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DECOMPOSITION AND CENTRALIZATION OF WAREHOUSE SYSTEMS IN ORDER TO RATIONALIZE MATERIAL FLOWS

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Abstract

The research that was carried out in this paper refers to the company for the production of paper. In this work was done decomposition storage and internal transport system in order to determine the critical place of business in the logistics system. After the decomposition, is created the project transition from a decentralized to a centralized storage system which can greatly contribute to the achievement of certain savings. In the current functioning of decentralized storage systems where each production facility has its own warehouse there has been a number of negative effects such as the accumulation of goods, non-selective approach to storage units, large fuel costs, damage to finished products, etc. By switching to a centralized storage system which includes storage of finished products on an ideal location from the point of connection to the production facilities and utilization of internal transport is carried out a series of benefits.

***Key words**: Logistics, warehouse, production, internal transport*

1 INTRODUCTION

In order to be able to manage the company's own performances, carry out their measurement and monitoring, and implementation of corrective procedures, one of the main prerequisites is decomposition of logistics system. This paper includes decomposition of storage and internal transport system with the aim of determining critical places of business in the logistics system. An example of storage system decomposition is given in [4], and, on the basis of that, the selection of key performance indicators in a storage system is given in [3]. After decomposition, the SWOT analysis of the storage system with reference to internal transport has been made. In the current functioning of the decentralized storage system where each manufacturing facility has its own warehouse, a number of negative effects have been noted, such as the accumulation of goods, non-selective approach to storage units, large fuel costs, damage of final products, etc.
After that, a project of transition from a decentralized to a centralized storage system has been completed, which can greatly contribute to the achievement of certain savings highlighted throughout the paper itself.

2 DECOMPOSITION OF LOGYSTICS SYSTEM

The management system of production quality, in addition to internal quality control, works also on a principle of "feedback" where the quality assessment of final products is done by users, in order to obtain products that meet the needs of the entire market. If there is a deviation, then the correction of initial elements (material, technological process etc.) is done on the basis of information received, and all in order to obtain the desired results.
The most important manufacturing facilities within the company are three existing paper machines (PM_4 paper machine, PM_1 paper machine, and PM_3 paper machine) as well as manufacturing plants Paper Products and Cardboard Products.

2.1 . Decomposition of the storage system

Storage logistics is specific tertiary logistics which, by providing help and support in storage, placement and deployment using various storage manipulations and movement of material goods from the warehouse, offers fast, safe and rational management of the flows of material goods in many and different places: all types of warehouses, terminals of goods-transport centers, goods-trading centers, goods-distribution centers, logistics centers. [6]
A warehouse in a logistics network is like a human heart in a body. It collects raw materials, materials, final products and/or goods from a variety of sources and "pumps" them towards different places where there is a demand for them. Accordingly, it can be determined that "a delivery service" begins in a warehouse. When warehouse productivity declines, negative effects are felt throughout the whole area, that is, within the whole logistics network [2].
Regarding the storage mode of final products, the PM_4 paper machine has an independent storage system of goods with a total storage area of 1,600 m^2 and well organized work. The PM_4 paper machine is currently the only machine whose storage system of final products takes place using a barcode system.
Unlike the PM_4 paper machine, other manufacturing facilities are located in one building with two storage areas where one is used for the storage of final products from the PM_3 and PM_1 paper machines, while the other

one is a warehouse of final products from the manufacturing plant Paper Products. It is important to emphasize that in the warehouses of paper machines, a storage unit is a reel, while in the warehouse of the manufacturing plant Paper Products, a storage unit is a palette.

As a part of manufacturing processes, which are studied in this work, the company owns four warehouses which are used for the storage of final products from four manufacturing machines. The warehouses are:

- the warehouse of the PM_4 paper machine (Kraft Paper, MG paper),
- the warehouse of the PM_3-PM_1 paper machine (Fluting, Schrenz, Testliner),
- the warehouse of the manufacturing plant Paper Products (sacks and bags),
- the customs warehouse.

