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Design and Implementation of Special Chemical Management System Based on XML Encryption Principle

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A reasonable and effective special chemical management system can not only facilitate the application and use of chemicals by enterprises, but also facilitate the supervision of regulatory departments, and it can prevent special chemicals from flowing into illegal channels. In this paper, the design and implementation of special chemical management system is studied. A special chemical management system based on distributed workflow is designed. Symmetry and asymmetry XML encryption algorithms are combined together to ensure the information security of the system. This paper takes the special chemical management purchase process as an example to perform example analysis, and the study finally realizes the design of special chemical management purchase process, distributed circulation file and circulation file encryption based on XML encryption principle. The XML document encryption strategy proposed in this study can effectively ensure the safety of information related to special chemicals, and has certain practical application value.

1. Introduction

Special chemicals are usually highly toxic or corrosive. Although they can be used in people's production and life, if not used properly, they can also be used as raw materials for the production of poisons (Wodtke and Weikum, 1997). Therefore, the related business of special chemicals is the focus of management for regulatory departments of all levels. A reasonable and effective special chemical management system can not only become a useful regulatory tool for the regulatory departments to prevent special chemicals from flowing into illegal channels, but also facilitate the application and use of chemicals by business users.

At present, China has realized the network management of special chemicals. The regulatory departments of all levels and related special chemical enterprises can complete related business through the network platform. The regulatory departments can also supervise and manage enterprises through the network (Li et al., 2016). However, there are also problems such as the inability of the system to adapt to process changes, the need to improve the processing speed of the business, and the insecure database synchronization strategy (Ogunbode et al., 2018). The execution of the entire process instance in the distributed workflow management system is achieved through the collaboration of workflow engines distributed in different environments, which can reduce the engine load and improve the system operation speed (Lee et al., 2016). The distributed workflow management systems based on event-driven, removable proxy and persistent message queuing are typical distributed workflow products (Vernero and Montanari, 2010). In 1998, WEB Standardization Organization developed a circulationlined version of SGML, namely XML (Hanpattanakit et al., 2018). XML is a set of open standards that emphasizes the separation of content descriptions from formal descriptions. It is a lightweight data storage file that is interoperable and extensible, supports multiple encodings, makes applications more flexible, and its encryption can be refined to the element level (Schwarzman and Wilson, 2009), after a XML is encrypted, users can only access the relevant content that they are authorized. Although there are many research results on XML-based technologies at home and abroad, there are few studies on the management of special chemicals (Gao et al., 2008).

Based on the above analysis, in order to effectively protect the information security of the regulatory departments, meet the special needs of regulatory work, and flexibly adapt to the company's application and approval process for special chemicals, and to improve the processing rate of the business, this paper analyzes the requirements and main business processes of special chemical management system in detail,

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and based on this, introduces the distributed workflow technologies, and designs the system structure and overall architecture of the special chemical management system based on distributed workflow in detail. Taking the purchase of special chemicals as an example, this paper designs the special chemical management purchase process, distributed circulation file and circulation file encryption based on XML encryption principle, and verifies the practicality and effectiveness of the system by the implementation of the design.

2. Requirement analysis of special chemical management system

2.1 System distributed requirement analysis

The main business of the special chemical management system is the regulatory departments' approval for the company's business related to the special chemicals (Fish, 2011). In order to ensure the information security of the regulatory departments and improve the security level of the system, this paper uses a distributed workflow-based management system, in which the enterprises and the regulatory departments are in different network environments, and the information platform is different, the related data resources are called by the information flow engine through the Web service (Ohl and Moser, 2010). In addition, the system also needs to contact the relevant units in a vertical direction to achieve information resource sharing and business collaboration.

2.2 System function requirements

Supervisory departments of all levels, and the production, purchase, use, transportation and operation enterprises are related organizations involved in the special chemical management approval process. Therefore, the system should include the regulatory departments' business approval and inquiry, process management, process anomaly management, user management and access control, also it should provide various interfaces, data exchange and other functions (Tarasova and Makarova, 2013).

