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Intelligent Logistics Supply Chain Management Based on Internet of Things Technology

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Nowadays, a significant amount of research is being conducted on intelligent systems for supply chain management (SCM). The logistics industry is under enormous pressure due to the increasing number of people who are shopping online. The traditional logistics industry is in urgent need of high-tech support. It is a novel idea to use the Internet of Things to design a logistics management system, which combines the current field of logistics management with the field of the Internet of Things. There are many problems in the current logistics field, such as weak management, limited management scope and long management time. These shortcomings make traditional logistics management approaches unsuitable for the rapid development of online shopping in today's world. To solve these problems, this paper proposes a hybrid SCM system based on the integration of the Internet of Things with traditional logistics management systems and high-tech network technology. The method proposed in this paper uses a combination of the positioning algorithm of trilateration in the Internet of Things and the Multiple Dimensional Scaling (MDS) positioning algorithm to locate and transmit logistics information. The combination of the two has created a new digital logistics management system. The analytical results showed that with the proposed hybrid logistics management system, the weight of distribution reliability in logistics service was 0.371 and the user caring weight was 0.268, giving a total of 0.639, which is more than half of the total weight. This indicates that these two dimensions play a crucial role in the quality of logistics services. In addition, surveys were conducted on logistics pickup services and online shopping services. The survey results demonstrate that the proposed logistics management system is feasible. Overall, the results yielded by this study clearly show that the Internet of Things technology can be applied successfully to the current logistics management system, providing a possible direction for the future development of an efficient logistics management system.

Keywords: Internet of Things, logistics management, online shopping network, multidimensional scaling

1. INTRODUCTION

SCM is the management of logistics between the manufacturer or producer of an item and the end consumer. SCM involves the planning, implementation and control of logistics to ensure the efficient two-way flow of goods. It also tracks and traces the process and logistics information between the place of origin and the place of consumption to meet the logistics and delivery requirements of customers.

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At present, China has made great strides in the research on issues related to logistics and SCM systems that are appropriate for the current production and consumer environment. However, with the rapid development of electronic online shopping and online financial transactions, the traditional SCM system faces many problems. Therefore, it is essential to combine the current high-tech Internet of Things technology with the traditional SCM system to establish a new logistics path. However, the research on SCM systems in the context of the Internet of Things is still in its infancy.

Since its emergence in modern society, network technology has developed rapidly. Many scholars have carried out scientific research on SCM and logistics. Majumder's research pointed to new avenues for supply chain finance and banking research. This study opened a further frontier for potential researchers in the field [1]. Heilig's research pointed out that the main challenge of current logistics systems was to facilitate coordination and collaboration among the various parties, especially activities at the management interface at different stages of transportation, warehousing and other logistics activities [2]. Gaghman analyzed supply chain management systems in logistics. The aim was to understand the impact of logistics on organizational performance, which also helped to identify opportunities for cost/time elimination and/or value addition in the supply chain [3]. Hye discussed the intermediary role of enterprise technology integration and electronic logistics (E-logistic), which helped e-logistics companies to improve the satisfaction of retail supply chain [4]. These studies have examined the logistics and SCM system from various perspectives. However, their research did not link the logistics supply chain management system with the Internet of Things technology, which is not conducive to further research and development.

Nowadays, with the rapid development of science and technology, the use of IoT algorithms for the research of logistics supply chain management is a approach. Many experts and scholars have conducted in-depth research on the technical level of the Internet of Things. Tu's research explored the determinants of IoT adoption in logistics and supply chain management in order to understand the motivations and concerns behind enterprises' decisions to adopt IoT (Internet of Things) [5–6]. Cho's research proposed an IoT-based smart logistics model to maintain safe transportation. This mode focused on precise delivery management. The movement status of products was monitored and analyzed by means of embedded sensors (such as RFID) and transportation systems [7]. Treiblmaier conducted a descriptive, citation, thematic and methodological analysis. A comprehensive framework was proposed using IoT technology, which pointed to the future direction for research in logistics and supply chain management [8]. Although the aforementioned researchers carried out a diverse range of studies, these works were not comprehensive. Hence, further and more in-depth research is required. Most of their research principles are based on theory, and their reliability and practical application have not been tested.

At present, the traditional financial risk system monitoring platform has many problems. For example, the coordination between various departments in the logistics process is poor, leading to an increase in the cost of transportation and transfer of products. There are also problems such as slow logistics speed due to distribution methods and item manufacture. In today's environment characterized by rapid commercial and technological development, the SCM and logistics platform needs to implement the latest cutting-edge technology. In this paper, IoT technology is combined with the traditional financial supervision and SCM platform, in order to address many problems of the problems that existed in the past, and still exist to some extent. It can also speed up the logistics flow process so as to achieve the SCM's goals of "less waiting, quicker response".

2. LOGISTICS SUPPLY CHAIN MANAGEMENT

2.1 Logistics Supply Chain Management System

In recent years, the logistics industry has developed rapidly. The traditional SCM and logistics process is applied in the company's production, purchase, finance, sales and other departments. It is a large-scale integrated logistics management system that integrates logistics operations and logistics decision-making with the purpose of improving logistics efficiency and prioritizing the customers. The main components of the process are shown in Figure 1.

