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Design of Group Enterprise Financial Risk Control System Based on Big Data Clustering Algorithm

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In order to better protect the healthy and long-term development of group enterprises in an increasingly competitive economic market environment, this paper proposes the design of financial risk control system of group enterprises based on big data clustering algorithm. By optimizing the configuration of the system hardware structure, improving equipment functions, optimizing software operation process and algorithm, the system's operational efficiency and effectiveness is improved. Finally, the experiment conducted in this paper confirms that the design of group enterprise financial risk control system based on the big data clustering algorithm has very good practical application and fully meets the research requirements.

Keywords: big data clustering algorithm, enterprise finance, financial risk, risk control

1. INTRODUCTION

The size of financial risk will directly affect the success or failure of an enterprise in terms of its business strategy, investment, financing and operation. If an enterprise wants to be competitive in the market, it needs to take financial risk control measures [1]. It is particularly important for enterprises to choose financing methods reasonably, and know how to use effective supervision methods and how to treat financial risk awareness to control and prevent financial risks effectively. Enterprises need to use scientific financial management tools and modern management methods to improve the control of financial risks, so that they can be sustainable, and achieve stable long-term development [2]. The effective control of financial risk of enterprises will directly affect their development. For example, for their normal development and operations, enterprises must have certain working capital. However, some enterprises still face financial risks caused by poor management of operation capital or the business objectives of enterprises and their own financial capital capabilities are incompatible [3]. Without financial risk control, the imbalance of the capital chain will cause endanger the enterprise's operations, which can lead to losses that could have been avoided. Therefore, the enterprise must treat the financial risk appropriately and effectively control it, so it can help the development of the enterprise [4]. Enterprises will face various risks during their operations, financial risks in particular. The control of financial risks can reduce the number of risks to operations. For example, in "production and marketing" operations, if there is little or no coordination between departments, this could lead to an unnecessary increase in the number of goods being produced, poor sales, and an increase of cost and decrease of profits. This will inevitably have a negative impact on business and the development of the enterprise [5]. Financial risk control can enable the detection of trends timely through the analysis of

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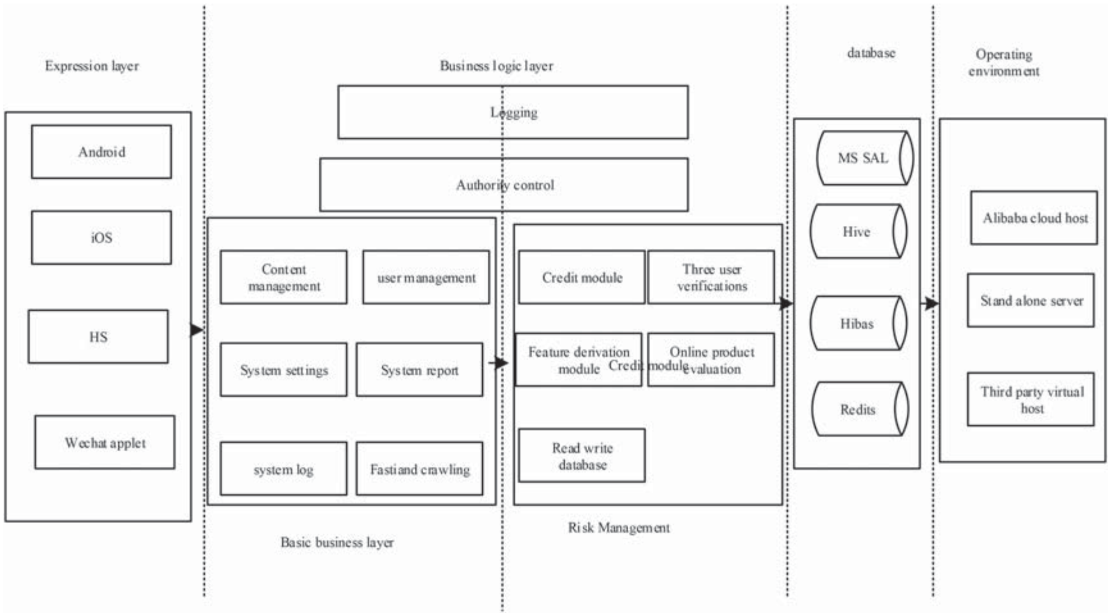

Figure 1 Overall structure of financial risk control system of group enterprises.

data, adjust the unreasonable state in the process of production and marketing in time, and reduce the loss rate of enterprises. Therefore, financial risk control is the key factor to achieving the main goal of an enterprise: to maximize the financial benefits derived from its business activities [6].

