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ANALYSIS AND EVALUATION OF SELECTED TRANSPORT PROCESSES IN THE INLAND INTERMODAL TERMINAL

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Abstract: *Proper operation of the intermodal transport chain depends on the proper functioning of the terminals, including their ability to perform cargo handling infrastructure, cost- effectiveness and scope of services, quality and reliability. Modern combined transport terminal is more than a simple transshipment point. It develops in the creation of centers freight with a wide range of services.*
Simulation tests confirmed that the storage process guided by specific rules may result in a significant reduction in energy demand in the course of handling containers. Depending on the size of the node handling, the degree of use and speed of movement of the intermodal units can be a saving of up to 50%.
This article is a presentation of the progress of work on the project , which aims to develop a practical method that allows to use the knowledge to creating the functionality of intermodal transport terminal, taking into account the characteristics of its work, including efficiency, effectiveness, reliability, safety, ecology.

Key words: *intermodal terminal, transshipment technology, container*

1 INTRODUCTION

After the difficult years of 2008-2010 container transport becomes stronger. In Poland it is visible seeing more and more new container handling transshipment points. Currently, the total container turnover in the market of intermodal transport is estimated by the owners of intermodal companies over 2.0 million TEUs per year (for comparison, in 2007, there are approximately 1.4 million TEU).

Facing of the White Paper on Transport recommendations (document leading transport policy in Europe) the increase of intermodal transport seems to be natural phenomena, nevertheless as a logistics process requires scientific work and research. The effect of which is to strengthen the competitiveness of intermodal transport to the traditional road to the carriage of highly processed goods.

Modern combined transport terminal is more than a simple transshipment point. It develops in the creation of centers freight with a wide range of services [3], [5]. Sea terminals are to be run in such a way as to reduce to a minimum residence time of the loading units within the terminal. Using sophisticated technology, handling, such as full automation of the process can substantially reduce the time of cargo handling, eliminate errors, increase the level of safety and reliability[1], [2], [4]. These technologies are extremely expensive and are not widely used. In smaller ports, high throughput is achieved by streamlining operations. The inland terminals link transport and storage functions. Problem in intermodal transshipment hubs is linked with choosing appropriate method of container warehousing [10], [11]. Very often it is necessary to move container several times from one point to another during process of storage. The results are more expensive container service and probability that containers can't be easy available then are needed.

The increase in intermodal transport is a natural phenomenon in the face of the White Paper on Transport recommendations. Nevertheless, intermodal transport as a logistics process requires scientific work and research, the effect of which is to strengthen the competitiveness of intermodal transport to the traditional road to the carriage of highly processed goods.

Intermodal technology functioning is mainly based on experience in Poland. Over the years, intermodal transport was underrated way of transporting goods. Its principal advantage lies in combining functionality with the ability to cargo transport and storing in intermodal transshipment point. Intermodal transport technologies are shown in [6]. Design rules container terminals are presented in the [9]. Both publications are land-based container terminal.

Both the technology and design rules terminals do not show know how to manage the movement of cargo units inside the terminal. However, the functioning of the inland container terminals is far different from the typical container ports on which there is a lot of information in foreign literature [12].

Sea terminals are to be run in such a way as to reduce to a minimum residence time of the loading units within the terminal [8]. This is due to the need for high bandwidth as a result of the conditions established infrastructure and container turnover. Using sophisticated technology, handling, such as full automation of the process can substantially reduce the time cargo handling, eliminate errors, increase the level of safety of the process. These technologies are extremely expensive and are not widely used. In smaller ports, high throughput is achieved by streamlining operations. One of the solution is increasing tariff for storage of cargo at the port [15].

The inland terminals, as mentioned previously, links Transport and storage functions. In this case, the tariff for the storage of empty containers or loaded is decreasing. Both types of containers are stored within a storage space. Problem in intermodal transhipment hubs to

adopt an appropriate method of storage of intermodal units, the implementation process container depots, so that there was no need of their translocation to another storage location. In reality Polish intermodal hubs, stacking containers and large volume of financial and intuitive decision-making, such situations often occur. This is the reason for the formation of additional costs and sometimes even necessary, adjusting the container several times.

In the international literature, little space is devoted to the theme of inland terminals. Generally it is a showcase of new technologies intermodal attempt to analyze their applicability, detailed technical solutions. There is no literature on the process of storage. There have been no analysis of the arguments has to be taken into account when storing. Do not analyzed the information contained in the transport documents for their use in the management of places components in intermodal transshipment node. We can say that this area of knowledge is not recognized, and the practice sets the rules in force here.

The remainder of this article outlines basic procedures performed during the reception and dispatch of goods to and from the container terminal. The principles of selecting the places of storage containers, and indicated the formation of any disruption to the service container terminal.

