THE LOGISTICS FLOW IMPROVING NPI/NEW PRODUCT INTRODUCTION MATERIAL AND STOCK IN NPI ZONES

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Abstract

The article deals with increasing the efficiency of logistics flows in a company that carries out its activities in the field of the development and production of turbochargers. The presented study contains an analysis of logistics activities and processes, an analysis of stock levels and inventory management, and an assessment of the effectiveness of the implemented information system in the selected NPI/New Product Introduction warehouse. The analysis of the processes resulted in specific outputs with the definition and evaluation of the shortcomings of the warehouse system that is implemented in the company, and possible variants of solving the identified problems was proposed, which will contribute to increasing the efficiency and effectiveness in the very process of storing and managing these special products in the company. As a result, the study presents the design of variants, the selection of the optimal one using selected decision-making methods and the introduction of a new warehouse system, which leads to the efficiency of the entire storage process in the NPI warehouse. The output of the study is also the implementation of the selected variant in industrial practice, which is declared by the processed project of introducing the selected variant.

Keywords: Logistics, process, stock, warehouse, efficiency, decision making

1. INTRODUCTION

Logistics is a very broad field that largely affects the proper operation of the entire company. As long as all logistics activities work correctly, we hardly notice logistics. But we will realize its importance the moment any problem suddenly arises, be it during supply, storage, or shipment of goods. The effects of bad logistics can be serious for the company, in some cases even liquidating. For these and other reasons, more and more emphasis is placed on logistics in companies. [1,2]. We rank warehouse management among important parts of logistics as a whole. Logistics deals with the overall optimization, coordination and synchronization of all activities, the chains of which are necessary to economically achieve a given final result [3,4].

The logistics system as a whole consists of three subsystems:

- Material system – this includes material records, material security management, implements material flow.
- Information system – works with data on the previous, current and expected state of the material flow.
- Management system – processes information at the point of origin in real time. The effectiveness of this management is influenced by the quality of information, its availability and timeliness.

More and more demands are placed on the optimization of stock levels. In the case of optimal inventory management, costs are not the only aspect we follow. For each company, it is necessary to assess the way of inventory management individually. Each company has different economic conditions, different inventory management and valid legislative standards of the country in which the economic activity is carried out. It is important to observe the following aspects to determine the right strategy:

- degree of processing of the item (production stocks, unfinished or finished products),
- type of demand (dependent, independent, trending, seasonal),
- the place in the company's material flow where the stock is currently located,
- types of stocks according to ABC classification (XYZ) analysis.

Warehousing is an important component of the entire logistics process of the company, and logistics managers are well aware of the need to improve the productivity of warehouse operations. This can be done in many ways. Most often, system-oriented programs are used for this purpose (they directly affect the way different elements of the logistics system interact) or programs based on motivation (employee training, rewards, bonuses) [5-7].Optimizing warehouse processes in an economic sense is not a priority for the company, because it does not fundamentally affect the value of the product, as the storage processes produce only a few activities that add value to the product. The main reason for the emergence of various problems in the warehousing process is the fact that there is no standard in this area from which businesses can base themselves. [8-10]. Therefore, if a company wants to start optimizing its warehouse processes, it must first analyze them, specifically create:

- analysis of efficiency and productivity of work in warehouses in terms of increasing and reducing costs. The most suitable solution is the automation of warehouse operations,
- performance analysis between supply and customer chains within the selection of a suitable storage system and integrate this system into the material flow.

However, many causes of excess storage can be relatively easily eliminated with the help of modern technologies or at least significantly reduce their impact on the costs and efficiency of the company's production. Increased visibility in the logistics chain can lead to greater efficiency in all processing activities. The introduction of automation into the storage process makes it possible to obtain real-time information about stocks, as well as information about the state of progress and storage locations, etc.. This system allows companies to gain control over all activities in the warehouse and thus significantly increase the overall productivity of warehouse activities [11-13].

2. CASE STUDY

Each enterprise has its own specific purchasing goals, its own purchasing policy and uses different procedures for the procurement of input materials depending on the nature of the manufactured products, the size of the enterprise, the distribution of suppliers and the technical equipment of the enterprise. In the investigated company, the inventory management system is closely monitored. Inventories are created in centers directly related to production or shipping, from the material itself needed for production, through stocks of unfinished production to final products.

