Development and Application of an Information Platform for Water Conservancy Standards

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Abstract: Standards serve as a key mechanism for guiding and supporting the planning, design, construction, operation, and iterative upgrading of smart water conservancy. Addressing the standardization needs of water conservancy in the Inner Mongolia Autonomous Region, this paper develops an information platform for water conservancy standards, covering three core functional modules: standard management, application process documentation management, and an expert database. The platform significantly enhances the management efficiency of local water conservancy standards in Inner Mongolia, enabling data sharing and high-efficiency utilization of standards. Through the standard management module, a comprehensive repository for water conservancy standards has been established, effectively improving the efficiency of standard formulation. Furthermore, leveraging the expert database module, the platform facilitates the development of a localized water conservancy standardization expert repository, expands the talent pool for local water conservancy standardization, and promotes the high-quality advancement of water conservancy standardization in the Inner Mongolia Autonomous Region.

Keywords: Standards; Information Platform; Data Sharing; Efficient Utilization

1. Introduction

Informatization, networking and intelligence have become a major global trend in the world due to the rapid development of information technology [1-3]. In the context of the high-quality development of China's water conservancy sector, informatization construction has become a key step for water conservancy to achieve digital transformation in the new era. Over the years, the Ministry of Water Resources has released several policies such as the Guidance on Vigorously Promoting the Development of Smart Water Conservancy, the Implementation Plan for Promoting Smart Water Conservancy During the "14th Five-Year Plan" Period, the Top-level Design for Smart Water Conservancy, and the "14th Five-Year Plan" for Smart Water Conservancy. These documents establish a timeline and roadmap, task documents and responsibility lists for the development of smart water conservancy, ushering in a wave of water conservancy informatization [4,5]. Furthermore, standardization work, as a key support for the development of the water conservancy sector, plays an irreplaceable role in ensuring national water security. Standardization permeates every link of work, and plays a strategic and fundamental role in the construction, implementation, and sustainable development of smart water conservancy in China, such as digital twin basins, water networks, and hydraulic engineering [6-9].

Inner Mongolia Autonomous Region, as one of the ecological security barriers in northern China, faces the dual pressures of water scarcity and low water-use efficiency [10]. So, water conservancy standardization has turned into an important lever to solve water problems in the region. The Implementation Plan for the National Standardization Development Outline issued by the autonomous region in 2022 outlines the development objectives for 2025 and 2035, which include establishing more than 100 standards within advantageous and distinctive industry standard systems, and formulating (or revising) more than 500 local standards. It is planned to further deepen the standardization strategy, optimize the standardization governance system, enhance the

effectiveness of standardization governance, and strengthen standardization reform and innovation to speed up the construction of a standards system to ensure high-quality development. Against this backdrop, the development of a water conservancy standardization information platform serves as a key carrier of technical standard integration and management efficiency improvement, and is of great significance for implementing the "Three-North Shelterbelt Program" ecological strategy and building "happy rivers and lakes". Therefore, in the digital age of water conservancy, promoting the informatization of water conservancy standards in Inner Mongolia is highly necessary.

Based on the standardization needs of water conservancy in Inner Mongolia, this paper develops an information platform for water conservancy standards, and constructs the water conservancy standards database, intelligent analysis system and expert database management platform. Through the platform, water conservancy standards data can be shared and effectively used, the management level of water conservancy standards can be improved, and high-quality water conservancy development can be achieved in the Inner Mongolia Autonomous Region.

2. Current Development and Practical Needs of Water Conservancy Standardization Platforms

2.1 Current Development of Water Conservancy Standardization Platforms

Currently, the standardized management of China's water conservancy sector is gradually transitioning toward informatization and intelligence; however, there are still significant disparities among provincial-level platforms. The national-level water conservancy standards database—the Ministry of Water Resources' "Full-text Public Access System for Water Technical Standards"— has initially achieved public access to standards, but the system is basically limited to simple queries and lacks dynamic business collaboration capabilities. At the provincial level, developed provinces like Jiangsu and Zhejiang have already put in place platforms for integrated standard management, which enable online drafting, expert review, and full process management. By contrast, there are still the following challenges in the water conservancy standardization in Inner Mongolia:

(1) Severe information silos: Local, sectoral, and national standards are stored separately in different departments without a unified data warehouse, thus causing inefficient retrieval across departments.

