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*Original Paper*

# A Logistics Information System Model of Agricultural Product Based on Cloud Computing

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***Abstract***

*Cloud computing technology can play an important role in the various links of agricultural products logistics system, and provide strong technical support for the development of logistics management. The system architecture of agricultural product logistics information system based on cloud computing is drawn in the paper, which include the base layer, service layer, interface layer and user layer. From the perspective of the system functions, the agricultural product logistics information system based on cloud computing is designed to contain six subsystems of the planting management subsystem, process management subsystem, storage management subsystem, transportation management subsystem, order processing subsystem, consumer query subsystem. It has the features of with the help of the RFID technology, cloud computing technology and data mining technology. We decompose the index evaluation system of the agricultural product logistics information system into twelve scheme layers, and use the analytic hierarchy process to determine the weight of the evaluation indexes of each layer.*

***Keywords***

*logistics information system, agricultural product, cloud computing*

## 1. Introduction

Cloud computing is the ability to provide services in the form of service based on the distributed network architecture to provide sustainable service. It provides the service access and management interface, and the supplier can service continuously update and incubation service, which has strong adaptability and expansibility; the resources are aggregated in a resource pool on the formation of resources management, automation and rapid delivery; based on shared resources, through the measurement to determine how much the service consumption of resources, cost accounting and billing. The construction of public logistics information platform is to integrate logistics resources of agricultural products, relying on the establishment of software and hardware system based on public information platform to achieve integration and cooperation of logistics resources and improve the efficiency of logistics operation. The main functions of the public logistics platform are the collection of information, the processing of information, the transmission of information, the storage of information, and the publication of information.

The main advantage of introducing cloud computing technology in the construction of public information platform is to establish a virtual supply chain system, connect the public logistics information platform with e-commerce platform, financial service providers and enterprise logistics

departments. The exchange of data between business and industrial platform through the cloud platform, the integration of integration, specialization of agricultural products logistics, will continue to match the supply and demand of the customers and suppliers.

The services have solved the problem that companies with more information data can't save their information, and develop their own logistics information platform on the platform, as well as software and services. Customers, agricultural products processing enterprises and sales enterprises can understand the logistics resources of agricultural products in time, and choose the logistics resources needed according to their own requirements and characteristics of agricultural products. The information platform can also be used to analyse and predict the demand for logistics, to plan logistics facilities and reduce unnecessary waste of resources. Integrate the circulation information of agricultural products. The use of a platform to complete the production and sales for all kinds of flow of information collection, increase agricultural products trading opportunities, shorten the residence time of farmers or agricultural products in the distribution centre, logistics centre, directly reduce the loss of goods, improve agricultural products freshness, and reduce duplication of construction site and maintenance costs. Promote the standardization of logistics. Information includes the basic properties of agricultural products, logistics characteristics, logistics enterprise information, and so on. The establishment of logistics process standards, reduce the damage of agricultural products and agricultural products, transportation time and cost.

## 2. Key Technologies of Agricultural Product Logistics Information System Based on Cloud Computing

### *2.1 RFID Technology*

A complete RFID recognition process can be completed by many parts, such as the electronic tag, the reader, the antenna, and so on. When the electronic tag is attached to the surface of the material to be identified or inside, and enter the reader identification range, the reader will automatically in the form of non-contact reading and storing content of the electronic tags, to realize the automatic collection of the object information data, and automatically load the data object recognition function. Compared with traditional barcode technology, RFID technology has many advantages, such as readable writing, fast reading speed, long read and write distance, large data storage and long service life, and it is the only automatic recognition technology that can realize multi-target recognition.

At present, our country's RFID technology is widely used in the fields of automation control, storage management, product anti-counterfeiting, charging and so on, and the prospect of development is very wide. Now, as a new automatic recognition technology, RFID technology has been well popularized in China. This situation is due to the successful implementation of many large RFID projects in many parts of the world. China, as the largest application area of RFID, has played an indelible role in the popularization and application of RFID technology.

