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Driving Mechanisms and Competency Modeling for Cultivating Business–Engineering Integrated Talent in Inland Open-Economy Hubs

Xiaomei Duan [1, *]

[1] School of Business Administration, Chongqing Technology and Business University, Chongqing 400020, China

[*]**Corresponding Author**
Xiaomei Duan

duanxiaomei@ctbu.edu.cn

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Abstract

Inland regions are becoming critical areas in China's open strategy, urgently needing international talents with skills in business, engineering, and digital technology. This study takes Chongqing as a case to propose a restructured model of international business education to support the construction of inland open-economy hubs. Utilizing a multi-level analytical framework, the research reveals the demand-driven mechanism for business－engineering integrated talents within technology-intensive global value chains and introduces a "dual-core, three-tier" competency model. This model, through the integration of curriculum modules, provides a practical guide for educational reform in inland regions to integrate into the global economy.

Keywords: Inland open-economy hubs; Business － engineering integration; International business education; Competency modeling; Curriculum reform

1. Introduction

The reform of New Liberal Arts programs and related professional curricula originates in the necessity for higher education systems to respond proactively to profound structural transformations in the external environment (Ministry of Education of the PRC, 2020). China's pattern of external opening is currently undergoing a fundamental transition—from a predominantly coastal-led model toward a dual system characterized by coordinated inland–coastal interaction. National strategies such as the Belt and Road Initiative and the development of the Western Land–Sea New Corridor have progressively extended the spatial depth of opening-up, reshaping the geography of global circulation across the country's interior (National Development and Reform Commission [NDRC], 2019; NDRC, 2021).

In 2023, rail–sea intermodal services along the Western Land–Sea New Corridor exceeded 9300 trips, generating cargo flows valued at more than RMB 280 billion (Western Land–Sea New Corridor Logistics and Operations Organization Center, 2024). This rapid scaling has begun to fundamentally alter the organization of inland industries and the structure of talent demand, with implications extending well beyond logistics efficiency. Within this strategic context, national planning frameworks designate Chongqing as both the Logistics and Operations Organization Center of the Western Land–Sea New Corridor and a strategic linkage node within China's dual-circulation development paradigm (The Central Committee of the CPC & State Council, 2021). This positioning signals a structural shift in the city's development logic—from a traditional transit hub toward a strategic platform aggregating high-end factors such as logistics, trade, finance, and data, thereby accelerating the transition from transfer-based growth to value creation.

Against this backdrop, inland open-economy hubs represented by Chongqing exhibit an increasingly pronounced demand for deep business–engineering integration. As a globally significant electronic information manufacturing base, Chongqing accounts for approximately one-third of global laptop production, with exports from the Xiyong Comprehensive Bonded Zone alone exceeding 38 million units in 2024 (Chongqing Customs, 2024; Chongqing Municipal Bureau of Statistics, 2024). However, the sustainability of such world-class industrial clusters increasingly depends not on scale or efficiency alone, but on capabilities in digitalized cross-border supply-chain governance, the agile application of high-standard trade rules such as the Regional Comprehensive Economic Partnership (RCEP), and the effective navigation of complex technical trade barriers (State Administration for Market Regulation, 2023).

The rapid expansion of high-technology and high–value-added exports has fundamentally redefined talent requirements. Industrial upgrading increasingly necessitates a shift away from single-function "trade executors" or "technical engineers" toward cross-boundary integrators capable of aligning international business rules and market strategies with industrial processes, intelligent manufacturing systems, and digital tools for data analysis and platform operation (Commercial Industry Committee of CCPIT, 2024). This transformation in talent demand closely aligns with the objectives articulated in China's New Liberal Arts initiative, which emphasizes the deep integration of humanities and social sciences with science, engineering, and emerging technologies (Xu and Wang, 2025; Xiao, 2025).

Systematically exploring and constructing a business－engineering integrated talent cultivation paradigm is therefore not merely an internal imperative for disciplinary development within universities. Rather, it constitutes a critical educational response that supports inland open-economy hubs in moving from corridor-based growth toward high-value port economies and value-chain-oriented development (OECD, 2018). Situated at the intersection of national strategy, industrial transformation, and educational reform, this study systematically examines what types of international business talent should be cultivated in inland open-economy hubs.

