Application of ABC-Kraljic Classification in Inventory Management Within Traditional Small Foreign-Related Manufacturing Enterprises

Feiyan Zhong(✉)

Guangzhou City Construction College, Guangzhou, China
zfy2009@foxmail.com

Abstract. Inventory management is a crucial part of supply chain management and plays an important role in the business operation and development of manufacturing enterprises. The outdated inventory management methods and extensive material classification methods adopted by traditional small manufacturing enterprises have become major constraints to their development. To address the inventory management challenges of small foreign-related manufacturing enterprises, the inventory management of company D is taken as a case study in this paper. The conventional ABC classification method and Kraljic matrix method are integrated to build an ABC-Kraljic classification matrix model, based on which the company's materials are classified into four categories: high-value high-risk strategic materials, high-value low-risk leverage materials, low-value high-risk bottleneck materials, low-value low-risk routine materials, and differentiated inventory classification management measures are proposed based on material characteristics to reduce supply risk and purchasing cost and improve the core competitiveness of manufacturing enterprises.

Keywords: ABC-Kraljic classification · material classification · inventory management · supply risk · purchasing cost

1 Introduction

Manufacturing industry holds a pivotal position in the national economy and improves production efficiency and reduces production cost largely through production management and inventory management. As supply chain integration develops, inventory management has become a crucial part of supply chain management and has an increasing impact on enterprises, which is especially important for manufacturing enterprises. Inventory materials constitute the basis of manufacturing enterprises for production and operation, and the high cost of inventory has a direct impact on the operating cost and economic efficiency of enterprises. To survive in the competitive international market where many enterprises are facing survival of the fittest test, efforts are not only required to improve the quality of products and services, but also to reduce business operating costs.

J. Yang et al. (Eds.): ICMSEM 2022, AHE 12, pp. 111–123, 2023.
https://doi.org/10.2991/978-94-6463-038-1_12

When compared with the retail industry and the new intelligent manufacturing industry, the traditional small manufacturing enterprises still use outdated inventory management methods, along with excessive stagnant materials and persistently high inventory costs, which are constraints to their development and put them at a disadvantage to peers.

In response to the challenge of inventory management and to reduce the cost of inventory management, scholars at home and abroad have been working on inventory management theory since the 1950s. From then on, the inventory management challenge has gradually become the center of concern in the theoretical and business circles at home and abroad. In 1951, H.F. Dickie of General Electric Company (USA) applied the "80/20 rule" proposed by Italian economist Pareto (1897) to inventory management, and named it ABC classification method, putting forward the popular idea of maintaining stringent control over high-value low-variety items and simple control over low-value high-variety items. The core idea of this method is still widely used in multiple fields. However, as the complexity and diversity of material types, quantities and influencing factors have increased, the ABC classification method, which is a one-dimensional item classification method that only takes into account financial factors, is no longer adequate for the increasingly complex inventory management model. For this reason, Kraljic Peter (1983) published "Purchasing Must Become Supply Management" in Harvard Business Review, where he first proposed a two-dimensional item classification method, namely the Kraljic matrix method. The method considers two factors, item importance and supply risk, and classifies materials into four main categories: routine materials, leverage materials, bottleneck materials, and strategic materials [4]. The method has attracted close attention of scholars internationally and has been applied to contemporary corporate procurement and supplier management. For example, Based on the Kraljic procurement matrix method, a procurement portfolio model was developed for drugs in the healthcare industry to classify different categories of drugs according to strategic impact and supply risk, and develop differentiated procurement strategies (Arantes, Alhais, Ferreira, 2022) [1].