As can be seen from Figure 1, most of the departments involved in traditional logistics and SCM systems are separate and have independent functions, each performing its own duties without affecting others. Hence, each department carries out specific logistics operations within its own domain.

2.2 Logistics Supply Chain Process

An efficient logistics and supply chain operation process is the foundation of the entire logistics system. A good logistics process not only effectively reduces the transportation time; it also, saves human, material and financial resources. The layout of the current logistics and supply chain process is shown in Figure 2.

As can be seen from Figure 2, various departments in the logistics supply chain process are interlinked and connected end to end. In the logistics operation, the logistics processing center is an important department that maintains the normal operation of the entire system. The processing center gathers each departmental link in the logistics. It distributes and processes logistics information and provides professional and integrated logistics and transportation solutions.

2.3 Deficiencies in the Current Financial Supervision System

At this stage, the functional departments in the logistics supply chain system are independent of each other. This structure is rational, but it lacks fluency in increasingly complex logistics supply chain management. The entire logistics system lacks optimization and synergy. When dealing with online payment scenarios, various departments may be inaccessible. There is no way to connect the front and back processes, resulting in the failure of the overall supply chain.

Many experts and scholars have studied the current situation of logistics and SCM. Park noted that as economies expand and manufacturing activity increases, interest in and demand for cargo logistics is increasing and becoming more diverse. Goods are transported by sea and/or by land, but there is currently insufficient research on the actual situation of heavy cargo flow [9]. Ramos's research pointed out that supply chain flexibility and responsiveness are crucial because

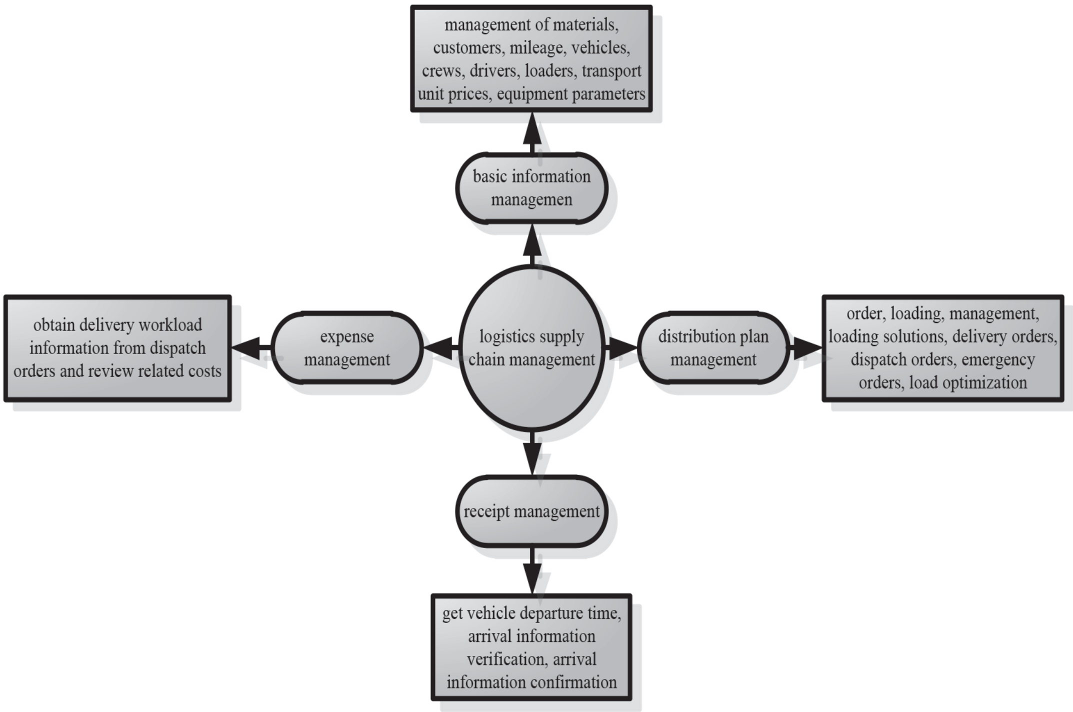

Figure 1 Logistics supply chain management system.