The customs warehouse is a building for the storage of final products in a situation when the existing storage capacity is full. This is the single storage building located outside the manufacturing plants.

The total storage surface of all four warehouses is 7,020 m^2 (without the paths for moving forklifts) with the total capacity of over 14,670 t of all final products of the Natron-Hayat company.

There are two basic strategies in the management of inventory and storage processes: a centralized and decentralized system. [1]

The Natron-Hayat company has a decentralized model of the storage of final products which includes the storage of products at several locations. In this case, each manufacturing facility has a separate warehouse planned for the storage of its own products. Due to the lack of storage space, the areas for the storage of the products from the PM_3 paper machine and PM_1 paper machine have merged. As stated, the customs warehouse is separated from all manufacturing facilities and represents an auxiliary warehouse as an individual entity.

A warehouseman, as a part of storage process, receives goods delivered to the warehouse, performs its storage and its dispatch from the warehouse, and keeps records of goods. During the research, it has been noted that the current number of employees in these three warehouses is 33 employees including: forklift drivers, auxiliary workers, main warehousemen and registrars.

In the warehouses, people who are currently working have a long experience in keeping warehouses, receiving and dispatching goods as well as handling all transport reloading means.

The current arrangement of employees in the storage system is:

- the warehouse of the PM_4 paper machine: 13 workers
- the warehouse of the PM_3 & PM_1 paper machine: 18 workers,
- the warehouse of the manufacturing plants Paper Products: 2 administrators.

2.2 . Decomposition of internal transport

Internal transport represents a logistical process of great importance not only because it is, in fact, "a bloodstream" of the enterprise's organism, but it also largely affects business results. The amount of the impact is reflected in a fact that the costs of internal transport range from 10 to 90 % of total operating costs. Therefore, internal transport is the focal point of optimization.

Each transport causes costs, but these costs do not increase the value of production. Since transport costs are directly proportional to the time, the time should be shortened as much as possible. But shortening the transmission time can be achieved by organization and mechanization. Shortening the time for mechanization is achieved by using the most suitable means of transport. Mechanized transport simplifies, facilitates and accelerates the process of making a profit and thus shortens manufacturing time. Means of transport make savings on space in workshops and warehouses, increasing the speed of material flow or cleaning the ground surface in a workshop as it is the case of circular transmission. The mechanization of internal transport allows improved efficiency in production and a substantial increase in productivity.

Since the basic consumption in internal transport comes from the size of odometer and means of transport as well as pure work consumption, these issues should be given special attention during the process of design and organization. Since there is a lot idle time in transport, it is necessary to use the operation of the means of transport in a rational way based on a detailed study of the transport system, storage location and organization of production workshops and workplaces. [5]

The reloading processes and industrial transport use means of cyclical effects, which include: a tow tractor with a trailer, Mercedes-Benz truck, forklift stackers of the capacity up to 2 t as well as a railway wagon with a makeshift tow vehicle (loco-tractor) with internal combustion engine. What is also used, in addition to reloading means, is a mobile ramp for horizontal loading of trucks. The total number of forklifts used to perform the tasks of transfer (loading, unloading) is five, of which four forklifts within their lifting mechanism have a gripping tool in a shape of a spoon, and one in a shape of a fork (Figure 1)

Fig. 1 *A forklift with a gripping tool in a shape of spoon and in a shape of fork*

There are also two tow tractors, one of which is used for towing a trailer in domestic road transport and the other one for towing and moving railway wagons during loading and also for domestic rail transport.

In addition to these means of transport, there is a Mercedes-Benz truck for internal transport. One of the primary functions of this truck is to provide manufacturing facilities with final products from the PM_3-PM_1 warehouse which use reels as raw material to manufacture additional products (cardboard, sacks, bags). Furthermore, the truck is used to transport the reels to the customs warehouse in situations when the storage capacity of the PM_3-PM_1 warehouse is full.

