Management and Production Engineering Review
Volume 9 • Number 4 • December 2018 • pp. 96–105
DOI: 10.24425/119550

THEORY OF CONSTRAINTS AS A STIMULUS TOWARDS WAREHOUSE TRANSFORMATION PROCESS ON THE EXAMPLE OF THE DISTRIBUTION CENTER

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Received: 29 May 2018
Accepted: 21 August 2018

Abstract
In the face of challenges faced by today's managers, such as unreliability of processes conducted within the company, low quality of materials, too long time of fulfilling the customer orders and missing the deadlines of their implementation, the role of dynamic parameters of the warehousing as the source of competitive advantage of a modern enterprise is growing. The aim of the study is to identify and analyze the factors determining the effective implementation of the warehousing in the Distribution Center. In the research there has been adopted the following hypothesis: with the increase in the number of customer orders, which is characterized by an increasingly smaller number of assortment items, the importance of managing constraints limiting the material flow within the warehousing is increasing. The above-mentioned hypothesis is verified in accordance with the test procedure including literature research and a case study. The research results show that the Theory of Constraints is an excellent tool supporting the transformation of the warehouse management method. With the help of the Theory of Constraints it is possible to determine precisely the places in the material flow, where the adaptation actions undertaken bring down the greatest effects.

Keywords
warehousing, picking, efficiency, competitiveness, Theory of Constraints.

Introduction

The key skills of a modern enterprise are: full control over processes, effective planning, effective implementation of company processes and appropriate adaptation to changes and risk.

Contemporary changes within the mechanism of creating sources of competitiveness of the companies push the enterprises, operating in the field of warehousing, into verifying the level of effectiveness of operational activities carried out throughout the entire warehouse. In view of the tendency of the continuous increase of customer orders, which is characterized by an increasingly smaller number of assortment items, the importance of improving dynamic parameters of the warehousing, as a source of competitive advantage of a modern enterprise, is increasing.

The aim of the study is to identify and analyze the factors determining the effective implementation of the warehousing process in the Distribution Center.

In the research there has been adopted the following hypothesis: with the increase of customer orders, which is characterized by an increasingly smaller number of assortment items, the importance of managing constraints limiting the material flow within the warehousing is increasing.

The following partial hypotheses are the development of the above main hypothesis:

H1: Companies that manage the material flow occurring within the warehousing and ignore the role of constraints in the material flow, incur additional costs.

H2: The Theory of Constraints applied in the process of improving the way of warehouse management increases the effectiveness of the flow occurring within the material flow and becomes a decisive tool affecting the success of the adaptation of the actions which are undertaken.

The above-mentioned hypotheses are verified in accordance with the examination procedure including literature research and a case study.

Warehousing Process in the Distribution Center

The warehousing in the analyzed Distribution Center is divided into four stages.

The four stages of the warehousing process are depicted in Fig. 1.

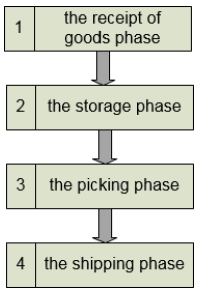

Fig. 1. Four stages of the warehousing process. Source: Own Study based on [1–4].

The first stage is the receipt of goods. After this phase the storage phase follows. Then, in the specially separated zone, the picking operation takes place. The last stage of the warehousing is the shipping operation [1–4].

Each phase corresponds to a separate zone in the examined warehouse.

In the receipt of good phase, which starts the warehousing in the Distribution Center under analysis, the entries of the goods to the warehouse are registered.

There is a distinction between outside supplies and internal deliveries. The latter are carried out within the production departments of the examined enterprise. In the enterprise, there are additionally so-called deliveries from collaborating entities performing specific services on previously entrusted materials.

The receipt operation to the warehouse starts with the unloading carried out by means of internal transport, i.e. hand-lift trucks and forklift trucks. The goods put back on the designated area are subject to the initial inspection, based on which it is ensured that there is no damage of the received and packed cargo units. The goods, which do not meet the receipt criteria at the initial assessment stage, are returned to the supplier. The units that have passed the initial inspection and do not have any signs of damage and loss of the cargo units, are subject to the full identification.

As part of the receipt operation, the finished goods are sorted. Some of them, on delivery to the Distribution Center, are already stored on the pallets, and in the case of finished goods received from the internal production department, are stored in metal containers or stands. The assortment brought loosely in containers must be additionally sorted and manual work prevails here.

