Development and Implementation of Enterprise SIMS Based on B/S Mode

Xize Liu¹,²,*
¹China National Institute of Standardization, Beijing, China
²Department of Industrial Engineering, Tsinghua University, Beijing, China
*Corresponding author e-mail: liuxz@cnis.ac.cn

Abstract. In order to effectively improve the level of enterprise standardization by means of information technology, the enterprise standardization information management system (SIMS) is designed based on B/S mode. The hierarchical design mode of MVC is adopted. Based on the development framework of SSH, the overall framework and subsystems of the system is constructed, which integrates multiple functions such as authority management, documents and resources management, project management, knowledge management, application integration and expansion. It expounds the implementation logic and the system functions of the foreground system, and designs the function framework of the background system from three aspects: the classification and coding rules of the standardized documents and resources, the establishment and maintenance of the process model, and the authority management. Finally, combined with the standardization requirements of a construction machinery enterprise, the secondary development and application of the system are carried out, which proves the effectiveness of the system.

Keywords: Enterprise Standardization, Information Management System, Business Logic, System Design, Classification and Coding

1. Introduction
The informatization of enterprise management has a great influence on the management efficiency of an enterprise. With the rapid development of internet and digital technology, the informatization level of domestic enterprises is improving rapidly, and the pace of digital transformation is also gradually accelerating. As the basis of digitization and intelligence, standardization has been paid more and more attention by the state and enterprises. The national "the 14th five-year plan of the People's Republic of China for national economic and social development and the outline of long-term goals for 2035" clearly proposes to enhance the innovation power of enterprises by improving standards [1]. More and more enterprises organize standardization activities to improve innovation ability and enterprise efficiency, and the demand for standardization information management system (SIMS) is also increasing year by year [2,3]. However, in the research of mainstream enterprise information systems such as PDM, MES and ERP, there is a lack of information management and related function support for standardization activities [4,5,6]. Some scholars have studied the design of enterprise...
security SIMS, and put forward the technical route and architecture of system construction. However, on the one hand, the relevant research results are only applicable to the security field, on the other hand, they do not integrate security standardization into the construction of overall enterprise SIMS [7,8,9]. Therefore, there is a lack of standardized information management system which is widely applicable and can be effectively integrated with other information systems, so as to deeply combine the business process of enterprise standardization activities and the characteristics of standardized documents and resources (D&Rs), improve the efficiency of enterprise standardization.

At present, because of the universality and depth of enterprise standardization activities need to be improved [10], and most enterprise standardization activities still fail to use informatization means, which leads to many problems in the process of enterprise standardization, such as low efficiency and poor confidentiality of standardization documents formulation, and difficulties in searching, updating, maintaining and pushing the documents. Through the design and implementation of information management system, we can timely formulate relevant standardization documents, update enterprise standardization information, and realize the effective allocation of enterprise standardization resources (equipment, products, raw materials, personnel, etc.).

One of the main achievements of enterprise standardization activities is standardization documents and related standardization resources. Therefore, how to manage the D&Rs information effectively, classify the D&Rs reasonably and improve the efficiency of standardization in the information environment have become the core problems of system construction. Based on B/S structure and modular software design and integration method, this paper puts forward the framework of a general enterprise SIMS, and constructs a prototype system.

2. System Design

2.1. System Design Goal and Framework

![Image of System Framework](image)

**Figure 1.** Overall framework of enterprise SIMS

The system is oriented to enterprise standardization activities, which effectively manages a large number of standardized information, documents and resources generated in the activities. According to the enterprise's demand for standardized resources and practical application, the system can be divided into five subsystems supported by each other, including: management and process modeling, basic data management, standardization knowledge management, standardization project management and application integration extension, as shown in Figure 1. The goal of the system is to complete the standardization process management of the enterprise, the management of standardization projects, the
classification and coding management of standardized D&Rs, the management of standardization knowledge, the effective management of the system itself, and the effective allocation of standardized resources, so as to improve the operation efficiency of the enterprise and the level of standardization. It uses the structured integrated wiring system and computer network technology to integrate all functions and information into the related, unified and coordinated system, so as to make the resources fully shared and realize centralized, efficient and convenient management.

As Figure 1, the design of the information management system is based on the general B/S structure and distributed database, which includes three types of servers, namely, the web server for foreground users, the web server for background system integration, and the MySQL database for data storage. The software development tool is MyEclipse, the development language is Java, the running platform is ExtJS, the server is Tomcat7.0, the operating system is windows10, and the browser is IE10.0 (compatible with Firefox, Maxthon and chrome).

