or even to specific domestic regions. As is widely acknowledged, several decades ago, railway vocational institutions served as staff training schools for various railway bureaus. For instance, Guangzhou Railway Polytechnic originated as the driver training school of the former Guangzhou Railway (Group) Corporation (now China Railway Guangzhou Group Co., Ltd.). Consequently, senior teaching staff at these institutions were historically employees of their respective railway bureaus. Following the transfer of these schools to local administration, their primary objective remained training technical personnel to meet the operational requirements of their affiliated railway bureaus, thereby ensuring transport safety through the supply of skilled labor. Prior to the new era, internationalization of vocational education was never a mandatory component of institutional operations; it remained merely an optional enhancement, serving as a supplementary measure. With the global expansion of China's high-speed rail technology, cultivating localized rail-

way talent in target countries has become a crucial component of this international outreach. Faced with this new landscape of China's high-speed rail industry going global, the existing competency frameworks of vocational college teaching staff proved inadequate for this task. Beyond meeting foreign language proficiency standards, understanding the target country's political landscape, cultural context, educational systems, and religious beliefs is also an essential consideration for teachers delivering international courses.

3.3. Scarce Teaching Resources

International railway technical training programs are generally designed to serve the target countries of China's railway "going global" initiative, cultivating localized technical and skilled personnel for them. This inherently means that international training efforts cannot be a one-size-fits-all approach; they require tailored preparation based on the characteristics of each target nation (Zlatkin-Troitschanskaia & Pilz, 2022). Training resources for a specific trade within one international program, such as textbooks and courseware, cannot be directly repurposed for another program after mere superficial updates. Each railway system exhibits high technical specificity, and the accurate translation and expression of technical terminology across languages constitutes a demanding undertaking. Consequently, teaching resources for international training cannot be adopted indiscriminately; each must be meticulously crafted. The Jakarta-Bandung High-Speed Rail project represents China's inaugural high-speed rail "going global" initiative, marking the first systematic international training program for Chinese high-speed rail technology. No existing teaching materials or courseware were available. While Chinese standards demonstrate considerable adaptability, the Jakarta-Bandung project's natural conditions, including topography and climate, alongside external factors such as legal frameworks, differ from those in China. Consequently, the project implemented necessary adaptations to Chinese standards to align with Indonesia's specific local circumstances. These locally adapted elements, some of which involve corporate confidentiality, present challenges for academic staff not directly involved in high-speed rail construction. Access to specific details remains limited, making it difficult to accurately reflect these nuances in teaching content.

3.4. Teaching Is Constrained by Time and Space

International training programs are delivered to overseas participants, with geographical distance necessitating either instructors travelling to the target country or participants coming to China for instruction. For overseas projects like the Jakarta-Bandung High-Speed Railway, which represent a comprehensive "going global" initiative encompassing the entire system, all elements, and the full industrial chain, technical training is required for every job role. This entails numerous training subjects and extended training cycles. For domestic institutions undertaking training for a specific trade, virtually all faculty members within that discipline must be involved.

Long-term deployment to the target country for teaching inevitably disrupts domestic teaching activities within that discipline, rendering this model unsustainable. Online teaching also presents challenges such as time zone differences and scheduling conflicts with domestic teaching hours. The barriers to teaching imposed by time and space constitute a major challenge for international training.

4. Exploration and Practice at Guangzhou Railway Polytechnic

Guangzhou Railway Polytechnic undertook the specialized theoretical training for two cohorts of the Jakarta-Bandung High-Speed Railway EMU Mechanics Training Program and one cohort of the Non-Destructive Testing EMU Mechanics Training Program. The total training duration amounted to 1070 hours, with 92 trainees participating. Specific details are outlined in **Table 1**. During the implementation of the Jakarta-Bandung High-Speed Railway international training program, Guangzhou Railway Polytechnic undertook several exploratory initiatives and practical innovations, which are detailed below.

Table 1. Information on Guangzhou Railway Polytechnic undertaking training for the Jakarta-Bandung High-Speed Railway Project.

