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REVIEW

Maritime Language Services for Shanghai International Shipping Center: An Innovative Model and Its Implementations

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ABSTRACT

The construction of Shanghai's International Shipping Center has entered into a more advanced phase of development, in which the soft infrastructure such as language service capabilities manifested its indispensable role. Yet the potential of maritime language services in the pursuit of the Center's capacity to sustain global competitiveness has been underestimated. The current provision of maritime language services is frequently regarded as a peripheral supporting function rather than a strategically valuable asset managed in a systematic and standardized manner. To address this gap, this study employs a design-oriented research approach. It introduces an innovative tripartite collaborative governance model that integrates Government, Industry, and Academia. The model is structured around four interconnected strategic pillars—strategic positioning, industrial integration, talent cultivation, and technological empowerment. Through this framework, the paper identifies and elaborates on six key growth areas, such as building integrated service platforms and cultivating interdisciplinary talent, which translate the model into actionable implementation pathways. This research makes a dual contribution. Conceptually, it advances the field by re-framing maritime language services from a discrete operational concern into a strategically managed component of soft infrastructure, providing a novel governance lens. Practically, it offers a systematic blueprint for policymakers and industry stakeholders. The proposed model and its identified growth areas directly contribute a feasible roadmap for enhancing the language service ecosystem, thereby injecting new vitality and a substantive stimulus into the high-quality, competitive development of Shanghai's International Shipping Center.

Keywords: Maritime Language Services; Shanghai International Shipping Center; Language Governance; Service Model Innovation

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1. Introduction

The Shanghai International Shipping Center has been expediting its development towards the strategic goal of full completion. The Center's current strategic framework comprises four critical and interrelated aspects: consolidation of shipping functionality, enhancement of high-end services, advancement of green and intelligent upgrading, and optimization of the business and commercial ecosystems. It is thus widely recognized that these initiatives will collectively contribute to the construction of a globally leading international shipping center[1, 2]. Against this backdrop, the Center has undergone paradigm shifts as the demands and priorities of distinct developmental stages vary considerably[3, 4]. While hardware infrastructures remain essential components, strategic leverage is increasingly driven by soft infrastructure. The former may include deep-water ports, extensive logistic chains, etc. While the latter injects strategic power to sustain the industrial long-term development and guarantee operational efficiency. Soft power encompasses a number of elements such as the establishment of standards and regulations, the provision of professional services, and the improvement of operational efficiency. As a vital element of soft infrastructure framework, specialized maritime language services are a crucial component that deserves adequate investment and attention[5]. Language services in the maritime industry facilitate cross-lingual and cross-cultural communication that exist at all nodes of the shipping value chain and all business scopes, ranging from pilotage to marine insurance and arbitration.

Despite the broad recognition of its demand, the current state of maritime language services has not brought its functional value to the fullest. Due to the lack of strategic supervision, the notable feature of maritime language services exhibits a certain degree of fragmentation, as well as a relatively reactive and ad-hoc operational tendency. This leads to a rather siloed language service ecosystem, in which language support is always delivered by freelance interpreters, non-specialized translation agencies, and in-house teams. Yet none of these service providers are capable of systematically aligning with multiple departments, including maritime administrative authorities, shipping enterprises, and others, in turn exacerbating service fragmentation. A more fundamental flaw emerges, compounding the above issue: a need for competent maritime language professionals, together with the unclearly shaped managerial responsibilities across organizational structures. During the actual provision of maritime language services, a critical bottleneck lies in the shortage of service providers with sufficient domain expertise and experience[6]. Most translators are not educated in the specialties of maritime law, seafarer training techniques, and other related courses. Meanwhile, the majority of maritime professionals often lack the advanced bilingual and intercultural communication skills requested for the upscale negotiations and technical documentations[6, 7]. The prevailing pattern of maritime language services has yet to develop into a systematically integrated capability that addresses the industry's essential concerns.

Existing research has effectively delineated the complex architecture of macro-level language policies within international maritime governance. From the perspective of governance, enhanced language service capabilities are a prerequisite for boosting the competitiveness of the shipping industry[5]. Critical studies have deconstructed the geostrategic considerations behind the International Maritime Organization's (IMO) dual policy of multilingual administration and monolingual operational communication[8], maintaining it as a framework of "strong ideology but weak practice"[9]. Concurrently, a substantial body of work meticulously documents the micro-level communicative challenges arising from this policy-practice gap, identifying language barriers as a persistent factor in maritime incidents and highlighting deficits in seafarers' operational English proficiency[9]. Such optimized language services will be able to elevate governance level in the shipping sector, foster a favorable regional business environment, and enhance the national soft power in global maritime affairs. "Institutional power" is exemplified by the capacity to draft compelling proposals, articulate nuanced positions, and navigate the protocols of authoritative maritime bodies such as the International Maritime Organization (IMO)[7, 9].

However, a critical analytical gap persists: while these studies expertly diagnose the problem at either the policy or individual level, they seldom provide a coherent framework to explain how to systematically translate policy into practice or orchestrate the key stakeholders necessary to build sector-wide language capacity[10]. To align language services with core objectives of the shipping center, effective coordination

across multiple relevant departments presents a significant opportunity to unlock the potential of the Center's soft infrastructure. The study seeks for a new theoretical lens by conceptualizing maritime language services not merely as a subordinate issue but as vital component of soft infrastructure. Its core insight lies in formalizing a meso-level ecosystem framework that drives development through the synergistic integration of strategic positioning, industrial application, talent cultivation, and technological empowerment, thereby transforming language support from a peripheral cost into a core enabler of operational safety, efficiency, and competitive advantage.

Therefore, this study is driven by the following core research question: How should a systematic innovation in the maritime language service model be conceptualized and implemented? The goal is to move beyond its current limitations and to become a strategic enabler for the comprehensive development of international shipping center?