2. Driving Mechanisms of Business–Engineering Integrated Talent Cultivation in Inland Open-Economy Hubs

The logical starting point of New Liberal Arts reform and professional curriculum restructuring lies in a systematic response to profound external transformations in the political economy and technological environment of higher education (Ministry of Education of the PRC, 2020). The transition of international business talent cultivation toward a business–engineering integrated paradigm in inland open-economy hubs is not the result of isolated educational experimentation. Instead, it is driven by a multi-level and interlocking mechanism shaped by national strategies at the macro level, industrial restructuring at the meso level, and labor-market evolution at the micro level.Together, these forces form a systemic and path-dependent driver that compels higher education institutions to recalibrate their talent supply structures in response to evolving development needs.

2.1. Macro-Level Strategic Drivers: National and Regional Policy Architecture

At the macro-level, national development strategies provide an authoritative policy framework that exerts a directional and normative influence on educational reform. The Master Plan for the Western Land–Sea New Corridor explicitly emphasizes the deep integration of transportation corridors with industry, trade, and the digital economy, signaling a strategic shift from infrastructure expansion toward system-level value creation (National Development and Reform Commission [NDRC], 2019) .This repositioning transcends traditional logistics functions and generates demand for talent capable of simultaneously navigating international commercial rules, industrial operations, and digital technologies.

Policy initiatives such as the promotion of “single bill of lading” multimodal transport systems further illustrate this transformation. Their effective implementation relies not only on legal and commercial expertise, but also on professionals who can integrate data standards across rail, maritime, customs, and platform-based systems (Office of the China (Chongqing) Pilot Free Trade Zone, 2023). The Implementation Plan for Promoting the High-Quality Development of the Western Land–Sea New Corridor during the 14th Five-Year Plan Period reinforces this orientation by prioritizing the construction of “smart corridors” and explicitly embedding big data and blockchain technologies into corridor governance. At the strategic level, digital technology application is thus institutionalized as a core competency requirement for international business professionals (NDRC, 2021).

At the regional level, the Outline Plan for the Construction of the Chengdu–Chongqing Twin-City Economic Circle assigns Chongqing a dual role as both an international comprehensive transportation hub and a national center for advanced manufacturing (The Central Committee of the CPC & State Council, 2021). This dual mandate inherently challenges the traditional separation between logistics-oriented engineering education and international trade–oriented business education. Complementary municipal policies further emphasize the integration of manufacturing and services and the acceleration of digital trade development, accompanied by targeted talent support measures (Chongqing Municipal People’s Government, 2021). Taken together, these policy signals delineate a clear “capability frontier” for talent cultivation, within which business–engineering integration becomes a structural requirement rather than an optional enhancement.

2.2. Meso-Level Industrial Drivers: Pressure Transmission from Industrial Upgrading

At the meso-level, regional industrial upgrading translates strategic intent into concrete enterprise-level capability demands, thereby exerting direct pressure on educational systems. Chongqing's electronic information industry exemplifies this mechanism. As the sector extends upstream into research and development, testing, and supply-chain coordination, firms increasingly require international business professionals who can participate in supplier technical evaluation, assess the compliance implications of key component specifications, and collaborate with engineers to address overseas technical disputes (Chongqing Municipal Bureau of Statistics, 2024).

Empirical evidence indicates that insufficient familiarity with foreign technical standards imposes substantial losses on exporting firms, underscoring the emergence of "technical communication capability" as a critical occupational threshold (State Administration for Market Regulation, 2023). Similarly, traditional export-oriented industries such as motorcycles and general machinery frequently encounter technical trade barriers related to emissions, safety, and energy efficiency when entering overseas markets. Effective responses require business personnel who can interpret detailed technical standards, coordinate product adaptation with engineering teams, and prepare compliance documentation—tasks for which graduates of conventional international business programs are often underprepared.