2 THE NEED FOR QUALITY IN USE OF INTERMODAL TRANSPORT

The proper functioning of the whole chain of intermodal transport depends largely on the proper functioning of the terminal, including first and foremost on their ability to perform cargo handling infrastructure, cost- effectiveness and scope of services, quality and reliability. Modern combined transport terminal is more than a simple transshipment point. It develops in the creation of centers freight with a wide range of services.

EU report [13] the most characteristic tendencies in the development of combined transport terminals in Europe include, among others:

• transition from isolated terminals to integrated logistic centers freight handling the " hub " of the terminal for combined transport as a key location in the center, while the development of a network of medium and even small terminals with maximum loading process automation;

• concentration of resources to improve service processes in terminals, especially automated cargo handling, cargo handling technology standardization and implementation of complex information technology systems .

Combined Transport Development Strategy in Poland (Published in 2004) shows such the need to develop innovative technologies for intermodal terminals. In turn, released in 2006 by the General Department for Energy and Transport of the European Commission's publication " In search of the slide Intermodality efficiency growth" simply points to the need for research projects focused on solving the problems of intermodal transport in order to increase its efficiency and wider dissemination.

Mentioned basic needs include:

• improving the quality of services with a focus on the creation of information technologies in the management of terminals,

• looking for ways to achieve synergies between the supply chain for intermodal transport

• further harmonization and interoperability between transport modes, manifested in new technologies, transport and handling of intermodal loading units.

Among the solutions sought European Commission proposes to focus on the work of, among others:

• identify problems and bottlenecks in the operation of intermodal terminals

• identification of tasks to increase efficiency of intermodal terminals , and these tasks with the help of state institutions and businesses.

Conducted by the author identification of multimodal transport operators in Poland have indicated that postulates presented above are still very relevant. For many years, one can observe the dynamic growth of transported cargo units in Poland related to intermodal transport . They are expected to be a solution that will allow for further sustainable development of transport in Poland. These are primarily solutions for qualitative and quantitative evaluation of the work, analytical tools, and tools that enable better management of the company in the operational field.

3 PRINCIPLES IN CONTAINER STORAGING

The ground terminals loaded containers are stored mostly to three layers to four layers vain. The storage yard in a terminal is usually divided into rectangular regions called storage blocks or blocks. A typical block has seven rows (or lanes) of spaces , six of Which are used for storing containers in stacks or columns, and the seventh reserved for truck passing . Each row typically Consists of over twenty 20 -ft container stacks stored lengthwise end to end . For storing a 40 -ft container stack , two 20 -ft stack spaces are used.

Load distribution and hence the allocation of storage is done by machine operators. This is done on the basis of their experience and relying on the information derived from public goods . Basic information to be taken when allocating loads are:

• whether the container is empty, loaded , refrigerated, tank , ADR / RID;
• the size of the container,
• the expected storage time charge on the terminal ,
• the recipient,
• the gross mass,
• operator.

The essential art of machine operators to memorize and consistently putting in a storage container so as not to turn the download does not require adjustment of the upper layers of containers . This task is difficult and involves unreliability . This problem increases the lack of information from one of the main customers of schedule downloads terminal at the time of arrival of containers by rail to unload the cargo units . As a result, the containers are unloaded in free space components (cached) , and after being informed of the date of delivery segregated and placed in the correct order.

Schedules cargo operations are difficult to define because they vary depending on the sender or recipient, traffic conditions , etc. , although this time the service should be as short as possible. Therefore, previous planning manual handling is often very difficult , if not impossible , due to random factors beyond the control of the operator terminal. To transfer the containers in the number of hours between scheduled transport services large batches , the temporary storage of containers is essential. Meets the buffer function terminals.

Unfortunately, the container terminal is limited capacity and technology used transport units , thus piling up more layers to increase capacity. This increases the number of containers in the landfill , but very often difficult to locate the container , and the effective execution of transshipment operations on it. As the number of handled cargo units , there are new problems with little turnover of the cargo container to find the company was not a problem for those involved in the physical handling of cargo. Today, however, the terminal supports more load and hence there is a possibility of a problem to locate the container that is to be assigned.

During the deployment analyze intermodal cargo transshipment node can watch two indicators:

• rotation ratio

• the intensity of use of the component.

Rotation ratio is the number of container shifts performed per unit time with respect to one component of the terminal. This means that the residence time of the free- space component may be relatively short, but the number of containers in a given location may be large. This means that the area is heavily used, but due to the large rotation load . Achieving high turnover ratio is desirable for marine terminals, where it counts the technical efficiency of the transport process and land-based terminals , where the number of occupied seats begins to cause complications in the implementation of the basic functions of transport. The intensity of the storage is a busy time of the landfill by the same unit load per unit of time. The smaller the value of this ratio the greater the rotation of the loading unit is characterized by a terminal.

4 PROCEDURES CHARCTERISTICS

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5 THE RESULTS

During the more than 800 observations the distance of transportation was measured and time recorded. Table 1 shows summary information for the group of observations.

