Research on the management information of scientific research institutes

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Abstract. Through the analysis of the management information system, this paper analyzes the pain points in the process of enterprise information construction, and puts forward solutions from the aspects of master data management, process management, the application of ESB and other basic common platform construction. Finally, this paper analyzes the special situation of informatization construction in military research institutes, and probes into the difficulties and development direction of informatization construction.

1. Management information system

The system of management informationization is relatively large, and it cannot be simply equated with office automation. The management informationization runs through the daily office, scientific research and production, product security and other aspects of scientific research institutes. Its broad definition refers to the integration of modern information technology and advanced management concepts, transforming the production and management methods, management and organization methods, and integrating internal and external resources to enhance the management level and work efficiency of enterprises and enhance their competitiveness.

Management informationization usually has a unified presentation portal, which can be composed of multiple business application systems, such as collaborative office system, human resource management system, financial management system, project management system, asset management system, product lifecycle management system, and archives control system, etc.

Its basic structure is shown in the figure 1.

Servers, storage, and network attachments, etc form the hardware foundation of the information system. The core data generated in the enterprise operations constitute the data resource layer (personnel, products, projects, assets, files, etc.), and the business process is governed by business relationships. Derived various application systems, the inter-system, system and data layer should follow the interface specification and data standard of the transport layer. The construction of the application system should consider the concatenation of its associated processes, the collection of agency information, and the unified management of accounts. For single-point registration and other requirements, military enterprises should consider the requirements of security and confidentiality management.
2. The problems in management informatization

2.1. The problem of "information island"

In the process of information construction, the term "Information island" appears frequently. With the development of enterprises, the demand for informationization of various departments is constantly clear, but limited by the limited knowledge of information, the individualized requirements of the system and the diversity of products and developers, and the construction of business application systems are mostly focused on solving the business problems of the department, without considering its expansion and standardization. Each department in the enterprise independently builds its own small house, and the result is a chaotic complex with varying levels and styles.
2.2. Nonstandard business process

The management of the process runs through the operation of the enterprise. Most of the work can be summarized and processed into several steps, such as business initiation, approval, signing, execution, feedback, evaluation, and archiving. With the processing of the business, the business approval process and business form are generated.

As shown in the figure, a financial reimbursement process, in turn, must be approved by the department head, approved by the competent department, approved by the competent authority, and finally submitted to the financial reimbursement. Since the approval nodes in the process design need the applicant to select and approve the approver, each step is returned to the applicant after approval.

The process is optimized, and the node selected by the applicant can be embedded in the form. For example, in the application form, the information of the competent department and the leader of the supervisor is selected, and the content of the form is directly read after the approval of the node, and the process is executed. Push to the next node approver. The optimized process reduces three nodes and is expected to reduce process time by approximately one-third.

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2.3. System maintenance is difficult

The development of various business application systems within the unit relies on external vendors. Due to the diversity of application development environment and application scenarios, the latter maintenance cannot be separated from the support of system developers. The application system in the unit is mostly customized according to its own needs. The strengths and weaknesses of the system depend on the strength of the developer and the post-sales support capability.

When the unit informationization develops to a certain level, the demand for information interaction and sharing becomes more and more urgent. In the initial stage of system integration, most
units will propose the requirements of unified display, unified user management, and single sign-on of accounts. But in the initial stage of enterprise development, due to the small number of application systems and low complexity, the point-to-point approach is adopted to integrate. This kind of integration method is quick, the technology structure is simple, and the cost is low. It is the first choice for the SMEs in the initial stage of informationization.

However, because of the point-to-point connection between each system and n subsystems, each system has n-1 paths expected to connect. As the number of systems increases, each system needs to be integrated with other n-1 systems. Cutting a single system failure may affect other n-1 systems. The mesh connection will be very bloated and huge, and the maintenance of the system will also lead to the whole body. The troubleshooting of each system may involve the cooperation of multiple integrated systems, under these circumstances, it is difficult to maintain.

3. Solutions and construction ideas

In view of the problems faced by management informationization, the ways to solve the above problems are discussed from the aspects of the application of master data and ESB, the specification and combing of the process, and the standardization of development and operation and maintenance.