2. FINANCIAL RISK CONTROL SYSTEM OF GROUP ENTERPRISES

2.1 Hardware Setting of Financial Risk Control System of Group Enterprises

The financial risk control system of group enterprises is to influence and adjust the financial activities and operations of the group company by using relevant information and specific methods for financial management and risk control, so as to achieve the financial objectives and operation objectives specified in the business strategy, and reduce the possibility of financial risks [7]. Because the group's financial risk is one of the main risks facing the group company, the group company should identify the financial risks of various business activities and formulate targeted countermeasures [8]. The product platform, from the logical layer, adopts the coupled distributed architecture, which is mainly divided into the following four layers: presentation layer, business logic layer, risk control layer, data layer and operation environment [9]. The business logic layer comprises a basic business logic layer and risk control layer, as shown in the Figure 1.

The risk control layer is located in the middle level of the financial risk control system of the whole group enterprise, and the risk decision is realized through the interaction with the business layer and the data layer [10]. The following is a top-down sequence of the structure of the financial risk control system of the whole group. Here, the risk control layer is the main architecture layer comprising the risk control system and will pay attention to the introduction of it. For the financial risk control system of the whole group enterprise, the performance layer is the main channel through which the system interacts with the loan users, and also the main channel for loan entry, which is divided into Android end, IOS end, HS end and WeChat applet end. When users operate through various front-end channels, the system will send specific requests to the business layer [11]. The business logic layer returns the credit result according to the specific situation of the product application by the user, and issues loans according to the results. The business logic layer includes the basic business layer and the risk control layer. The basic business layer consists of content management, user management, system log, data crawling and other modules. Risk control comprises model management, product monitoring, model testing and risk-related decision-making. The basic business layer provides basic business support for the risk control layer, and will respond to the users' operation in the financial risk control system of the whole group enterprise [12]. The basic business layer sends to the risk control layer the information details of the users who currently request loans. This is done through the message system kaflca, which makes risk decisions according to the internal risk control system. In addition, an important part of the basic business system is rawler capture. Crawler crawling data of fastlend include data of Jingdong, Alipay transaction data, mobile phone contact information and mobile phone short message service account information [13]. The front end will first let the user authorize the corresponding operation rights, and input the corresponding account password at the same time, which is done by a spider monitor and spider agent. The risk control layer is the architecture layer where the risk control system is located [14]. The specific architecture diagram is shown in Figure 2 below.

The risk control system receives the application users from the basic business layer through the kaflca message system. The system makes the corresponding decisions according to the internal anti-fraud process and credit model, and the

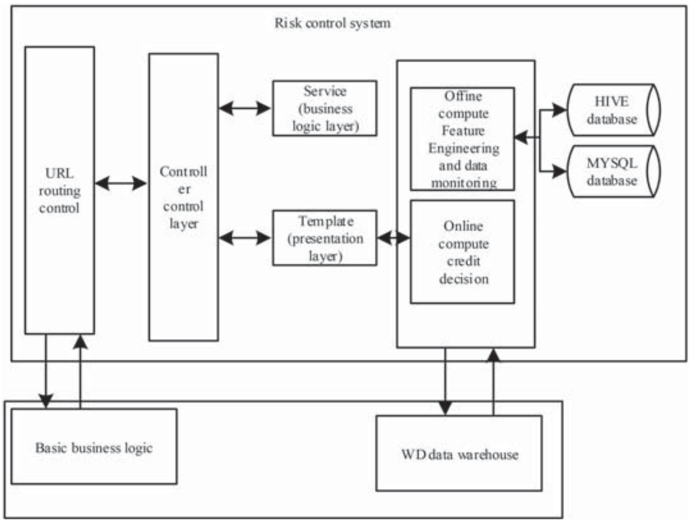

Figure 2 Group financial control system architecture.

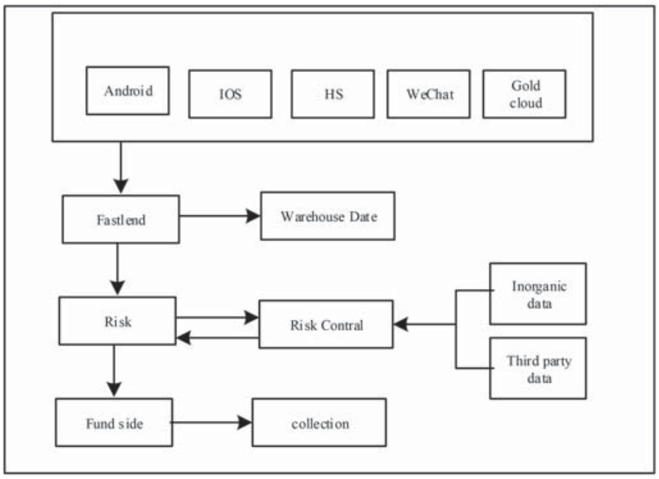

Figure 3 Business process of enterprise financial risk management project.

application users are sent back to the basic business layer through kaflca [15]. The monitoring module of the risk control layer queries the order schedule of the system to count and show the results that the risk control personnel need. The data layer provides data support for the whole system, including data storage, data query, data calculation, etc. [16]. The data layer is based on the Hadoop platform. The details of real-time data log, transaction list and trajectory behavior are stored in HBase, while offline batch data is stored in hive. In the data layer, hive and HBase cooperate as follows: extract the data source to HDFS for storage through ETL tool, clean, process and calculate the original data through hive, store the hive cleaning results in H Base if they face the scene of massive data random query, and the data application queries the data from HBase.

