OPTIMIZATION OF LOGISTICS IN THE CHOSEN COMPANY

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The question of logistical optimization is becoming more and more relevant today, especially considering the rising warehouse and mainly transport costs. It should be noted that minimizing the total cost of logistics cannot be a solution only individual cost items, but a complete solution of all logistics costs, with a formulating of the overall optimization. Although there are many theories that can be applied in practice, but always we meet with certain specifications to which we must respond properly and reflect their influence in the final outcome. In our work we refer in especially to such a solution, supported by theory and with lots of specifications, which we implemented in the company BJE Slovakia, which also brought positive results in considerable savings firm costs.

Introduction. The analysis of material flows deals with the analysis and descriptive methods in creating material and information flows in the selected company. We are focusing on reducing the handling time, an optimal layout of workplaces, the opportunity for an automatic tracking of inventory, and ways to save money spent on stocks and handling processes. An advantage is the concept of material flows optimisation and the introduction of continuous material and information flows through a series of warehouse operations. The rationalisation of material handling is significantly influenced by the material itself, its composition and the method of its storage in handling and transport units. The mechanisation of material handling and handling equipment can rationally and effectively contribute to the serviceability of material flow by simple adjustments.

Material and Methods

The content of this article is a kind of audit manual to specify handling costs, which are part of logistics costs. We have gained the data for solving this issue in Bang Joo Electronics Slovakia spol. s r. o. (hereinafter referred to as ‘BJE’) and through expert consultations done in a particular establishment.

Our role is:

- to gain knowledge of the flowing stream of information, of using information and communication means in this company (communication via the Internet and software packages), and to demonstrate the benefits of their use;
- to analyse the material flows in the given company by direct observations and discussions with experts in this field;
- to suggest possible solutions for an effective and rational use of existing handling facilities;
- to apply the data gained to the selected methods, to use the graphical representation of these processes, and then to evaluate them;
- on the base of real variables (the use of handling equipment in warehouses and production areas, the management of stocks, storage methods and sub-contracting between this sub-contractor and its main customer), to prepare a concept with respect to costs for the company (of storage and the operation of manufacturing processes).

Our goal has been to optimise the material flows, to reduce the length of transport distances, and to maximise the use of handling equipment. We were able to meet this goal.

Results and Discussion. The concept of material handling optimisation cannot be addressed separately without knowing other logistics costs, as a sharp fall in costs in one area can dramatically increase costs in other areas (e.g. costs in transport can rise with reducing storage costs). Therefore, we try to rationalise the complex logistics costs and their overall reduction.

To calculate the material flow, we have determined the optimum amount of deliveries, which is the amount of stock delivered to store by a single application. It is gradually depleted from the store according to production needs and the intensity of consumption. It was calculated according to Wilson's formula:

$$Q* = \sqrt{\frac{2 \times \lambda \times No}{Ns}}, \quad \text{kg/order} \qquad (1)$$

$Q*$ – optimum order, kg
λ – intensity of consumption, $kg.month^{-1}$
No – cost of communications, EUR
Ns – cost of storage, EUR

The optimum length of a delivery cycle represents a time interval from the arrival of an order to the warehouse until a complete depletion of all stocks. It depends on the size of the ordered quantity of stocks and on the intensity of their withdrawal from the warehouse. Calculation is according to the following formula:

$$T^* = \frac{Q^*}{\lambda}, \quad \text{time interval} \qquad (2)$$

T^* – delivery time, month^{-1}

Q^* – optimum order, kg

λ – intensity of consumption, kg.month^{-1}

Optimum turnover, i.e. the number of orders made over a certain period, or how many times the purchase of stocks is made until their full putting on the market. Optimum turnover is calculated as:

$$V^* = \frac{1}{T^*}, \quad \text{number of orders/time interval} \qquad (3)$$

V^* – optimum turnover, number/time interval;

T^* – delivery time.