Although the wireless RF card information can realize the automatic operation of non-contact, but considering the need for specialized information access card, our agricultural products logo also uses one-dimensional bar code for the ordinary way, it is easy to manually enter information related to agricultural products, but also for the convenience of the final consumer information on the goods read and use. We plan to use the one-dimensional bar code, is generated according to the specific information of the goods, all agricultural products have unique characteristics to facilitate the operation of agricultural products security after day. With bar code labels, any individual business without personal high-tech RFID card reader can also be easily monitored in all aspects such as warehousing,

warehousing, logistics and so on.

*2.2 Cloud Computing Technology*

Cloud computing is a new computing model that effectively acquirement, dynamic computation and real-time analysis of resource data on the Internet through the Internet, its purpose is to provide users with computing power, storage space and various software services. In the cloud computing environment, cloud providers to build application templates, users do not need to pay the cost of maintenance of computer hardware, and only Xiang Yun suppliers pay related costs can be obtained according to their own needs to build the application, users need data resources are from the nonphysical entity cloud. It creates a virtual form of equipment and resources, provides an extended platform service through virtualization, and can use cloud resources flexibly. Resource pooling is a configuration mechanism that can manage and dispatch data resources uniformly. When users input data, they can use data at the same time without being limited by time and space, and share resources to different users with virtual technology. The placement and management strategy of resources is transparent to users. Through virtualization technology can eliminate the differences of heterogeneous servers, a cloud computing centre can reach tens of thousands of physical servers, these large-scale computing resources together, can form a super computing pool, therefore, cloud computing ability can bring large scale enterprises and users.

The cloud will disperse resources effectively concentrated in the cloud platform for logistics enterprises, which can obtain a lot of useful information from the cloud platform, such as real-time inventory information, delivery information, vehicle information, traffic information, the cold chain logistics enterprises in the distribution business can be flexible to meet a variety of needs. Cloud computing can carry out big data analysis. By virtualization technology, large-scale computing cluster can be realized. Using this supercomputing resource, we can make reasonable analysis of massive data, and optimize the decision-making of cold chain logistics such as inventory, transportation and location. Cloud computing software service platform, users can get through cloud infrastructure, application services, software and hardware and other useful resources, no need to take for the purchase of equipment, software upgrades, hardware maintenance costs, users only need to press the required to pay fees according to their service, improve the efficiency of logistics and distribution services.

*2.3 Data Mining Technology*

With the development of computer and related science and technology, the complexity of logistics activities and cumbersome, in the development process of logistics exists in every kind of information to enhance scientific decision-making level better, improving the competitive advantage of enterprises, to extract from the mass data of the enterprise to provide useful information. The objective basis of decision making and enterprise development planning. On the other hand, the advent of the era of big data makes it difficult for enterprises to analyse useful information from many data in a simple and accurate way. For more convenient access to information, the need for related data storage and data processing technology has been created. Data processing technology, such as data warehouse and data mining technology, came into being. With the further development of computer technology and mathematics, we can use mathematical knowledge and computer technology to mine big data and extract useful information.

Data warehouse is based on simple classification and processing of logistics information data, and constantly optimize data and improve data, providing data source for datamining which generally involves all procedure for hunting the information among many data applying the algorithm searching. This method is usually classified to computer science field, achieving the above objectives employing

machine learning, statistics analysis, information retrieval, expert system and pattern recognition. With the changing market environment and the coming of the big data era, how to tap the needs of potential customers has become a severe challenge for the long-term development of enterprises, and is also a rare opportunity for enterprises.

In today's era, the person who can understand information or information sensitivities in time can get the initiative in the increasingly fierce market competition, and achieve fast logistics services. Data mining technology is to deal with some basic data to depth the actual significance of data mining, to provide the basis for the decision of the enterprise. Nowadays, data mining technology is playing a more and more important role in the contemporary era of big data.

## 3. System Architecture of Agricultural Product Logistics Information System Based on Cloud Computing

For all kinds of logistics enterprises, logistics center and logistics department and other related enterprises to provide a complete solution, depending on the scale of the cloud computing capacity and standard logistics process, accurate control of each link, decision support and intelligent comprehensive information sharing to complete logistics in various industries need information requirements. The platform structure planning follows the principles of advanced, reliability, expansibility, maintainability, integration, openness, security and practicality. We design the overall framework of the public information platform for agricultural products logistics based on cloud computing. The structure of agricultural product logistics public information platform is divided into four layers, which are the basic layer, the service layer, the interface layer and the user layer. Among them, the basic layer is mainly composed of hardware infrastructure.

