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# Study on the policy diffusivity of China's marine strategic science and technology power building based on LDA modelling

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The world's maritime countries are competing for the strength of marine science and technology. Throughout the world, the systematic construction of marine strategic scientific and technological strength has become a decisive factor in marine scientific and technological competition, and it is an inevitable choice for China to cope with marine scientific and technological competition. As far as science and technology policy is concerned, the efficiency of policy supply directly affects the effect of science and technology implementation. Therefore, it is urgent to clarify the mechanism of policy diffusion that influences the development of marine strategic scientific and technological forces. This paper employs a case study approach to examine the diffusion characteristics of China's marine science and technology policies. The analysis is based on the marine science and technology policies issued by the Chinese government at the central, provincial and municipal levels since 2002. The study employs an LDA model and text-mining techniques in the R language to construct a comprehensive understanding of the diffusion process. The study reveals that China's marine science and technology development policies exhibit a top-down diffusion trend. Furthermore, the implementation intensity and responsiveness of lower-level governments to higher-level policies are increasing. The diffusion of policy themes displays clear temporal characteristics, with policies undergoing continual refinement in the context of top-down content diffusion. However, there is less interaction between bottom-up policies. In this regard, we should improve the overall effectiveness of the marine strategic scientific and technological strength policy system, optimize the policy diffusion mechanism of marine strategic scientific and technological strength, and strengthen the construction of a public participation consultation system to strengthen the overall play of China's marine strategic scientific and technological strength.

KEYWORDS

**strategic maritime science and technology forces, policy diffusion, LDA modeling, maritime power building, marine policy**

# 1 Introduction

Since the twenty-first century, marine science and technology have entered the forefront of global scientific and technological competition, and the world's marine powers have formulated marine science and technology development strategies that are in line with the characteristics of each country. The marine science and technology policy of the United States focuses on the monitoring of the marine environment, deep-sea exploration, marine security, and sustainable development of the marine and other hot topics. Russia's marine science and technology policy focuses on marine military, polar research, marine ecological protection, marine transportation, and other fields. The European Union focuses on ocean observation, maritime biology, polar research, and other aspects. Japan focuses on issues such as marine security, Arctic research, marine environment, and maritime surveillance. Australia focuses on marine sovereignty and security, marine ecosystems, climate change, and so on. Strengthening marine strategic scientific and technological strength is an important support for the construction of a strong marine power. How to improve the system of marine strategic scientific and technological strength has become the focus of attention in the political and academic circles.

Marine science and technology policy has become an important supporting element to promote the development of marine science and its technology innovation. In 2008, the introduction of "the National Plan for Promoting Marine Science and Technology (2008-2015)" marks that the construction of China's marine strategic science and technology strength system has entered the stage of overall planning and systematic promotion. In 2016, General Secretary Xi Jinping pointed out at the National Science and Technology Innovation Conference that "National laboratories are vital to strengthening the country's strategic scientific and technological power". In 2017, the report of the 19th National Congress of the Communist Party of China (CPC) emphasized that "the construction of the national innovation system and the strategic scientific and technological power should be strengthened", which marks China's strategic capacity in science and technology become the commitment at the national level. In 2021, "the National 14th Five-Year Plan" proposed to "accelerate the construction of a strategic scientific and technological strength led by national laboratories". In 2022, the report of "the 20th National Congress" of the Communist Party of China (CPC) proposed to "implement the innovation-driven development strategy and strengthen the national strategic scientific and technological power". On the road to development in the new era, it is necessary to continuously enhance the marine strategic science and technology strength and add impetus to improve the system. In 2024, when attending the plenary session of the delegation of the People's Liberation Army (PLA) and the Armed Police Force (APF) at the Second Session of the 14th National People's Congress (NPC), General Secretary Xi Jinping emphasized that "it is necessary to outstanding development point, focus on the implementation of strategies and plans related to the building of strategic capabilities in emerging fields, enhance the capability of comprehensive ocean management". This provides ideological guidance and action guidelines for us to build a national strategic scientific and technological strength in the field of oceans and fully promote the construction of a maritime power in the new era. Since entering the 21st century, a series of marine science and technology policies have been issued by both the central government and the regional government, focusing on building a marine strategic science and technology strength as well as making breakthroughs in key technologies in the field of marine science and technology, which have made great contributions to supporting the construction of marine power. At present, China's marine science and technology is leading the marine economy to achieve new leaps with an upward trend, but there is still a significant gap between the marine science and technology strength of the developed countries in the world. For example, the Chinese tuna industry faces technical challenges, including the difficulties involved in the preservation process and the limited extent of deep processing. This has resulted in a relatively short and limited domestic supply chain, with China at the end of the international market chain. The high-end fresh and refined products markets for tuna have been dominated by foreign enterprises for an extended period. Additionally, there is a notable issue regarding the control of key technical equipment by external entities. A similar situation is evident in Antarctic krill fishing, where China has developed a state-of-the-art krill fishing and processing vessel. Yet, key components such as pumping systems necessitate imports. Facing challenges such as the lack of independence of key marine technologies, the weak capacity for original innovation, and the talent shortage, it is necessary to master the "bottleneck" technology in the field of marine strategic science and technology, track critical technology routes and the development trends of developed countries. In this process, achieving a great leap forward development of marine technology innovation, which enables China to catch up with or even surpass the marine technology level of Western developed countries in accelerating the process of building maritime power, has become a practical problem that China urgently needs to solve. In this process, marine science and technology policy, as a kind of public policy, undoubtedly exerts a far-reaching influence on the enhancement of the strength of marine science and technology in China and the realization of its leap-forward development. This is especially true in the context of the government-led management system in China, wherein government policy plays a pivotal guiding role in marine science and technology innovation and serves as a critical means to coordinate the input of marine science and technology elements. The government's strategic allocation of resources, including human capital and production tools, is instrumental in directing investment towards areas with the greatest development prospects and investment value. This approach is expected to catalyze the growth of emerging marine industries and high-tech industries, propelling continuous updating and iteration within these sectors, thereby accelerating the nation's leap-forward development in the field of marine science and technology.

The characteristics of China's "ocean" governance determine that the grass-roots unit plays a crucial role in the implementation

of the central policy. The policy of marine strategic science and technology strength from the top-level design to the implementation at the grassroots level requires comprehensive policies and coordination among departments at all levels. The top-down diffusion of policies should ensure that they can reflect the responsibilities of each department according to local conditions, while ensuring that their goals and styles align with central and local policies. It is against this backdrop that facing the strategic need to promote high-quality development of the marine economy and relies on innovation to drive a maritime power, there is an urgent need for significant breakthroughs in marine science and technology innovation, and the formulation of scientific and effective marine strategic science and technology policy is very critical to promote the comprehensive enhancement, progress, and development of marine strategic science and technology power. In this paper, the policies of marine strategic science and technology strength building issued by the central government, ministries and commissions, provinces, and municipalities from 2002 to 2024 were chosen as the research samples. Based on the text mining technology of R language, deeply exploring the policies for building marine strategic scientific and technological strength at the national, ministerial, provincial levels, finding out the themes of various policies by using the LDA model, and analyzing the focus and trend of them, then further discovering the interactive relationship and the evolution route between policies at different levels aim to put forward targeted policy recommendations for the further development of China's strategic marine science and technology strength.

The remainder of this paper is organized as follows: In Section 2, we review the relevant literature. In Section 3, we analyze the current situation of China's policies of marine strategic science and technology forces from national, provincial, and municipal perspectives. In Section 4, we propose the model and its assumptions. In Section 5, we show the results of the model by utilizing the data of the last 22 years. In Section 6, we give concluding remarks and suggest directions for future work.

## 2 Literature review

The strategic scientific and technological power of the oceans has become a decisive factor in the international competition over the oceans, covering a wide range of fields and with a strong interdisciplinary character. Existing research has focused on four main areas: ecological and environmental governance, the marine economy, scientific and technological innovation, and international law.

In terms of ecological and environmental governance, many researchers have advocated the establishment of marine ecological and environmental accountability mechanisms from the governmental perspective (McNelis and Schweitzer, 2001), the strengthening of integrated government management (Young et al., 2007), and the realization of the value of ocean management (Ottersen et al., 2011) to address the marine ecological crisis. Mei et al. (2018) have examined the sustainable development goals from several perspectives. The study shows that sustainable development of the oceans cannot be achieved without achieving other sustainable development goals. A collaborative systems project, such as the sustainable building of biodiversity (Morgera and Ntona, 2018), must be undertaken by many sectors from different perspectives.

