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## LOGISTIC AND INFRASTRUCTURE PRINCIPLES FOR PASSENGER TRANSPORTATION IMPROVING

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**Abstract.** The study is devoted to determination of logistic and infrastructural principles for passenger transportation improvement basing on methods of scientific identification and systematic approach. The determined principles were used for developing “Program complex for providing data processing during examination of passenger traffic using calculation means at city, local, intercity and international routes”.

**Keywords:** passenger transportation, logistic and infrastructure principles, transport system, service system, transport management informatization.

### Introduction

The effectiveness of logistics solutions for transport infrastructure suggests the expediency of considering such approaches in solving passenger transport problems, which, in spite of even a crisis, would provide socially necessary transport services to the population. After all, the global objectives of logistics are precisely the achievement of maximum effect with a minimum of costs for the volatile market of transport services.

Thanks to the systematic study of passenger transport issues regarding the correct understanding of the action mechanism for scientifically grounded methodology of transport infrastructure development, it is necessary to generalize and systematically work out the previously developed theoretical and practical approaches to solving the main tasks of passenger transportation. That is why the streamlining and formalization of the logistic principles of improving the transport services for the population is relevant, as the Ukrainian transport system has not met the world standards yet and it must be integrated into the European one (Denysenko *et al.* 2016).

The lack of a logistic system approach and methodology for improving passenger transportation doesn't allow forming the logistic principles of their construction regarding:

- consideration complexity of the logistics system elements from the origin of demand for transportation to its satisfaction;
- reasonableness of the optimal service level for the population and determination of ways to achieve it, taking into account the effective resources use;

- ensuring the compliance of the vehicle capacity with the demand for transportation;
- estimation of the final results of work on the amount of profit and reduction of the grant;
- transportation and providing related services for passengers with a single structure capable of making competent decisions in the passengers and carriers' interests;
- adequacy of information and the use of computer technology, which should be the adviser in the decision-making process;
- staffing with logistics knowledge (Molitor *et al.* 2013).

The *aim* of the study is to demonstrate the methodology of improving passenger transportation in the context of implementing a systematic approach that involves using modern logistic principles that will ensure the design of a passenger transport system in space and time, providing passenger, financial and information flows.

### Literature overview

The prospects of further informational support, automation of work and the placement of workplaces in the form of computer network terminals directly at the place of workers' residence need a radical revision in the future, such as urban planning decisions and forms of urban transport, that is, the elimination of fixed routes and schedules of traffic, reducing the average capacity vehicles, using suburban traffic. Such cardinal solutions will succeed only in changing the principles of transport systems development, increasing their flexibility and effi-

ciency, and the ability to respond quickly to changing operating conditions (Vorkut *et al.* 2016).

For the first time application expediency of the logistics principles in solving the passenger transport problems were laid out in 1995 in the article by O.S. Ignatenko, V.S. Marunich, I.M. Duma “Logistics and passenger transportation” (Ignatenko *et al.* 1995). The application of logistic and infrastructure principles for improving passenger transportation is important and is at the stage of project and program development. In particular, it is mentioned in the resolution of the Verkhovna Rada of Ukraine (The Ukrainian Council) dated on August 31, 2015 No. 656-VIII “On the Prior Approval of the Draft Law on Amendments to the Constitution of Ukraine on the Decentralization of Power” in the analytical notes “Transport Policy of Ukraine and its Heading to the Norms of the European Union” and “On Priority Measures to Overcome the Crisis in the Ukrainian Transport and Road Complex”, in other legislative and regulatory acts. Indeed, the important theoretical and practical aspects of this problem need to be properly programmed, organized and financially supported.

### Main material

We emphasize that under the conditions of various socio-economic systems, most of the city problems are universal. So, in European countries, where urban development management is determined by market relations, transport problem has become more acute than it was under planned economic management and the priority of public transport development. This led to existence of over 100 transportation technologies in developed countries, characterized by a high level of systems complexity and freedom of its elements, while about 10 technologies were used in domestic transport.