2.3 Main business processes

There are about 140 business processes related to the special chemical management system (Hong and Heo, 2004), but these processes are basically the same, in which, enterprise account opening, purchase license application, transportation license application, purchase return, data modification, enterprise qualification change, enterprise attribution place change, license record and certificate revocation, overdue warehousing alarm, inventory cross-border alarm are some typical business processes in the special chemical management system (Carminati and Ferrari, 2003). This paper takes a special chemical purchase license application as an example to describe its process in detail, as shown in Figure 1. Enterprises that purchase special chemicals should first apply for and obtain a purchase license of corresponding level. The purchase application form should include the corresponding qualifications of the enterprise. After submitting the application, the application cannot be modified. If the application is to be modified, it should be withdrawn. The local county-level approval department approves the purchase application of the enterprise, focusing on the authenticity, purchase quantity and use of the transaction. If the qualification is found to be incomplete or expired during the review process, the application will be rejected and the enterprise needs to modify it again.

3. Design and implementation of special chemical management system based on XML encryption principle

3.1 Distributed workflow system architecture

From Figure 2 we can see that, in the system distributed workflow organization graph, the two workflow engines on the enterprise side and the regulator side are parallel, the enterprise side submits the business application through the web browser, the workflow engine creates or executes corresponding activity instances according to the local process definition files. Through the message service function, the activity instances can be sent to the regulator side workflow engine of the regulatory departments to realize the collaborative work of the enterprise and the regulatory department.

3.2 System architecture

In order to be able to clarify the decomposition of project tasks, to describe all the contents of the system at all levels, and to reflect the sustainability and scalability of the system, this paper adopts the idea of modular planning and hierarchical construction to design the system architecture (Si et al., 2012), Figure 3 shows the hierarchical structure of the system. It can be seen from the figure that the system is divided into four layers, wherein the application layer provides a platform for the operation of the workflow approval system, it includes three parts: the enterprise subsystem system, the supervision subsystem and operation management

subsystem. The execution of the entire process is controlled by the workflow engine. Therefore, the control layer is the core of the whole system. The description of various service interfaces and the access control of the database are implemented by the service layer and serve the upper layer through the Web service. The operation of all data such as workflow instance data information and modeling data information required by the system is completed by the data layer.

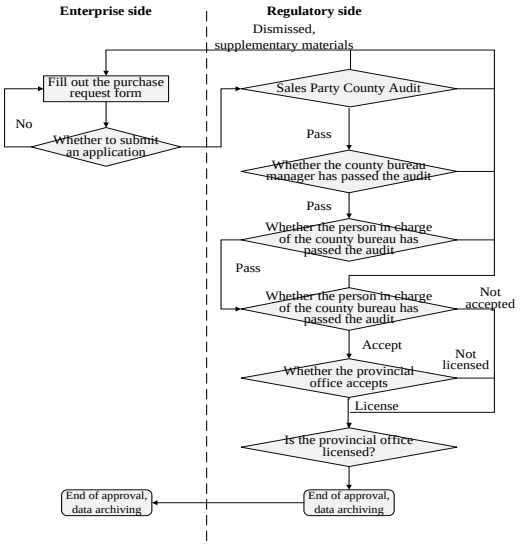

Figure 1: Special chemical transportation license approval process.