2.2 Software Function Optimization of Financial Risk Control System in Group Enterprises

Taking an actual business situation, this paper first introduces the financial risk control system of the group enterprise, and then analyzes the requirements of the financial risk control system in detail. Requirements are discussed from four perspectives: functional requirements, performance requirements and algorithm requirements [17]. Add database requirements to illustrate the special requirements of big data credit for database. The system is an important part of the company's actual operation product line, which makes decisions for the providers of online lending and controls the operation of the whole lending system [18]. Before introducing the risk control system, whole product line system structure must be understood. The business process of the whole product is shown in Figure 3:

The front-end import channel is the beginning of the whole business operations. The front-end group obtains users from various channels and sends their loan applications to fastlend for allocation. Fastlend fetches the corresponding data and stores it in WD after authorization according to the loan type sought by the user [19]. WD is the data warehouse of the system, which stores all kinds of information of users and provides data for later in band credit. Fastrend dispatches risk to issue a loan review request, and risk will request the financial control system to produce a credit result by applying for financial information and user information

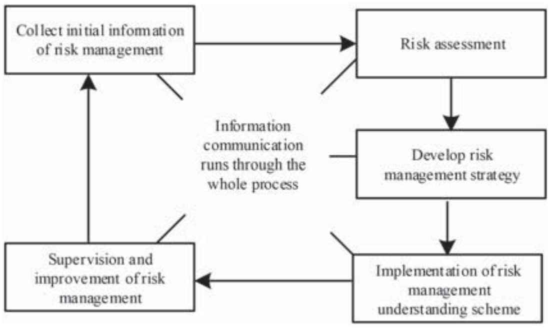

Figure 4 The role of information communication in risk management.

Table 1 Use cases of enterprise risk decision.

Case number	**USI Product**	**Case name**	**Risk decision**
Activists	**loan system**	**Priority**	**High**
Describe	This use case describes the decision-making function of the product loan system cabinet using the risk control system		
Preconditions	The data acquisition interface of the system runs normally		
Basic process	(1) The product loan system sends the user usable information, etc. (2) The system returns the corresponding credit result		
Abnormal process	The sub control system returns to the JSON string		

of the group enterprise, and return it to risks to make a corresponding loan and collection through risk decision. At the same time, the financial information of group enterprises is different at different stages. In fastlend, identity information, including registered email, mobile phone number and ID card information, is generally checked. This stage is the email stage [20, 21]. After that, the product stage is concentrated in the risk control system, including before the order stage and at the order stage. The financial risk control process of modern centralized procurement cannot do without the communication of information. In order to control the internal financial risk, it is necessary for the group company to establish an efficient communication procedure to obtain information about centralized procurement and provide it to all personnel who need that information. The information is collected, generated and transmitted by the information system, ensuring the quality of information in terms of content, timeliness, accuracy, reliability and availability. The role of information communication in risk control is shown in Figure 4.

The specific group enterprise finance has four stages: email, before order, order, and loan. Three verifications of user information are carried out and anti-fraud analysis is conducted. After the users pass the credit model, the credit results are obtained. At this time, the order stage will be entered, and the credit data and results will be saved in the data warehouse by the wind control system, and the risk will return the risk control results by dispatching the interface of the wind control system. Finally, the loan stage mainly deals with the loan and collection. According to the use case diagram, the product loan system is the main user of the risk control module. First, anti-fraud decision-making includes anti-fraud strategy and anti-fraud model. The anti-fraud model is embedded in the system, but the anti-fraud strategy is updated and changed constantly, which includes blacklist verification and three verifications of identity. The specific use cases are shown in Table 1.

The whole system adopts Microsoft's. Net development platform to design and develop B/S structure of application system based on network framework 3.5 architecture. The platform provides a multi-tier distributed application model, component reuse, consistency of security model, and flexible transaction control. In order to improve the performance and reliability of the system, the function of accounting processing, interest processing, data processing and other functions, improve the performance and reliability of the whole system The system is designed as a three-tier structure, in which the system management and security management functions are unusual. Because enterprises want a stable, safe and reliable system, safety management must be the first priority. The data in this system is related to the financial system, and the security problems become more prominent. Therefore, the confidentiality of information in the security management system must be considered, as is shown in Figure 5 below.

