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OPTIMISATION APPROACH TO CONTAINER CHAIN TECHNOLOGY

ABSTRACT

This paper deals with the selected optimisation approach to container chain technology, focusing on the consignment of cargo from the shipper. The basic characteristics of the container chain technology are analysed first, followed by establishing the optimisation possibilities. A hypothesis is set asserting that the technology of all the chain parts has to be optimised in order to achieve optimum functioning of the container chain. Therefore, the container chain has been analysed as a system consisting of subsystems of the shipper, transportation, storage and receiver (consignee). Due to similarity of the optimisation processes, we have only dealt with the optimisation process of the container chain technology from the shipper's view, for the case of streamlining of the current condition, reconstruction and project design on new organisation scheme.

KEY WORDS

traffic optimisation, container chain technology, efficiency of transport

1. INTRODUCTION

The basic elements characterising the container chain are those of technological and organisational integration. These elements support the analysis of the container chain as a sub-system in the transport system

The technological integration of certain procedures in the chain is subject to the compatibility of means of transport and equipment of individual transport branches. It depends in particular on the possibility of combining smaller load units and pallets in container units.

A container as a load unit may contain one piece or several pieces of goods and pallets with goods. The container is formed as a load unit in order to consolidate a greater number of piece- or palletised goods of the same or different kind, into a bigger standardised piece of load. In the course of the transportation process, the goods are exposed to numerous handling operations related to packing, loading, discharge, re-loading, storage, etc. By means of a container, manipulation of a greater quantity of goods, employing appropriate mechanisation is made possible.

Container as a load and handling unit allows for efficient technological integration of the container transport chain. The organisational integration of the container chain is characterised by a co-ordinated management of transport processes, applying information technology to transport processes, transport documentation, transport rates, and other.

In compliance with the characteristics of the container chain, there is also the possibility of optimisation of its technology. An efficient performance of goods transportation by means of container chain can be provided by the optimisation of all of its links.

The optimisation procedure depends on numerous factors, and in particular on the characteristics of the container chain subsystems from the view of transportation volume, periodic and quantitative oscillating of goods flows, as well as with respect to its purpose: is the optimisation being introduced as a means of streamlining of the current condition, a measure in reconstruction, or as a new organisation project design.

2. BASIC CHARACTERISTICS OF THE CONTAINER CHAIN

A transport chain represents the integrity of all internal and external transports of raw materials, goods in process and finished products in the course of carriage, processing and assembly, packing, warehousing and transportation, provided that standardised load units are used in that procedure.

A container chain comprises integrated and scheduled processes that assure high rationalisation level and performance resulting in:

- the formation of load units - containers, at the user's end after the production process has been completed;
- mechanised loading, re-loading and discharge between different means of transport in different transport branches;

- information technology system, management system, and certain organisational measures in view of integrating concrete procedures in the transport process, or physical distribution of goods respectively, in a complete transportation chain.

The realisation of a container chain is only reasonable in case better economic effects are to be achieved, and the general efficiency of the transport process is improved and exceeds the results obtained by employing other transport technologies. We have to bear in mind that a particular link in a container chain may be more expensive, however, if savings are achieved in other links of the chain, the joint effect is favourable.

An optimum container chain allows for:

- savings in packing, securing and storage of goods,
- better utilisation of transport capacities in different transport branches,
- reduction of cost in handling operations and employing work force,
- replacement of physical work of stevedores with mechanisation,
- general streamlining of the transport process, and others.

In addition to favourable results provided by the container chain in a transport process, there are also some deficiencies, such as the investments required, giving up one's autonomy, in part, aggravated technological planning, and others.

In order to guarantee efficiency of the container chain technology and its individual links, the following requirements must be observed:

- to establish and bring into line all the possible transport combinations according to the set and known criteria,
- to choose the best variant by bringing into line the interests of all chain participants, and co-ordination thereof,
- to harmonise transportation functions as regards manipulations in loading, re-loading, discharge and warehousing,
- to adjust the capacities of each link in the chain,
- to employ respective standardised means of transportation in all traffic branches, as well as handling facilities and appliances.