No.	Training course	Lesson periods	Number of trainees	Training period
1	EMU Mechanical Engineer Training Program, Phase I	500	40	2023.2.28-2023.6.12
2	EMU Mechanical Engineer Training Program, Phase II	500	40	2023.11.14-2024.2.27
3	High-Speed Rail Flaw Detection Team	70	12	2024.2.27-2024.3.8

4.1. Leveraging the Vocational Education Alliance to Forge a Concerted Effort for the Internationalization of Vocational Education

Building upon China's established railway education framework, comprising undergraduate railway universities, vocational railway colleges, railway bureau training bases, and railway technical schools, the international expansion of China's railway vocational education must inherently follow a systematic approach. Following the coordinated overseas ventures of China's national railway enterprises, Southwest Jiaotong University spearheaded the establishment of the Rail Transit Vocational Education Alliance in 2015 and the Belt and Road International Railway Talent Education Alliance in 2018 (Luo, 2017; Liu, 2023). These alliances coordinate resources from universities, vocational colleges, railway bureau training bases, railway technical schools, and railway operation, construction, and equipment manufacturing enterprises to provide comprehensive, multi-tiered educational and training services encompassing theoretical instruction and practical training for partner organizations in target countries. Operating as the general contractor under the alliance banner, they undertake training projects in target

countries, subsequently dividing these into sub-projects. Each member institution then undertakes relevant sub-projects based on its respective professional strengths. This model leverages the distinct professional strengths of member institutions while eliminating the administrative burden of international training management for individual units. It not only ensures the successful completion of training programs but also achieves a synergistic effect where the whole is greater than the sum of its parts. As one of the alliance's inaugural members, Guangzhou Railway Polytechnic undertook the training of EMU mechanics, forming part of the carrier strike group spearheaded by Southwest Jiaotong University to safeguard the success of international training initiatives.



Figure 2. Group photograph at the inaugural meeting of the Belt and Road International Railway Talent Education Alliance.

4.2. Recruit, Nurture, Retain and Deploy Teaching Staff to Ensure a Fully Equipped and Highly Competent Teaching Team

As the inaugural successful implementation of China's high-speed rail technology going global, the Jakarta-Bandung High-Speed Railway project has prompted Guangzhou Railway Polytechnic to prioritize this training initiative to ensure the smooth delivery of international training programs. Based on the training curriculum for EMU mechanics, a teaching team has been assembled primarily from faculty within the college of Locomotive and Rolling Stock. To address specialized content such as electrical power supply systems covered in the courses, additional subject-specific instructors have been selected from across the college to supplement the teaching team. To meet international training requirements, the teaching team underwent specialized training to enhance foreign language delivery skills, upgrade professional knowledge, and deepen understanding of Indonesian culture, customs, and religious practices. Based on training evaluations, the most outstanding instructors were selected to form the core teaching team, with part-time employment agreements signed. This teaching team serves as the fixed faculty for a training cycle and is prioritized for subsequent training sessions. Teach-

ers not selected for the core team function as backup and reserve instructors, addressing unforeseen circumstances during training and supporting talent pipeline development. This model of cultivating, selecting, retaining, and utilizing teaching staff ensures a consistent supply of the most professional and outstanding international instructors.

4.3. Collaborative Development of Training Resources through University-Industry Partnerships

To address the shortage of training resources, Guangzhou Railway Polytechnic sought resources through the Vocational Education Alliance platform. It collaborated with Southwest Jiaotong University, China Railway Beijing Group Co., Ltd., and CRRC Qingdao Sifang Co., Ltd. to form a course development team, jointly creating training materials and courseware. Course standards and training plans were formulated in accordance with China State Railway Group's requirements for EMU mechanics, incorporating specific demands of the Jakarta-Bandung High-Speed Railway project in Indonesia. Typical work tasks were translated into classroom instruction based on job competency requirements. As Guangzhou Railway Polytechnic delivered theoretical training for EMU mechanics, the program emphasized specialized knowledge. Following a developmental pathway from foundational to applied knowledge, the curriculum development team structured the content into three modules: Basic Knowledge (18%), Professional Knowledge (74%), and Related Knowledge (8%). Basic Knowledge primarily covers fundamentals in electrical engineering, electronics, mechanics, and computing, aiming to solidify trainees' engineering foundations and lay the groundwork for specialized studies. Specialist knowledge constitutes the bulk of the curriculum, concentrating on the nine key systems and ten supporting technologies of EMUs. This aims to cultivate trainees' understanding of the structure and functions of each EMU system. Related knowledge focuses on introducing EMU operational control systems and specialized maintenance equipment, enabling trainees to master position-specific knowledge when undertaking EMU mechanic roles. Through the systematic implementation of three training modules, a structured framework of knowledge and skills has been established for EMU mechanics.