On the ocean economy, Mao et al. (2023) suggests, from the perspective of balancing economic and social benefits, combining ocean carbon sinks with carbon trading, making full use of the strategic advantage of "blue carbon", establishing an "ecological compensation mechanism for ocean carbon sinks" (Li et al., 2023), and using its potential to promote the development of industries related to the ocean economy.

Furthermore, some scholars posit that science and technology innovation function as a mediating variable, and that technological innovation plays a pivotal role in fostering the high-quality development of regional economies (Li and Hu, 2021). To enhance the level of regional technological innovation, it is necessary to improve the endowment conditions and allocation efficiency of technological innovation factor investment (Wang and Yang, 2020). The development of marine science, technology and innovation policies have the potential to exert a significant impact on the long-term and short-term growth of the marine economy (Wu et al., 2020).

Chen et al. (2023) examine the effectiveness and sustainability of strategic scientific and technological forces in the oceans from the perspective of international law. Emphasizes the need for more effective ocean governance through the establishment of robust legal mechanisms, ongoing dialogue, and the development of international frameworks to ensure effective and sustainable management of marine resources in the face of technological advances and global environmental threats (Rozwadowski, 2021). Nevertheless, global ocean governance is still afflicted by a multitude of deficiencies, including vague governance concepts and imperfect governance systems (Jin and Cui, 2023). The diffusion of strategic scientific and technological power in the oceans seems to be more complex in the context of dual intergovernmental interactions and games, both vertically and horizontally.

The theory of policy diffusion was initially proposed by the American scholar Jack (1969). In the 1980s, the American scholar Rogers (1983) proposed a theoretical framework for understanding the diffusion of public policy innovation. Rogers argued that policy diffusion is the process of multiple exchanges of public policy innovation activities among the members of a social system through certain channels. Rogers' framework was based on summarizing and reflecting on the research results of public policy innovation and public policy convergence. Since then, foreign scholars have begun to pay increasing attention to the development process of policy diffusion in terms of time, space, and organizational hierarchy. Among the various diffusion patterns identified by Berry (1994) are national interaction, regional diffusion, leadership follow up, and vertical influence. Marsh. and Sharman (2009) and other scholars posit that the primary motivators of policy diffusion are learning, competition, coercion, and imitation. Brown and Cox (1971) and others provide a summary of the characteristics of

policy diffusion, which can be described as an S-shaped diffusion curve in time, a spatial proximity effect, and a "leader-follower" cascade effect within a region. These significant findings have significantly contributed to the refinement of the theory of policy diffusion. The end of the Cold War saw a proliferation of studies on national strategic power, which became increasingly diverse (Anthony and Thomas, 1982). National strategic power gradually assumed an important place in the political life of many countries (Edward, 1972). The advent of the twenty-first century has witnessed the emergence of a novel phenomenon, namely the policy proliferation feature of strategic scientific and technological forces in the oceans and seas. Doloreux and Melancon (2009) highlighted the necessity for the strategic scientific and technological forces of the oceans to focus on the resolution of "neck-breaking" technologies in the field of the oceans, the enhancement of the original innovation capacity, and the promotion of the in-depth integration of industrial innovation capacity. This research also posits that scientific research institutions are the primary source of original innovation and advocates for laboratories to play a pivotal role in the systematization of strategic scientific and technological forces in the oceans. Zhang and Zhu (2019) examine the mechanisms of policy diffusion in China from the perspective of directed binary event history analysis. Indeed, the phenomenon of policy proliferation can be attributed to interdependence (Maggetti and Gilardi, 2016). It is, therefore, crucial to pay close attention to the coordination and linkage of the constituent entities and to gather the advantageous resources of all parties for synergistic development. This will ensure that the strategic scientific and technological forces of the oceans are full of vigor and vitality (Bertolt, 2016). In the context of the construction of strategic marine science and technology forces, Dedehayir et al. (2018) highlighted the need to address the issue of weak original innovation capacity. He emphasized the importance of integrating and optimizing the allocation of various types of scientific and technological resources, focusing on key core technologies related to the sea. This process involves the complex network of various innovation bodies, with each subject influenced by several factors. In this process, the complex network formed by the interconnection and interaction of various innovation subjects is affected by numerous factors (Li et al., 2021). It is, therefore, necessary to optimize the influencing factors to improve the overall effectiveness of the strategic scientific and technological force system of the ocean.

A review of the research conducted by scholars on the policy of building strategic scientific and technological forces in the oceans reveals that, although the angle of the research are different, all of it emphasizes the need to strategically plan the oceans from the perspective of an institutionalized layout. The program has yielded fruitful outcomes in the domains of policy evolution and characterization and has amassed expertise in qualitative evaluation. Nevertheless, several challenges remain. Firstly, the strategic scientific and technological forces in the oceans are characterized by a high degree of uncertainty and a scope of influence that is more difficult to define. Second, the diffusion mechanism of maritime strategic S&T power policy is the interaction of multiple mechanisms, which makes the dual intergovernmental interactions and games of the diffusion mechanism, both vertically and horizontally, even more ambiguous. Based on the theoretical assumption of hierarchical policy diffusion, this paper focuses on the relationship between the central government, national ministries, and local governments in the policy diffusion of marine strategic S&T forces and their interaction process, empirically examines the change of policy content in the policy transmission process, and analyzes the characteristics of China's policy diffusion of marine strategic S&T forces by condensing and comparing the policy concerns and focus.

## 3 Analysis of the current situation

The marine strategic science and technology strength is an important support and main driving force for promoting the construction of an ocean power, and plays a decisive role in key areas such as China's maritime security, maritime competition and economic development. Taking General Secretary Xi Jinping's important exposition on building a strong marine power as a fundamental guideline, many coastal provinces and cities in China are further expanding the focus and breakthrough point of development to the marine field, seizing the commanding heights of marine development, and making new historic achievements in the construction and development of marine strategic science and technology strength.

From the perspective of policy introduction, a total of 40 policies with significant guidance and direction on marine strategic scientific and technological strength have been issued at the national and ministerial levels since the 16th National Congress of the Communist Party of China, involving the Central Committee of the Communist Party of China, the State Council, the Ministry of Natural Resources, the Ministry of Ecology and Environment, the Ministry of Science and Technology, the National Development and Reform Commission, the Ministry of Agriculture and Rural Affairs, the Ministry of Transport, and the China Coast Guard. The contents of the policies are constantly being refined, and a systematized pattern of marine strategic science and technology strength is steadily being formed. A systematic pattern of scientific and technological forces has been steadily formed, such as "the Outline of the National Plan for Marine Development by Reliance on Science and Technology" issued by the State Council, "the 14th Five-Year Plan for Marine Ecological Environmental Protection" issued by the Ministry of Ecology and Environment (MEE) and six other departments, and "the 14th Five-Year Plan for the Development of the Marine Economy" issued by the National Development and Reform Commission. Under the guidance of the central government, local governments have introduced a series of policies that meet their own development needs, for example, Hainan Province issued "the 14th Five-Year Plan for the Development of Marine Economy", Guangxi Zhuang Autonomous Region issued the "Strategic Plan for the Development of Guangxi's Maritime Economy (2021-2035)", Guangdong Province issued "the 14th Five-Year Plan for the Development of Guangdong's Marine Economy", etc.

From the viewpoint of policy content, through a review of the existing policies of the central government, ministries,

commissions, provinces, and municipalities, it is found that the policies involve the marine economy, marine industry, marine ecology, marine biology, marine engineering, and so on, and they concern more widely, while the connotation of the policies on marine strategic scientific and technological strength is constantly being enriched (Table 1). Specific types of policies include marine resources development, the cultivation of marine talents, the marine environment monitoring, the construction of marine science and the technology infrastructure, sea-related basic research, and transformation of marine scientific achievements.

Overall, since the 16th National Congress of the Communist Party of China (CPC), the policy of building marine strategic scientific and technological strength has shown a top-down diffusion trend. Local governments have actively responded to the central government's policies, strengthening the implementation and shortening the response time. The degree of coincidence between the policy text and the policy focus is high, and the similarity between policy focuses is high, mainly focusing on scientific and technological innovation, marine industry, marine ecology, etc. As shown in Table 2, from the perspective of national level, provincial level and municipal level, the three policy elements: scientific and technological innovation, marine industry and marine ecology are constantly refined with the downward level and become easier to implement for grass-roots government departments.

# 4 Study design

## 4.1 Model construction

LDA (Latent Dirichlet Allocation) is a document topic generation model. It is also known as a three-layer Bayesian probabilistic model, which contains a three-layer structure of text, topic, and vocabulary. The LDA model enables the construction of a mapping relationship between text, topic, and vocabulary. Based on the constructed policy topics, it is possible to ascertain the changes of different policies over time and to determine the intensity of policy topics, which in turn allows the attention and research intensity of policies to be gauged. This enables the diffusion of policies to be reflected.

