

Reform and Practice of an Engineering Postgraduate Training Pattern in an Open-Ended Base: Taking Foshan Base as an Example

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Abstract: The flawed engineering practice is considered the main factor that is affecting to the development quality of engineering postgraduates. Taking Foshan Base as an example, this paper has analyzed the operational pattern, practice teaching model, and internal governance system of the open-ended base as a new system for engineering practice and proposed several suggestions for the reformation of engineering postgraduates based on the construction effect.

Keywords: Open-ended base; Engineering postgraduate; Foshan Base

Online publication: September 22, 2022

1. Background

As one of the manufacturing hubs across China, Foshan City has established advanced industrial clusters. In 2021, the GDP (Gross Domestic Product) was more than CNY 1.2 trillion (ranking the 17th in China) and the gross output value of industry above the designated size was more than CNY 2.5 trillion (ranking the 6th in China). So far, Foshan has nearly 8000 national high-tech enterprises and yet its massive manufacturing industry is in urgent need of qualified engineers. The “List of Urgently Required Talents in Foshan (2021)” includes 10 industries (436 positions in total and 71 of them are in severe shortage). In this case, 35 out of the 71 positions are engineering, accounting for more than 50%. Each year, the number of for PCB (printed circuit board) engineers and embedded software engineers exceeds 20,000 people. On the other hand, China began to train full-time engineering postgraduates in 2010, with the intention of reforming the existing training pattern, improving engineering postgraduates’ capability in their profession and innovation by creating a new channel for engineering practice. In this context, Guangdong Province Graduate Joint Training Base (Foshan), also known as Foshan Base, was founded to present an innovative open-ended university-enterprise training model committed to solving the disconnection between theory and practice and between study and application when developing engineering postgraduates, offering top engineering talents for local manufacturing groups, and realizing an integration development between graduate education and local industry. This study takes Foshan Base as an example to analyze the mechanism and performance of it as an open-ended base and is of significance to perfecting the training mode of engineering postgraduates and discusses the theory of industry-education integration.

2. Literature review

As engineering postgraduates are potential top engineering talents, training affairs have always been a key

topic for research and practice in higher education in developed countries, and various university-enterprise joint training practices are carried out by different countries and regions following their requirements for talents. Specifically, these practices can be divided into two categories: (1) governmental, including the dual system (Germany), the sandwich mode (the UK), and the industry-academic-government model (Japan); (2) non-governmental (i.e., enterprise/university-dominant), including the cooperative education mode (the US) and the TAFE (Technical and Further Education) model (Australia)^[1,2]. In China, the research on the joint training model for engineering masters and PhD started late and most engineering postgraduates are currently trained within traditional bases that are either led by one single university or enterprise or both universities and enterprises, without the involvement of the government^[3,4], or adopt the government-involved multi-agent collaborative joint training base model, including Jiangsu Graduate Workstation and Guangdong Province Graduate Joint Training Base^[5].

The traditional base model is mainly characterized by the single-subject curriculum or the dual-subject curriculum established by the collaboration between universities and enterprises where the subject (school) and object (enterprise) are independent of each other^[6]. However, the dual-subject curriculum faces the following problems: (1) for the internal system, the problems are outdated management concepts, inconsistent quality standards of training, incomplete base construction, unstable sources of funding, and other problems persistently exist^[7-9]; (2) for the construction mechanism, Xuxin Chu, Yonghong Ma et al. has analyzed the construction needs of the traditional joint training base, social responsibilities and economic interests of various subjects, and the contradictions among the industry, universities, and research. Based on the analysis, it was considered that the current engineering education system in universities is not in line with the enterprises' principle of creating income, resulting in the insufficient initiative of the enterprises. Moreover, they concluded that, to some extent, while the universities fail to take the needs of enterprises' development as one of the considerations in talent development, the enterprises fail to make timely feedback to the universities, leading to more problems such as incomprehensive university-enterprise joint training and lack of internal cooperation^[10-12]; (3) As for the organizational structure and other elements, DingXuan Zhao et al., Yu Yang, Zhenhong Wang, Shulin Zhang et al. pointed out that an imbalance of supply (the universities' talent development) and demand (the enterprises' effective needs) exists due to several factors, including the shortcomings of the current industry-education engineering base which prioritizes university-enterprise joint training, the lack of cooperation between the government, universities and enterprises, the absence of a long term prospect for joint training, the unclear responsibilities of each party during the process, and the absence of macroscopic regulation from the government^[13-17].