Compared with the traditional platform, the biggest difference in its architecture lies in the full use of virtualization technology. The service layer is divided into three layers: IaaS, PaaS, and SaaS. IaaS integrates computing resources, storage resources, and network resources into pools through virtualization technology to realize the virtualization management of resources. PaaS serves the Internet resources into a programmable interface, providing a valuable service platform for third party developers. SaaS is a platform for all the network infrastructure and software and hardware operation needed by the service providers to build information for enterprises, and enterprises can rent software services as needed. The interface layer provides two services for the user. The first is to provide standardized interfaces for various physical terminals. It ensures user access platform more convenient and improves the efficiency of the platform. It is the application programming interface used by the developer and the Web Service called by the external user. The user layer of public information platform for agricultural products logistics mainly includes farmers, logistics providers, logistics service providers, logistics providers and government departments.

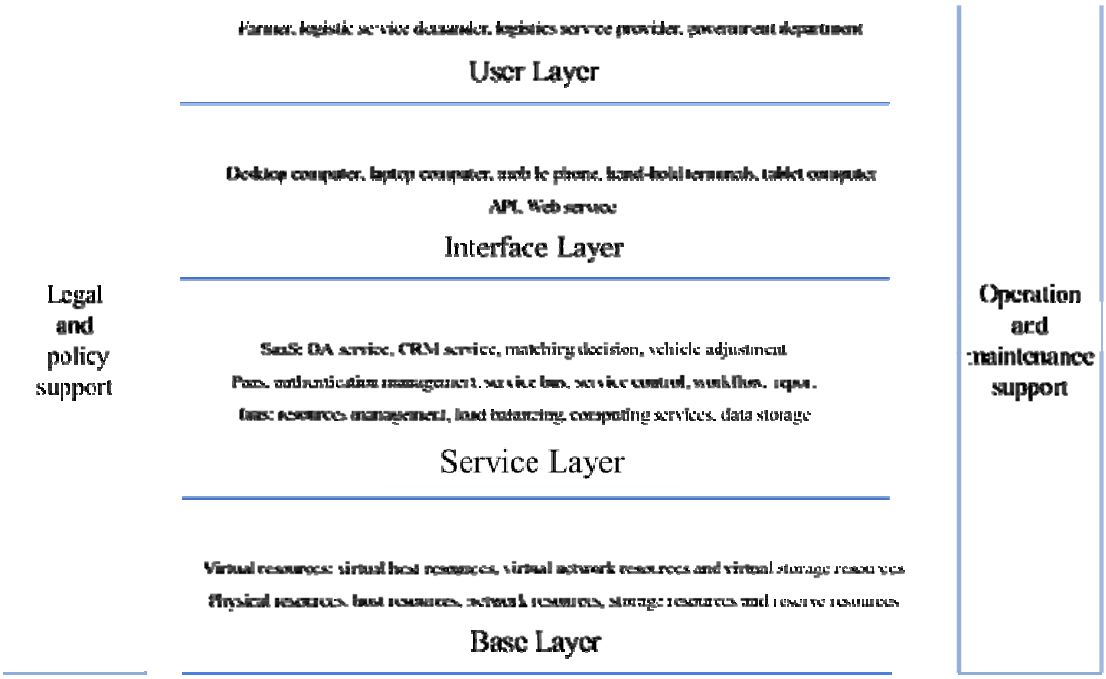


**Figure 1. Overall Architecture of Agricultural Product Logistics Information Platform Based on Cloud Computing**

## 4. Subsystems of Agricultural Product Logistics Information System

Through RFID technology, cloud computing platform and data mining technology, we divide the agricultural product logistics information management system into six parts: planting management subsystem, process management subsystem, storage management subsystem, transportation management subsystem, order processing subsystem, consumer query subsystem in the preliminary planning and design process. The relationships among the subsystems is shown in Figure 2.