Because the enterprise standardization system is oriented to internal personnel, the front page of the system is designed with jQuery framework, which simplifies the development process and improves the development efficiency. The server adopts MVC layered design pattern, based on SSH (Struts2 + Spring + Hibernate) development framework, so that the development focus on the accurate expression of enterprise standardization business logic.

2.2. Function design of SIMS

The main functions of each subsystem are described in Table 1. Through the organic integration of each subsystem, the whole process of enterprise standardization and the D&Rs information generated in the process are effectively managed, and the D&Rs and related knowledge are quickly pushed according to the user's needs.

| Number | Subsystem name                     | Main function                                                                                     |
|--------|-----------------------------------|---------------------------------------------------------------------------------------------------|
| 1      | Management and process modeling   | Manage users, roles and permissions; Manage the whole process model of enterprise standardization activities; Standardize the system data |
| 2      | Basic data management             | Functions of management of standardized D&Rs including attribute set management, D&Rs’ name standardization, D&Rs classification and management and effective configuration of D&Rs |
| 3      | Knowledge management              | Mining and management of enterprise standardization experience and standardization related knowledge |
| 4      | Project management                | According to the process model of standardization activities, manage the project approval, plan, budget, task, release, statistics and other activities of enterprise standardization projects |
| 5      | Application integration extension | Manage the functions compatible with other information systems, including standardized requirements management, system interface management, notification information management, etc. |

Further functional design is carried out for the subsystem. The functional structure of each subsystem is shown in Figure 2. Due to the length limitation of this article, there are only some key functions in Figure 2.[8,11].
2.2.1. Foreground system. The users of enterprise SIMS are internal personnel. The foreground system is mainly for the managers of standardization projects and users of standardization D&Rs. The main foreground functions include enterprise standardization project management, information query, classified retrieval and upload in knowledge management, standardization forum. Web based system development supports browser access, and the system could automatically jump the user interface to the required functions according to the preset user permissions.

When using the project management function, it is necessary to clarify the project content and the information of project participants. Their personnel information mainly includes: name, department, contact information, project responsibilities, etc.; Project content mainly includes project stage division, stage work content, input and output, and basic information of standardized documents. Generally, the content of project management mainly includes schedule management and task management. Schedule management can be realized by integrating some commercialized project management systems (such as MS Project), while task management needs to decompose and plan tasks based on the background system's project process modeling.

In the use of enterprise standardization information query function, by entering keywords for information retrieval. The standardized information is presented in the form of classified list through background matching, and online reading and downloading functions of files are provided. When using the knowledge management function, users can obtain standardization related knowledge through keyword search, and upload standardization knowledge according to the specification provided by the system. Besides users can share and exchange knowledge in the standardization forum in real time.

2.2.2. Background system. The background system is mainly developed for the management personnel of the system to manage and maintain the basic data and rules of the background system. To sum up, system managers need to carry out three aspects of work.

Firstly, the D&Rs classification and coding rules, classification structure and data specification are established for the standardized documents, resources and knowledge. Including: defining the classification and management logic of the background system, maintaining the classification and
management and query functions of the system; establishing all kinds of information and data specifications involved in the system, such as the normative requirements of the name, the normative requirements of information input / output / upload, etc.

Secondly, establish and maintain all kinds of process models related to enterprise standardization as well as the association and call logic of all kinds of information and systems involved, including enterprise standardization project management process model, document / resource approval process model, system / database association and call, etc.

Thirdly, according to needs, add, delete or collect users into groups, and distribute the users’ right to achieve the system authority management. According to the general process of enterprise standardization activities, the enterprise roles involved are project management personnel, design and use personnel of standardization D&Rs, and system data maintenance personnel, etc. The system is designed with the idea of modularization, and each function module can be freely adjusted to the corresponding role in the authority management.

3. Application Examples

Based on the standardization requirements of a construction machinery enterprise, this paper designs and develops an application example of enterprise SIMS. It introduces the application of different functions designed in Figure 2. in enterprise standardization.

3.1. Management and System Modeling Subsystem

The subsystem includes three sub modules: user management, system data normalization and process modeling, as shown in Figure 3. User management module provides management functions among users, permissions and roles; system data normalization module standardizes and unifies names and units; process modeling module intuitively defines the process contents and participating roles involved in standardization work, so as to improve the efficiency of standardization.

3.2. Basic Data Management Subsystem

D&Rs category creation and coding is the first step to realize coding rules. Reasonable coding must have certain basic principles. And reasonable coding rules can greatly improve the efficiency of data search, update and maintenance. Figure 4. shows the function of creating new categories and coding rules in the system, and Figure 5. shows the user's foreground interface of classification tree and retrieval function, which provides the download and reading of files.