2. Literature Review

2.1. Language Use in Service Contexts

Despite technological advancements, scholars in service management have emphasized that language remains an essential component in all service interactions, whether implicit or explicit[8]. The foundational role of language is embedded within several service theories that conceptualize provider-customer interactions, including service-dominant logic[11], service logic[12], and customer-dominant logic[13]. Given the dyadic nature of services, language use is significantly more critical than in advertising or product contexts, yet language research remains better developed in these two domains. The deepening of globalization means that customers and service providers often speak different native languages; being served in a second language makes it difficult to understand reactions caused by language divergence. Research on language in services elaborates on how language influences services in multiple ways. First, service providers need to manage language issues before, during, and after the customer-provider interactions[14]. Understanding the strategic role of language in mediating customer interactions at various touchpoints is paramount for optimizing service delivery and value creation. This is particularly relevant to maritime language services where multiple interaction points exist in the shipping operations. Second, focusing predominantly on spoken exchanges offers only a partial understanding of language in service environments[15]. To fully grasp service interactions, research must account for the multimodal nature of communication, which integrates verbal, written, and bodily expressions. Third, while current research predominantly examines customer reactions to language issues, its focus on customer responses remains incomplete[16]. There is a need for a more comprehensive approach to framing language services as integrated systems, wherein the quality and efficacy of communication outcomes depend on the alignment between service providers' personnel competencies and the organizational context.

Languages are believed to be instrumental in communicative contexts; despite this, their role extends far beyond merely serving as functional tools[17]. The provider's choice of service language may have a profound impact on customers' perception of the service interaction as well as the service provider. Early studies have recognized that services depend on interactions between customers and service providers[18, 19]. A significant gap exists in the service literature: while the nature of service interactions has been extensively studied, how they are transformed in cross-linguistic settings, where participants do not share a native language, remains underexplored. This gap is prominent in maritime contexts, given the multi-lingual nature of practitioners in the shipping industry. Moreover, there is a notable paradox in the field of language use in services, while more than half of sovereign countries in the world are multilingual and a majority of consumers speak more than one language[20]. This paradox is also reflected in maritime language services; cross-linguistic service interactions remain underexplored.

Given that language use in services is a complex issue, different perspectives (customer, employee, and managerial) and methodological approaches (quantitative, qualitative) have been advancing the understanding of language use in services. Holmqvist et al.[16] proposed to examine the language issues across three stages: before, during, and after the service experience. Research on pre-service has emphasized its pivotal role in forming consumers' perceptions and influencing their decisions. De Angelis et al.[21] revealed that abstract language in service referrals is more likely to enhance persuasiveness and facilitate mental imagery processing among

customers who possess prior service knowledge. Furthermore, Zhang et al.[22] noted that service messages with a high noun frequency tend to be perceived as more informative. They also identified distinct linguistic preferences among different bilingual speakers and found that these vocabulary preferences could have an impact on spoken communication. Expanding the scope beyond spoken communication, Sundar et al.[23] documented that visual information triggers perception, which exerts direct influence on the usage intentions of socially visible services and status-conscious consumers. Taken together, the above findings recognize that either verbal or visual forms of pre-service language could serve as valuable tools for shaping consumers' cognitive evaluations and service acquisitions across industries.

Language use during the service encounter could exert an influence on customer perceptions and industrial operations. It might be perceived as discrimination due to the lack of accommodation for minority languages, which in turn causes a negative impact on the long-term relational bonds between service providers and client groups. Choosing between a majority and a minority language tends to activate social stereotypes, which directly impacts practical outcomes such as negotiation success. Customers may resort to code-switching as a strategic communicative practice to navigate and adapt to cultural contexts. From the employee perspective, language can also reverse or reinforce power hierarchies, crafting authenticity or managing interactions.

Research on post-encounter language use primarily focuses on its impact on word-of-mouth (WOM) and service evaluations. A result consistently replicated across multiple contexts indicates that language divergence leads to negative outcomes (diminished trust, lower satisfaction, and reduced WOM intentions) for customers using a non-native language[24]. And Zhang et al.[22] further reported that key linguistic features, particularly noun-verb structures, shape both the tone and persuasiveness of WOM. However, current research in this domain is largely confined to the exploration of behavioral intentions. Notably, significant gaps exist in service recovery scenarios, especially when tailored apologies and remedial strategies are needed to address setbacks related to language issues[10]. To address the analytical limitations of previous studies, future research should also incorporate computational linguistics techniques to examine post-service sentiment feedback[25].

The extant literature collectively converges on a central theme: language functions as a critical determinant of service outcomes, transcending its role as a mere communication medium. Notably, linguistic impact permeates the entire service process, including pre-encounter decision-making, shaping in-encounter perceptions of authenticity and power dynamics, and guiding post-encounter evaluations and feedback. This indicates that future inquiries require a much broader investigative scope that incorporates both the industrial and organizational perspectives. Meanwhile, to address the practical needs of service contexts, a plural methodological approach contributes to advancing the breadth and depth of language service studies.

2.2. The Landscape of China's Language Service Industry

China's language service industry has undergone four developmental phases since the late 20th century (see **Table 1**): the initial budding stage (1980s), the rapid growth stage (1990s to early 2000s), the stable development (up to around 2011), and the subsequent prosperity phase (up to the present)[26]. As the language service industry has advanced through these developmental phases, it has moved beyond conventional translation services to encompass a diverse array of service activities, such as localization services, multilingual content management, and cross-cultural consulting. Meanwhile, the current landscape of the language service industry is characterized by large-scale and technological integration.