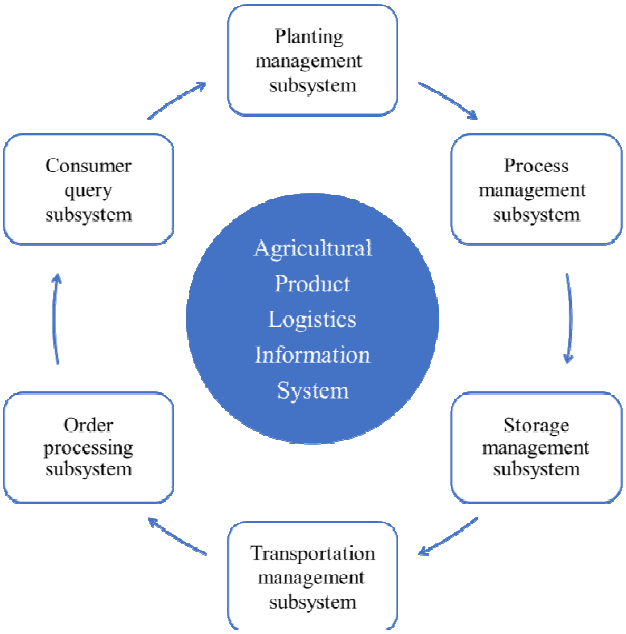


**Figure 2. Subsystems of Agricultural Product Logistics Information System**

*4.1 Planting Management Subsystem*

For producers or providers of agricultural products, we all require that they deliver products to the logistics system. We must clearly and accurately register the series of related agricultural products. There should be clear data on the origin information, breeding time and quarantine status of agricultural products to ensure the conservation of food quality and safety from the source. Then, by the logistics system attached to the RFID electronic tags in agricultural products as a mark to vector label code, and related/raise information written to the RFID tag, as agricultural products identity data in the label, the synchronization of logistics system is stored in the database to facilitate the inquiry and comparison.

*4.2 Process Management Subsystem*

The processing management subsystem is mainly to record the basic information of processing. For example, processing time, processing materials and so on should be registered. For livestock products, special information such as quarantine and immunization information should be registered. All data will be kept in logistics information management system. The transparency of the traditional production and processing of agricultural products is not high, and the quality and safety problems are not easily accountable. The use of large data and cloud computing technology can be a good solution to this problem. The electronic label code is set up for different categories of raw materials, specialized database is input, and real-time monitoring of the entire production process of agricultural products, including the growth status of agricultural products, processing operation procedures and the corresponding operators. Once the quality and safety problems arise, it is also beneficial to the accountability, to determine the liability of the accident, and to record the files. It is also possible to make use of the existing data to predict and analyse it, which is convenient to prevent and prevent the occurrence of food safety accidents.

*4.3 Storage Management Subsystem*

In the information system of agricultural product logistics management, the storage management subsystem is a very important system module. The function modules of the subsystem include warehouse management, inventory management, transfer service and other functions. Large data and cloud computing technology can improve the level of warehouse automation management. The RFID labels on fresh agricultural products pallets and packages are installed, and intelligent readers are installed at the entrance and exit of cold storage, which reduces manual operation, saves time for warehousing operations and improves operation efficiency. To realize the dynamic perception of stored goods and install various inductors in cold storage, we can perceive the change of the quantity and status of goods in cold storage, and create conditions for rational control of inventory. In conclusion, the application of big data and cloud computing technology will greatly improve the level of warehouse automation management, and realize the automatic regulation of storage conditions, improve the efficiency of warehouse operation management, and save inventory management cost.

*4.4 Transportation Management Subsystem*

The main function of transportation management subsystem is to record and transmit information of transportation company, transportation vehicle information, transportation time, place of departure, destination and so on, and upload it to logistics information management system. According to the distribution of shunting on the goods delivery arrangement with plan and distribution plan. The route arrangement is mainly based on the route arrangement of the goods on the distribution sheet and the transfer in the middle of the way. The order confirmation mainly records the delivery of the goods and arranges the whereabouts of the rejected or undelivered goods. Track information tracking management mainly refers to the state of the vehicle, including document information, time, direction, state, region,

logistics centre, location, whether the fault, so fault level, starting time, the elimination time, can be introduced into the global positioning system, information into the state of global positioning system tracking module. To achieve real-time tracking of vehicles in transit query.

