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# Research on China-Malaysia New Engineering Talent Cultivation Paths from the Perspective of Industry-Education Integration: A Case Study of Xiamen University of Technology

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**Abstract:** China-Malaysia higher education cooperation has become an important testing ground for cultivating new engineering talent that can operate across borders. Taking the partnership between Xiamen University of Technology (XMUT) and Universiti Sains Malaysia (USM) as its object, this documentary case study traces how cooperation beginning with a single research platform in November 2021 evolved, through four identifiable stages, into a systematic, three-dimensional, and sustainable architecture for cross-border, bachelor-through-doctorate cultivation of new engineering talent. Stage I (2021–2022) established the International Industrial IoT Research Institute under a four-party mechanism of Chinese and Malaysian universities and enterprises; Stage II (2022–2025) extended cooperation from joint master's training to doctoral training with mutually appointed supervisors; Stage III (2023–2026) added a Sino-foreign cooperative undergraduate program in microelectronics approved by China's Ministry of Education in May 2026, completing coverage of the bachelor, master and doctoral levels; and Stage IV (2025 onward) upgraded the jointly built China-Malaysia Artificial Intelligence Joint Laboratory into a national-level international research cooperation platform. The stages are cumulative rather than parallel: governance assets, co-developed curricula, dual mentorship, and mutual recognition created early become the enabling conditions of later stages. The study extracts the mechanisms behind this evolution, discusses operational constraints, and derives implications for replicating the model in other ASEAN-China partnerships.

**Keywords:** Industry-education integration; New engineering talent; China-Malaysia cooperation; Cross-border talent cultivation system; Xiamen University of Technology; Universiti Sains Malaysia

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# 1. Introduction

## 1.1. Transnational engineering talent and the industry-education integration imperative

Engineering practice is increasingly transnational: supply chains are being reconfigured, the ASEAN-China digital economy is integrating rapidly, and shared infrastructure frameworks continue to expand [1–2]. Engineers must therefore master not only technical domains such as intelligent manufacturing, microelectronics and green energy, but also cross-border project coordination, joint research governance and regulatory interoperability [3]. Nationally bounded curricula, however, rarely cultivate such institutional fluency; closing the gap requires industry-education integration at transnational scale — as foundational architecture for curriculum co-design, faculty exchange and competency benchmarking rather than peripheral internship add-ons [4]. China-Malaysia cooperation is an instructive laboratory for such models because the two countries combine complementary industrial structures with active education opening-up policies. Yet most studies examine isolated reform elements — one course, one internship scheme or one college — rather than the multi-stage process by which an entire cross-border cultivation system is built. How bilateral cooperation matures into an institutionalized, whole-pipeline system therefore remains under-explored, and this is the question addressed here.

## 1.2. The strategic position of Xiamen University of Technology

Xiamen University of Technology is an application-oriented public university in Xiamen, Fujian Province, at the heart of the China-Malaysia economic corridor. Formally designated a national pilot institution for applied engineering education, it is committed to practice-oriented curricula and industry-responsive pedagogy [5]. Since November 2021, it has pursued a progressively deepening partnership with Universiti Sains Malaysia (USM), a leading Malaysian research university in Penang, a node of the Malaysian electronics and semiconductor industry. The partnership is analytically valuable for its staged institutional trajectory: from one jointly established research institute, it expanded into joint master's and doctoral cultivation, then into a full Sino-foreign cooperative undergraduate program, and finally into a national-level international research cooperation platform — covering talent cultivation from bachelor to doctoral level and cooperation from talent co-cultivation to project co-research. This trajectory is documented in agreements, ministry-level approvals, and project archives accumulated under the funded program on constructing a China-Malaysia internationalized talent co-cultivation system for new engineering (Project No. JYCG202559).

## 1.3. Research questions, scope, and paper structure

Three questions guide this study: (1) through which stages and milestones did the XMUT-USM cooperation evolve between 2021 and 2026; (2) which mechanisms produced a systematic, three-dimensional, and sustainable cultivation architecture; and (3) what constraints emerged and what lessons are transferable to other ASEAN-China partnerships. The scope is bounded to cooperation in electronic information, flat-panel display, and integrated circuits at the higher education level, from bachelor through doctoral cultivation, and the study relies on documentary evidence so that every factual claim is traceable. Section 2 reviews the literature, Section 3 presents the evidence base and analytical framework, Section 4 reports the four-stage evolution, Section 5 discusses mechanisms and constraints, and Section 6 concludes.