By 2023, China's language service industry had exceeded an output value of RMB 1.982 trillion with over 1.24 million related enterprises engaged in this sector[27]. Artificial intelligence technologies have emerged as a key driver for the rise of intelligent language services. As a hallmark of the contemporary industry landscape, intelligent language services have achieved a scale of RMB 61.69 billion, with a rapid growth in the number of enterprises specializing in AI-assisted translation[26]. Driven by this technological enhancement, the human-machine collaboration model (typified by machine translation post-editing, MTPE) has become the mainstream model in this sector. During this process, the market has created demand for new hybrid positions, such as AI language engineers. Another notable trend in the sector is market diversification: service types have expanded to over

20 categories, and demand for non-English language services is steadily on the rise. Geographically, the language service industry remains concentrated in major metropolitan areas such as Beijing, Shanghai, and Guangdong, while other regions, including Jiangsu, Zhejiang provinces and other provincial capitals have also witnessed significant growth in the sector.

Table 1. Key developmental phases of China's language service industry.

Developmental Phase	Time Period	Key Characteristics
Initial Budding Stage	1980s	Market-oriented services emerged; substantial growth in the number of institutions.
Rapid Growth Stage	1990s–early 2000s	Dramatic expansion in enterprise quantity; foundational companies established.
Stable Development Stage	2000–2011	Industry maturation with expansion into technology development and consulting domains.
Prosperous Stage	2011–Present	Chinese firms rank globally; deep AI integration; intelligent services become a major sub-market.

2.3. Current Research Status and Trends in Maritime Language Services

The rapid development of the shipping industry has driven maritime language services to evolve from a narrow focus on translation or interpretation to a comprehensive, interdisciplinary domain of both research and practice. This shift encompasses linguistics, maritime sciences, and information technologies that support innovations in the standardized maritime interpretation and language crew language proficiency assessment. Domestically, studies on maritime language services have increasingly been situated within the national strategic frameworks like the "Maritime Power" and "Belt and Road" initiatives. Scholars have emphasized its role as national strategic facilitator of international trade, maritime safety, and global maritime governance mechanisms[7]. Thus, the scope of research has broadened to cover diverse maritime text types and industrial scenarios, including rigorous, standardized wordings in international maritime conventions, vessel construction terms in shipbuilding contracts, voyage reports, terminology and syntactic structures in International Maritime Organization (IMO) proposals, and communication interactions in port state control. Cultivating high-end, interdisciplinary talent remains the focus, and the required skill set is often summarized as "maritime expertise + foreign language proficiency + diplomatic acumen + IMO procedural knowledge"[7]. Specifically, maritime expertise meets the operational needs of the shipping industry, foreign language proficiency entails mastery of maritime languages and the ability to resolve disputes in cross-cultural negotiations, and IMO procedural knowledge guarantees compliance with international maritime regulatory conventions[9]. This signals a strategic shift from framing the maritime language services merely as a linguistic activity to conceptualizing them as a professional and specialized service that facilitates maritime safety, international trade, and global maritime governance.

Internationally, as maritime English is emphasized as a branch of English for Specific Purposes (ESP), maritime language service research has long been anchored in maritime safety and standardized communication. This is exemplified by the Standard Marine Communication Phrases (SMCP) developed by IMO, which includes over 1,000 standardized phrases covering navigation, collision avoidance, and emergency response to reduce communication-induced accidents. This positions maritime English as a bridge between linguistic standardization and practical safety needs. Given the fact that 80% of global shipping crews are multinational, studies on maritime language services also intersect closely with human factors in maritime operations. Studies systematically analyzed how language barriers and cultural differences contribute to maritime incidents, such as the misinterpretation of standardized marine phrases and the divergent implied meanings among multinational crews. Effective language services have been positioned as a fundamental component of maritime operational safety. Parallel to this focus, Chinese scholars emphasize trends in maritime language services, including project management. This orientation effectively aligns the specialized field of maritime language services with the macro commercial language services industry[28, 29].

Domestic and international studies on maritime language services reveal several future trends. This trend centers on deep technological integration of applying Artificial Intelligence (AI), advanced machine translation, and large-scale term banks. These technology-assisted approaches help tackle the two key challenges: massive data volumes and the highly specialized terminology inherent to maritime language sources[29]. Another important focus is building

multilingual maritime corpora and knowledge graphs. These directly meet the need for consistent translation and efficient knowledge management in the maritime language services. In addition, emphasis has also been placed on cross-cultural maritime communication. Researchers also pay attention to localizing technical materials, regulatory documents, and training programs. These efforts aim to ensure semantic clarity and compliance with international and industrial standards. They apply to diverse linguistic and cultural contexts, helping reduce the risk of miscommunication in maritime operations. A holistic perspective that includes emergency language response for maritime incidents highlights the field's progress. It is moving on the trajectory towards a more standardized, technology-driven, and strategically vital discipline essential for safe and efficient global maritime operations.

The field of maritime language services is experiencing a significant transformation. It has moved beyond its traditional role as a purely linguistic endeavor to become a strategically important, interdisciplinary professional support. Its future development depends on the integrated advancement of three promising areas: coordinated technological innovation, cultivation of specialized professionals, and strong policy support. This integrated approach is crucial for effectively dealing with the complexities of global maritime operations. It helps enhance maritime safety, improve operational efficiency, and strengthen international cooperation mechanisms. In turn, it supports the implementation of national maritime strategies and global maritime governance goals.

3. Core Growth Areas in Maritime Language Services

Theoretical research in maritime language services is shifting toward several key growth directions. Each of these directions aligns with both fields' academic demands as well as practical challenges from the industry. One of the foci is developing integrated research networks, which help strengthen the field's methodological foundation. Strengthening domestic and international collaboration through these networks helps promote joint exploration of forefront issues and effectively link language resources. Meanwhile, building synergy between standardization and innovation helps connect the formal communication protocols and the dynamic realities of multilingual maritime operations [7]. In addition, focusing on seafarer-centered communication research helps deepen the understanding of psychological and socio-cultural factors in multilingual crew interactions.

