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INFORMATION TECHNOLOGY THROUGHPUT CAPACITY OF TRANSPORT MEANS IN LOGISTICS

Today's problems in transportation processes in road traffic are growing continuously, even more so in case there are no technological, and particularly information technology innovations. Innovations in the domain of monitoring, directing, managing and controlling systems of traffic flows are realistically possible at present. Experiences show that the significance of technological innovations in the information subsystem in traffic technologies can be of great advantage.

WPŁYW TECHNOLOGII INFORMATYCZNEJ NA PRZEPUSTOWOŚĆ ŚRODKÓW TRANSPORTU W LOGISTYCE

Dzisiejsze problemy w procesie transportu w ruchu drogowym rosną nieustannie, tym bardziej w przypadku, jeśli nie są wprowadzane innowacje technologiczne, zwłaszcza w zakresie systemów informatycznych Innowacje w zakresie systemów monitoringu, kierowania, zarządzania i kontroli przepływów ruchowych są obecnie realnie możliwe do przeprowadzenia. Doświadczenia pokazują, że znaczenie innowacji technologicznych w podsystemach informatycznych technologii transportowych mogą być wielką zaletą.

1. INTRODUCTION

The tendency, objective and purpose of this discussion is to provide the initial impetus to the creation of a new term, the term of "information technology throughput capacity of the traffic network". Until now mainly the "construction throughput capacity of traffic routes" had been considered traditionally, and it was reflected in the number of traffic lanes.

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Searching for solutions at this level, in the phase of relative good construction level of the network of traffic routes, proves to be increasingly expensive and generally more difficult, and the actual possibilities seem to be reduced. In these conditions there is no other way out but to find the solution in the implementation of the intelligent transport systems in the transportation processes in all types of movements. The ideas are not new, the assumptions for their realisation are increasing and the experiences are accumulating.

The elimination of disproportion between the advanced information technologies and the road traffic technologies should be the first step in bringing the transport activities closer to the level of utilisation which allows the usage of transportation processes at the level which they deserve regarding their significance for the economy in general.

The interaction between the transportation process and almost all the other activities in life stipulates the increasing share of logistic approaches in planning, coordinating, monitoring and managing all the processes that include the movement of resources regardless of the phase in which this process is carried out.

Starting from the fact of the increasing information integration in the world, efforts should be invested into the creation of assumptions for the establishment of an integration system in the transportation process that will be free of spatial borders and that will be compatible with other processes of its immediate environment.

2. ROAD TRAFFIC LOGISTIC SYSTEMS

Logistic processes act in the interest of their environment. They are a necessity and a consequence of the basic existential functions. Although their development depends on the environment, they are getting transformed and they develop faster than their environment.

In the previous phases of environment development, in this case – the city, the role of transportation process has also been changing, with its significance increasing. In such conditions, the development of single elements of the transportation processes did not proceed uniformly. In the first phase the inferior role was played by the users (demands for transport higher than the possibilities in supply), the second phase saw a more intense development and an increase in the number of transportation means, and in the third phase there was lagging behind in the construction of the infrastructure.

In such conditions, efficient solutions should be used to introduce order, i.e. the system needs to be put under control. The tendency to control the system had been realised even before, but it was carried out to a lesser extent at the lower level – the level of elements. Previous solutions are not satisfactory any more, so that a new subsystem needs to be created which will coordinate the three traditional subsystems of the logistic system, Figure 1.

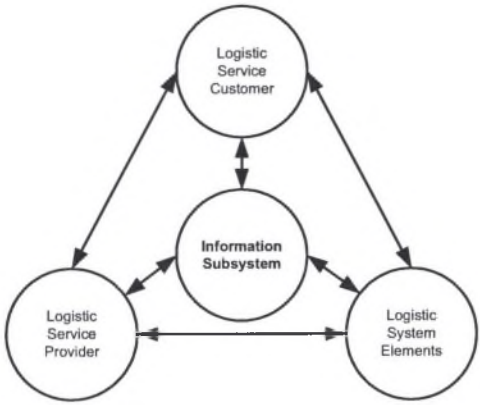

Fig.1. Logistic system

Successful coordination requires the realisation of the basic logistic assumptions, introduction of rules and criteria for the operation of the system.

