The Application of EIQ Analysis to The Order Picking of Book Industry

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Abstract—EIQ analysis is based on the order data for logistics planning and has a guiding significance to the selection of order strategy. This article describes the steps and methods of EIQ analysis, combined ABC classification of book enterprise orders to carry on the EQ, EN, IQ and IK analysis. According to EQ, EN, IQ and IK analysis, entries and items are divided into Class A, Class B and Class C. Class A orders as priority orders should be used in batches picking; Class B orders should be used in general picking; Class C orders as non-priority orders on the basis of artificial picking orders can be combined and use wave picking strategy. Meanwhile, Class A items which are priority items can be placed in easy picking and exit from the position near or easy job to shorten the distance picking; Class C items should be placed on top of the storage area and placed in a position which is far from the exit; Class B items can be placed in the remaining positions. By the EIQ analysis results can understand order demand characteristics and provide data support for reservoir area layout, has chosen the equipment selection, strategy planning.

Keywords-EIQ analysis; order; ABC classification; book industry; picking

I. INTRODUCTION

With the continuous deepening of reform and the growing cultural needs, the book industry has made considerable progress. Because of the rapid development of the book industry, the level of logistics operations has higher requirements. Book logistics operations includes purchase, storage, sorting, shipping, distribution, etc., sorting operation consumes the most resources. How to determine the reasonable and effective picking strategy according to the order data is the main problem for the book enterprises. EIQ analysis is an effective method for analyzing the logistics characteristic based on the item and quantity of the orders and has guiding significance for the chosen strategy [1].

The layout of this paper is as follows. In the second section, the basic concept of EIQ analysis is simply made. The third part describes the steps of the implementation of EIQ analysis, and each step makes specific instructions. In the fourth part, the order data of book enterprise are analyzed practical applications, according to the EIQ analysis results to understand demand characteristics, select the appropriate picking strategy. The fifth part summarizes the whole article.

II. EIQ ANALYSIS

EIQ analysis is created by Japan authority logistics experts Suzuki shin, according to the order items and quantity for logistics planning. The so-called EIQ refers to entry, item and quantity.

E refers to every order received by the logistics center. Entry specific needs in the same period are picking, and distribution to the same place at the same time features. That is, as long as the order deadline, a few strokes of additional orders can be combined into a single order, the logistics operation process regarded as the same order; otherwise, the same batch of orders requires different times or different locations and distribution, to logistics centers with multiple orders deemed necessary for order split. These two cases occur frequently in real operation.

I mean commodity items or categories. As long as different quality, quantity, packaging unit, and other forms of packaging products, are treated as different items, in principle, to encode the logistics center as case basis. In actual operation should be noted that the coding, maintenance and unification of the commodity.

Q refers to the number of ordered data, which is the bridge between the entry and the item, and analyzes the quantity distribution of the entries and the items can exhibit characteristics of customer demand.

EIQ analysis method is to use E, I, Q cross analysis of the three logistics elements lead to EQ, EN, IQ and IK analysis. EIQ analysis results can understand the characteristics of the order data, so that different customers and different items take different picking strategy [2-3].

III. APPLICATION STEPS OF EIQ ANALYSIS

The application steps of EIQ analysis [4-5] is shown in Fig .1.
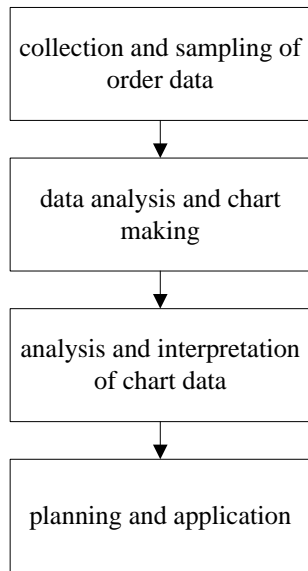

Figure 1. EIQ analysis Implement steps

Collection and sampling of order data: EIQ analysis data can select day, week, month or even quarter as the time range according to the commodity characteristics and operation cycle. This time range should be representative and can reflect the order characteristic. Since the book industry shipments daily fluctuation is bigger, it is difficult to select a representative day. Order data can be compared to select the appropriate time range [6].