The LDA formula can be expressed as a Bayesian probability model, as follows:

$$P(w, z|\alpha, \beta) = \prod_{k=1}^{K} \frac{\Delta(nk_k + \beta)}{\Delta\beta} \prod_{m=1}^{M} \frac{\Delta(nm_m + \alpha)}{\Delta\alpha} \quad (1)$$

In Equation 1, the parameters $\alpha$ and $\beta$ are *a priori*, in that they are set before the model is run. The symbol k denotes the total number of topics, while *nkk* represents the observations for each word of the part k topics, ordered according to word number 1-V.*nmm* represents the observed data obtained by statistically counting the topics of the part m text set, with each word numbered 1-k.

Prior to undertaking a model run, it is necessary to determine the *a priori* parameters of the model. In this paper, we utilize the Gibbs sampling technique, setting the parameter $\alpha$ of the document-topic distribution to 0.10, the parameter $\beta$ of the topic-word distribution to 0.02, and the number of iterations to 5000.

The optimal number of topics for this study was determined through the application of constant model fitting. The intensity of the policy theme is calculated by determining the relative importance of each theme within the entire hierarchical text. This indicates the degree of concentration and consideration given to each theme within the policy text. The precise formula is as follows:

TABLE 1 The policy elements and the main contents of the strategic scientific and technological forces in the oceans and seas, by sector (province and city).

| Policy points | Thrust |
|---|---|
| Maritime economy | Enhanced monitoring and assessment of the marine economy; Promoting the transformation of the marine economy into a quality and efficiency-oriented one; Growing the size of the marine economy; Guaranteeing the sustainable development of the marine economy; The construction of marine economic platforms for the delivery of marine public technical services, ecological and environmental protection, marine management decision-making assistance and scientific and technological information services, among others, is a key objective. |
| Marine industry | Building a modernized marine industrial system; Attracting capital and innovation factors to the maritime industry; Promote the division of labor among coastal cities and counties in the marine industry and the coordination and interaction of land and sea resources; Promoting technological upgrading in the marine industry; Strengthening the division of labor and graded distribution of marine industries, accelerating the construction of marine industry technology R&D and transformation centers |
| Marine ecology | Marine ecological early warning monitoring; Focuses on supporting marine ecological research and application areas; Create a high-quality marine economic development belt; Strengthen the protection and restoration of marine ecosystems; Technical system for the assessment of marine ecological assets; Assessment of marine ecosystem health and integrity |
| Marine life | Foster the construction of a public R&D base for marine biotechnology; Promote the research, development, and production of marine bio-pharmaceuticals, marine functional health food, new marine biological raw materials, marine modern traditional Chinese medicine, and marine biological gene products; Nurturing several enterprises in the field of marine biology and innovative small and medium-sized enterprises with independent intellectual property rights; Deeply explore marine biological genetic resources and promote the large-scale production and demonstration application of marine biological materials; Integration and industrialization of marine biotechnology |
| Ocean engineering | Cultivate world-class advanced manufacturing clusters of marine engineering equipment, actively develop general contracting and specialized services for marine engineering, and promote the development of marine engineering equipment to the deep and distant sea and polar areas; Strengthening the integrated application of marine engineering technologies |

TABLE 2 Comparisons of the policy elements among national, provincial, and municipal marine strategic scientific and technological forces.

| Thrust | Rank | | |
|---|---|---|---|
| | National level | Provincial level | Municipal level |
| Scientific and technological innovation | Strengthening original and cutting-edge scientific and technological research | Implementation of the Energy Level Improvement Project of the Science and Technology Innovation Platform; the Key Core Technology Research Project. | Supporting the development of a marine science and education community and providing funding for key technical and policy research in the marine industry; Support universities and colleges in building partnerships with offshore enterprises |
| Marine industry | Optimizing the layout of the industrial chain and improving the resilience of the supply chain | Implement key core technology research projects; Accelerating the development of marine living resources; Building characteristic fishery clusters and promoting large-scale and standardized aquaculture | To establish clusters of marine industries that possess distinctive characteristics, including but not limited to ships, offshore equipment, marine transportation, marine biology, and medicine; Carrying out intelligent land-based recirculating aquaculture, research, and development of new materials for marine organisms |
| Marine ecology | Strengthening the prevention of pollution of the marine environment and the protection of marine biodiversity | Constructing a regular system for the management of marine pollution and establishing a sound network for monitoring the marine environment; Improving the compensation mechanism for ecological protection and protecting marine ecology | Realization of real-time automatic monitoring of sea outfalls and establishment of "one mouth, one book" management files; Strengthening the management of nature reserves, continuous follow-up and monitoring, and preventing the invasion of exotic organisms |

$$P_k = \frac{\sum_i^N \theta_{k_i}}{N} \quad (2)$$

In Equation 2, *Pk* represents the topic strength of the part k topic, *θki* denotes the probability of the part k topic word in the part i text, and N denotes the number of topic words under the topic.

This paper employs the LDA model to construct a three-dimensional mapping matrix of text-topic-vocabulary for different levels of policies. The similarity of the topics of policies at each level is then calculated, along with an understanding of the characteristics of the top-down diffusion of policies and the logic of the evolution of policies.

## 4.2 Research methodology

Policy texts are analyzed using computer programming languages and theories from the fields of knowledge diffusion and information diffusion. This study is based on relevant research findings, which have been organized into five steps.

The first step involves the organization and archiving of the policy text, the formatting and editing of the text, the comprehensive consideration of the research theme, and the extraction of high-frequency words using software to generate a word cloud map, with the elimination of invalid words.

The second step involves the processing of the collated policy documents using the jiebaR lexical tool. This tool is employed for lexical processing, syntactic and grammatical analysis, and the construction of lexical vector representations.

The third step is to construct the LDA model, identify the key parameters, and execute the LDA model through the R language software to generate key data such as theme intensity.

The fourth step is utilizing the model data, summarizing the textual themes, completing the internal information mining, and employing Dream wave software to visualize the LDA model and generate key diagrams.

The fifth step is the interpretation and evaluation of the findings of the textual analysis and the analysis of the policy diffusion features of the study.

## 4.3 Variable selection and data sources

This paper utilizes data from the Chinese government website, the official websites of various departments, and the official websites of provincial and municipal governments. The data is collected using crawler technology and concerns policy texts about the construction of strategic scientific and technological forces in the oceans. By combing the relevant policies issued by the central government and ministries and commissions since 2002, and after eliminating the duplicated documents, such as return receipts, policy interpretations, implementation programs, and plans, we screened out 20 national-level policy texts issued by the Central Committee of the Communist Party of China and the State Council, 20 ministerial-level policy texts issued by national ministries and commissions, and 49 most representative policy documents from coastal provinces and municipalities. This resulted in 89 policy texts, totaling more than 420,000 words. For further details, please refer to Table 3.

TABLE 3 Basic statistics on the selection of policy texts.

| | National level | Ministry level | Coastal provinces and municipalities |
|---|---|---|---|
| Number of documents | 20 | 20 | 49 |
| Issuing department | Central Committee of the Communist Party of China (CPC) State Council (PRC) | Ministry of Natural Resources, Ministry of Science and Technology, National Development and Reform Commission, Ministry of Agriculture and Rural Affairs | Liaoning, Fujian, Hebei, Zhejiang, Jiangsu, Shandong, Shanghai, Tianjin, Hainan, Guangdong, Guangxi |

# 5 Analysis of the empirical results

## 5.1 An analysis of high-frequency vocabulary in policy texts

After segmenting the policy text, we drew a Word cloud diagram of the policies on the marine strategic scientific and technological power at the national level, provincial level, and municipal level based on the high-frequency words repeated in these three levels after extracting and removing these words (Figure 1). The comparison reveals that these high-frequency words in the distribution of policies at different levels have consistent policy objectives, but their specific policy expressions have different focuses, reflecting the common concern and strategic considerations of governments at all levels toward the development of marine strategic science and technology strength.

Further in-depth analysis of the top 20 words with high frequency of occurrence (Table 4) revealed that at the national level, words such as "scientific and technological innovation", "marine economy", and "special planning" appeared more frequently, indicating that the national level attaches great importance to top-level design and macro-control. At the provincial level, the frequency of "emerging industries", "technological achievements", and "key technologies" has increased compared to the national level, which reflects that provincial governments are actively responding to and undertaking national policies while refining and implementing them. At the municipal level, words such as "economic development", "industrial chain", and "competitiveness" frequently appear in policy texts which mostly used as work tools in policies, reflecting that local governments pay more attention to the effectiveness of policies when promoting policy implementation.

