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Research Article

The Application and Benefit Evaluation of Digital Enterprise Resource Planning System in Supply Chain Management

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ABSTRACT

Because of the lack of effective quantitative benefit evaluation methods for applying digital enterprise resource planning systems in supply chain management, this paper proposes a supply chain management benefit evaluation method after implementing the ERP system. This method starts from the two aspects of ERP implementation cost and quantitative income, establishes the evaluation index system of supply chain management benefit, then normalizes each index, uses the Delphi method to determine the weight of each quantitative income, constructs the evaluation model of enterprise supply chain management benefit after ERP implementation, and finally obtains the evaluation score in the form of the ratio of quantitative income to ERP implementation cost. In order to verify the feasibility of the model, the data of CM company from 2015 to 2022 are selected for simulation experiments. The calculated benefit evaluation score is consistent with the actual situation of the company's operation. Therefore, the model can effectively evaluate the benefits of applying digital enterprise resource planning system in supply chain management and provide strong support for enterprise management to plan ERP implementation and follow-up maintenance decision-making.

Keywords: Enterprise Resource Planning, Supply Chain Management, Benefit Evaluation, Digital Enterprise Resource Planning System.

INTRODUCTION

Global economic integration is gradually formed with the rapid development and broad application of information technology. In the increasingly competitive market environment, enterprises are facing unprecedented pressure of development (Fela et al., 2022). It is not feasible for modern enterprises to improve their efficiency by increasing the price of products. With the continuous development of the times, the concept of supply chain management has been paid more and more attention by more and more enterprises (Nair, Reddy, & Samuel, 2014). As a new type of management concept and systematic advanced management mode ("Four Strategies For Diagnostic Supply Chain Management," 2023; Winter, Dopler, Müller, & Zeisler, 2023), supply chain management is an integrated management of logistics (ElMesmary & Said, 2019), capital flow (Chen, 2022), information flow (Timakov, 2022), people flow and business flow from upstream suppliers to downstream customers from the whole supply chain, to pass more value to customers at lower cost.

Since the 1990s, information technology based on computer technology has been widely used in enterprise management, product design, and manufacturing. The

development of enterprise informatization has also reached a very high level. Enterprise informatization uses advanced management concepts and information technology to improve management and service levels to support business decision-making. Enterprises can quickly respond to the needs of the outside world (Telukdarie, 2016a, 2016b), thereby improving their core competitiveness and adaptability and promoting their development. International and domestic enterprises are currently carrying out or have constructed large-scale high-investment information projects represented by ERP, ERP application integration, and other projects (Chen, Wu, Chen, & Hung, 2021; Menshikova, Smirnova, Shtrafina, & Privalov, 2021). Enterprise managers are concerned about ERP projects' late return rate and corresponding risks. However, more adequate digital enterprise resource planning systems in applying quantitative benefit evaluation methods in supply chain management still need to be more adequate. Domestic and foreign scholars have researched this issue.

Some scholars proposed to evaluate the ERP project as a typical capital investment, mainly from the perspective of the quantification of costs and the benefits of monetary forms and tried to predict the time value of money to support the decision. (Farah & Jihane, 2022)verified through qualitative and quantitative research that implementing ERP systems will benefit enterprises in accounting and financial information and management. (Teittinen, Pellinen, & Järvenpää, 2013)analyzed the benefits of four years after the implementation of ERP in the enterprise. The analysis results show that implementing an ERP system needs to join the control mechanism to affect the later benefits. The study of ERP implementation in small and medium-sized manufacturing enterprises (Mohanta & Patnaik, 2019) proposed that ERP software can improve productivity and efficiency and reduce costs.

At present, most enterprises can only describe qualitatively when evaluating the benefits of supply chain management after the implementation of ERP, such as improving efficiency, reducing costs, at most partial quantification, and improving efficiency in a certain process link. However, it is not possible to evaluate the payback period and the accurate benefits as a whole and quantitatively as investment and construction projects. If this problem cannot be solved well, the management of the enterprise will always be skeptical about the benefits of ERP. In the ERP projects of large enterprises in developed countries, a relatively mature theory and practice of project benefit analysis has been formed to guide the construction of large-scale enterprise information projects. However, there are relatively many methods, the level is uneven, and the forms are diverse. The application of different types of information projects is not the same. At present, there are not many practical applications in China, especially for the benefit analysis of supply chain management after the implementation of ERP in large enterprises. Therefore, this paper studies the benefit evaluation method of supply chain management after the implementation of the ERP system.