On the practical side, the maritime language service sector needs to seize two development opportunities. One involves addressing competency issues: there is a shortage of professionals with comprehensive capabilities in "maritime expertise + multilingual proficiency + technological literacy"; the other lies in the technology level: with insufficient application of intelligent tools in on-site maritime communication scenarios [5]. Specifically, improving workplace communication competence through immersive, scenario-based training programs simulates cross-border coordination or emergency response scenarios, making them a critical area for development. In the meantime, connecting AI-compatible language infrastructure with corresponding linguistic resources will help accelerate the development of next-generation maritime language technologies. As shown in **Table 2**, several growth areas point to the future developmental path of the sector. This integration is poised to institutionalize language support as an indispensable component of maritime operations. It will shift linguistic services from a peripheral auxiliary function to a foundational element embedded in every critical operation of the shipping industry [5, 10].

Table 2. Area for growth in maritime language services.

Dimension	Area for Growth	Development Focus
Theoretical Research	Multiple Research Perspectives	Building collaborative research networks; sharing linguistic resources; systematic and localized research
	Standardization-Application Connectedness	Building alignment between international standards (e.g., SMCP) and actual communication needs in complex, multilingual maritime operational environments.

Table 2. *Cont.*

Dimension	Area for Growth	Development Focus
Theoretical Research	Human-Related Communication	Advancing research on the cultural, psychological, and socio-linguistic dimensions of multinational crew interactions and professional communication patterns.
Practical Application	Workplace Communicative Competence	Designing both evaluation and training systems that effectively develop seafarers' cross-cultural and situation-appropriate communication skills.
	Technology-Empowered Language Service Infrastructure	Building specialized linguistic resources, including maritime corpora and terminology databases, to enable next-generation language technologies.
	Systemic Integration of Operational Experiences	Embedding language services as critical components in maritime safety protocols, workflow systems, and management frameworks.

Through synthesizing current and emerging trends, along with domestic and international literature, future maritime language services appear to revolve around four interconnected domains: First, AI will be integrated with the quality assessment of machine translation systems. Intelligent agents will also be tailored to handle specialized maritime communicative scenarios and documents, and intelligent speech recognition could be used in VHF (Very High Frequency) communications to break real-time language barriers between crews and shore bases. Second, more efforts could go into building large-scale, multilingual terminological databases and knowledge graphs. These provide the basic foundation for translation, instruction, and intelligent applications, such as the Maritime English-Chinese Parallel Corpus. Third, service activities might focus on the relationship between standardization and localization, balancing the global regulatory consistency and regional adaptability. Their major task is to produce high-quality translations of international maritime conventions (e.g., International Convention for the Safety of Life at Sea or SOLAS, International Convention for the Prevention of Pollution from Ships or MARPOL), technical standards, and operational manuals that are both linguistically accurate, culturally appropriate, and legally sound. Fourth, scholars should shift their attention to prioritizing cross-cultural maritime communication. It may include designing curriculum programs to improve practical interactional skills of multinational seafarers, port officials, and shipping managers. Language training aims to eliminate communication frictions in diverse professional contexts, and it contributes greatly to advancing the broader discipline of maritime language and culture studies [30].

The above trends reflect the evolution of maritime language services. They have been expected to shift from focusing solely on translation skills to becoming a comprehensive, interdisciplinary domain that intersects linguistic, education, maritime science, information technology, psychology and national strategies. Future research should proactively adapt to industrial changes, such as safe, intelligent, and green shipping. It also needs to engage deeply with global academic frontiers. This multi-dimensional integration is essential for strengthening connections with key industrial strategies, such as IMO's global maritime governance goals. It also helps the field adapt to technological changes in the industry. This convergence plays a constructive role in building a more solid framework for maritime language services. It also advances service content, boundaries, and directions to meet the complex needs of the global maritime industry.

4. Developing an Innovative Model for Maritime Language Services

4.1. Theoretical Basis for the Model

The study proposes an innovative model for maritime language services, which is supported by two theoretical perspectives: language governance and industrial synergy. Language governance theory provides the organizational and political framework for all stakeholders, including the regulatory body IMO and language service providers. Industrial synergy theory provides economic and operational principles for integrating language services into the maritime industry. These two theoretical foundations help develop a coordinated, multi-dimensional approach. This approach addresses the complex needs of the global shipping industry

and supports the development of Shanghai's International Shipping Center.

First, within the dual theoretical framework of the maritime language service innovation model, language governance theory provides a rigorous basis for understanding and organizing the language service ecosystem. Unlike the traditional perspective of language planning, which emphasizes national sovereignty, language governance shifts its focus to the joint cooperation of multiple stakeholders. This multi-stakeholder perspective aligns with the interdisciplinary nature of maritime language services. It may suggest that governance mechanisms include both top-down policy guidance and bottom-up operational demands[30]. This perspective is crucial for conceptualizing the G-I-A (Government-Industry-Academia) tripartite mechanism that consists of the three major participants of the model. It follows that government acts as a strategic facilitator and regulator, industry functions as an essential driver and standard-setter, and academia serves as an engine for knowledge innovation and talent cultivation[31].

