Research on the Competence Improvement Path of Public Administration Undergraduates Serving Marine Science and Technology Innovation: Based on a Policy Text Analysis

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Abstract. Against the integration of China's marine power and innovation-driven strategies, marine science and technology (S&T) innovation has become a core pillar of high-quality national development. As a systemic project, it requires compound and professional competence of public administration talents. To address policy demands and talent cultivation pain points, this study analyzes 100 marine S&T innovation policy texts via Nvivo12 to identify three-dimensional demands: governance capacity, ecological coordination, cutting-edge interdisciplinary integration. Combined with McClelland's Iceberg Model, a benchmark competence system is constructed, including explicit capabilities (policy analysis and text transformation, organizational coordination and project management, digital and intelligent tool application) and implicit qualities (national strategic service motivation, collaborator role identity, public value ethics, cross-cultural communication). Targeted paths are proposed from curriculum learning, practical training and value cultivation, providing empirical references for talent cultivation and governance talent supply in marine S&T innovation.

Keywords: Public administration undergraduates; Marine science and technology innovation; Competence; Policy text analysis; Iceberg Model

1 Introduction

The integration of China's marine power and innovation-driven strategies has positioned marine S&T innovation at the core of high-quality development. It is a complex systemic project involving policy transmission, multi-stakeholder coordination and international governance, also raising a key question: what capabilities do public administration undergraduates need to contribute to marine S&T innovation?

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Practical demands are clear: policy implementation needs text interpretation, innovation ecosystem construction relies on organizational coordination, and technological iteration calls for value judgment. Industries such as offshore wind power and shipbuilding urgently need compound talents with international standards and professional technology expertise[1]. The New Liberal Arts initiative drives liberal arts students from "bystanders" to in-depth participants in S&T innovation, highlighting the irreplaceable role of public administration talents. However, existing research only macro-discusses liberal arts-S&T innovation adaptability, with fragmented studies on undergraduates and a lack of policy text-based demand disaggregation, leading to inoperable competence improvement paths[1].So this study disaggregated talent demands based on policy text analysis and explored targeted improvement paths by drawing on McClelland's Iceberg Model ,which aims to provide empirical support for public administration talent cultivation reform and a reference for undergraduates' capacity development.

2 Concepts and Theories

2.1 Marine Science and Technology Innovation

Marine S&T innovation refers to innovative activities carried out in the marine field with the goal of creating new knowledge and technologies and realizing economic, social and ecological values [2]. It is a systemic project involving industry-university-research collaboration, international cooperation and policy support. It requires public administration talents as system architects and value guardians to coordinate multi-dimensional goals.

2.2 Competence Model

Adopting McClelland's (1973) definition, competence is the underlying characteristics distinguishing outstanding and average job performance[3]. His Iceberg Model divides competence into explicit characteristics (knowledge, skills) and implicit characteristics (social roles, self-concept, motives), with the latter driving individual behavior fundamentally[4]. This study focuses on public administration undergraduates' basic practitioner qualities—the essential and operable knowledge, skills and literacy for responding to marine S&T innovation's demands.

3 Literature Review

3.1 Liberal Arts Talent Cultivation and S&T Innovation Adaptability

The New Liberal Arts transforms liberal arts talent cultivation from knowledge imparting to compound capacity development. Fan (2020)[5] emphasized breaking

[1] Ministry of Natural Resources, National Development and Reform Commission, Ministry of Industry and Information Technology, et al. Guiding Opinions on Promoting the Large-scale Utilization of Marine Energy [EB/OL]. (2025-02-26)

disciplinary silos and enhancing S&T innovation participation awareness; Mi & Wu (2024)[6] proposed that New Liberal Arts talents need to possess digital literacy and the ability to apply intelligent tools; Xue (2026)[7] advocated integrating data analysis and AI into liberal arts education. The above studies have reached a basic consensus: New Liberal Arts talents need both humanistic literacy and technical practical capabilities to participate in S&T innovation as core participants.

3.2 Demand for Compound Talents in Marine S&T Innovation

The academic community unanimously recognizes the urgent demand for compound talents in marine S&T innovation. Zhang & Wang (2025)[8] argued that developing new marine productive forces relies on improving marine labor quality and cultivating technological compound talents; Liu (2025)[9] emphasized deepening industry-university-research collaboration and expanding the "international blue partnership".

3.3 Competence Research on Public Administration Talents

Competence theory has a mature application framework in public administration. Besides McClelland's Iceberg Model[3] as the basic evaluation framework, Xu et al. (2022)[10] constructed a professional competence evaluation index system for public administration undergraduates using the Analytic Hierarchy Process (AHP).