LITERATURE REVIEW

Enterprise Resource Planning

ERP is the most advanced enterprise management model in the world today. Its earliest concept was proposed by Gartner Group Inc. a well-known computer technology consulting and evaluation group in the United States, in 1990. Its basic idea is to regard the business process of the enterprise as a closely connected supply chain and closely link the supplier and the procurement, production, sales, and customer relationship within the enterprise to facilitate the effective management of all links in the supply chain, realize the dynamic control of the enterprise and the integration and optimization of various resources, improve the basic management level, and provide a full range of solutions for the enterprise. Throughout the world, scholars agree that the development of ERP has gone through the following stages (**Figure 1**):

(1) 1940s: the Management Information System (MIS) stage. In order to ensure production and reduce inventory, western economists have studied the law of inventory material consumption over time and put forward the order point theory, which sets up safe inventory and maximum inventory for materials.

(2) 1960s: the Material Resources Planning (MRP) stage. With the emergence and development of computer systems, it is possible to perform complex operations on extensive data quickly. In order to solve the shortcomings of the order point method, MRP was developed; that is, MRP achieved three innovations based on the order point: First, the demand for all materials is linked through the product structure. The material demand is divided into independent and non-independent requirements and processed separately. Third, the inventory status data of the material is introduced into the time coordinate. However, MRP is only limited to material requirements and is only part of production management.

(3) 1980s: the Manufacture Resources Planning (MRP II) phase. Based on MRP, the functions of the production center, processing hours, and production management are increased to realize the dynamic management of production, supply, and sales.

(4) 1990s: the Enterprise Resource Planning (ERP) phase. ERP is the next-generation manufacturing system and resource planning software of MRPII. In addition to MRPII 's existing production resource planning, manufacturing, finance, sales, procurement, and other functions, there are quality management, laboratory management, business process management, product data management, inventory distribution and transportation management, human resource management, and periodic reporting systems.

(5) 21st century: the E-commerce Enterprise Resource Planning (e-ERP) stage. The maturity of Internet technology increases the ability of enterprise information management systems to realize information sharing and direct data exchange with customers or suppliers, thus strengthening the connection between enterprises, forming a standard development chain of survival, and reflecting the supply chain management idea of enterprises to achieve survival

competition. ERP system to achieve this function so decision-makers and business departments can achieve cross-enterprise joint operations.

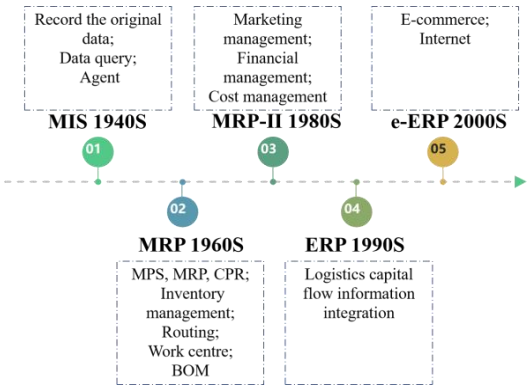

Figure 1. The Development History of Enterprise Resource Planning

Supply Chain Management

The " supply chain " idea originated from Peter Drucker's " economic chain. " In the 1980s, Michael Porter developed the " value chain" concept, which links several strategically related value activities in business operations. It includes basic activities such as logistics, production, and sales and auxiliary activities such as procurement and human resource management. With the development of information technology and the change in the demand environment, it eventually evolved into the concept of supply chain, which mainly focuses on the network chain relationship between core enterprises. The definition of supply chain in the American Association for Production and Inventory Control (APICS) vocabulary is a global network of products and services from raw materials to end customers through information flow, logistics, and cash flow (Stark, 2020). The definition of "supply chain management" in the national standard issued by China is as follows: a supply chain is a network chain structure formed by upstream and downstream members of raw material suppliers, manufacturers, distributors, retailers, and end users involved in the production and circulation process. Supply chain management plans, organizes, coordinates, and controls all the activities involved in the supply chain by using information technology to plan business, capital, and information flow.