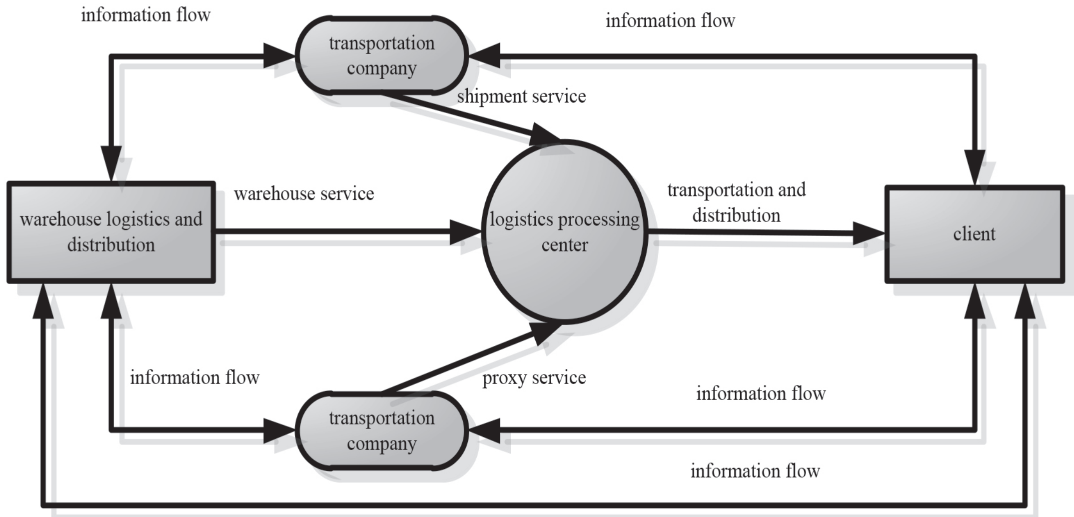

Figure 2 Flow chart of logistics supply chain.

demand is volatile and short lead times are a must. A high level of logistics performance is critical to providing excellent operational efficiency and a high degree of customer satisfaction [10].

Therefore, in order to overcome the above deficiencies in the SCM system, this paper studies the effect of combining the traditional SCM with the Internet of Things technology [11–12]. Based on the Internet of Things technology, a stable and efficient logistics supply chain structure is established to achieve the rapid transmission and exchange of logistics information. Internet technology and logistics transaction information are interconnected. High-speed and reliable technology for information collection is used to correlate and match transaction information between customers and logistics companies with network transmission technology. Using the powerful information processing technology of the Internet of Things, the corresponding logistics transaction information is analyzed to achieve "zero-time consumption, fast processing" logistics and supply chain transportation [13–14].

3. IOT TECHNOLOGY

3.1 Logistics Management System Model in the IoT Environment

Logistics companies face several coordination problems in regard to management [15]. The Internet of Things architecture poses a multi-dimensional collaborative man-

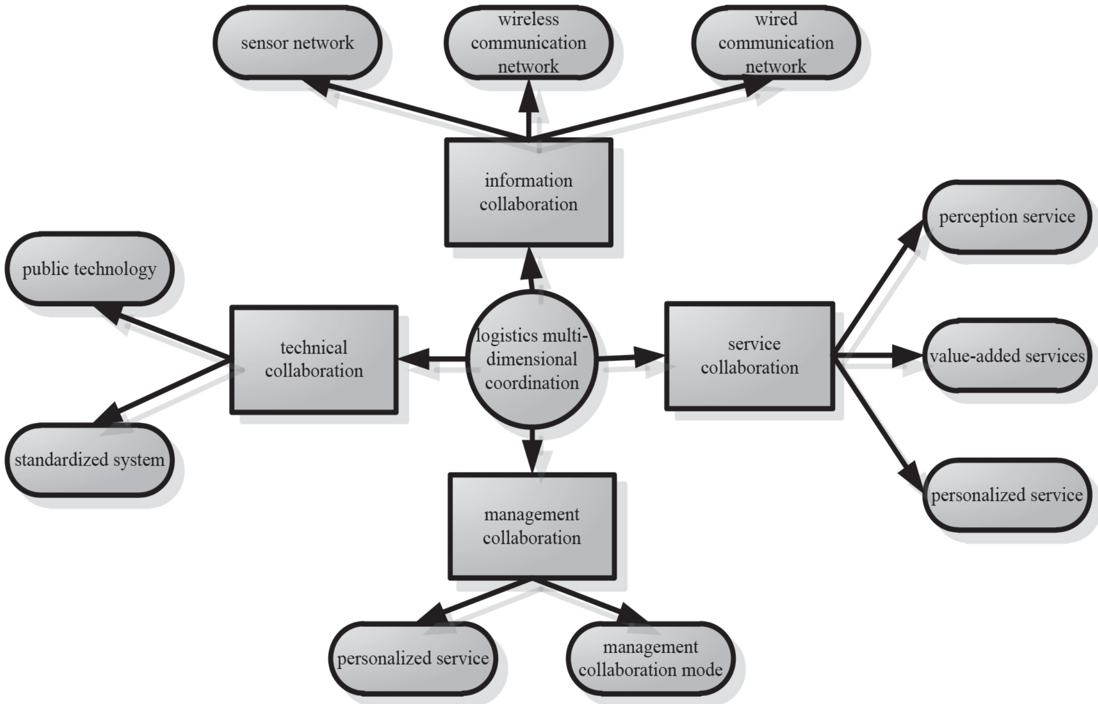

Figure 3 Logistics multi-dimensional collaborative classification diagram.

agement problem to logistics companies. Multi-dimensional collaboration has four dimensions. The status of the logistics company in terms of each dimension is analyzed one by one. The parameter formula for the logistics system is established based on this. The current logistics management system has complex requirements. The multi-dimensional collaborative model is shown in Figure 3.

The logistics in the IoT system has the following synergistic characteristics.

(1) Multi-dimensionality. The first characteristic of IoT systems is multi-dimensionality. From the perspective of perception, a standardized system is built through technical collaboration. From the network layer analysis, information from sensors, wireless and wired communication networks is used in coordination. At the application level, there is service coordination whereby the aggregation of supply chains provides integrated services for the company's logistics operations. In terms of of management, there is management coordination to manage the internal functions of the logistics enterprise. Multiple dimensions are combined to form a more complete and unified system.