As inventory management methods become more science-based and diversified, manufacturing enterprises no longer use only a solitary inventory management model, and instead make corresponding inventory management strategies tailored to material characteristics and inventory costs. To improve the efficiency of material management, companies and scholars have introduced other methods for combination and improvement based on the conventional ABC classification method and Kraljic matrix method. For example, Ma Lin,Wu Cuihua (2015) [5] introduced fuzzy clustering method to classify elevator materials and combined the classification results with Kraljic matrix to give corresponding purchasing strategies; Ma Huixuan (2018) [6] used ABC classification method and Kraljic matrix classification method to classify suppliers and determine the corresponding management strategies;Fang Zhongmin, Han Fuyi, Ma Rong (2019) [2] added FSN classification method to the conventional ABC classification method in order to construct a fuzzy ABC-FSN classification method to classify and manage the inventory materials of CRRC Zhuzhou Electric Locomotive Co., Ltd. Ghanbarizadeh, Arad, Heydari, Jafar, Razmi Jafar. (2019) [3] developed a purchasing portfolio model (PPM) consisting of DEMATEL and ANP (DANP) and VIKOR based on the Kraljic model. Yu

Junfu, Yu Zhen (2022) [7] proposed a differentiated purchasing management strategy based on Kraljic model from two dimensions of profit impact and supply risk.

To sum up, most scholars have combined and improved the conventional ABC classification method and Kraljic matrix method based on those methods respectively. Although there are also many advanced inventory management methods and material classification methods, these methods may be more fit for some intelligent and new enterprises; while for some smaller traditional manufacturing enterprises, they do not have the means to implement advanced inventory control methods due to the constraints of capital, manpower quality, management level and IT capability. Despite the shortcomings of the conventional classification methods, as long as the advantages of those methods are given full play and effectively combined on this basis to make up for the shortcomings, the conventional methods can be brought into full play.

However, at present, quite a few scholars focus more on the improvement of inventory management methods in modern large and medium-sized enterprises and pay limited attention to the inventory management challenges of traditional small manufacturing enterprises. The outdated inventory management methods and extensive material classification methods of traditional small manufacturing enterprises are the obstacles to their development. The introduction of science-based material classification methods to reduce supply risks and purchasing costs and improve inventory management efficiency is therefore one of the effective ways for these companies to survive in the competitive international market. To this end, this paper using a small traditional foreign-related artificial plant company as a case study combines the conventional ABC classification method and Kraljic matrix method to develop a differentiated inventory management strategy tailored for the company's multi-variety and multi-model material characteristics in order to improve the level of material inventory management, reduce the cost of inventory and improve the business efficiency.

2 Theoretical Basis

2.1 ABC Classification Method

ABC classification method is a common analysis method for inventory management, which classify items into three levels, i.e. particularly important item class A, important item class B and marginally important item class C, depending on the quantity of varieties of materials and the funds proportion, and then defines different levels of management, such as very tight control, less tight control and minimal control, according to different levels. The specific classification is shown in Fig. 1.

The proportion of ABC-based variety category shown in Fig. 1 only represents general situation, but due to the different material characteristics and material usage of different enterprises, the proportional range of classification may also vary. Therefore, when adopting ABC classification method, enterprises should take into account the actual enterprise situation and divide the specific range according to the nature of materials and the importance of production and operation activities to enterprises, and take corresponding management measures. For example, class A item is generally of high value and less variety of materials, which is the focus of daily management and needs to be tightly controlled. As this material occupies high inventory capital, it is possible

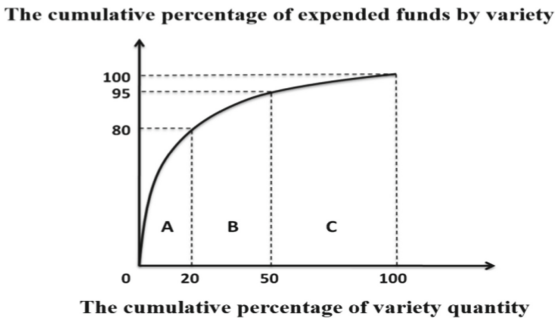

Fig. 1. Schematic diagram for ABC classification

to maintain a low inventory level by increasing the number of orders and reducing the single order quantity; class B item is of medium value and variety, which can be less tightly controlled, e.g. determining the order quantity and reserve amount according to major categories and adopting the EOQ method to minimize ordering costs; class C item is generally of low value and many varieties of materials, which can be managed in a more relaxed and extensive way to control the materials in a simple way, and because of the small proportion of inventory capital, higher inventory level is allowed, and the order quantity can be increased to reduce the number of orders and the ordering cost.