Above, the traditional dual-subject administration model is subjected to formalism, in which both the cooperation between and determination of universities and enterprises are inadequate. The triple helix theory declares the necessity and feasibility for governments to engage in technological innovation and that the government is an important bridging and driving force in the initial stage of industry-education integration. With regards to the existing construction challenges in the traditional bases, Shibo Qin, Yanzhi Lin, et al., Chuhua Yan et al., and Jiangong Zhang et al. pointed out that the open base is an integrated government-industry-university-research platform architecture that includes four elements (professional quality improvement, expertise development, and project practice [provided by enterprises])^[18,19]. It is highly capable of integrating, linking, and sharing the innovation resources from many parties and functioning as a practice platform jointly established by multiple subjects^[20]. Also, it strengthens the benefit coupling mechanism between subjects and significantly improves the enthusiasm of each party to participate in the joint training^[21]. The ultimate objective is to build a mechanism of collaborative governance where both core stakeholders and other related parties are involved by persuading the government to engage in the base construction and actively promote, coordinate and guide university-

enterprise cooperation.

3. Foshan open-ended base

In 2015, Foshan Base was built to solve the shortage of engineering talents and indigenous technologies in its regional advanced manufacturing industry. Foshan Base is an open-ended industry-education postgraduate joint training base designed to develop and provide first-class engineers and create independent creative intelligence for Foshan’s advanced manufacturing industry by a university-enterprise joint training flow involving the enterprises (problem provider), the base (problem reviewer), the universities (problem receiver), the instructors (problem analyzer), and the students (problem respondent).

3.1. Operational mechanism

3.1.1. Operational pattern

The base adopts a “1 (center)+N (universities)+N (enterprises)” pattern (Figure 1). Specifically, the center is an independent legal person institution responsible for routine management of the base and offering services and evaluations for the university-enterprise joint training practice. Up to now, Foshan Base has recruited 25 universities inside and outside Guangdong province and 152 enterprises (mostly national high-tech enterprises).