(2) Coexistence. The various dimensions of the logistics system coexist. Logistics systems have many dimensions, and they are mutually reinforcing. Together, multiple dimensions form a logistics management system.

(3) Cooperation. Logistics companies do not exist in isolation. They are required to cooperate with other supply chain companies, and also require alliances and cooperation with interdependent peer companies to provide checks and balances for each other.

(4) Information sharing. An important attribute of a logistics system is information sharing. Benefiting from modern information network technology, logistics companies have real-time interaction technology showing logistics information, which effectively prevents inefficiency in company operations caused by delay in receiving logistics information. Fast and efficient logistics information-sharing technology can ensure the stability of the logistics transportation process.

3.2 Localization Algorithm Based on Trilateration

In IoT positioning, the measurement of distances between nodes always includes errors. In general, the smaller the value of the measurement error, the higher the positioning accuracy. In order to further improve the positioning accuracy, this paper uses a positioning algorithm based on trilateration [16–17]. First, the positioning algorithm needs to obtain the initial value of the node position. Then, the node positions are computed using the weighted least squares method. This algorithm is typically used for node localization in a two-dimensional plane.

The steps of this positioning algorithm are as follows:

By trilateration, the initial value of $(x_1, y_1, \ldots, x_n, y_n)$ for a certain node coordinate is measured. In order to improve the measurement accuracy, the average value calculated by three anchor nodes that are not collinear is selected. The operation is as follows:

Assume that (x_{in}, y_{in}) is the nth estimate of the ith node. $\left(u_{n_1}, v_{n_1}\right)$, $\left(u_{n_2}, v_{n_2}\right)$, and $\left(u_{n_3}, v_{n_3}\right)$ are the real positions of the three anchor nodes, respectively. Among them, n_1, n_2, $n_3 \in \{1, \ldots m\}$ are not equal to each other. The distances between this node and the three anchor nodes are d_{i,n_1}, d_{i,n_2}, and d_{i,n_3}, respectively. It is then calculated with the following formulas:

$$\left(x_{in} - u_{n_1}\right)^2 + \left(y_{in} - v_{n_1}\right)^2 = d_{i,n_1}^2 \tag{1}$$

$$\left(x_{in} - u_{n_2}\right)^2 + \left(y_{in} - v_{n_2}\right)^2 = d_{i,n_2}^2 \tag{2}$$

$$\left(x_{in} - u_{n_3}\right)^2 + \left(y_{in} - v_{n_3}\right)^2 = d_{i,n_3}^2 \tag{3}$$

After subtracting Formula (1) from Formula (2), and Formula (2) from Formula (3), a system of simultaneous formulas are obtained:

$$\begin{aligned} &2(u_{n_1} - u_{n_2})x_{in} + 2(v_{n_1} - v_{n_2})y_{in} \\ &\quad = d_{i,n_2}^2 - d_{i,n_1}^2 + u_{n_1}^2 + v_{n_1}^2 - u_{n_2}^2 - v_{n_2}^2 \end{aligned} \tag{4}$$

$$\begin{aligned} &2(u_{n_2} - u_{n_3})x_{in} + (v_{n_2} - v_{n_3})y_{in} \\ &\quad = d_{i,n_3}^2 - d_{i,n_2}^2 + u_{n_2}^2 + v_{n_2}^2 - u_{n_3}^2 - v_{n_3}^2 \end{aligned} \tag{5}$$

The nth evaluation of the ith node is:

$$\begin{aligned} \begin{bmatrix} x_{in} \\ y_{in} \end{bmatrix} &= \begin{bmatrix} 2(u_{n_1} - u_{n_2}) & 2(v_{n_1} - v_{n_2}) \\ 2(u_{n_3} - u_{n_3}) & 2(v_{n_2} - v_{n_3}) \end{bmatrix}^{-1} \\ &\times \begin{bmatrix} d_{i,n_2}^2 - d_{i,n_1}^2 + u_{n_1}^2 + v_{n_1}^2 - u_{n_2}^2 - v_{n_2}^2 \\ d_{i,n_3}^2 - d_{i,n_2}^2 + u_{n_2}^2 + v_{n_2}^2 - u_{n_3}^2 - v_{n_3}^2 \end{bmatrix} \end{aligned} \tag{6}$$

The N estimates are calculated and the average is taken as the initial value of the node, namely:

$$\begin{bmatrix} \widehat{x_\iota} \\ \widehat{y_\iota} \end{bmatrix} = \begin{bmatrix} \frac{\sum_{n=1}^{N} x_{in}}{N} \frac{\sum_{n=1}^{N} y_{in}}{N} \end{bmatrix}^T \tag{7}$$

The distance between each node is measured using TOA (time of arrival) ranging technology [18]. A multivariate Taylor series expansion model is created:

$$D = Q\Delta + E \tag{8}$$

Next, the position deviation is calculated using Weighted Least Square [19]:

$$\begin{bmatrix} \Delta x_1 \\ \Delta y_1 \\ \vdots \\ \Delta x_n \\ \Delta y_n \end{bmatrix} = \left(Q^T T^{-1} Q\right)^{-1} Q^T T^{-1} D \tag{9}$$

In the formula, T is the covariance matrix of measurement errors.