Data analysis and chart making: using statistical method to EQ, EN, IQ and IK analysis, and charting the analysis results.

Analysis and interpretation of chart data: use EQ analysis to understand each order's shipment quantity and quantitative distribution, and to determine the important orders and the corresponding picking strategy; Use EN analysis to master each order's shipment items, and to determine the appropriate picking method; the use of IQ analysis to understand single item's shipment quantity and determine inventory levels and processing methods of different items; the use of IK analysis to master commodity shipment frequency and determine regular items, and also can cooperate with IQ analysis to determine the selection of the picking strategy[7].

Planning and application: The choice of order picking strategy based on analysis results.

IV. PRACTICAL APPLICATION OF EIQ ANALYSIS

Taking a week's order data of a book enterprise as an example, using EIQ analysis to analyze the order data and plan the picking strategy. Specific order data is shown in Table I.

TABLE I.   ORDER DATA FOR BOOK ENTERPRISE

Entry	Item												EQ	EN
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12		
E1	21	13	9	17	10	0	19	12	17	0	0	14	132	9
E2	33	0	17	39	24	58	21	23	8	32	27	21	303	11
E3	19	5	22	0	11	41	25	0	16	54	49	6	248	10
E4	0	7	10	15	8	21	12	14	9	20	0	11	127	10
E5	352	11	43	12	23	249	17	12	12	18	72	10	831	12
E6	12	0	22	6	9	32	31	6	17	33	41	5	214	11
E7	307	13	20	11	32	278	42	11	15	29	137	12	907	12
E8	14	9	8	7	0	16	10	9	11	10	11	0	105	10
E9	33	5	31	0	7	42	35	12	17	19	0	7	208	10
E10	27	0	0	11	14	23	16	13	0	15	17	10	146	9
E11	18	6	45	6	9	67	47	10	31	34	0	6	279	11
E12	16	8	12	0	8	20	14	0	13	26	17	0	134	9
E13	22	0	7	13	22	18	18	15	0	14	0	12	141	10
E14	31	5	18	5	0	49	21	13	17	22	29	8	218	11
E15	299	8	6	11	19	215	7	6	9	70	69	10	729	12
E16	17	0	15	10	11	31	13	10	0	16	18	9	150	10
E17	234	11	0	8	23	222	12	9	14	21	30	8	592	11
E18	19	0	13	0	10	13	0	9	10	17	15	7	113	9
E19	21	6	15	10	12	17	0	10	13	15	0	10	129	10
E20	39	0	22	17	19	35	29	19	0	33	0	0	213	8
IQ	1534	107	335	198	271	1447	389	213	229	498	532	166	5919	
IK	19	13	18	16	18	19	18	18	17	19	13	17		205

A. EQ Analysis and Application

Each entry's shipment quantity are arranged in descending order, and sorted are numbered 1,2, ... 20. EQ analysis table is shown in Table II.

TABLE II. EQ DISTRIBUTION TABLE

Entry number	E	Q	Entry cumulative shipments
1	E7	907	907
2	E5	831	1738
3	E15	729	2467
4	E17	592	3059
5	E2	303	3362
6	E11	279	3641
7	E3	248	3889
8	E14	218	4107
9	E6	214	4321
10	E20	213	4534
11	E9	208	4742
12	E16	150	4892
13	E10	146	5038
14	E13	141	5179
15	E12	134	5313
16	E1	132	5445
17	E19	129	5574
18	E4	127	5701
19	E18	113	5814
20	E8	105	5919

Assuming that the ratio of 5:3:2 of orders' shipments and cumulative shipments are ABC classification. Since shipments have been in descending order, then the top 50% of shipments and cumulative shipments on behalf of key orders which orders smaller and shipments more, which are classified into Class A; the final 20% of shipments and cumulative shipments on behalf of non-priority orders which orders more and shipments smaller, and these orders are classified into Class C; the rest are classified into Class B. After determining the ratio of ABC classification, EQ analysis also needs to separate the A, B, C class orders from the graph. It is necessary to determine the A, B classification critical point, B, C classification critical point and establish EQ-ABC classification reference data table as shown in Table III [8-9].