Second, the industrial synergy theory provides a theoretical basis for the vertical and horizontal integration of maritime language services in the value chain of the shipping industry. This theory holds that the interaction and collaboration across different industrial sectors generate synergistic effects, yielding outcomes greater than the total of individual contributions[28]. Thus, it is advocated that maritime language services move beyond standalone operations and integrate with the core maritime sectors, such as maritime law, marine insurance and shipping logistics, thus enhancing the overall operational efficiency and value creation of the system[10]. This theoretical foundation further defines the four core pillars: the Strategic Pillar ensures alignment with overarching industrial objectives; the Industrial Pillar drives deep in-depth integration with high-value maritime sectors; the Talent Pillar demands an interdisciplinary talent pool; and the Technological Pillar advances the convergence of linguistic technologies with maritime operational systems.

4.2. The G-I-A Tripartite Collaborative Governance Mechanism

The proposed model centers on the dynamic interactions among government, industry and academia (see **Figure 1**). This tripartite governance mechanism clarifies the respective roles of all parties and cultivates a cohesive, collaborative ecosystem for maritime language services. This framework underpins the achievement alignment, operational efficiency and sustainable capacity building for key stakeholders[32].

In this model, the government acts as a strategic facilitator and regulatory authority, with its role centered on top-level policy design, regulatory provision, and the development of a supportive service ecosystem. This involves formulating targeted national or municipal policies that position language services as critical soft infrastructure for enhancing the overall competitiveness and institutional discourse capacity of a modern shipping center. In practice, this means the government must take responsibility and coordinate multi-stakeholder efforts to support for key infrastructure and ensure the consistent implementation of relevant policies.

Industry acts as an essential demand driver and service co-creator within the ecosystem. Encompassing port authorities, shipping enterprises, logistics companies, and maritime legal and financial institutions, this collectively defines the scope of language services and operational requirements. Industrial stakeholders are in the best position to define language service requirements spanning daily operational needs and global business activities, and actively co-developing industry standards, validating operational protocols, and enhancing the effectiveness of technology adoption. The industry's drive for service innovation is clearly demonstrated by the fact that over 44% of language service providers have actively adopted AI translation technology, leveraging its advantage to advance technology application. Furthermore, by offering practical training opportunities and real-world project data, the industry plays a pivotal role in cultivating future maritime talent and providing practical research platforms for academic institutions.

Academia encompasses universities and research institutions, and plays three critical roles. First, it addresses the talent shortage by developing interdisciplinary training programs to foster future 'maritime language engineers' with integrated linguistic and maritime competencies. These professionals possess solid linguistic proficiency, maritime expertise, industrial experience, and technical capabilities that are essential for meeting the industry's interdisciplinary demands. Second, it undertakes pioneering research on mar-

itime language services. For instance, it explores the application of domain-specific large models to break the barriers in emergency language communication. Third, it provides empirical evidence to inform policy analysis and strategic insight, thereby translating the research outcomes into actionable recommendations for policymakers.

The G-I-A model frames the tripartite synergy as the synthesis of maritime language services into a strategically collaborative asset. Its efficacy hinges on a clear division of workflow where the government sets the strategic vision and policy, industry ensures relevance and practical application of the services, and academia provides talent and knowledge for continuous innovation. It is the collaborative advantage that drives the ecosystem beyond fragmented service functions, making it a real source of empowerment for the shipping center.