The manufacturing facilities are systematically linked with transport networks allowing them the distribution of final products by road and rail transport. In the internal transport of the company, these two objects, together with their units, are also connected to road and rail networks.
The structure of industrial transport consists of: industrial - rail and road transport within the company with its own fleet, monorails, various cable cars, storage systems, reloading machines, equipment. The road and rail network is one of the fundamental elements in internal transport. Based on the above, it can be concluded that the company's own internal transport takes place by rail and road vehicles.
As a part of the overall internal transport, road transport currently prevails, and the reason for this is the existing machinery and current human resources within the company.
Rail transport is mainly used when loading and preparing to dispatch final products from the company as well as for the transfer of products from the warehouse of the PM_4 paper machine to the customs warehouse.
It is important to emphasize that all manufacturing facilities are connected to rail and road networks, in order to load and transport final products and provide the facilities with raw materials and other production materials.
Regarding the means of transport for internal transport, at their disposal the warehouses currently have: Mercedes-Benz truck, a tow tractor with a trailer, loco-tractor for towing wagons and a wagon of S class. These vehicles have a function to perform internal transport in the company. As a part of activities, the means of transport perform the following:

- provide other manufacturing facilities with products of paper machines in order to process and produce final products (cardboard, sacks, bags, etc.),
- transfer of final products from the PM_3 paper machine to the warehouse of the PM_3-PM_1 paper machines in order to store them,
- transport of a certain amount of final products to the customs warehouse.

The loco-tractor exclusively performs work in rail transport within the company. It has a function to manipulate with all railway wagons during loading and dispatching final products from the PM_4 paper machine. It is also used to transport a certain amount of final products from the warehouse of the PM_4 paper machine to the customs warehouse in a situation when the storage capacity is full.
Figure 2 shows the loco-tractor with a function to transport final products from the warehouse of the PM_4 paper machine.

Fig. 2 *Loco-tractor for the transport of railway wagons in internal transport*

Besides the fact that these warehouses have access to road and rail networks, they are also connected to each other so that intercommunication is possible. The distance between two buildings with the warehouses is close to 150 m.
In warehouses, reloading activities are currently being carried out by five frontal industrial forklifts with a seat for a driver. All forklifts are powered by internal combustion engine of which four with a diesel aggregate while one is gas-powered. Four forklifts within their lifting mechanism have a gripping tool in a shape of a spoon and one forklift in a shape of a fork. The forklifts fall into the category of medium load capacity from 12 to 32 kN.
In the system of dispatching final products, we also include eight employees who process supporting documentation for the drivers of freight vehicles, that is, the invoices for the goods delivered.
For the uninterrupted loading of road vehicles within the PM_3-PM_1 warehouse, it is used a mobile ramp which further facilitates and speeds up the process of loading the truck. Figure 3 shows the mobile ramp in the PM_3-PM_1 warehouse.

Fig. 3 *Display of the mobile ramp*

In addition to the mobile ramp, there are two fronts with fixed ramps that are used in the warehouse of the PM_4 paper machine used for horizontal loading road vehicles. The fact is that for uninterrupted work and functioning of all manufacturing facilities, it is also necessary to own supporting facilities. Some of them which are located in the vicinity of the above mentioned plants are a gas station, a car repair workshop that supports transport and reloading vehicles, as well as a fire protection service. Based on the research and interviews with employees of the logistics sector, it is concluded that the existing "supporting service facilities" meet current requirements and provide additional support to the performance of all logistical activities related to transport sub-systems and storage of company's products.

3 CENTRALIZATION OF WAREHOUSE SYSTEM

This kind of centralization can provide a company with:

- a number of savings,
- better organization,
- better visibility of the content in the warehouse,
- better monitoring and control of the entry and exit of products from the warehouse,
- better connection between manufacturing facilities,
- the independence of a manufacturing process from free storage space,

- easier and faster movement of forklifts,
- easier and faster loading,
- reducing damage to goods,
- preparation of all supporting documentation in one place,
- better safety working conditions,
- better conditions for internal transport of goods from manufacturing facilities to warehouses, and from warehouses to manufacturing facilities,
- creating a better image of the company,
- more parking space for vehicles waiting for loading,
- easier access of road vehicles to all reloading fronts,
- significant savings on the basis of fixed and variable costs, etc.