Then the products are directed to the quantitative and qualitative control. The quantity control verifies the number of units stored on the pallets or in the metal containers. The purpose of it is checking the quantitative and qualitative compliance with a delivery document. The next step is the qualitative control, which in the examined enterprise takes the form of a visual inspection.

The delivery, which is consistent with the order and passed positively the receipt control is subject to system records. The revenue proofs are issued. The valuation of inventories, made during the receipt phase, is important due to the possibility of changes in the prices of materials, their purchase and shipping as well as production costs. The valuation of materials upon their receipt to the warehouse is carried out according to the criteria of the actual price or the fixed record price, whereas the actual price may be shaped at the level of the material price or the purchase and shipping or production costs.

For supplies that do not meet the quantitative or qualitative requirements of the order, a discrepancy report describing non-compliance is generated. In this situation, the supplier may complete the missing assortment in the next delivery or in another option – a faulty delivery, containing loss or damage, is sent back to the supplier.

The formed stock keeping units are directed by employees of the receipt zone to the next zone. This is the storage zone.

In the Distribution Center undergoing the study, two ways of received materials storing are distinguished. They are stored directly on the warehouse

floor without storage devices or stored in storage facilities. In the first variant, the assortment taken from the receipt zone is stored without storage devices in the form of piles, which can be arranged in rows or blocks, in suitable carriers such as metal containers, stands or pallets and appropriately stacked. In the second case, the assortment is directed to the racks. The pallets are located in two or three rows of racks.

In the season, when there is often no place for stored goods and the quantity of the stored assortment increases periodically, the stock keeping units forming blocks are compacted. The blocks created spread, often blocking the communication routes in the warehouse. The number of rows in the blocks as well as the number of the stock keeping units in the individual block rows grow. Blocks prepared in this way are devoid of internal corridors, which blocks access to the individual stock keeping units. Despite the difficulties in access to the individual stock keeping units, the efficiency of storage space utilization increases with the block storage of pallets, metal containers and stands for logs.

Physical allocation of the stock keeping units in the storage zone depends to a large extent on the decision of the warehouse workers. Usually the employees, by choosing the location of the stock keeping unit, try to make sure that the buffer storage places of a given assortment position are as close as possible to the picking places of this assortment, which are determined by the method of permanent storage places. When storing in storage facilities, usually the top rows of racks form a storage zone called a buffer zone, while the lower levels of the rack create a picking zone. In the case of block storage, the entire field is registered in the system as a storage field. Within this storage field, the first stock keeping units in the row of the block form a picking zone.

Workers of the storage zone with the task of placing a specific stock keeping unit, intuitively go to the storage area of a given type of assortment, which usually falls just above the picking zone. In the storage area, the workers look for the first free row located just above the picking zone of the given assortment and locate the units there. Then, the selected location address are recorded in the IT system.

In the picking zone the goods are placed according to the method of permanent storage places. In the case of logs stored in the metal containers, picking places take the form of two stacked boxes, from which the assortment is systematically collected in accordance with the order of picking.

The small unit assortment is located on fixed shelves and on shelves in collective cartons. Above the picking zone there is a storage zone in which the stock keeping units are buffered.

Picking of customer orders is carried out in the examined enterprise in the majority of cases in the picking area. It can also take place in the storage area when the picking locations are empty and there was no replenishment. Workers of the picking zone carry out the order picking tasks assigned to them in the given case, which are identical with the client order. The picking takes place according to the man-to-goods method. The picking zone employee chooses by themselves the order of collection specified in the order picking task of the assortment items. The distance travelled by the warehouseman during the execution of the order depends, to a large extent, on their individual choice of moving within the three storage halls. The process ends when the employee takes and puts the last item from the customer order on the stock keeping unit. It happens that the client's order takes longer than one shift. In such situations, employees who finish the shift, put forward the order, which has not been completed, to the picking zone leader of the next shift.

The last operation which is carried out in the examined enterprise within the storage process is the dispatch. Complete loading units are directed to separate fields in the dispatch area. From this field, shipping together with documentation is directed to a specific recipient. However, before it happens, the goods are subject to packaging and dispatch control. Depending on the form of the load, the goods are loaded manually or it is possible to mechanize the loading works in the case of pallet load units.