Digital transformation further intensifies this pressure. Cross-border e-commerce has become a standard pathway for firms' global expansion, while supply-chain digitalization increasingly binds commercial decision-making to technological platforms (Chongqing Municipal Commission of Commerce, 2024). From Internet of Things–enabled logistics tracking to blockchain-based certificates of origin, business processes are now deeply embedded within digital infrastructures (Office of the China (Chongqing) Pilot Free Trade Zone, 2024). As a result, data-driven decision-making and platform-based operations have become non-negotiable competencies, reinforcing the necessity for integrated business–engineering skill sets.

2.3. Micro-level Job Drivers: Emerging Occupational Profiles and Competency Decomposition

Macro and meso-level drivers ultimately crystallize into concrete competency requirements through labor-market dynamics. Analysis of recruitment practices and emerging job descriptions in Chongqing reveals the rapid emergence of business–engineering integrated positions with distinctive capability profiles (Commercial Industry Committee of the China Council for the Promotion of International Trade, 2024).

Positions such as intelligent customs and trade compliance specialists require proficiency in customs regulations alongside the ability to extract and process data from enterprise resource planning systems, operate single-window platforms, and understand technical classification rules. Cross-border supply-chain data analysts combine supply-chain management knowledge with advanced data analytics skills to translate quantitative insights into operational decisions. Digital

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overseas marketing managers must integrate cross-cultural understanding with platform analytics, content management systems, and collaboration with technical teams for website optimization.

Across these occupations, a common competency structure is evident. These roles occupy the intersection of commercial value creation processes and technological support systems. Their competency architecture resembles a layered configuration: a foundation of general international business knowledge, a top layer of industry- or market-specific expertise, and a central core composed of digital technology application capability, technical comprehension, and the integration of technical value into commercial decision-making. This micro-level evolution provides the most precise specification for educational output standards.

2.4. An Integrated Framework: The Strategic–Industrial–Occupational Tri-Level Mechanism

Synthesizing the above analysis, the driving mechanism for cultivating business–engineering integrated talent in inland open-economy hubs can be conceptualized as a tri-level interactive system encompassing the macro (strategy), meso (industry), and micro (occupation) levels (Figure 1).

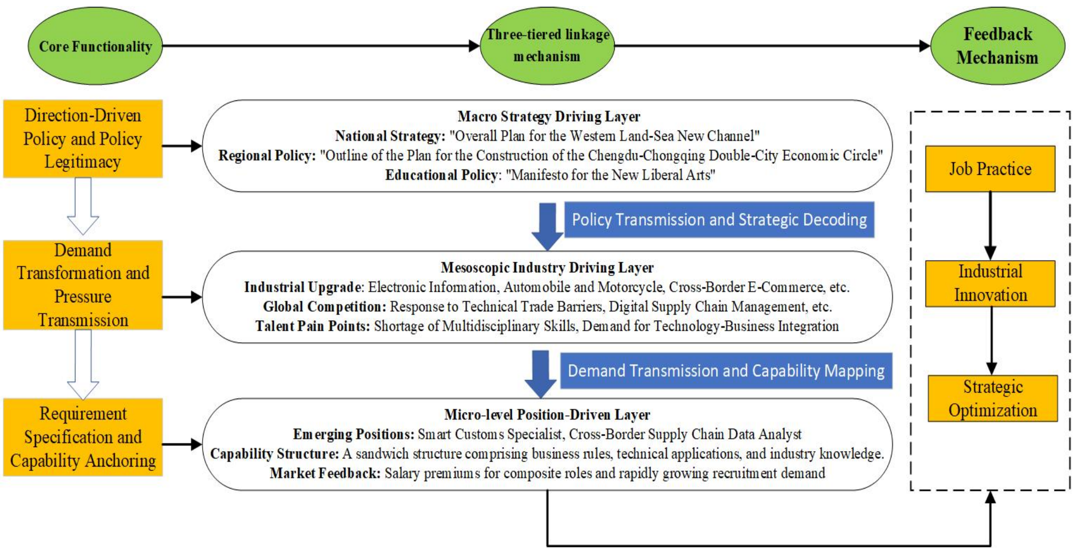

Figure 1. Three-Tier Driving Mechanism Model for Business–Engineering Integrated Talent Cultivation in Inland Open-Economy Hubs

The macro-level establishes strategic orientation and policy legitimacy; the meso-level translates strategic intent into concrete demand pressures; and the micro-level anchors these demands in observable competency requirements (NDRC, 2019; NDRC, 2021).