3.1. Location of the central warehouse

Fig. 4 *Layout of the company with the location of the central warehouse*

Figure 4 shows the layout of the facilities within the area of the company as well as the benefits from the internal transport of final products from a manufacturing process to the warehouse. The green color marks the position of the Central Warehouse, which consists of one large building and a small one located next to it, which we have mentioned previously in the work.
The red color marks the road network and the black color marks the rail network within the company. Also, it is important to emphasize that the Central Warehouse building is surrounded by additional supporting facilities.
Figure 5 shows the outbuildings which surround the future Central Warehouse. The red color in the picture marks the facility where the Fire Protection Service is located. The blue color marks the gas station while the green color marks the car repair workshop. All the supporting facilities are currently working for the company which could contribute to the quantity and quality of warehouse productivity.

Fig.5 *Display of the outbuildings next to the Central Warehous*

3.2. The current state of the central warehouse building

The warehouse is divided into four parts: the ground floor, first floor, second floor and customs warehouse. The first and largest part of the building includes the ground floor which has a storage area of about 4,000 m^2. The first floor of the building is of a smaller surface. It requires an investment in terms of upgrading, that is, the extension of the panel over existing supporting pillars. The total surface with the planned upgrading would be 850 m^2. The second floor also requires an investment as the first one. With the investment, the surface of the second floor would also be 850 m^2 as of the first one.

Fig. 6 *The current state of the building*

Figure 6 shows the current state of the building. It should be noted that the other building, the customs warehouse, does not require any investment, because this warehouse is currently in use. All of these investments require certain costs and represent the investments for which it will be tried to calculate the payback period in the further text of the paper. One of the main and biggest costs is the reconstruction of the building.
The height between the floors is 4.7 m and, if we take into account the fact that the lifting height of a reel during storage should not exceed 5 m by ISO standards, it can be concluded that the current height fully meets the standards. It is necessary to mention that the height of the most of the building is 13.5 m.
The fourth part of the central warehouse is planned to include the customs warehouse. The customs warehouse is located next to the building and has a storage area of 3,000 m^2. Because of the distance between these two buildings, it is planned to make a physical connection between them with a makeshift tarpaulin tunnel through which the transport of goods (final products) in and out of the warehouse will be carried out.

This tunnel would have to be covered to protect products from external influences during their transport between facilities. The length of the tunnel would be 50 m, which is the distance between these two facilities. The height and width of the tunnel would be 3 m, which is sufficient for two forklifts to pass by.

Table 1 The total storage surface of the central warehouse

Position name	m. u.	Dimensions	Surface
The ground floor	m^2	64x64	4,100
The first floor	m^2	17x50	850
The second floor	m^2	17x50	850
Customs warehouse	m^2	85x25	3,000
			8,800

If the surface of spare rooms is subtracted from the total surface of the central warehouse, the result is that the planned central warehouse of final products would have 8,800 m^2 of storage space at its disposal. This surface includes the paths for forklifts. It should be noted that from 60% to 90% of the total storage space is for the storage of products, and the rest of the space is designed for spare rooms, paths for forklifts, fire exits, toilets, rooms for drivers, etc.)

Table 2 Spare rooms within the central warehouse

Position name	m.u.	Dimensions	Surface
Spare room A	m^2	12.7x10	127
Spare room D	m^2	6.2x6.4	39.6
Spare room E	m^2	2.9x10	29
Spare room I	m^2	25.7x6.8	174.8
Spare room J	m^2	7.6x10	76
			446.4