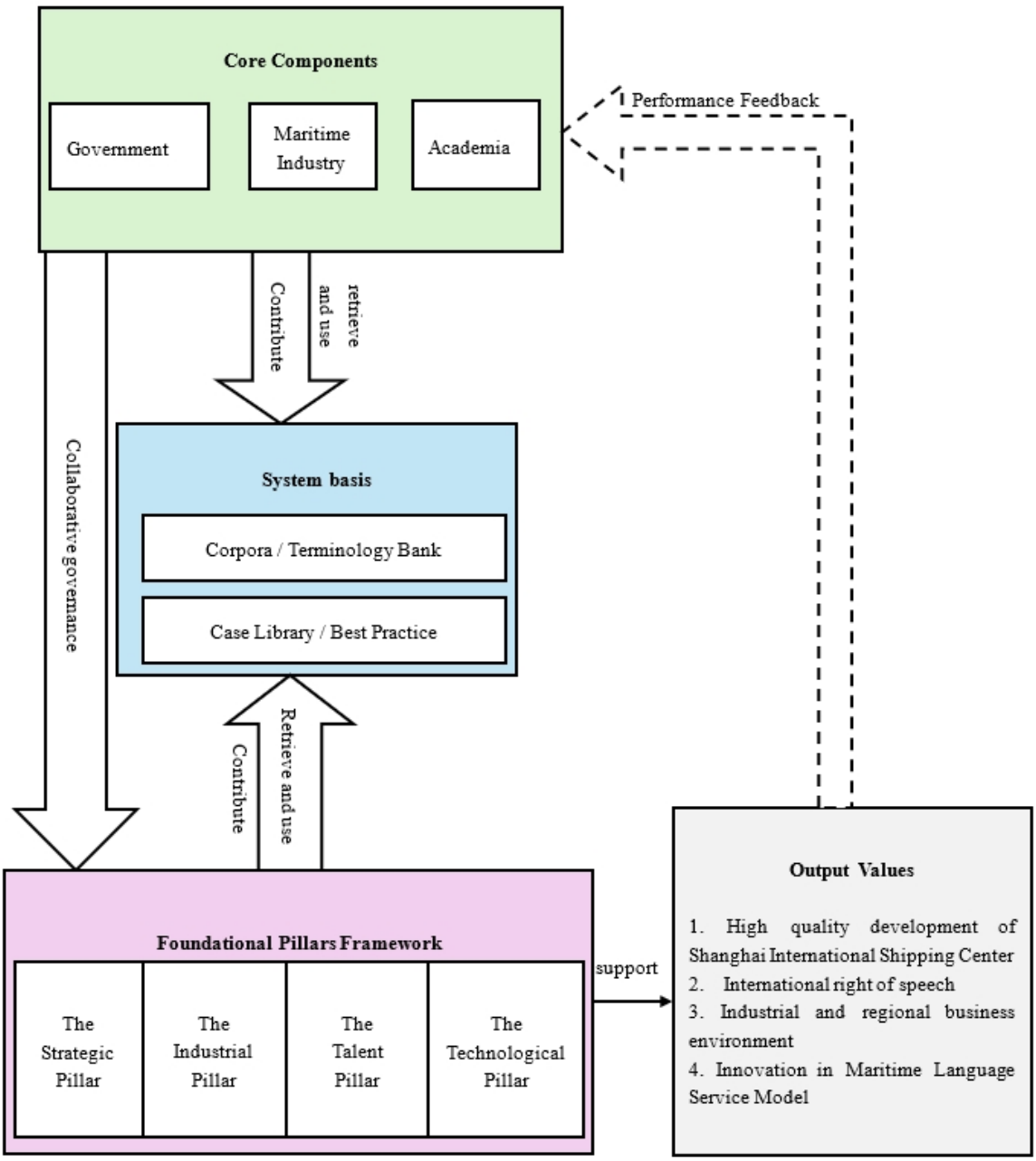

Figure 1. The G-I-A Maritime Language Service Model.

4.3. The Four Foundational Pillars Framework

The model rests upon four interdependent pillars, which constitute the G-I-A governance mechanism. This structure is designed to transform maritime language services from a set of auxiliary services into a cohesive, strategic competitiveness for the international shipping center.

4.3.1. The Strategic Pillar: Mainstreaming into Top-Level Planning

This pillar of the innovative maritime language service model advocates for the strategic integration of professional maritime language services into the national and regional strategic blueprints for shipping center's development. Such planned integration ensures that language support aligns with long-term objectives of shipping center's infrastructure construction, global shipping positioning, and global governance participation, thereby converting the language services into a value link in the chain of shipping centre development. This process requires a paradigm shift in which language capability should not be positioned as an auxiliary service but as a critical soft infrastructure. For implementation, dedicated policies and development roadmaps that explicitly outline objectives for language capacity building objectives on par with those suggested for enhancing the industry's global competence[31]. Additionally, dedicated funding streams and inter-departmental steering committees (spanning transport, commerce, and education ministries) need to be established in order to ensure policy coherence and implementation effectiveness, solidifying language services' role in the high-level strategic decision-making.

4.3.2. The Industrial Pillar: Deep Integration with High-End Services

The industrial pillar calls for synergistic integration of language services with high-value maritime operations, including shipping finance, marine insurance, and maritime law. The goal is to move beyond simple translation to provide advanced and scenario-specific language solutions that integrate into industry workflows. For instance, it may involve reviewing and drafting maritime charter parties, supporting cross-border arbitration, and handling marine insurance claims. Such specialized service content aligns with the observed industry trend where language services are increasingly acknowledged as a vital component of professional service offerings in global trade[30]. The performance of this pillar is thus gauged by the extent to which language services evolve into the fabric of high-end maritime business operations.

4.3.3. The Talent Pillar: Cultivating a "Domain + Language + Technology" Composite System

Targeting the severe shortage of specialized human resources in maritime language services, the talent pillar advocates a talent cultivation mechanism. It calls for a departure from the traditional disciplinary barriers to establish an integrated training system that equips graduates with three core competencies: profound maritime domain knowledge, exceptional bilingual/multilingual proficiency, and adeptness in up-to-date language technologies. Higher education institutes thus need to design interdisciplinary curricula that integrate courses in maritime logistics, maritime law, and marine operations with computational linguistics and translation technologies. Specifically, cultivating talent for international maritime organization language services aligns with the competency requirements of the New Liberal Arts philosophy[31]. Professional competence, including strong interpreting and cross-cultural communication skills, interdisciplinary knowledge, and problem-solving abilities sharpened by simulated work scenarios of global institutions. It also emphasizes establishing continuous educational pathways and industry-university internship bases to ensure a steady supply of talent that adapts to the sector's changing requirements.

4.3.4. The Technological Pillar: Constructing Intelligent Platforms and Corpora

As the technical backbone of the entire maritime language service model, this pillar emphasizes the construction of centralized and intelligent language technology infrastructure. Its core components include a national-level maritime terminological database and large-scale, multilanguage, domain-specific corpora. These resources must follow interoperable standards to enable seamless integration with port management systems, electronic data interchange platforms, and other digital operational frameworks[33, 34]. Additionally, this pillar promotes the development and adoption of AI-assisted intelligent language service platforms, with the corpora resources jointly providing real-time maritime translation, terminology management, and multilingual content generation[33]. Such technological integration is a

key driver of enhancing the efficiency and expandability of language services across the global maritime logistics chain.

5. Pathways and Policy Recommendations

5.1. Standardization and Service Infrastructure Development

The professional advancement of maritime language services depends on the establishment of robust frameworks and foundational service infrastructure. This developmental pathway addresses the critical industrial demand for consistency, quality assurance, and shared resources through two interconnected initiatives that collectively form the backbone of a modern maritime language service ecosystem.

5.1.1. Developing a Maritime Terminological Database and Multilingual Corpora

Establishing a centralized, authoritative maritime terminological database and corresponding multilingual corpora is one prerequisite for ensuring accuracy and interoperability in maritime communications. This development should adhere to a structured and active process. A government-funded project should gather and unify existing terminology resources from industry and academia, and structure the data in accordance with both industrial and linguistic rules. Subsequently, the G-I-A (Government-Industry-Academia) collaborative mechanism facilitates the continuous update of the database, while industrial stakeholders continuously validate new terminology derived from practical operational contexts. Meanwhile, academic partners take the lead in translation, semantic annotation, and contextualization efforts. Lastly, the process involves developing industry-specific software and translation platforms that directly access standardized terminology in operational workflows. The database infrastructure not only could enhance the accuracy and efficiency of maritime communication but also comprehensively support academic research activities in specialized sub-domains like maritime law, shipping logistics chain, and marine engineering.