Importantly, this mechanism is not a linear transmission chain but a dynamic feedback system. Successful practices at the occupational level stimulate enterprise innovation and industrial upgrading, which in turn refine and reinforce regional strategic objectives. Within this recursive process, the traditional discipline-centered talent supply model emerges as a structural bottleneck. Business–engineering integrated education reform thus represents a necessary and endogenous response to this tri-level driving mechanism.

2.5. Supplementary Evidence from Enterprise Consultation and Teaching Practice

To enhance empirical grounding, the conceptual model is further informed by exploratory enterprise consultations and preliminary teaching-practice observations conducted in Chongqing. Between 2022 and 2024, semi-structured interviews were conducted with managers and HR specialists from export-oriented manufacturing enterprises, logistics platform operators, and cross-border e-commerce firms located in the Western Land–Sea New Corridor region. Interviewees consistently emphasized difficulties in recruiting professionals capable of simultaneously understanding international trade rules, digital platforms, and basic industrial processes.

In parallel, pilot teaching practices were carried out within an international business program at a local university, where integrated modules incorporating supply-chain digitalization, technical compliance cases, and scenario-based projects were introduced on a trial basis. Feedback from students and enterprise mentors indicated improved capability in cross-disciplinary communication, data-informed decision-making, and rule-based problem analysis, compared with traditional course arrangements.

Although these observations do not constitute large-scale quantitative validation, they provide contextualized, practice-based evidence supporting the necessity and feasibility of the proposed business–engineering integrated competency model.

3. Theoretical Construction and Conceptual Elaboration of the “Dual-Core, Three-Tier” Competency Model

Building on the systematic decomposition of the driving mechanisms discussed above, the focus of talent cultivation reform shifts from explaining why transformation is necessary to clarifying what objectives such transformation should pursue. Existing discipline-centered competency frameworks in international business education are increasingly inadequate for addressing the strategic demands of inland open-economy hubs. In these contexts, commercial activities are deeply intertwined with industrial systems, digital infrastructures, and evolving regulatory regimes. In response, this study develops a structured, dynamic, and application-oriented “dual-core, three-tier” competency model to articulate, with conceptual precision, the capability architecture required for business–engineering integrated talent cultivation, thereby providing a clearly specified target framework for subsequent curriculum and pedagogical reform.

3.1. Theoretical Foundation and Logical Premises of Model Construction

The “dual-core, three-tier” competency model is theoretically grounded in competency-based education and constructivist learning theory, while being empirically anchored in the developmental practice of inland open-economy hubs. Competency-based education emphasizes that educational outcomes should be defined in terms of observable and assessable professional capabilities rather than abstract knowledge accumulation (Spady, 1994). This outcome-oriented perspective has been widely adopted in higher education reform to enhance alignment between educational provision and labor-market demand (Mulder, 2014).

In this study, "engineering" is used in a broad and functional sense to encompass not only conventional engineering knowledge, but also industrial processes, digital technologies, and applied technical systems that directly support business operations and value creation.

Constructivist learning theory further complements this perspective by positing that knowledge is actively constructed by learners through engagement with authentic and complex problem contexts rather than passively transmitted through instruction (Vygotsky, 1978). From this standpoint, business competence and technical competence do not exist as isolated domains; instead, they are integrated through situated learning processes in which learners resolve real-world, cross-boundary problems. Representative examples include coordinating tariff compliance and logistics optimization for intelligent manufacturing exports or integrating data governance with multimodal transport operations in corridor economies (Kolb, 1984).

Accordingly, the core premise of the model is that business−engineering integration does not emerge from the mechanical juxtaposition of heterogeneous knowledge domains, but from their " chemical synthesis " within scenario-driven tasks requiring coordinated application. This premise requires the competency model to exhibit interactivity, structural coherence, and generative capacity, enabling the progressive transformation of knowledge inputs into integrated problem-solving capabilities (Biggs & Tang, 2011).