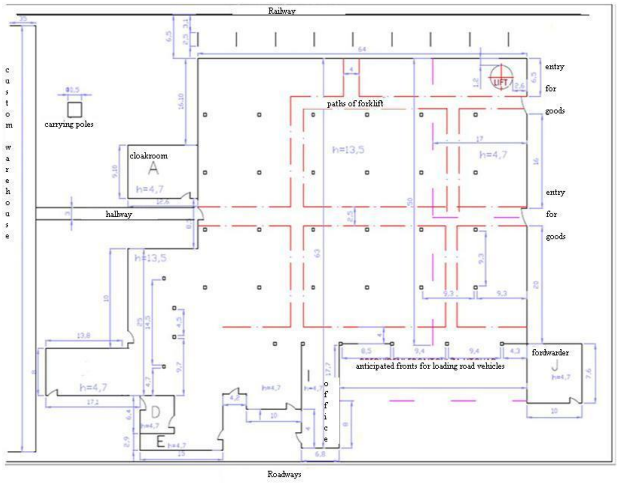

Fig. 7 *Layout of the central warehouse*

In the central warehouse building on the ground floor, there are five more spare rooms that can be used as offices, toilet and rooms for other personnel (forklift drivers, auxiliary workers, etc.) with a total area of 446.4 m^2. In Table 2, the spare rooms are indicated by the letters A, D, E, I, J. Table 2 shows the individual dimensions of each of the spare rooms that are located in the building of the Central Warehouse.
Figure 7 (Layout of the central warehouse) provides a graphic of the future central warehouse with all the dimensions of the facility and spare rooms. The proximity of rail and road networks is marked from the north and south side. The east side includes two entrances for receiving goods while on the west side there is a tarpaulin corridor that connects the building with the customs warehouse. Within the building, spare rooms (A, D, E, I, J) with marked dimensions are drawn in. The dotted red line indicates the paths for forklifts and the paths that lead towards the reloading fronts.

The previous Tables 1 and 2 show all surfaces of the inner part of the future central warehouse with all significant dimensions of the facility. Based on the data on the storage area surface in the central warehouse and the current storage capacity, the possibilities for improvements in terms of increasing storage capacities may be noticed. Namely, as stated previously in the work, the current surface storage of final products in the PM_4 warehouse, the PM_3-PM_1 warehouse and the warehouse of the manufacturing plant Paper Products is 7,020 m^2.
It is important to mention that the height to which reels are lifted in the PM_3-PM_1 warehouse is 3 m due to lower building height.

Table 3 Display of the currently available storage surface for final products

Warehouse	m.u.	surface
of the PM_4 paper machine	m^2	1,600
of the PM_3-PM_1 paper machine	m^2	1,210
of the manufacturing plant Paper Products	m^2	1,210
Customs warehouse	m^2	3,000
Total		7,020

If the current surface, which is 7,020 m^2, is compared with the planned surface of the central warehouse, which is 8800 m^2, the result is that the total storage surface increases for 1,780 m^2. This is one of the indicators for the profitability of the central warehouse project. The resulting surface comprises the area in the warehouse which includes: paths for the movement of forklifts, the space between the rows of sorted goods, the total area of supporting pillars.

3.3. Capacity of the central warehouse

The determination of warehouse capacity means the determination of a quantitative measurer for a technological warehouse element that needs to implement the technological requirement for preserving goods. This quantitative measurer is called a warehouse capacity and under different conditions can be presented by: the number of pallets, containers, the number of reels / rolls, tons, liters, square / cubic meters, etc.
As for the capacity of the central warehouse, there are significant improvements in terms of expanding the storage capacity of the company in relation to the current situation. This can be easily proved through the calculation regarding the storage surface. If the total storage surface of the central warehouse is 8,800 m^2 (if it is taken that the storage of products is 70% of the surface, the result is 6,160 m^2), then this amount is divided by the surface area of 1 m^2 occupied by one reel. Then it is multiplied with 4 reels (the average height of reel is 1.20 m) which is a permitted height for stacking reels in height, and the result is approximately about 24,600 pieces of reels that can be temporarily stored in the central warehouse building. Taking into account that an average reel is 900 kg, the result obtained shows that theoretically the central warehouse facility can store: 24,600 pcs of reels x 900 kg (the average weight of reel) = 22,176,000 kg i.e. 22,176 t of paper, that is, the products of the company. Based on the equation, it can be theoretically concluded that the total capacity of the central warehouse would be 22,176 t of goods.