According to the coupling coordination theory, the three levels of national, provincial, and municipal governments ultimately combined and became a community, jointly performing specific functions (Wang et al., 2021). Policies introduced at different levels complement each other and have their focuses. When fortifying the main body construction of marine strategic science and technology strength, classified policies and collaborative cooperation are used to enable it to explore autonomously and effectively dock with policy goals, confirming the importance of coupling coordination between systems in marine management, and laying a solid foundation for China's marine strategic scientific and technological innovation and the construction of a marine power.

Analyzing the attributes of these high-frequency words in detail, we can conclude that the words at the national level are more macroscopic and cover a wider range, while those at the provincial level have a clearer point of view, promoting economic and social development through the coordinated implementation of major plans, policies, and projects. Municipal-level policies focus on centering around major national strategies, combining them with local realities, and continuously strengthening their developing advantages. By combining Word cloud map and the high-frequency vocabulary, we can see that the marine strategic science and technology strength is characterized by top-down diffusion, with the central government formulating strategies and plans for the construction of it, and the provincial and municipal governments formulating specific policies to put it into practice.


FIGURE 1
Word cloud of strategic ocean science and technology forces policy text.

In conclusion, strengthening the national marine strategic science and technology strength is a complex systematic project that requires each to perform its function, an overall layout, and collaborate efforts.

In addition, from the timeline of high-frequency vocabulary, related high-frequency words are constantly evolving with the change of time. Specifically, it can be divided into the following three stages.

**Stage 1:** Foundation of Technology and Initial Prosperity of Industry (2002-2010).

In this period, the breakthrough of key technology is the focus of the development of marine strategic science and technology, and "key technology" has become the core high-frequency word. Scientific research institutions have invested heavily in research and development, focusing on solving basic technical problems such as ocean exploration and equipment manufacturing, laying a solid foundation for subsequent development. At the same time, "scientific research" focuses on basic fields such as marine resources and marine environment, which contributes to the theoretical system of marine strategic science and technology. In terms of the marine industry, the traditional marine fishery and coastal tourism have gradually developed, and the scale of "marine industry" has been continuously expanded, which has effectively promoted the growth of the "marine economy". The development of marine resources is mainly based on fishery resources, and the sustainable development model has been preliminarily explored.

**Stage 2:** Innovation Leading and Diversified Development (2010-2020).

At this stage, "scientific and technological innovation" and "innovative ability" have become high-frequency words, and scientific and technological innovation has become the core driving force for the development of marine strategic science and technology. The continuous improvement of the innovation system and the deep integration of Industry-University-Research have spawned a series of technological innovations and pushed marine science and technology to a new height. With the increasing frequency of marine

TABLE 4 Presents a list of the most frequently occurring terms in the text of the Strategic Science and Technology Strengths for Oceans policy.

| No. | National level | | Provincial level | | Municipal level | |
|---|---|---|---|---|---|---|
| | Word | Word Frequency | Word | Word Frequency | Word | Word Frequency |
| 1 | Marine Economy | 0.10963 | Marine Economy | 0.14801 | Science and Technology Innovation | 0.11250 |
| 2 | Science and Technology Development | 0.06478 | Economic Development | 0.12065 | Marine Industry | 0.08958 |
| 3 | Science and Technology Innovation | 0.06229 | Scientific and Technological Achievements | 0.06841 | Marine Economy | 0.08958 |
| 4 | Marine Ecology | 0.04734 | Emerging Industries | 0.05846 | Economic Development | 0.05417 |
| 5 | Marine Resources | 0.03488 | Marine Ecology | 0.05473 | Marine Biology | 0.04375 |
| 6 | Economic Development | 0.03488 | National Ocean | 0.04478 | Marine Ecology | 0.04375 |
| 7 | Marine Environment | 0.03239 | Key Technology | 0.03980 | Key Technology | 0.02708 |
| 8 | Marine Industry | 0.03239 | Marine Engineering | 0.03856 | Industry Chain | 0.02708 |
| 9 | Innovation System | 0.03239 | Marine Resources | 0.03607 | Infrastructure | 0.02500 |
| 10 | Innovation Capacity | 0.02990 | Marine Fisheries | 0.03234 | Emerging Industries | 0.02292 |
| 11 | Scientific Research | 0.02741 | Core Technology | 0.02612 | Industrialism | 0.02083 |
| 12 | Marine Biology | 0.02741 | Science and Technology Talents | 0.02488 | Research Institutes | 0.02083 |
| 13 | Key Technology | 0.02741 | Industrial Clusters | 0.02114 | Environmental Protection | 0.01875 |
| 14 | Research Institutions | 0.02741 | Environmental Protection | 0.02114 | Marine Resources | 0.01875 |
| 15 | Talents | 0.02492 | Comprehensive Mutilation | 0.02114 | Strategic | 0.01875 |
| 16 | National Marine | 0.02492 | Industrial Base | 0.01990 | Competitiveness | 0.01667 |
| 17 | Scientific and Technological Achievements | 0.02243 | Environmental Monitoring | 0.01866 | Marine Fisheries | 0.01667 |
| 18 | Environmental Protection | 0.02243 | Research Institutes | 0.01741 | Digitization | 0.01458 |
| 19 | Environmental Monitoring | 0.02243 | Public Service | 0.01617 | Marine Engineering | 0.01458 |
| 20 | Specialized Planning | 0.02243 | Transportation | 0.01368 | Intellectual Property | 0.01458 |

development activities, the problems of "marine ecology" and "marine environment" have become increasingly prominent, and relevant research efforts have been intensified, aiming at achieving the balance between marine development and ecological protection. The development of "marine resources" extends to deep-sea minerals, marine energy, and other fields, expanding the development space of the marine economy and promoting the diversification of "economic development".

**Stage 3:** Intelligent Convergence and Overall Upgrade (2020-Present).

In recent years, the development of marine strategic science and technology has entered the era of intelligence and digitalization, and emerging technologies such as artificial intelligence and big data are deeply integrated with marine science and technology. Intelligent equipment is widely used in marine monitoring, resource development, and other fields, which has greatly improved the efficiency and accuracy of marine environment monitoring, promoted the intelligent transformation of the marine industry, spawned new formats such as smart fisheries and smart ports, and further promoted the high-quality development of the marine economy. The research on "marine life" focuses on the medicinal value and bioactive substances of marine life, and the "innovation system" is continuously optimized to improve innovation ability and international competitiveness continuously.

## 5.2 Thematic analysis of policy texts

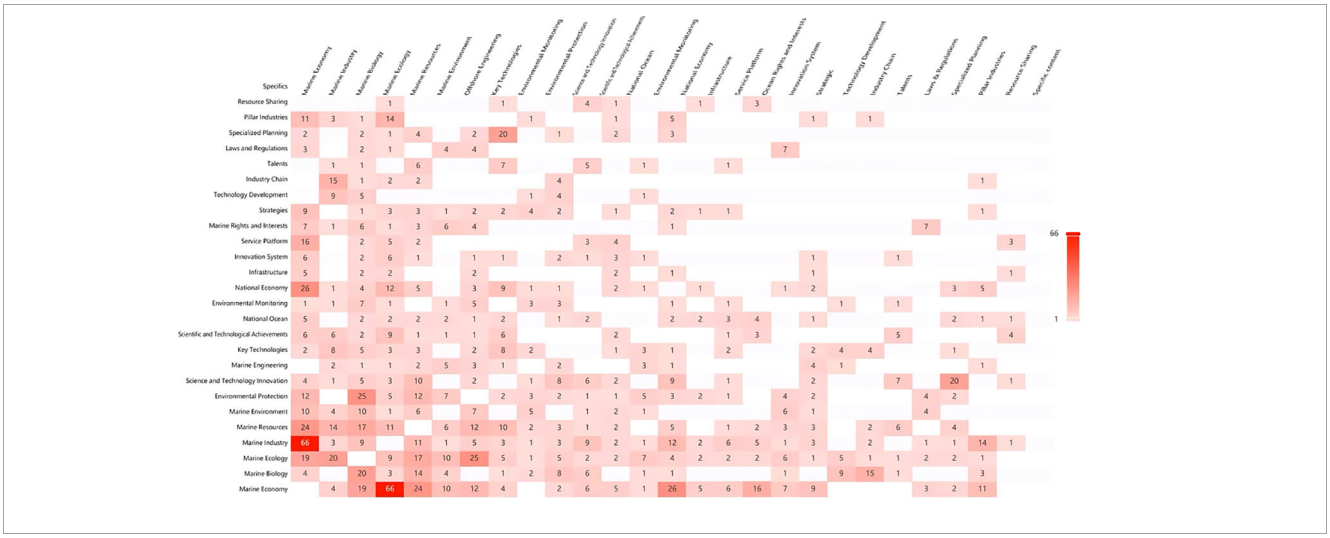
The LDA model can construct a mapping relationship between text, theme, and vocabulary. Based on the constructed policy theme, the changes in the diffusion of different policies can be discovered. Through the intensity of policy themes, the attention and research hot spot of policies can be discovered, thereby reflecting the diffusion of them.