3. OPTIMISATION OF CONTAINER CHAIN TECHNOLOGY FROM THE SHIPPER'S POINT OF VIEW

In order to achieve an efficient functioning of the transport system while applying the container chain, the technology of all the links in the chain must be optimised. Due to similarity of the optimisation pro-

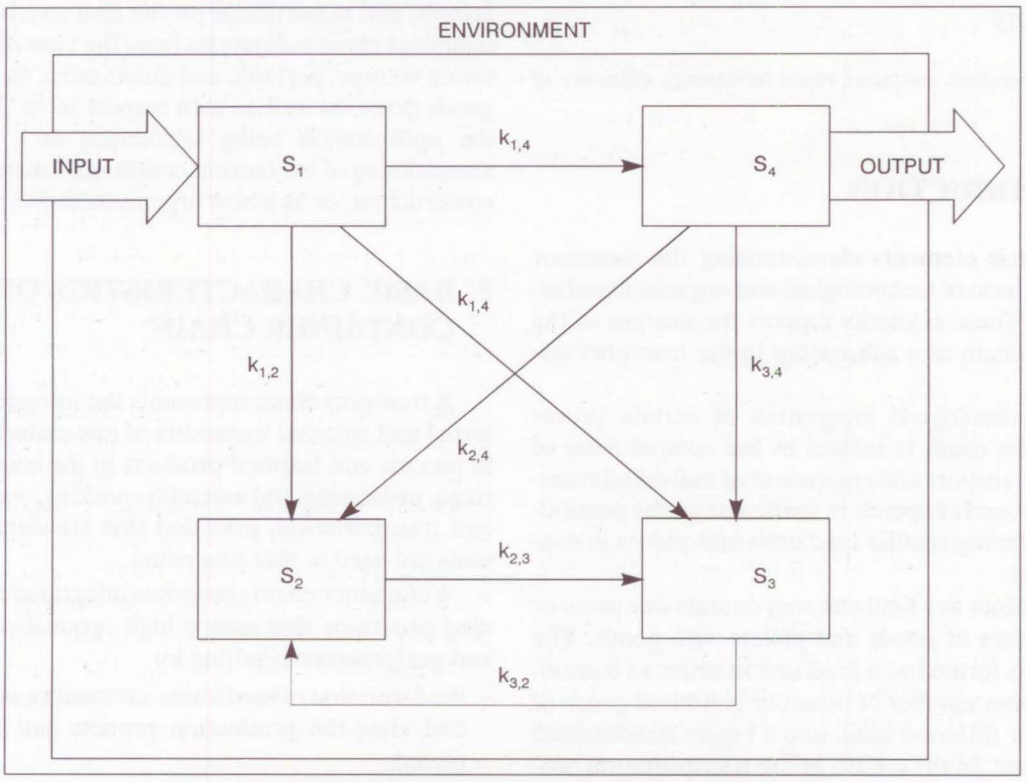

Figure 1 - Schematic display of the container chain system:
The designations denote: S_1 - shipper's subsystem, S_2 - transportation subsystem, S_3 - warehouse subsystem, and S_4 - receiver's subsystem

cesses, only the optimisation process of the container chain technology will be dealt with from the shipper's point of view. The container chain can be schematically presented as in Figure 1.

As shown in Figure 1, there are four basic subsystems that can be exposed: S_k (k=1,2,3,4) with mutual connections that can be shown in a matrix, in which 1 (one) stands for the case of existing connection, and 0 (zero) for a non-existing connection.

$$k = \begin{vmatrix} 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{vmatrix}$$

The connections between these subsystems S_1 to S_4 can be material, pertaining to power supply (energetics) and information technology. In the optimisation of the container chain, all these connections have to be optimised.

Material connections between the subsystems of the chain are represented by the flow of goods or load units respectively. Power connections exist among the tractive means of transport which use a certain kind of energy as the motive power.

Connections pertaining to information technology exist in the form of data, information, orders, notices, etc.; their function is in efficient realisation in the flow of goods.

In the optimisation of the shipper's subsystem technology S_1 of the container chain system, its structure which defines the way of optimisation has to be analysed. In order to perform the analysis of factors influencing the subsystem S_1 optimisation, the shippers must be divided according to the transportation work, which could be

- small,
- medium-sized,
- large.

