Integration technology of logistics information resources in electric power enterprises based on web services

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Abstract: In order to overcome the problems of high data access delay and poor security in current logistics management of electric power enterprises, the integration technology of logistics information resources in electric power enterprises based on web services is proposed. ID3 algorithm is used to rank the attributes of logistics information resources in power enterprises. Based on web services, three-dimensional mapping space is constructed by using attributes and management patterns of information resources. The best integration mode is obtained by combining rules, to realise the integration of information sources to resources storage and transmission. The experimental results show that the data access delay of the proposed technology is less than 10 s, and the security of data integration and the satisfaction of integration results are higher than 95%, which proves that the proposed technology is more reliable and effective.

Keywords: web services; power enterprises; logistics; information resource integration; ID3 algorithm.

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1 Introduction

According to the relevant requirements of electric power enterprises, logistics information management platform of enterprise needs to be further improved to achieve high-level information platform services, and promote that logistics management work can be faster and more comprehensive development (Koraki and Kai, 2017). Based on the overall needs of power enterprises, according to the principles of comprehensive coverage and module partition, the information resources of various parts of enterprise logistics are integrated to build an application management system which is consistent with the internal enterprise and can make the information system stable.

The integrated management platform of logistics information resources in power enterprises is a comprehensive information resources management platform which integrates management, service and operation based on the internet. The platform is used to fuse and share various types of information to provide users with more comprehensive services. The earliest computer to be used in power system is a miniature IBM computer arranged in the electric power logistics system of the USA, which mainly realises the automation management of logistics information resources. In the 1980s, in China, foreign computer information technology was combined and applied to the power system. Until the 1990s, computer technology has made a leap forward, and various types of system management software have been optimised (Zhang et al., 2017). Up to now, there have been many research results on information resources integration management of power enterprises in China.

Ma and Wu (2016) propose an integration technology of logistics information resources for electric power enterprises based on EA technology. The system structure of data resources integration is constructed by using SOA technology. The current information system data and applications can be connected and integrated by using modern EA technology. However, the accuracy of information resources integration is insufficient and the accuracy of this method is low. Ye et al. (2019) propose the integration technology of logistics information resources in power enterprises based on enterprise architecture. From the perspective of enterprise's overall situation, this paper uses Portlet technology to analyse the theoretical basis of the design of information integration model, and carries out the design and application of enterprise's information integration architecture model. However, this method is too simple and the scope of resource integration is limited. Zhang (2016) proposes a Spark-based integration technology of logistic information resources in power enterprises. The application of big data technology in power industry is analysed. The power data warehouse is designed and constructed by MAS technology, and the power data integration model is constructed. The connection between data is determined based on the cosine value of eigenvector angle, so that the inconsistent data can be repaired and integrated. The accuracy of information integration is high, but the efficiency is low and the effect is not ideal.

Because the current method is not based on web services, and ID3 algorithm is used to perform sorting operations on information resource attributes, the method has problems such as high data access delay and poor security. In order to solve the problems existing in the current method and realise the effective integration of the logistics information resources of power enterprises, ID3 algorithm is used to sort the related attributes of the logistics information resources of power enterprises. Based on web services, the three-dimensional mapping space is constructed with attribute characteristics to realise the effective integration of information resources. The best integration method is obtained by using the synthesis rule to realise the resource integration from information source to storage and transfer. The data access latency, data integration security and integration result satisfaction of different methods were compared. The experimental results show that the proposed method has better practical significance.

2 Integration technology of logistics information resources in electric power enterprises

2.1 Architecture of resource integration management

The technology of integrated management for logistics information resources in electric power enterprises is divided into seven management modules, which are accessory equipment management module, low-value consumables management module, maintenance management module, heating subsidy management module, logistics-related cost management module, labour insurance supplies management module and authorisation management module. Each module is interrelated to each other to better realise the integration of logistics information resources (Liu et al., 2016).

2.1.1 Accessory equipment management

This part regards fixed assets account of ERP financial as the basic data. It is composed of three management sub-accounts, i.e., the real estate and land, the rental of idle houses and the accessory equipment.