2.2 Kraljic Matrix Method

Although the ABC classification method is easy to operate and saves labor, it only considers the relationship between inventory items and inventory occupied funds, and lacks consideration of other key factors. The Kraljic matrix method makes up for the shortcomings of the ABC method by combining material importance with supply risk [4]. The "material importance" mainly includes the proportion of the cost of the item to the total cost of the product, the proportion of the purchasing amount of the item to the total purchasing amount, the impact of the item on the quality of the product, the loss caused by the shortage of the item, etc.; the "supply risk" mainly includes the number of suppliers, the intensity of supply competition, the ability to guarantee supply, the reliability of suppliers, the possibility of substitution, etc.

The Kraljic matrix method classifies inventory items into four categories based on the above two factors: strategic, leverage, bottleneck and routine (see Fig. 2). Enterprises should adopt appropriate inventory management strategies based on the characteristics of the four categories of items. For example, strategic items usually have high value, few suppliers, high supply risk, and high purchasing difficulty, which are therefore classified as high-value high-risk items, and these items should be managed in a focused manner to reduce supply risk by addressing the causes of risk. Leverage items are of higher value, generally with multiple suppliers, lower supply risk, moderate purchasing difficulty, which are therefore classified as high-value low-risk items, and such items will require continued good sources of supply. Bottleneck items are of low value, but are supplied from a single source, with suppliers in a dominant position, high supply

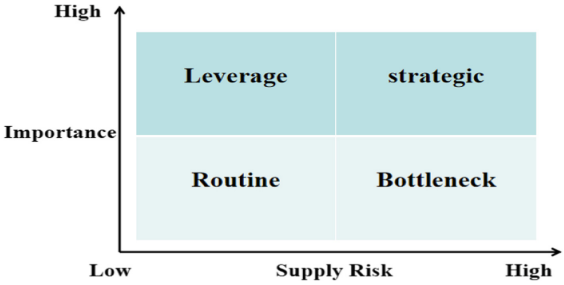

Fig. 2. Matrix diagram for Kraljic classification

risk, and high purchasing difficulty, which are therefore classified as low-value high-risk items, and such items will require both supply assurance and supply risk reduction. Routine items are of lower value, with more available suppliers, lower supply risk, and less purchasing difficulty, which are therefore classified as low-value low-risk items, inventory management workload should be simplified as much as possible, and the best supplier should be selected.

3 Empirical Analysis

3.1 Analysis on Inventory Management Challenges of Company D

Company D is a foreign-related processing and export enterprise engaged in the design, development, production and sales of premium artificial plants. The company classifies the materials involved into two categories: universal materials and non-universal materials. Universal materials are applicable to various order products with wide application, such as silk-screen fabric, color paste, paste, color powder, plastic, plastic bags, sealing glue, cartons, etc. These materials are mainly used in silk-screening workshop, dyeing workshop, injection workshop and packaging workshop; non-universal materials are only applicable to a certain order product, which are usually ordered according to customer requirements, such as iron wire, iron stand, iron basin, rattan hoop, fruit, etc. These materials are mainly used in injection and flower stringing workshop (see Table 1).

According to the survey, there are many varieties and models of materials in Company D. Its single inventory material classification standard only divides materials into two kinds, universal materials and non-universal materials, but the management methods for both kinds of materials are more or less the same, and it is difficult to put in place many details, which often leads to mistakes in inventory counting, receiving and dispatching, thus generating a large amount of stagnant materials and high inventory costs. This shows that the main concern of the company is that its material classification method is simple and extensive, and the inventory control strategy is one-dimensional and outdated, and it fails to adopt the corresponding inventory management strategy according to the characteristics of materials and suppliers.