Effective internal supply chain management is the basis of scientific inventory management. Atnafu and Balda proved that inventory management has a significant positive impact on the competitiveness of manufacturing enterprises by modeling and analyzing the data of 188 micro and small manufacturing enterprises. They also list five standard inventory management methods: ABC classification, EOQ quantification, JIT production, VMI strategy, and demand forecasting (Atnafu, & Balda, 2018). Information technology can help enterprises effectively cope with the growing complexity and dynamics at the enterprise level while improving the flexibility of the enterprise itself (Lotfi, Mukhtar, Sahran, & Zadeh, 2013). Through supply chain management and information sharing, manufacturing enterprises can reduce inventory, eliminate uncertainty, save costs, and strengthen process synergy to respond to market demand faster and improve their competitiveness and profitability (Koliousis, He, Wu, & Sarpong, 2022; Santoso, Siagian, Tarigan, & Jie, 2022; Zhang, 2020). Antti and Pekka's data analysis from 151 factories shows that the information processing ability of ERP systems is conducive to the planning and control of manufacturing enterprises under the dynamic market demand (Tenhil & Helki, 2015). The most significant benefit of an ERP system to supply chain management is the function of real-time tracking and internal process integration. The ERP system can effectively integrate sales, production, and inventory management in the enterprise supply chain (Kelle & Akbulut, 2005). Through the supply chain management maturity model, Huang and Handfield show that enterprises using ERP systems perform better than those without ERP systems in supply and production management(Huang & Handfield, 2015) (see **Figure 2** for details).

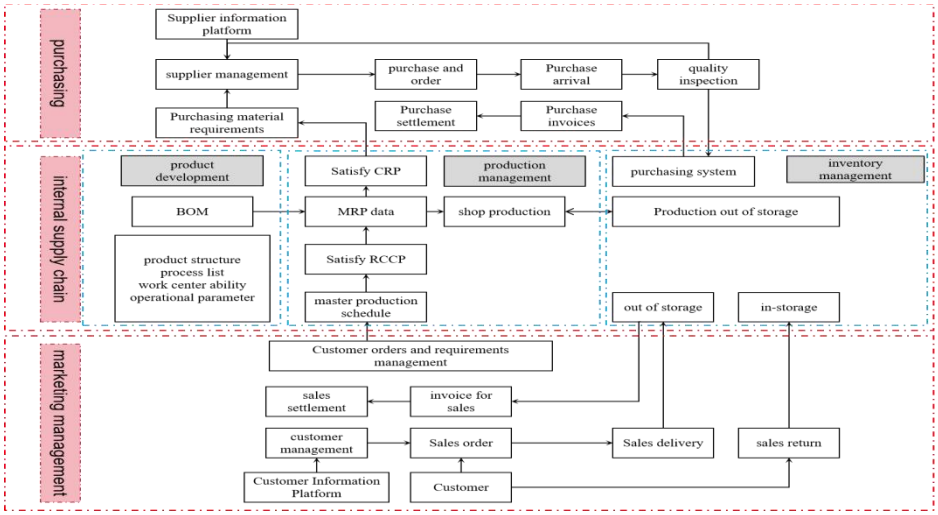

Figure 2. Supply Chain Management Diagram

Application of Digital Enterprise Resource Planning System

The supply chain can be divided into the internal supply chain and the external supply chain. The internal supply chain refers to the supply and demand network composed of procurement, production, warehousing, and sales departments involved in producing and circulating products within the enterprise. The external supply chain refers to the supply and demand network composed of raw material suppliers, manufacturers, storage and transportation suppliers, retailers, and final consumers involved in the production and circulation process of products related to the enterprise. The difference between an internal supply chain and an external supply chain is that the external supply chain focuses on the coordination between enterprises. In contrast, the internal supply chain focuses on coordinating departments within the enterprise.

From a global perspective, at least 30,000 companies are currently implementing ERP systems. 80% of the world's top 500 enterprises use ERP software as their decision-making tool and daily workflow management; ERP has dominated foreign enterprise management software. The implementation of ERP in Western developed countries has achieved great success. According to the American Association for Production and Inventory Control (APICS) statistics, the use of an ERP system can bring the following economic benefits to the enterprise on average: inventory decreased by 30% to 50%, delayed delivery decreased by 80%, procurement lead time shortened by 50%, downtime reduced by 60%, manufacturing cost reduced by 12%, management level improved, management personnel reduced by 10%, production capacity increased by 10% to 15%. Some scholars believe that with the implementation of an ERP system, the average increase in production line productivity by 5%~10%,e the assembly line productivity by 25%~40%, reduction overtime by 50%~90%, reduced procurement costs by 5%, the on-time delivery rate can be as high as 90%~97% (Yadav, Yadav, Dhar, & Mohan, 2023).

According to the in-depth research and investment prospect analysis report of China's ERP software industry (2023-2030), the scale of China's ERP software market increased from CNY 20.9 billion to CNY 38.5 billion from 2016 to 2021, with a year-on-year growth rate of 13%, showing a strong growth trend and injecting a strong impetus into the economic activities of enterprises. The " White Paper on China 's Industrial Software Development in 2021," written by Aliyun Innovation Center, Whale Research Institute, and Bayun Industrial Service Platform, shows that the localization rate of ERP software in China is high. However, the domestic high-end market share still needs to be improved. Domestic software accounts for 70% of the domestic market share. The products of domestic ERP manufacturers mainly occupy the market of small and medium-sized enterprises, and the high-end ERP software of large and medium-sized enterprises is still dominated by foreign markets. SAP and Oracle occupy the first and second positions, respectively, with 33% and 20% market shares. The third is Yonsuite, accounting for 14%, and IBM accounted for 8%, ranking fourth. Kingdee is fifth, at 6%. It can be seen that China's ERP manufacturers are weak compared with foreign manufacturers (**Figure 3**).