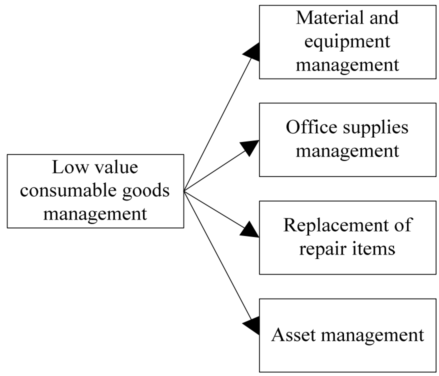
The information resources of rental real estate can be managed accordingly, and the information of rent collection can be prompted to users by the management platform. The accessory equipment management sub-account can be built for each real estate, which includes a series of equipment such as elevators, water supply and heating. The use and annual inspection of accessory equipment can be recorded and transmitted to users. The main ways of information notification are window prompt and short message prompt.

2.1.2 Management of low-value consumables

In this module, low-value consumables account in the form of card is constructed to manage information such as logistic office users of power enterprises (Zhi et al., 2016).

The most important one is material management, which mainly includes the aspects shown in Figure 1.

Figure 1 Material management



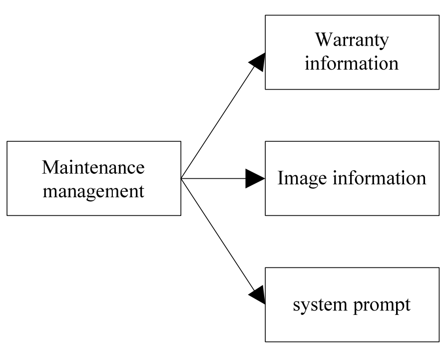
Material management in Figure 1 mainly includes material equipment, office supplies, replacement of repair items and asset management to realise information management of office supplies in power enterprise departments.

2.1.3 Maintenance management

In this module, it records the historical maintenance information of large, medium and small accessory equipment, and then realises the query of historical information resources. Users only need to input the corresponding index items to get historical information.

In addition, the basic units of power enterprise logistics can use this module to realise the functions of maintenance and image transmission (Wang et al., 2016a). Maintenance management requirements are shown in Figure 2.

Figure 2 Maintenance management requirements

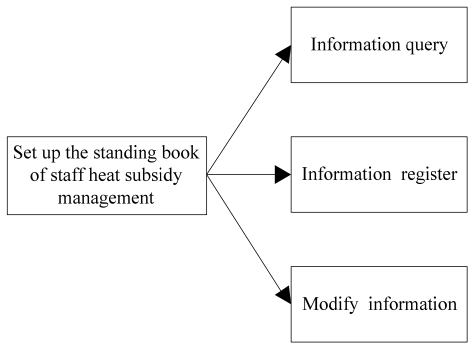


2.1.4 Management of subsidies for heating fees

This module can query the status of each worker's heat subsidy by constructing the worker's heat subsidy account, and manage the information and enjoyment of the worker's heat subsidy accordingly. At the same time, it can register and modify the information of the heat subsidy (Qu et al., 2017; Li et al., 2017).

As shown in Figure 3, a schematic diagram of worker's demand for heat subsidy management is given.

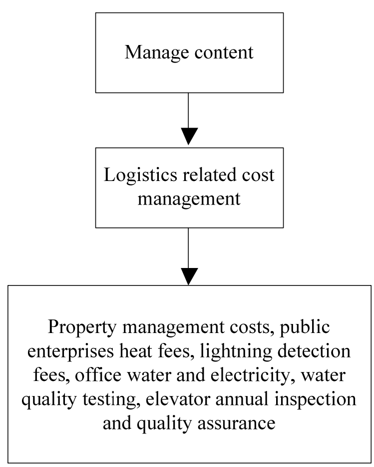
Figure 3 Schematic diagram of management needs of staff and workers' heat subsidy



2.1.5 Logistics-related cost management

The module manages the overall cost accordingly, including property management cost, public enterprise heating fee, office water and electricity, etc. Figure 4 shows the requirements of logistics-related cost management.

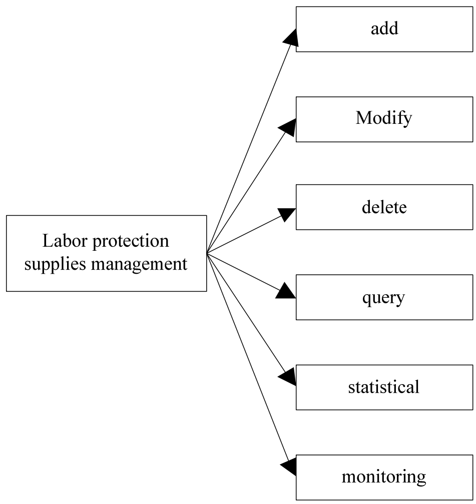
Figure 4 Requirements of logistics-related cost management



2.1.6 Labour insurance supplies management

In this module, the management account of labour insurance supplies is built to manage labour insurance supplies information. Users can use the integrated platform to update, modify and delete the information of labour insurance products accordingly (Lou et al., 2016). Figure 5 is a schematic diagram of the demand for labour insurance supplies management.

