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STOCKS VOLUME OPTIMIZATION AND THEIR MANAGEMENT IN CASE OF RISK

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Abstract

Stocks management is an important component of the accounting works and the research thereto may be developed on several directions, considering the array of practical situations that may occur in different fields of the economic activity. A main objective of stocks volume optimization refers to the stocks establishment and maintenance under cost minimization conditions. The attainment of this objective requires the harmonization of the contradictory relation between the purchasing expenses and the storage expenses. The most frequent situation in stocks management is when the spans of time between purchasing are not equal, running the risk that the delivery time agreed by contract may not always be observed. In this case, the contradictory relation between profitableness and risk is questionable, being necessary to make up a safety stock. A realistic solution is the one optimizing the costs generated by the safety stock establishment, considering the purchasing delay frequency.

Key words: stock management, optimum stock, safety stock, stock accountings
JEL classification: M41

1. Stocks management – a complex process for improving the performance of a company

A company's performance improvement implies the optimum and as accurate as possible measurement of efforts and effects, the efficient use of the company's resources, as well as the identification of the consumption reduction ways, where stocks hold a significant position. Stocks accounting organization and management are ever more based on the structure and dynamics elements research, but especially on decoding the future evolution trends of the phenomena occurred inside and outside the company.

Production stocks management is a complex process ensuring the use of the material resources with the expected efficiency and utility in terms of the storage process. A main objective of the stocks economical and financial management refers to the stocks establishment and maintenance under cost minimizing conditions.

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2. Sizing stocks effectively and pertinent

The optimum stocks management shall ensure the consumption continuity. This objective may be attained by eliminating or diminishing the purchasing uncertainty and by ensuring the balance between the supplier's delivery potential and the resources demand. The consumption ensuring uncertainty may be determined by the following: unawareness of the resource request, delivery potential, and non-compliance with the delivery time. Under all such conditions, the malfunctions are taken over by the safety or the reserve stocks. Even if there may be a balance between the supplier's delivery potential and the resource demand, the economic activity may not be developed without stocks due to the differences between the production dynamics and the rhythm of purchasing.

Generating great stocks by economic entities may have positive influences in case of a non-favorable influence of the raw material price or of getting some more favorable conditions from the suppliers in order to forward great orders.

The influences may also be negative in the following situations: raw material price decrease, raw material processing technology change, qualitatively superior substitutes, and physical and moral degradation losses.

Stocks sizing is the operation settling the optimum need of material current assets for a certain value-expressed period of time for the proper running of the forecast object and volume of the activity.

Managers are directly interested in optimizing the stocks volume and in organizing an efficient management control. The management control is the process ensuring the managers that the resources are acquired and used in an efficient, effective and pertinent manner. [Gervais, 2005, 20]

The stocks optimum level implies the highest effect, so that every entity may run its business with the lowest production costs and the highest benefits, hence the lowest storage costs.

For the analytical computation to optimize the stocks levels, one should know the storage process for the following "types of administration" [Başanu, 2001, 107]:

- the equal – span constant administration;
- the equal-span variable request administration;
- irregular span variable request administration;
- the two-warehouse administration type (S, s).

The equal-span constant request administration means that the recurrent purchasing for the reinstatement of the current stock shall be carried out in quantitatively equal batches. With this type of administration, one could forecast the running-out phenomenon of the current stock. In such circumstances, the safety stock shall be used in order to avoid the production interruption. This type of administration may be efficiently used by the facilities that have a constant product catalogue, with a time-balanced purchasing volume and traditional relationships with their suppliers.

The equal-span variable request administration requires recurrent purchasing of variable quantities at certain order-releasing calendar moments; the duration of the recurrent purchase is always the same. This type of administration is difficult to carry out and does not exclude the stock shortage phenomenon. That is why it is necessary to have an alarm level of the current stock.

Irregular span variable request administration does not enable one to know the order-releasing moments in advance. The re-purchasing is performed in fix batches and the alarm level is considered equal to the safety stocks. This type of administration is efficiently used by non-nominated high-volume production enterprises, by the service suppliers and by the manufacturers of consumer goods upon request.