3.1. Application of master data and ESB

Master data refers to high-value, reusable data shared between systems, such as materials, suppliers, customers, finance, employees, products, etc.

![Image]

Master Data Management (MDM) is used to ensure the real-time, consistency and reliability of master data in the enterprise. It provides a unified data source and coding system, creating application and changing processes for unified data, managing data quality, and implementing data centralized collection and distribution.

The implementation of master data management can be divided into the following steps:

3.1.1. Data status survey and demand analysis. The data is screened, and the basic data types, the data volume, the information systems of the respective mappings, and the integrity of the data are sorted and counted, and the application scenarios of each data are emphasized, the information system that needs to refer to the data, and the interaction of the data are analyzed.
3.1.2. **Data preparation and specification standards.** According to the research situation, the data is filtered, and the business demand department participates in the formulation of data standards, such as the financial department, project management department, human resources department, purchasing department, and quality department, respectively, for relevant financial data, project data, customer data, personnel data, Material box supplier data, product quality data, etc. are screened and coded. At the same time, it is necessary to establish mapping rules for new and old codes, and clean the historical data to ensure data quality and consistency.

3.1.3. **System integration and implementation.** It mainly includes user management, permission setting, data resource management process development; import of historical data, establishment of data resource pool; definition of data source system, use system, design integration interface, and definition of interface specification for subsequent access system integration.

3.1.4. **Operation and maintenance of the system.** Maintain data, timely data evaluation and integrity check, and monitor the distribution and growth of analytical data, interactive use, and data management performance.

Enterprise Service Bus (ESB) refers to the combination of traditional middleware technology and technologies such as XML and Web services. ESB provides the most basic connection center in the network and is a flexible interconnection architecture that integrates applications and services. ESB is the industry's recognized solution for application integration. Its main functions are as follows:

- **Router:** used for data transfer between services;
- **Converter:** conversion of a transport protocol between the requester and the provider;
- **Translation machine:** conversion of the data format between the requester and the provider;
- **Event processing:** collect and process business time from different data channels

The ESB can improve the network call relationship between the original application systems, reduce the integration complexity and development difficulty between the systems, and improve the standardization of interaction between the systems. At the same time, the amount of integrated development caused by system changes and iterations is minimized, which effectively reduces the cost of information operation and maintenance.

In the implementation process of the ESB, it is also necessary to pay attention to some problems brought by the bus architecture, such as the data surge and interface congestion caused by the concentration of the interface channel, the data delay caused by the processing speed limitation of the bus, and the concentration of the data volume. Network pressure issues, etc. For the corresponding problems, the network architecture, interface services, and cluster load should be optimized according to the current status of the enterprise network. Plan as early as possible to reduce implementation risk.

3.2. **Process sorting and application of BPM platform**

In process management, process modeling is the final display of its process engine application. The key links and most of the workload are still the planning and combing of the process. According to the existing management system documents, the flowchart shown in the form is visualized, optimized and refined into electronic processes that can be realized by the system, and the monitoring, analysis and optimization of the management process are integrated into the process management according to the needs of the work and the characteristics of the process engine. In the formation, planning - combing - modeling - operation and maintenance - monitoring - analysis - optimization of the benign cycle of iteration.

There are many systems, processes, and knowledge in the enterprise, scattered in various systems and departments. Process combing refers to in-depth and meticulous analysis, collation and refinement of the business characteristics and management status of the entire enterprise, focusing on the internal and external factors of the enterprise, clarifying the key points of management, the key issues to be solved in information management, and possible solutions. Way, degree of resolution, etc.
The size of the process combing workload is closely related to the refined management level of the enterprise. If the system documentation is sound and the standardization degree is high, the process combing work is easier to advance. On the contrary, if the enterprise is in the ascendant period and the relevant management processes and systems are still not perfect, the process of combing the work is more difficult. In this case, it is recommended to sort out the key processes in a thick line, and then refine the related process as the enterprise develops. The difficulty in facilitating the process of the process is that this is a work involving all employees of the enterprise management department and the business department. The informationization department often cannot accurately grasp the relevant work processes of the business department, and the business department has the means and presentation of informationization. I don't understand, communication and cooperation in the construction process are often directly related to the success or failure of the project. The process combing contains the following key points:

- The systematicity of process grooming, it is recommended to use the process planning method to analyze the company's business value chain model from the company's top-level process plan, and then go to the end-to-end level process planning until the operation layer process, sub-processes, activities and tasks;
- Improve the quality of process grooming, pay attention to the value orientation of process design, streamline the process interface, detail the responsibilities of each position/role in the process, establish effective control rules and procedures, and solidify the excellent business practice experience into the process. To ensure efficient and smooth business operations;
- In the process of process grooming, it is necessary to emphasize the leading role of business experts, rather than the responsibility of the process management department, and not the leading of the informationization department;
- Communicate fully with the informatization personnel in the process of process grooming, on the one hand, enable the informatization personnel to fully understand the business design rules, and on the other hand, help the business personnel to think about how to use IT tools to improve the process design quality.

The Business Process Management (BPM) platform helps companies optimize their business, integrate systems, improve management efficiency, and replace existing systems that do not meet their needs. The BPM platform is a systematic management method that aims to continuously improve end-to-end business processes and to continuously improve work efficiency. The process is planned, combed, modeled, operated, monitored, analyzed and optimized. Monitor and analyze the execution time and execution status of each node in the analysis process, analyze the problems existing in the business process, optimize the process in management, shorten the processing time of the process, and improve work efficiency.

The BPM platform is a low-code, fast-developing process management platform. Process designers do not need high code development experience to complete process and form design. The platform is simple and flexible, and can design and execute more complex business processes. Rather than simple approval, data exchange between various forms is realized, and platform data is managed in a unified manner.

The BPM platform includes process grooming, process design development, process engine, application integration, process monitoring, process analysis and other components. Its main advantages are process grooming, monitoring and analysis.

3.2.1. Process combing. The process grooming tool is based on the life cycle management functions such as process drawing, presentation, approval, release, evaluation, update, etc., through the unified platform to achieve information sharing and collaborative work within the organization, from system management, organizational positions, strategic performance, Risk management, quality management and other management dimension integration and process integration, breaking the management island, forming a multi-management system integration based on the actual business path-process of the
enterprise, realizing the effective unification and implementation of the entire operation management system.

3.2.2. Process monitoring. Users manage processes through process monitoring components, including replacement execution versions, agent to-do management, job transfer management, and audit log queries. And monitor the process execution, view the process execution process, check the process, activity, activity item results are correct, performance and other indicators and monitoring of the process's running status (start, suspend, wait).

3.2.3. Process analysis. All process data in the BPM system, including process instances, process nodes, etc., need to be stored in a specific format. Using BI technology to conduct multi-dimensional and in-depth analysis of process data through data warehouse, find process problems, and provide basic data for optimization process. The BPM process analysis dimensions include: process quantity, time, cost, recovery status, timeout status, reminder status, reason for initiation, and end method. The BPM system can generate various analysis reports for the above various dimensions, and the report tool can support custom development.

3.3. Standardization of development and operation and maintenance
With the growth of the scale of enterprise information systems, the task volume and cost of operation and maintenance and development are intensifying, and most enterprises will shift from outsourcing operation and maintenance to autonomous operation and maintenance. The complexity of the information system is different, the development environment is diverse, and the system development and maintenance have higher requirements for the operation and maintenance personnel. The establishment of a professional operation and maintenance development team is heavier for most enterprises. Therefore, the compromise between independent operation and maintenance and outsourcing operation and maintenance is more common in enterprises. Faced with the pain points of system maintenance, the following three solutions are proposed.

3.3.1. Standardized standardization of system development. In the initial stage of system development, technical architecture standards, component standards, platform integration specifications, code specifications, software process management specifications, etc. are determined. Informatization personnel should deeply participate in the development of the system, understand the configuration, change, and development process of the system, accumulate development and design experience, and require the system developer to train the enterprise informatization personnel to develop and apply the system. At the same time, the project should have a complete delivery, including instructions for use, design documents, test reports, and so on.