Optimum average stocks – calculation according to the following equation:

$$\bar{Q} = \frac{Q*}{2}, \quad \text{kg} \qquad (4)$$

$\bar{Q}$ – optimum average stocks, kg

$Q*$ – optimum amount of the order, kg

Variable costs – they depend on the volume of production and are calculated using the following equation:

$$Nv = \sqrt{2 \times No \times Ns}, \quad \text{EUR} \qquad (5)$$

Nv – variable costs, EUR

Total costs – they represent all expense items in ensuring one order. Calculation is carried out as follows:

$$Nc = \lambda \times Oc + \frac{\lambda}{Q*} \times No + \frac{Q*}{2} \times Ns, \ \text{EUR} \qquad (6)$$

Nc – total costs, EUR

Oc – costs of purchase, EUR

Based on the results, we have written into Table 1 the real and optimum values and the situation of granulate in store.

Table 1.

Calculation of optimum parameters for granulate

Situation of stocks (granulate) in store				
Input value	**Index**	**Optimum value**	**Real value**	**Unit**
Intensity of stocks use	λ	42,000	46,583	kg.month^{-1}
Storage costs	N_s	0,031	0,028	EUR.kg^{-1}.month^{-1}
Acquisition costs	N_o	0,18	0,18	EUR
Purchase price	O_c	1,438	1,438	EUR.kg^{-1}

Delivery time	T	0.1	0.1	month
Comparison of real and optimum values				
Calculation	**Index**	**Optimum value**	**Real value**	**Unit**
Amount of delivery	Q	698,39	774	kg
Delivery time	T	0,0166	0,0166	month
Turnover	V	60	62	times.month^{-1}
Average stock	Q^*	349,19	387,00	kg
Variable costs	N_v	0,11	0,10	EUR
Total costs	N_c	60455,45	67049,93	EUR

Then, we examined the material flow in this company (Fig. 1), its volume, intensity, direction and frequency. By examining various points in the company between which the material is transported, we subsequently determined the priority sites that can be optimised and rationalised.

For an effective functioning of material flows and reducing the transport and handling costs, we have reconsidered in BJE the arrangement of individual workplaces, production facilities, assembly centres and storage facilities. For material flows it is important to be most effectively placed where the strongest intensity of material flow is. Thus, these workplaces should be located as close as possible to each other. That can be achieved by placing the subjects in a triangular manner.

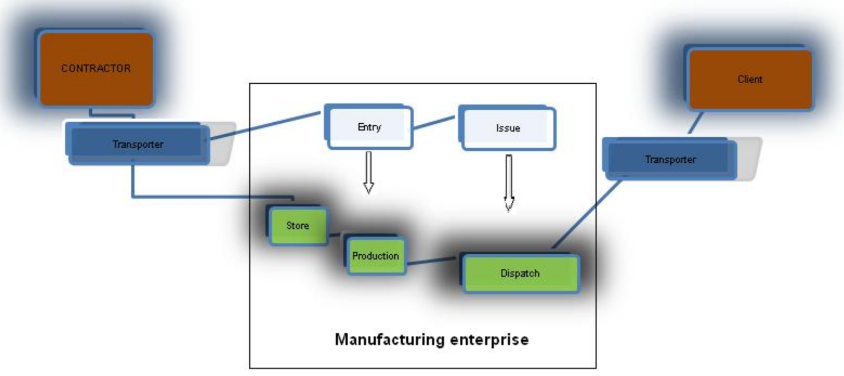

Fig. 1 Scheme of material flow in BJE.

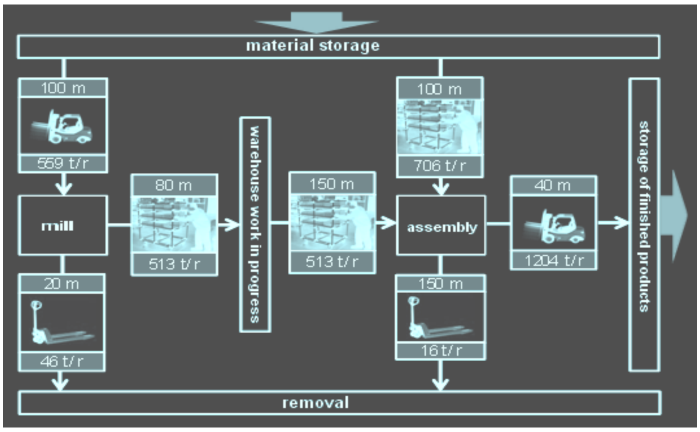

Fig. 2. Scheme of handling equipment for maintaining the material flow.