The two-warehouse administration type means that the spans of time and the requests are variable and the supply batch is regular. The “S, s” administration type name expresses the essence itself of this work procedure, where “s” signifies the re-purchasing level, while “S” signifies the re-purchased quantity. Such an administration optimization means that the two “S” and “s” levels should go steady in order to obtain the lowest work effort to comprise and maintain the production stock.

The optimum size of the stocks is the one that balances the contradictory relation between the supply-transportation expenses (Ct) varying according to the supplies number and the storage expenses (Cd) varying according to the volume of stocks. For the establishment of the optimum raw material and consumables stocks, a mathematic solution shall be set out between the frequent renewal of the stocks and the stocks renewal on large time spans. If one shall choose a frequent stocks renewal, the transportation – supply expenses would grow, while the maintenance-storage expenses would go down. An stocks renewal on larger time spans would lead to the decrease of the transportation – supply expenses and the increase of the maintenance-storage expenses.

In case of equal-span regular demand administration, the Wilson-Whitin model may apply optimizing the stocks volume starting with the stocks leading to the creation of the total cost. This cost shall be minimum, given the operation activity maximization.

The reasoning of the optimum stock determination according to Wilson-Whitin model is [Simon, 1997, 1537]:

$$Cts = Ca + Ct + Cd$$

$$Ca = S \cdot u$$

$$Ct = \frac{S}{q} \cdot a$$

$$Cd = \frac{q \cdot u}{2} \cdot i$$

$$Cts = S \cdot u + \frac{S}{q} \cdot a + \frac{q \cdot u}{2} \cdot i$$

where: Cts = stocks incorporation total cost
Ca = purchasing cost
Ct = supply-transportation expenses
Cd = storage expenses
a = unitary fix cost to prepare a new supply
u = unitary supply cost
i = storage cost on stock unit
q = stock’s optimum size
S = yearly supply needed

The point where the first derivate of the total cost versus the stock volume equals zero, signifies the minimum total cost.

The stocks optimum size is the following:

$$q = \sqrt{\frac{2S \cdot a}{u \cdot i}}$$

By knowing the optimum stocks, one can determine the number of purchase-orders (P.No.) and the average span between two purchasing actions (i_m):

$$P.No. = \frac{S}{q}; \qquad i_m = \frac{q \cdot T}{S}$$

T = number of calendar days for that particular period (T_{year} = 360 days)

Example:

A wood-processing company purchases raw material (conifer logs) in order to produce timber.

The necessary quantity for one year (S) is 9 500 m^3, a new order preparation cost (a) is 1200 lei, the purchasing unit price is 1 000 lei/m^3, and the storage cost is 0.5 lei for one stock unit.

- The optimum purchasing stock is:

$$q = \sqrt{\frac{2 \cdot 9500 \cdot 1200}{1000 \cdot 0,5}} = 213,54 \ m^3$$

- The number of purchasing orders:

$$P.No. = \frac{9500}{213,54} = 44,49$$

- Average span between two purchasing actions:

$$i_m = \frac{213,54 \cdot 360}{9500} = 8,09 \text{ days}$$

In order to have the minimum stock incorporation total expenses during one year, it will be necessary for the company to release orders every 8^{th} day, and the quantities that are to be specified in the contracts for each orders shall be 213,54 m^3.

The Wilson – Whitin model may also be extended to the optimization of the in-process product stocks and of the final product stocks. In this case, “Ct” refers to the supply-transportation expenses of the in-process product batches and the release-expenses of a new final product-delivery order, while “Cd” includes the maintenance expenses of the in-process and of the final product stocks.

The described mathematic model to optimize the stocks volume on a particular purchasing case where the spans of time between supplies are considered regular, the purchasing is rhythmically conducted and stocks are put-up and delivered for consumption step by step until total elimination.

The stocks volume optimization issue shall be approached in relation with the stocks rotation speed. The more accelerated the rotation speed is, the smaller the stocks volume that the economic entity may use to solve out its scheduled economic activities. The stocks rotation speed shall be compared over a certain period of time in order to reach some conclusion and to act upon the stocks level for the benefit of the company. The acceleration of the rotation speed has positive influence on the profit and on the profitableness rate.