TABLE III. EQ-ABC CLASSIFICATION REFERENCE DATA TABLE

		A, B classification critical point	B, C classification critical point
Theoretical classification value	Percentage classification value	50%	80%
	Cumulative shipments critical point	2959.5	4735.2
Actual classification value	Number	4	11
	Shipments	592	208
	Cumulative shipments	3059	4742
	Error bars X value	16	9

Use EQ distribution table and EQ-ABC classification reference data table make EQ Plato as shown in Fig .2.
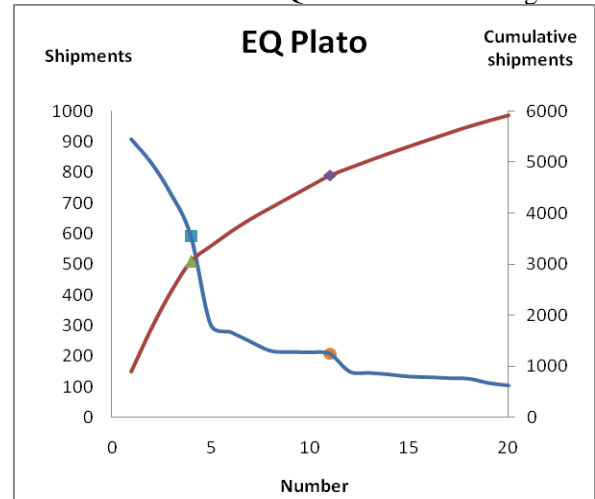

Figure 2. EQ Plato

From EQ distribution table and EQ Plato, it can be seen that: the book enterprise's order shipments distribution tends to polarize and orders can be classified by ABC classification. E7, E5, E15 and E17 are Class A orders, their orders accounted for 20.00% of total orders, shipments accounted for 51.68% of total shipments, should be used in batches picking; E2, E11, E3, E14, E6, E20 and E9 are Class B orders, their orders accounted for 35.00% of total orders, shipments accounted for 28.43% of total shipments, should be used in general picking; E16, E10, E13, E12, E1, E19, E4, E18 and E8 are Class C orders, their orders accounted for 45.00% of total orders, shipments accounted for 19.89% of total shipments, on the basis of artificial picking orders can be combined and use wave picking strategy.

B. EN Analysis and Application

The book enterprise's orders data shows that the total number of book item is 12. Statistics of the number of every order's shipments item can be drawn into EN distribution as shown in Fig.3.
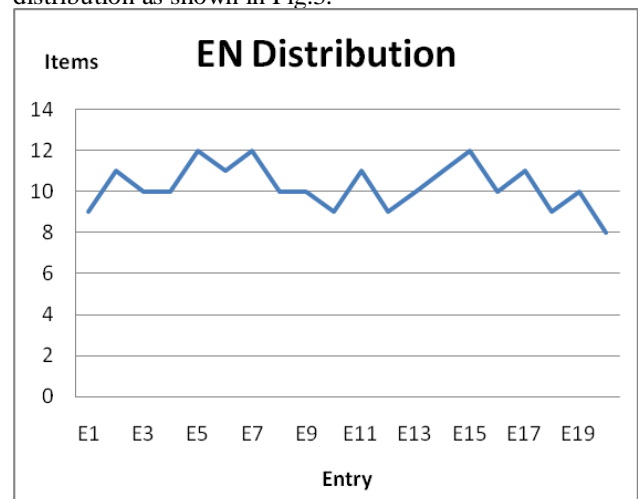

Figure 3. EN Distribution

According to EN distribution can be seen: The maximum number of commodity items is 12, the minimum

number of commodity items is 8 and the number of items in each order commodity hovering around 10. Because of the high repetition rate of orders commodity items, batch picking can be considered.

C. IQ Analysis and Application

Each item's shipment quantity are arranged in descending order, and sorted are numbered 1,2, ... 20. IQ analysis table is shown in Table IV. Assuming that the ratio of 5:3:2 of orders' shipments and cumulative shipments are ABC classification and the establishment of IQ-ABC classification reference data table is shown in Table V.