In addition to the more used ERP software, the more famous ERP suppliers abroad are Infor (United States), Sage (United Kingdom), Epicor (United States), Exact (Netherlands), QAD (United States), Ding Jie (China, original Digital China), Tide (China) and so on.

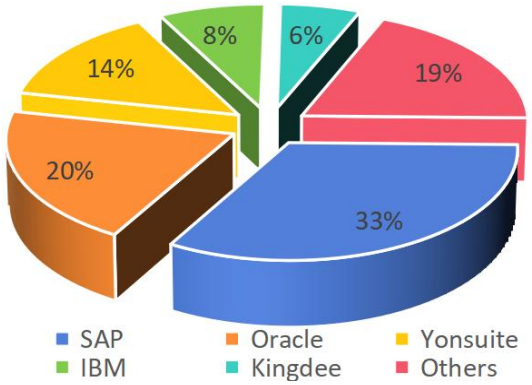

Figure 3. The Proportion of High-end ERP Software in the Market of Large and Medium-sized Enterprises

Benefit Evaluation

Due to the ERP project involves complex content, including the concept of change, the transformation of the mechanism, business process reengineering, implementation methods, project management and software (consultant) company's service level, and a series of practical problems, so the whole project has a wide range, rugged, long cycle and complex system characteristics. Value tracking and benefit analysis through managing time and resource inputs to achieve project objectives. The core idea of achieving benefits is that if the actual benefits the project stakeholders hope to obtain are finally realized, the investment is successful. Combined with the research status at home and abroad, the methods currently used for ERP project benefit evaluation are mainly divided into the following: ABCD evaluation method, D & M model, analytic hierarchy process, etc.

(1) ABCD Detection table Method

The earliest ABCD test table was given in 1977 by 0liver Wight, a pioneer of MRPII, with 20 questions. These 20 questions are divided into three groups according to technology, data accuracy, and system usage. Each question is answered as ' yes ' or ' no. ' The second version of the test table was expanded to 25 questions and added a group content: education and training. The second edition of the ABCD detection table is trendy and easy to use. In the 1980s, the ABCD detection table was further improved and expanded, and the third edition was launched. Its coverage is not limited to MRPI but includes the enterprise's strategic planning and continuous improvement process. However, the third version of the ABCD detection table is not widely circulated. The fourth edition of the ABCD test table was launched by Oliver Wight in 1993. This is not a person's or even a few people's work but the focus of a dozen years of research and implementation of the application of the

company's experience. This test table is no longer a table of dozens of problems.

However, it is divided into five chapters according to the basic enterprise functions: strategic planning, human factors, collaborative spirit, total quality management and continuous improvement, new product development, planning, and control process. Each chapter begins with a concise qualitative description of the different qualitative characteristics of the four levels of ABCD for the issues considered in this chapter and then lists some detailed questions. The answer to these detailed questions is no longer ' yes ' or ' no 'but is scored from 0 to 4. If the average score is more than 3.5 points, it is considered that the enterprise has reached A level for the problems considered in this chapter, 2.5 points to 3.49 points to B level, 1.5 points to 2.49 points to C level, and less than 1.5 points to D level. Only the fifth chapter is about the implementation and application of MRP / ERP. This change in the ABCD test table reflects the integration trend of various management ideas.

(2) D&M model

In the early 1990s, American professors Delone and Mclean proposed the D & M model. By summarizing the relevant research results of predecessors, this paper puts forward six leading indicators of an information system project: the quality of information system, the quality of information, the application of the system, user satisfaction, personal influence, and organizational influence. These two scholars explained the relationship between the index system, a milestone in successfully evaluating information projects. After that, the research on evaluating information system projects is based chiefly on the D & M model. For example, Australian scholar Sddon proposed an improved D & M model that is widely accepted by the theoretical community. In the late 1990s, the American Standardization Research Institute conducted a comprehensive survey on the return on investment of SAP projects of SAP customers. It proposed project performance evaluation methods based on the D & M model, including project driving factors, transaction processing indicators, and critical success factors.