Taking into account the urgent needs of passenger transport, overcoming the resource crisis and knowledge of natural ways of development, the article presents the methodological basis of a transport system in the form of twenty logistic principles, which are divided into the fundamental, determining, providing and principles of harmonization (Figure 1).

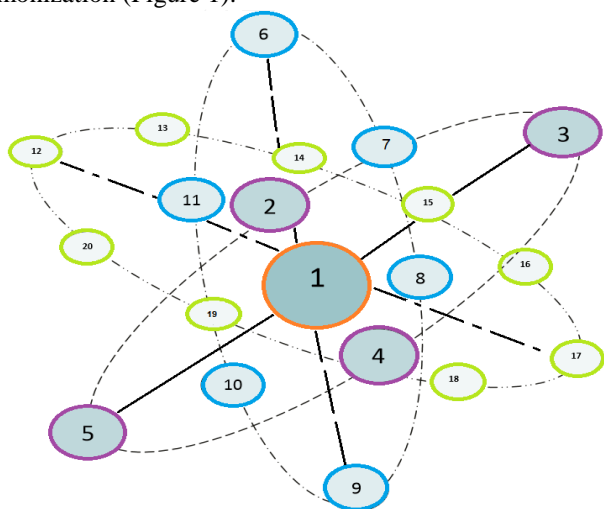


Fig. 1. Scheme of logistic and infrastructure principles for passenger transportation improvement (Marunych *et al.* 2017):

*Fundamental:* 1 – meeting the demand for transportation. *Indicative:* 2 – taking into account the transport service quality; 3 – conformity of the load capacity in the magnitude system and demand fluctuations; 4 – transportation timeliness; 5 – attribution to the field of demand. *Providing:* 6 – financial sufficiency of system development; 7 – optimization of the park structure; 8 – differentiation of tariffs by the level of service quality; 9 – the legal settlement perfection; 10 – system safety of transportation; 11 – commercialization and concreteness. *Principles of harmonization:* 12 – implementation of logistic and infrastructure approach; 13 – general coordination of various transport modes operation; 14 – complexity of technological support; 15 – compliance of specialists; 16 – unification of reporting and single ticket use; 17 – relationship ordering; 18 – unity of management; 19 – information management; 20 – cyclic control closure.

As a service system, passenger transport is aimed at satisfying the demand of the population for transportation, which is the first and fundamental principle of its construction. It is the concept of demand as the needs of the population in passenger transport, which must be met by transport (Melnychenko *et al.* 2016), cannot be characterized only by quantitative indicators: the volume of traffic, passenger traffic. This is due to the fact that earlier, passenger transport was related to material production, when it was believed that the implementation of the annual plan for passenger transportation is the main indicator of satisfying the needs of the population in services. In the conditions of the planned economy, transport development was stimulated, depending on the increase in volumes of transportation, and capital investments were allocated precisely at their growth. Since this growth slowed down year after year, investments declined. For example, in 1990, the minimum volume of centralized capital investment for transport development was planned in the last 10-15 years. Such an approach to planning cannot be called scientifically sound, and it could not stand the test of time due to the fact that it did not take into account the costs of increasing the level of transport services. Proceeding from this, the second defining principle of improving passenger transport system in the conditions of transition to market relations can be considered the need to take into account not only intensive indicators of development, but also indicators of transportation quality.

Quality service of the population can be based on the development of a new mechanism for forecasting transportation, which involves the definition of not only voluminous long-term values (which include the annual volume of traffic and passenger traffic), but also the amount of passenger traffic, which characterizes the process of transportation the most objectively in time and space. Only by means of a rational design and management of the transportation process on the basis of passenger traffic information, in practice, compliance with the capacity of the transport system can be achieved with the magnitude and fluctuation of demand, which is the third determining principle. But this requires a revision of the existing methodology for determining and forecasting traffic volumes and passenger flows.

