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THE WILSON MODEL IN ENTERPRISE STOCK MANAGEMENT

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This article considered problematic issues related to the practical leverage of the Harris-Wilson optimal order quantity model. The development of the Harris-Wilson model was studied within the framework of the set goal, the conditions of use of this model were analyzed and considered, its main parameters were given, and the main disadvantages of its use in a modern enterprise were identified. It is also determined that the presence of optimal stock at the enterprise, which can be ensured by organising the management and control of flows of material and financial resources, according to the state and level of stocks, will allow the enterprise to function smoothly with a small number of material resources and small amounts of abstract working capital invested in these stock, and this, in turn, will allow us to identify extra supplies, the implementation of which will allow us to reduce the supplies themselves and increase production efficiency. Therefore, building an effective stock management process is a relevant and promising direction for modern enterprises. It has been proven that the choice of the model for the optimal order quantity contributes to the minimization of the enterprise's costs for stock and is one of the ways towards their effective management. The result of the study was an analysis of the use of the optimal order quantity model at modern enterprises, taking into account all its features. This model allows reducing the total cost of stock which in turn reduces the increase in the price of goods, thereby positively affecting the competitiveness of the enterprise. The prospects for further research on this topic are the modification of this model depending on the features of the enterprise's functioning.

МОДЕЛЬ УІЛСОНА В УПРАВЛІННІ ЗАПАСАМИ ПІДПРИЄМСТВА

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Ключові слова:
запаси, система управління запасами, оптимальний розмір замовлення, модель управління запасами

Актуальність проблеми оптимізації запасів підприємства та ефективного управління ними обумовлена тим, що стан запасів має визначальний вплив на конкурентоспроможність підприємства, його фінансовий стан та фінансові результати. Забезпечити високий рівень якості продукції та надійність її постачання споживачам неможливо без створення оптимальної величини запасу готової продукції, а також запасів сировини, матеріалів, напівфабрикатів, продукції незавершеного виробництва та інших ресурсів, необхідних для безперервного та ритмічного функціонування виробничого процесу.

Ставлення до запасів неоднозначне. З одного боку, занижені запаси матеріальних ресурсів можуть призвести до збитків, пов'язаних з простоями, з незадовільним попитом, і, отже, до втрати прибутку, а також втрати потенційних покупців продукції. З іншого боку, накопичення зайвих запасів пов'язує оборотний капітал підприємства, зменшуючи можливість його вигідного альтернативного використання та уповільнюючи його оборот, що відбивається на величині загальних витрат виробництва та фінансових результатів діяльності підприємства. Економічні збитки завдають як значна наявність запасів, так і їх недостатня кількість.

Тому в умовах ринкової економіки менеджер підприємства, керівництво та співробітники його служб постачання та збуту повинні прагнути до ефективного управління рухом матеріальних та фінансових ресурсів – управління процесами постачання та збуту, запасами та оборотними коштами, вкладеними в ці запаси. Наявність оптимальних запасів на підприємстві, яке можна забезпечити шляхом організації управління та контролю за потоками матеріальних та фінансових ресурсів, за станом та рівнем запасів, дозволить підприємству безперебійно функціонувати при малому обсязі матеріальних ресурсів та невеликих розмірах абстрактних оборотних коштів, вкладених у ці запаси. Це дозволить виявити зайві запаси, реалізація яких дозволить знизити самі запаси і, підвищити ефективність виробництва.

Тому побудова ефективного процесу управління запасами є актуальним та перспективним напрямом для сучасних підприємств.

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Formulation of the problem

One of the important factors in increasing the efficiency of business activity is effective stock management. Stock management is a solution to tasks related to accounting, systematization, analysis, and optimization of the supplies level. Stock management is based on the study of receipt and consumption patterns of stock. Modern enterprises have not yet included stock management as part of the main directions for their behaviour strategy which is actively carried out in the market environment, and they clearly do not use this factor enough to increase competitiveness.

