REDUCING TRANSPORT COSTS DUE TO OPTIMIZATION OF WAREHOUSE LOGISTICS

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Abstract: *in this article, the authors calculated one of the possible options for optimizing warehouse space in the logistics chain for cargo delivery. The authors studied existing methods of organizing warehouse work and compiled a heat map of the warehouse. Based on this analysis, one of the most effective algorithms for sorting a two-dimensional data array in a warehouse was applied, which made it possible to obtain a performance gain of almost 25%, compared to the basic one, random storage of goods in the warehouse amounted to 7000 hours (22000 hours of work versus 29000).*
Keywords*: optimization, cargo flow, cargo handling, sorting, algorithm, warehouse space, performance, efficient.*

СНИЖЕНИЕ ТРАНСПОРТНЫХ РАСХОДОВ ЗА СЧЕТ ОПТИМИЗАЦИИ СКЛАДСКОЙ ЛОГИСТИКИ

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Аннотация: *в данной статье авторами был рассчитан один из возможных вариантов оптимизации складской площади в логистической цепочке доставки грузов. Авторами были изучены существующие методы организации работы складского хозяйства и была составлена тепловая карта склада. На основе этого анализа был применен один из наиболее эффективных алгоритмов сортировки двумерного массива данных на складе, что позволило получить выигрыш в производительности почти на 25%, по сравнению с базовым, случайным хранением товаров на складе составил 7000 часов (22000 часов работы против 29000)*
Ключевые слова*: оптимизация, грузопоток, грузопереработка, сортировка, алгоритм, складская площадь, производительность, эффективный.*

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One of the key strategic directions for increasing the competitiveness of the national economy is the formation of an effective logistics system for the delivery of goods. Prompt and timely delivery of goods, first of all, ensures the adequacy of the movement of finished products and raw materials in the domestic market and reduces the cost of products delivered to consumers. In the logistics chain, the movement of material flows through warehouses affects the price of goods in terms of delivery costs. To increase the efficiency of a warehouse, it is enough to optimize the main process - cargo handling. Material handling involves the movement of goods over short distances, usually within the warehouse itself or between storage areas and vehicles. Efficiently operating warehouses reduce travel time to a minimum and make necessary movements as efficient as possible.

In this article, the task of optimizing cargo handling comes down to rethinking the approach to storing goods in a warehouse. Let's take as a basis the main optimization problem, in the form of reducing the time between the need to deliver goods for unloading and the time of delivery of goods from the point of acceptance to the point of storage. Each section of the chain is characterized by the time spent between it and the next section, and the whole process is expressed through formula (1):

$$t_{\text{цикла}} = \sum_{i=0}^{n} t_i, \quad (1)$$

Where: n – number of operations

t – time spent on a specific area

The output is the following list:

As a basis for the theoretical model of the warehouse, we will take the turnover of vegetable products in the Surkhandarya region of the Republic of Uzbekistan; in 2022 it amounted to more than 700 thousand tons. Vegetable products are a highly diversified product that arrives and ships from the warehouse unevenly in time and volume. Let's imagine the warehouse territory in the form of a two-dimensional heat map, each cell of which characterizes the intensity of goods turnover, on a scale from 1 to 100:

13	31	71	57	33	100	32	65	86	57	
34	15	88	25	98	32	1	63	59	78	Точка приемки
88	58	67	93	8	49	11	28	97	90	
52	47	40	8	30	65	99	73	88	2	
60	96	82	58	32	12	10	85	24	74	
27	57	85	96	24	55	86	14	51	8	
40	25	89	27	11	54	35	60	43	52	
30	90	34	62	52	2	12	44	66	80	Точка отгрузки
4	97	99	16	63	93	40	12	92	45	
70	52	37	1	50	98	92	65	7	17	

Fig.1. Warehouse heat map.

This map illustrates the random storage of goods in a warehouse, based only on approaches[1]:

- First to come, first to go
- First to come, last to leave

If we take each level of the warehouse as a time interval, and proportionally divide it into time zones for access to goods, then access to goods in the first time zone will be 1 minute, access to goods in the second time zone will be 2 minutes, and so on.PBy multiplying the intensity of access to a cell with its time zone, we get the total time spent on completing the work of delivering the cargo:

$$t = \sum_{i=1}^{n} x_i * y_i, \quad (2)$$

where: xi – number of requests for the product;

y_i– time to access the product.

Based on the calculation results, we obtain the following table showing how much time it takes to complete the full cycle of processing all goods in the warehouse. So, for example, for 280 products from a 10 time group it will take 280 * 10 hours:

Table 1. Cumulative processing time for cargo flow.

10	9	8	7	6	5	4	3	2	1
280	585	144	252	222	110	32	21	198	eleven
340	495	688	518	576	35	392	210	132	72
280	216	552	399	342	420	72	300	104	34
720	342	792	469	432	265	292	147	82	1
350	702	576	567	54	490	236	261	190	12
110	495	720	63	354	145	328	21	182	33
150	288	368	609	558	355	280	156	158	71
190	162	344	658	264	40	80	171	124	83
690	828	296	399	342	400	172	222	20	81
240	243	752	105	126	180	4	132	162	45

Let's adopt the bubble sort algorithm[2]to the heat map presented in Table No. 2:

Based on the bubble sort algorithm, we obtained the following result. In this case, the time gain reaches 25%.

[1]Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Gwynne Richards, 2011.

[2]Introduction to Algorithms. Thomas H. Cormen, 1989.

10	9	8	7	6	5	4	3	2	1		
7	25	34	39	52	59	65	77	94	97		
14	23	33	41	54	58	75	76	87	98	Точка приемки	
1	18	30	39	47	57	66	76	85	95		
7	15	30	45	55	60	73	77	89	96		
6	15	28	45	46	57	69	82	86	96		
10	17	28	35	49	59	70	75	93	96		
8	23	25	45	46	55	72	75	92	99		
15	23	29	40	45	58	75	78	93	99	Точка отгрузки	
3	19	27	44	49	63	65	82	88	100		
12	23	31	35	55	65	74	79	92	95		

Fig.2. Warehouse heat map after optimization.

It is necessary to apply optimization approaches to the supply chain at each of its sections; this is especially effective provided that the entire chain is controlled by one company, in which case the volume of information flow data opens up enormous opportunities for process optimization. In this article, one of the most effective algorithms for sorting a two-dimensional data array in a warehouse was used, which made it possible to obtain a performance gain of almost 25% compared to the basic, random storage of goods, i.e. the time gain was 7,000 hours (22,000 hours of warehouse work versus 29,000).

References / Список литературы

1. Logistics: Textbook / A.M. Gadzhinsky. - 20th ed. - M.: Publishing and trading corporation "Dashkov and K*", 2012. - 484 p.
2. *Bowersox D., Kloss D.* Logistics. Integrated supply chain. – M.: Olimp-Business, 2010. – 640 p.
3. *Dybskaya V.V.* Warehousing management in supply chains. 2009.
4. *Жураев М.Н., Омонов Б.Ш. & Кенжаев С.Н.* (2021). Формирование моделей управления объемами перевозок в соответствии с потребностями потребителей. Universum: технические науки, (5-2 (86)), 87-92.
5. Logistics: An Integrated Supply Chain. M: Olymp-Business, 640 p.
6. Gwynne Richards, Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. 2011.