Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 187 (2017) 749 – 755

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Scientific Conference Transbaltica 2017:
Transportation Science and Technology

# Using the Saaty Method and the FMEA Method for Evaluation of Constraints in Logistics Chain

Štefan Kudláč*, Vladimíra Štefancová, Jozef Majerčák

*University of Žilina, Slovakia*

**Abstract**

In the context of ensuring the efficient functioning of logistic chains is necessary to identify and eliminate any restrictions that may have the major impact on the resulting efficiencies of realised transports. For a comprehensive evaluation of potential constraints in terms of logistics operators, freight forwarders, carriers and other entities involved in the implementation of supply chain due to the demands of our customers it is essential to thoroughly analyse the logistics chain and then identify and evaluate all relevant constraints. The evaluation of constraints has to be based on predetermined criteria. Based on the research realised at Žilina University, Department of Railway transport, it is efficient to evaluate these constraints by using a combination of multi – criteria analysis method – Saaty method combined with the use of risk assessment techniques FMEA. These methods are applied for the problem of choosing a suitable carrier for the realisation of the shipment. The result of multi – criteria evaluation allows choose the optimal variant of realisation of logistics chain by the comparison of the level of constraints in various variants of proposed logistics chains.



Peer-review under responsibility of the organizing committee of the 10th International Scientific Conference Transbaltica 2017

*Keywords:* constraints, logistics chain, TOC, FMEA, Saaty, evaluation, analysis, efficiency

* Corresponding author.
*E-mail address:* stefan.kudlac@fpedas.uniza.sk



Peer-review under responsibility of the organizing committee of the 10th International Scientific Conference Transbaltica 2017
doi:10.1016/j.proeng.2017.04.433

## 1. Introduction

| Nomenclature | |
|---|---|
| TOC | Theory of constraints |
| FMEA | Failure Mode and Effect Analysis |
| RPN | Risk Priority Number |
| POF | probability of occurrence of failure |
| FS | failure severity |
| PFD | probability of failure detection |

As a part of the sustainable development of freight transport, the solution is to support the use of intermodal transport and thus support the modal shift from road to environmentally friendly modes of transport such as rail, inland waterways and maritime transport. In the context of ensuring the effective functioning of logistic chains is necessary to identify and eliminate any restrictions that may have the major impact on the resulting efficiencies of realised transports.

For a comprehensive evaluation of potential constraints in terms of logistics operators, freight forwarders, carriers and other entities involved in the implementation of supply chain due to the demands of customers it is essential to thoroughly analyse the logistics chain and then identify and evaluate all relevant constraints. The aim of a comprehensive evaluation of constraints in logistics chain is to provide information to subjects about the level of all constraints in logistics chain.

The result of the comprehensive evaluation of the constraints in the specific logistics chain is a dimensionless number that indicates how the proposed logistics chain meet set restrictive criteria. This result can be compared to the result of evaluation of another logistics chain. This parameter allows the comparison of the proposed variants of logistics chains.

## 2. Redefinition of the notion constraints from view of logistics chains

Theory of Constraints TOC – important in manufacturing, defines constraints as the most important limiting factor that stands in the way of achieving the goal. The concept of limiting the TOC is often replaced with term “bottleneck”. In terms of TOC, “bottleneck” is any resource whose capacity is equal to or less than the request to the source.

According to ČSN EN 14943 the constraints are defined as any element or factor making the system impossible to achieve better performance with respect to the objectives.

Both of these definitions perceive the constraints as a factor limiting performance in terms of insufficient capacity. In this case the analysis of the logistics chain tries to evaluate the overall efficiency of the logistics chain. Therefore, we think that the limiting is factor not only with low capacity, but also with very high capacity.

Disproportionately high capacity of transport means or too high production capacity of element of the production system compared with other elements of the system appears to be highly inefficient.

It is therefore necessary in the logistics point of process evaluation, which lies between the source point and the point of cut (Fig. 1) to assess the constraints in the material flow, financial flow and information flow at the same time. The optimum condition occurs when the offer is equal to demand (1).

$$O = D, \tag{1}$$

where: $O$ – Offer; $D$ – Demand.

This raises the following possible results of the analysis of the logistics point of cut:

- $O = D$ – optimal state;
- $O < D$ – bottleneck;
- $O > D$ – inefficiency, which appears as a bottleneck in another logistics point of cut.