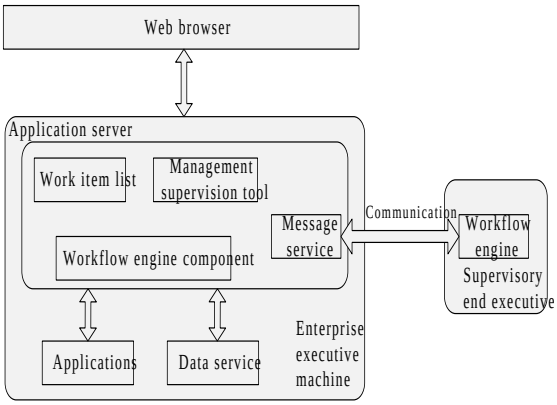

Figure 2: System distributed workflow organization graph

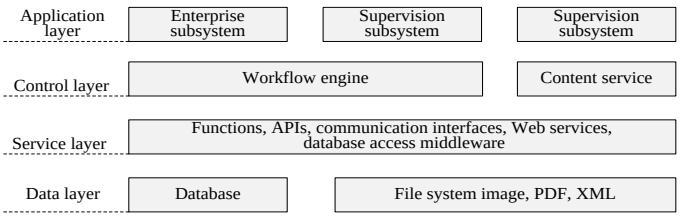

Figure 3: System hierarchy graph

3.3 System overall architecture.

The system includes workflow definition tools, process definition synchronization, workflow engine operation, distributed process monitoring, form data mapping and data synchronization modules. The data exchange of the system is based on the data synchronization module (Bertino et al., 2017), Figure 4 shows the overall block graph of the enterprise side, and the regulatory department is the same.

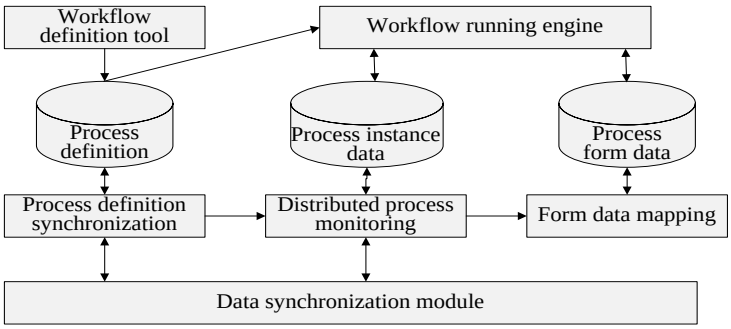

Figure 4: Overall block graph of the enterprise side

3.4 Design of distributed workflow circulation files

This paper takes the form of XML document to describe the data information of distributed workflow circulation. The XML document structure is described by an XML schema file, the element defines the elements in the document, the attribute defines the attributes in the document, and the complex type is defined by the complexType. Figure 5 shows the node relationship designed by the XML document schema defined by the purchase business process.

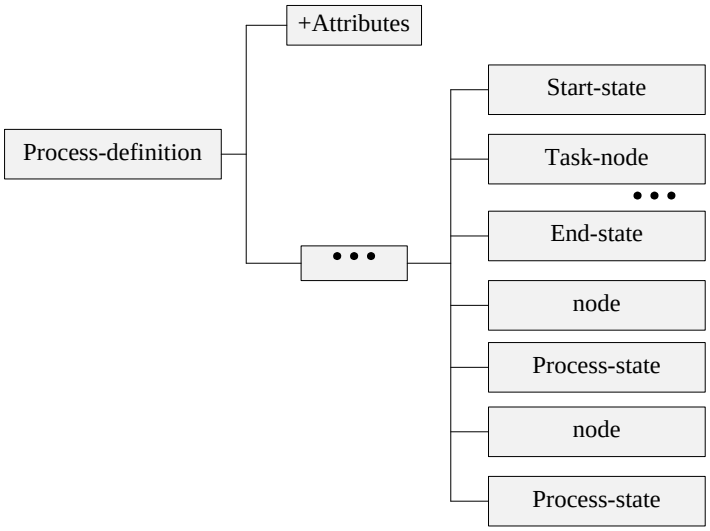

Figure 5: Purchase business process definition XML document schema diagram

Figure 6 shows a portion of the code for an XML document defined by the special chemical purchase business process designed in this paper.

```
</task-node>
<task-node name="cchargepeople">
        <task name="accepted"/>
        <transition name="accepted" to="end"/>
        <task name="naccepted"/>
        <transition name="naccepted" to="end"/>
</task-node>
<end-state name="end"/>
<node name="revocation">
        <transition name="" to="revo-sub-process"/>
```

Figure 6: Part of the code for the XML document defined by the purchase business process

3.5 XML circulation file encryption design

XML encryption is to convert the data that needs to be encrypted into a string that cannot be recognized by ordinary people after selecting an appropriate encryption algorithm. The selection of encryption and decryption algorithms and the determination of encrypted data are two key tasks of XML encryption, symmetric and asymmetric encryption are two encryption algorithms commonly used in XML. The secret key used by the sender encryption and the receiver decryption in the symmetric encryption algorithm is the same secret key agreed in advance, its advantage is that the processing speed is fast. In the asymmetric algorithm, the secret key is divided into two types: public key and private key, so the asymmetric algorithm is more secure. In order to achieve fast and secure encryption of data, this paper adopts an algorithm that combines the symmetric algorithms with the asymmetric algorithms.