For the internal risk decision-making module, the anti-fraud strategy requirements in the anti-fraud module are as follows: it can distinguish new and old users, the credit of high-quality old users can be directly exempted from returning results, and the bad former users are added to the blacklist. If new users apply, they should consider their loan qualification and repayment ability in terms of several factors. At the same time, the blacklist should be checked. For the other modules in the risk decision module, the machine learning training model is used, and the specific requirements are introduced in the algorithm requirements analysis. Woe actually refers to the difference between "the proportion of responding customers in all responding customers in the current group" and "the proportion of unresponsive customers in all unresponsive customers in the current group". To determine the value

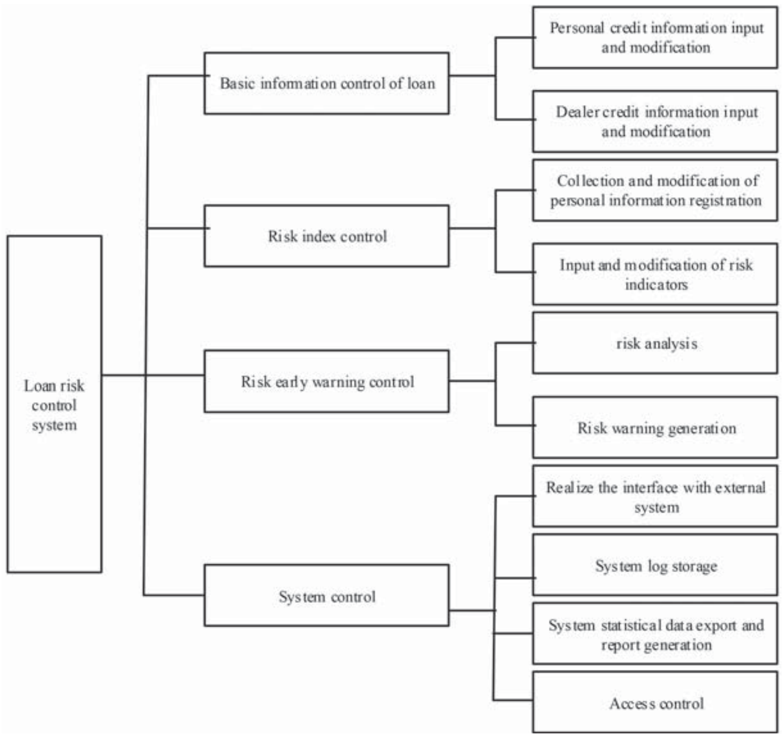

Figure 5 Optimization of system function structure.

of woe, we need to group the measured variables. After grouping, for group I, the calculation of woe is as follows:

$$\begin{aligned} WOE_i &= ln(py_i/pn_i) \\ &= ln\left(\frac{\#y_i/\#y_T}{\#n_i/\#n_T}\right) \\ &= ln\left(\frac{\#y_i/\#n_i}{\#y_\tau/\#n_T}\right) \end{aligned} \tag{1}$$

For the credit model in this system, y_i is the proportion of responding customers in this group, that is, the corresponding default customers account for all responding customers in all samples. pn_i is the proportion of unresponsive customers in this group to all unresponsive customers in the sample. At the same time, it can be seen from the final transformation of the formula that woe represents the ratio of responding customers and unresponsive customers in the current group, and the difference between this ratio in all samples. The larger the woe is, the greater the difference is, and the more likely are the sample response in this group. The smaller the woe, the smaller is the difference, and the less likely the sample response in this group will be. The IV value represents the predictive power of an original variable. Based on the formula of woe value, the formula of IV value is as follows.

$$IV_i = (py_i - pn_i)^* WOE_i \tag{2}$$

Then the IV value of the whole variable is added to the IV value of all grouped variables to obtain the formula.

$$\Delta IV = \sum_i^n IV_i \tag{3}$$

The woe and IV of each group of variables imply the predictive ability of the group to the objective variable. However, the IV value indicates the ratio of the number of individuals in the current group of variables to the total number of individuals, which has an impact on the prediction ability of variables. This is because IV considers the coefficient, which takes into account the ratio of the sample in the group to the whole sample. The lower the ratio, the less is the contribution of the group to the overall prediction ability of the variable. In the capital asset pricing model, the expected rate of return of a security (or portfolio) is the risk-free rate of return plus the systematic risk premium of the security. Namely:

$$R_j = \Delta IV R_f + \beta_j (R_m - R_f) \tag{4}$$

In the capital asset pricing model, the system risk index is used to measure the sensitivity of the change of individual securities return to the change of market portfolio return. The R coefficient can be positive or negative. Generally, the RM coefficient of market portfolio is defined as 1, and the R coefficient of risk-free asset is defined as 0. If the risk situation of a certain security is consistent with that of the whole security market, its R coefficient is equal to 1. If the R coefficient of a security is greater than 1, the risk degree is greater than the whole market risk. Conversely, if the R coefficient of a security is less than 1, then the risk degree is less than the whole market risk.