(3) Analytic Hierarchy Process

The analytic hierarchy process (AHP) is a multi-objective evaluation and decision-making method first proposed by American scholar T.L.Saaty in the 1970s. The analytic hierarchy process is a practical multi-objective decision-making method that mathematicalizes the decision-makers ' evaluation and decision-making process of complex systems. The basic idea of this method is to decompose complex problems into several levels and then analyze them layer by layer. The highest level of decision-making is the overall goal of solving the problem, called the target layer; the measures and evaluation criteria involved in the middle layer to achieve the overall goal are called the criterion layer; the lowest layer is the various schemes applied to solve the problem, called the scheme layer. A specific logical relationship exists between the adjacent upper and lower layers, which is connected by a straight line to form a hierarchical structure of system analysis. After the hierarchical structure is established, the judgment matrix is determined by experts by comparing the indicators with the logical relationships between the upper and lower levels. Then, the maximum eigenvalue of the matrix and its corresponding eigenvector are obtained, and the consistency test is carried out to judge the logic and rationality of the evaluation results. The feature vector of each index in each layer is the relative importance of each evaluation factor, that is, the relative importance of each index, and finally, the composite weight of each level relative to the whole target layer.

METHODOLOGY

The Current Situation of the ERP System in CM Company

Taking CM company as an example, this paper introduces the ERP system used by CM company. CM company's business scope includes design, research and development, production and sales of all kinds of copper and copper alloy plate and strip , feed and sale of non-ferrous metals. In the Chinese market share of more than 1.6%, proprietary and agent with the enterprise related goods and technology involved in trade and import and export business.

The system performs daily work according to the following supply chain management process: the sales department completes the plan submission, the general manager audits the sales department's submission plan and issues it to the production department, the production department completes the required material purchase list according to the sales plan and submits it to the procurement department. The procurement and cost departments arrange reasonable bidding time with the production plan and market price. After bidding, the procurement department reports the results to the company's procurement management leading group and the general manager. After the verification is correct, the winning bidder signs the technical agreement and final contract. The winning bidder's supply and demand production department, procurement department, cost department, management leading group, and general manager's representative are on-site for acceptance. The payment is initiated by the production department and approved by the cost department, procurement department, financial department, and corresponding leaders until the company's general manager completes the payment. The ERP system interface of CM company is shown in **Figure 4**.

Figure 4. ERP System Page

Analysis of ERP Implementation Cost

In this paper, the benefit evaluation of supply chain management after ERP implementation is mainly carried out from two aspects: ERP implementation cost and supply chain management benefit. The analysis of ERP system implementation cost composition is essential for ERP implementation cost estimation. For the ERP system of CM enterprise, its implementation cost composition project can be divided into hardware facilities, software configuration, daily maintenance, and human resources cost. The implementation cost structure is shown in **Figure 5**.

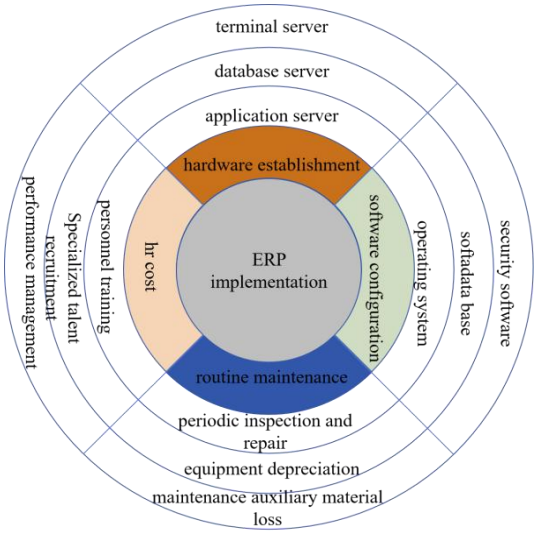

Figure 5. ERP Implementation Cost Structure

The total cost of ERP implementation of CM company can be calculated by Formula (1):

$$C_i = Y_i + R_i + W_i + H_i + \alpha \qquad (1)$$

In Formula (1), the total cost of CM company is Ci; α is the cost caused by uncontrollable factors during ERP implementation, operation, and maintenance. It is obtained according to financial statements during ERP implementation and can be directly generated according to data in ERP during ERP operation and maintenance. Yi, Ri, Wi, and Hi represent the cost of hardware facilities, software configuration, daily maintenance, and human resource costs. With the continuous change of ERP implementation and operation and maintenance stage, the composition of the four significant costs is also changing, so the corresponding calculation method is as follows:

$$Y_i = \sum_{j=1}^{n} y_j, j = 1,2,\cdots\cdots,n \qquad (2)$$

$$R_i = \sum_{j=1}^{n} r_j, j = 1,2,\cdots\cdots,n \qquad (3)$$

$$W_i = \sum_{j=1}^{n} w_j, j = 1,2,\cdots\cdots,n \qquad (4)$$

$$H_i = \sum_{j=1}^{n} h_j, j = 1,2,\cdots\cdots,n \qquad (5)$$

In the above formula, taking the cost of hardware facilities as an example, yi comprises several small expenditure items, and the number of calculations is n. After adding up, the total annual cost of hardware facilities Yi is obtained. According to the other enterprise costs in the previous year, λ is determined, so the total input cost of the commercial circulation enterprise can be calculated.