In general, the supply process consists of sub-activities such as purchasing or ensuring inputs into the production process, then transport to the warehouse and storage itself. All the company's activities are elaborated in detail in the company's internal directives, defining the goals, powers and responsibilities of individual employees, and specifying the exact procedure for the course of individual activities in the company.

2.1 Purchase

Ensuring materials for the smooth running of production is an essential basis for early and complete satisfaction of customer requirements. The entire shopping process in the company is ensured by the so-called material planners whose task is the purchase of incoming components, including the incoming inspection of these components. The purchase of material is carried out on the basis of a pre-approved production plan. Special components and material for special production are always ordered in exact quantities, according to

customer requirements, as the price of these input materials is always higher than for mass-produced components.

2.2 Transport to individual warehouses

Ensuring the transport of input materials to the company's external warehouses is carried out by several suppliers, i.e. different external transport companies, depending on the countries from which the goods are ordered.

Within the framework of suppliers from the EU, trucks with a transport time of approx. 7 days are used as a standard for the transport of materials and components. The second option is vans, which is a faster method of transportation, but is not used as a priority. In the case of an emergency, it is possible to provide a supply to the internal warehouse within a maximum of 24 hours, if the goods are available at the supplier's warehouse.

From Asia, the transit of material is primarily carried out by ship transport, as this type of transport is the cheapest. The delivery time is approx. 8 to 10 weeks, but since production is planned well in advance, or for a longer period of time, a longer delivery time is no problem. The second option is train transport, which has a transport time of about 4 weeks and is used occasionally. Exceptionally, a special flight can also be used, which is of course a financially expensive matter, therefore it is used only in necessary urgent cases.

Transportation from the external warehouse to the internal warehouse takes place continuously, and the company uses the services of an external company for this.

2.3 Storage

Warehouse management in the company fulfills an important role as an intermediate link between production and consumption, so it is part of the logistics chain in the company. Warehousing is a set of activities including the receipt of material into the warehouse, connected with incoming inspection, storage and issue of material.

Main external warehouse

The warehouse serves for the accumulation of supplies of input material from various suppliers, the subsequent sorting and repackaging of input components. According to the production plan, the warehouse management system (MHS) evaluates the need for material and components for the next 24 hours. Based on this request, the necessary material is dispatched to the internal warehouse

External packaging warehouse

The warehouse is used for packaging material, or packaging for finished final products

Internal warehouse

It is located right next to the production hall in the main building of the company. It is used to store materials needed for planned production for the next 24 hours. At the same time, it also stores semi-finished products, but also finished products waiting to be shipped to the customer, so it also has several zones. Internal warehouse is equipped with rack systems with narrow aisles designed for storing large and medium-sized components. Small components are stored in KARDEX AND MODULA4 lean lifts. In addition to these systems, the warehouse also has drop gravity stands, so-called Kan Ban, which also contribute to the smooth and efficient use of warehouse stocks. Each type of material has a precisely determined position/shelf where it should be stored. The MHS stock management system is also used in the internal warehouse, which continuously evaluates the need for material according to the production plan and according to the current consumption of the given material on individual production lines, performs automatic material consumption on the production lines. If necessary, the system will send a request to the internal warehouse, which type of material from which position in the warehouse and in what quantity must be moved to the production hall on a

specific production line. This process is carried out continuously by several suppliers, each with specific components and specific production lines. On the return journey, warehouse workers collect empty containers and store them for a certain time in the company's internal warehouse. Other employees of the warehouse have the task of collecting full packaging boxes with finished final products from individual lines, and also store them in the internal warehouse.