Finally, in the initial recursion, let $\tilde{x}_1^{(0)} = \hat{x}_1$, $\tilde{y}_1^{(0)} = \hat{y}_1, \ldots, \tilde{x}_n^{(0)} = \hat{x}_n$, $\tilde{y}_n^{(0)} = \hat{y}_n$ then in the next recursion, there is:

$$\begin{bmatrix} \tilde{x}_1^{(l+1)} \\ \tilde{y}_1^{(l+1)} \\ \vdots \\ \tilde{x}_n^{(l+1)} \\ \tilde{y}_n^{(l+1)} \end{bmatrix} = \begin{bmatrix} \tilde{x}_1^{(l)} + \Delta x_1 \\ \tilde{y}_1^{(l)} + \Delta y_1 \\ \vdots \\ \tilde{x}_n^{(l)} + \Delta x_n \\ \tilde{y}_n^{(l)} + \Delta y_n \end{bmatrix} \tag{10}$$

In the formula, 1 is the number of iterations. The calculation flow above is repeated until $\Delta x_1, \Delta y_1, \ldots, \Delta x_n, \Delta y_n$ is small enough. There is a predetermined limit value of ε that makes Inequality $\sum_{i=1}^{n} (|\Delta x_i| + |\Delta y_i|) < \varepsilon$ true. At this time, $(\tilde{x}_1, \tilde{y}_1, \ldots, \tilde{x}_n, \tilde{x}_n)$ is the estimated position of the node.

3.3 MDS-based Positioning Algorithm

The positioning algorithm based on MDS uses the MDS algorithm to calculate the initial value of the node position. Then the least square method is used to calculate the estimated value of its position [20]. This algorithm is typically used for node localization in a two-dimensional plane.

The steps of this positioning algorithm are given below.

First, the squared distance matrix is constructed as:

$$M = \begin{bmatrix} 0 & d_{1,2}^2 & \cdots & d_{1,(n+m)}^2 \\ d_{1,2}^2 & 0 & \cdots & d_{2,(n+m)}^2 \\ \vdots & \vdots & \ddots & \vdots \\ d_{1,(n+m)}^2 & d_{2,(n+m)}^2 & \cdots & 0 \end{bmatrix} \tag{11}$$

Second, the matrix M is doubly centered, that is, the center matrix J is multiplied by M. The definition formula of J is:

$$J = E - (x + y)^{-1} \cdot I \tag{12}$$

Among them, E is the $(x + y)$ dimensional identity matrix. I is an all-ones matrix of $(x + y)$ dimension. The matrix A after double centering is:

$$A = -\frac{1}{2} JDJ \tag{13}$$

Matrix A is decomposed. Because A is a symmetric positive semi-definite matrix, the singular value decomposition to $A = V \Lambda V^T$ form can be used. Λ in the formula is the diagonal matrix formed by the eigenvalues arranged from largest to smallest:

$$\Lambda = diag\left[\lambda_1, \lambda_2, \ldots, \lambda_{(n+m)}\right] \tag{14}$$

Among them, $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_{(n+m)}$ is the eigenvalue. V is an orthogonal matrix column:

$$V = \left[e_1, e_2, \ldots, e_{(n+m)}\right] \tag{15}$$

Among them, $e_1, e_2, \ldots, e_{(n+m)}$ is the feature vector. The first w eigenvalues in Λ are taken to form matrix Λ_w. The first w eigenvectors in V are taken to form V_w, and the coordinate matrix is:

$$R = V_w \Lambda_w^{\frac{1}{2}} \tag{16}$$

Node positions are also calibrated. Then the initial value of the position of the node is:

$$\begin{aligned} &\hat{X}_1 \; \hat{X}_2 \; \ldots \; \hat{X}_n \\ &\quad = Q_1 \left[R_1 - R_{n+1} \quad R_2 - R_{n+1} \cdots R_n - R_{n+1}\right] \\ &\quad + X_{n+1} \; X_{n+1} \; \cdots X_{n+1} \end{aligned} \tag{17}$$

Among them, the coordinate adjustment matrix is:

$$Q_1 = X_{n+1} - X_{n+1} \; X_{n+2} - X_{n+1} \cdots X_{n+m} - X_{n+1} \\ \times R_{n+1} - R_{n+1} \; R_{n+2} - R_{n+1} \cdots R_{n+m} - R_{n+1}{}^{-1} \tag{18}$$

The same method uses TOA (time of arrival) ranging technology to measure the distance between each node. The model of the multivariate Taylor series expansion is created as:

$$D = Q\Delta + E \tag{19}$$

Using the least squares method (Least Square, LS), the positional deviation is solved [21]:

$$\begin{bmatrix} \Delta x_1 \\ \Delta y_1 \\ \vdots \\ \Delta x_n \\ \Delta y_n \end{bmatrix} = \left(Q^T Q\right)^{-1} Q^T D \tag{20}$$

Then the estimated location of the unknown node is:

$$\begin{bmatrix} \tilde{x}_1 \\ \tilde{y}_1 \\ \vdots \\ \tilde{x}_n \\ \tilde{y}_n \end{bmatrix} = \begin{bmatrix} \hat{x}_1 + \Delta x_1 \\ \hat{y}_1 + \Delta y_1 \\ \vdots \\ \hat{x}_n + \Delta x_n \\ \hat{y}_n + \Delta y_n \end{bmatrix} \tag{21}$$

4. REALIZATION AND TESTING OF INTELLIGENT LOGISTICS SUPPLY CHAIN MANAGEMENT PLATFORM

4.1 Realization of Intelligent Logistics Supply Chain Management Platform

The logistics information platform based on the Internet of Things involves the participation of many departments and enterprises. Hence, the volume of data to be transmitted and processed is huge. Therefore, when building the platform, several principles must be followed.