## 2. Literature review

### 2.1. Industry-education integration: From policy discourse to institutional practice

Industry-education integration has moved from policy articulation to operational practice in both countries. In China, new engineering reforms and the construction of engineering industry colleges push universities toward co-governance with enterprises, shared curricula, and joint laboratories [6–7]; in Malaysia, quality assurance is outcomes-based, and employer co-design is encouraged. Both systems nonetheless face similar frictions — limited faculty industry immersion, weak incentives for curriculum co-development with firms, and underdeveloped feedback and assessment instruments — and integration depth depends less on formal agreements than on interactive environments and aligned stakeholder incentives [4, 8–10]. The literature concludes that sustainable integration requires durable institutional mechanisms, but offers little evidence on how such mechanisms accumulate through staged cooperation between two universities in two countries.

### 2.2. Bilateral engineering education: Structural asymmetries and convergence points

China's engineering education framework, governed by the Ministry of Education through centralized standardization and the Sino-foreign cooperative education approval system, differs structurally from Malaysia's outcomes-based system accredited by the Malaysian Qualifications Agency. The asymmetries appear most acutely in qualification articulation, credit transfer and cross-border degree conferral, yet convergent priorities — sustainability competencies, Industry 4.0 digital fluency and project-based assessment — make pragmatic alignment possible even where regulatory infrastructures are not yet interoperable [5, 11–12]. Postgraduate cooperation is especially instructive, because joint training bases and shared supervisors force quality assurance standards to be negotiated concretely [13]. The XMUT-USM case offers a rare, well-documented instance of such convergence across a full multi-stage trajectory.

### 2.3. The new engineering paradigm and the gap this study addresses

The new engineering paradigm shifts attention from atomized technical competence toward integrated professional identity, requiring engineers to combine domain expertise with intercultural collaboration, systemic awareness, and industry co-design capacity [14–15]. Reform studies across disciplines — rail transit course groups, architectural talent models, applied talent training systems, chemical engineering curricula, intelligent manufacturing specialty groups, AI-enabled civil engineering teaching and digital-twin supported integration — show that discipline-specific adaptation, not generic templates, determines success, while platform-based enablers such as industrial internet architectures and AI+X centers are increasingly emphasized [3, 5, 12, 16–23]. Two gaps remain: most studies are single-dimensional and rarely reconstruct the longitudinal process by which a partnership accumulates assets stage by stage, and few anchor analysis in the concrete regulatory steps through which a genuinely cross-border, full-level cultivation system becomes possible. This study addresses both gaps through process-oriented analysis of the XMUT-USM cooperation from 2021 to 2026.

## 3. Research design, data sources and analytical framework

### 3.1. Case selection and documentary evidence base

XMUT and USM were selected because their partnership is complete and well documented: by May 2026, it had achieved formal coverage of the bachelor, master, and doctoral levels, making the full pipeline observable within one case. The evidence base comprises the November 2021 agreement establishing the International Industrial IoT Research Institute; the 2023 cooperation intention agreement for the undergraduate program; approvals from China's Ministry of Education, the Malaysian Ministry of Education, and the Xiamen municipal government; institutional reports on jointly built platforms and postgraduate cultivation; and the archive of the funded project (No. JYCG202559). The observation window spanning November 2021 to May 2026 is long enough to reveal stage transitions rather than isolated events. All documents underwent chronological process tracing and cross-verification, with ambiguous items flagged rather than inferred, yielding high internal validity; external generalizability is bounded and discussed in Section 6.