2.1. LOGISTIC ENTITIES

The users of logistic service include all the entities that generate transportation requirements, i.e. define the logistic services in the immediate communication with the logistic service providers.

The logistic service providers are entities in the transportation function. The information subsystem provides them with the support in performing the basic tasks:

- determining of the actual indicators of vehicle operation,
- continuous improvement of the transportation processes,
- evaluation of the functionality of "outsourcing",
- cost-efficiency analysis of purchasing new vehicles,
- strategic development planning.

The logistic system elements include the object of transportation, transport means, and other infrastructure resources with their capacity and similar features.

2.2. INFORMATION SUBSYSTEM

The advanced information system in traffic assumes the formation of databases containing all the elements of the logistic system. These include, first of all, the data about the transport demands and their users, transport means and their owners, and finally databases about all the technologically relevant features of the infrastructure resources. As the basis of the mentioned information, the production material sector is combined with the production sector and the production sector with the commercial sector, and all together are combined with the logistic service providers, Figure 2.

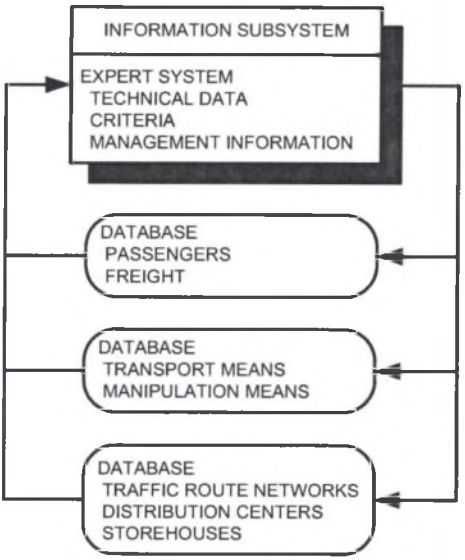

Fig.2. Information subsystem scheme

The logistic service provider receives passengers' transport demands in road traffic mainly directly and usually in the standard forms: inquiry, order, reservation, etc. The cargo transportation demands are received directly or via mediators within the logistic chain, with the widest variety of forms and data transmissions about the cargo.

The logistic service provider can obtain the data about the conditions in the network of traffic routes by submitting a direct inquiry to the authorised services or by using their general information about the conditions on the traffic routes through usual forms of information: radio, teletext, Internet, WAP, etc. The data about the capacity features of the distribution centres and other infrastructure facilities are exchanged by the classical communication systems among the mentioned entities and the logistic service provider.

2.2.1. TRANSPORTATION MEANS

Data on the transportation means, manipulation devices and transportation instruments cannot be transmitted by classical communication systems, since the information carriers are to a great extent dislocated and mobile. The communication between them and the central expert system can be realised only via wireless connections. Therefore, very often several different terminal instruments are used onboard vehicles such as the installed computers with a display or portable computers (PDA) which transmit information towards the central information system in a wireless way, usually via the GSM network. The data are obtained from various sensors (cargo mass – transport means loading), barcode readers (data about the cargo on the packaging labels, transmitters of GPS vehicle positioning systems (data on the current geographic position of the vehicle) or by inputting drivers' messages via keyboards onboard vehicles.

Fig.3. Terminal instruments onboard transport means

Within the context of transport means management based on the obtained data about the current position of the transport means, its load, known transportation requirements with locations and cargo features, there is the inevitable issue of the vehicle routing problem (VRP). In order to get the picture about the complexity of the vehicle routing problem and the scheduling, only the basic conditions of the transportation processes need to be mentioned:

- variation in days, quantities, times of delivery of goods,
- variable number of logistic service users,
- restrictions regarding delivery, legal restrictions, and restrictions imposed by the traffic system,
- delivery within a wider geographic area,
- various characteristics of the infrastructure facilities at destinations.