Using the Theory of Constraints for the process of On-Going Improvement

In the process of the material flow there is a number of malpractices affecting both the material flow rate in the warehousing and the level of operational costs.

The significance of the process of the On-Going Improvement increases due to the inserted in the warehousing process steady trend of an increasingly smaller number of assortment items within the customer order.

The conducted analysis of the customer orders according to the line order criteria within customer order presented in Table 1 and Fig. 2 depicts that one fifth of all the customer orders consitute orders with only one assortment item. Quantity and quality corectness of these orders' implementation is directly visible on the level of the corectness of the

whole order. Up to 40% of all the orders consitute orders which consist of one, two or three assortment items. After taking into consideration five assortment items – 50% of all the orders are obtained. Cumulative 80% of all the customer orders consitute orders up to twenty assortment items.

Table 1
Summary of the customer orders according to the line order criteria within the whole customer order. Own Study.

Number of the line orders within one customer order	Percentage of the orders within all the orders	Cumulative percentage of the orders within all the orders
1	21.49%	21.49%
2	11.56%	33.05%
3	7.00%	40.05%
4	5.41%	45.46%
5	4.03%	49.48%
6	3.76%	53.24%
7	3.17%	56.41%
8	2.93%	59.34%
9	2.44%	61.78%
10–20	17.87%	79.65%
21–30	7.68%	87.33%
31–40	4.16%	91.49%
41–50	2.60%	94.09%
51–100	4.32%	98.41%
101–200	1.28%	99.69%
201–300	0.20%	99.89%
301–400	0.07%	99.96%
401–500	0.01%	99.97%
> 500	0.03%	100.00%

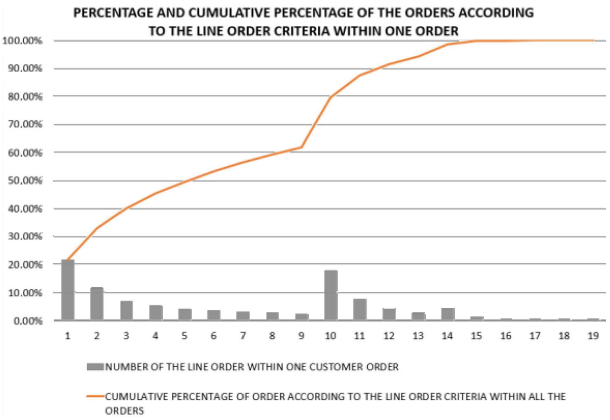

Fig. 2. Summary of the customer orders according to the line order criteria within the whole customer order. Own Study.

Taking into account the above-mentioned analysis, the increase in the number of customer orders, which is characterized by an increasingly smaller number of assortment items, forces the enterprises to introduce the On-Going Process implementation aimed at effeciency improvement of all the actions undertaken within picking area.

Maintaining and steadily strengthening the change trend in the order attitude pushes the enterprises operating in the field of warehousing into verifying the level of effectiveness of operational activities conducted within the warehousing area.

Undertaking the improvement actions allows the elimination of a range of malpractices, which by decreasing efficiency of the warehousing process, generates additional operational costs resulted mainly from waste. Particularly the waste can be observed in the area of waiting, overprocessing, defects or motion. These waste types involved in the enterprise activity increase the operational costs of warehousing [5–7].

Already at the first stage of the warehousing the malpractice which is common among warehouse employees is the updating of stock levels based on transport documents without making a quantitative control of actually accepted materials. Such activities result in incompatibility between the inventory stocked in the warehouse and the system state.

Also, the lack of quantitative control of collective cartons in internal deliveries carried out by the production department is a serious failure. The state registered in the system deviates from the actual state in the warehouse. This is because the states registered in the system in cases of internal deliveries are updated, similarly to external delivery, based on the quantities declared by the production department. These quantities are repeatedly given false by the production department. The statistics are regularly overstated by the production in order to improve the efficiency ratio of Overall Equipment Effectiveness. This is the parameter, which integrates qualitative, performance and availability factors, that are crucial for the production assessment.

As part of the existing warehousing technology, the practices of warehouse keepers confirm the noncompliance with the First In First Out principle, in which the first delivered cargo units are dispatched in the first place. In the storage area, the employee by themselves decides on the target allocation point of the stock keeping unit. The system does not indicate the location address. Therefore, there are coincidental storage locations for stock picking units in the surveyed company. During the allocation of further product items in the zone, places in the picking zone are replenished first, and the remaining goods are directed to the storage zone, in the reserves. When allocating the assortment straight to the picking zone, neighboring picking locations are often scanned by

mistake. Such practices contribute to the inconsistency of stock levels in individual warehouse locations.