Analysis of the latest research and publications

Analysis of the latest research on our issue makes it clear that this problem is still relevant in the scientific environment today. Such scientists: D. A. Besabar, A. P. Dolgov, F. Harris, and B. Wilson, devoted their overseas and domestic economies studies to the issue of using the Harrison-Wilson model in management stocks [1, p. 89; 4 p. 270; 9, p. 135; 10, p. 116]. The scientific works of scientists have made a significant contribution to the development of theoretical research, but there are still a number of debatable issues that need to be resolved: the structure and assessment of costs associated with placing an order. Solving these issues makes it possible to improve the policy of stock management at enterprises and increase their competitiveness.

Formulation of the purposes of the article

The purpose of this article lies in the study of the Harris-Wilson optimal order quantity model nature and the generalization of its advantages and disadvantages in management stocks to substantiate the features of its effective use in modern enterprises.

Results

The main task of any enterprise is to obtain profit and maximize it. An important condition for the implementation of plans for the production of products, the reduction of their cost price, and the growth of profit and profitability is the provision of the enterprise with stocks of decent quality and the declared range exactly on time and in full [3, p. 114].

By properly managing stocks, an increase in the level of efficiency in the use of all resources can be achieved as well as an increase in the speed of circulation of invested capital. With the help of the stock management system, orders are placed and received, and control over the fulfilment of orders is carried out. This system allows you to track orders and get answers to the following questions: has the supplier received the order, have they shipped the ordered materials, are deadlines being met, are there procedures for re-issuing orders and returning unnecessary or defective materials? To achieve greater operational efficiency, proper stock management is necessary, i. e., the leverage of certain stock management models that can help the enterprise increase turnover and maximize its profits.

Thus, the main goal of stock management is the timely delivery of inventory and minimizing the costs associated with ordering and storing it. For this, it is necessary to calculate the optimal quantity of the order or delivery, i. e., the optimal quantity of the order.

In domestic practice, a situation often arises when the size of the order is determined for personal organizational reasons. For example, the convenience of transportation or the possibility of loading warehouses. Meanwhile, in a system with a fixed order quantity, the purchase volume should be not only rational but also optimal. The optimization criterion in this situation is the minimum total cost of stock storage and repeat of order.

Economic optimal quantity is the amount of stock ordered that provides the optimal combination of costs for their acquisition and storage. To determine the optimal level of stock order, it is necessary to reduce the relevant costs for acquisition and storage [8, p. 63].

Although this model is popular, its creation has not been sufficiently investigated in the scientific environment for a period of time.

This model was invented by Ford Whitman Harris in 1913, and only in 1934, Robert B. Wilson analyzed the model suggested by Harris F. and formed the principle conclusion that in order to achieve the economic optimal quantity, it is necessary to achieve a balance between the costs of placing an order and costs according to the stored stock in the warehouse [9, p. 135; 10, p. 116].

Harris F. proposed in his model to consider the total (aggregate) costs associated with inventories as the sum of fixed and variable costs over a certain period. The graphic model of Harris F. is shown in Figure 1.

According to the figure, we can come to the conclusion that there is a relationship between the set up cost curve, holding cost curve, the curve for total cost and the order quantity.

In this case, the set up cost function is expressed by the equation: $y = k \times x^{-1}$, where k is a constant coefficient, x is the order quantity. Then the holding cost function is expressed by the linear equation: $y = b_0 + b_1 \times x$, with $b_0 = 0$.

Total variable costs are expressed by the equation: $y = k \times x^{-1} + b_1 \times x$.