Construction of Supply Chain Management Benefit Evaluation Model

The core of the benefit evaluation of supply chain management after ERP implementation is constructing an index system, which includes the division of ERP implementation cost and quantitative income. Quantitative income includes the following four aspects: reducing cost, increasing income, improving efficiency, and reducing loss. Specific to the Z company supply chain management are: reduce procurement costs (X1), increase sales revenue (X2), improve production efficiency (X3), and reduce material losses (X4).

Then the collected data are normalized by the maximum and minimum methods. Since the method is a linear transformation, it retains its original meaning without losing any information. The input normalization formula is as follows:

$$X'_{\mathrm{i}} = F_w - \frac{X_i}{p\prod X_{\max} - X_{\min}} \qquad (6)$$

In the formula, Fw is the normalized input value X, the unprocessed input value Xmax, where the x input value Xmin is the minimum. The original p indicators are linearly combined to form a new comprehensive index.

This paper uses the Delphi method to determine the weight of each quantitative income, as shown in **Table 1**.

Table 1. Quantitative Income Weight

Quantitative Income Items	Weight
Lowering the procurement cost（X1）	0.27
Increase sales revenue（X2）	0.22
Improving production efficiency（X3）	0.39
Reduce material loss（X4）	0.12

Combined with the evaluation index, the enterprise supply chain benefit evaluation model is constructed after implementing ERP. The model is shown in Formula (7):

$$S = \frac{\sum_{\mathrm{i=1}}^{\mathrm{n}} \lambda X'_i}{C'_{\mathrm{i}}} \qquad (7)$$

In the formula, X 'i is the comprehensive index obtained by the normalization of quantitative income, λ is the weight of quantitative income, and C'i is the comprehensive index obtained by the normalization of ERP implementation cost.

After implementing the ERP system, the whole enterprise supply chain management benefit evaluation process is shown in **Figure 6**.

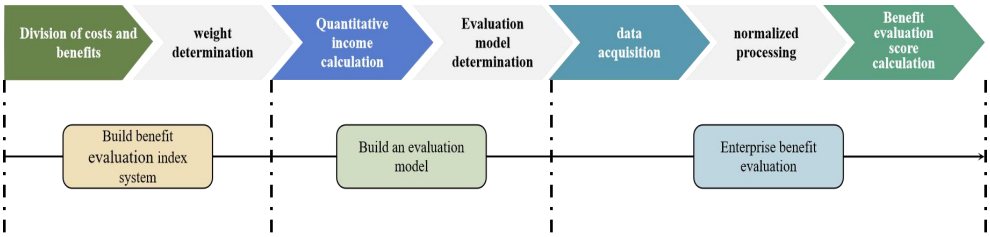

Figure 6. Benefit Evaluation Flow Chart

RESULTS

In order to verify the feasibility and generalization of the model proposed in this paper, CM company is selected as the main experimental object, and industries A, B, C, and D are used as the comparison experimental group. The data source mainly comes from the business database of each company's ERP system and a large number of behavior logs generated by accessing these systems. The ERP implementation cost data mainly comes from the financial statements during the implementation period.

The ERP implementation cost and company operation data of CM company from 2015 to 2022 are shown in **Table 2**. Among them, 2015 and 2016 are the ERP implementation stage, 2021 is the ERP system update stages, and the input cost is high. The rest of the year is the normal operation and maintenance stage, and the cost is relatively low and stable.