The study provided the data on the total amount of final products that could be temporarily stored in the existing capacities, specifically in the three warehouses of the company. The data are presented in Table 4.

Table 4 Display of the current potential of the warehouses

Warehouse	m.u.	amount
of the PM_4 paper machine	t	4,500
of the PM_3-PM_1 paper machine	t	2,500
of manufacturing plant paper products	t	170
Customs warehouse	t	7,500
Total		14,670
of the manufacturing plant Paper Products	pal	**350**

Using the data, it can be calculated that the total surface of all three existing warehouses can be currently used to store the amount of 14,670 t goods, not including 350 pallets that can be placed in the warehouse of the manufacturing plant Paper Products.

If the amount obtained in the previous calculation for the possible capacity of the central warehouse, which is 22,176 t, is compared with the current capacity of 14,670 t, significant differences are observed, which are primarily related to different heights of stacking reels.

While preparing for the work, a problem that has been noted during the interviews with employees is the lack of storage space for storing final products. The above part of the text emphasizes the consequences that arise due to the lack of storage space, which have many negative effects on the company. From the previous calculation, it can be seen that the central warehouse also provides better results in this business segment of the company.

Based on the above-mentioned data regarding the surface and capacity of the central warehouse, it can be concluded that the planned building can provide the required surface for receiving and temporary storing the products of all manufacturing machines in the Natron-Hayat company that have been involved in this project.

3.4. Work stages in the central warehouse

The following part of the paper proposes the transport mode of goods from manufacturing plants to the central warehouse and the system of storage of final products in the warehouse.

The main indicators of the development of daily transport and storage stage are: the current number of manufacturing machines that are operational, daily output of manufacturing facilities, the capacity of loco-tractor in one cycle, required number of people and machinery, distribution of duties and responsibilities, arrangement of people, etc.

It should be emphasized that it happens rarely in practice that during the same day all the manufacturing plants are operational. This particularly refers to the PM_3 and PM_1 paper machines. To describe the work stages of the central warehouse system, it will be started with the data on the optimal manufacturing, that is, when all manufacturing plants are operational (daily production of 450 t of goods). Guided by this information, it leads to the conclusion that it is necessary for the loco-tractor to perform three cycles in one day. To carry out this process, it is required to determine how many people and machinery are needed to complete it.

In the above-mentioned part it is noted that the current manufacturing process takes place in two separate facilities which imposes the use of at least two forklifts in both buildings. Their task is to store goods in the existing warehouses, which in this case could serve as auxiliary warehouses, until the stage which includes the arrival of loco-tractor.

Fig. 8 *Visual display of the activities in the PM_4 warehouse*

Figure 8 shows reloading cycles of the forklift describing the activities that it carries out during one cycle. In order to describe this as better as possible, what is taken as an example is the warehouse of the PM_4 paper machine, which has the highest daily production.

The reloading cycles of the forklift in the warehouse of the PM_4 paper machine would be:

- reception of reels from the manufacturing process,
- removal of reels from a roller conveyor (Figure 8.1),
- temporary storage of reels until the arrival of the loco-tractor,
- loading of reels on the loco-tractor (Figure 8.2 and 8.3),
- transport of the loaded goods from the warehouse of the PM4 paper machine,
- movement of the loco-tractor to the central warehouse (Figure 8.4),
- unloading the loco-tractor,
- reception of the goods in the central warehouse,
- storage of the goods and its disposal at the well-known place in the central warehouse.

Figure 8, under the number 1, shows the forklift that is receiving reels from the roller conveyor. According to the data obtained during the research, the maximum capacity of a conveyor belt is seven reels which the conveyor fulfils in 20 min. This means that, within this period, seven reels come out of the manufacturing process over the roller conveyor.