4.4. Dual-Teacher Online and Offline Approach Breaks down the Barriers of Time and Space in the Classroom

With teaching staff and course materials in place, organizing and delivering training for overseas participants remains a critical task. Under the coordination of the alliance's lead institution, Southwest Jiaotong University, the Jakarta-Bandung High-Speed Railway Project innovatively proposed a dual-teacher online + offline teaching model, overcoming the spatial and temporal barriers of overseas training. This dual-teacher approach involves domestic subject specialists and overseas language instructors delivering synchronized lessons: Chinese faculty teach in Mandarin, while Indonesian language instructors simultaneously conduct ses-

sions in the local language. The online + offline delivery model operates as follows: Chinese and overseas teams conduct synchronous web-based teaching, with overseas language instructors and trainees participating in physical classrooms. The classroom setup is illustrated in **Figure 3**. Two critical elements ensure optimal classroom delivery. Firstly, seamless integration between instructors is paramount. To achieve this, Chinese subject specialists and foreign language instructors conduct thorough pre-lesson coordination, meticulously reviewing every sentence and image in the teaching materials. This process effectively equips language instructors with subject expertise. Secondly, teaching materials must be seamlessly aligned. While developing the Chinese courseware, the team concurrently produced English versions (see **Figure 4**). The language instructor then adapted these into Indonesian materials. During sessions, Chinese instructors used the Chinese courseware while Indonesian classrooms synchronously accessed the English materials. Each learner held a tablet displaying the Indonesian courseware, thereby minimizing language barriers to knowledge transmission. Beyond the courseware, subject specialists provided knowledge extensions, which tested the teaching team's capabilities. Where necessary, domestic subject specialists delivered instruction in English to minimize comprehension errors arising from language translation. This approach ensured the language instructors grasped the material first, thereby facilitating the learners' understanding.

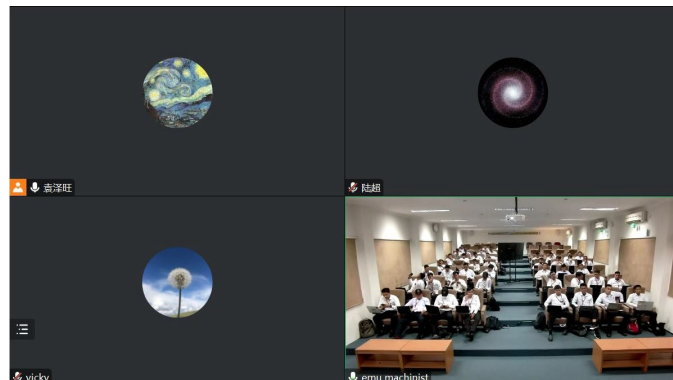


Figure 3. Dual-teacher online + online teaching classroom.

■ Coupler Buffer Device of EMU

◆ The automatic coupler buffer device is used in the EMU, which can realize automatic link decomposition and manual decomposition of machinery, gas circuit and electricity.

- ◆ The automatic hook buffer device mainly consists of:
- (1) Installation of hanging system;
 - (2) buffer system;
 - (3) Connecting system;
 - (4) Composition of electrical connectors and other modules.
- It can realize the machinery between EMUs.
Connection of electrical and wind circuits.

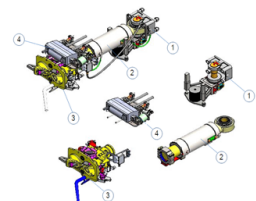


Figure 4. Lecture slides.

5. Summary

Guangzhou Railway Polytechnic has trained 92 localized EMU mechanics for Indonesia. These employees are now serving as EMU mechanics at KCIC, with some trainees even taking on team leader roles, providing technical assurance for the safe operation of the Jakarta-Bandung High-Speed Railway. Practice has demonstrated that collective overseas deployment through vocational education alliances represents a viable pathway for China's vocational education sector to expand internationally and establish its training brand. However, the lack of interactivity and poor classroom feedback remain shortcomings of online training. The Jakarta-Bandung High-Speed Rail represents China's inaugural high-speed rail export project. With more high-speed rail initiatives set for systematic overseas deployment in the future, Guangzhou Railway Polytechnic stands well-prepared to undertake technical skills training for China's high-speed rail expansion. This readiness stems from the institution's establishment of a dedicated teaching team for the Jakarta-Bandung project, its accumulated expertise in curriculum resource development, and its proven experience in delivering international training programs. The innovative outcomes developed for this project, including the teaching model and faculty team formation strategy, may also be applied to international training programs in other fields.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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