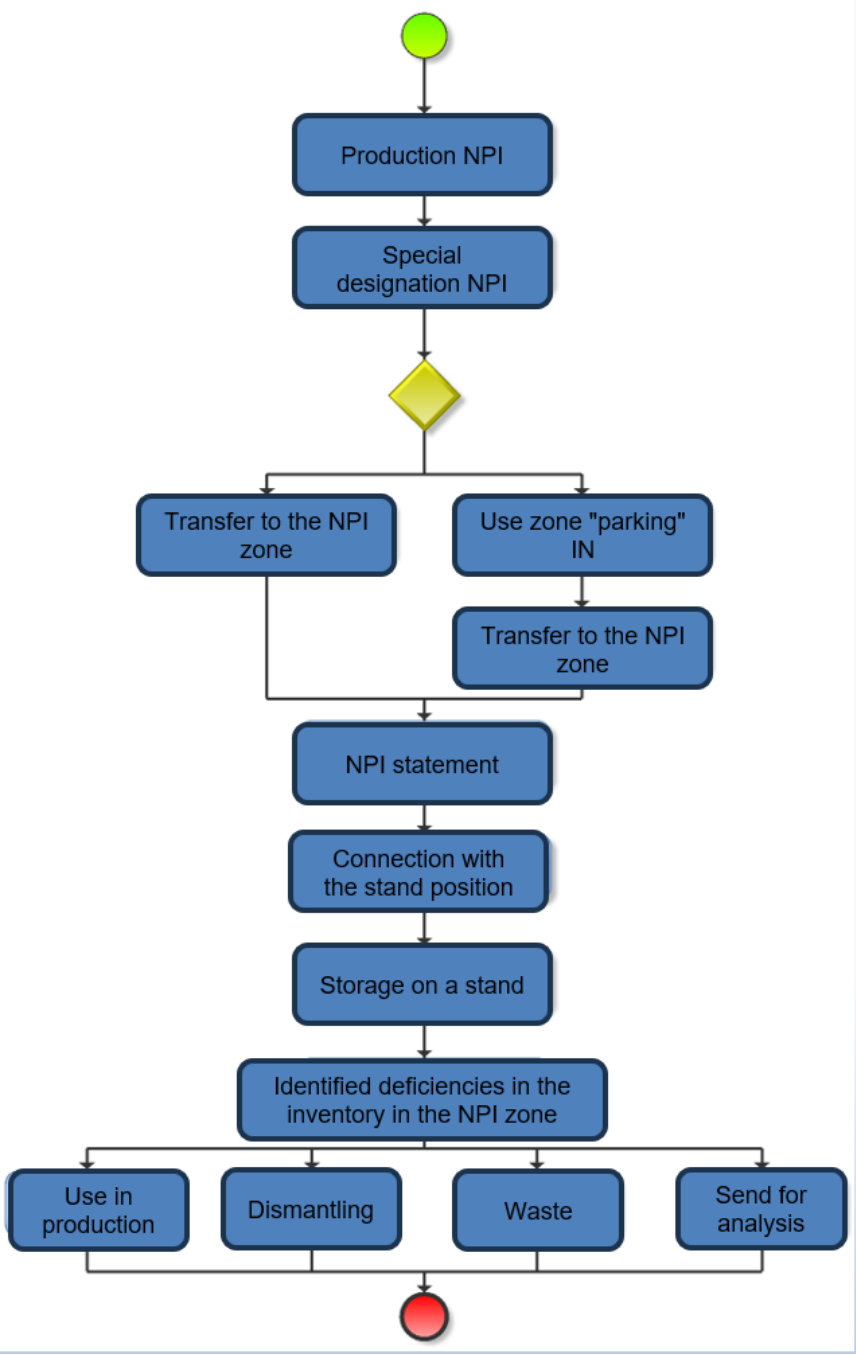

Figure 1 Flow diagram of the storage process in the NPI warehouse

The flow of packaging, materials and final products

The customer sends empty packaging to the packaging warehouse, which is checked, cleaned, weighed, prepared and then shipped to the internal warehouse in the required quantity based on the report from the production plan. There they are unloaded and subsequently delivered to individual production lines in

accordance with the production plan. Full packaging boxes are concentrated in an internal warehouse, where they are checked and weighed. If necessary, e.g. when the scale does not fit, the number of pieces of components in individual boxes is recalculated. Boxes that are in good order proceed to the next process, they are either stored for a certain time or, in the case of urgent orders, they go directly to export for the customer. From there, the empty packaging is returned to the external packaging warehouse.

NPI department in the company

NPI is a department that, based on specific requirements from customers, is responsible for introducing new products into NPI/New Product Introduction production. In this department, the responsible employees deal with both the technological assessment of the production process and the quality of these new products, as well as the material flow of components that do not yet fall into the phase of serial production, and thus must be specially marked and their application in production must be separately registered and ensured. Project leaders are responsible for all ongoing projects in this department, who are responsible for the entire course of individual projects. Project processes are managed by process project engineers who are in charge of specifications, installations, but also deal with all design elements of manufactured products. Project coordinators are in charge of all logistical flows within individual ongoing processes, whether they are ordered components needed for special production or already manufactured products. The NPI department also has its own experts to assess the quality of manufactured special products

Identification and description of the main identified problems.

- Manual writing of identification labels

We consider the biggest shortcoming in the NPI warehouse to be the fact that the labels containing the data on the manufactured SBR products are written by hand by the employees.