2.2.1 The Realization of Financial Risk Control in Group Enterprises

The purpose of financial risk identification is to fully understand the exposure of various risks faced by the financial activities of enterprises, and make a preliminary assessment of the size and impact of various risks, so as to determine the key points and countermeasures of financial risk management

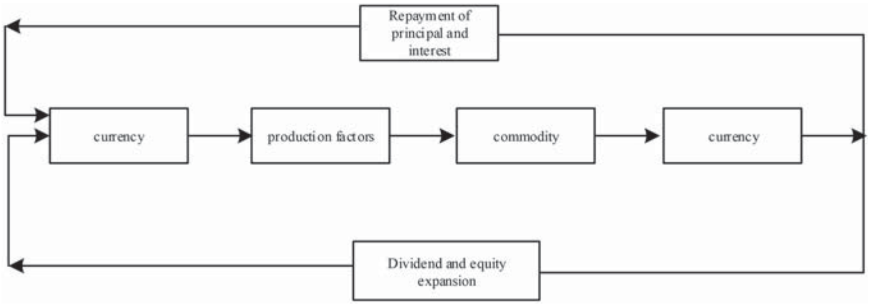

Figure 6 Enterprise financial activities and financial risk assessment process.

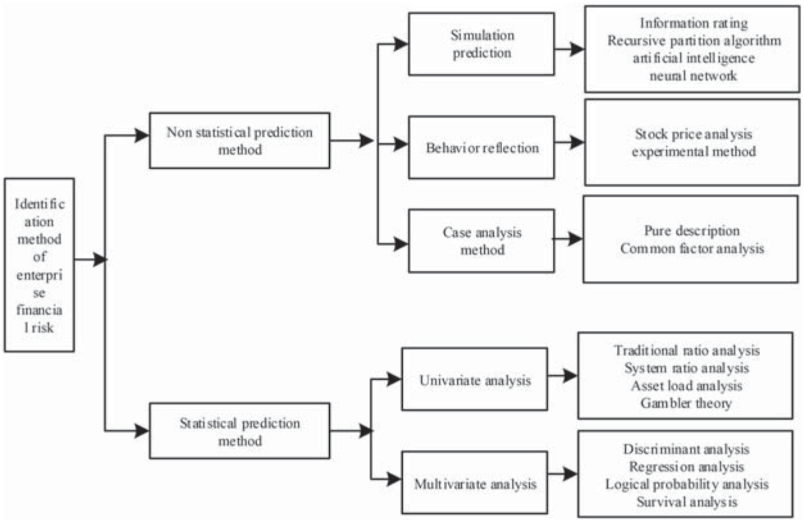

Figure 7 Financial risk identification model.

in view of their risk factors. Financial risk identification involves determining: the financial risks that enterprises face in their manufacturing and overall operations; the characteristics of financial risks, the main causes of financial risks and the methods used to identify financial risk. The research on financial risk identification has been carried out for quite some time both locally and internationally. Generally speaking, the research methods adopted are either statistical and non-statistical, where statistical methods include single variable analysis and multivariate analysis. Non-statistical methods include: simulation prediction, behavior reflection and case analysis. A detailed classification of financial risk identification methods is shown in Figure 6.

The possible risks to group company's centralized procurement mainly include payment risk, price risk, asset security risk and procurement cost risk. The internal financial control department of centralized procurement evaluates the financial risk by calculating the financial risk early warning index before centralized procurement. The commonly-used assessment method is the risk coordinate diagram. Enterprise finance generally refers to the financial activities and financial relationships of an enterprise. Specifically, it refers to the activities of fund raising, investment, consumption, recovery and distribution in the process of social reproduction and the economic relations embodied in them. Due to the existence of various uncertain factors, financial risks may exist in every link of capital movement in the process of social reproduction, as shown in the Figure 7.

The risk coordinate chart is created to indicate the probability of risk occurrence and the impact of risk on the objective as two dimensions on the same plane. Either or both qualitative and quantitative methods can be used to determine the probability of risk occurrence and the impact of risk on the objective. The qualitative method is used to describe directly the probability of risk occurrence and the impact of risk in words, such as "extremely low", "low", "medium", "high" and "extremely high". For example, after the evaluation of the group company, it is concluded that the probability of payment risk occurrence is extremely low and the impact is medium; price risk has a high probability of occurring, and high impact; the probability of threat to asset safety is medium, and the impact is medium; the probability of purchasing cost is low and the impact is low. The combination of the possibility of financial risk and the degree of impact is shown on the coordinate charts in Tables 2 and 3.

The quantitative method is used to describe the probability of risk occurrence and the degree of risk impact on the target in terms of quantity and practical significance. For example, the probability is used to express the probability of risk occurrence and the amount of possible loss is used to express the degree of risk impact on the target, as shown in Figure 8.

