

# Employing Theory of Constraints in Warehousing Operation: Case Study at Harald Pihl AB

FABIAN UNGHANSE

Department of Industrial Management & Logistics

Faculty of Engineering, Lund University

Box 118, 221 00 Lund, Sweden

fabian@unghanse.se

## Abstract

*This article is based on a master thesis that employs Theory of Constraint to a warehouse operational. The foundation of the thesis is to understand why warehouses still encounter problems with their operational work, even though warehouse operational is a well explored field with numerous of theory providing strategies and solutions to improve warehouses at a operational level. Warehouse managers need a philosophy and/or tool to evaluate and select which solutions and strategies to implement to the their warehouses. This is where Theory of Constraints becomes valuable since it is a management philosophy for improvements work. To investigate if warehouse managers could benefit from Theory of Consatrain a case study was performed and evaluated at Harald Pihl AB, where the goal was to improve their warehouse operation.*

## I. INTRODUCTION

**T**HE role of the warehouse has changed a lot over the past years. It has transformed from being just a costly storage room close to customers to a value-adding key component in any supply chain. This change has increased the pressure on how the operational work is executed. With this change a lot of theory has been developed for the warehouse operation field and there are solutions and strategies for all common problems of operational work. In spite of this warehouse managers struggle to implement the right solutions and strategies to maintain the performance of the warehouse. The warehouse managers need a tool to help them identify problems, evaluate solutions and strategies as well as to implement the changes. Theory of Constraints is a young management philosophy for improvements work. It has been successfully employed into a great variety of business areas and logistic problems have been solved by employing this philosophy. To investigate if Theory of Constraint can be employed to warehouse op-

eration, a case study was executed at Harald Pihl AB, who has a warehouse with low level of strategies and a need for increased performance to maintain their service level in the future.

## II. PROBLEM & CASE DESCRIPTION

Warehouse managers need a tool to use when they plan to execute improvements work for their warehouse operation. It is hard for managers to realize what the actual problems and bottlenecks are. When bottlenecks are identified they need to be solved which could be very complicated, even though the literature on warehouse operation provides numerous solutions and strategies for common problems. Each warehouse is unique and a specific solution might only be optimal for a certain type of warehouse. This forces manager managers to evaluate solutions in detail which can be cumbersome when just reading about them. The last step towards an improved warehouse is to implement the selected solutions and strate-

gies, which might be the most critical step since it may bring a lot of value if performed correctly but may also cause new serious problems to arise when executed erroneously.

Theory of Constraint is a management philosophy for improvements work that has been employed to help solving different problems within logistics and was from the beginning a production technology. This philosophy has acquired a lot of success in many different business areas. Warehouse operation is an area where it has not yet been employed but an area that could be very beneficial by doing so. The thesis and the case study focused on revealing the answers for three research question that could provide enough information about how to use Theory of Constraints for different stages in the improvements work.

**RQ 1** How ToC can be employed in a warehouse operation to identify bottlenecks?

**RQ 2** What tools and techniques should be used to solve/reduce the identified bottlenecks?

**RQ 3** What future plan can be developed based on ToC?

To answer these research questions a case study was performed at Harald Pihl AB. Harald Pihl AB is northern Europe largest alloys and titanium retailer and is situated north of Stockholm. They built their head quarter and warehouse in 2006 and have since steadily increased their market share and sales annually, which they believe will continue. The increased sales have put higher pressure on the warehouse performances. Until today the warehouse have had low degree of strategies on every level and due to a lot of tied up capital the company wants to improve their operational work with the resources they have today. Their main existing strategy is to ship all orders arriving before noon the same afternoon, this is also their desired service level and part of their customer contract which they wish to maintain in the future, even if sales are forecasted to increase from 6000 to 7500 orders per year.