Considering the oscillations in consigning the goods, the shippers can be classified as

- shippers consigning goods in set time intervals,
- shippers whose shipments depend on the season, or as the case may be.

The S_1 subsystem of the container chain can be analysed as a system which consists of numerous elements that are mutually closely related and in interaction, as shown in Figure 2.

The optimisation of the shipper's system S_1 is performed by optimisation of its elements A_i and their connections K which represent the input / output parameters. From the general point of view it can be defined that the shipper's subsystem S_1 has the following elements that can be optimised:

- dimensions and the number of loading points,
- type of loading mechanisation,
- number of employees in charge of loading,
- characteristics of the place for depositing containers,
- characteristics of the place for storing containers,
- manner of stowing the filled containers in the warehouse,
- distance from the place of container deposit or storage to the point of loading,
- manner of supervision and of keeping the records of containers in the course of loading,
- characteristics of the place for filling containers,
- production plan,
- commodity flows within the production, and the quantity of material,
- degree of integration with the production process,
- characteristics of work organisation related to the shipper,
- characteristics of the shipper's information support
- other elements.

Optimisation must be performed especially in case of a project design related to a new production line, a reconstruction or streamlining of the current condition.

In view of the optimisation, the correspondence matrix of technological elements and requirements is very convenient in order to establish the condition in a small-sized organisation, on the occasion of a planned reconstruction. This matrix allows for an uncomplicated perception of problems and a joint comparison of requirements and needs. In such cases we have a large quantity of input data, but also numerous limiting factors are present, which must be observed: this can be presented by a certain algorithm.

At the shipper's end, the procedure of container chain optimisation starts with the definition of technological requirements and elements in the function thereof. At a certain level of generalisation, technological requirements are defined with the quantity and features of the goods, as well as the time, place and occurrence probability of the requirement.

By knowing the manner of realisation of technological requirements, and the correlation between element - requirement, we become aware of the existence of certain problems. There, the technological elements represent all the transport and handling units, working force and other appliances and facilities of the container chain. In such a case, eliminating the unnecessary technological requirements can often solve problems of that kind. In the next phase, possible points for optimisation must be established so as to render the solution of the remaining problems possible.

The essential phase in the container chain optimisation is to define the dimensions of technological elements. As the transport processes are in most cases in-