After further iterative optimization of the LDA model, this paper ultimately determines that the model performs best when the number of topics is set to 20. Based on the topic matrix of the LDA model, a total of 60 policy topics were condensed into three levels (Table 5). Calculating the policy theme intensity of each theme based on its weight in the entire hierarchical text, reflecting its popularity and attention in the policy text. Based on the intensity distribution in the table, analyze the top 3 intensity rankings as

TABLE 5 presents the distribution of policy themes and theme intensity at different tiers.

| No | National level | | National level | | National level | |
|---|---|---|---|---|---|---|
| | Policy theme | tf-idf | Policy theme | tf-idf | Policy theme | tf-idf |
| 1 | Marine Economy | 0.05292 | Marine Economy | 0.04745 | Science and Technology Innovation | 0.06950 |
| 2 | Marine Industry | 0.04606 | Marine Industry | 0.04610 | Marine Industry | 0.06662 |
| 3 | Marine Ecology | 0.03986 | Technology Innovation | 0.04507 | Marine Economy | 0.06623 |
| 4 | Scientific Research | 0.03856 | Marine Ecology | 0.03263 | High Quality Development | 0.03859 |
| 5 | Marine Biology | 0.03704 | Marine Engineering | 0.02689 | Marine Ecology | 0.03799 |
| 6 | Environmental Protection | 0.02773 | Marine Fisheries | 0.02453 | Industry Chain | 0.03201 |
| 7 | Environmental Monitoring | 0.02519 | Key Laboratory | 0.02459 | Infrastructure | 0.03109 |
| 8 | Technology Innovation | 0.02454 | Industry Clusters | 0.02351 | Talent Cultivation | 0.03112 |
| 9 | Resource Sharing | 0.02437 | Environmental Protection | 0.02268 | Industry-Academia-Research | 0.02950 |
| 10 | Science and Technology Management | 0.02429 | Talent Cultivation | 0.21083 | Innovation System | 0.03046 |
| 11 | Marine Engineering | 0.02334 | Industrial Base | 0.02033 | Marine Resources | 0.02881 |
| 12 | Data Sharing | 0.02224 | Public Service | 0.01998 | Industry Clusters | 0.03869 |
| 13 | Service Platform | 0.01990 | Biological Products | 0.01972 | Digitalization | 0.03832 |
| 14 | Ocean Satellite | 0.01963 | Resource Development | 0.01875 | Marine Engineering | 0.02732 |
| 15 | Basic Science | 0.01945 | Strategic Planning | 0.01852 | Economic Innovation | 0.01652 |
| 16 | Renewable Energy | 0.01875 | Investment Promotion | 0.01722 | Industrial Development | 0.01567 |
| 17 | Shipbuilding Industry | 0.01868 | Digital Economy | 0.01008 | Resource Allocation | 0.01628 |
| 18 | Environmental Protection | 0.01817 | Self-Reliance | 0.00908 | Major Projects | 0.01594 |
| 19 | Marine Fisheries | 0.01432 | Opening to the outside world | 0.00878 | Spatial Layout | 0.01475 |
| 20 | National Ocean | 0.01392 | Science and Technology | 0.00808 | Core Competitiveness | 0.01377 |

TABLE 6 Presents the correlation of high-frequency words in policy texts at the national level.




popular topics. The popular policy themes at the national level are (1, 2, 5), that at the ministerial level are (1, 2, 3), and that at the provincial level are (1, 2, 3).

For high-frequency words at the national, provincial, and municipal levels, we used Python and combined them with matrix tables (Tables 6–8) to create a network relationship diagram (Figures 2–4).

From the viewpoint of national-level texts, the themes of the marine strategic science and technology strength policy cover such fields as the marine economy, ecology, industry, resources, and environment, and the comprehensiveness and overall nature of the policy are outstanding. As shown in Table 5, among the hot topics such as “Marine Economy”, “Marine Industry” and “Marine Ecology”, “Marine Economy” is the most popular which has associated words involving science and technology, economy, ecology, and other aspects. These terms are clustered in the policy text, reflecting that the state focuses on the driving role of marine strategic science and technology strength in the economic, ecological, industrial, and other fields, and takes the development as the starting point for the implementation of the policy of marine strategic science and technology strength. In Figure 2, conversely, constructs a complex correlation network among various elements in the marine field intuitively and vividly. It can be seen that “marine economy” is located at the center of the network, closely connected with many elements such as “marine ecology” and “emerging industries”, which profoundly shows that the marine economy is in a leading position in the whole marine strategic system and has a strong radiation-driven influence. This point is consistent with the themes presented in Table 6, including those related to “marine economy” and “marine industry”, as well as

TABLE 7 Presents the correlation of high-frequency words in policy texts at the provincial level.

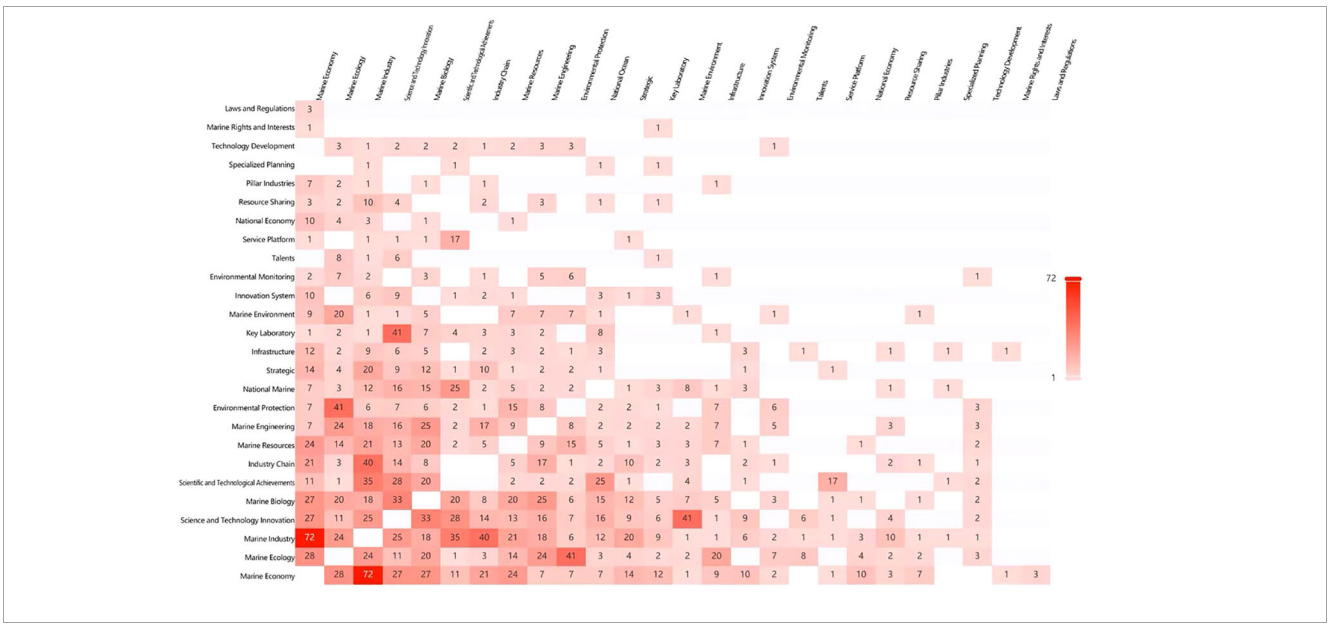
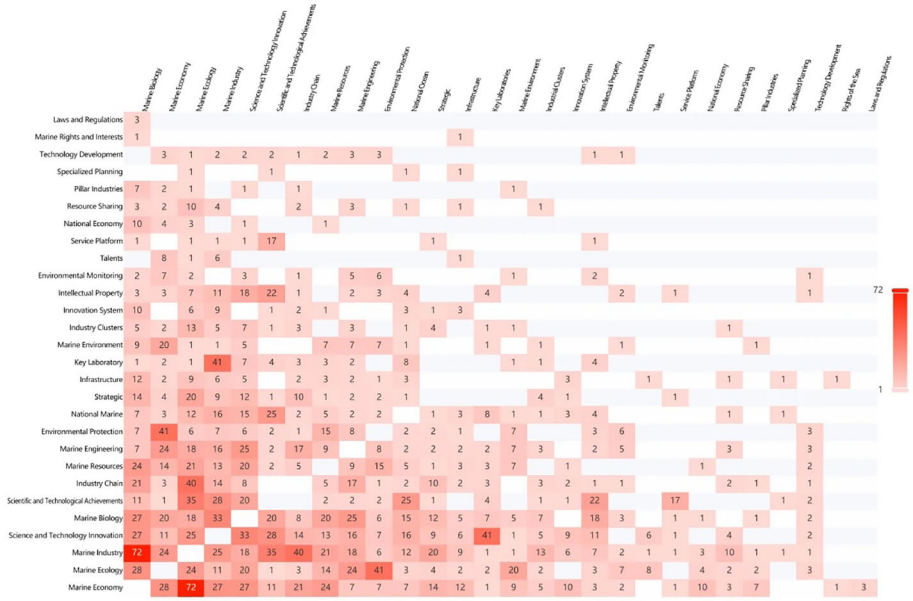


TABLE 8 Presents the correlation of high-frequency words in policy texts at the municipal level.