TABLE IV. IQ DISTRIBUTION TABLE

Number	I	Q	Item cumulative shipments
1	I1	1534	1534
2	I6	1447	2981
3	I11	532	3513
4	I10	498	4011
5	I7	389	4400
6	I3	335	4735
7	I5	271	5006
8	I9	229	5235
9	I8	213	5448
10	I4	198	5646
11	I12	166	5812
12	I2	107	5919

TABLE V. IQ-ABC CLASSIFICATION REFERENCE DATA TABLE

		A, B classification critical point	B, C classification critical point
Theoretical classification value	percentage classification value	50%	80%
	Cumulative shipments critical point	2959.5	4735.2
Actual classification value	number	2	7
	Shipments	1447	271
	cumulative shipments	2981	5006
	Error bars X value	10	5

Use IQ distribution table and IQ-ABC classification reference data table make IQ Plato as shown in Fig .4.
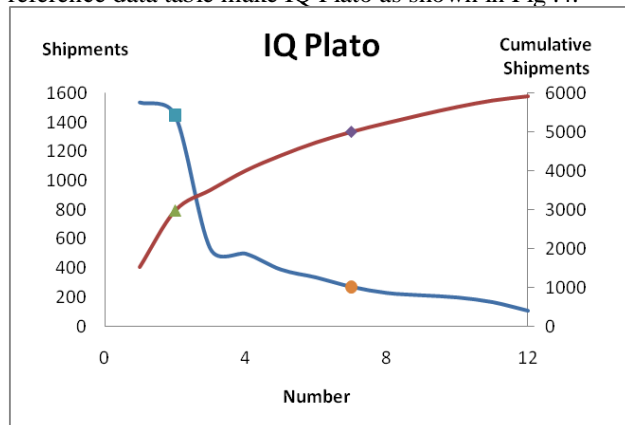

Figure 4. IQ Plato

From IQ distribution table and IQ Plato, it can be seen that: the book enterprise's item shipments distribution tends to polarize and items can be classified by ABC classification. I1 and I6 are Class A items, their items accounted for 16.66% of total orders, shipments accounted for 50.36% of total shipments, should be ensured adequate supply. In addition, Class A can be placed in easy picking and exit from the position near or easy job to shorten the distance picking. I11, I10, I7, I3 and I5 are Class B items, their items accounted for 41.76% of total orders, shipments accounted for 34.22% of total shipments. I9, I8, I4, I12 and I2 are Class C items, their items accounted for 41.76% of total items, and shipments accounted for 15.42% of total shipments. Class C should be placed on top of the storage area and placed in a position far from the exit.

D. IK Analysis and Application

According to order data for book enterprise can be seen: The highest number of each item's shipping times is 19, the lowest number of each item's shipping times is 13, the average number of each item's shipping times is 17 and the gap of every item's shipping times is not large. IK analysis can also be combined with IQ analysis to calculate the average of single product single shipment (Table VI) to classify and determine the storage arrangements and equipment use [10].

TABLE VI. THE AVERAGE OF SINGLE PRODUCT SINGLE SHIPMENT

	IQ	IK	IQ/IK
I1	1534	19	80.7
I2	107	13	8.2
I3	335	18	18.6
I4	198	16	12.4
I5	271	18	15.1
I6	1447	19	76.2
I7	389	18	21.6
I8	213	18	11.8
I9	229	17	13.5
I10	498	19	26.2
I11	532	13	40.9
I12	166	17	9.8

From Table VI, it can be seen that: I1 and I6's total shipments and average single shipments are large, planning should be assigned a fixed storage spaces and to ensure a high level of inventory. I11's total shipments and average single shipments are relatively large, so that the classification is not obvious sense. I2, I3, I4, I5, I7, I8, I9, I10 and I12's total shipments and average single shipments are small. These items should be assigned elastic storage spaces and cargo space size should be appropriate to adjust, picking area and storage areas can be combined to reduce excess inventory and inventory levels.

V. CONCLUSION

EIQ analysis departures from the order data, according to the supply chain downstream customers' demand characteristics, combines with the ABC classification, EIQ analysis results are obtained. According EIQ analysis, it can be understood that the order features, provide data support for the warehouse layout and order picking strategies. In addition, through EIQ analysis, companies can also get a lot of useful information, including changes

in market demand trends, logistics equipment selection and logistics system planning[11].

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