3.3.2. Establish operation and maintenance development own knowledge base. In the development, testing, and operation phases, detailed problems should be recorded on the problems and solutions of the system. The daily operation and change process of the system should be standardized, and the knowledge base of operation and maintenance development should be established to facilitate the later maintenance and traceability of problems. The establishment of its own knowledge base can effectively protect the informationization results of enterprises, train the ability of the information construction team, get rid of the dependence on the developers, and share the development and application knowledge of the system to avoid the fault of system operation and maintenance development caused by single person loss.

3.3.3. Improve the professional level of the information team. Gradually build a professional team of information construction and maintenance, enhance the professional level of construction and management personnel through training and communication, strengthen the development and
application of information systems, understand the application system in the construction process, and gradually weaken the dependence on the developers.

4. The particularity of information construction in military research institutes

The particularity of the military research institute industry has caused more restrictions on the interaction of its information. Its corporate information involves not only trade secrets but also part of state secrets. Information transmission involving state secrets is physically isolated from the external network, and has strict control over the import and export of its information. Many security products are deployed inside the network (identity authentication, intrusion detection, and three in one), there is a strict censorship system for the application system. Therefore, the complexity of its network environment makes it difficult to deploy and operate the application system.

4.1. The relationship between information sharing and security

Informatization construction is the representation of information technology application. It is the process of information acquisition, transmission, processing, regeneration and utilization. The process of obtaining and transmitting information of military research institutes has special requirements.

The classified information system has strict control over the scope of information, and the control of authority and the control of users are more granular. A layer of checkpoints is added to the interaction of data. Military research institutes use centralized input and output to manage. Strictly control the information exchange between the confidential network and the outside.

Information sharing and security are not contradictory. They should not be squandered because of data security issues. Under this circumstance, the information should be controlled from the source. When the data is generated, its confidentiality management should be done, and the flow direction should be controlled according to the confidentiality level and the knowledge scope, and the information confidentiality management should be integrated into the development framework of the information system.

4.2. Difficult to integrate with the Internet

The network of military research institutes is mostly a classified network. It is strictly prohibited to access the Internet according to relevant confidentiality requirements and is physically isolated from the external network.

In order to adapt to the development trend of informatization and intelligence, most military research institutes use the two networks of confidential network and non-close network to handle daily work in parallel, and separate confidential business and non-confidential business. Utilize the convenience of Internet technologies such as mobile office and cloud applications to improve work efficiency and information application level.

4.3. The network environment is more complicated

In the confidential network of military units, there are related requirements and restrictions on software and hardware. The deployment of application systems must follow strict review standards, its functions and composition, administrator and user authority, development unit qualification, and system security. Analysis, software test reports, etc. are reviewed. Strict security domain partitioning for confidential and non-conflict applications, and strict restrictions on their interactions between domains. Security and confidential products such as access control, auditing, and intrusion detection should be deployed on the hardware server and terminal as required.

Explore the application of private cloud platform, build a lightweight client environment, achieve unified online design, controllable software and hardware versions, unified deployment of online design resources, and online high reliability storage of design data.
5. Conclusion
Through the analysis of the management information system, this paper analyzes the pain points in the process of enterprise information construction, and proposes solutions from the aspects of the main platform construction such as master data management, process management and ESB application. Finally, the paper analyzes the special status quo of information technology construction of military research institutes, and discusses the difficulties and development direction of its information construction.

Informatization construction has the characteristics of large investment, slow effect and long cycle, and the construction of the underlying platform is even more so. The construction content is to lay the foundation for the overall information construction. The effect is often subtle and affect the business system, which cannot directly show the construction effect. In the process of construction, we should do a good job in the popularization and publicity of informatization, and strive for the recognition of leaders and the cooperation of relevant departments. In order to control construction risks and reduce implementation resistance, enterprises should adhere to their own characteristics, adhere to the principles of overall planning, step-by-step implementation, and key breakthroughs, and promote the construction of informatization in an orderly manner.

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