(1) Compatibility

Logistics and supply chain information involves many different sectors of the economy. Different sectors have different information needs and their own unique logistics information coding and decoding systems. Therefore, the construction of the logistics information platform needs to focus on the specific needs of different customers, so as to provide an interface compatible with their logistics information system.

(2) Openness

At present, logistics information is used in many fields, making the transparency of logistics information very important. The logistics supply chain information management platform should not only provide information flow among various internal departments; it should also maintain the exchange of information with various external information sources. Therefore, the transparency and availability of logistics information is extremely important.

(3) Scalability

After the logistics information management platform is built, it provides users with long-term logistics information services. Therefore, scalability and ductility are very important. The approximate number of users of the management platform, their logistics communication needs, and the technology involved in the development of the management platform itself must be considered. The construction of a scalable and flexible platform should be taken into account from the outset.

(4) Standard

The construction of the logistics information platform should follow the internationally recognized information transmission and interaction protocol. The application service sub-platform should also be developed according to the general standard, so as to provide a logistics information application service.

Based on the above basic principles, an intelligent logistics management platform architecture is proposed, shown in Figure 4.

4.2 Quality Assessment of Intelligent Logistics Supply Chain Management Platform

This survey questionnaire was distributed to a number of experts who have been engaged in the logistics industry for many years. They are experienced and have unique insights into this industry. In addition, a number of staff engaged in logistics were selected. They have worked in the logistics industry for many years, and their input is valuable from the practical perspective. as it is based on practical application. Based on research on logistics management systems and analysis of the knowledge and experience of experts in the relevant logistics industry, this article conducted a questionnaire survey of these experts and set 20 quality evaluation indicators for logistics supply chain management systems.

Based on these questionnaires, membership analysis was performed on these 20 quality evaluation indicators. When the indicator was lower than 50%, it could be considered as a useless indicator. After membership analysis and removal of insignificant indicators, 16 effective indicators were obtained. The results are shown in Table 1.

Not all of above indicators are not all applicable to the current logistics environment. Therefore, the importance analysis method should be used to calculate the important weights of all the above indicators, so as to remove the less important indicators obtained. Then, in the same way, experts were asked to rate the weight of the above indicators. The scores ranged from 1 to 10 points. 1 indicates not important, 5 is generally important, and 10 indicates very important. The scores obtained via the questionnaires were used to calculate

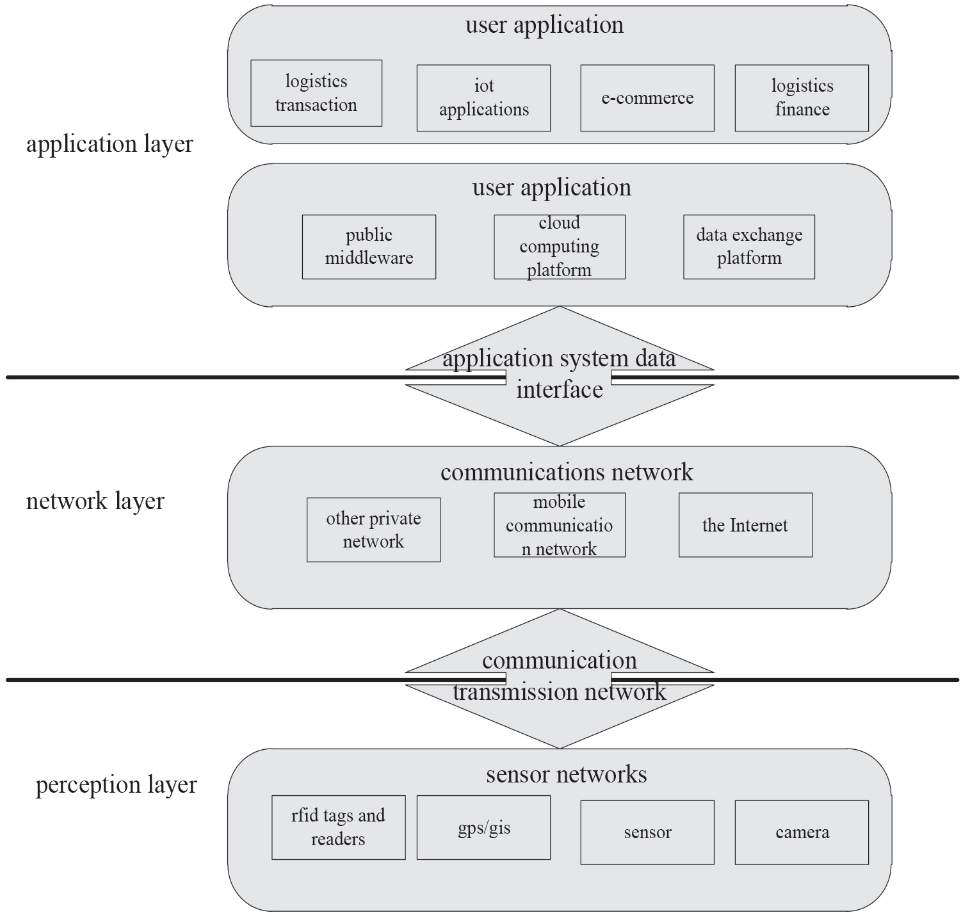

Figure 4 Architecture of intelligent logistics management platform.