"scientific and technological innovation" and "marine ecology". In Table 6, the co-occurrence frequency of "marine industry" and "scientific and technological innovation" is as high as 41 times, which reflects that the development of the modern marine industry in China is facing the deep adjustment of industrial structure in terms of optimization and transformation and upgrading. Combined with the "14th Five-Year Plan" it can be seen that with the exploitation and utilization of marine, the development of the

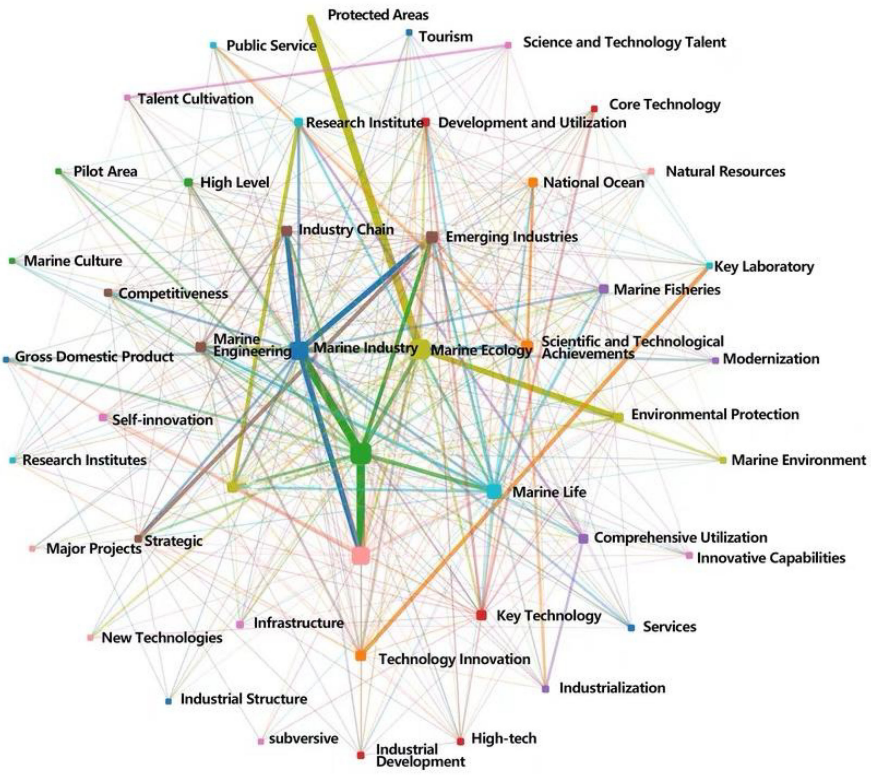



FIGURE 2
Illustrates the network of high-frequency words in national-level policy texts.

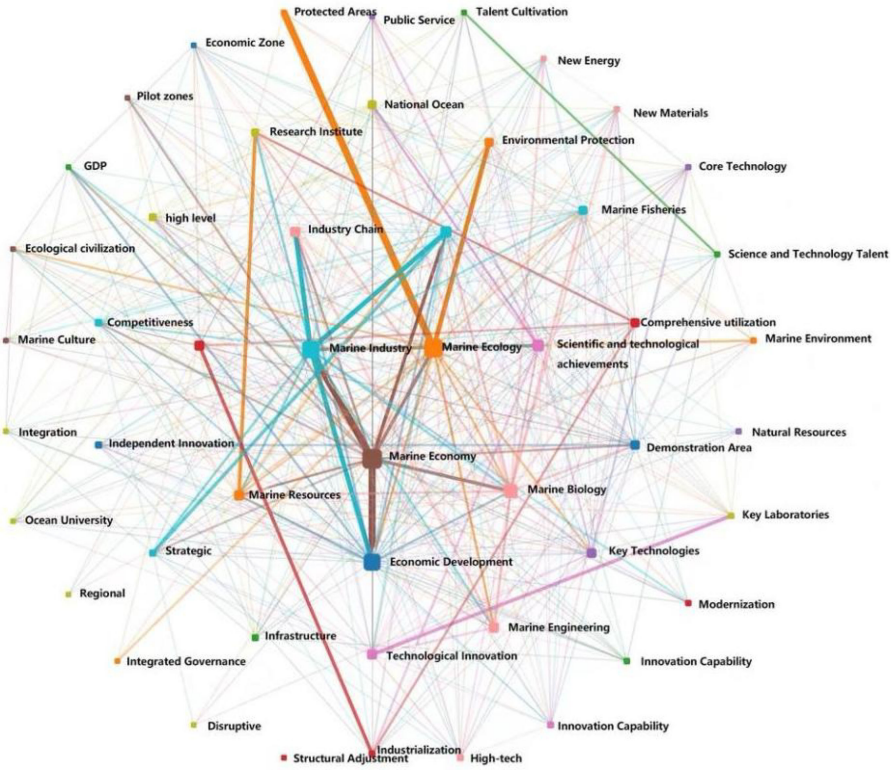



FIGURE 3
Illustrates the network of high-frequency words in policy texts at the provincial level.

modern marine industry has faced profound adjustments in industrial structure optimization and transformation upgrading. A series of strategic scientific and technological needs in the field of the marine industry have fully emerged, especially the requirements to further shorten the technological gap between marine-related industries, strengthen the technological penetration and integration between enterprises, promote the in-depth integration of the marine innovation chain and industrial chain, and provide strong technical support for the iterative upgrading of the marine economy in the new era. To build a mechanism for Interval Industrial Labor Division and Cooperation, it is necessary to improve the cluster resource allocation capacity, industrial supporting capacity, and radiation-driven capacity, especially focusing on promoting the optimization of the structure of the marine industry, starting with the marine emerging industries such as bio medicine, seawater desalination, application of new materials, green environmental protection equipment, marine resources, etc., accelerating the systematic construction of national marine strategic scientific and technological strength, and promoting a high degree of aggregation of various types of marine industrial innovation factors to lay a solid foundation for strengthening the national marine strategic science and technology strength in the field of marine emerging industries.

From the provincial level, the marine strategic science and technology strength policy has been about the marine economy, economic development, and scientific and technological achievements. Combined with Table 5, “Marine Economy”, “Marine Industry” and “Technological Innovation” are the top 3 popular themes. Further, from Table 7, we can find that “Marine Economy” “Marine industry” and “Technological innovation” have a high frequency of co-occurrence, for example, marine economy and marine industry appear 72 times, which proves that these three topics are hot topics again. As shown in Figure 3, “technological innovation” is connected with “independent innovation”, “scientific and technological achievements” and “core technology”, which highlights the importance of scientific and technological innovation in the provincial marine strategy. These themes show that local governments pay attention to the implementation of science and technology innovation policies, and formulate clear work priorities, fully demonstrating the role of local governments in guiding and promoting the construction of the national marine strategic science and technology strength system. “Industry” has become a high-frequency word of the policy theme, and its corresponding terms such as “Marine Science and Technology”, “Scientific and Technological Achievements”, “Marine Engineering”, and “Special Funds” are gathered in the policy text, showing a certain co-occurrence frequency, such as the co-occurrence of “Industrial chain” and “Marine science and technology” is 40 times. These reflecting the local government in promoting the construction of marine strategic science and technology strength always aim to build a strong maritime province, by strengthening the reshaping of the national marine strategic science and technology strength institutional mechanism,