In summary, existing research has explored liberal arts-S&T innovation adaptability, marine talent demand and public administration competence, but has three deficiencies: (1) studies targeting public administration undergraduates are fragmented; (2) lack of policy text-based demand disaggregation; (3) no refined competence improvement paths for undergraduates. Based on this, this study focuses on public administration undergraduates, takes 100 marine science and technology innovation policy texts as the analysis object, uses content analysis to identify the characteristics of policy demands, constructs a competence element system combined with the Iceberg Model, and proposes targeted promotion paths. It is expected to provide theoretical support and practical guidance for public administration talent cultivation .

4 Research Design

4.1 Data Source and Research Method

This study selected 100 marine science and technology (S&T) innovation policy texts released in recent years by central authorities (e.g., the State Council), local governments of coastal provinces and cities (e.g., Shanghai, Qingdao), and industrial organizations (e.g., China Association of the National Shipbuilding Industry) as research objects. These texts cover key areas including policy formulation, project management, industrial development, and resource guarantee, ensuring the authority and representativeness of the data.

Quantitative analysis method of policy texts[11] was adopted. First, Octopus crawler technology was used for batch crawling and sorting of policy texts, with invalid and duplicate texts excluded. Subsequently, Nvivo12 software was employed for text coding and word frequency statistics.

4.2 Generation of Word Frequency Statistics Table

Nvivo12-generated word frequency statistics (Table 1) show "Ocean" (2.74%) as the core word, with "Development" (1.40%), "Industry" (1.06%), "Technology" (0.92%) and "Innovation" (0.87%) depicting a policy landscape of industrial upgrading and technological innovation. Notably, the appearance of "Management" (0.29%) and "Service" (0.45%) provide textual evidence for public administration's involvement in marine S&T innovation.

Table 1. Word Frequency Statistics of Marine S&T Innovation Policies

Word	Count	Weighted %	Word	Count	Weighted %
Ocean	3994	2.74	Field	526	0.36
Development	2045	1.40	International	509	0.35
Industry	1538	1.06	Platform	509	0.35
Construction	1380	0.95	Carry out	501	0.34
Ship	1357	0.93	R&D	489	0.34
Technology	1334	0.92	System	472	0.32
Innovation	1267	0.87	Ecosystem	463	0.32
S&T	1113	0.76	Key	453	0.31
Economy	948	0.65	Green	442	0.30
Enterprise	881	0.60	Cooperation	430	0.30
Equipment	749	0.51	Resource	429	0.29
Promote	722	0.50	Management	424	0.29
Project	721	0.49	Manufacturing	394	0.27
Accelerate	687	0.47	Implement	393	0.27
Service	656	0.45	Build	393	0.27
Enhance	650	0.45	Research	389	0.27
Strengthen	645	0.44	Level	375	0.26
Advance	637	0.44	Center	356	0.24
Support	635	0.44	National	345	0.24
Intelligent	612	0.42	Port	332	0.23
Application	585	0.40	Product	330	0.23
Engineering	567	0.39	Guarantee	329	0.23
Key point	546	0.37	Design	327	0.22
System	544	0.37	Unit	323	0.22
Capacity	540	0.37	Quality	317	0.22

5 Results and Discussion

Based on word frequency statistics, three-dimensional demands of marine S&T innovation for public administration talents are identified.

5.1 Governance Capacity Demand

Governance-related words ("Service":656, "Management":424, "Cooperation":430, "International":509) show China's marine S&T innovation aims to build a systemic project of public services, industrial governance and cross-border cooperation. This dimension requires three capabilities: (1) public policy interpretation capacity—to accurately understand strategic intentions and transform them into implementation plans; (2) organizational coordination capacity—to balance interests in the innovation ecosystem with the participation of multiple stakeholders; (3) international communication capacity—to communicate effectively in global marine governance.

5.2 Ecological Coordination Demand

Ecological words ("Enterprise":881, "Platform":509, "Ecosystem":463, "System":472) outline a government-guided, enterprise-dominated, market-oriented innovation ecosystem. This dimension demands: (1) resource integration capacity—to promote the efficient allocation of innovation elements; (2) platform construction capacity—to design and optimize carriers for the transformation of scientific and technological achievements; (3) coordination mechanism optimization capacity—to understand and improve the interaction mechanism among stakeholders[12].

5.3 Cutting-edge Interdisciplinary Demand

Cutting-edge words ("Green":442, "Intelligent":612, "Guarantee":329) highlight marine S&T innovation's mission to drive green economy, apply intelligent technologies and safeguard national security. This dimension requires interdisciplinary capabilities: (1) scientific and technological literacy—to understand the technical logic of artificial intelligence, big data and other technologies; (2) digital skills—to master data processing and the application of intelligent tools; (3) ethical judgment—to remain sensitive to algorithm ethics and data security; (4) risk analysis—to undertake emerging functions such as ethical review and risk assessment.

