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CASE STUDY OF OPTIMISATION MATERIAL REPLENISHMENT SYSTEM VIA PRINCIPLES OF LOGISTICS

Peter Ignácz
CEIT Pro, s.r.o., Univerzitná 8413/6, 010 08 Žilina, Slovakia, peter.ignacz@student.tuke.sk

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Abstract: The system of supplying production cells, production lines, warehouses are an inherent process without which it could not be produced. It is precisely for the responsibility and importance of this process that in practice, logistic processes are over-sized or efficient, but with a great deal of waste, just for safety, so that production is not compromised. There are a number of supply systems and principles, even almost fully automated, but they are still relatively inaccessible to many businesses. Therefore, this article approaches how the supply system can be simplified and streamlined.

1 Introduction

The article was created on the basis of a case study from practice. The topicality of the article also suggests the situation in almost every industry sector where there is pressure to increase process efficiency to increase competitiveness. Efficiency in the process can be understood as the performance or operation of the process with minimal cost, while respecting its quality. This process efficiency can be searched for, respectively. in the process of production of products, but also in the process of supplying production lines, i.e. in service and logistics processes. The article compares the production line supply to the Milk Run delivery system, but without fixed time circuits and standardized work with the Milk Run system, along with a precise route, time and standard operations.

2 Data and methodology

The following figure (Figure 1) captures the material flow of the production supply process in the state of the art:

Figure 1 Flow of material in the current state of supply
Source: Internal document of company, edited by author

The image captures the flow of material while supplying small warehouses near workplaces and also supplying workstations from small warehouses. The potential for the use of the rectangular layout of the production hall is relatively unused and the flow of material is considerably complicated precisely because of the need to pass through workplaces (production sections).

Waste arising from this supply system:

- Long travel distances - Worker usually walks on foot and pushes the trolley with the material
- Crossing workplaces - risk of injury
- Small warehouses are created in the workplace - inventory is not performed, unknown inventory
- Fatigue of the linefeeder, fluctuation – it is not possible to accurately map what movements it performs

In the future state, it is necessary to make several changes in the distribution of supply points in order to increase the efficiency of supply, thereby creating a new logistics system. The system consists of a set of elements between which there are bonds, relationships, and which has a certain level of organization [1]. The point of supply was transformed from a partial storage zone to a shelf within the operator's direct reach at the workplace. All material stored in the workplaces will be centralized, stored and picked in a supermarket - a central warehouse.

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Figure 2 Visualization of material flow with new supply points
Source: Internal document of company, edited by author

Supply logistics resolves the clearance and inspection of goods, storage and warehouse management, in-house transport, planning, management and control of material and information flows [2]. Supplying material to newly designated supply points will result in a reduction in inventory of material at workplaces. The material imported in the past to the partial storage sites at the workplaces will be stored in the supermarket and the new supply points will only be sized for the required amount of material calculated for the time span of the workstation inventory necessary for continuous production between the two supply cycles.

New supply points (Figure 2) are for production cells:

- C1 – Test line.
- C2 – Small assembly.
- C3 – Test line.
- C4 - Large assembly.
- C5 – Medium assembly.
- C5 – Warehouse of small parts.
- C6 – Test line.
- C6 – Welding line.
- C7 – Assembly line.
- C7 – Assembly line.

Supply points are "pulled out" to the main traffic lane compared to the current state. The potential for the use of the rectangular shape and the deployment of individual operations was relatively little used. In spite of the simple "layout", the linefeeder was forced to pass through individual workplaces, which significantly prolonged the time needed to fill the material in the workplaces. The layout of production operations is linked to two types of aisles:

- Main aisle (horizontal).
- By the side aisle (vertical).

To eliminate the passage of the supply while supplying through the alleyways and through the workplaces, new supply points for manufacturing operations were located on the main horizontal aisle. This placement should contribute to simplifying material flow, speeding up supply and shortening supply routes, as it eliminates unnecessary routes through workplaces. Material flow is an important factor in the design of production systems [3,4].