In the surveyed company, it is a common warehousing practice to store the assortment on heterogeneous carriers. These are pallets, metal containers or stands on which more than one inventory item type is stored. Within one carrier there are both high and low runner products. This method of storing materials aims to increase the level of use of storage space which is deceiving. In practice, however, storing within one carrier several articles from low and high runner products results in permanent blocking of the carrier with low runners which as a result, reduces the level of buffer site utilization. In addition, the picking operation from a heterogeneous carrier is time-consuming because the direct access to a specific position is hindered and it is necessary to hand over the item within the carrier in order to find the specific material.

When replenishing picking positions in pallet racks, the number of product items placed in the picking location is manually declared. After completing the collection locations, the remaining quantities are placed back in the reserve location. Here, however, mistakes often occur, because the carrier with the assortment is put in the wrong place, i.e. not in the place from where it was originally taken.

An additional difficulty is the organization of the picking zone for logs in the stacked metal containers. When picking metal containers are empty and need to be replenished, the containers that are stacked on the higher levels, must be moved to another location in order to replace the picking metal containers.

It happens that during the order picking phase, the system directs employees to the so-called buffer area. The employee, seeing this buffer area in the system, has to refer to his knowledge and experience, and physically pick the assortment item from the place where it is usually stored. In the system, they approve the collection of the detail from the buffer area. In the case of identifying a damaged unit, during the order packing operation, the employee again goes to the buffer area to pick the undamaged assortment and completes the dispatch.

Another impediment in the flow in the warehousing process is caused by the fact that the picking of the order includes both small items, logs and large-size assortment located in separate halls. So, a warehouseman aiming to complete the entire customer order, often moves several times between the halls, personally deciding on the order of the collected items. Such a picking technique means a high level of waste resulting from unnecessary motion of warehouse staff and goods around the warehouse. This is an inefficient picking technique. The picking operation takes place in the enterprise in an uncontrolled manner and is characterized by big defects.

A common failure of warehouse employees in an enterprise is blocking the communication ways by the assortment stored on carriers and prepared either for storing at higher levels of pallet racks, or for replenishment. Due to insufficient space in individual zones, the assortment is often stored in communication routes. In the same places there are also often stored goods ready for shipment. The buffers stored in such a way make it difficult to access certain product items. Warehouse workers, acting under time pressure, often damage goods stored in communication routes.

In order to make the transformation of warehousing and exclude the sources of waste which exert an impact on the whole warehousing process efficiency and the level of customer service, it is important to know which constraints affect performance in any part of the warehousing [5].

Taking the above-presented information into consideration, the concept of the Theory of Constraints (TOC) is worth mentioning.

The author of this theory is E.M. Goldratt. The postulates of the Theory of Constraints were for the first time introduced in 1984 within the book titled 'The Goal: Excellence In Manufacturing' which offered comprehensive solutions for production management [8].

Acting according to the TOC concept requires the hollistic view on the whole system. An enterprise ought to be perceived as one united system, not the separate subsystems [9]. According to TOC concept, the enterprise is a network of the organisational unit chains which are linked with each other [9]. The goal of the enterprise is to succeed. In any business activity a constraint is an obstacle which prevents the whole system from obtaing its highest commercial performance. The huge number of dependencies in the framework of the institution of these systems is analogous to the theory of network of chains [10]. The strength of the entire chain is defined by the strength of the weakest unit which is called a bottleneck [9].

This theory focuses on the elimination or proper management of contsraints by matching the whole flow of material, product, information and human resources to the capacity of the flow [9].

This theory says that all efforts should be focused on the place where the maximum effect is achieved. This place, according to the Theory of Constraints, does not have to be limited. This can be an area that has a strong impact on the constraint itself. Manage-

ment in this case is done not by constraint, but by the area strongly correlated with this constraint.

In the surveyed enterprise, the entire warehousing process should be verified taking into account the material flow rate.

Due to the fact that this concept illustrates the generic procedures not only for the production constraints, but also depicts the improvement of the performance in the area of project management, distribution, marketing and human resource constraints [11, 12], it is worth taking into account this solution in the field of warehousing.