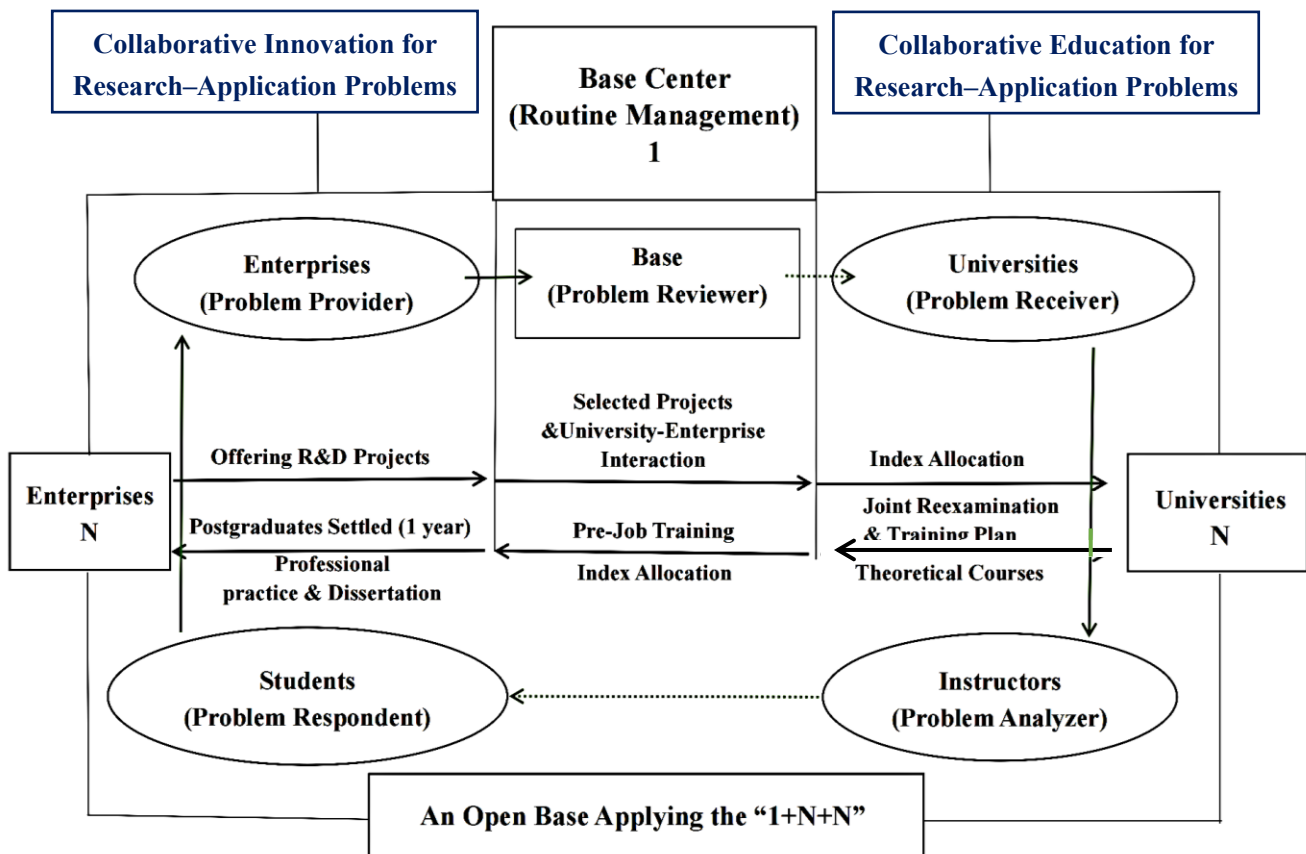


Figure 1. The “1 + N + N” Operational Pattern

3.1.2. Engineering practice teaching system

The base has initiated a “1 (bridging)-3 (cooperating)-5 (integrating)-7 (transforming)” teaching system for engineering practice: one base as the bridge and bond of university-enterprise cooperation to realize a triangle collaboration (among the base, universities, and enterprise); a five-element integration (involving

the industry, universities, postgraduates, applications, and transformations); seven transformations (management to service, scientific achievements to enterprise performance, classroom teaching to workshop practice, 1-to-1 training to n-to-1 training, theory to practice, application, thesis-emphasized laboratory study to technology innovation research the serves the industry). Eventually, it achieves the purpose of “writing a thesis, conducting a study, and finally integrating its achievements to enterprises.”

3.1.3. Governance system

Foshan Base has established a co-governance system involving multiple parties (Figure 2). To be specific, the macroscopical governance involves the base’s organizational leadership, coordination, division of responsibilities, and logistical support; the internal governance system can be divided into operational management mechanism, operational pattern, system construction, process management approaches of joint training, and quality assurance; the effectiveness evaluation involves examining and evaluating each party within the joint training flow and concerns the base’s evaluation models, approaches, and standards.