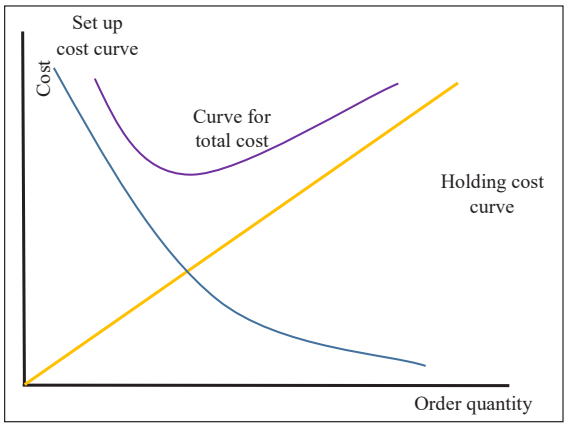

Fig. 1 – Graphic of the EOQ model

The basic conditions for using the EOQ-model are considered:

- unit cost is constant;
- this model considers only one type of product;
- the cost of fulfilling one order is constant and depends on the order quantity, i. e., on the number of units in one delivery;
- holding costs are constant and equal to the average order quantity;
- the size of the delivery batch is constant;
- the order arrives instantly at the moment of deficit.

The main parameters of the EOQ-model are presented (Table 1).

Therefore, some extensions can be applied to the EOQ model which allows taking into account the costs of backorders, especially when it comes to large volumes of goods.

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Table 1 – Parameters of the optimal order quantity model

Parameter	Description
Optimal order quantity (EOQ) model	$Q = \sqrt{\frac{2D \times R}{H}}$ Q is the optimal order quantity; D – total demand (units) during a certain period; R is the cost of setting up one order; H – the cost of holding a unit of stock during a certain period.
Number of deliveries	$N = \sqrt{\frac{D \times H}{2P}}$ N is the quantity.
Delivery frequency	$T = \sqrt{\frac{2P}{D \times H}}$ T is the period.

It should be noted that the formula of the optimal order quantity model has been severely criticized for the presence of a number of assumptions that complicate its use. Such assumptions are given in Table 2.

Analyzing the assumptions invented by Professor Douglas, it can be indeed concluded that such conditions describe an "ideal picture" that does not occur in real life.

Table 2 – Assumptions for using EOQ-model

Assumption	Author
1. Demand level is constant over the planning period.	Douglas M. Lambert – Professor of Marketing and Logistics, Fisher Business College [5, p. 92]
2. The lead time of the order is constant.	
3. The cost of setting up an order is constant.	
4. The transportation costs of the order are constant.	
5. Demand is fully satisfied.	
6. There are no transit stocks.	
7. There is one type of product in stock.	
8. The planning range is unlimited.	
9. Financial resources are unlimited.	

In our opinion, some conditions of use of the optimal order quantity model do not reflect the modern practice of economic activity, namely:

1) in the EOQ model, the amount of costs for the purchase of a product unit is constant, but in practice, there are discounts that provide different conditions for the purchase of products;

2) elements of cost change in direct proportion to the size of the order, but the costs related to the organization of cargo transportation by rail, for example, 10 transit rates, will differ compared to the delivery of cargo by warehouse method;

3) the classic EOQ model reflects a long period with multiple deliveries of goods. In practice, purchase prices for products tend to change several times during the year. One of the key points in international logistics is the seasonality of customs which directly affects the purchase price of products.

But in his work, Harris drew attention to the fact that this model is considered a practical tool that should be used wisely [9, p. 152].

Thus, the Harrison-Wilson formula can be used to determine the optimal length of the production cycle, namely, for example, when the costs of setting up equipment are incurred only once for each delivery batch produced. Equipment setup costs include additional labour and material costs. In order to use this formula when determining the duration of the work cycle, it is necessary to substitute the value of the costs for setting up the equipment, as indicated in Table 1.

Conclusions

Summarizing everything mentioned above, we conclude that the calculation of the optimal order quantity using the Harrison-Wilson model is a key issue in stock management policy. The analysis of this model allows minimizing the total costs of stock management which allows enterprise to reduce the growth of consumer prices, thereby positively affecting the competitiveness of the enterprise itself. But it should be emphasised that taking into account the development of economic activity, and the nature of foreign economic activity, this model needs modification depending on the situations that are considered.

A competent and skilled manager knows that it is appropriate to use modern control systems for the receipt and use of stocks at the enterprise. Modern information and technical equipment of accounting and analytical services of enterprises contribute to this as well.

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