Table 1 Membership table of logistics service quality evaluation indicators.

	Evaluation Metrics	Membership		Evaluation Metrics	Membership
1	Order release quantity	81.1%	2	Information quality	79.5%
3	Warehousing Demand Satisfaction Rate	73.4%	4	Inventory damage rate	78.9%
5	order execution rate	77.1%	6	order response speed	70.8%
7	delivery accuracy	71.2%	8	Error handling efficiency	81.0%
9	Goods in good condition	87.8%	10	Service attitude satisfaction rate	77.3%
11	Delivery timeliness	82.7%	12	Service Process Satisfaction Rate	82.1%
13	Shipping price	89.2%	14	Personalized service	76.4%
15	degree of electronic	85.9%	16	advance notice rate	73.3%

the average score for each indicator. The average of the three indicators of "information quality", "advance notification rate" and "electronic degree" was less than 5 points. Hence, these are indicators of qualities with the least importance, so they were eliminated.

These qualified indicators can be divided into four dimensions to illustrate the quality of logistics management. The four dimensions are: distribution reliability, service efficiency, facility guarantee, and user care. Then, the evaluation weights of these dimensions and indicators were calculated. Here, the analytic hierarchy process (AHP) was used to evaluate these four dimensions and 13 indicators hierarchically [22]. Likewise, AHP data was provided by experts in the logistics industry. The indicators at each level were scored according to their level of importance. The scores ranged from 1to 10 points, where 1 indicates both are equally important, and 10 indicates the most important. In order to facilitate the calculation, the valid questionnaires were analyzed with the aid of AHP analysis software. According to the calculation results, the questionnaires with high CR value were removed. Finally, the weight scores of each evaluation index were obtained. The results are shown in Table 2.

As can be seen from Table 2, the weight of delivery reliability was 0.371, which accounted for the largest proportion. This shows that the reliability of logistics distribution plays an important role in the quality of logistics services. It can also be seen from Table 2 that with the development of Internet of Things technology, people's requirements for personalized services are gradually increasing. This change has prompted

Table 2 Logistics service quality weight evaluation table.

first-level indicator	Weights	Secondary indicators	Independent weight
Delivery reliability	0.371	order execution rate	0.111
		delivery accuracy	0.222
		Goods in good condition	0.305
		Delivery timeliness	0.261
		order response speed	0.101
service efficiency	0.195	Service attitude satisfaction rate	0.561
		Service Process Satisfaction Rate	0.439
facility security	0.166	Order release quantity	0.295
		Warehousing Demand Satisfaction Rate	0.315
		Inventory damage rate	0.390
user care	0.268	Shipping price	0.406
		Error handling efficiency	0.363
		Personalized service	0.231

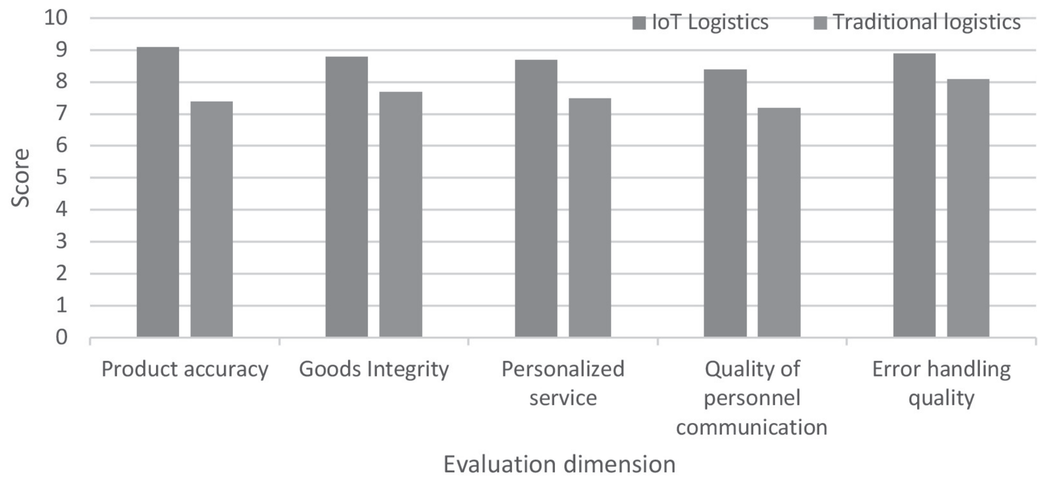

Figure 5 Logistics collection service quality score table.

the logistics company to change its concept, prioritizing the "people-oriented" modern service concept [23].