To expect results while dealing with warehousing, three factors considering change within the material flow have to be considered [11–13]:

- knowledge of what to change,
- knowledge of what to change to,
- knowledge of how to cause the change.

The Theory of Constraints implements the Five Focusing Steps which are directly associated with the change. To determine what to change, it is compulsory to refer to the first step within the Five Focusing Steps – the identification of the system's contraints.

In turn, to answer the question what to change to, it is obligatory to follow the second and the third steps from the Five Focusing Steps. These are: the decision how to exploit the constraints and subordination of everything else to the above-mentioned choice.

Determination how to cause the change is done by elevating the system's constraints [13].

Referring to the Theory of Constraints, the tool of the Five Focusing Steps is called the Process on On-Going Improvements which is shown in Fig. 3 [5, 8, 10–12, 14–22].

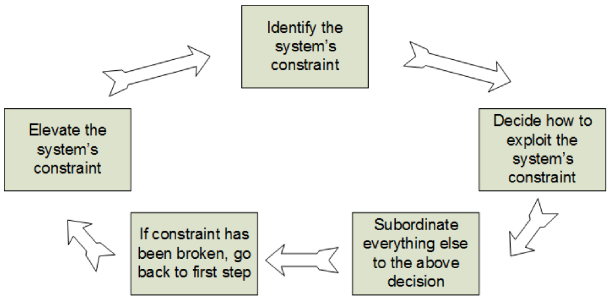

Fig. 3. Five Focusing Steps Principle. Source: Own Study based on [5, 8, 10–12, 14–22].

The first step of improvement based on the Five Focusing Steps Principle in the management of constraints is to identify the constraints in the system. Identifying the right constraint within the system is crucial [9]. Recognition of the constraint in the analysed system is vital as indicating the limitation is the beginning of activities directed at improvement of the situation [14].

The analysis of the entire warehousing process carried out in process perspective shows that the picking phase is a constraint in the system. Therefore, the alteration has to begin from the weakest link.

The company's activity is limited by a constraint, and the throughput of the picking phase determines the throughput of the entire warehousing system. It is this area, where piles of unfinished work are collected in the form of unfulfilled orders. The rate of human resource usage in the picking area is the highest, yet these workers never rest and still perform duties with delays. The picking phase, being the critical point of the whole warehousing process, requires reorganization and redefining the character and form of the assortment flow from the supplier to the recipient. In the area of picking, there is the source of the majority of problems. The constraint limits the throughput of the whole system. Increasing the quality of the other subsystems, the local efficiency will not exert an impact on the performance of the entire system [20].

The next step of the analysis based on the Five Focusing Steps Principle is the second stage, which is the maximum exploitation of the constraint.

In this step, all factors that cause time wasted on this resource should be eliminated, particularly waiting, overprocessing, motion, transport and defects. The overriding type of waste is all kinds of waiting. The key action is to eliminate all waiting of the constraint. In the next steps of elimination, further types of waste are subject to elimination.

If the system loses time due to the fact that the constraint is not operating – this causes the loss that cannot be regained. In order to obtain the maximum capacity of the system constraint, the limitation point ought to act without any interruption.

Changes made on this level of advancement are aimed at improving the activity of picking of the customer orders without transformation of the employment structure of warehouse workers and reduction of the malpractice factor in the area of customer order fulfillment. The knowledge of the position of a constraint requires taking into consideration the scale of limitations in the material flow in order to prevent the system from additional costs.

In order to achieve this, it is necessary to exclude heterogeneous carriers from the picking operation. It is a highly problematic practice, as it prevents the direct access to the specific position assortment and it is necessary to hand over the goods within the carrier in order to find a specific index. Such activities

are time-consuming and cost-generating. They hinder the implementation of the second stage of the Five Focusing Steps Principle that is the maximum exploitation of the constraint. Therefore, in the newly developed warehousing technology oriented to the maximum exploitation of the constraint, the total elimination of heterogeneous carriers and the transition to a homogeneous carrier system was assumed.

On the other hand, as part of the elimination of waste taking the form of unnecessary motion of goods and employees, a new standard of effective strategy of parallel picking was applied. Before the change, a warehouseman often moved several times between different halls to complete the entire order.

The basis for the analysis and evaluation of the work organization in the warehouse is the analysis of the spaghetti diagram shown in Fig. 4, which illustrates the movement of the warehouseman implementing the order. The analysis of the distance covered by the warehouseman becomes the basis for formulating corrective recommendations.