With this manual form of writing out identification labels, various errors may occur during the receipt, storage and issuance of NPI material, which the worker may not notice. Inaccurate material identification based on inaccurate or erroneous data on the label, inaccurate allocation, result in error rates.

- Incorrect and incomplete data on identification tags

It happens that the material remains only on the transport cart or is stored on the shelf without being entered into the MHS database. This happens when the identification label is not written completely, it lacks essential input data, e.g. the number of the technician who produced the given SBR batch. Thus, the material cannot be thoroughly identified, and this later causes various problems.

- Insufficient identification system of SBR products

The lack of an automatic NPI identification system is felt by the department mainly during inventories. Deficiencies caused by out-of-date product data are regularly manifested, where the actual status does not correspond to the status in the company's MHS system. There is an inability to identify and locate components. Many shortcomings are caused by the human factor. Since the SBR number is written manually and is not in the MHS system, a physical check directly in the warehouse is necessary to solve any problem.

- Lengthy and inefficient inventory

In the warehouse, there are regularly products that, for various reasons, were not properly stored and identified, that is, they are not in the company's MHS system. The inventory takes an average of 4 days, so it is lengthy and inefficient at the same time.

- Insufficient capacity of the NPI warehouse

After conducting an analysis of the current situation in the NPI warehouse, it was found that the storage of materials and stock of special products in the NPI warehouse was inefficient, limited by the capacity of the

warehouse space, and also due to the accumulation of hard-to-identify items, there is less and less room left in the warehouse for handling them. Material also accumulates in the parking IN zone. Thus, work becomes increasingly inefficient and the possibility of error increases.

- Unsecured "parking" zone

It can be accessed by every production operator, but also by all other employees who have the competence to get into the production hall. It is not possible to check it in any way, so it sometimes inadvertently happens that special SBR products are used from it for mass production and thus become devalued

- Presence of excess stock

While performing the analysis/inventory in the NPI warehouse, we found that a significant number of products and stocks could not be identified, we could not prove their need for future planned SBR production, or they were already after the date of planned production or shipment to the applicant of this special production batch.

- Redundant movements of workers

When dealing with various situations and problems that occur on a daily basis, it is necessary for an employee of the NPI department to physically check SBR products directly in the warehouse.

Proposal of a solution for streamlining inventory management and implementation of the selected variant

Implementation of the Kardex Shuttle storage system

The new system designed by KARDEX consists of 1 Kardex SHUTTE vertical elevator module with a single access opening for the dispatch area. The new solution requires only 13.5 m² of space to store more items than in the original warehouse.