6 Competence System and Promotion Paths

6.1 Competence Element System

Based on the three-dimensional demands proposed in the previous section and combined with McClelland's Iceberg Model, a seven-element competence system is constructed (Figure 1).

Explicit capabilities focus on the practical operation of policy implementation and digital tools, specifically including: policy analysis and text transformation capacity, which refers to disaggregating macro strategies into implementable tasks; organizational coordination and project management capacity, which involves coordinating resources and promoting project implementation in multi-stakeholder collaboration; and digital and intelligent tool application capacity, which uses data and AI to support scientific decision-making.

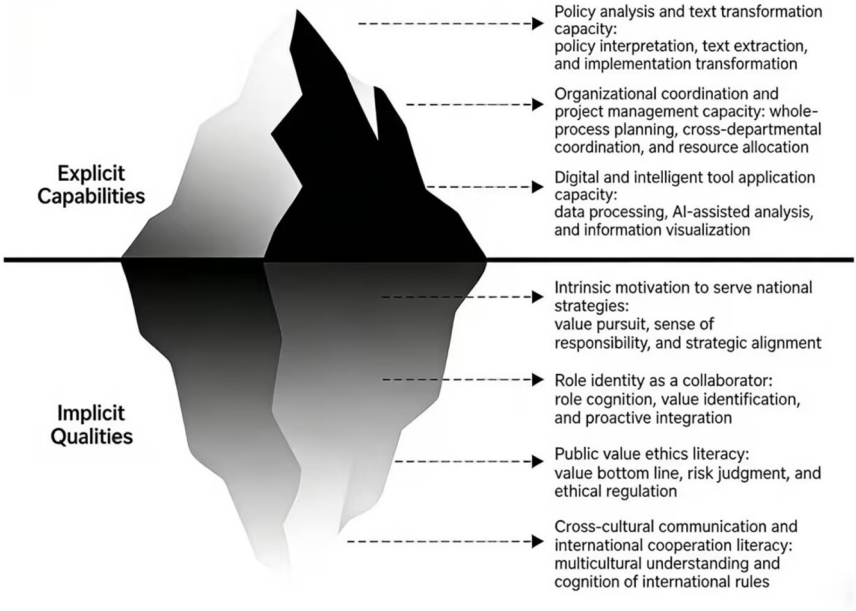

Fig. 1. Competence Elements and Related Connotations

Implicit qualities focus on the driving level of value identification and strategic thinking, mainly reflected in: intrinsic motivation to serve national strategies, derived from a profound recognition of building a strong science and technology country; role identity as a collaborator, which means abandoning the mentality of "liberal arts bystanders" and proactively integrating into innovation teams; public value ethics literacy, which balances technical rationality with humanistic values; and cross-cultural communication and international cooperation literacy, which involves possessing the vision and ability to participate in global scientific and technological governance.

6.2 Self-promotion Paths

Three targeted improvement paths are proposed based on the competence system:

1.Curriculum learning path. Undergraduates should take the initiative to select courses related to the three modules of "policy analysis and text interpretation", "project

management", and "digital technology and intelligent tools". The policy analysis module can strengthen strategic interpretation capacity, the project management module can improve practical operation level, and the digital technology module can help master data analysis and AI tool application.

2.Practical training path. First, actively participate in university-government-enterprise collaborative practice, strive for internship opportunities in marine-related government departments, and engage in policy research and document drafting. Second, take part in project training in marine-related enterprises to exercise organizational coordination capacity in real scenarios. Finally, join interdisciplinary innovation teams to improve coordination capacity through collaboration with science and engineering students.

3.Value cultivation path. Public administration undergraduates should not only take general education courses on marine strategies and public values to strengthen the concept of national marine rights and interests and the concept of sustainable development, but also participate in special seminars on scientific and technological ethics to cultivate sensitive judgment on algorithm ethics and data security. Ideally, they should strive for opportunities to participate in international exchange programs to cultivate a global vision and cooperation literacy through cross-cultural practice.

7 Conclusion

Marine S&T innovation is a systemic project driven by technological breakthroughs, institutional innovation and governance optimization, and public administration undergraduates are an important reserve force for marine governance modernization. This study addresses the deficiencies of existing research and provides specific guidance for undergraduates to enhance marine S&T innovation service capacity, enabling their role transformation from "bystanders" to "participants" and "drivers" of S&T innovation. The study also offers empirical support for New Liberal Arts-based public administration talent cultivation and marine S&T innovation governance talent supply. Future research can expand policy text samples, introduce empirical research and follow-up evaluation to optimize the competence model and paths, providing more solid talent support for China’s marine power strategy.

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