*4.5 Order Processing Subsystem*

In the logistics business, warehousing, distribution processing, processing from the supplier to send the allocation of general shipping application form and distribution application. Order processing centre produces notice of purchase, distribution notice, warehouse transfer notice and distribution completion notice. It is equivalent to the confirmation of the customer's receipt. It can be said that the order processing centre mainly provides the functions of management, inquiry, modification and printing for the various instructions issued by the merchant. At the same time, the feedbacks information from business department to merchants, mainly including order type, order allocation, order confirmation, order printing, order inquiry and so on.

*4.6 Consumer Query Subsystem*

The main function of consumer inquiry subsystem, is to provide consumers with a convenient and reliable means of agricultural products. According to the visible one-dimensional bar code electronic label, consumers can purchase records all the logistics of agricultural products in the online query directly, while the query system can also carry out product quality tracking based on consumer feedback, to help consumers and producers to complete product quality tracking.

## 5. Main Features of Agricultural Product Logistics Information System

*5.1 Accurate Information Collection*

The characteristics of agricultural product logistics management information system is based on the purpose of establishing traceability system of agricultural products quality and safety. The information management system of agricultural products logistics mainly has the following technical characteristics. Accurate and fast data acquisition. In the various stages of the circulation of agricultural products, including the origin of agricultural products, transport vehicle charging stations, freight yards, warehouses, wholesale markets of agricultural products and other places, REID read-write equipment is installed, and agricultural products or vehicle transportation information is collected to store the database, forming agricultural product logistics cloud. The information of agricultural products is accurately recorded, preserved and convenient for each node to be inquired in time, so that the traceability of agricultural products is more rapid, real-time and accurate. The tags used in the system are readable and writable, and all information in the whole process from planting/breeding to product sales can be written into the same label. After reading the information of clothing products from RFID tags, RFID readers or sensing devices are sent to the RFID middleware system for processing. The RFID middleware system takes the electronic coding of the agricultural product as the information source, gets the detailed information of the agricultural product in the local management system, or sends it to the Internet to query. Finally, the detailed information of the agricultural product information and the number of RFID reader and writer number are stored in the information system database.

*5.2 Mass Information Processing*

All the distributed heterogeneous logistics resources in agricultural product supply chain are gathered in the cloud, and management is achieved through resource modelling and unified description. The logistics information system constructed by cloud computing platform technology accepts all kinds of logistics needs of every node enterprise at any time, and integrates massive information according to

actual needs through optimization calculation, and provides a complete solution to the needed enterprises. Agricultural producers, logistics providers, distributors and consumers can collect information and feedback information in a timely manner, and jointly participate in the production, transportation and sale of agricultural products. At the same time, consumers can easily find information about the quality and safety of agricultural products in real time through the Internet tools such as computers and mobile phones.

*5.3 High Level of Automation Management*

Large data and cloud computing technology can improve the level of warehouse automation management. The RFID labels on fresh agricultural products pallets and packages are installed, and intelligent readers are installed at the entrance and exit of cold storage, which reduces manual operation, saves time for warehousing operations and improves operation efficiency. In order to realize the dynamic perception of stored goods and install various inductors in cold storage, we can perceive the change of the quantity and status of goods in cold storage, and create conditions for rational control of inventory. In conclusion, the application of big data and cloud computing technology will greatly improve the level of warehouse automation management, and realize the automatic regulation of storage conditions, improve the efficiency of warehouse operation management, and save inventory management cost. Large data and cloud computing are applied in the transport link. The application of large data and cloud computing technology in the transportation of agricultural products can greatly improve the transport efficiency of agricultural products and realize the effective circulation of agricultural products. First, the timely and accurate dispatch of agricultural transportation vehicles can be realized to improve transportation efficiency and avoid ineffective transportation. Secondly, the dynamic perception and monitoring of the agricultural products in transportation are carried out to ensure the quality and safety of the products. Combined with storage management, transportation decision can be made more scientifically to improve the rationality of transportation and reduce the loss. Large data and cloud computing are used in the construction of information sharing. The use of large data and cloud computing to share and synchronize information will facilitate the cooperative operation of the participants in the various links of the cold chain logistics. Rapid information transmission and computation speed reduce the phenomenon of information distortion, and enable participants to excavate and analyse the information of all aspects of agricultural cold chain logistics timelier and accurately to provide guarantee for future high-quality logistics services.