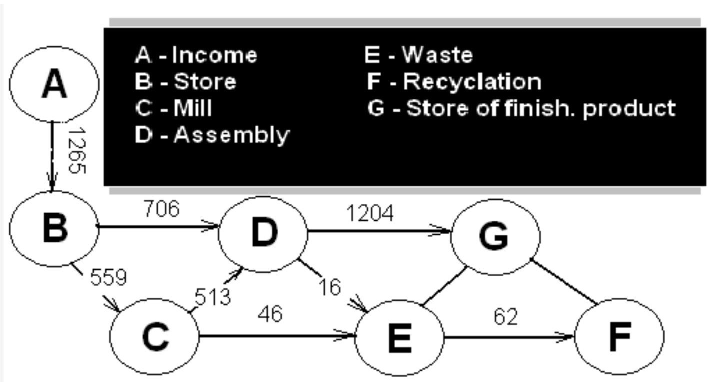

Fig. 3 Deployment of workplaces according to the triangle method in BJE.

The capacity of individual material flows determines the ability to carry out a certain performance over a certain period of time. In our case, it is the time during which the mill is able to press out a raw product. The pressing of a raw bar for our reference model takes 1 minute and 24 seconds at the point *C*, and the time of completion of a finished product on the assembly line takes 1 minute and 50 seconds at the point *D*.

The flow of material from the assembly hall is provided by a forklift with a maximum capacity of 1,500 kg. Areas for the movement of this forklift are unnecessarily large, so there would be possible, in terms of both the capacity and performance as well as in terms of volume, to increase the amount of material flow. We have proposed fork extension sleeves (Figure 4) for an effective use of the forklift. Using the parameters, the payload transport capacity can be expressed as follows:

$$Pd = \frac{dj}{tj}, \quad \text{pcs.h}^{-1} \qquad (7)$$

Pd – transport capacity, pcs.h^{-1}
d_j – transport unit, pcs
t_j – time unit, h

When transporting goods in BJE in the original way, only one stack could be moved, representing 90 pcs of finished products in 6 minutes. The capacity of goods transport by the forklift was calculated as follows:

$$P_d = \frac{90\,pcs}{0.1\,h} = 900, \quad \text{pcs.h}^{-1} \tag{8}$$

According to the method of transporting the goods proposed by us, it was possible to relocate one more stack (i.e. two stacks simultaneously), representing an increase of amount by 100 % (i.e. to 180 pcs), but in the same time of 6 minutes. The capacity of transport is calculated using the following equation:

$$P_d = \frac{180\,pcs}{0.1\,h} = 1{,}800, \quad \text{pcs.h}^{-1} \tag{9}$$

That has brought to BJE time saving in handling the goods using the forklift, and the remaining time can be spent in other warehouse operations (e.g. the preparation of goods for dispatch). We have achieved an efficient use of handling equipment in the given flow.

One of the partial objectives was to minimise the total procurement costs of stocks. We have calculated the optimum amount of stocks, and these values were compared with actual indicators. As we did not measure identical numerical parameters, we calculated the amount of cost savings. Since we calculated with one stock item only, we would quantify multiple cost savings for all stock items. The said company decided to accept this proposal. First, they began with a gradual reduction of stocks to the optimum level calculated by us.

Fig. 4. The use of traditional and extended forks in the store of BJE Conclusion.

Further, we made a more efficient material flow using the triangle method. As the length of these flows affects the continuity of the production process, our goal was to find an optimal solution. We proposed to substitute the mill by the store of unfinished production. However, we failed to implement it in practice because of continuous company's production activities. The company would consider the implementation of this concept in case of a scheduled outage during the summer months. That would bring to the company a considerable shortening of stocks flow, an improved overview of handling processes, and a reduced area used for this handling.

The use of forklift fork extension sleeves in order to increase the amount of flow is also considered an effective concept. We implemented this concept almost immediately in the said store by purchasing the sleeves, which the company was yet lacking. The proposed solution enabled the transport of a double amount of stocks over the same period of time and the same handling costs, by which the company yielded savings of time and funds.

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