The distance that the loco-tractor needs to pass from the place of loading (the warehouse of the PM_4 paper machine) to the place of the storage of goods (the central warehouse) is 100 m. The period for which it is assumed that the loco-tractor may cover the distance is 7-10 minutes. The period includes the loco-tractor driver's manipulation of the switch which is located halfway on the route. It is important to mention that the distance from the place of loading to the first railway switch used for directing the loco-tractor to the central warehouse is 50 [m]. This indicator is derived taking into account examples of the transport of final products from the warehouse of the PM_4 paper machine to the customs warehouse located at a similar distance from the central warehouse. On this route there is a railway switch whose time of changing the direction of movement is included in the transport of goods.

A similar procedure is also carried out in another building where is the warehouse of the PM_3-PM_1 paper machines and the warehouse of the manufacturing plant Paper Products. The difference in the cycles is that the distance

from the building to the central warehouse is 250-300 m and the machines do not have such a capacity as the PM_4 paper machine (240 t per day), so the number of cycles in one day would be slightly smaller.

It should be noted that according to the research carried out for this work, the period required for the loco-tractor to cover the specified route is 12-15 minutes including the manipulation of switch. As a part of the route, there is one railway switch for changing the direction of the movement of transport vehicles.

Regarding the warehouse of the manufacturing plant Paper Products, in order to dispatch a delivery of sacks or bags, it is necessary it has been stored for seven days due to the process of adhesive required to be done on each bag at a certain temperature without excessive movement.

After the arrival of the loco-tractor to the central warehouse, the goods are received or scanned and barcodes are allocated to all final products. It is recommended that the second floor is used for the disposal of bags and the products from the PM_3 paper machine, while the first floor would be used for the products of the PM_1 paper machine. Other final products from manufacturing facilities would be stored on the ground floor in the customs warehouse. This arrangement has been determined by the intensity of product deliveries.

According to scope of operations and intensity of loading, it is proposed that minimum four forklifts are engaged in the central warehouse. Thus, one forklift stacker within its lifting mechanism has a gripping tool in a shape of a fork and three forklift stackers within their lifting mechanism have a gripping tool in a shape of a spoon.

In addition to the activities of the transport of final products from the manufacturing plant to the central warehouse, the transport cycles also include the activities of providing certain facilities with paper from the central warehouse. The facilities are also connected by rail on the distance of 250 m in different directions.

It is important to emphasize that there is a certain decline of the railway at an angle of about 10% from the manufacturing plant Paper Products to the central warehouse which is an additional factor in facilitating the transport of final goods in a situation when the loco-tractor works under load.

3.5. The mode of transport of final products to the central warehouse

In order to understand the mode of transport of final goods from manufacturing plants to the central warehouse, it is necessary to explain a daily production of machines: the PM_1 paper machine, PM_3 paper machine, PM_4 paper machine, manufacturing plant Paper Products, as well as the future investment, the PM_6 paper machine. It should be noted that the information about the PM_6 paper machine has been obtained through the interviews with employees who will be involved in the investment. The following part of the paper is also based on the fact that the PM_6 paper machine as the future one has already been in operation and that it produces a certain amount of products, as shown in Table 5.

Table 5 Display of the total storage capacities of the company on a daily basis

Position name	m.u.	amount
PM_4 paper machine	t	240
Warehouse of the PM_1 paper machine	t	100
Warehouse of the PM_3 paper machine	t	40
Warehouse of the manufacturing plant Paper Products	t	96
PM_6 paper machine	t	70
Total		**546 t**

Looking at the map with the geographical representation of the positions of all manufacturing facilities, it is easy to notice that there are two units. The first unit includes the PM_1 paper machine, the PM_3 paper machine, the PM_6 paper machine and manufacturing plant Paper Products, and another unit comprises the PM_4 paper machine which is the largest and most important manufacturing plant of the company. All of these manufacturing facilities are connected by railway, so the idea which arises is that the mode of transport from the manufacturing plants to the central warehouse is done by rail transport. Of course, another mode, the road traffic, is not excluded, but in this case it will be used for emergency shipments to the central warehouse.

Regarding the resources required for this type of transport, the company owns a loco-tractor and an open type wagon of the "Special S class flatbed wagons", for which certain modifications have been made to form a closed wagon for the transport of final goods to the customs warehouse in a situation when the existing storage capacity of the PM_4 warehouse is full.