5.1.2. Establishing Service Quality Standards and Certification Framework

The development of comprehensive quality standards and an independent certification system addresses the fundamental challenges of market fragmentation and quality inconsistency in maritime language services [30]. To advance this initiative, a national working group led by the China Translation Association and comprising industrial practitioners and academic specialists should be set up to formulate a series of relevant standards. Three critical dimensions shall be covered: service procedures across the project lifecycle, competence requirements for different maritime language service positions, and product quality metrics for assessing translated materials' quality and practicality. In parallel with standard development, an independent third-party certification body should be authorized to audit and certify language service providers. To complement this formal certification, a digital client feedback platform should also be established. This integrated approach of standardization and certification has far-reaching significance in driving the professionalization of the maritime language service industry. And it could further establish reliable benchmarks for service excellence across the global maritime sector.

5.2. Service Ecosystem and Collaborative Innovation

The transition toward a platform-based ecosystem represents a strategic evolution in maritime language service delivery, shifting from fragmented, project-based services to an integrated, cross-stakeholder collaborative innovation model. This pathway leverages digital infrastructure to operationalize the G-I-A governance framework, establishing sustainable mechanisms for resource sharing and value co-creation.

5.2.1. A Government-Industry-Academia-User (G-I-A-U) Collaborative Innovation Platform

Establishing a physical-digital hybrid platform is conducive to institutionalizing cross-sector collaboration in maritime language services. This entails creating a centralized hub, termed the "Maritime Language Service Innovation Platform", equipped with clearly defined governance structures and operational protocols. The platform's architecture should also feature a steering committee comprising senior representatives from maritime authorities, leading port and shipping enterprises, academic institutions, and language service user representatives, responsible for setting strategic

priorities and allocating resources. Supported by a dedicated project management office, the platform would facilitate joint research and development initiatives, aligning industry-identified challenges with academic research capabilities and government funding priorities. Critically, the platform must integrate a user engagement mechanism through which frontline operators, vessel traffic service controllers, and maritime arbitrators will directly contribute to validating solutions and refining requirements, thereby closing the gap between theoretical research and practical application.

5.2.2. Resource Sharing and Information Exchange Mechanisms

The platform's efficacy in information exchange rests on the following aspects, namely protocols governing data sovereignty, intellectual property, and knowledge flows. Core to this is implementing a tiered data sharing mechanism that classifies resources ranging from publicly accessible multilingual glossaries to domain-specific operational terminologies. Technically, this requires developing standardized data interchange protocols to ensure interoperability between the platform and existing enterprise systems deployed by shipping companies, ports, and educational institutions. A pivotal component involves establishing clear intellectual property management rules that protect contributors' rights while enabling sufficient openness. Furthermore, the platform should deploy AI-powered matchmaking algorithms to intelligently identify specific language service needs and align appropriate academic expertise and specialized translators with relevant project data resources.

5.3. Reforming for Systematic Talent Cultivation

The establishment of a sustainable talent pipeline is critical for the long-term advancement of maritime language services. This pathway strategically addresses the need for a continuous supply of qualified professionals through a holistic approach that integrates interdisciplinary education, internship training, and career development mechanisms.

5.3.1. Talent Cultivation through Interdisciplinary Integration

Educational institutions are in a unique position to cultivate graduates with the competencies required for maritime language services. In particular, maritime education institutions should establish dedicated programs that encompass three major dimensions: an interdisciplinary framework, maritime knowledge, language proficiency, and technological literacy. As such, these programs must systematically focus on the core competencies required of maritime language service providers. The coursework may include maritime studies, translation and interpretation, and computational linguistics. Meanwhile, curricula have to be tailored to maritime language application contexts, including terminology management, technical writing for shipping documents, and AI-assisted translation. Furthermore, the implementing a micro-credential or certificate system would attract students from diverse academic backgrounds to acquire targeted skill sets in maritime language services, thereby enhancing their employability and adaptability to evolving industry demands. These educational reforms and advancements should be supported by corresponding pedagogical methods that emphasize case-based learning and project work based on real industrial scenarios.

5.3.2. Industry-Academia Collaborative Practice Bases

Systematic collaboration between educational institutions and maritime enterprises could further bridge the gap between theoretical knowledge and practical application demands. Students and junior seafarers can always benefit from immersive learning environments, such as practice bases within ports, and internship opportunities in shipping enterprises. It is also advised that real-world industry instruction be operated under a dual-guidance system [8]. One of its advantages lies in having both industry professionals and academic supervisors jointly mentor students, ensuring that teaching and learning align with both educational objectives and industry standards (see e.g., Wan et al. [35]). The bidirectional instruction approach could also contribute to faculty professional development, enabling instructors to update their professional knowledge and instructional resources. This dual-channel collaboration creates a constant feedback loop between education and practice, ensuring talent training is responsive to industry needs.

5.3.3. Enhancing Career Pathways and Incentive Structures

Clear career development routes with competitive incentive mechanisms are prerequisites for maintaining a

steady supply of professionals within the maritime language services sector. Besides, a certification system can be established by professional associations to recognize different levels of expertise ranging from junior language specialists to senior maritime communication consultants. By implementing this career ladder, various language service roles in maritime organizations are thus open to the qualified talent. It should be emphasized that specialized composite skills are required for posts such as database management, quality assurance, or localization project management. Additionally, recognition incentives celebrating excellence in maritime language services would also enhance professional prestige and attract talent across the industry.