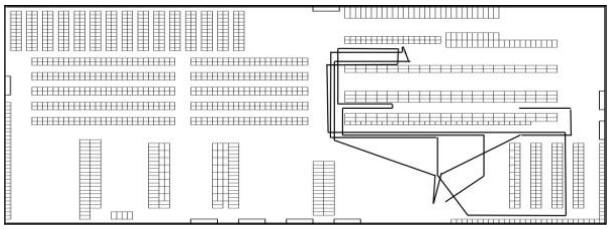

Fig. 4. Picking scheme – implementation of the order. Own Study.

A dispatch order implemented in accordance with the new strategy is conducted in several separate zones in parallel. In the case under study, the order is carried out in separate three halls with such division that only a small part is gathered in one hall, the second hall has a large size assortment dispatched in small quantities, and in the third hall there is the large and log assortment collected on full carriers, that is in large quantities. Then, the parts of orders completed in the parallel system are subject to consolidation, control and packaging in newly designated locations. In the new approach, the positions of packers and pickers of orders are independent.

Another change introduced within the software application supporting the warehousing – the Warehouse Management System, aimed at speeding up picking operations and exclusion of emptying the picking locations within the picking zone. For this purpose, the level of dispatch quantity of the single assortment has to be indicated, beyond which the warehouseman should get the goods from buffer places. The goods taken from the buffer places cover each time the multiple of the collective cartons. Single pieces are always taken from the picking zone. This practice protects the warehouse from the constant necessity to replenish the picking locations of high-runner indexes which are dispatched in large quantities.

The third stage is the subordination of everything to the constraint. This stage is reduced to ensure that the remaining parts of the system supported the constraint [14]. This activity within the flow process is referred to as synchronization.

Waiting in the picking zone is generated as a result of discrepancies in the warehouse between the state registered in the IT system and the state actually available in the individual locations of storage and picking. Warehouse practices should exclude the lack of quantitative control of assortment taken from the production department or from the suppliers or collaborators. Only the reliable records of the receipt material based on the acceptance control will ensure the reliability of information stored in the warehousing.

Another practice contributing to the emergence of inconsistencies in the inventory in particular locations is that the choice of the target location is performed by the worker of the storage area. These locations are usually determined by the fixed location storage method and occurr just over the picking zone of the given index. During such an operation, it is common to enter to the system the false addresses of neighboring buffer. In order to exclude such malpractices, the special settings in the Warehouse Management System have been implemented, which force the placement of the goods in the buffer zone according to the random location storage method at the location specified by the system. The additional confirmation of the correctness of the action undertaken is the scanning of the address code of the appropriate location.

Changes made in this step are aimed at supporting the plan implementation of the synchronisation of resources which do not consitute the constraint with the resource which causes the limitation in the flow. The actions taken on the level of the third step pursue to the acceleration of customer orders' implementation with the unchanged employment structure of warehouse employees and reducing the level of incorrectly prepared customer orders, which exerts an influence on the financial condition of the enterprise.

The fourth stage of activities carried out in accordance with the Five Focusing Steps Principle is the improvement of the action of the constraint by investing in machinery, people and time [14].

To support the work of pickers, reorganization was carried out in the storage area. Within the framework of the fourth step, there took place the new hall overtaking and its adapatation to storing and picking of the small assortment items and logs. The additional hall, but foremost the warehousing technology change, which included the purchase of pallet racks with and without shelves, effectively increases the quality of the picking of customer orders retaining the employment structure of warehouse employees and limiting the factor of incorrectly prepared customer orders.

The measures taken within the alteration process of the warehousing technology have the greatest impact on the performance of constraint.

The storage of logs without storage facilities has been abandoned. The metal containers stored on the higher levels had to be moved to another storage area while the replenishment of the empty picking metal containers was carried out. Such activities are time-consuming and even if they are performed by employees of the storage zone, they have a huge impact on the delays of employees completing orders. The transition from the storage without storage devices to storage with storage devices requires the implementation of new storage technology and investment in solid frame racks.

This technology assumes storage in the range of pallet racks with and without shelves. The racks are divided into two zones. The first zone, the lower one, is located on the lower levels of the rack and it is the picking area. The upper zone is a buffer, managed according to the random location storage method, which directly affects the improvement of the storage space usage parameters.