Figure 5 Schematic diagram of labour insurance supplies management requirements



2.1.7 Authorisation management

This module is mainly responsible for the security of logistics information resources in power enterprises. Considering the particularity of logistics information resources in power enterprises, the design of management authority is realised by using the mode of agent access and hierarchical authorisation. In privilege setting, security management is more flexible and convenient according to hierarchical privilege management (Lv et al., 2017).

In the hierarchical authorisation, the authority is divided into two levels: the user's right of application database and the user's right of system. User rights are managed and configured according to the scale of application software. Administrators assign and manage the rights of database users. The portal setting authority of logistics information resources integration in power enterprise includes operators, roles and authority. Among them, authority labels the operation with permission. Managers arrange various roles for operators, and use them to set permissions for roles, so as to determine the permission of operators.

There are two modes of role setting: administrator gives each role a set of permissions, gives an operator several roles, and the operator uses inherited role authority to have permissions; the operator is directly given a set of corresponding permissions (Wang et al., 2016b; Jiang et al., 2019).

Proxy access: refers to the access of database using application service layer. Users do not need to connect with database or directly to access database. The Middleware in application server receives all requests for information resources operation. When the authentication of middleware is completed, the corresponding service process is invoked to realise information resources access.

In the process of using proxy access technology and hierarchical authorisation, it can not only reduce the pressure of managers, but also hide information resources without exposing the database directly in the public network, thus reducing the number of attacks on resource integration database and ensuring data security (Lu et al., 2016).

2.2 Integration technology of logistics information resources in electric power enterprises based on ID3 algorithm

The integrated management of logistics information resources in electric power enterprises is a key component of the daily operation of electric power enterprises. The research on a logistics information resources integration technology with relatively comprehensive performance, relatively convenient operation and timely response can effectively improve the work speed of logistics staff. Therefore, the integration of logistics information resources in electric power enterprises can be realised based on web services (Zhang and Pan, 2016). Web service is a technology of service-oriented architecture. By providing services through standard web protocols, it can ensure the interoperability of application services on different platforms.

Assuming that S represents the set of logistics information resources of electric power enterprises, which includes attribute subset A of network information resources, source subset R of network information resources, destination subset T of network information resources, subset M of network management modes, and subset O of network application occasion. n represents the number of network information resources, then there are:

$$S = \{A, R, T, M, O, n\} \tag{1}$$

where M is a set of network management modes and means. In order to facilitate calculus in the integration of logistics information resources in power enterprises, it is assumed that the elements of method set are the way of storage and transmission, and are defined as α and β. Among them, $\alpha = \{\alpha^m, \alpha^t, \alpha^l\}$ represents a set of elements in set α of network management modes (Li et al., 2016). α represents the enumeration value of network management elements.

Figure 6 is a mapping model of logistics information resources integration in power enterprises.

ID3 algorithm is a greedy algorithm used to construct decision trees. The advantages of ID3 algorithm are: assume the space contains all the decision trees, search space is complete; not susceptible to noise; you can train instances that lack attribute values. Therefore, this algorithm is selected to be applied to information resource integration. According to ID3 algorithm, the sample set S of network information resources is operated as follows: the decision attribute class set A^{*n} is obtained from the set A of S attributes, and then there are:

$$A^{*n} = \varphi_{ID3}(S) \tag{2}$$

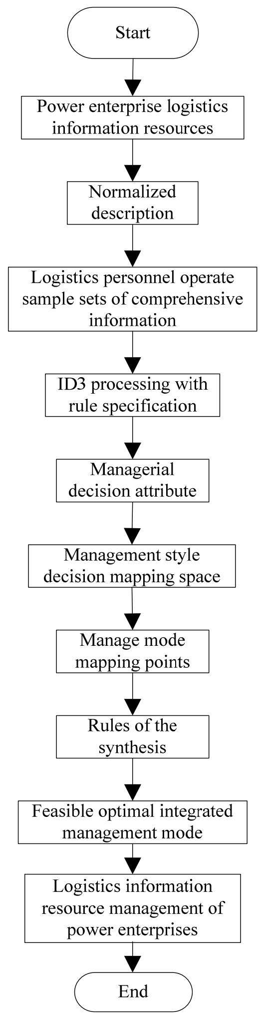
Formula (2) represents the acquisition of the set of attributes by operating on the set of S according to the ID3 algorithm. A^{*n} is not only the basis of information resources integration, but also the basis and reference attribute of constructing classification integration model (Mo and Zhang, 2017; Xie and Lai, 2016).