![Figure 3. Example of management and system modeling subsystem](image)

![Figure 4. Creation of new category and coding rules](image)
3.3. Standardization Knowledge Management Subsystem

Standardization knowledge management can share, classify, organize, upload and download knowledge on the basis of enterprise standardization process, which can guide enterprise standardization activities. The subsystem can also manage the patent knowledge, standardization experience and documents, as shown in Figure 6.

![Figure 6. Standardized knowledge management subsystem](image)

3.4. Standardization Project Management Subsystem

The standardization project management of this system is realized by integrating common project management system (such as MS Project) and secondary development. The main content of secondary development is the compatible interface between systems.

3.5. Application Integration Extension Subsystem

Based on the application integration expansion subsystem, it can establish the interface with PDM, ERP, CAD and other information systems, support the SIMS to view the relevant documents, models, drawings and other contents of standardization online, improve the work efficiency of enterprise standardization, and provide standardization support for other information systems. Figure 7. shows the browsing function of standardized product structure integrated with Pro/E System in the SIMS.

![Figure 7. Browsing function of standardized product structure integrated with Pro/E System](image)
To sum up, by the use of SIMS, enterprises can effectively carry out standardization activities, timely obtain relevant information of standardization D&Rs and knowledge, and improve the level of enterprise standardization. At present, the system has been able to operate stably. It can normalize the process of enterprise standardization activities, enable enterprises to effectively manage existing standardization D&Rs, orderly carry out enterprise standardization activities, and improve the efficiency of standardization.

4. Conclusion
The development of enterprise SIMS based on b/s structure is helpful to manage the standardization activities of enterprises conveniently, efficiently and systematically. It could save costs, and improves the efficiency of standardized D&Rs greatly. And it enables all departments of the enterprise to make effective statistics and management on the existing standardized D&Rs and knowledge, so as to achieve the best standardization efficiency. In the future, the function and practicability of the system will be expanded further in order to make it more compatible with other information systems. And the enterprise informatization system supported by the SIMS would be formed.

Acknowledgments
This work was financially supported by Dean fund project of China National Institute of Standardization under grant No. 572020Y-7470,572020Y-7471, and project of Shandong Provincial Market Supervision Administration under grant No. 572019Z-7237.

References
[1] National People's Congress, the 14th five-year plan for national economic and social development of the people's Republic of China and the outline of vision and objectives for 2035. Xinhua News Agency, http://www.gov.cn/xinwen/2021-03/13/content_5592681.htm., 2021. 3.11.(in chinese).
[2] Lei J., Analysis of the design of enterprise SIMS. Standardization and Quality of Machinery Industry, 2020 (12): 35-38.(in chinese).
[3] Sui Y., Ding R.; Wang, H Q., Research and Development of a Management Information System for Standardization of Safety Production in an Operating Nuclear Power Plant in China Hedongli Gongcheng/Nuclear Power Engineering, 2018, v 39, n 4, p 152-156.
[4] Zhang H., Zhao F., shaoxiaodong, dingxinxing. Collaborative creation and release system of product graphic parts catalogue based on model. Journal of China engineering machinery, 2020,18 (05): 412-419.(in chinese).
[5] Zhang Z., Lai S Q., Design and development of MES system of intelligent manufacturing production line. Manufacturing Automation, 2020,42 (08): 85-86+116.(in chinese).
[6] Liu D SH., Wei B K., Y W., et al.. Design and construction of ERP system of mining enterprises based on VB. Manufacturing automation, 2021,43 (02): 1-5.(in chinese).
[7] Qin J., Wang J., Zhang SH P., Study on the management system of mine safety standardization document based on b/s model. Nonferrous Metals Science and Engineering, 2011,2 (04): 81-85(in chinese).
[8] Zhang J R., Huang Y X., Yan ZH G., et al., Design of SIMS for coal mine safety production. Industry and Mine Automation,2019,45(12):81-85(in chinese).
[9] Jia M T., Deng Y F., Feng J., Research on the implementation system of mine safety standardization based on information fusion. Science and Technology of Safety Production in China, 2017, 13 (02): 62-67.81-85(in chinese).
[10] Cai H Y., Standardization Construction of Old-name Enterprises. Social Scientist, 2018, (09): 117-123.(in chinese).
[11] Liu Y., Chen F M., Gao J M.. Development of product standardization information system for collaborative design of networ. Machine Tool and Hydraulic, 2006, (09): 212-215.(in chinese).