Considering the timeliness of transportation as their performance exactly in time, the ambiguity of this concept for different types of communication should be empha-

sized. For urban and suburban transportation, which is characterized by mass, timeliness is, first of all, the regularity of the rolling stock. Regarding taxi transport, which ensures the fulfilment of individual orders, timeliness is the delivery of passengers at their request. Timeliness for long distance and international transportation means guaranteed transportation in a pre-determined period. The fulfilment of passenger requirements for the timeliness of transportation is the fourth decisive principle for the transport services improvement.

The analysis of the principles under consideration, as well as the assertion that the process of satisfying the population in transportation could not be separated and accumulated, that does not allow the work of passenger transport to be considered a commodity, that is, the transportation of passengers cannot be attributed to material production (Wiesenthal *et al.* 2015). This formed the basis of the fifth defining principle, when satisfaction of the population needs in passenger transportation belongs to the field of services which are a labor product.

The implementation of the above-mentioned definitions is possible only on the basis of legal, technological and resource support. It is known that the optimality of the park structure can be achieved with the financial sufficiency of the passenger transport system development, which involves improving the economic state of production, more efficient use of budget allocations. This principle, which is considered to be the sixth provider, can be realized on the basis of development and introduction of a modern transport financing mechanism in market conditions.

Transportation efficiency depends to a large extent on the structure of the rolling stock of passenger transport fleet, which requires urgent optimization. Only thanks to this reduction of time spent by passengers on travel by 25-30%, operating costs by 15-20% and rational use of all types of resources can be achieved. Such an approach to law can be considered the seventh principle of improving the transport services for the population.

In order to make the population be interested in improving the quality of transportation for the priority direction of passenger transport as a socially necessary type of service, it is necessary to differentiate tariffs by the levels of service quality, which can be considered as the eighth providing principle.

The complexity of the passenger transport system and the existence of objective contradictions between the passenger and carriers' interests determine the need for a clear legislative and legal framework. In Ukraine, the Laws "On Transport", "On Road Transport" were adopted; the Resolution of the Cabinet of Ministers of Ukraine dated on February 18, 1997, No. 176 "Rules for the provision of passenger motor transport services", dated on January 29, 2003, No. 139 "Procedure for carrying out a tender for the carriage of passengers on a public bus route"; Orders of the Ministry of Infrastructure of Ukraine on February 9, 2004 №75 "Order of regular, irregular and circular passengers traffic by road transport in international traffic", dated on July 15, 2013, No. 480 "Passenger and luggage transportation by road", etc. Consequently, further improvement of the legal framework for the pas-

senger transportation can be considered the ninth principle of ensuring.

In modern conditions, the legal basis of transportation determines their systemic security, which in the broad sense includes physical and environmental aspects. This is due to the immediate vital interest of the population, above all, in reducing the rate of traffic accidents, air pollution, territory and reducing noise, which reduces the harmful impact of the transport system on the environment. Thus, systemic transport safety can be considered the tenth principle of improving the population transport services.

Today, the development of passenger transport is associated with the availability of various forms of vehicle ownership and infrastructure. The creation of a transport services market is an urgent matter that involves the transition from state ownership to other forms with the possibility of commercial relations between carriers and enterprises of other industries and the population. This will lead to the elimination of the public transport monopoly and the revival of competition, which in the developed countries provides high quality transport services to the population. Thus, urgent measures to create a market for transport services, based on the commercialization and specificity of relations, should be considered the eleventh principle.

For a proper understanding of the passenger transport role in servicing the population, it is necessary to clearly distinguish between such concepts as the work of transport and its products. The products of transport are often identified as its work, which creates a distorted idea of the activity end result. For quite a long time, the main indicator of the transportation plan was the passenger traffic in passenger-kilometres, later taken measurements of the plan in passengers also did not show a picture of the transport products, because this indicator characterizes the implementation of the plan for the passenger departure, that is, only the initial stage of the transportation process. In other words, all stages of the transport service process, which is considered as a logistical and infrastructure system, should be considered. This is the twelfth principle of consistency (Taniguchi *et al.* 2015).