Internal data source is the basis of decision-making regarding the risk control system. In model training, the original data is generally offline data. This kind of data is stored in hive data warehouse and HDFS. In the online environment of risk-related decision-making, these internal

Table 2 Risk control possibility assessment.

Score	A	B	C	D	E
Text description	Very low	Low	Secondary	High	Extremely high
possibility	It doesn't normally happen	Rarely	In some cases	More often	It happens all the time
Probability of occurrence	Less than 10%	10%–30%	30%–70%	70%–90%	More than 90%

Table 3 Risk impact assessment.

Score	A	B	C	D	E
Text description	Very low	Low	Secondary	High	Extremely high
Percentage of loss caused by financial risk in pre-tax profit	Less than 1%	1%–5%	6%–10%	11%–20%	More than 20%

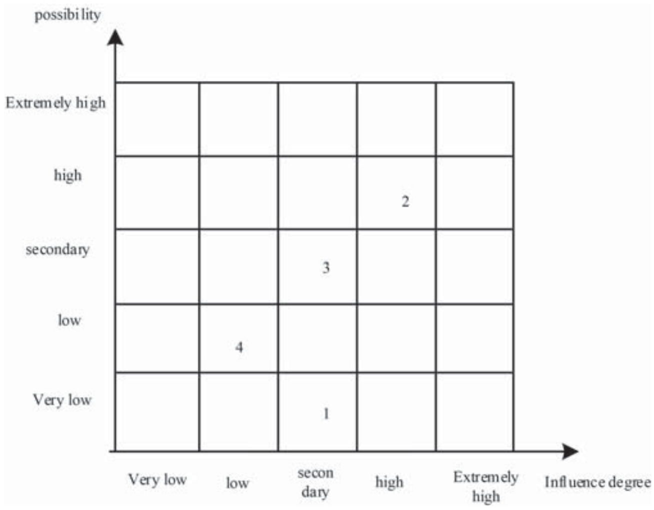

Figure 8 Degree of impact on target.

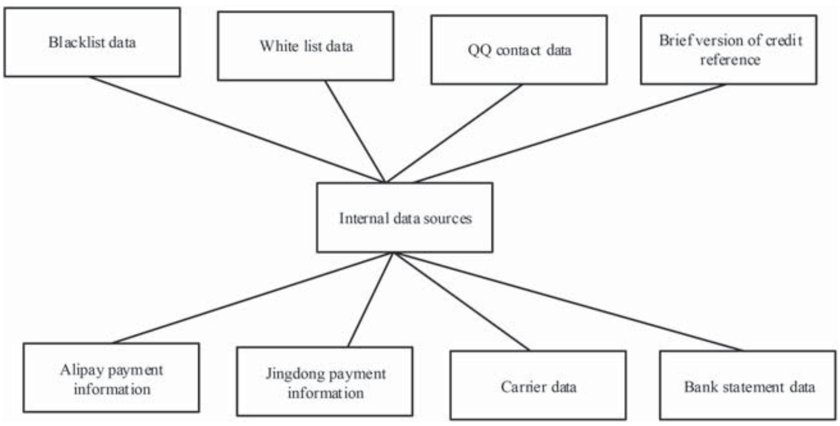

Figure 9 Internal data source structure of risk control system.

data sources are mainly stored in the MySQL database cluster. In other words, the data in a hive data warehouse is a copy of the data in the MySQL database, which is transferred to hive by running the batch every night. The composition of internal data sources is shown in Figure 9 below.

In addition to internal data, the system can refer to a third-party data source. For example, alliance, Bairong, etc. With the increase in the number of external testing requirements, in order to enable the tester to complete the test process efficiently, comprehensively and to a high standard, and to enable the data users to quickly achieve effect, third-party data evaluation will often be carried out. During the evaluation, the third-party data test samples are sampled according to the population to ensure the coverage of different products. The financial risk control system passes through four stages of information flow: risk data loading layer, risk information modeling layer, risk knowledge analysis layer and risk learning feedback layer. The original data is converted

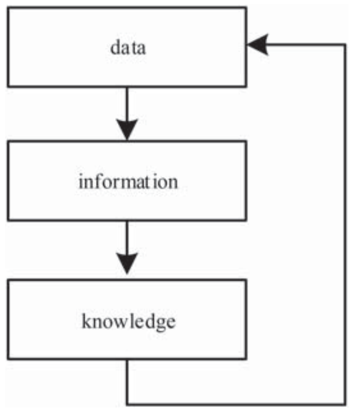

Figure 10 Closed loop structure of data processing of the system.