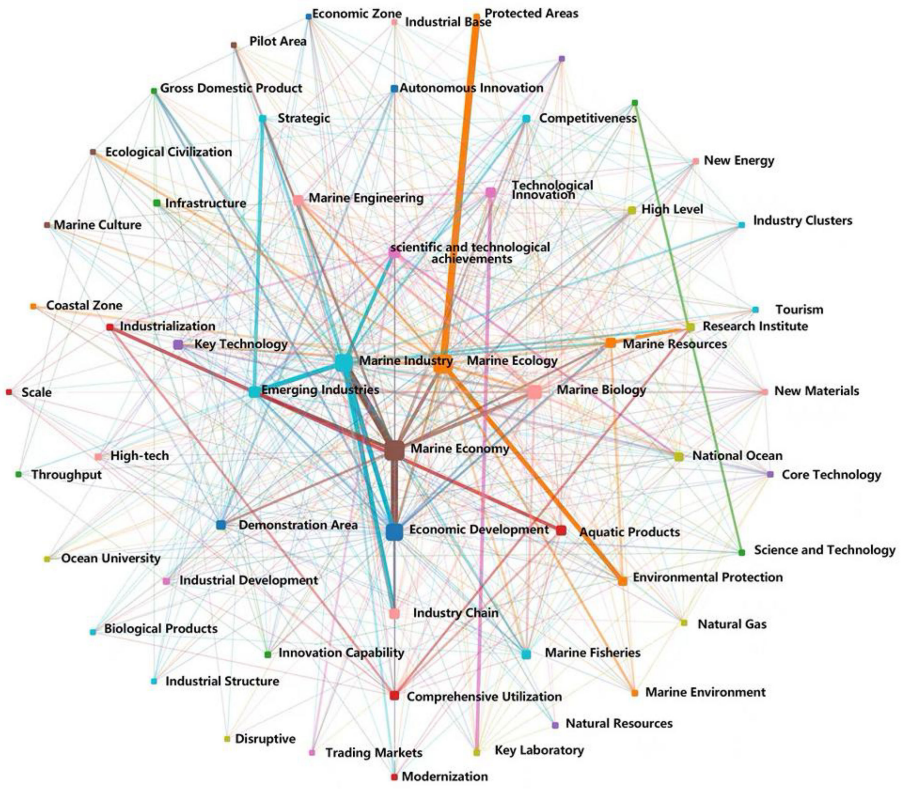



FIGURE 4
Presents a network relationship map of the high-frequency words in municipal-level policy texts.

stimulating and attracting funds into the emerging marine industrial field. In the previous policy collection, it is found that there are two peak periods for local governments to introduce policies on the construction of marine strategic science and technology strength namely the period of 2012-2013 and the period of 2021-2023. The first period is because the report of the 18th National Congress of the Communist Party of China (CPC) points out that 'it is necessary to build a strong marine country", so local governments have introduced a series of related policies. The second peak period corresponds to the goal of building a modern marine industry system and strengthening national strategic science and technology strength in "The 14th Five Year Plan and the Outline of Long Range Objectives for 2035", therefore local governments have actively introduced many policies on that.

From the municipal level, combined with Table 5, "Science and Technology Innovation", "Marine Economy" and "Marine Industry" are the top three popular themes. And combined with Table 8, it can be seen that "scientific and technological innovation", "marine economy" and "marine industry" have a high frequency of co-occurrence, occurring 72 times, 40 times and 27 times respectively. These themes indicate that local governments have increased their support for marine industry and marine economy. which indicate that have paid more attention to the marine industry and the marine economy, hoping to promote the development of the industry and the economy through scientific and technological innovation. For example, during the 14th Five-Year Plan period, Qingdao City issued the "15 Policies to Support the High-Quality Development of Marine Economy in Qingdao", and Fuzhou City issued the "14th Five-Year Plan for the Development of Marine Economy in Fuzhou", which emphasize the support of science and technology for the development of the ocean at a specific level. Science and technology innovation has become the focus of municipal policies, and its corresponding terms such as "Science and Technology Economy", "Marine Industry", "Key Technologies", "Intellectual Property Rights", and "Technology Development" also appear frequently in the policy texts of various regions. In addition, as shown in Figure 4, the "marine industry" is connected with "emerging industries", "industrial chain" and "industrial structure", showing a complete chain of marine industry development. All of them emphasize China's technological autonomy in advantageous fields such as marine equipment, marine new energy, and bio medicine, which promote the birth of original, strategic, and integrated innovations. This point in the theme of "Science and Technology Innovation" corresponds to the high-frequency terms like "Emerging Industries", "Traditional Industries", "Biological Products", "Ocean-going Products", "Marine Products", "offshore fishing", "advantageous industries", "marine engineering", "research institutes" and so on can be seen. Scientific and technological innovation has become a hot spot, further clarifying the national marine strategic science and technology areas and key directions, enhancing independent research and development capabilities,

which is beneficial for China to overcome the technical stranglehold in the marine field as well as promote the innovation chain, industry chain, supply chain interconnection. At the same time, as a direct response of cities to the national marine strategic science and technology strength policy, making scientific and technological innovation the key of the municipal policies, considering high-quality industrial development as a helper, to achieve the high-quality development of regional marine economy and ensure the construction of a strong marine country.

## 5.3 Characterization of policy diffusion

The study of 45 policies from the perspective of policy diffusion, in conjunction with the quantitative analysis of the LDA model, revealed that the policy on strategic scientific and technological forces in the oceans exhibits the following three characteristics:

Firstly, the proliferation of strategic marine science and technology power policy themes exhibits clear temporal characteristics. Before the 18th National Congress of the Communist Party of China (CPC), China lacked a comprehensive understanding of the strategic scientific and technological capabilities of the oceans, which constrained the rapid development of China's marine field to a certain extent. Nevertheless, the 18th National Congress of the Communist Party of China (CPC) report proposed a comprehensive strategy for the development of a robust maritime power. Over time, the ideological implications of the strategy for marine strategic scientific and technological forces have been further enhanced through practical implementation. At the practical level, the Party and State levels have issued a series of policies on strategic scientific and technological forces in the oceans and seas from the overall perspective of building a strong marine power. These policies have achieved remarkable results in providing marine public goods, clarifying the organizational structure of the oceans, safeguarding the rights and interests of the oceans, and reinforcing the concept of ocean governance. Consequently, they have contributed to the further advancement of China's strategy of building a strong marine power. During this period, the State Council continued to issue the "Twelfth Five-Year Plan for the Development of the National Marine Economy", the "Thirteenth Five-Year Plan for the Development of the National Marine Economy" and the "Fourteenth Five-Year Plan for the Development of the National Marine Economy". These plans provide overall planning for the development of the marine economy. The National Marine Economic Development Plan and the National Marine Economic Development Plan for the Fourteenth Five-Year Plan were issued to provide overall planning for the development of the marine economy. The phenomenon of policy proliferation has been on the rise, with an increasing number of policies being introduced at both the ministry and provincial levels. This has been accompanied by the emergence of a plethora of detailed policies, such as the "13th Five-Year Plan for the Development of the Marine Economy of Shandong Province" issued by Shandong Province and the "14th Five-Year Plan for the Development of the Marine Economy of Guangdong Province" issued by Guangdong Province.

Secondly, the policy on strategic scientific and technological forces in the oceans is undergoing constant refinement in terms of its content in the context of proliferation. In terms of policy themes, the provincial and municipal governments have implemented the spirit of General Secretary Xi Jinping's important exposition and instructions on the development of the marine economy and the construction of a strong marine country. Moreover, they have demonstrated a profound comprehension of the elevated standards for marine operations espoused by the mission of comprehensively advancing the great rejuvenation of the Chinese nation through Chinese-style modernization. Also, they have concentrated on the pivotal areas and pivotal links, and have made substantial progress on the pivotal tasks. Finally, they have integrated the work grasp with the specific circumstances of each location. The policy theme is becoming increasingly detailed, thereby ushering in a new era of the construction of a strong marine nation. In the case of marine economic development demonstration zones, for example, the joint issuance by the National Development and Reform Commission and the Ministry of Natural Resources of the Circular on the Construction of Marine Economic Development Demonstration Zones in support of the construction of 14 marine economic development demonstration zones, which were set up at the municipal level and in relevant parks according to different locational advantages, each demonstration zone has a specific mandate with a different focus and landing point. To illustrate, the primary objectives of the Marine Economic Development Demonstration Zone in Ningbo, Zhejiang Province, are to investigate the market-based allocation of marine resources, to advance research, development, and industrialization of marine science and technology, and to innovate a green development model for the marine industry. The primary objective of the Zhejiang Wenzhou Marine Economic Development Demonstration Zone is to investigate the potential for private enterprises to contribute to the reform and innovation of marine economic development, with a particular focus on enhancing cross-strait marine economic collaboration. The primary objectives of the Weihai Marine Economic Development Demonstration Zone in Shandong Province are the advancement of offshore fisheries and marine pastures, the transformation and enhancement of traditional marine fisheries, and the conceptualization of an integration and agglomeration development model with the marine medicine and biological products industries. In contrast, the Shandong Rizhao Marine Economic Development Demonstration Zone is focused on the innovative development of international logistics and shipping services, as well as the construction of a marine ecological civilization.

