

Specification of Negative Effects Applying the Theory of Constraints Tool: A Case Study

Vladimír Lupták

Department of Transport and Logistics
Technology and Business in České
Budějovice name of organization
České Budějovice, Czech Republic
luptak@mail.vstecb.cz

Ondrej Stopka

Department of Transport and Logistics
Technology and Business in České
Budějovice name of organization
České Budějovice, Czech Republic
stopka@mail.vstecb.cz

Mária Stopková

Department of Transport and Logistics
Technology and Business in České
Budějovice name of organization
České Budějovice, Czech Republic
stopkova@mail.vstecb.cz

Karel Jeřábek

Department of Transport and Logistics
Technology and Business in České
Budějovice name of organization
České Budějovice, Czech Republic
jerabek@mail.vstecb.cz

Abstract—In regard to the functional system or process, there is always at least one constraint; and some advanced techniques, that use a focusing process to identify this constraint and restructure the rest of the organization around it, may be implemented. The paper deals with the application of the specific Theory of Constraints tool in given logistics operation within particular manufacturing and distribution enterprise. The objective of this utilization is to define the most significant cause in terms of determined negative consequences. The relevant effect on cost value, effectivity and profitability as well as quality is the crucial reason to detect a particular cause resulting in negative consequences. The selected enterprise specifies seven main consequences and due to the construction of the special diagram of causes and consequences (as a part of the Theory of Constraints tools), it was possible to determine the most important cause.

Keywords—logistics, distribution, manufacturing, inventory management, stockholding management, Theory of Constraints, bottleneck

I. INTRODUCTION

Corporate logistics includes several parts, among which a lot of various relationships exist, and these parts are affected by each other. In some cases, this reality may have negative consequences on some processes in logistics chain. Understanding the relationships of some parts in this chain is a fundamental aspect for an effective management. By applying specific tools, the Theory of Constraints (hereinafter referred to as TOC) allows identifying these relationships and helps to understand the significant causes and consequences in the entire manufacturing and distribution chain. The aim of this case study is to specify a bottleneck using the principles of the special diagram for better view of links among causes and consequences in particular manufacturing and distribution enterprise.

It may be stated that TOC is a management approach considering that at any given time, an organization is limited from achieving its highest goal by a single constraint. This theory provides tools to help identify and break through the constraint.

II. DATA AND METHODS

TOC is a tool for identifying and analyzing the problem. This theory views any system as the chain, where any chain is only as strong as its weakest part. It deals with the search for the weakest parts - so-called bottleneck. For the proper analysis of the process, it is necessary to know not only the whole chain, but also to understand the parts themselves from which the chain is composed [1], [2].

The bottleneck can be referred to as any limitation that inhibits the maximum possible sources and activities flow across the chain. Therefore, it is considered the crucial factor (process point) and priority emphasis should be placed on it. It is advisable to provide the ideal conditions for its running (operation), since its slowdown would lead to a more noticeable decline in system productivity. Once the material flow is increased and optimized, it is necessary to analyze the logistics chain again and find another bottleneck. It may be the same part of the chain or any other [3]–[5]. A graphical representation of a bottleneck in the logistics chain is shown in Figure 1.

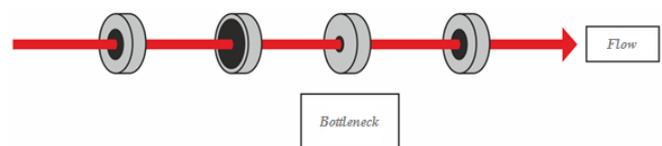


Fig. 1. The bottleneck (source: authors)

A. General Procedure of the Theory of Constraints Tool

It is possible to use the following simple steps to remove a constraint - the bottleneck. This procedure covers five follow-up steps, as illustrated in Figure 2 [6]:

Step 1: Identification of the constraint

In the first step, it is necessary to identify the particular constraint. As a rule, it is known where this constraint is, but it is necessary to verify and subsequently describe suspicion. For this purpose, an analysis of the current state is desirable to be used.

Step 2: Maximum utilization of the constraint

After determining the constraint, it is important to ensure its maximum and effective utilization. It does not make sense to expand one part of the functional system unless it is fully utilized.