3.2. The Dual-core of Competency: Open-Rule Practice and Technology-Integrated Innovation

The "dual core" constitutes the foundational pillars of the model, representing two interdependent clusters of competencies essential for business–engineering integrated talent cultivation.

Core I: Open-Rule Practice Capability

Open-rule practice capability refers to the capacity to conduct cross-border commercial activities efficiently, compliantly, and strategically within global and regional regulatory frameworks. Under conditions of accelerated rule evolution and deepened opening-up, this capability extends beyond traditional trade execution to encompass strategic rule interpretation and operational application (WTO, 2020).

First, global and regional rule application capability emphasizes operational proficiency in applying high-standard trade agreements such as the Regional Comprehensive Economic Partnership (RCEP), including rules of origin accumulation, tariff differentials, and institutional coordination across regional economies (Urata, 2018). Second, cross-border operation and compliance execution capability covers end-to-end processes such as market entry, international logistics coordination, export controls, and cross-border data governance. The increasing prevalence of technical trade measures faced by exporting firms underscores the importance of this capability for sustaining market access (OECD, 2023). Third, cross-cultural business negotiation capability involves effective communication and relationship management across institutional and professional cultures, particularly when commercial objectives must be translated into technical or contractual parameters.

Core II: Technology-Integrated Innovation Capability

Technology-integrated innovation capability represents the distinctive value-added dimension of business–engineering integration. Data-driven decision-making capability involves the systematic collection and analysis of international market and supply-chain data to support strategic and operational decisions (McAfee & Brynjolfsson, 2012). Intelligent tool application capability requires not only operational familiarity but also conceptual understanding of digital technologies such as blockchain, the Internet of Things, and artificial intelligence, enabling informed application and governance-aware use. Process-level technological comprehension further enables business professionals to coordinate effectively with engineering teams by understanding key production processes, quality systems, and technical constraints.

The two competency cores interact through a reinforcing feedback loop in which technological capability enhances rule implementation efficiency, while regulatory understanding constrains and guides technological application. Together, they form an integrated competency system oriented toward value creation in open-economy environments.

3.3. The Three-Tier Knowledge Architecture: From Integrative Cognition to Capability Generation

To support the progressive formation of dual-core competencies, the model incorporates a three-tier knowledge architecture aligned with established theories of cognitive development and competency formation (Bloom et al., 2001). Rather than constituting a static classification of courses, the three-tiers form a cumulative learning pathway in which competencies are generated through sequential cognitive integration, functional coupling, and scenario-based application. Each tier functions simultaneously as the learning outcome of the preceding stage and as the enabling condition for subsequent competency development.

Tier I: General Integrative Layer (Foundations of Integrative Cognition)

This tier establishes a shared cognitive foundation by dismantling disciplinary silos at the conceptual level. Courses emphasize inland open-economy systems, digital transformation, and global governance, enabling learners to recognize the structural interdependence between technological systems and commercial value creation. By cultivating integrative cognition and systems awareness, this layer provides the necessary conceptual prerequisites for students to meaningfully engage in cross-disciplinary knowledge coupling in subsequent learning stages.

Tier II: Foundational Coupling Layer (Cross-Disciplinary Knowledge Integration)

Building upon the integrative cognitive framework developed in Tier I, this tier facilitates the transition from conceptual understanding to functional coupling. Core international business courses are restructured to embed technological content, while analytical methods, data tools, and information systems are introduced to support applied learning. Through shared analytical frameworks and tool-based learning, students begin to connect business logic with technological processes, thereby transforming abstract integrative awareness into operational cross-disciplinary competence.

Tier III: Professional Generation Layer (Scenario-Driven Capability Synthesis)

Based on the coupled knowledge structures formed in Tier II, this tier focuses on transforming integrated knowledge into actionable professional capabilities. Teaching is organized around authentic scenarios characteristic of inland open-economy hubs and implemented through project-based learning and industry collaboration. Learners synthesize regulatory knowledge, technological tools, and industry-specific expertise to deliver integrated solutions, thereby internalizing dual-core competencies through practice and experiential learning (Kolb, 1984). In this stage, competency generation is completed through repeated engagement with complex, real-world tasks that mirror actual occupational contexts.