Table 1. Material use at Company D

S/N	Material name	Material user	Universality
1	Silk-screen fabric	Silk-screening workshop	Universal
2	Color paste	Silk-screening workshop	Universal
3	Paste	Silk-screening workshop	Universal
4	Color powder	Dyeing workshop	Universal
5	Plastic	Injection workshop	Universal
6	Plastic bag	Packaging workshop	Universal
7	Sealing glue	Packaging workshop	Universal
8	Carton	Packaging workshop	Universal
9	Iron wire	Injection workshop	Non-universal
10	Iron stand	Flower stringing workshop	Non-universal
11	Iron basin	Flower stringing workshop	Non-universal
12	Rattan hoop	Flower stringing workshop	Non-universal
13	Fruit	flower stringing workshop	Non-universal

3.2 Application of the ABC-Kraljic Classification Model

To address the inventory management challenge of Company D, a science-based material classification method is introduced, combining the ABC classification method and the Kraljic matrix method to establish the ABC-Kraljic classification matrix model. The specific implementation steps are as follows: firstly, according to the company's business characteristics and material properties, the ABC classification method is used to classify the company's materials on a preliminary basis; secondly, on the basis of the ABC classification results, the material importance and supply risk are used as the basis for classification, and the materials of company D are reclassified based on the Kraljic matrix method to establish the ABC-Kraljic classification matrix model; finally, according to the classification results, the corresponding inventory classification management measures are taken according to the properties of different materials.

3.2.1 Primary Classification by ABC Classification Method

3.2.1.1 Implementation Steps

A) Identify statistical period

According to the survey on the basic inventory data of the company, it is found that the demand for universal materials is more stable, and therefore the inventory data from January to June of a certain year is selected as the statistical basis; while for the company's non-universal materials, since the orders demand differs in each season, among which the demand is larger from April to August and it is more difficult to manage the inventory, it can be used as a key period for study. As the demand for non-universal

materials changes more frequently, one month can be selected as the statistical period, and therefore June, which is more representative of the recent period, is selected as the statistical period.

B) Collect data

Collect inventory data about universal materials and non-universal materials in the statistical period according to the ABC classification criteria, such as variety quantity, monthly inventory quantity, unit price, consumption amount and other inventory data.

C) Process data

The collected data are calculated and analyzed according to the ABC classification principle. First, the variety quantity of each material is summarized and the percentage of the variety quantity of each material to the total variety quantity is calculated. Then, the unit price of each material is multiplied by the inventory quantity for the statistical period respectively to get the consumption funds of each material and the percentage of consumption funds of each material to the total funds is calculated.

D) Make ABC classification table

The basic inventory data and the data calculated by aggregation are filled into the ABC classification table separately, and then arranged in descending order by the size of consumption funds.

E) Identify material classification level

The three levels of ABC are determined according to the percentage of consumption funds and the percentage of variety quantity in the ABC analysis table.

3.2.1.2 Classification Results

A) Classification results of universal materials

The classification of universal materials in Company D is shown in Table 2, with 65.8% of the total funds consumed for silkscreen fabric and plastic, and 6.6% of the total variety quantity. As these two materials are very important raw materials for Company D, and fall into the category of low-variety high-value materials, they are therefore classified as class A. The total funds consumed for mill base and paste is 22%, with 15.1% of the total variety quantity. These two materials are the relatively important auxiliary materials of the company, the variety quantity and value are general level, they are therefore classified as class B; while the remaining materials consume a total of 12.2% of the funds, the variety quantity accounts for a total of 78.3%, belong to high-variety low-value materials, so they are classified as class C.