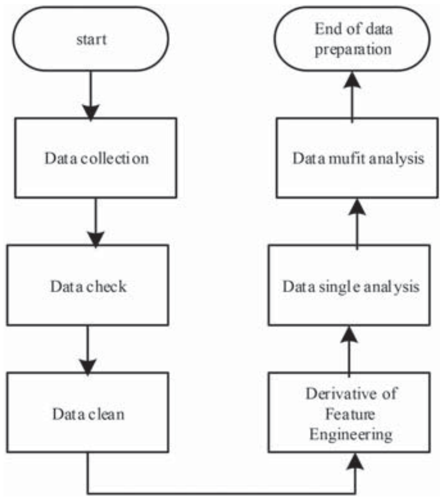

Figure 11 Enterprise financial risk information management process.

into information, then pinto knowledge for the purpose of risk decision-making, and then the results of risk control are recorded in the system for case study, thus forming a closed-loop information flow, as depicted in Figure 10.

Data preparation involves data collection, data checking, data cleaning, feature derivation and feature screening of feature engineering. Data preprocessing refers to data completion, data checking and data cleaning. After preprocessing, the data items that cannot be directly used are extracted and integrated through feature derivation. Then, the features are screened to select the better features to include in the model. The data preparation process is shown below in Figure 11.

The automatic script used for data checking is checkdata.py, which is applied to check the uniqueness of data. Data checking refers to the name of a variable with a definite meaning after data collection, and the attributes in different data sources are also uniformly coded. The repeatability field and linear-related field are deleted. Data checking is conducted to ensure that data is consistent with the uniqueness of business logic. For example, to protect the user's mobile phone number and ID number encryption, we must have uniqueness. Second, the same user can be identified as a unique user in different data sources. Here, the third-party data source and internal data source must have the same unique attribute identifying the user. The purpose of drawing a risk coordinate map is to make a direct comparison of multiple risks, so as to determine the order and strategy of risk management. As shown in Figure 12, the chart is divided into three regions A, B and C. The group company decides to take all risks in region A and no longer increase control measures; strictly control the risks in area B and implement special supplementary control measures; and ensure that risks in area C are avoided and transferred, and that precautionary measures are prioritized.

The information system of internal financial risk control of modern centralized purchasing should have risk control as its core. The information system includes logistics management, price management, supplier management, budget management and other necessary modules. During the risk assessment stage, the system can automatically collect market information, calculate various related financial indicators, and set the procurement budget according to the preset conditions. In the risk management stage, according to the risk management strategy of the group company, the information system has the function of decision consultation and support, and puts forward the corresponding strategy. In the stage of implementing the risk control scheme, the information system guides and restricts the centralized purchasing personnel so that they operate according to the risk management and procurement contract in the key links

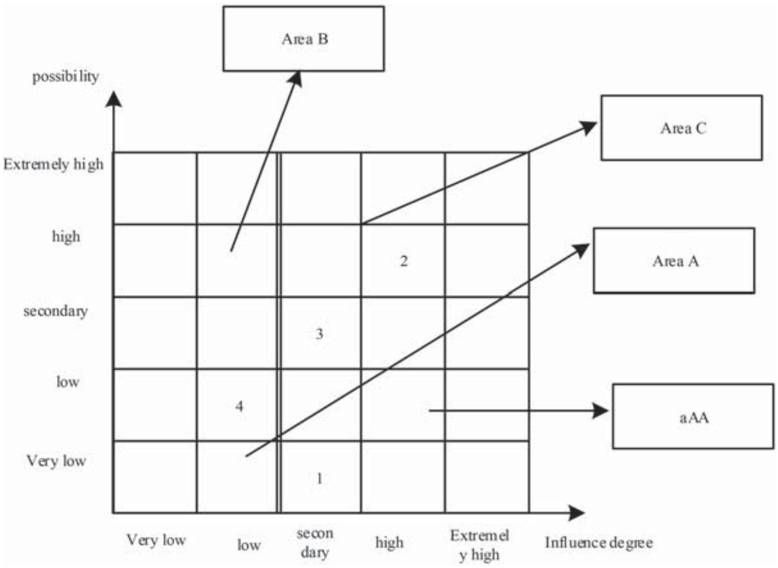

Figure 12 Policy suggestions for internal financial risk control of group companies' centralized procurement.

Table 4 Experimental environment data.

Operating system	Linux centos 6.4
Hive version	Hive-1.1.0
Python version	Pyhton-2.7.4
Hadoop version	Hadoop-1.2.1

of material or service procurement price, material or service quality, procurement cost, logistics distribution and payment for goods according to the predetermined scheme, so as to fully reduce any operational risk in the centralized purchasing process. The information system can regularly generate reports on the implementation of centralized procurement and report to the management and the board of directors. The risk management department can also monitor the financial risk control situation through the information system, timely understand the progress of centralized procurement, and make appropriate suggestions.

3. EXPERIMENTAL RESULTS

Before the software products are fully online, the test phase must be conducted. Also, due to the specific features of a risk control system, the test comprises a function test, a non-functional test and an algorithm test after the small flow is online. The credit model can meet the basic requirements of overdue rate and pass rate through the small flow test. The system adopts Hadoop distributed system in Feature Engineering, and the online environment is the web environment, so the environment is different at this time. The characteristics of the engineering test environment are shown in Tables 4 and 5 below.