3.4. Structural Characteristics and Analytical Value of the Model

Analytically, the "dual-core, three-tier" model represents a dynamic, three-dimensional architecture in which open-rule practice capability and technology-integrated innovation capability function as vertical pillars spanning the horizontal tiers of knowledge formation. Their convergence at the professional generation layer yields graduates equipped with integrative capabilities for complex problem-solving.

The model exhibits three defining characteristics: dynamic adaptability to technological and regulatory change, regional embeddedness allowing scenario localization, and explicit capability orientation with assessable learning outcomes. Collectively, these features reflect a shift from discipline-centered education toward a competency-centered paradigm, consistent with the broader objectives of New Liberal Arts reform (Ministry of Education of the PRC, 2020).

4. Knowledge Architecture and Curriculum Mapping Based on the "Dual-Core, Three-Tier" Model

The practical value of a competency model ultimately lies in its capacity to guide curriculum reconstruction and instructional design. The "dual-core, three-tier" competency model developed in the preceding section defines a clear target state for international business talent cultivation in inland open-economy hubs. The key challenge, however, is to translate this abstract capability framework into an operational and coherent curriculum system. This requires not incremental course adjustment, but a capability-oriented reengineering of the existing knowledge architecture to ensure systematic alignment between educational inputs and competency outputs (Biggs & Tang, 2011).

4.1. Structural Constraints of Traditional International Business Curricula

Most traditional international business curricula remain embedded in a discipline-centered structure shaped by the industrial economy. When confronted with the integrated competency requirements of inland open-economy hubs, this structure exhibits several systemic limitations.

First, curricular objectives are fragmented and knowledge is compartmentalized. Core courses such as international trade theory, international finance, and international business law are typically organized as parallel and self-contained units, each emphasizing internal theoretical completeness. Weak horizontal linkages prevent the formation of problem-oriented learning trajectories capable of integrating dispersed knowledge around complex real-world tasks, such as digitalized corridor logistics or intelligent product compliance. As a result, students accumulate isolated cognitive components rather than functional integrative capabilities (Barnett, 2006).

Second, curricular content is increasingly decoupled from contemporary practice. Slow textbook revision cycles have generated a widening gap between academic instruction and the rapid evolution of digital trade, supply-chain technologies, and platform-based business models. Traditional emphases on documentary credits and conventional trade procedures persist, while emerging issues such as cross-border e-commerce autonomy, cross-border data governance, and smart contract applications remain marginal within the curriculum. This temporal mismatch weakens graduates' immediate applicability in technologically dynamic environments (OECD, 2018).

Third, technological elements are structurally peripheralized. Information systems, data analytics, or e-commerce-related courses are often positioned as general electives rather than integrated components of the professional core. Their content is frequently generic and detached from core business decision-making contexts, limiting students' ability to establish meaningful cognitive connections between technological tools and commercial strategy (McAfee & Brynjolfsson, 2012).

Finally, practical training remains superficial and weakly coupled with capability formation. Experimental teaching is often confined to closed-system simulations or short-term observational internships, which rarely expose students to authentic data, real decision constraints, or complex task environments. Consequently, practice modules fail to function as effective mechanisms for integrative competency generation (Kolb, 1984).

These limitations underscore the necessity of reconstructing international business curricula around occupational capability logic rather than disciplinary completeness.

4.2. Core Principles for Curriculum Reconstruction Aligned with the Model

To ensure structural alignment with the "dual-core, three-tier" competency framework, curriculum reconstruction should adhere to three interrelated principles.

The first is the principle of deep integration. Curriculum design must move beyond the mechanical aggregation of business – engineering courses toward genuinely integrated courses whose learning objectives explicitly encompass both commercial and technological dimensions. Assessment should prioritize students' capacity to synthesize heterogeneous knowledge within complex scenarios rather than evaluate isolated knowledge recall.

The second is the principle of scenario anchoring. Representative real-world scenarios drawn from inland open-economy hubs—such as digitalized multimodal transport coordination, cross-border e-commerce expansion, or compliance challenges in high-end manufacturing exports—should serve as organizing anchors for course content. Within these scenarios, theoretical knowledge, regulatory frameworks, and technological tools are embedded into coherent task sequences, enabling capability formation through situated learning (Lave & Wenger, 1991).