Based on web services and combining the attributes in A^{*n}, three-dimensional mapping space is to construct, there are:

$$A^{*n} \rightarrow \Omega_{X,Y,Z} \tag{3}$$

If $p_i(x, y, z) \in \Omega_{X,Y,Z}$, then it represents that a certain information resource is a mapping point in three-dimensional space.

Figure 6 Mapping model of logistics information resources integration in electric power enterprises



Under $\Omega_{X,Y,Z}$, according to the integration rules, the feasible optimal integration management mode is obtained.

$$m(\alpha\beta) = \varphi[p_i(x, y, z)] = \alpha_j^m \alpha_j^t \alpha_k^l \beta_i^m \beta_j^t \tag{4}$$

According to the above calculation, the rule of composition can be expressed as:

$$\sum_{j=p} \omega\alpha_{ij}^{m} = \max_{\substack{q=1,\dots,n \\ i=x,y,z,\dots}} \left\{ \sum_{j=p} \omega\alpha_{ij}^{m} \right\} \tag{5}$$

According to the rules of integration, the best management mode is obtained, to realise the management process from information source to storage and transmission.

$$R \xrightarrow{M^*} T \tag{6}$$

Assuming that there is a point $P = P_i(x, y, z)$ in the three-dimensional management mapping space, then there are the following relations:

$$\begin{aligned} P = P_i(x, y, z) &= \left(\alpha_x\beta_x, \alpha_y\beta_y, \alpha_z\beta_z\right) \\ &= \left(\alpha_{xi}^{p}, \dots, \alpha_{xj}^{q}\beta_{xi}^{p}, \dots, \beta_{xj}^{q}\right) \\ &= \left(U_x, U_y, U_z\right) \end{aligned} \tag{7}$$

$$U(u) = \alpha_{ui}^{m}\alpha_{uj}^{t}\alpha_{uk}^{l}\beta_{ui}^{m}\beta_{uj}^{t} \tag{8}$$

In the above formula, the standard for storage medium of network secret dimension is α_x^m, the standard for storage medium of network time-sensitive dimension is α_y^m, the standard for storage medium of network quantity dimension is α_z^m, the standard for storage time of network secret dimension is α_x^t, the standard for storage time of network time-sensitive dimension is α_y^t, the standard for storage time of network quantity dimension is α_z^t and the standard of three network dimensions for storage location is α_x^l, α_y^l and α_z^l, respectively.

In the integration of logistics information resources in power enterprises, the attributes of network information resources based on web services have corresponding requirements for management methods and means. In general, a relatively excellent management mode is selected for a variety of attributes at the same time (Deng et al., 2016). Based on the attributes of network secret level, time sensitivity and quantity size, the resource integration management mode is selected. ID3 algorithm is used to construct the basic and reference attributes of the classification integration model, construct the 3d mapping space based on web services, and optimise the management mode, so as to realise the integration of logistics information resources of power enterprises based on web services (Wang and Zou, 2017).

3 Experiments and discussion

In order to verify the overall performance of integration technology of logistics information resources based on web services for power enterprises, an experiment is conducted. The experiment chooses a provincial electric power service company as the experimental object, integrates its logistics information resources in an all-round way.In order to improve the reliability of the experiment, refer to the experimental data setup and data preprocessing methods in Zhang (2016). And chooses any group as the initial simulation parameters to compare the resource integration effect based on this method. The experimental environment is configured as follows: Intel Pentium Dual E2200 @

2.20 Ghz is the processor of the experimental hardware configuration, and the algorithm is written in Java language. The test platform is shown in Figure 7.