Step 3: Subordinating the each part of the chain (system) according to the defined constraint

The enterprise has to respect the specified restriction and subordinate remaining activities in order to no further bottlenecks occur.

Step 4: Expanding the constraint

If the previous steps have been executed correctly, the constraint can be expanded. If the previous steps were omitted, it would cause that the overall flow does not increase after expanding the specific constraint. It is caused due to the reason that the constraint may not be dependent on the capacity of one particular part but, it has to consist in the comprehensive organization activities (system as a whole).

Step 5: Return to step 1

After removing the specific constraint, the whole logistics chain becomes more efficient. However, it is logical that now, some of other parts have become weaker, and thus the entire identification and determination process must start over and over again. This process, if an enterprise continually improves its processes quality, will significantly increase its profits.

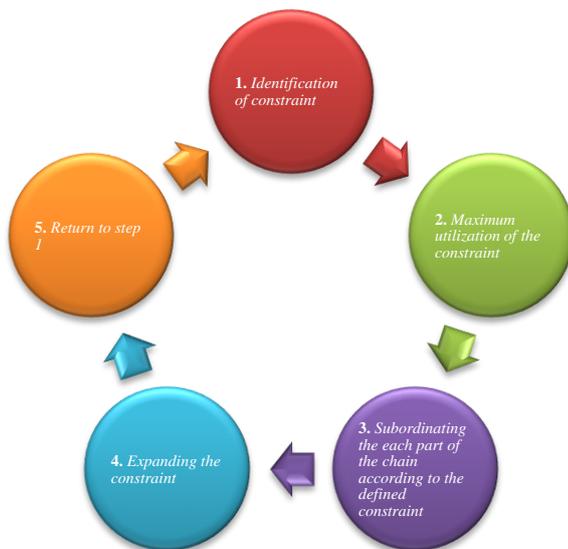


Fig. 2. The Theory of constraints steps illustration (source: authors)

B. Specification of Constrains in a Given Enterprise

As mentioned, one of this theory tools is applied in order to specify the particular bottleneck. To determine the bottleneck according to the TOC principles, the current state of logistics processes must be overviewed [7].

In this case study, enterprise management determines seven potential constraints and relationships among them (Fig. 3.). Description of potential constraints is as follows:

A. Employees work reluctantly

Employee reluctance [8] has started to become a long-standing problem in various fields of business. The case study enterprise employs 172 employees in manufacturing,

distribution and warehouse. Due to the low number of employees, there is often employees shift between warehouse and manufacturing areas place. Out of that number, there are 40 agency staff. Due to the nature of the work, the working team is not suitably stable. According to the conducted survey, employee dissatisfaction consists primarily in the amount of relatively unnecessary work load (the work that would not arise from more efficient storage management).

B. Ineffective utilizing the fund of working time

Apart from the low number of employees, the inefficient use of working time is also recorded, especially if it is necessary to perform a stock searching, frequent stock-taking, or long-term order completion.

C. High storage costs

Company management considers high storage costs to be an issue. Monthly costs are at the level of about CZK 350,000. Annual amount of these costs is at the level of CZK 4,200,000.

D. Customer dissatisfaction

Several buyers, especially domestic ones, make their own distribution process (carriage). Their dissatisfaction consists specifically in the long-lasting loading operations, or waiting for given order completion. Selected enterprise pays its attention on continuous manufacturing process. Thus, it is possible that a specific order is not ready in time, due to the fact that employees focus on the supply within the specific production operation rather than on the completion of orders for given day.

E. Low utilizing the storage space

When calculating the percentage utilization of the warehouse area, it was found that the used area does not make up to 50% of the total area.

F. Dissatisfied leadership

Leadership dissatisfaction is mostly caused due to the high cost of external storage because of low utilization of own storage areas.

G. Thefts in the warehouse

Stocktaking has shown an increasing tendency regarding the stock thefts. Most commonly stolen commodities include chemicals used while production stages. However, it is not such a big issue to invest in the camera system. Enterprise has to set the priorities.