The third is the principle of dynamic balance between frontier orientation and regional embeddedness. Curriculum content must integrate frontier developments in digital trade, intelligent logistics, and data analytics while embedding region-specific strategies, corridor economies, and industrial structures. This balance ensures graduates possess both global competence and localized applicability. The operationalization of these principles is illustrated through the integrated curriculum modules presented in the following section and summarized in Table 1.

Table 1. Credit and Hour Allocation for Core Integrated Curriculum Modules

Module	Credits	Total Hours	Lecture (%)	Practical / Project (%)
Intelligent Cross-Border Supply Chain Management and Data Analytics	4	64	40%	60%
Global Digital Trade Operations and Compliance	3	48	45%	55%
Advanced Manufacturing and International Technical Trade Compliance	3	48	50%	50%

4.3. Core Integrated Course Modules Supporting Dual-Core Capability Formation

Based on these principles, the curriculum system can be modularly reconstructed around a set of integrated course clusters that primarily support the foundational coupling and professional generation tiers of the competency model.

Module I: Intelligent Cross-Border Supply Chain Management and Data Analytics

This module supports cross-border operational capability and data-driven decision-making. Students engage with IoT-enabled logistics visualization, demand forecasting, multimodal transport optimization, and digital traceability for compliance risk monitoring. Evaluation emphasizes analytical rigor and solution feasibility.

Module II: Global Digital Trade Operations and Compliance

Anchored in full-cycle cross-border e-commerce operations, this module integrates market-entry analytics, platform-based operations, digital marketing optimization, cross-border payment systems, taxation fundamentals, and data compliance. Project-based learning structures require students to synthesize commercial strategy, technological tools, and regulatory requirements within a unified operational framework (OECD, 2023).

Module III: Advanced Manufacturing and International Technical Trade Compliance.

Focusing on export-oriented manufacturing industries, this module integrates technical standard interpretation, export control compliance, technology contract governance, and foundational industrial process cognition. Through simulated negotiation and case analysis, students develop the ability to coordinate technical and commercial considerations in international market entry. Together, these modules constitute the curricular backbone supporting dual-core competency formation.

Each module is designed as a medium-sized integrated course emphasizing the balance between conceptual instruction and scenario-based practice. A higher proportion of practical hours is allocated to ensure capability formation through project work, data analysis, and simulated decision-making tasks. The modular design allows flexible adaptation to different institutional credit systems.

4.4. Implementation Pathways for Cross-Disciplinary Curriculum Integration

Effective implementation of integrated curriculum modules requires institutional mechanisms capable of overcoming organizational and disciplinary barriers.

First, engineering-oriented courses should be adapted for business application through modular redesign and micro-credentialing, enabling business students to acquire essential technological tools without excessive technical abstraction. Second, cross-disciplinary teaching teams and dual-instructor mechanisms should be institutionalized to ensure instructional coherence, supported by corresponding adjustments in workload recognition and incentive structures. Third, scenario-based project platforms should be developed through collaboration with local governments, industrial parks, and leading enterprises, providing access to authentic data, realistic problem contexts, and sustainable practice environments (Etzkowitz & Leydesdorff, 2000).

Through these mechanisms, the curriculum system becomes a functional carrier of the "dual-core, three-tier" competency model, translating theoretical objectives into concrete educational processes.

In practice, interdisciplinary curriculum implementation faces institutional barriers, particularly in faculty collaboration and resource integration. Differences in disciplinary language, evaluation standards, and workload recognition often constrain sustained cooperation between business - engineering faculty. To address these challenges, universities should institutionalize cross-disciplinary teaching teams supported by joint workload accounting, co-teaching incentives, and shared curriculum development platforms.

In addition, modular teaching materials and shared case repositories jointly developed with enterprises can reduce coordination costs and enhance teaching consistency. These institutional arrangements are critical for ensuring the scalability and sustainability of business–engineering integrated curriculum reform.