Tab.1 *The overall results of the observation*

Operation	Mean value	Std deviation	Variance
Setting up the drive [s]	17.98	8.48	71.94
Drive [s]	28.45	20.49	419.87
Distance (without) [m]	54.04	38.37	1472.23
Setting to download and download [s]	15.57	6.00	36.02
Setting up the drive [s]	18.57	10.34	106.90
Drive [s]	33.64	17.24	297.12
Distance (with) [m]	65.45	39.82	1585.83
The setting for unloading and unloading [s]	19.00	11.00	121.08

As can be seen from the data presented in the table 1 most of the time during the execution of the discharge cycle takes a ride with the cargo, immediately after driving without a load. The total cycle takes an average 133s reloading while driving is more than 62s. It can be seen here that one of the fundamental option of shortening the cycle is shortened drive to and with the container. Reloading cycle-times differ depending on the relationship of handling. The table 2 and table 3 present results for handling relationships and track - first floor, and track - the fourth floor.

In relationships I track - I floor the average operating time was 123s. Like the collective results are also driving time was the largest (total 55 s). Due to the experience of the operators turned out to be a very short time - away containers. Due to the visibility of the container, and no need for very precise withdrawal of the unit load on the already standing - another - this time was the shortest of all possible relationships.

Tab.2 *Results of the unloading in relation I track – I floor*

Operation	Mean value	Std deviation	Variance
Setting up the drive [s]	16.76	8.86	78.44
Drive [s]	25.29	20.18	407.22
Distance (without load) [m]	45.47	31.99	1023.14
Setting to download and download [s]	14.71	5.16	26.60
Setting up the drive [s]	20.88	17.20	295.74
Drive [s]	30.12	18.98	360.11
Distance (with load) [m]	62.00	42.39	1796.50
The setting for unloading and unloading [s]	15.29	7.74	59.97

Tab.3 *Results of the unloading in relation I track – IV floor*

Operation	Mean value
Setting up the drive [s]	22.00
Drive [s]	31.50
Distance (without load) [m]	50.00
Setting to download and download [s]	11.00
Setting up the drive [s]	14.00
Drive [s]	26.50
Distance (with load) [m]	20.00
The setting for unloading and unloading [s]	45.50

Unloading on the fourth floor proved to be far more time-consuming. The average duration of the operation was over 150s., in this case, almost one third the time it took defer the load on a high level. Driving time with load were similar to those obtained with the unloading of the first floor: a little over 55 s. Table 4 contains the time and speed of the crane with load. The observations can be noted that the experience led operators overcome the greatest distance putting the container on the third layer. Regardless of the level of deposition of the load, the speed obtained without charge are - as expected - higher than the load.

Tab.4 *Time and distance with and without load*

Without load	time		distance	
floor	I track	II track	I track	II track
1	30.12	21.25	62.00	32.50
2	34.45	26.67	71.68	43.33
3	40.64	26.83	71.18	46.50
4	26.50	26.00	20.00	30.60

The studies lead to the following general conclusions:

• If taking account time of operations it does not matter whether the container is deposited on level 1 or level 2.

• Postpone the level 3 lasts longer than half the level of 1-2.

Putting container on level 4 in comparison to the level 1 is three times longer.

• The difference between putting on levels 1 - 2 and level 3 allows for passing around 5-10m.

• The difference between putting on levels 1 - 2 and level 4 allows the passing of about 50-60m.

6 CONCLUSIONS

As practice shows decision problem applies to most containers. In addition, during the work simulation should pay attention not only to the time of transhipment single container , but also groups: there may be a situation where it is worth to lose a few seconds for one to gain even a few minutes in subsequent operations.

Implementation of the described research is related to the development of effective methods of reducing the operative time for the container terminal cranes . The result, which seeks to provide the following effects:

• reducing the number of meter hours by shortening cycles of loading.

• reducing the number of operations by 10%.

It is worth noting that the assumption that the cycle will be shorter loading only 1 minute obtain savings in the form of one review per year (terminal, where the project is implemented annually performs about 150 thousand cycles). When reducing the number of operations by 5% we obtain a reduction of another review annually. By reducing the cycle of 1 minute and reduction cycles by 10% saving on fuel inspections and within five years will amount to nearly EUR 550 000.

Contemporary challenges for the transport of lead by monitoring parameters such as efficiency , productivity, quality and safety. This can be done by streamlining the demand for transport services , even within the systems already considered environmentally friendly . This will ensure that they maintain both business and cares for the environment at the same time economically rational.

The practical effect of study is to prepare a computer program to support operations in intermodal transshipment node . The developed program will support the decision of the Broadcasting space for container storage sued to obtain the following benefits:

• reducing the number of operations at the terminal intermodal,

• reducing energy needs during handling unit loads at the terminal intermodal,

• Shorter handling unit loads,

• Increased machine productivity within the terminal handling by reducing machine cycle times.

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