5.4. Technology Enablement and Scenario Implementation

The integration of advanced technologies serves as a critical pathway to enhancing the efficiency, accuracy, and extendibility of maritime language services. This implementation strategy is anchored on adopting intelligent language solutions in critical operational contexts while pursuing synergistic integration with other digital systems.

5.4.1. Implementing Intelligent Language Technologies in Specific Shipping Contexts

Deploying artificial intelligence (AI) and natural language processing (NLP) technologies in maritime language services should prioritize several high-impact maritime operational scenarios. This priority enables a restructuring of language service ecosystem and a manifestation of the value, productivity and growth of such services. Key implementation contexts, such as vessel traffic service (VTS) communications, can potentially enhance seafarers' situational awareness through speech recognition and real-time transcription systems. Meanwhile, real-time communication records should be created for post-incident analysis and training purposes. Another scenario is in maritime law and insurance claim processing, where extensive multilingual documents could be reviewed and analyzed by intelligent agents. In this context, relevant legal precedents and potential inconsistencies should be sought out for reference. In maritime language education settings, AI-augmented writing assistants could be used to train students and junior seafarers in creating a variety of maritime regulatory documents and ship manuals. These frontline uses of language service technologies will solve real-world problems while promoting the advancement of such technologies. Furthermore, operational data and user feedback could contribute to the optimization of the evolution of such technologies.

5.4.2. Fostering Technology Fusion and Innovation

The close integration of language technologies with core maritime digital systems serves to create unified operational environments for the shipping industry, such as ECDIS (Electronic Chart Display and Information System) and vessel monitoring tools. Such technological advancement and integration could be further optimized through relevant language services applied in operational scenarios [33]. The innovative capacity within digital maritime ecosystems will reduce linguistic and technical barriers across diverse maritime operational scenarios.

6. Conclusions

This study proposes a language service model for Shanghai's International Shipping Center, which fundamentally depends on the robust delivery of high-quality language support. Centered on Government-Industry-Academia (G-I-A) collaboration, the model is supported by four core pillars: strategic positioning, industrial integration, talent cultivation, and technological empowerment. It also demonstrates the necessity for maritime language services to evolve from peripheral support into a strategic component of the International Shipping Center's soft infrastructure. The proposed G-I-A model addresses the policy-practice disconnect and associated operational risks, providing a systematic pathway for multi-stakeholder collaboration. This study also provides approaches to translate language services into actionable policies and practices. This study concludes that only synergistic efforts in these core areas can enhance the operational safety, efficiency and competitiveness of the shipping center.

The theoretical contribution of the study lies in two aspects: First, this research enriches the language service studies by applying and advancing the theoretical foundation of language governance to the maritime domain. It suggests that the research perspective of maritime language services should move beyond a narrow, translation-centric view of language service models. Instead, maritime language ser-

vices should act as a critical synergistic component of the shipping industry and a driving force for regional economic ecosystems. Second, the model provides a novel analytical perspective for dissecting and facilitating stakeholder collaboration at the implementation level. The analysis and restructuring of complex stakeholder relationships and resource dependencies explicitly highlight the necessity of building the sector-specific language capacity. Theoretically, the model redefines sector-specific language capacity as a common-pool resource that generates value through structured collaboration, thereby directly addressing the implementation gap identified in previous studies.

This study advances maritime language service research conceptually by introducing a novel Government-Industry-Academia (G-I-A) collaborative governance model, which reframes the domain's core problems and solutions. Conceptually, it shifts the analytical focus from discrete descriptions of macro-level policies or micro-level communicative failures towards a meso-level governance ecosystem. It transcends the critical diagnosis of the "policy-practice disconnect" by reconceptualizing maritime language services not merely as a cost of compliance but as a productive strategic infrastructure integral to operational safety and competitiveness. Rather than offering another descriptive analysis, the model provides a prescriptive and integrative framework that structures the synergistic advancement of strategic positioning, industrial integration, talent cultivation, and technological empowerment. Thus, it moves the field beyond identifying "bottlenecks" to theoretically proposing "strategic pathways" for robust, sector-specific language capacity building.

In practice, this study offers a clear strategic roadmap for stakeholders to carry out maritime language services for the construction of the international shipping center. It provides governments with decision-making suggestions for policy intervention and strategic investment in language infrastructure, including maritime terminology databases and standardization verification. For industry stakeholders, this research outlines methods for strengthening language capabilities to enhance operational efficiency, mitigate risks, and consolidate competitive edges in global competition. For academic institutions, the model identifies key directions and thus assists in understanding the role of interdisciplinary curriculum reform and its applied research. It offers insights into the cultivation of specialized maritime language service talents and closing the critical gap in the supply of such professionals. Taken together, the study has significant implications: the practical value of language services can extend to national strategic interests. It demonstrates how to operationalize the macro-level policies analyzed in earlier studies and mitigate the well-documented micro-level challenges, thereby providing a transferable framework for other global, specialized multilingual industries. These efforts will elevate the nation's discourse power in international maritime affairs, thereby securing the construction of the Shanghai International Shipping Center and enhancing China's influence in the rule-making processes that shape global shipping.

This study is primarily conceptual and exploratory, and its theoretical model requires verification through large-scale evaluation and empirical case validation. Future research could prioritize two directions: first, the quantitative measurement of the model's impact on key performance indicators of the shipping center; second, further exploring tailored AI implementation for digitalized language service architectures.

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Data Availability Statement

The data supporting the findings of this study are obtained from the previously published literature, which are fully cited in the reference list.

Conflicts of Interest

The author declares no conflict of interest.

AI Use Statement

During the preparation of this work, the author used DeepSeek for grammar correction and spell checking. The author subsequently reviewed and edited the content as necessary and takes full responsibility for the final content of the published article.

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