In particular, because the company cluster master permission is too high, the test is carried out on the node. The test environment of the system is shown in Table 5:

The function test of the system includes the feature engineering function test and the test of the internal module of the system. The function test of feature engineering tests the integrity of the feature engineering data, whether the Hadoop environment data reading is successful, etc. The system test tests the interface of four modules in the detailed design, and checks whether the returned data meets the business requirements, and also tests the anti-fraud subprocess. Table 6 below shows the test case of feature engineering, which is intended to verify whether the automatic script of feature engineering can be derived from the user sample information uploaded by the risk control personnel.

The following table shows the test for the risk decision module of the risk control system, conducted to verify whether

Table 5 System test parameters.

Operating system	Linux centos 6.4
Hive version	Hive-1.1.0
MySQL version	MySQL Cluster5.5.19
Web.py version	Web.py-0.39
Memory	8G

Table 6 System feature test case table.

Test Case ID	RC001
Test case name	Feature Engineering automated script testing
Objective	Does the script work properly
Priority	1
Preconditions	Hive data warehouse service is normal
Test process	1. Upload user sample files to HDFS 2. Input the sample address
Expected results	After running, the generated files are stored in the response HDFS
Test result	Feature engineering results are saved in HDFS path
Conclusion	The test results meet the expectations

Table 7 Test case of system's non-public function.

Test Case ID	**RC005**
Test case name	System non-functional test
Objective	Reliability testing
Priority	1
Preconditions	Functional test passed
Test process	1. The server of risk control system is not shut down 2. Try credit request 3. Simulate new user requests
Expected results	The system is running normally
Test result	The request can be returned normally
Conclusion	The test has been passed

Table 8 System small flow test case.

Test Case ID	**RC006**
Test case name	Model small flow test
Objective	On line reliability of xgboost-l model
Priority	1
Preconditions	The first mock exam of A/B test
Test process	1. Modify A/B test options 2. Observe the risk decision of the new model on that day 3. Observe the overdue situation of risk decision-making users of the new model one month later
Expected results	Pass rate and overdue rate in accordance with the product formulation
Test result	-

Table 9 Main indicators of enterprise total monitoring module.

Test point	**Preconditions**	**Expected results**	**Actual results**
Important function point: can the financing amount exceed the proportion limited by the board of directors?	The system sets the financing balance ratio at 100% of the net capital	The administrator receives the alert email	The administrator receives the alert email
Key function point: can the customer be alerted when the deposit is lower than 150%?	Client margin is less than 150%	The administrator mailbox receives the alert mail	The administrator mailbox receives the alert mail
Test the monitoring effect when the margin balance is close to the saturation value	The system sets the upper limit of the financing balance	Alert is sent when when the balance of securities lending reaches or exceeds	Securities lending balance exceeds the alert threshold

the external service interface of risk decision module works normally and whether the risk decision is correct. The reliability of risk control system is determined by a non-functional test, and the reliability is indicated by the amount of time that the system's operation was failure-free. The test case table is shown in Table 7 below.

The system test includes A/B test, which is introduced by the detailed design of an A/B test module. The actual effect of the new system and the old system should be compared in terms of real online products. A small flow test is the specific application of A/B test when the proportion of small flow test options in A/B test is 1:9, the new system will take 10% of the flow of the old system to test the effect. The specific test cases are given in Table 8.

The Xgboost-l system was tested online in December 2017. Forty-nine people entered the new system on that day; 32 (65.3%) of them passed the test. After one month's observation, the pass rate is stable at about 68.7%, and the expected rate in the first month is 9.6%, which is in line with the expected rate for this product. In order to test the correctness and stability of the system, several test cases are designed as shown in Table 9.

The results of the test show that the system has good accuracy and stability. The paper describes in detail the design of the main modules of the risk control system of a margin trading business, and explains the relevant operation interface and results. After the system has been designed by computer language, it is implemented. The monitoring effect is tested to determine whether the customer is alerted if the margin is less than 10%, whether the financing balance exceeds the proportion limit by the board of directors, and whether the balance of the margin is close to the saturation value.

4. CONCLUSIONS

In a fiercely competitive market, financial risk is the key factor that enterprise managers need to consider. The real-time dynamics of the external and internal environments of an enterprise requires it to make full and appropriate use of modern information tools combined with financial management tools and methods. Through the identification, analysis, and evaluation of big data, an enterprise recognize opportunities for growth and development, and make well-informed decisions accordingly. Using scientific methods to avoid the possibility of financial risk, improve the staff's awareness of internal control of financial risk, control the risk in small things, and evaluate outcomes by means of astringent internal audit system, an enterprise can establish a solid foundation for its future long-term development.

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