III. RESULTS AND DISCUSSION

Based on the aforementioned constraints, a so-called diagram of causes and consequences (Fig. 3.) has been constructed to find causes of constraints. The procedure of searching the most important causes is as follows [8]–[9]:

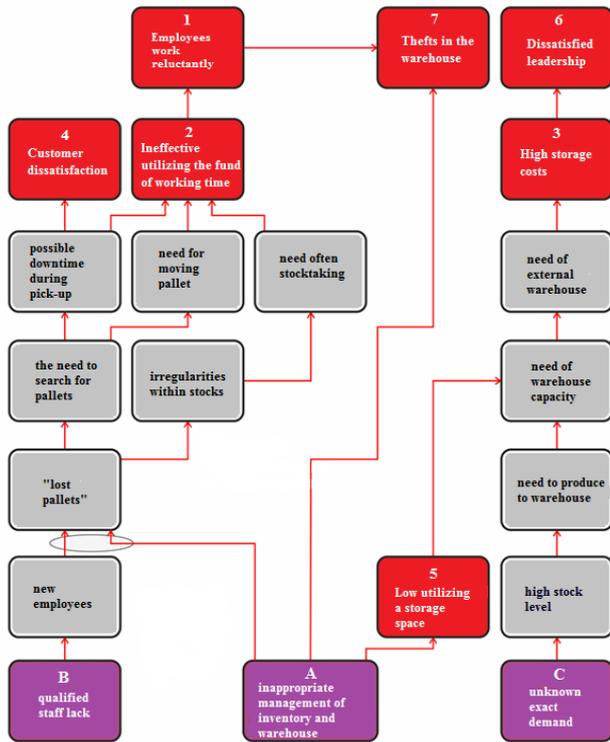


Fig. 3. Diagram of causes and consequences (source: authors)

Constraints designated by the management are highlighted in red and numbered. For each constraint, its origin (input cause) was explored, which subsequently leads to the construction of the diagram of causes and consequences, finally specifying the crucial issue (major undesirable effect). In the diagram, these input causes are highlighted in violet and marked by A, B and C. They represent factors directly or indirectly affecting specified constraints [10]–[13].

One clutch is also part of the diagram of causes and consequences. It points out that inappropriate inventory management, in combination with new, inexperienced, unskilled or poorly trained employees, leads to the loss of pallets in the warehouse and distribution spaces. Specifically, it leads to their poor location and difficult searching consequently [14]–[19].

IV. IDENTIFICATION OF THE BOTTLENECK (KEY UNDESIRABLE EFFECT)

After identifying three causes, it is necessary to find out which of them is the key one, i.e. the bottleneck. This is determined using the impact analysis of causes and consequences which examines the effect of causes on the creation of constraints. The Table 1 summarizes obtained results of this analysis. Relationship between the cause and the consequence (relevant constraint) is marked by 1. Mark 0 then indicates that the relationship does not exist [20]–[23].

TABLE I. ANALYSIS OF CAUSES AND CONSEQUENCES

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total | % |
|----------|---|---|---|---|---|---|---|-------|-------|
| A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 100 |
| B | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 4 | 57.14 |
| C | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 28.57 |

Source: Authors

The analysis shows that the cause A (background highlighted in gray), i.e. the inappropriate inventory management and stockholding (warehouse) management, results in the creation of all constraints and needs to be solved immediately [24]–[26].

V. CONCLUSION

The objective of this research study was to apply the particular theory of constraints tools in order to identify the most considerable cause resulting in negative consequences in a given logistics operation. The special diagram showing relationships and links among individual causes and relevant consequences was constructed for the selected enterprise dealing with distribution, warehousing and manufacturing services. Aim of this diagram was to find the particular bottleneck, i.e. the crucial undesirable effect (limiting element throughout the enterprise logistics chain activities). As the bottleneck, an inadequate inventory management and stockholding management (warehouse) was determined.

The second factor, significantly causing the negative consequences, is specified the deficiency of the qualified staff. Thus, it may be declared that the improvement of the whole warehouse management state, including stocks, utilizing the warehouse spaces as well as warehouse staff quality, will lead to operation costs optimization, comprehensive improvement of the enterprise effectiveness and productivity.

Within this case study, it was confirmed that by implementing suitable methods and techniques of the Theory of Constraints, the enterprise may appropriately and easily specify the exact point of the enterprise processes or system (device, machine, staff, workplace or enterprise segment) with the most important negative effect on its operation. By identifying the most important limiting factor (i.e. constraint) that stands in the way of achieving specific enterprise goals, enterprise or society may systematically improve this constraint (or other constraints) until it is considered no longer to be the limiting factor.

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