## 6. Evaluation Indexes of Agricultural-Product Logistics-Information-System

*6.1 Figure of Index System*

The agricultural-product logistics-information-system of cloud computing is the core as well as foundation of logistics enterprise operation. The logistics information department is good and bad about the logistics enterprises' whole logistics ability. The evaluation of the logistics-information-system is so necessary for construction of the system to the logistics enterprises. It is very necessary to objectively evaluate and analyse the logistics information system by using the scientific evaluation system, and correctly understand the effect of the construction of the enterprise logistics-information-system to mend the current along with long-term competitiveness to the enterprises and promote sustainable development. We should first set up a set of evaluation index system, which is to select a set of evaluation criteria to determine the advantages and disadvantages of the information system projects. Then we propose an indicator model for the system evaluation using cloud computing, which is divided into four aspects. They are system construction evaluation index,

system performance evaluation index and system benefit evaluation index as well as social benefit evaluation index, as shown in Figure 3.

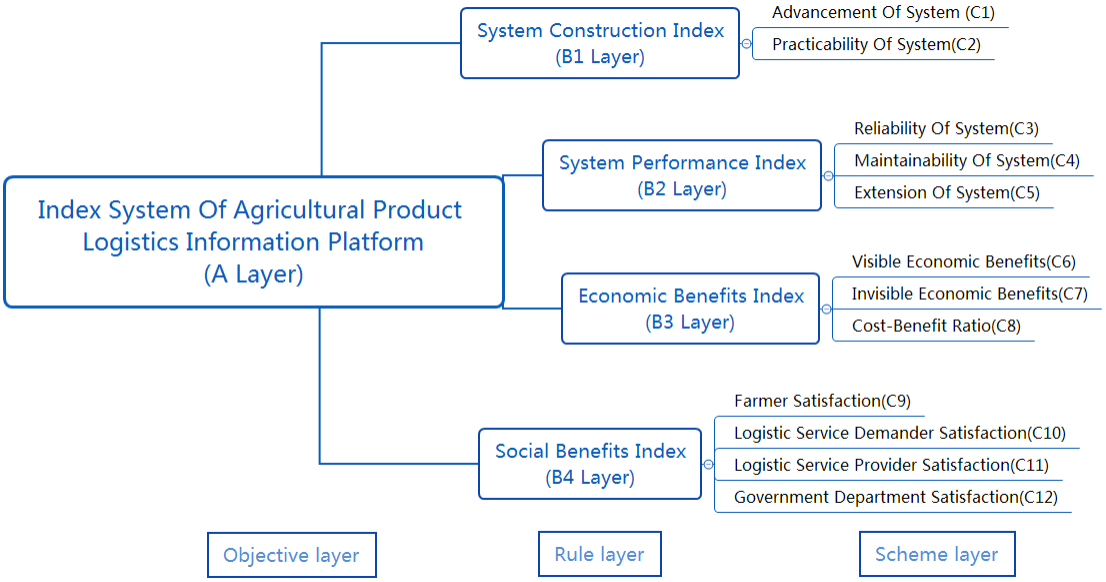


**Figure 3. Figure of Index System of Agricultural Product Logistics Information Platform**

*6.2 Elaboration of Index System*

System Construction Index.

Advancement of system. Advancement of system refers to the leading level of the information system on the overall level. It is embodied in the overall program and method of the whole system development. Whether it is advanced or not, is it advanced overall of the hardware, software technology, network and communication technology. It is not more expensive and more advanced, it should be integrated into consideration of the overall advanced nature. The life cycle of the information system with advanced level is long.

Practicability of system. The information system investment should be matched with the functions realized, that is, the performance price is high. High prices are not equal to high performance. The blind pursuit of advanced technology, and the pursuit of goals to achieve or to achieve the function of the relationship between small computer “high consumption”, even if the strength of capital, as a scientific evaluation index to measure the economic benefits, this system project practicality is not good.

System Performance Index.