To avoid mistakes when collecting small items from the picking zone and to permanently eliminate the waste of mistakes made when completing the small item assortment, separators effectively separating neighboring assortment items were used. The assortment locations separated by separators block the possibility of movement of collective cartons between the locations. In addition, it was ensured that while planning the location of similar products of different colors in picking area, they ought to be separated from each other in order to exclude mistakes in the picking of the wrong assortment from picking areas.

The assortment location planning in the halls proceeds according to the frequency of picking and the size of the dispatches. The assortment locations with the highest rate of frequency of picking are planned to be the closest to the dispatching zones in the next halls. This approach ensures the fastest flow of materials in the warehouse and the shortest distance covered by warehouse employees. The capacity of picking shelves is determined on the basis of the size of the dispatches by a single index number. By measuring the capacity of picking locations, two aspects ought to be taken into consideration. The first one is the total space in the warehouse intended for the picking zone. In turn, in order to exclude frequent replenishment of picking points in the picking zone, and thus not to generate unnecessary motion in the warehouse, a limit is set in the size of the dispatch in the Warehouse Management System, above which the assortment is taken from buffer zones, not picking zones. The level of available inventory in the picking zone is determined by the width and height of the shelf. Each rack is marked, and in the case of the picking zone, where the fixed location storage method applies, racks with assortments assigned in them are signed with the name of the stored assortment and the index number. New settings in the Warehouse Management System make it impossible for warehouse keepers to decide on the target locations of individual carriers in the storage zone. According to the random location storage method, the system imposes the location to which the carried is to be directed. Such practice facilitates the observance of FIFO rules in the warehouse.

The storage area located on the upper levels of palette racks managed according to the random location storage method with the exclusion of non-homogeneous carriers, optimizes the use of storage space. The introduction of the random location storage method and the exclusion of heterogeneous carriers effectively exclude the malpractice of blocking communication ways by pallets waiting to be stored in the zone.

In the area of the fourth step, referred to increasing the capacity of the constraint, TOC enables investments which contribute to the improvement of the efficiency of the whole system by enforcing the constraint. If the constraint is broken, which ought to happen as a consequence of the Process of On-Going Improvement of performance resulting from the fourth step, it is necessary to search for another component which blocks the efficiency of the system [8].

The Theory of Constraints applied in the Process of On-Going Improvement within the warehouse management increases the effectiveness of the flow occurring within the material flow and contributes to the success of the adaptation of the actions which were undertaken.

The fulfillment of all the previous steps caused the breakdown of the constraint. Furthermore, the

constraint has ceased being perceived as a disadvantage, on the contrary, this limitation has become the opportunity for the development of the enterprise [19].

The last step is to revert to the first stage and verify the process in terms of the occurrence of new constraints in the system.

Conclusions

The assumptions of the project are significant improvement of the material flow rate in the warehousing process in the Distribution Center which is examined.

Referring to the application of the Theory of Constraints, a constraint in the system has been identified which determines the possibilities of the entire warehousing system. In the examined case, the picking zone is the constraint, and the rate of implementation of client orders in this zone defines the rate of material flow in the whole warehousing system.

The Theory of Constraints proves that the key in flow of the material management is the focusing the effort of the whole enterprise on the place, where the maximum effect can be achieved. This place is either the constraint or the area strongly affecting the work rate of the constraint.

Although in the analyzed case, the impediment in material flow occurs during the picking operation, the changes considerably have to include operations which are in the vicinity of the constraint and exert a strong impact on it. These operations, being a source of waste in the enterprise, are the most important factors that contribute to the improvement of the effectiveness of the picking phase.

Therefore, in this particular case not only the role of constraints in the material flow cannot be ignored, but also the warehousing technology matters, as it exerts a strong impact on the limitation in the system by shaping the level of operational costs and influencing directly the effectiveness of the picking activities.

Although this is the picking phase that is the critical point of the whole warehousing process, nonetheless, its improvement is strongly associated with the warehousing technology alteration so that reorganization and redefining the character and form of the assortment flow from the supplier to the recipient.

The steps undertaken within the change of the warehousing technology have the greatest influence on the work of the constraint. The picking itself and thorough analysis of it made it possible to determine the directions of improvement activities made in the field of the warehousing technology.

Although well planned and controlled picking phase of the storage process may become an important attribute of the competitiveness of the modern enterprise, the areas in the vicinity of the picking zone play a key role in the conducted project.

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