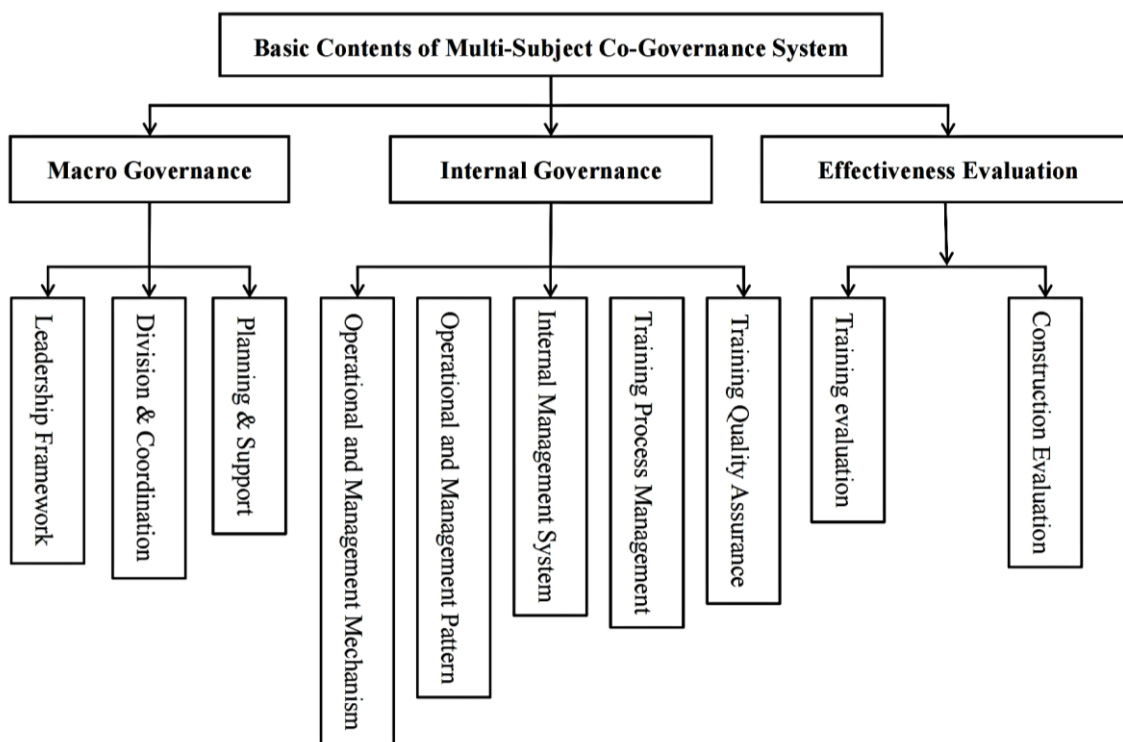


Figure 2. A co-governance system

3.2. Implementing measures

3.2.1. Condition guarantee

In routine management agency for joint training, the base center continuously provides favorable development conditions and has absorbed a batch of high-quality enterprises and universities for joint training and set post allowances for instructors, performance rewards and fellowships, and financial aids for postgraduates to encourage more enterprises, universities, and postgraduates to participate in the joint training.

3.2.2. Project-driven strategy

The problem-oriented joint training applies the practical engineering difficulties from the enterprise as the topics for dissertations. In this case, the enterprises shall put out the content of the required research and

development projects through the base's information management platform. Then, with these enterprise-provided projects, the postgraduates may finish their engineering practices and dissertations.

3.2.3. Multi-instructor system

The joint training adopts the "2 + 2" multi-instructor system, which appoints full-time teachers from the universities or part-time teachers from the enterprises as the main instructors to lead the postgraduate joint training and the HR specialists and R & D engineers from the enterprises to direct the ideological and political education and engineering practice, respectively, during the joint training.

3.2.4. Bridging programs

The pre-job programs offered by the base include "Culture and Policies in Foshan", "Base Management System" and "Experience Sharing." The pre-job programs offered by the enterprises include "Joint Training Management System", "Safety Requirements", and "Post Expertise." The instructors from the universities and enterprises provide project-based courses for the postgraduates to undertake. And the base offers many public courses, including "Innovative Entrepreneurship" and "Psychological Adjustment & Crisis Intervention."