B) Classification results of non-universal materials

The classification of universal materials is shown in Table 3. The iron basin and iron stand consume 60.9% of the total funds and 6.3% of the total variety quantity, which belong to important-grade high-value low-variety materials, so they are classified as class A; while the fruit and rattan hoop consume 27.7% of the total funds and 15.5% of the total variety quantity, which belong to middle-value middle-variety materials, so they are classified as class B; while the iron wire consumes 11.4% of the total funds and 78.2% of the total variety quantity, which belong to low-value high-variety materials, so they are classified as class C.

Table 2. Universal materials of Company D by ABC classification (Source from January to June of a certain year)

S/N	Material name	Variety quantity	Percentage of variety quantity	Consumed funds (RMB)	Percentage of consumed funds	Classification level
1	Silk-screen fabric	6	5.7%	806,400	40.2%	A
2	Plastic	1	0.9%	512,430	25.6%	A
3	Color paste	15	14.2%	303,000	15.1%	B
4	Paste	1	0.9%	138,600	6.9%	B
5	Color powder	8	7.5%	39,360	2.0%	C
6	Plastic bag	6	5.7%	48,600	2.4%	C
7	Sealing glue	1	0.9%	19,440	1.0%	C
8	Carton	68	64.2%	135,960	6.8%	C
Total		106	100%	2,003,790	100%	

Table 3. Non-universal materials of Company D by ABC classification (Source from June of a certain year)

S/N	Material name	Variety quantity	Percentage of variety quantity	Consumed funds (RMB)	Percentage of consumed funds	Classification level
1	Iron basin	6	2.7%	66,957	30.7%	A
2	Iron stand	8	3.6%	65,790	30.2%	A
3	Fruit	13	5.9%	31,845	14.6%	B
4	Rattan hoop	21	9.6%	28,579	13.1%	B
5	Iron wire	172	78.2%	24,880	11.4%	C
Total		220	100.0%	218,052	100.0%	

3.2.2 Establish ABC-Kraljic Matrix Classification Model

Based on the ABC classification results, the ABC-Kraljic matrix classification model is established by combining the Kraljic matrix method with the material importance and supply risk as the classification basis to reclassify the materials of Company D.

3.2.2.1 Implementation Steps

According to the data information in Table 2 ABC classification of universal materials and Table 3 ABC classification of non-universal materials, the average monthly consumption funds of universal materials and non-universal materials are calculated, and the average monthly consumption funds of each material are calculated as a percentage.

According to the data information in Tables 2 and 3, the variety quantity of each material is calculated as a percentage.

According to the supply of different materials, the quantity of suppliers of each material and the procurement lead time are listed.

According to the delivery status of each material supplier, along with the supplier quantity, procurement lead time and other supply information, the conclusions on the size of the supply risk of materials are drawn.

According to the various data information listed in the table, along with the ABC classification results, the main materials are classified into strategic materials, leverage materials, bottleneck materials and routine materials according to their importance to the company's production and supply risk, and the ABC-Kraljic classification table is established (see Table 4).

Table 4. Company D's materials by ABC-Kraljic classification

Material name	Average monthly consumed funds(RMB)	Percentage of total consumed funds	Variety quantity	Percentage of all varieties	Supplier quantity	Purchase lead time (days)	ABC Grade	Matrix classification level
Silk-screen fabric	134,400	24.3%	6	1.8%	1	15	A	Strategic materials
Plastic	85,405	15.5%	1	0.3%	1	30	A	Strategic materials
Iron basin	66,957	12.1%	6	1.8%	1	15	A	Strategic materials
Iron stand	65,790	11.9%	8	2.5%	2	30	A	Leverage materials
Color paste	50,500	9.1%	15	4.6%	2	7	B	Leverage materials
Fruit	31,845	5.8%	13	4.0%	2	30	B	Leverage materials
Rattan hoop	28,579	5.2%	21	6.4%	2	30	B	Leverage materials
Paste	23,100	4.2%	1	0.3%	1	7	B	Bottleneck materials
plastic bag	8,100	1.5%	6	1.8%	1	7	C	Bottleneck materials
Sealing glue	3,240	0.6%	1	0.3%	1	7	C	Bottleneck materials
Iron wire	24,880	4.5%	172	52.8%	3	15	C	Routine materials
Carton	22,660	4.1%	68	20.9%	2	7	C	Routine materials
Color powder	6,560	1.2%	8	2.5%	3	7	C	Routine materials

3.2.2.2 Classification Results

According to the classification in Table 4, Company D's materials are classified into four kinds: strategic materials, leverage materials, bottleneck materials, and routine materials (see Fig. 3).