4.3 Evaluation Results of Logistics Supply Chain Management

In scientific research, not only theoretical support is needed; the satisfaction of relevant users when actually using a system, also needs to be investigated. The results obtained from users are used to support the theoretical nature of the research, and provide valuable data to validate the research results. In this study, valid data were obtained using the scoring system described above [24]. A logistics company compared the evaluation data for the Internet of Things technology with the data of previous years when traditional logistics methods were applied.

Logistics collection is the most important link in the logistics operation process. The quality of the collection service has a crucial evaluation value to the logistics system. Here, the five – product accuracy, product integrity, personalized service, personnel communication quality, and error handling – were selected for quality scoring. The scoring results are shown in Figure 5.

According to the survey data, in terms of these five dimensions, users were more satisfied with with the logistics supply chain management system based on the Internet of Things technology than with the traditional logistics management system. It shows that users are more satisfied with the collection service of the new logistics network logistics system, which is valuable for research on logistics management system.

Nowadays, online shopping is becoming increasingly popular. Online shopping presents not only opportunities but also challenges to the logistics industry. People are paying greater attention to the logistics of online shopping. Therefore, the same method was used to score online shopping satisfaction. Here, three dimensions of real-time delivery information, electronic degree and delivery speed were selected for quality scoring. The scoring results are shown in Figure 6.

The analysis of these three dimensions in the survey data shows that users are more satisfied with the online shopping service provided by the new logistics network logistics system. This provides a solid logistics foundation for an increasing number of mainstream online shopping methods in the future. It also points to a research direction for the future development of the logistics management system.

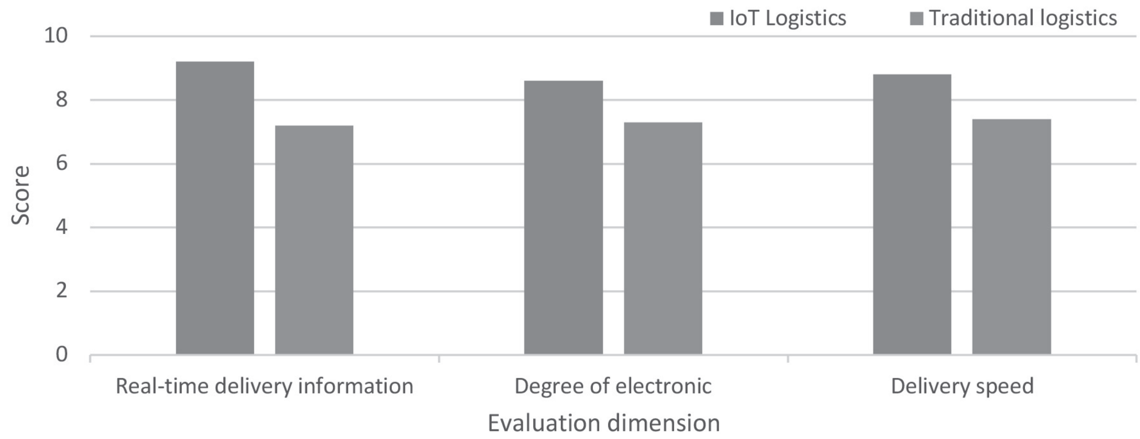

Figure 6 Online shopping service quality score table.

5. CONCLUSIONS

The intelligent logistics supply chain management system based on modern Internet of Things technology not only improves the anti-strike ability of the logistics system, but also improves the stability of the logistics system, which has a significant experimental effect on the logistics management system. This researcher believes that under the supervision of the hybrid intelligent logistics management system, the operating atmosphere of the entire logistics system has also undergone significant changes. The customer's participation in the transaction is strong, and the logistics flow is obviously improved. This intelligent logistics management system enables customers to transition from the traditional offline shopping method to the current active online shopping method by providing a stable logistics operation system. This encourages customers to engage in online shopping. Moreover, the hybrid logistics management system based on the Internet of Things can effectively improve the stability and efficiency in the process of logistics capacity. However, this system has two shortcomings. The first concerns the greater requirements for the network. A network with a large bandwidth is required to transmit logistics information. The second issue is that strong processing ability is required to process a large amount of logistics information and analyze its potential risks. Therefore, in order to support the operation of this logistics management system, not only high-speed network transmission conditions, but also powerful processors are required. Therefore, this system is not suitable for logistics companies that have poor network and internal processing systems. This is the shortcoming of the hybrid logistics management system. The advantages of openness, stability and immediacy of this logistics management system far exceed the traditional logistics management system. However, at this stage, logistics companies have strong requirements in terms of network and processing system hardware. Therefore, it does not apply to most logistics companies in the current price segment. For logistics companies, the network is a channel for the transmission of logistics information. The internal processing system is the brain that processes logistics information, which plays a vital role in the entire logistics management system. If the effect of these two hardware conditions is difficult to guarantee, this system is unlikely to operate smoothly. However, it can be believed that in the near future, with the advancement of society and the development of technology, hardware would no longer be the shackles of technology. Therefore, in the future, the traditional logistics management system must be combined with the Internet of Things to achieve a hybrid intelligent system that keeps pace with the times and drives the development of the logistics industry with information technology.

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