### III. METHOD

The thesis had an induction approach, meaning that it is based on existing theory and after real-life observation theoretical conclusions were made to develop a new framework. The method used to conduct the research was explorative case study where the aim was to understand how a phenomena performs. To be able to execute the case study different types of data collections were made, where the most frequent used data collection method was observations. Observations were made to collect data about different flows in the warehouse as well as to see how different activities were performed. Interviews were also a central part of the data collection. They were held in the begging of the project to identify goals, expectations and problems and further on during the project they were held to confirmed the observations. Relevant literature has been used throughout the entire project in order to understand and learn about Theory of Constraints and to explore possible solutions for the case study.

The thesis process was carried as follows: Theory of Constraint was studied until a guide on how to use the philosophy could be established. When Theory of Constraints was learnt the case study started by first identifying the core problems in the warehouse operation, followed by seeking and finding solutions to the core problems and finally an implementation plan was conducted. After the case study was done the results and the work was analyzed and final conclusions were drawn.

### IV. FRAME OF REFERENCES

#### IV.1 Warehouse operation

Warehouse operation mainly consist of four activities:

- Receiving & Shipping
- Put-Away
- Storage
- Picking

These four activities were deeply studied in the literature by identifying common and general problems and also by providing solutions and strategies to overcome them. The literature identifies a few common non value-adding sub-activities, such as transport, material handling and space utilization. The solutions and strategies in the literature try to improve these and more undesirable activities that may occur in a warehouse. The idea for receiving and shipping is to match these activities so that material can go straight from a receiving dock to a shipping dock without the need of storage or allocating the docks in between to minimize the transport from the docks to the storage area. Picking is the most labor intense and time consuming activity in the warehouse and therefore addressed in a lot of literature. The picking process is similar to the put away process and the strategies used for picking can be applied for the put-away process as well. The activities are executed most optimal by batching orders, pick or put-away multiple orders at the same time, or zoning; one employee is responsible for a certain area and have to pick and put-away all material that is required from that area. For storage, the focus is on utilizing the space as efficient as possible indicating that the type of goods stored has a key influence. Mainly, a warehouse can either have single deep storage; every location can be reached by hand or truck, or multi-deep storage where goods are stored behind each other. For multi-deep storage the warehouse can apply First-In-First-Out (FIFO) or First-In-Last-Out (FILO) approach. To be able to apply FIFO the storage must be designed so picking and put-away is done from different sides of the storage and for FILO the picking and put-away is done from the same side.

## IV.2 Theory of Constraints

Theory of Constraints is a management philosophy created by Dr Elyahu Goldratt in the beginning of 1980 and have since developed from a production technology to the philos-

ophy it is today. The philosophy is used to perform improvements work and has become broad enough to be employed in almost any business area. The Theory of Constraints views the undertaken situation as a system with sub-activities and tasks where the aim is not to solve single activities or task but to find solutions to improve the whole system. In order to succeed in doing so, Theory of Constraints provides a clear approach and user-friendly tools. The approach is called focusing steps and can be applied as an overall approach for the project or be employed for every task within the, project depending on the scope of the project. The approach is the following:

- Set up the system's goal
- Determine the performance measures.
- Identify the system's constraint(s)
- Decide how to exploit the system's constraint
- Subordinate everything else to the decisions made in steps 3 and 4
- Elevate the system's constraint(s)
- Do not allow inertia to be the system's constraint. When a constraint has been broken, go back to step 1

Constraints are identified as activities that causes undesirable effects to occur in the system and are not caused by other activities. Undesirable effects are effects that prevents the system from performing at its best. To be able to identify, exploit and subordinate the system Theory of Constraints provides five tools that all goes under the name of Thinking Processes. These tools are, as the name suggests, tools for thinking and consists of a flow chart. They are all user friendly the outcome can be understood by almost anyone. The tools are the following:

1. *Current Reality Tree* The Current Reality Tree is mapped over the current system and is used to identify the constraints and how they effect each other and causes activities to arise. By comparing the constraint and to see which ones that have the highest influence on the undesirable effects the core problems, which

are preferable to start to improve, can be identified.