3.3 Improving Measures for Classified Management of Differentiated Inventory of Company D

According to the combined ABC-Kraljic material classification model, along with the material properties of Company D and the physical situation of suppliers (see Table 5), the company's materials are managed in categories.

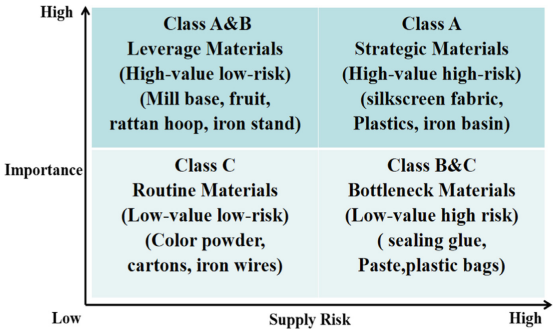

Fig. 3. ABC-Kraljic matrix classification

Table 5. ABC-Kraljic classification

Classification level	A	A&B	B&C	C
Matrix type	Strategic	Leverage	Bottleneck	Routine
Characteristics	High-value high-risk	High-value low-risk	Low-value high-risk	Low-value low-risk
Items	Plastics, silk-screen fabric, iron basin	Color paste, fruit, rattan hoop, iron stand	Paste, sealing glue, plastic bag	Color powder, carton, iron wire
Variety quantity	3.9%	17.5%	2.4%	76.2%
Funds share	51.9%	32%	6.3%	9.8%
Supply risk	High	Low	High	Low
Supplier quantity	Only one	More than one	Only one	Many

3.3.1 Strategic Materials

Company D's strategic materials mainly include plastic, iron basin and silk-screen fabric. The most important feature of this type of material is high value and high risk, so inventory management focuses on maintaining good relationships with suppliers, reducing supply risk and minimizing purchasing costs. For plastics, which are imported raw materials and there is just one supplier, a Singapore-based firm, the Company D has therefore become more dependent on the supplier, depriving the Company D of its price negotiation advantage and leading to consistently high purchasing costs. Imported raw materials can be localized by finding alternative sources in China or convincing some foreign suppliers who are willing to cooperate to invest and establish branch plants in China, which not only shortens the procurement lead time and reduces the supply risk faced by import procurement, but also saves purchasing costs. To address the problem of long procurement lead time, the Company D can be bound by contract to urge the supplier to deliver on time, and to pay a certain amount of liquidated damages to the company in case of overdue delivery, so as to ensure that the supplier can supply in time to reduce supply risk; for silkscreen fabric, the initial localization of imported raw materials has been achieved, but there is only one supplier available, the focus is therefore on establishing win-win strategic cooperation with it and signing long-term partnership contracts. Besides, through the long-term strategic partnership, certain price concessions can be obtained from the supplier to reduce certain purchasing cost; as for the iron basin, since the material is a non-universal item and it is usually specially made according to the order requirements, with high specialization and high price, the supplier usually starts production only after receiving the order from the company. As different orders have different specific requirements for the iron basin, and it is sometimes due to the order requirements expressed and misunderstanding between the two sides, which lead to the wrong product model. For this situation, the key is to improve the communication and coordination between customers, producers and suppliers. IT development department can be co-established by producers and suppliers to realize information sharing between supply and demand sides to ensure that products meet customer requirements, translate buyer's samples into seller's samples as far as possible, translate special products into standardized products, and compress procurement lead time so as to reduce supply risks and purchasing costs.