### 3.2. Analytical framework: Stage evolution and three anchor mechanisms

The analysis proceeds in two layers. The first is chronological, reconstructing the record as four stages defined by their dominant institutional logic and trigger events: platform foundation (2021–2022), joint talent cultivation (2022–2025), expansion of cooperative programs (2023–2026), and research leap (2025 onward). The second is interpretative, identifying at each stage the mechanisms that bind universities, enterprises, governments, and students into a working system through three anchors adapted from the literature: institutional commitment (governance and regulatory assets such as the four-party mechanism, ministry-level approvals, and mutually appointed supervisors), pedagogical mutuality (co-designed curricula, shared teaching teams, dual mentorship and joint assessment), and ecosystem interoperability (internship bases, joint laboratories, industry-funded projects, technology transfer, and mutual recognition of degrees). Applying both layers shows not only what happened at each stage but also why each stage made the next feasible.

## 4. Results: The four-stage evolution of XMUT-USM cooperation (2021–2026)

### 4.1. Stage I (2021–2022): Platform foundation through the international industrial IoT Research Institute

In November 2021, at the Maritime Silk Road International Conference on Industry-University-Research Cooperation, XMUT and USM signed an agreement with Chinese and Malaysian industry enterprises to jointly establish the International Industrial IoT Research Institute, addressing talent cultivation and key technology research in integrated circuits and the industrial internet of things through a four-party mechanism combining Chinese and Malaysian universities with Chinese and Malaysian enterprises. Leveraging this platform, XMUT was subsequently designated among the first batch of cooperating institutions under the Ministry of Education's China-ASEAN "Thousand Schools Hand in Hand" Program. Because the platform has grown across later stages, its cumulative outputs are recorded here: as of early 2026, the partners had jointly built the institute, the Intretech Technology Electronic Information Industry College (Intretech, a Xiamen-listed enterprise, stock code 002925) and an overseas postgraduate internship base, focused on electronic information, flat-panel display and integrated circuits. Joint research has extended to frontier topics such as brain-computer interfaces, and the industry linkages have generated more than 30 horizontal projects commissioned by enterprises, with patented technologies converted into applications adding more than 100 million yuan in new output value. Stage I thus created the governance platform, enterprise network, and physical infrastructure on which all later cultivation activities rely.

## 4.2. Stage II (2022–2025): Joint postgraduate cultivation from master's to doctoral levels

Building on the platform stage, the two universities enrolled the first cohort of jointly trained master's students in 2022. High-quality core courses from the Malaysian partner were introduced, and twelve "industry-close" courses were jointly developed by the universities and enterprises, supported by multi-stakeholder collaborative teaching teams. In 2024, doctoral joint cultivation was launched together with the mutual appointment of doctoral supervisors between the two universities, and the first jointly cultivated doctoral student enrolled at the end of 2025, focusing on integrated circuit design and artificial intelligence applications. By 2025, the cumulative number of jointly cultivated postgraduates had reached 23, with cultivation levels clearly spanning the transition from master's to doctoral training. Throughout this stage, a distinctive paradigm was consolidated — "university-enterprise dual supervisors plus research project-driven" cultivation, in which each student is guided by both an academic and an industry supervisor and advances through real research projects. The stage converted Stage I assets into a tested mode of cross-border postgraduate training: the master's track supplied the pipeline, mutually appointed supervisors supplied academic depth, and the enterprise network supplied the problems on which students trained.

## 4.3. Stage III (2023–2026): The Sino-foreign cooperative undergraduate program

In parallel, the two universities moved to the undergraduate level, where demand for integrated circuit talent is most intense. In 2023, they signed a cooperation intention agreement to apply for a Sino-foreign cooperative education undergraduate program in microelectronics science and engineering. The application then passed a sequence of regulatory milestones: in 2024 it received approval from the Malaysian Ministry of Education for the conferral of overseas degrees; in 2025 it was selected as a Xiamen municipal cultivation project for high-quality Sino-foreign cooperative education; and in May 2026 it passed the review of China's Ministry of Education and was officially approved. With this approval, the cooperation achieved formal coverage of the bachelor's, master's, and doctoral levels, offering an articulated cross-border pathway from undergraduate study into the jointly cultivated master's and doctoral tracks. During the same period, the skills training program in integrated circuit design and integrated systems co-delivered by the two universities was selected in 2025 as a Fujian provincial flagship project for the international opening-up of education, extending cooperation beyond degree education. Stage III thus added the base of the talent pyramid and, with earlier stages, turned the partnership into a complete education system reaching from first-degree students to doctoral candidates and continuing professionals.