3.2.5. Quality assurance

Based on the establishment of rules and regulations to standardize the training process, the base has formulated 16 management approaches such as "Daily Management of Postgraduates and Joint Training Performance Evaluation" and built a quality feedback mechanism combining daily supervision and random inspection to guarantee the quality of joint training.

3.3. Construction effect

At present, the base includes 25 universities across China, 152 enterprises, and 1637 engineering masters and doctors in its joint training project. The satisfaction rate of postgraduates to the base is 83.4%, which is higher than the national average (71.3%). The number of patents reaches 1.6 per graduate, the initial employment rate has been 100% consistently for three successive years, and massive pacemakers of innovative entrepreneurship are emerging. The joint training has facilitated the cooperation between the industry, universities, and researchers; 97 university instructors have solved 103 key technical challenges for the enterprises, increased their production value by CNY 0.71 billion, integrated 29 scientific and technological achievements into the enterprises, and have won 8 prizes in total for progress in science and technology above the municipal departmental level, and collaboratively developed 49 high-tech products. In addition, the joint training project has contributed to 8 enterprises in becoming high-tech enterprises. The joint training has also supported their teachers and students to start 8 businesses in Foshan. Due to all the aforementioned factors, Foshan Base has become an innovation powerhouse for the quality development of its advanced manufacturing industry.

4. Conclusion and suggestions

In light of the flawed engineering practice for engineering postgraduates, Foshan Base was designed to form a new open-ended channel, aiming to realize collaborative education and collaborative innovation through multi-subject integration. It has been proven that the open base strategy is capable of increasing the education quality of engineering practice for engineering postgraduates. To further optimize the support of engineering education for postgraduates to the local industry in talent and intelligence, it is recommended

to take the development of engineering practice platforms as a breakthrough to reform the existing development pattern of engineering postgraduates, further improve Foshan's open base model, improve the instruction of the enterprises towards base affairs, perfect the joint training management system, strengthen the management and evaluation in the enterprises involved in the joint training, the R & D projects, the instructors from the enterprises, etc., and accelerate the promotion in other regions.

Funding

This research was supported by Guangdong Province Graduate Education Innovation Program (2021JGXM103) and the 2020 "Research on Talents" Project by the Guangdong Planning Office of Philosophy and Social Science.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Geng LL, 2020, Models and Enlightenments of Industry-University-Research Collaborative Education in Developed Countries: Based on the Analysis of Germany, Japan and Sweden. *Chinese University Technology Transfer*, 2020(9): 35–39.
- [2] Ma YH, Zhang L, Zhang ZX, 2014, A Comparative Study of International Practices in Granting Professional Degrees. *Journal of National Academy Education Administration*, 2014(08): 89–94.
- [3] Wang FL, Wu JQ, Liang SC, 2020, Discussion on the Construction of Joint Training Bases for Postgraduates. *Education Forum*, 2020(07): 40–41.
- [4] Zhang XC, 2019, Reflections and Explorations on the Cultivation of Innovative Talents in Universities During the Construction of the Greater Bay Area. *Research in Higher Education of Engineering*, 2019(1): 99–102.
- [5] Zhao K, Yang Y, Li F, et al., Exploration on the Training Mode of Professional Degree Postgraduates Based on the Industry-University-Research Joint Training System. *Academic Degrees & Graduate Education*, 2017(03):44–49. <https://www.doi.org/10.16750/j.adge.2017.03.009>
- [6] Gan Q, Bo W, 2014, Serving the Occupations with Special Needs, Innovation Engineering Master's Degree Postgraduate Training Mode: Practical Exploration of the "2461" Postgraduate Training Mode of Chongqing University of Science and Technology. *Academic Degrees & Graduate Education*, 2014(08): 14–18. <https://www.doi.org/10.16750/j.adge.2014.08.011>
- [7] Liu CF, 2018, A Discussion on the Integrated Industry-University-Research Education Model. *Chinese University Science & Technology*, 2018(03): 67–68. <https://www.doi.org/10.16209/j.cnki.cust.2018.03.023>
- [8] Wei J, Ji HB, Gao XL, 2018, Thinking and Suggestions on the Training Program Reform for Engineering Postgraduates. *Journal of Graduate Education*, 2018(03): 30–35.
- [9] Wu K, 2021, Multi-Entity Synergistic Model and Strategy in I-U-R Collaborative Cultivation of Graduate Students. *Heilongjiang Researches on Higher Education*, 39(08): 92–97. <https://www.doi.org/10.19903/j.cnki.cn23-1074/g.2021.08.015>
- [10] Chu XX, Yang YR, Yang Q, 2018, Research on the Construction Mode of Graduate Education Base: Integration with Production and Research. *Academic Degrees & Graduate Education*, 2018(10):31-35.