(2) Low level of digitalization of business processes: Business processes like standard proposal, drafting, consultation, review and approval are still conducted in offline mode with long cycle times and lack of transparency.

(3) Lack of integration of expert resources: The expert information database is not always up to date and the information on some special areas is not fully covered, which makes it difficult to accurately meet the review needs of complex projects.

2.2 Core Needs of Water Conservancy Standardization in Inner Mongolia

Based on the autonomous region's ecological governance goals of the Three-North Shelterbelt Program, the "water-adaptive development" water-saving strategy, and the smart water conservancy construction objectives, and combined with field investigations and interviews with business departments, the platform needs to meet the following key needs:

(1) Data integration and data sharing. Construct a standards database with multiple water conservancy domains, and realize the structured storage and intelligent retrieval of multi-source standards, which include national, industry and local standards. Overcome information barriers and achieve data interoperability with the autonomous region's government cloud platform and water conservancy business systems.

(2) Standardization of business processes. Develop an online management process for the entire lifecycle of standards, and make the whole process of standard development digital. Improve process traceability and milestone control, making the responsibilities of each process traceable and process progress visible.

(3) Expert resources optimally allocated. Establish a dynamically-updated expert database with local water conservancy characteristics, featuring smart labeling and classification by specialty area, to enhance the efficiency and professionalism of expert review in the standard development process.

Based on this demand, the platform should be built around an integrated water conservancy knowledge base, standard business collaboration,

and expert data storage, thereby featuring intensive standard management, standardized business processes, and intelligent decision-making support, and ultimately enabling high-quality water conservancy development in Inner Mongolia.

3. Core Functional Design and Architecture of the Platform

The platform mainly includes three functional modules: water conservancy standard management, application process documentation management and expert database. The water conservancy standard management module aims to establish a water conservancy digital library, and provide the water conservancy standardization personnel with the functions of standard search and text reference in the drafting process. The application process documentation management module allows the standard issuing authority to review and manage standards submitted by the drafting organizations online. The expert database module is primarily employed for reference in the normal drafting procedure or emergencies related to water, to provide relevant experts to consult.

3.1 Water Conservancy Standard Management

The water conservancy standard management module has functions such as water conservancy standards import, deletion, modification, download and query. Standard query is the function of the core. Users can search by standard based on their needs, or perform a fuzzy search based on content. Users can input keywords or specific clause content in the system and obtain the related standard texts, and click on the result of the content query to jump directly to the same location for the corresponding clause in the standard text.

3.2 Expert Database

The expert database module is mainly used for the collection and storage of expert information in local water conservancy in Inner Mongolia. It allows expert information to be entered individually or in batches. As for the importation of expert information, when the same expert's contact phone number and work unit have been registered in the platform, the same information will be overwritten, preventing duplicate registration of experts.

4. Key Challenges and Countermeasures

4.1 Key Challenges

The R&D and application of the Inner Mongolia water conservancy standardization information platform are still in an early stage of R&D and application. The platform mainly relies on three modules—application process documentation management, water conservancy standard management, and expert database management—to achieve the digitalization of water conservancy standards in Inner Mongolia. Although preliminary progress has been made, there are still some aspects that need to be improved:

(1) The texts of the standards database are not up to date enough because standard development and revision are still ongoing. Although a huge number of existing standards were introduced during the platform construction, the platform lacks the ability to automatically monitor and capture new standard release information, and thus cannot actively track the changes that may occur in the status of standards after publication (revision, replacement, abolition), and cannot form an effective updating mechanism. Moreover, the water conservancy standards have different levels such as national standards, industry standards, Inner Mongolia local standards, group standards and enterprise standards. These various levels have different release platforms, management authorities and release frequencies. The platform has no efficient cross level standard information synchronization mechanism, and is not capable of keeping the texts in the database synchronized with all sources. Besides, water conservancy standardization work also needs the cooperation of various departments of Water Resources Department, autonomous region's standardization authority, even research institutes etc. The process of standard information being transmitted, confirmed and updated is inefficient and is prone to forming information silos, causing lags in data and ultimately leading to a lack of timeliness of the standards database texts, due to inadequate inter-departmental communication and coordination.