Table 2. Annual Input Costs and Normalized Post-processing Indicators

Year	Cost	Income	Net Profit	Net Profit Margin	Total Cost of Investment	Normalization Index
2015	10876	13379	1700.26	13.52%	821	0.075
2016	9798.19	13245.21	2652.31	21.30%	640	0.061
2017	10685.9	17616.13	5873.26	35.47%	213	0.021
2018	11602.75	21491.68	8599.42	42.57%	198	0.02

Year	Cost	Income	Net Profit	Net Profit Margin	Total Cost of Investment	Normalization Index
2019	12273.39	26434.76	12575.28	50.61%	202	0.021
2020	12942.29	29342.59	14639.74	53.08%	183	0.02
2021	12440.13	31689.99	17348.46	58.24%	497	0.055
2022	13997.64	36760.39	20557.13	59.49%	173	0.02

According to the data shown in **Table 2**, the cost savings and revenue increase data of CM company in each year can be calculated. In addition, the data on improving procurement efficiency and reducing material loss are generated by ERP's own calculation section, and the quantitative revenue data of CM company from 2015 to 2022 are drawn in **Figure 7**. Among them, 2015-2016 is the implementation stage of the ERP system, so some data are negative. In 2017, the ERP system was officially put into use, and the data in various aspects such as reducing costs, increasing revenue, improving efficiency, and reducing losses have changed greatly. With the stable use of the ERP system, the data began to decrease until 2020. CM's management believes that the existing ERP system has been unable to provide sufficient support for the company's leaders to make decisions, and the ERP system has been updated. The data for the year has increased, so it can be considered that the data is consistent with the company's operation.

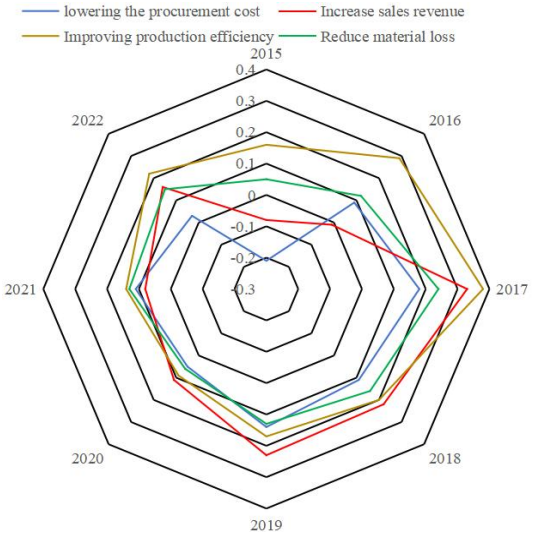

Figure 7. Quantitative Income Data for Each Year

According to the data shown in **Figure 7** and **Table 2**, the annual supply chain management benefit evaluation scores are obtained as shown in **Figure 8**. Among them, the highest score was 14.327 points in 2017, and the lowest score was −0.078 points in 2015, which is in line with the actual situation that 2015 was in the ERP implementation stage and 2017 was in the ERP stable maintenance stage. In addition, as the ERP system of CM company enters the stable maintenance stage, its benefit score decreases year by year, which is due to the normalization of ERP use and the obsolescence of the supply chain management process. Therefore, after CM company's ERP system is updated in 2021, the score of supply chain management benefit evaluation in 2022 has increased significantly.

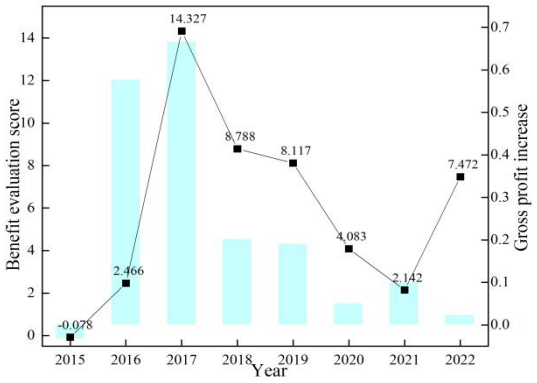

Figure 8. Annual Benefit Evaluation Score and Gross Profit Year-on-year

In addition, it can be seen from **Figure 8** that the supply chain management efficiency of CM enterprises has increased year by year, the gross profit has increased year by year, and the economic benefits of enterprises have continued to grow. In 2015, due to the relatively high investment cost of ERP implementation, and the ERP system has not been completed and cannot be put into use, it cannot bring benefits to the enterprise supply chain management. Therefore, the benefit decreased by 0.07% year-on-year. However, in 2016, after the ERP construction was completed and put into use, the supply chain efficiency was greatly improved, and the gross profit increase reached the maximum in 2017, which was 66.49%. This shows that the ERP system is helpful to the growth of enterprise profits. The evaluation model of enterprise supply chain benefit after the implementation of ERP designed in this paper analyzes the relationship between enterprise ERP infrastructure investment, input cost, enterprise operation, and production and operation efficiency, and gives full play to each other in the process of enterprise development. To a certain extent, it helps to increase the operating income of manufacturing enterprises and analyze the ERP system to provide help for the operating income of manufacturing enterprises.