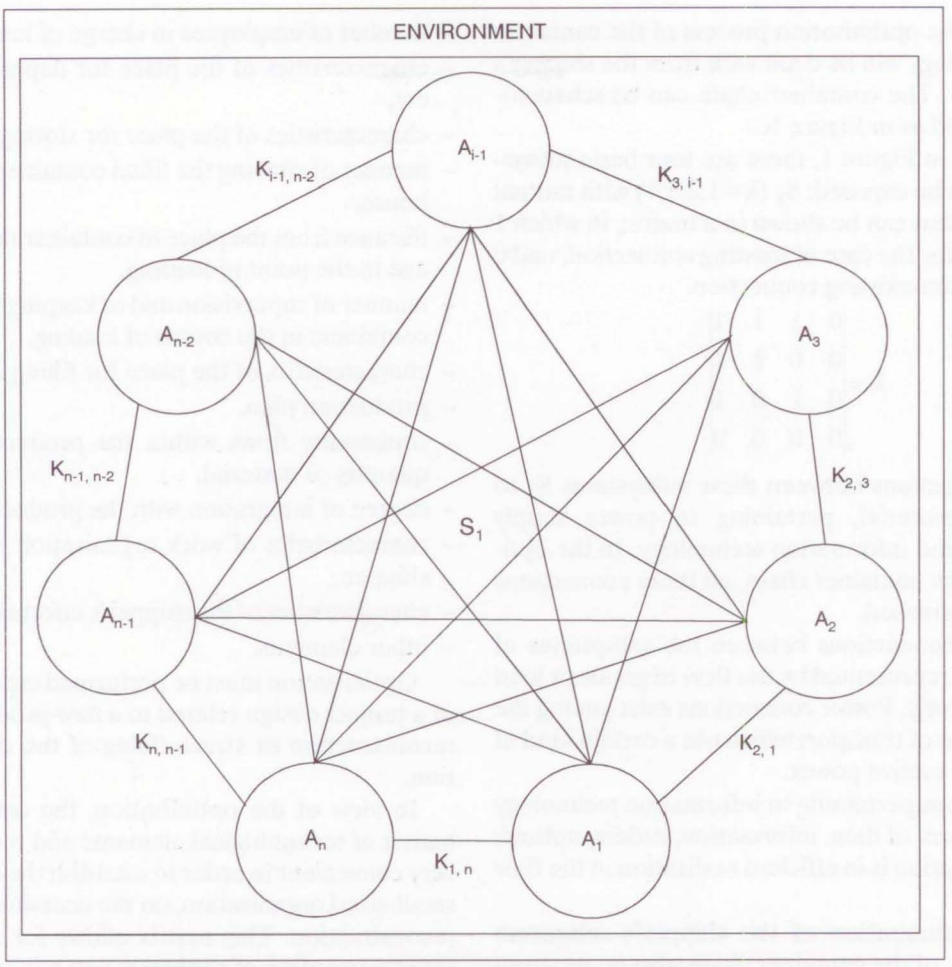

Figure 2 - Schematic display of mutual relation in the shipper's subsystem, in the container chain

cidental processes, the dimensioning has to be done by models, which will describe and realise this stochastic attribute by means of appropriate methods. The most efficient methods in defining dimensions in technological processes with stochastic nature include the methods of simulation.

The simulation methods in optimising technological elements in a container chain are particularly appropriate to define dimensions of the load capacity and the number of handling appliances and facilities, the number and dimensions of loading points, the availability and length of railway tracks, the dimensions of the areas for manoeuvring and parking of road vehicles, the capacity of warehouses, means of transport and loading mechanisation, etc.

In designing the project of a new organisation, the procedure of container chain optimisation is slightly different because there is only a very small quantity of input data in relation to the streamlining and reconstruction of the said condition. In this case, the need to perform certain preliminary research in order to obtain the data required on the characteristics of commodity flows or load units according to destinations and distances.

Based on this information and on the knowledge about the operating technology in a similar, existing organisation, gives sufficient ground to start work on designing the transportation process and its capacity.

4. CONCLUSION

The analysis of basic characteristics of the container chain technology shows that there is a possibility of optimisation in order to guarantee an efficient performance of the container chain technology and its individual links.

The selected procedure of the optimisation of container chain technology from the shipper's point of view is based on the optimisation of container chain as a system with the subsystems of the shipper, transportation, warehousing, and receiver.

The analysis of the shipper's subsystem as a subsystem in the container chain system shows a great number of interrelated elements that are in constant interaction. In such case, the optimisation procedure will be realised by optimisation of individual elements and their connections.

Considering the cognisance obtained by prior analyses, we may conclude that the simulation methods are the most convenient to define dimensions of technological elements in the course of transportation processes optimisation. These methods are in particular acceptable in defining the dimensions of the number and load capacity of handling devices, dimensions of loading space, the number and dimensions of other elements of traffic infrastructure, the capacity of transport conveyance and handling devices, etc.

The findings obtained in this paper allow for an approach in the optimisation of concrete container chains, as well as in palletised cargo and transport chains in general.

SAŽETAK

OPTIMIRANJE TEHNOLOGIJE KONTEJNERSKOGA LANCA

Rad obrađuje odabrani pristup optimiranju tehnologije kontejnerskoga lanca, s naglaskom na pošiljkama robe od strane prijevoznika. Prvo se analiziraju osnovne značajke tehnologije kontejnerskoga lanca, a zatim se obrađuju mogućnosti optimiranja. Iznosi se pretpostavka da valja optimirati tehnologiju svih dijelova lanca kako bi se postiglo optimalno funkcioniranje kontejnerskoga lanca. Stoga se kontejnerski lanac analizira kao sustav koji se sastoji od podsustava prijevoznika, prijevoza, skladištenja i primatelja. Zbog sličnosti postupaka optimiranja, rad obrađuje samo postupak optimiranja tehnologije kontejnerskoga lanca s gledišta prijevoznika, za slučaj moderniziranja sadašnjeg stanja, rekonstrukcije i izrade projekta nove organizacijske sheme.

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