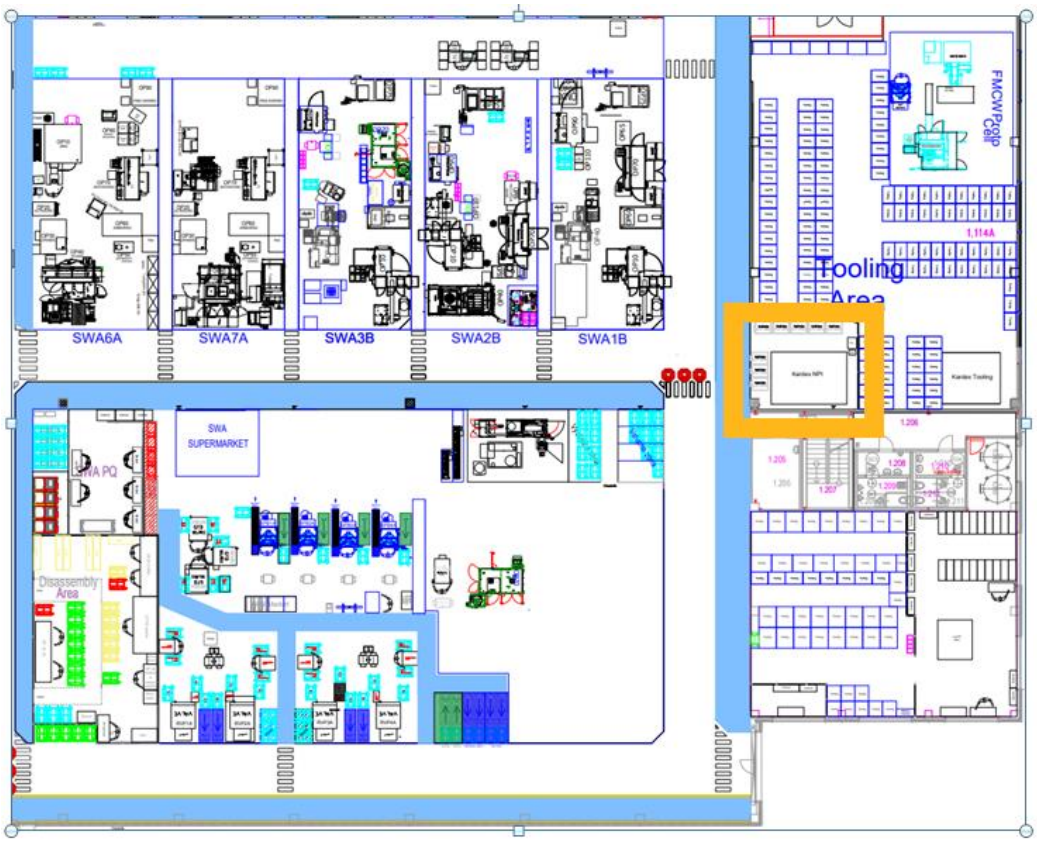

Figure 2 Layout of the production hall with markings of the proposed KARDEX module

The vertical elevator module would be located directly next to the production hall like the original premises of the NPI warehouse (see **Figure 2**), but it would occupy much less space.

The introduction of this option would not require any intervention in the building or other construction work. The only modifications would be related to adapting the electrification and freeing up space for the new storage module.

As part of this solution, we could increase the capacity of the NPI warehouse by up to 38%. One of the biggest advantages of this variant of the solution is the possibility of streamlining the storage process in the NPI warehouse with new warehouse software.

Advantages:

- saving space in the production hall,
- increasing the capacity of the NPI warehouse,
- improvement of the storage process with new software,
- improved ergonomics when handling goods.

Disadvantages:

- the necessity of training employees,
- the need to prepare a place for the new system.

The Kardex Shuttle is the most efficient way to keep parts safe, clean and organized in a very small and compact space. It allows loading up to 480 kg on one shelf. The installed KARDEX module includes 34 such shelves, **Figure 3.**

Figure 3 The final arrangement of the shelves in the KARDEX system

2.4. Design of a new form of identification labels

When designing the new form of identification labels, all identified deficiencies on the original labels were taken into account, while the practical experience of the employees of the company's NPI department was also based on it. The design of the new label can be found in **Figure 4**.

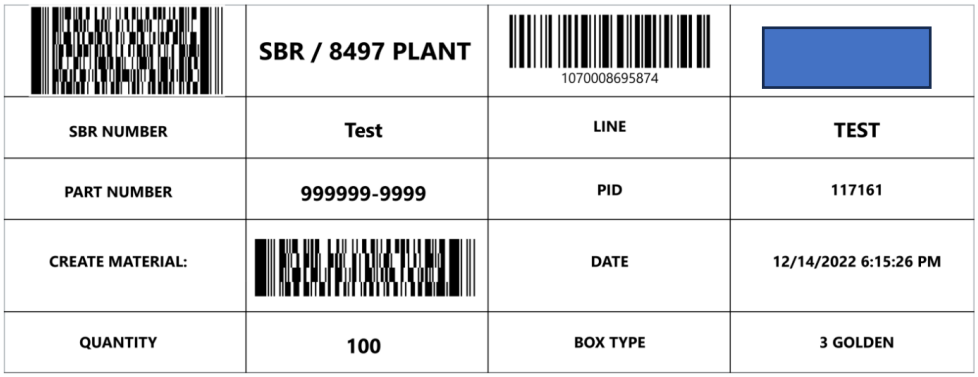

Figure 4 The new form of the identification label

The most important change in the new storage system, and for streamlining the functioning of the NPI warehouse, is that it contains the SBR code of the material (see **Figure 5**), which could not be entered into the MHS system. The new Power Pick information system offers this option. The SBR code is located on the new identification tag and can be read directly with a scanner.

Materiál	Aktu Σ	SBR	ID Kontajner	Pořadové č Σ	Bin	datum naskladně
		fh				
847321-0007	4	FH35	1070008651008	4	2 CHRA	06.12.2022
904105-0009	17	FH47	1070008770138	14	1 SWA	12.01.2023
904105-0009	32	FH47	1070008770134	14	1 SWA	12.01.2023

Figure 5 The items in the new Power Pick storage system

The main benefit of the introduction of the new storage system is the streamlining of the inventory process in the NPI warehouse, but also of all other processes related to the SBR procedure at the NPI department in the company. The purpose of the introduced system is, among other things, to simplify the supply of NPI products on the production lines and more clearly record the stock of these products.