2. *Evaporating Cloud* The Evaporating Cloud is a problem solving tool that views a problem as a conflict between two arguments that strive for the same goal but can not co-exist in the current situation. By viewing the problem as a conflict more creative solutions can be found.
3. *Future Reality Tree* The Future Reality Tree is a map over how the system will look and how activities will effect and develop other activities. It shows if the undesirable effects will disappear and if any new effects will arise. The map is an effective tool to use to overcome resistance to change.
4. *Prerequisite Tree* The Prerequisite Tree is a implementation tool that identifies obstacles that might occur from the implementation. The aim is to lock down the obstacles and to find ways to overcome them before they arise.
5. *Transition Tree* The Transition Tree is an action plan for how the implementation should be executed. It too tries to identify if the implementation will bring new undesirable effects that can be prevented before they arise.

## V. CASE STUDY

The case study was started by performing interviews to be able to set the goals, find expectations and identify the problems. To get an understanding of how the warehouse performed and to identify the flows in the warehouse, observations were held. From the observations undesirable effects were identified. These were double handling, a lot of resources are used for every put-away and pick, resources are not ready to be used and incoming and outgoing goods are placed inappropriate. By combining the observation and the undesirable effects the Current Reality tree could be developed and the core problems

where identified to be the way the company sorted their orders that should be pick for the day as well as the infrastructure & design, meaning where resources and storage areas are located, the layout in the storage and in what order tasks are executed.

The idea was to extinguish as many of the undesirable effects as possible by solving the core problems. Three main conflicts were identified and solved. The first conflict dealt with how the orders were sorted, the second was about how to handle incoming and outgoing goods and the third conflict was the structure and strategy about a specific storage area, holding lighter goods for hand picking.

The solutions that were found were to introduce a new order sorting algorithm, install two new storage racks for incoming and outgoing goods as well as packaging material and to redesign the hand picking storage area to a Forward Picking Area with a new strategy. These solutions were taken into consideration and by introducing hem to the Current Reality Tree, the Future Reality Tree was developed and the benefits of the new solutions appeared.

A Prerequisite Tree was developed after the solutions had been presented for the company. From the presentation it was clear that the change of strategies and routines for the employees would be the largest obstacles to overcome for the solutions to become successful to the warehouse. To overcome these obstacles, seminars and workshops should be executed where the employees can understand the changes and see the benefits of them.

The last step was to conduct the action plan for the implementation and the Transition Tree identified how much time and resources that would be necessary to use for the different implementations while at the same time showing what effects that could come from the implementations. There are three critical improvement areas to block out the possible undesirable effects. The sorting algorithm has

to be designed in an accurate way from the beginning, the redesign of the hand picking storage area and the allocating of the goods must be determined before the physical change work start and how to split the new racks between incoming and outgoing goods and packaging material must be predetermined.

## VI. CONCLUSIONS

From studying the literature of warehouse operation it can be said that there are lots of different good solutions and strategies that can be adapted to a warehouse in order to increase the improvements, but there is no good existing tool to evaluate what to choose. By employing Theory of Constraints the whole change of operational work in a warehouse can be facilitated. From the case study it can be said that the approach of Theory of Constraints, the Focusing Steps, should be followed. The two first steps are essential to form a base for the task and the following five steps drives the improvements work forward. It is better to execute a few steps correctly than to execute all steps carelessly because there is no point to continue improving if the foundation is not build correctly. The Focusing Steps can either be used as an overall approach for the project or be employed to every task within the project.

It is a good approach since by employing it to tasks in the project the tasks can be executed easier and with better outcome which will lead to a better outcome overall. To answer the research questions, the approach should be used to every activity and the tools should be used follows:

### **RQ 1** Current Reality Tree

### **RQ 2** Evaporating Cloud and Future Reality Tree

### **RQ 3** Prerequisite Tree and Transition Tree

By following the approach and employing the right tool for each task should facilitate the evaluation work for warehouse managers that look for new solutions and strategies to implement to improve their warehouse. It does not take long to learn and understand Theory of Constraint and after some training it is not hard to use it in reality.

This study is based on one case study performed at a warehouse that had low level of strategies and only one loop of the focusing steps were executed, which created a need for future studies within this area which could include either multiple loops with this approach or to employ Theory of Constraints to a warehouse with higher level of existing strategies.