The acceleration of the stock rotation speed may be provided by technical, organizational and financial actions that shall be applied during each phase of the operating process: purchasing, production and trading.

During the purchasing phase, decisions and actions are necessary to ensure the elimination of the dead time due to purchasing shortage. The round-the-clock running of the production process requires permanent stocks of raw material and consumables. The purchasing optimization may be achieved by increasing efficiency, by fast adaptation to the market conditions, by suppliers selection according to certain criteria, by concluding the contracts in due time and by the compliance thereto. During this phase it is necessary to reduce the transportation, handling and storage losses. One cause of the rotation speed slowdown during this phase is the extra stocks due to improper contracting or certain product production stoppage.

During the production phase, the stocks volume depends mainly on the costs and on the duration of the manufacturing cycle. Any way of reduction is also a way of accelerating the stocks rotation speed. This objective may be attained by the due organization of the production, by settling some rational manufacturing flows and by choosing the best manufacturing technologies.

During the trading phase, the products dispatching and the fast receiving of their value lead to re-making the liquidities. The company's general liquidities shall be determined by comparing the total current assets to the total short-lived assets. The immediate sale of the final products occurs when they match the market's requirements in terms of volume, structure and quality. The acceleration of the rotation speed during the trading phase may be achieved by reducing the reimbursement period, by rhythmically procuring the products and by reducing the selection and packaging time.

3. Analysis of costs incurred for safety stocks

The most frequent stock management circumstance is when the spans of time between procurements are irregular running the risk that the delivery time agreed in the contract may not always be complied with. Thus, purchasing delays may occur. In such cases, the contradictory relation between profitableness and risk becomes questionable, requiring safety stocks. These are the quantities of material goods accumulated in the economic entity's storeroom deemed to ensure the production continuity, when the current stock has run out and its supply is delayed due to the supplier's malfunction or to transportation, or to the consumption increase over the forecast limit during that administrative period.

A prudent risk approaching policy shall ensure a safety stock creation that would cover the current stock breakage in case of supply delays. This policy is recommended whenever the stock breakage generated costs or whenever the costs caused by the operations stoppage are very high. For a wood processing company, the quantity of necessary raw materials for one year (S) is 9 500 mc and the supply delays take one to four days. Under these conditions, the safety stock (Ss) must be:

$$\text{Ss} = \frac{9500}{360} \cdot 4 = 106m^3$$

This policy records high storage costs of the safety stock.

An aggressive, risk neglecting policy shall lead to the determination of an average safety stock as an arithmetic mean of the safety stocks for each supply delay, including the non-delayed situation. Based on the above-mentioned data, the average safety stock (Sms) is:

$$\text{Sms} = \frac{9500}{360} \cdot \frac{0+1+2+3+4}{5} = 53 \ \text{m}^3$$

Shall the supply delays be up to 2.5 day, the economic entity shall cover the safety stock storage expenses, and if the delays take more than 2.5 days, occasional costs may occur due to stock shortage.

A more realistic policy [Stancu, 2002, 126] would optimize the costs generated by each one of the above-mentioned policies. Two stages are run in order to enforce this policy:

- determining the costs generated by each level of the safety stock, in all possible cases of supply delays;
- determining a consequences pattern derived from each level of the safety stock on stocks management based on the supply delays frequency (statistically registered).

For the analyzed economic entity, an stock breakage cost of 1 200 lei is admitted for the first day of supply delay, of 1 300 lei in the second day and for the following days. The necessary quantity of raw material for one year is 9 500 m^3 and statistically there were recorded delays up to 4 days. The unit purchasing price is 1 000 lei/m^3, and the storage cost is 0,5 lei for one stock unit. Based on these data, the safety stock-generated costs shall be calculated and they are shown in table no. 1.