Stock software Power Pick

Above all, the inventory management solution must be simple with a clearly structured process and minimize the risk of errors in all tasks. Power Pick Global warehouse management software from KARDEX s. r. about. meets these requirements, increases accuracy, efficiency, safety and flexibility, optimizes storage in combination with KARDEX machines, **Figure 6**. The system provides simple storage and collection of goods, warehouse management, spatial management, reporting and simple management of user rights. More than 25 additional options include advanced reporting, batching, kiosk storage, label printing, SAP integration, serial number handling, weight management and zone handling.

Thanks to the new storage system in the NPI warehouse, we managed to achieve the following benefits.

- Elimination of excess stock
- Reduction of redundant movements and work
- More efficient and faster inventory execution
- Streamlining the storage process by scanning
- Streamlining the storage process by scanning
- Increasing the storage capacity of the NPI warehouse
- Saving floor space
- Improvement of workplace ergonomics

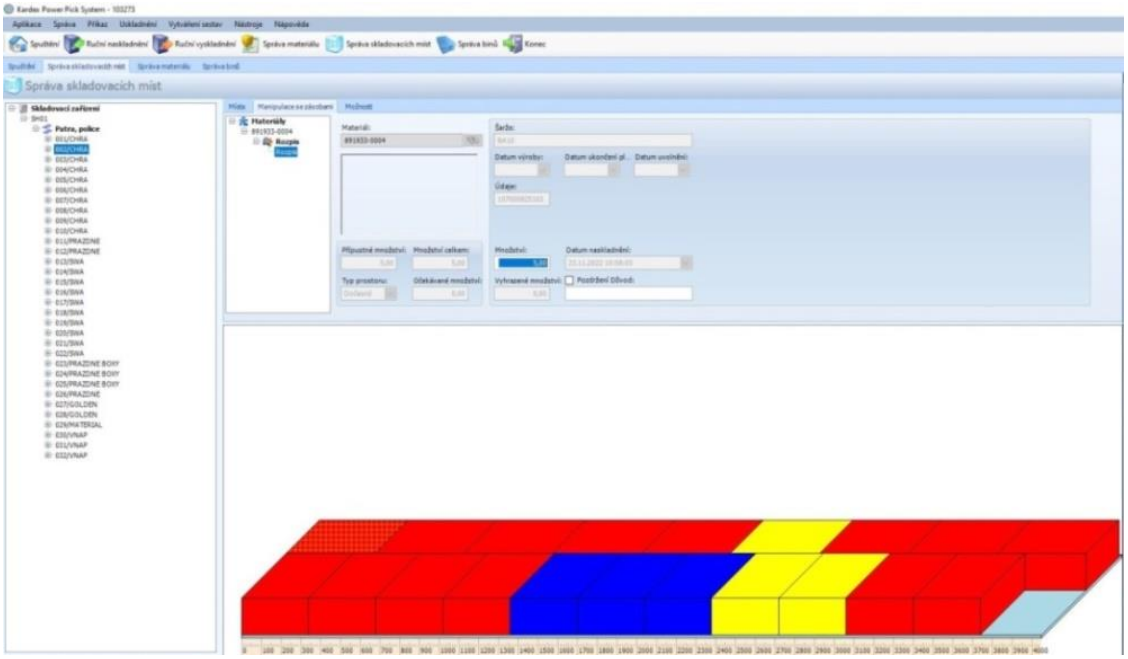

Figure 6 The arrangement of CHRA boxes in the KARDEX system

3. CONCLUSION

Since logistics and logistics processes are nowadays considered to be one of the key factors in the correct and efficient functioning of not only manufacturing companies, but also in the world of transport and distribution, or other branches of industry, it was also necessary to analyse the state of logistics in the case study and to assess the current state of a specific, selected, special warehouse of the company, which showed signs of deficiencies and thus provided room for improvement and efficiency in order to increase the level of efficiency and proper functioning of the logistics flows of this warehouse. The aim of the study was to focus on the analysis of logistics activities and processes, the state of supply and the management of warehouse stocks, the assessment of the effectiveness of the established information system in this selected warehouse and subsequently to propose changes that will contribute to the increase of efficiency and effectiveness in the very process of storage and management of special NPI products.

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