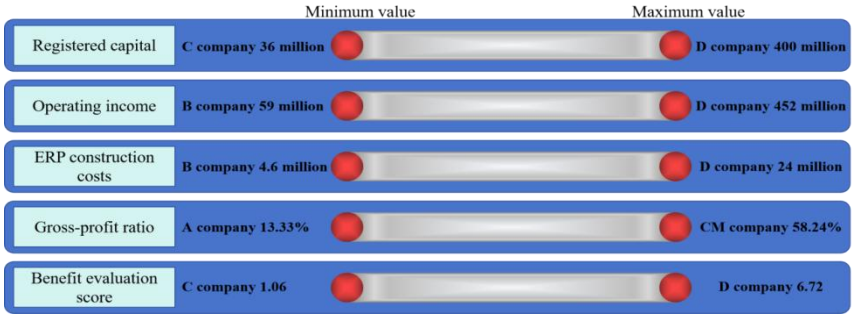

Figure 9. Comparison of the Operating Conditions of Each Company

In order to verify the feasibility of the evaluation model of enterprise supply chain management benefits after ERP implementation, A, B, C, and D manufacturing enterprises of the same type as CM company were selected for comparative experiments. The four comparison companies completed the construction of the ERP system in 2015 and before. Among them, the company with the least registered amount is C company, with a registered amount of 36 million yuan, and the largest registered amount is D company, with 400 million yuan; the operating data of each company in 2022 are selected, mainly including operating income, ERP construction input cost, gross profit rate, and benefit evaluation score. The comparison of each company is shown in **Figure 9**.

DISCUSSION

The model designed in this paper is used to evaluate the benefits of enterprise supply chain management after ERP implementation from 2014 to 2022, and the results are shown in **Figure 10**. The construction of the ERP system is completed and put into use, which can bring more objective benefits to the enterprise supply chain management. However, with the increase in the service life of the ERP system, the enterprise benefit increases year by year, but the benefit evaluation shows a decreasing trend, that is, the benefit growth trend slows down. Among them, the annual cost of A company for ERP system maintenance is low, so the benefit evaluation score is close to zero; Company D spends about 8 million yuan per year on ERP system maintenance, so the company's benefit evaluation score decreases with the trend, but the decrease is small, indicating that the company's ERP system can still bring more objective benefits for supply chain management. Based on this, it can be considered that the benefit evaluation model of enterprise supply chain management after the ERP implementation proposed in this paper is replicable for manufacturing enterprises.

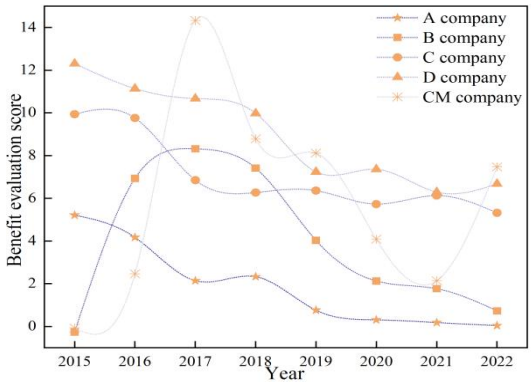

Figure 10. Muti-company Benefit Evaluation Results

In this paper, the Delphi method is used to determine the weight of each quantitative income, that is, the weight mainly comes from expert opinions, which are inevitably biased. In addition, quantitative income only includes four aspects: reducing cost, increasing income, improving efficiency, and reducing loss, without considering personnel performance and other items. Therefore, the evaluation of supply chain management benefits after ERP implementation is still not comprehensive enough, and the level involved is shallow. There is still room for further improvement, optimization, and exploration in theory and research.

CONCLUSION

By consulting a large number of literature, this paper understands the development history and application status of enterprise resource planning, supply chain management, and digital enterprise resource planning system application, introduces the ERP system of CM company, and, based on this, completes the supply chain management benefit evaluation after ERP implementation, as follows:

(1) This paper establishes that the evaluation index system of supply chain management benefits from two aspects: ERP implementation cost and quantitative income.

(2) The indexes are normalized Based on the evaluation index system. The weight of each quantitative income is determined by the Delphi method, and the evaluation model of enterprise supply chain management benefit after ERP implementation is constructed.

(3) The index data of five manufacturing companies such as CM from 2015 to 2022 are selected to verify the benefit

evaluation model of enterprise supply chain management after the implementation of ERP. After calculation, the benefit evaluation score of supply chain management is consistent with the actual operation of the company, so the model is feasible and replicable.

(4) The results of the study of ERP implementation of enterprise supply chain management benefit evaluation work provide effective and technical ideas that can be used for reference.

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