Figure 7 shows the XML information security model, which divides XML encryption into four steps:

(1) XML plaintext conversion, which converts data of other formats into files of XML format.
(2) XML ciphertext conversion, the XML plaintext of the first step is converted into XML ciphertext by the encryption algorithm selected in this paper. In order to ensure the non-repudiation of XML, multi-signatures are required.
(3) Decrypt the XML ciphertext and convert it into XML plaintext.
(4) Convert the decrypted XML plaintext into other required format documents.

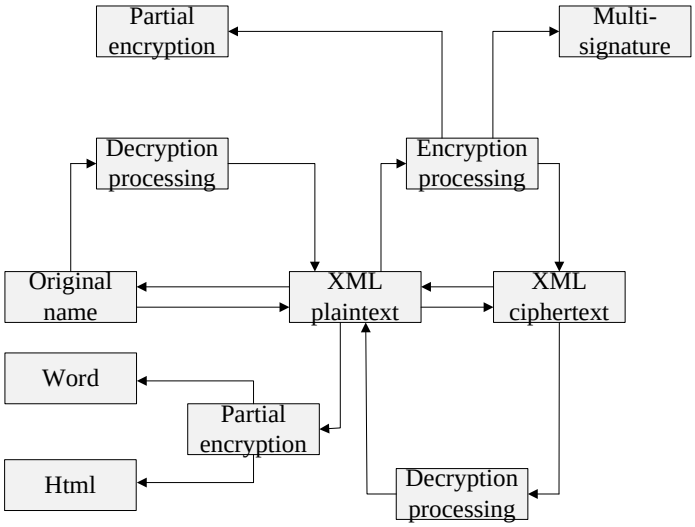

Figure 7: XML information security model

Figure 8 shows an encrypted XML instance file based on the special chemical purchase business process example designed above. By encrypting XML, users can only access content that they are authorized to access, and if they are not authorized, they cannot access it.

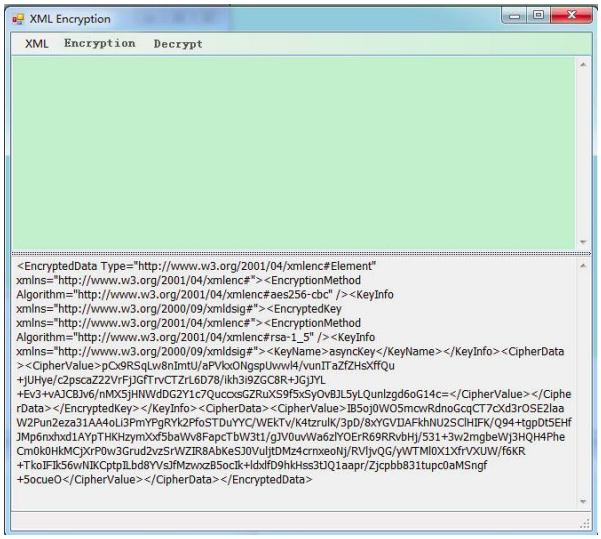

Figure 8: Encrypted element

4. Conclusion

In order to ensure the safety of special chemical information and improve the processing efficiency of the business, this paper studied the design and implementation of special chemical management system. The specific conclusions are as follows:

(1) Starting from the requirements of special chemical management system, this paper studied the distributed requirements, functional requirements and main business processes of the system, taking the purchase of special chemicals as an example, it designed a special chemical purchase process.
(2) This paper analyzed and designed the distributed workflow architecture, system architecture, system overall architecture, and the distributed workflow circulation files.
(3) Taking the special chemical purchase process as an example, this paper designed and implemented the circulation file encryption based on XML encryption principle, the design results showed that the XML encryption strategy designed in this paper was safe and effective.

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