## 4.4. Stage IV (2025–): Research leap to a national-level joint platform

The most recent stage elevates the research dimension of the partnership. In 2025, the China-Malaysia Artificial Intelligence Joint Laboratory, jointly built by the two universities, was included in the "Strategic Science, Technology and Innovation Cooperation" key special program under China's National Key Research and Development Program, administered by the Ministry of Science and Technology, and was thereby upgraded into a national-level international research cooperation platform — the first of its kind in the partnership. The upgrade changed the structure of the cooperation: earlier stages were led by joint talent cultivation with research as a supporting vehicle, whereas the cooperation has now evolved into a two-way synergistic mode of "talent co-cultivation plus project co-research," in which doctoral students and faculty move between joint projects and the cultivation pipeline. The stage matters for two strategic industries — artificial intelligence and integrated circuits — and, though still unfolding, already demonstrates the completion of an evolution from project-level cooperation to an ecosystem in which talent cultivation and research are institutionally coupled at national scale.

### 4.5. Cross-stage synthesis: From isolated projects to an integrated cultivation architecture

The four stages follow a consistent logic of cumulation. Stage I supplied governance and infrastructure; Stage II validated the cross-border postgraduate training mode; Stage III completed the pipeline with an approved undergraduate program and professional training; and Stage IV coupled the completed pipeline to a national-level international research cooperation platform. The result is the systematic, three-dimensional and sustainable architecture that the partners describe: systematicity in articulating the bachelor, master and doctoral levels with degree education and skills training; three-dimensionality in the simultaneous presence of university, enterprise and government actors and of Chinese and Malaysian regulatory frameworks; and sustainability in the self-reinforcing loop whereby approved programs generate students, students feed joint research, and joint research attracts the industry projects and national programs that sustain them. **Table 1** summarizes the milestones.

**Table 1.** Milestones of the four-stage XMUT-USM cooperation (2021–2026)

| Stage | Period | Representative milestones |
|---|---|---|
| Platform foundation | 2021–2022 | November 2021: joint establishment of the International Industrial IoT Research Institute under a four-party mechanism of Chinese and Malaysian universities and enterprises; selection among the first batch of institutions of the China-ASEAN “Thousand Schools Hand in Hand” Program |
| Joint talent cultivation | 2022–2025 | 2022: first joint master’s cohort and Malaysian core courses; twelve industry-close courses jointly developed; 2024: doctoral joint cultivation with mutual appointment of doctoral supervisors; end of 2025: first joint doctoral student; 23 jointly cultivated postgraduates cumulatively |
| Cooperative programs | 2023–2026 | 2023: intention agreement for the undergraduate program in microelectronics science and engineering; 2024: Malaysian Ministry of Education approval for overseas degree conferral; 2025: Xiamen municipal cultivation project; May 2026: approved by China’s Ministry of Education, completing bachelor-master-doctoral coverage; 2025: skills training program named a Fujian provincial flagship education opening-up project |
| Research leap | 2025– | 2025: China-Malaysia Artificial Intelligence Joint Laboratory included in the “Strategic Science, Technology and Innovation Cooperation” key special program and upgraded into a national-level international research cooperation platform |

## 5. Discussion

### 5.1. How the four stages built a systematic cultivation architecture

The case shows that a transnational industry-education integration system is assembled stage by stage, each layer built on the assets of the previous one. Institutional commitment was established early and deepened continuously: the four-party mechanism created shared governance, successive ministry-level approvals in China and Malaysia converted private agreements into legally recognized programs, and mutual appointment of doctoral supervisors embedded commitment in academic careers. Pedagogical mutuality was built through the twelve industry-close courses, multi-stakeholder teaching teams, and the dual-supervisor paradigm, ensuring that Chinese, Malaysian, academic, and industrial perspectives all shaped what students learned. Ecosystem interoperability grew from the overseas internship base and enterprise-funded projects of Stage I to the jointly operated research platforms of Stage IV, while degree-conferral approvals and the articulated bachelor-master-doctoral pathway dismantled the credential barriers that typically obstruct cross-border education. The central insight is that no single element sufficed: the platform made joint training possible, joint training justified the undergraduate program, and the completed pipeline made a national-level international research cooperation platform a natural next step. This cumulative logic explains why the partnership achieved measurable outputs at every stage.