Reliability of system. Reliability of system is determined by the factors such as the hardware system reliability, the software system reliability and the data reliability. Reliability to the system is usually the primary concern of the user, especially the financial system and the single system, which require higher reliability. System reliability refers to the expectation of a program to complete its function under the required precision. Specifically, in the running environment, the program and all data elements run the error free probability of different test cases within the prescribed running time or prescribed operation times. Maintainability of system in the operation of the system, due to the changes in the environment, human error, so that the system is inseparable from the regular maintenance activities.

Maintainability of system. Maintainability of system marks the size of the effort needed to determine the errors in the system and to correct the errors. The maintainability of the system is determined by

factors such as the degree of modularization, simplicity and consistency of the system itself. In the face of the changes in the environment, the increase of business volume and the expansion of the business scope, the information system often faces new problems such as updating, expanding and networking.

Extension of system. The extension of the system refers to the extensibility of the system processing capability and the system function. The extensibility of the system can be divided into the extensibility of the system structure, the extensibility of the hardware and the extensibility of the software function, etc. This is mainly determined by the characteristics of the hardware, the characteristics of the software system, the standardization of the development of the system and the degree of standardization.

Economic Benefits Index.

Visible Economic Benefits. They are the economic benefits that can be calculated quantitatively with money, mainly from the saving of production cost and the improvement of production efficiency. For example, information systems take the place of automated means to replace part of the artificial information processing process, resulting in the reduction of efficiency and so on.

Invisible Economic Benefits. They are the economic benefits which are difficult to be quantified and cannot be directly embodied in the currency. It mainly includes: to provide more timely and accurate, be more and better information for enterprises or organizations; improve enterprise and organization flexibility; we promote enterprises to understand the environment, improve the organizational planning; support management personnel to put forward a better solution to speed up the decision-making process and so on.

Cost-benefit ratio. It is the ratio of the economic benefit created by the logistics information system to the total investment in the construction of the logistics information system. Benefit has immediate and long-term benefits. Visible benefits in the current benefits can be accurately accounted for, but its intangible benefits and long-term benefits are difficult to accurately calculate. When evaluating, experts from the industry can be estimated according to the actual situation.

Social Benefits Index.

The index of social benefits mainly includes the farmer satisfaction, logistic service demander satisfaction, logistic service provider satisfaction and government department satisfaction. Their results are often obtained through questionnaires.

*6.3 The Evaluation Indicator Weight Setting*

As a famous decision analysis method, the Analytic Hierarchy Process (AHP) has been applied successfully in many fields, and the basic idea of analytic hierarchy process in many areas is based on the analysis of what indicators to be evaluated, and then these indicators are divided into several levels according to certain principles. We analyse and compare these index data to get weight of different kinds of indicators in the system. Analytic hierarchy process is generally divided into three levels, namely, target level, criterion level and program level. In practical applications, we can increase the level of analysis based on the complexity of the system. The determination of evaluation index weight applying the method of AHP is shown in Table 1.

**Table 1. Determination of Evaluation Index Weight Based on AHP**

| Index name | Weight |
|---|---|
| Advancement of system | 0.0527 |
| Practicability of system | 0.1237 |
| Reliability of system | 0.0841 |
| Maintainability of system | 0.0763 |
| Extension of system | 0.0057 |
| Visible Economic Benefits | 0.0793 |
| Invisible Economic Benefits | 0.0258 |
| Cost-benefit ratio | 0.1230 |
| Farmer satisfaction | 0.1254 |
| Logistic service demander satisfaction | 0.0418 |
| Logistic service provider satisfaction | 0.0985 |
| Government department satisfaction | 0.1639 |

## 7. Conclusion

Based on cloud computing, a agricultural-product logistics-information-system makes all farm products safer and more controllable from the pastoral to the dining table, and provides more convenient services for the public's life. The main conclusions of this paper are as follows:

(1) The evaluation model of agricultural-product logistics-information-system applying cloud computing contains a base layer, a service layer, interface layer as well as a user layer.

(2) The evaluation system model includes the planting management subsystem, process management subsystem, storage management subsystem, transportation management subsystem, order processing subsystem, consumer query subsystem.

(3) The evaluation system model has the features of accurate information collection, mass information processing and high level of automation management.

(4) The index evaluation system is divided into twelve scheme layers, and the weight of the evaluation indexes of each layer is determined by AHP.

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