<https://www.doi.org/10.16750/j.adge.2018.10.006>

- [11] Ma YH, Chen D, 2018, Research on the Dynamic Mechanism of Enterprise Participation in Cooperative Education. *Higher Education Exploration*, 2018(03): 5–13.
- [12] Yuan JY, Industry-University Integration in China: Historical Evolution and Ultima Strategic Choice. *China Higher Education Research*, 2018(04): 55–57. <https://www.doi.org/10.16298/j.cnki.1004-3667.2018.04.11>
- [13] Zhao DX, Wang M, Lu HB, 2021, Multi-Agent Cooperative Training Mode for Engineering Professional Degree Postgraduates. *Academic Degrees & Graduate Education*, 2021(12): 9–19. <https://www.doi.org/10.16750/j.adge.2021.12.002>
- [14] Yang Y, 2019, The Logic and Way Out of the Construction of Educational Practice Base for Professional Postgraduates: A Study of the Educational Practice Base of Master of Engineering. *Education Science*, 35(05): 92–96.
- [15] Wang ZH, 2014, Value Orientation of School and Enterprise Interest Community and Realization Ways. *China Higher Education Research*, 2014(02): 78–80 + 94. <https://www.doi.org/10.16298/j.cnki.1004-3667.2014.02.019>
- [16] Zhang SL, Qian YL, Pei X, et al., 2019, The Evaluation and Propulsion Path of the Joint Cultivation of Master of Engineering in China under the Criteria of Industry-Education Integration. *China Higher Education Research*, 2019(03): 77–82. <https://www.doi.org/j.cnki.1004-3667.2019.03.14>
- [17] Gu YD, Liu ZX, Lu Y, 2022, Innovative Practice of the Integration between Industry and Education in the Training of Graduate Students for Professional Degrees in Engineering under the Model of Industrial Colleges. *Journal of Higher Education Management*, 2022(04):105–113. <https://www.doi.org/10.13316/j.cnki.jhem.20220615.0>
- [18] Qin SB, 2016, Construction and Practice of “Internet+” Collaborative Education Mechanism from the Perspective of Triple Helix. *Enterprise Reform and Management*, 2016(5): 3.
- [19] Lin YZ, Xu XY, Li X, et al., Exploration of the Training Model of Practical Ability for Full-Time Professional Degree Postgraduates: Taking the Model Applied by Guangdong Shunde Innovative Design Institute as an Example. *Academic Degrees & Graduate Education*, 2017(3): 6.
- [20] Yan CH, Wang ZH, Deng QY, 2011, Government-Dominant, University-Led, Enterprise-Driven: Reflections on the Construction of a School-Enterprise Cooperation Guarantee Mechanism. *China Higher Education Research*, 2011(04): 80–82. <https://www.doi.org/10.16298/j.cnki.1004-3667.2011.04.026>
- [21] Zhang JG, Xie ZM, Huang LJ, 2022, Research on Evaluation of Off-campus Practice Bases of Full-Time Master of Engineering Based on PDCA Theory. *Modern Educational Technology*, 32(04): 78–87.

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