Figure 7 Experimental platform

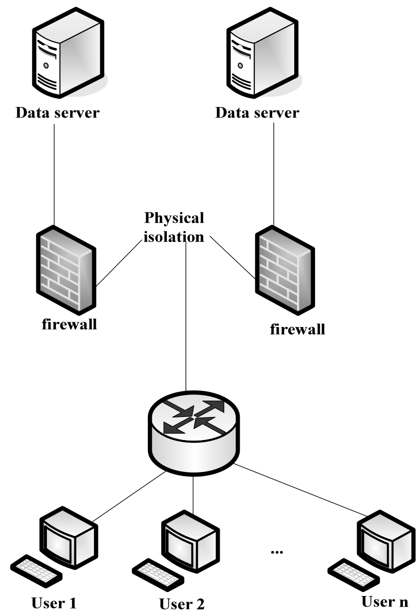


Figure 8 Data access delay comparison of different research results

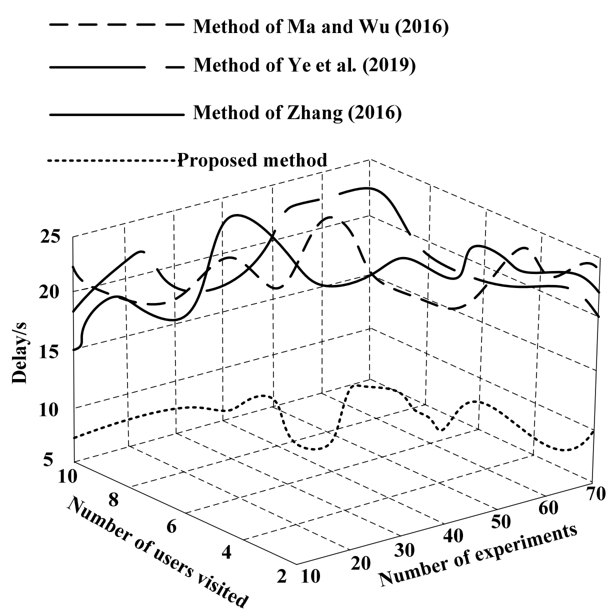
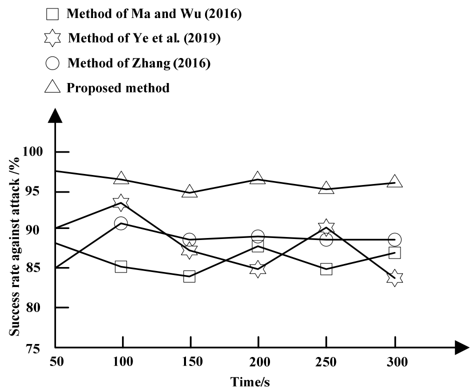
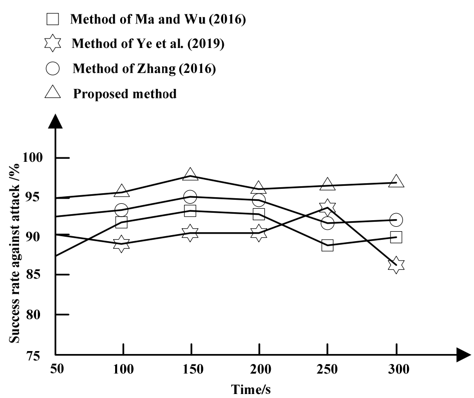


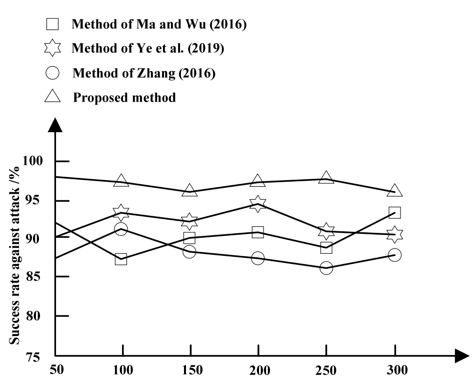
Figure 9 Data integration security comparison of different research results, (a) data integration security of different results under 10 tests (b) data integration security of different results under 20 tests (c) data integration security of different results under 30 tests



(a)