5. Conclusions and Implications

Situated at the intersection of China's deepening inland opening-up strategy and the digital transformation of regional industries, this study addresses the growing structural misalignment between traditional international business education and emerging talent demands. Following a coherent analytical trajectory — from problem diagnosis and driver decomposition to objective reconstruction and pathway design — this study responds to the core question of what type of international business talent should be cultivated in inland open-economy hubs. By constructing and operationalizing the "dual-core, three-tier" competency model and its curriculum mapping framework, the research offers a conceptually grounded and practically actionable blueprint for advancing New Liberal Arts–oriented business education reform.

5.1. Conclusions

First, the demand for business–engineering integrated talent in inland open-economy hubs represents an irreversible, system-level educational transformation driven by the interaction of strategy, industry, and labor markets. At the macro-level, national and regional development strategies—such as the Western Land–Sea New Corridor and the Chengdu–Chongqing Dual-City Economic Circle—have redefined inland regions from peripheral spaces of openness to strategic platforms of value creation. At the meso-level, industrial upgrading in export-oriented manufacturing sectors has translated these strategic orientations into concrete enterprise-level capability gaps, particularly in digital supply-chain governance and technical trade compliance. At the micro-level, emerging occupational profiles articulate explicit competency requirements that integrate commercial rules, industrial knowledge, and digital technologies. These three layers form a dynamic feedback mechanism in which traditional discipline-centered education structures have become a critical bottleneck, rendering systemic educational reform both necessary and urgent.

Second, although the competency model and curriculum modules are developed based on the case of Chongqing, their applicability may vary across inland regions with different industrial structures and openness levels. Regions dominated by resource-based industries or with limited participation in global value chains may require contextual adjustment of scenario design, technological depth, and industry focus.

Nevertheless, the underlying logic of the "dual-core, three-tier" model—integrating open-rule practice capability with technology-integrated innovation capability through scenario-based learning—possesses strong transferability. Future research should explore localized adaptations of the model across diverse inland regions to refine its scalability and contextual responsiveness.

Third, translating the competency model into educational outcomes requires a capability-oriented restructuring of the curriculum system rather than incremental course adjustments. Guided by the principles of deep integration, scenario anchoring, and frontier–regional balance, the study demonstrates how integrated course modules can embed technological elements into core business processes. Through engagement with high-fidelity inland open-economy scenarios, students are enabled to develop and integrate dual-core competencies in the process of solving complex, real-world problems.

5.2. Educational Reform and Policy Practice

The findings of this study carry implications for educational reform and policy practice at multiple levels. Rather than offering general normative recommendations, this section delineates differentiated and actionable implications for key stakeholders involved in business–engineering integrated talent cultivation.

At the policy level, education authorities are encouraged to incorporate business–engineering integration into competency standards and evaluation frameworks for international business programs, particularly in inland regions undergoing open-economy transformation. This includes supporting flexible curriculum accreditation mechanisms, encouraging cross-disciplinary faculty collaboration, and aligning talent cultivation objectives with regional industrial upgrading and digital transformation strategies. By embedding educational reform within broader systems of industrial and innovation governance, policy frameworks can enhance the strategic responsiveness of higher education.

At the institutional level, universities and colleges should shift from discipline-centered curriculum design toward competency-oriented program structuring. This may involve reorganizing course modules around integrated learning outcomes, establishing cross-school teaching teams that bridge business－engineering domains, and introducing scenario-based and project-oriented courses aligned with regional economic practices. Such institutional arrangements enable universities in inland regions to translate abstract reform principles into operational teaching models.

At the practice level, enterprises and industry partners can participate as co-educators by providing authentic application scenarios, data resources, and project mentorship. Through structured collaboration with universities, enterprises contribute to the co-construction of learning contexts that reflect real-world regulatory, technological, and operational complexity, while simultaneously cultivating talent aligned with their own development needs. This form of engagement supports the formation of a sustainable university–industry collaboration ecosystem.

Collectively, these multi-level implications reinforce the role of New Liberal Arts reform as a systemic transformation that connects competency modeling, curriculum innovation, and regional development practice, rather than as an isolated adjustment within individual disciplines.

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