According to information from the warehouse of the PM_4 paper machine, the loco-tractor has a pulling power of 60 kN, while the amount of goods that can be transported by the wagon is 40 t, which is its total load capacity.

Based on the data, it can be concluded that current resources of the company do not meet the current manufacturing capacities, so it is necessary to provide additional resources in rail transport. There is a need for the provision of additional wagons to meet the capacities of the internal transport of final products to the centers of storage systems.

If Table 5 is carefully examined, it can be concluded that the optimal daily paper production is about 546 t. In order to transport final products from the manufacturing facilities to the central warehouse, it is necessary to carry out the transport at certain intervals. In this case, it is a minimum of four cycles in 24 hours. A required period to perform the cycle of transporting the products to the central warehouse would be determined by the total production on a daily basis of all manufacturing machines that are included in the storage system of the central warehouse.

Regarding the ideal production, it means that all of these machines are in manufacturing function for 24 hours, and in practice it does not happen often due to: the quantity of orders, collected raw materials (waste paper), free storage space, warehouse stocks.

3.6 The possibility to dispatch final products from the central warehouse

Based on the research for the work and conversation with employees of the Department of Logistics as well as of

the Sales Department, they have provided information on the current mode of shipment of final products from the Natron-Hayat company. It should be emphasized that the Natron-Hayat company exports to over 40 countries around the world and this trend is constantly increasing. In addition to many European countries, the products are exported to overseas countries, such as China, Egypt, Kenya, Sri Lanka, etc. Most of the dispatch of final products is completed by road transport, more precisely, 82% while 18% by rail transport.

When observing the entire process of the dispatch of a road freight vehicle, it has been noticed that a process to dispatch a truck, starting from its access to the front for loading up to its exit from the factory, requires 90 minutes in ideal conditions.

In situations when the storage capacities are full, the overall process from the entry of the truck into the area of the company, the process of loading, creation of complete supporting documentation to its exit from the area of the company lasts up to five hours or longer.

The establishment of the central warehouse and grouping of certain tasks would lead to certain savings and significant shortening the dispatch of road and railway vehicles. The central warehouse has a large storage area in front of the building which would allow more space for the maneuver and operation of forklifts during a loading process. The result would be faster and more organized way of loading and shipment of road vehicles.

In order to speed up the process of shipment, within the central warehouse, the spare rooms would be adapted for invoice clerks and freight forwarders' offices. Bringing the warehouse workers, invoice clerks and freight forwarders together would significantly speed up the dispatch of final products

The entire process of checking the supporting documentation of a road vehicle should be made at the same time with the loading process of the road vehicle. This would help to avoid the numerous delays and interference, and the time of loading, that is, dispatching the vehicle would be reduced to a minimum.

One of the innovations that would be introduced as a part of the customs warehouse activities is local (house) customs clearance where the forwarding house in cooperation with the customs terminal (DC Tešanj) would carry out the customs clearance of goods at the factory. Within the central warehouse, an adequate area would be allocated for this purpose.

Introducing this type of dispatching final goods within the central warehouse would speed up the entire process of shipment. Also, the introduction of the "house customs clearance" would help to avoid going to the customs terminal and waiting for the road vehicle due to customs clearance. A similar process would be applied to the shipment of final products by rail transport. This method of shipment would be performed in a way that at the time of loading railway wagons, supporting documentation is being prepared. This is another indicator of positive aspects for establishing the central warehouse which would solve one of the weaknesses of the company.

4 CONCLUSION

By switching to a centralized storage system which includes storage of finished products on an ideal location from the point of connection to the production facilities and utilization of internal transport is carried out a series of benefits. This way of storage in a given company can achieve a number of positive effects of which are the most important savings on the basis of fixed and variable costs, easier access reloading fronts, reducing damage to the goods, lighter and faster loading, increasing security conditions of work and so on. Considering the savings, that are realized by swiching to a centralized warehouse system, and necessary investment funds, return period of the same is slightly less than five years, what is a relatively short period.

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