(2) Shortage of local talent for water conservancy standardization and difficulty in platform promotion. Nationwide, very few organizations have full-time personnel specifically dedicated to water conservancy

standardization; and even those personnel mostly serve on a part-time basis. "Technical standard development" is already included in the talent evaluation system for the assessment of professional titles, but there is no special post dedicated to full-time standardization engineers, resulting in platform operation and maintenance relying on temporarily assigned personnel. Furthermore, the current training is held at the autonomous region level and a regular training mechanism at the level of league (municipality) and below is lacking. As a result, Inner Mongolia grassroots personnel lack sufficient awareness of platform functions and are unable to fully tap the effectiveness of the system, thus creating an invisible obstacle for the system's implementation.

(3) Lack of feedback mechanisms and real-time platform improvement functions. The system has not yet been widely used throughout Inner Mongolia, and the small scale of water conservancy standardization talent results in little feedback on the information platform. Furthermore, the platform was not designed with basic interactive features like "problem reporting", "feature suggestions", or "error feedback", meaning there's no way to report a problem when it affects the platform's functionality. This means that the platform can't leverage crowdsourced wisdom, and some of the limitations of the system during use are not effectively communicated or resolved.

4.2 Countermeasures

In order to promote the high-quality development of water conservancy in Inner Mongolia, the water conservancy standardization information platform as an important tool for the development of smart water conservancy must be perfected through targeted actions with the principle of "the standards database is the foundation, talent is the guarantee, and feedback is the evolutionary mechanism". The following countermeasures (CM) address the above challenges:

(1) Set up the dynamic collaborative governance mechanism, and continuously optimize the water conservancy standards database. Connect authoritative data sources automatically, such as the Standardization Administration of China platform and the database of the standards published by the Ministry of Water Resources and the local standards database of the Administration for Market Regulation of Inner Mongolia, so as to keep up with the newly published, revised and abolished standards. At the same time, establish a regular information coordination group to supplement, import or update the standard text library of water conservancy on the platform in time to ensure the timeliness of the standard text library.

(2) Further build a water conservancy standardization talent team in tiers and broaden the application of the information platform. To overcome the bottleneck of talent shortage, a three-pronged approach should be taken, including institutional safeguards at the grassroots, empower the grassroots level and reduce the workload technically. In Inner Mongolia, create standardisation officer posts at the league/municipality level as full-time jobs, and incorporate the post into the professional title promotion system, replacing the publication requirement. At the same time, strengthen the construction of water conservancy standardization talents, organize water conservancy standardization experts to give standardization training courses, improve water conservancy standardization personnel's ability to use the platform, and gradually expand the use of the platform in Inner Mongolia.

(3) Develop a co-governance model for users that would allow the platform to be upgraded incrementally in function. Achieve continuous functional evolution through a user co-governance model including user participation, intelligent analysis and agile response. Integrate a floating "Feedback" button throughout the entire platform interface, receive text, screenshot and Mongolian voice feedback to make sure to complete the problem reporting and demand/feature request within 3 seconds. At the same time, develop an AI system to optimize the content: automatically detect frequent pain-point scenarios by tracking user behavior. Moreover, set up a tiered response mechanism — hot-fix for interface defects within 48 hours and correction for relevant issues within 72 hours — so as to finally establish a living platform ecosystem, with users setting the direction for the evolution of the water conservancy standardization platform, to achieve iterative evolution and functional improvement of the platform.

5. Conclusion

This paper builds an Information Platform for Water Conservancy Standardization in Inner

Mongolia, which is able to solve the dilemmas of current Inner Mongolia standard regulatory authorities, such as low efficiency, ambiguous process, and too complicated administration, in a dynamic business environment. The platform has greatly enhanced the water conservancy standards management efficiency of the autonomous region and realized full sharing and highly efficient use of the water conservancy standards. The specific achievements are reflected in: (1) Full lifecycle standard management. A water conservancy standards digital library has been successfully established, significantly improving the efficiency of standard formulation and the convenience of retrieval. (2) Standardized process management: The processes and material requirements for each stage of standard development have been clearly defined, which makes the review of materials submitted by competent authorities and the supervision of drafting organizations clearer. (3) Expert resource integration: The platform has facilitated the building of a localized water conservancy standardization expert database and effectively expanded the talent pool for water conservancy standardization. This platform's development and application have laid a solid foundation for the promotion of the standardized and efficient operation of water conservancy standardization in the Inner Mongolia Autonomous Region and provided strong support for the high-quality and sustainable development of water conservancy standardization in the region.

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