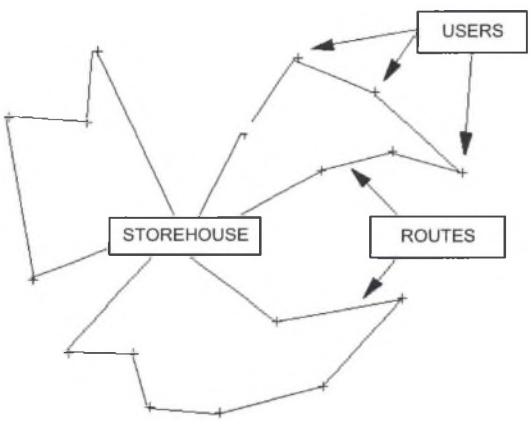

Fig.4. Graphic presentation of transport means routes

Often there are restrictions imposed by the service users such as:

- every user has a certain quantity that has to be delivered (and/or taken over),
- some users have time windows during which unloading cannot be carried out; (the user is ready to take over the delivery between 10.30 – 11.30 and between 14.00 – 16.15, and these time windows are favourable for the users because they know when they can expect the delivery and therefore can make an optimal schedule of receiving the suppliers, but are not favourable for the service provider since they restrict the flexibility – it may happen that two neighbouring users have time windows for delivery which are very different),
- users where certain transportation means cannot be used (dimensions),
- some users have priorities in delivery.

The optimal route is the one on which all the factors of the transportation process: specific users' requirements, characteristics of the transport means, drivers, transportation items, overall costs of the logistic service and final profit of the logistic service provider insure optimal usage of the logistic resources with the best ratio of the overall costs and the total profit for a certain transportation process.

2.2.2. TRANSPORTATION PROCESS QUALITY CRITERIA

Until now, in presenting the function of the transportation process quality, the only thing that needed to be processed was the speed, where:

$$v_{pr} = \frac{\sum_{i=1}^{n} l_i}{\sum_{j=1}^{n} t_j} \qquad (1)$$

For a detailed analysis of the function of the transportation process quality criteria from the aspect of the service provider, other quality indicators have been determined as well, such as:

- engagement of the transport means,
- static load,
- dynamic usage of nominal loading capacity,
- utilisation of the travelled distance,
- correct functioning of the transport means, etc.

The introduction of the new term of information throughput capacity leads to the issue of the changed criteria of the transportation process quality that would take into consideration also the efficiency of the information subsystem, its compliance with the specific requirements of various service users, which is measurable only through the satisfaction of the very users.

3. CONCLUSION

Assumptions of good development strategy and harmony of road traffic functioning are numerous. Today good development strategy means the strategy which finds its implementation within the framework of principles of intelligent transport systems.

The information subsystem is oriented towards improvement of efficiency and functionality of the overall logistic service it supports, thus making the transportation process more efficient and more available and therefore also more acceptable for the users.

The influence of the advanced information subsystems on the logistic system through the realisation of the tasks of positioning, navigation and routing of the transport means is clear and is reflected in the following benefits:

- possible gathering of more information at smaller cost,
- increase in the overall efficiency of the logistic system,
- possible fast reaction in case of incident,
- increased traffic safety.

Following the development of technological ideas in the traffic processes, changes can be noted that lead to the following claim: if the traffic system has already been relatively well developed, one should not continue with its even more intensive construction, but should rather tend to make better use of the existing system. Today's information technologies make this possible, and the "future" ones will stipulate this, since, unlike the construction throughput capacity of the traffic routes, the information throughput capacity can be realised within the framework of sustainable development.

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