Based on this simplification of the supply route, you can create a standard supply worksheet and create the time standard itself. Supply circuit of linefeeder will always begin and end at one point and the point will be a centralized component store. In the central warehouse there will be loading of full packing, picking up of material and also unloading and storing empty returnable containers. The supply route will only lead along the main aisle with pockets near the assembly sites, testing, welding lines and connector stores.

During the supply, a wheeled tractor will be used to pick up all the necessary parts in each circuit. Such a solution also takes account of ergonomics at work and also the reasonable load of the logistics operator during the supply of lines through work change. In the future, in the time of a possible increase in production, in the case of the incorporation of new machines into production, the tugger will be equipped with a further set of peripherals as required for the material to be transported, thus ensuring efficient supply from the central warehouse to workplaces.

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Figure 3Visualization of tugger with hardware, Source: Internal document CEIT Pro, Ltd.

For the purpose of this work, the standard times of individual actions were defined on the basis of professional literature. The data in the table (Table 1) was used in the calculations of individual standard times in the established logistics. The design of the bench supply with ideal working conditions for use in the real system is subject to verification by in-service testing.

Table 1 Standard times for standard work calculation

1 step (approx. 90 cm) = 0.6 s.
Transport time (typical tractor speed is 4 km / h) = 1.1 m/s.
Get in tugger = 3.9 s.
Get off from tugger = 3.9 s.
Unloading transport unit = 7.0 s./transport unit
Loading the transport unit = 7.0 s./transport unit

Table 2 Proposal of standard work sheet for linefeeder

Standardized work of linefeeder					
	Direction	**Activity**	**Parts**	**Duration**	**Transport time**
1	From central warehouse to supply points C7	Deliver, unload, load parts	Component 1	147.8 s.	13.63 s.
2	From point C7 to point of supply C6	Deliver, unload, load parts, unpack the packaging	Component 2	147.8 s.	18.18 s.
3	From point C6 to assembly line C5	Deliver, unload, load parts and components	Component 3	179.8 s.	27.27 s.
4	From point C5 to assembly line and tester C4	Deliver, unload, load parts and waste	Component 4	89.8 s.	45.54 s.
5	From point C4 to test line C3 TL	Deliver, unload	Component 5	21.8 s.	13.63 s.
6	From point C3 TL to point of supply C2	Deliver, unload, load parts and waste	Component 6	147.8 s.	27.27 s.
7	From point C2 to point C1 TL	Deliver, unload	Component 7	21.8 s.	36.36 s.
8	From point C1 TL to central warehouse	Unload empty containers and load full	-	287.8 s.	181.81 s.
Overall:				1044.4 s.	363.69 s.
Total supply time:				**1408.09 s. (23.47 min.)**	

3 Results

Since the calculation for standardization of the supply process in the supply chain in the Milk Run and Kanban style supply workflows with the empty shelf signal in the racks, the time came to a circle of 23, 47 minutes, which is about 40% of the time in one hour (Table 2). Therefore, it is possible to introduce a 1 hour supply chain in the company, which represents during work shift in production:

Work shift = 8 hours 30 minutes – 30 minutes lunch break = clear time 8 hours / shift

8 hours / 1 hour circuit = 8 supply circuits / shift

Advantages of 1 hour supply circuit:

- Logistics operator passes every workplace in the company every hour

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- In case of an unscheduled change in the production order, the material can be delivered within an hour.
- It can flexibly respond to changes and requirements of production lines.
- He has a clear idea of the state of inventory in each workplace.
- Enough time for other activities.
- Can provide a clear report on the stock status of the individual materials in the warehouse.

With a supply time for one circuit of approx. 24 minutes, along with the loading of the required workplace material and unloading of empty packaging in the warehouse, there remains plenty of time for other operator activities outside the Milk Run supply, such as:

- Disposal of waste from workplaces.
- Charge the trolley battery.
- 5S

4 Conclusion

Comparison of supply times in the current state and in the proposed state is not possible because the supply circuit has not been made or defined in the current state. However, it is clear from the material flows that the proposed circuit will save considerable time. The article highlights the fact that a relatively simple adjustment of the system can be more efficient in the production supply process, possibly gaining time and capacity of human resources for irregular activities that no one has in standard work in the company.

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