Thirdly, there is a paucity of bottom-up policy interaction in the strategic marine science and technology forces policy. The study revealed a general consistency and strong correlation between policy themes at all levels. However, this consistency is primarily observed in the form of top-down policy implementation, with less exploration of policy innovations by local governments. Like the number of practice models, such as marine laboratories and marine universities, that have been incorporated into national policies is relatively limited, and the implementation cycle is lengthy.

The main reason of the lack of bottom-up policy interaction is that, the strategic objectives of the central and local governments on marine development are not coordinated. The main goal of the central government in marine development is to promote comprehensive green transformation and sustainable development. This includes improving the development and protection system of marine resources, systematically planning the development and utilization of marine resources, and promoting the coordinated and sustainable development of land and sea. The local governments focus on the key areas of marine economic development and develop toward the sea. For example, Guangdong province focuses on a diversified layout and promotes the modernization and innovative development of marine fisheries, marine tourism, and marine equipment. Fujian province improves the layout of the marine economy by building a demonstration zone for marine economic development and promotes the development of the marine industry through policy support, especially preferential tax policy. The disharmony between the two strategic objectives objectively hinders the two-way interaction of marine strategic scientific and technological strength policies.

Another reason is that, the disharmony between the authority and responsibility of the central and local sea-related departments is also one of the important factors. In 2018, the responsibilities of the former State Oceanic Administration were integrated, and on this basis, the People's Republic of China (PRC) Ministry of Natural Resources, the Ministry of Ecology and Environment of the People's Republic of China, and the People's Republic of China (PRC) National Forestry and Grassland Bureau were established. The integration of responsibilities helps to clarify the division of tasks among departments, but the ocean is an interdisciplinary field, and different responsibilities belonging to different departments may bring communication and coordination problems. First of all, the functions of sea-related management departments or institutions overlap. On the one hand, the relationship between the vertical management system and the local hierarchical management system has not been straightened out. Beihai Bureau, Donghai Bureau, and Nanhai Bureau under the Ministry of Natural Resources play an important position in marine management, and their functions include but are not limited to marine natural resources management, marine ecological protection, and comprehensive coastal zone management. Their scope of responsibilities overlaps with that of provincial-level sea-related functional departments. Secondly, there is a serious phenomenon of fragmented division and governance between maritime affairs management departments. In terms of departmental relations, the lack of a systematic, holistic, and coordinated management system for departments ignores the internal relationship between departmental functions, which objectively hinders the information sharing and supervision of marine management between departments, resulting in the lack of a unified overall decision-making mechanism for marine management.

So in order to enhance the overall effectiveness of the national marine innovation system, it is necessary to strengthen the top-level design, enhance the integrated development of marine science and technology resources, facilitate the smooth exchange of policy between the lower and higher levels of government, increase the support for local policies, correctly address the relationship between the national marine strategic scientific research forces, marine colleges and universities, and enterprises and other key bodies of marine scientific and technological innovation, and give full play to the advantages of various types of scientific and technological innovation key bodies. The objective is to establish an innovation platform, conduct joint major scientific and technological research, and facilitate the construction of a marine strategic scientific and technological innovation system that is characterized by benign interaction, synergy, and high efficiency across all subjects, aspects, and phases.

## 6 Conclusions and policy recommendations

Taking the marine strategic S&T power-building policies introduced since the Sixteenth National Congress of the CPC, this paper analyzes the thematic and diffusion characteristics of China's marine strategic S&T power-building policy hierarchy using the LDA model, and draws the following conclusions: The proliferation of the policy theme of building strategic scientific and technological forces in the oceans has obvious time characteristics, and since the 16th National Party Congress of the CPC, departments at all levels and in all parts of the world have intensively introduced a series of innovative policies in the field of marine strategy, actively responding to the policies of higher levels and focusing their efforts on building strategic scientific and technological forces in the oceans and seas, which has made a great contribution to the development of China's marine cause. And in the process of diffusion, the top-down content of policies issued by various levels and departments is constantly refined. This has resulted in improvements to the efficiency of policy transmission, with greater commonality and similarity observed in policy themes. However, specific policy statements have different emphases. It addresses the common concerns and different strategic considerations at all levels of government regarding the development of strategic scientific and technological forces in the oceans and seas. This is evidenced by the prevalence of terms such as "science and technology innovation", "ocean economy" and "special planning" in the policy themes at the national level. This reflects the importance attached by the national level to top-level design and macro-control. At the provincial level, policy themes are focused on "marine engineering", "the marine industry", "technological innovation", "related matters". At the municipal level, the focus is on the transformation of scientific and technological achievements, industrial clustering, and talent training. Nevertheless, there is a paucity of bottom-up policy interaction in the transmission process.

The strategic deployment of the three key objectives of the Twentieth National Congress of the CPC, namely the development of the marine economy, the protection of the marine ecosystem, and the acceleration of the construction of a strong marine country provides the framework for the implementation of this policy. It is imperative that China accelerates the systematic development of its national marine strategic scientific and technological forces. In

addition, it must promote the framing and systematization of policies for the construction of a strong oceanic state, and facilitate the rapid landing and efficient implementation of marine strategic scientific and technological policies. The delayed inception of our strategic marine science and technology forces has resulted in a paucity of bottom-up policy interaction. The implementation of multiple policies during the systematic construction of strategic marine scientific and technological forces has made it more challenging to coordinate and manage operations effectively, which is not conducive to the overall performance of strategic marine scientific and technological forces.

In this regard, this paper puts forward the following three suggestions.

Firstly, to enhance the overall effectiveness of the policy system of marine strategic science and technology strength. When formulating this policy, it is necessary to improve the coordination mechanism of the various marine departments, establish a global collaborative mindset, and, with a strong sense of responsibility and mission, comprehensively integrate the team spirit into the allocation of marine resources, the formulation and implementation of marine policies, the cultivation and management of talent team. To give full play to its supporting role in accelerating the development of the marine field, and effectively improve the usefulness of the national marine innovation system, and enhance the people's marine welfare.

Secondly, to optimize the mechanism of policy diffusion of marine strategic science and technology strength. Governments at all levels should set up specialized policy feedback channels, and through the construction of feedback mechanisms, smooth policy communication channels between lower-level governments and higher-level governments to ensure that problems during policy implementation can be reported and solved in a timely manner. At the same time, it is to strengthen the analysis and judgment of the feedback information to provide a scientific basis for policy adjustment; optimize the system of inter-ministerial joint conferences, enhance policy coordination across departments and regions, and establish a sound system for coordinating marine information. By stipulating when local governments should disclose relevant maritime information, strengthening horizontal connections between local governments, promoting mutual assistance and information sharing among them when facing the same maritime affairs, forming policy synergy, and enhancing coordination and management capabilities.

Thirdly, to strengthen public participation in the construction of the consultation system. Various types of stakeholders such as enterprises and social organizations should be introduced to participate in marine governance by holding regional ocean affairs symposiums, soliciting public opinions and suggestions, allowing the public to attend some ocean conferences, etc. Every type of governance method, including market competition mechanisms and social synergy mechanisms, should be used to allow plural subjects to give full play to their functions of participating in policy formulation, decisions, and implementation as well as supervision and external accountability, so as to create a favorable social environment for the entire process of marine policy, and to correct policy implementation deviations timely, thus creating a comprehensive management and innovation pattern that integrates all parties. If the interaction and communication between superiors and subordinates are smooth, the scientific of regional ocean policy formulation and the smoothness of its implementation by local governments need to be improved, and their ability to integrate marine resources, capacity of marine policy, and marine management needs to be enhanced.

In future research, marine strategic scientific and technological forces should focus on the country's overall strategic needs, explore how to strengthen the coupling effect among science and technology, industry, and economy by evaluating its correlation with policy implementation performance, and further investigate how to fully exploit the advantages of institutionalization and co-assimilation of marine strategic scientific and technological forces.

## Data availability statement

Publicly available datasets were analyzed in this study. The data that support the findings of this study are openly available at the website of government of China.

## Author contributions

YF: Methodology, Software, Writing – original draft, Funding acquisition. HX: Writing – original draft, Writing – review & editing. YW: Methodology, Writing – review & editing. FC: Funding acquisition, Methodology, Writing – original draft. BG: Software, Funding acquisition, Writing – original draft.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

## Publisher's note



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