### 5.2. Complementarity and asymmetry as catalytic mechanisms

Complementarity between asymmetric partners is a second mechanism. XMUT and USM do not replicate each other: USM contributes research depth, doctoral supervision capacity, and access to Malaysia's quality assurance system, while XMUT contributes applied teaching capacity, deep ties to the Fujian electronics industry, and proximity to the integrated circuit and display clusters of the Xiamen area. Structured through explicit role allocation, these differences become strategic assets: the doctoral track relies on USM's research infrastructure and XMUT's industry-funded projects; the undergraduate program leverages XMUT's microelectronics teaching strength while USM's postgraduate pipeline gives graduates a progression route; and the joint laboratory couples Malaysian research capacity with Chinese application scenarios. Symmetrical duplication would have required far larger investment for far smaller gains. Bilateral partnerships should therefore be engineered around comparative advantage rather than formal symmetry.

### 5.3. Constraints, enablers, and transferability

The case also reveals constraints. The bachelor's program was approved in May 2026 and enrolled its first cohort in September, while the doctoral track admitted its first student only at the end of 2025; thus, the full pipeline remains to be tested operationally. Cross-border alignment problems documented in the literature — academic calendar synchronization, credit transfer between differently accredited systems, intellectual property arrangements, and the administrative cost of dual-country approvals — appear here as ongoing management burdens, and the cooperation depends on sustained funding and on the continuity of key individuals. The mitigating enablers are equally clear: the four-party structure distributes risk; dual-country approvals provide regulatory stability that outlasts individual agreements; the dual-supervisor and mutual-appointment systems embed cooperation in careers rather than projects; and the completed pipeline generates a self-renewing supply of students whose training feeds the joint research agenda. For other universities, the transferable lesson is staged sequencing: begin with a bounded platform that both sides can staff and fund, convert early experience into formally approved programs, and only then scale toward full-pipeline and research-platform cooperation.

## 6. Conclusion

### 6.1. Core contributions

This study offers a process-oriented account of how China-Malaysia cooperation in new engineering education can mature from a single project into an integrated cultivation system. Empirically, it reconstructs the four-stage evolution of the XMUT-USM partnership from 2021 to 2026 and documents, within one case, the completion of bachelor-master-doctoral coverage and the elevation of a jointly built laboratory to a national-level international research cooperation platform. Theoretically, it shows that the systematicity, three-dimensionality, and sustainability of such an architecture result from cumulative stage sequencing rather than from any single agreement. Practically, it offers other universities a replicable roadmap: platform foundation, level-by-level cultivation expansion, program formalization through dual-country approvals, and research-platform coupling, with role allocation based on comparative advantage at every step.

### 6.2. Recommendations

Five recommendations follow. First, the universities should move the newly approved undergraduate program into operation, aligning its curriculum and quality assurance with both the Malaysian Qualifications Agency framework and China's engineering education accreditation criteria so that bachelor-to-doctoral articulation works as designed. Second, they should convert the mutual appointment of doctoral supervisors into a standing cross-institutional mechanism with joint criteria, shared research funding, and explicit intellectual property protocols. Third, they should extend the industry-close course model and the dual-supervisor paradigm across the whole pipeline, downward to the undergraduate program and outward to the flagship skills training. Fourth, they should use the national-level artificial intelligence laboratory as the anchor of a shared research agenda integrating doctoral projects, industry-funded problems, and the internship base. Fifth, they should disseminate the staged model through the funded project's outputs and China-ASEAN cooperation frameworks so that other universities can adapt its sequencing logic.

### 6.3. Limitations and future research

Three limitations apply. First, this is a single case, and generalization to partnerships with different industrial bases or regulatory settings requires caution. Second, the observation window ends just as the undergraduate program is approved and the doctoral track begins, so operational performance of the complete pipeline cannot yet be evaluated. Third, the documentary method cannot capture informal dynamics that qualitative fieldwork would reveal. Future research should track the first cohorts of both new programs over several years, compare the XMUT-USM trajectory with other ASEAN-China partnerships, and develop quantitative indicators of the systematicity and sustainability of cross-border cultivation systems.


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## Disclosure statement

The author declares no conflict of interest.

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