3.3.2 Leverage Materials

Company D's leverage materials mainly include mill base, fruit, rattan hoop, and iron stand, whose main characteristics are high value and low risk. Since the number of suppliers is more than one and there is room for choice, the key management focus is mainly on improving the dominant purchasing position and reducing purchasing costs. For this purpose, the company can continue to look for some suppliers who offer lower prices and shorter delivery periods and sign cooperation agreements with them, so as to obtain more favorable prices and thus minimize purchasing costs in order to compress the company's capital tied up in inventory.

3.3.3 Bottleneck Materials

Company D's bottleneck materials mainly include paste, sealing glue, and plastic bags, whose main characteristic is low value and high risk. Since there is only one logistics supplier of this type available, the key management focus is to find new suppliers for reducing the supply risk. As the company's materials of this type are all universal materials, and the quality of the existing suppliers is not consistent, so it is possible to find new suppliers and choose a supplier with good quality and low price, develop a close and long-term relationship with it, and increase the order volume to obtain greater price concessions, which can not only reduce the supply risk, but also further reduce purchasing costs, so that they can be transformed into a low-value low-risk routine materials.

3.3.4 Routine Materials

At present, the company's routine materials mainly include color powder, cartons and iron wires, whose main characteristics are: high varieties, low value, large supplier quantity, easy access to products, which are therefore classified as low-value low-risk materials. However, due to the wide variety involved, accounting for 70.8% of the total variety quantity, routine materials bring certain difficulties to the procurement and management efforts. Therefore, the key to management of this type of material is to optimize the purchasing process and reduce management costs. By adopting the management cost minimization strategy and centralized purchasing, combined order material purchasing, choosing suppliers with complete varieties and excellent product quality as far as possible, making each purchase contain as many varieties of materials as possible, and clarifying the price protection clause, thus reducing the purchasing workload and management costs.

4 Conclusions

This paper takes the inventory management of a traditional small foreign-related manufacturing company, Company D, as a case study, and creates an ABC-Kraljic classification matrix model by integrating the conventional ABC classification method and the Kraljic matrix method, and applies the model to the inventory management of the company. The empirical method shows that combining the two conventional classification methods and adopting differentiated classification management-based improvement measures for inventory and suppliers not only give full play to the advantages of the two classification methods and avoid the shortcomings, but also effectively compress the procurement lead time, reduce supply risk, purchasing cost and inventory management cost, and improve the efficiency of enterprise inventory management, thus helping to improve the core competitiveness of traditional small manufacturing enterprises.

References

1. Amílcar Arantes; Andreia Frias Alhais; Luis Miguel D.F. Ferreira (2022). Application of a purchasing portfolio model to define medicine purchasing strategies: An empirical study. J. Socio-Economic Planning Sciences. 4(25): 101318

2. Fang Zhongmin, Han Fuyi, Ma Rong (2019). Application of Fuzzy ABC-FSN Classification in Enterprise Inventory Management. J. Logistics Technology. 38(01): 114-119.
3. Ghanbarizadeh Arad, Heydari Jafar, Razmi Jafar (2019). Ali Bozorgi-Amiri, A purchasing portfolio model for the commercial construction industry: a case study in a mega mall. J. Production Planning&Control. 30:1283-1304.
4. Kraljic, Peter (1983). Purchasing Must Become Supply Management. M. Harvard Business Review. 10:109-117.
5. Ma Lin, Wu Cuihua (2015). Research on Elevator Material Classification and Purchasing Based on Fuzzy Clustering. J. Journal of Southeast University (Philosophy and Social Sciences Edition). 17(S1): 70-73.
6. Ma Huixuan (2018). Research on Supplier Management for Operating Cost Optimization of Company F. D. Tianjin University.
7. Yu Junfu, Yu Zhen (2022). Differentiated procurement management strategy based on material classification. J. Manufacturing Technology and Machine Tools. 03:162–165.