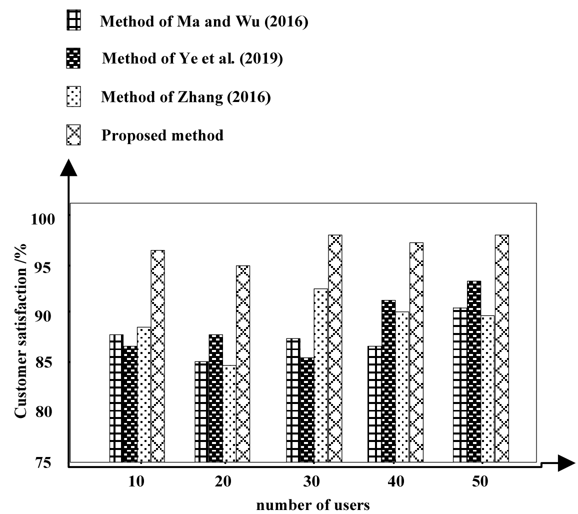


(b)

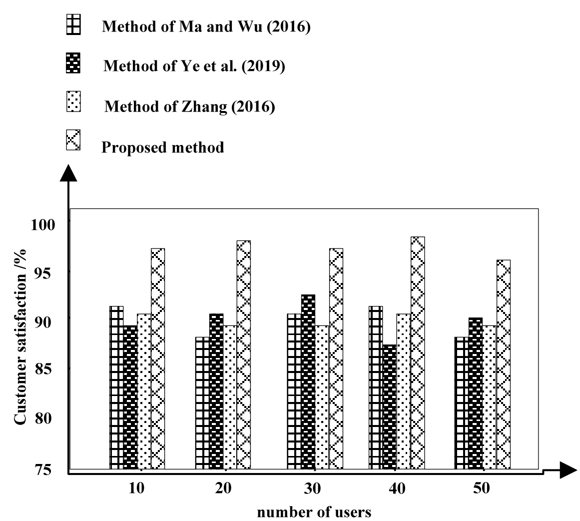


(c)

Figure 10 Comparison of user satisfaction with different research results, (a) satisfaction with integration results under five user visits (b) satisfaction with integration results under 10 user visits



(a)



(b)

The experimental indicators are as follows:

1 data access delay: time to retrieve packets

2 security of data integration: verify the robustness of the experimental method

3 user satisfaction of integrated results: test the effect of actual application.

The experimental results are shown in Figure 8.

Analysis of Figure 8 shows that the data access delay of integration technology for logistic information resources based on web services is less than 10 s, while the data access delay of other methods is between 15 and 25 s, which are significantly higher than that of the proposed method, which proves that the proposed method is more efficient. This is due to the use of ID3 algorithm for sorting the attributes of logistics information resources in power enterprises, which improves the integration efficiency of effective information and has higher real-time performance.

Figure 9 shows that the data integration security of integration technology for logistic information resources based on web services is always higher than 95% under different experimental times, while the data integration security of other methods is lower than 95%. Obviously, this proves that the security performance of the proposed method is higher. This is because in the process of information resource integration, the proposed method comprehensively considers the influence of several attribute characteristics, such as secret level, time sensitivity and quantity on the selection of resource integration management mode, thus effectively improving the security of resource integration.

Figure 10 shows that the satisfaction of data integration results of integration technology for logistic information resources based on web services is higher than 95% at different times, while the data integration security of other methods is lower than 94%, obviously lower than the method in this paper, which proves that the practical application value of the proposed method is higher. This is due to the introduction of web services to build an integrated framework of logistics information resources in power enterprises, which facilitates user access and real-time retrieval, and can adjust and manage according to user needs, thus improving user satisfaction.

4 Conclusions

1. With the continuous growth of information technology, the effective integration of information resources can provide more optimised and accurate decision-making support for enterprise decision-making, which plays a very important role in the development of power enterprises.
2. Aiming at the problems of high data access delay and poor security in current logistics management of electric power enterprises, the integration technology of logistics information resources for electric power enterprises based on web services is proposed.
3. The ID3 algorithm is used to rank the attributes of logistic information resources in power enterprises. Based on web services, the three-dimensional mapping space is constructed by utilising the attributes and management modes of information resources, and the optimal integration mode is obtained by combining rules to realise the integration of information sources to storage and transmission.
4. The experimental results show that the data access delay of the proposed method is less than 10 s, the security of data integration and the satisfaction of integration results are higher than 95%, showing that the proposed method has high efficiency of integrated management.

5 In the process of experiment, because of the construction of experimental device with small-scale low-voltage active power distribution network and the setting of experimental environment parameters, the experimental environment is different from the real environment. The experimental results deviate from the actual results, but do not affect the experimental conclusions. The next step is to optimise the logistics workflow as the focus of research, in order to better meet the needs of workers and user, to lay the foundation for the expansion of resource integration platform.

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