Table no. 1 - The safety stock generated costs

Days of delay	**Safety stock volumes**				
	0	26 m^3	53 m^3	79 m^3	106 m^3
0	0	36,111 lei	73,611 lei	109,722 lei	147,222 lei
1 day	1 200 lei	0	36,111 lei	73,611 lei	109,722 lei
2 days	2 500 lei	1 200 lei	0	36,111 lei	73,611 lei
3 days	3 800 lei	2 500 lei	1 200lei	0	36,111 lei
4 days	5 100 lei	3 800lei	2 500 lei	1 200 lei	0

A safety stock calculated for one day of supply delay must be of $\frac{9500}{360} = 26 \ \text{m}^3$. When there are no supply delays, this safety stock is useless, generating an additional cost of: $26 \cdot 0{,}5 \cdot \frac{1000}{360} = 36{,}111$ lei. In case of one day of supply delay, there is no additional cost, because the safety stock was consumed and covered the stock shortage. In case of two days of supply delay, the company shall cover an stock breakage cost of 1 200 lei. The cost for three days of delay is
1 200 lei + 1 300 lei = 2 500 lei and for four days of delay, the cost is 1 200 lei + 2 · 1 300 lei = 3 800 lei.

A safety stock calculated for two days of supply delay shall be of $\frac{9500}{360} \cdot 2 = 53 \ \text{m}^3$. When there are no supply delays, this safety stock generates an additional cost of $53 \cdot 0{,}5 \cdot \frac{1000}{360} = 73{,}611$ lei. In case of one day of supply delay, the same safety stock will determine an additional cost of 36,111 lei. For two days of supply delay there is no additional cost be-

cause the safety stock is consumed. If there are three days of delays, the stock breakage cost will be of
1 200 lei. The same type of cost will be of 2 500 lei for a four-day delay of the supply.

Following the same methodology as presented above, the safety stocks were calculated for three and four days of delay. The additional stocks generated either by these stocks either by the stock breakage, are presented in table no. 1.

The consequences pattern determined by each level of the safety stock (table no. 2) shall be determined based on the statistically recorded occurrence frequency of the supply delays. For the analyzed economic entity, these frequencies are:

- 0.1 when there are no supply delays;
- 0.2 for one-day supply delays;
- 0.4 for two-day supply delays;
- 0.2 for three-day supply delays;
- 0.1 for four-day supply delays.

Table no. 2 – Pattern of the consequences determined by each level of the safety stock

Days of delay	**Frequency**	**Safety stock volumes**				
		0	26 m^3	53 m^3	79 m^3	106 m^3
0	0,1	0	3,611 lei	7,361 lei	10,972 lei	14,722 lei
1 day	0,2	240 lei	0	7,222 lei	14,722 lei	21,944 lei
2 days	0,4	1 000 lei	480 lei	0	14,444 lei	29,444 lei
3 days	0,2	760 lei	500 lei	240 lei	0	7,222 lei
4 days	0,1	510 lei	380 lei	250 lei	120 lei	0
TOTAL	1	2 510 lei	1 363,611 lei	504,583 lei	160,138 lei	73,332 lei

By analyzing the data in the above table, one could conclude that the 106 m^3 safety stock determines the lowest total cost of 73,332 lei, thus this being the most favorable decision.

4. Conclusions

The need of accountings and stocks management modernization lies in the fact that it supplies an important volume of information used by managers in their decision-making process. Accountings and stocks management organization shall rely more on effectively knowing the means and the resources, on the operational follow-up of the value movements, on the attentive research of the structure and the dynamics elements, but especially on decoding the future evolution trends of the phenomena occurring inside and outside the company.

Stocks size optimization and their management under risk-posing circumstances require the aggregation of accountability, financial administration, management control, financial management and economic mathematics knowledge. We consider that the stocks volume may be optimized by using all the factors that accelerate the stocks rotation speed, also considering the company's real needs of consumption. Analyzing a wood processing company's storage process we can get to the conclusion that there is an stock sequence in different operation stages, of different physical sizes and of increasing values on measurement unit.

In order to optimize the stocks size, we suggest the use of a non-equal span variable demand administration. This choice is substantiated by the fact that most of the industrial production is conducted on the basis of the clients' orders and consequently, the raw material and consumable re-purchasing shall be made in the quantities required by the forecast production volume on irregular spans of time. The only issue that may occur is the supply delay. In this case, considering the contradictory relation between profitableness and risk, it is necessary to constitute a safety stock with a minimum cost.

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