In the conditions of the planned economy there was a paradoxical situation when all types of passenger transport were carried out and often over fulfilled the plans of transportation, and the population demand for various types of communication was satisfied only by 80-90%. This is explained, first of all, by a violation of the logistical approach, when each mode of transport is considered separately and carries out transportation within its scope - rail and road from the station to the station, sea and river - from the port to the port, that is, incomplete products were produced that did not have total consumer value because the passenger was almost not delivered to his destination. Today it became clear that the rational passenger transportation by several modes of transport cannot be ensured if they operate as independent systems. That is why the thirteenth principle of improving transport services should be the coordination of various modes of transport.

Along with the logistic approach to solving the problem of smoothing the contradictions between the passengers and enterprises interests, the adequacy and complexi-

ty of technological support, which is the fourteenth principle, is a key factor.

The importance of this principle is confirmed by individual examples of complexity in the development and implementation of unified technologies for different types of transport for the route systems, traffic schedules, automated transport process control systems and ticket sales, etc.

A comprehensive solution to these problems for different types of transport is impossible without proper training of personnel, which is the fifteenth principle. This approach has already been implemented with the improvement of the training system at National Transport University, where such new majors as “Urban transport systems” and “Logistics” were introduced, which include the training of highly skilled specialists for transport infrastructure.

The disparity in transport management, the lack of a comprehensive approach to technological provision impedes the transportation throughout the passengers’ way. Regarding this, it would be expedient to consider the actual issue of reporting unification on the passenger carriage, as well as the introduction of single tickets for passenger transport using several transport modes. This can be called the sixteenth principle of improving passenger transport.

As practice shows, implementing complex technologies of passenger transportation by several modes in modern conditions should be based on the economic interest of all participants in the transportation process. The overall effect received from the implementation should be shared among all parties in proportion to the level of services provided and the costs associated with the implementation of the traffic carried out by this technology. The mutual responsibility of the participants in such transportation should be determined by the rules of carriage, and its specific size - by agreements for the passenger carriage within the unified technology framework. This can be considered the seventeenth principle of improving the transport services for the population.

Regional transport authorities should undertake the development and implementation of integrated technologies and the necessary regulatory framework, measures that would provide timely operational information on actual traffic volumes, their distribution in time between transport nodes, etc. Work will be funded by transport companies that are participants in this transportation. In this case, regional transport authorities are the part of economic relations with carriers and become interested in the successful work of subordinate enterprises. This should be considered the eighteenth principle.

Further improving of transport operations and transport services should be based on the appropriate in-

formation management of passenger transport. This applies to the nineteenth principle of transport system development.

The modern concept of comprehensive operation of various modes of transport should be the basis of automation development, which will ensure the transportation throughout the way of passengers moving, thus creating conditions for actual process optimization, when it does not break into pieces within the departments by modes of transport. That is why, that part of the transportation, where it involves several modes of transport, in order to ensure that the loading of the rolling stock is uniform, the scheduling of the traffic is carried out, etc. cannot be outside the authorities’ attention. Therefore, the main task of the transport management informatization, which must be performed with different modes of transport, is the cyclic control. This is the twentieth principle of improving passenger transport services.

## Conclusions

The tasks of improving passenger transportation, which should be solved for introduction of logistic and infrastructure principles of its construction, should include:

1. Basics for organizational structures of transportation management taking into account passengers’ interests at the state, transport and statistical levels, which will influence the progressive transport systems design;
2. Mutual planning of urban and region development with their transport systems and coordination of different modes of transport; development of methods for stimulating the increase of transport services for the population;
3. Development of a methodology for transport infrastructure and introduction of advanced technologies taking into account economic and environmental aspects;
4. Saturation of transport infrastructure with specialists in logistics training.

Implementation of the obtained results will allow

- setting up transportation according to demand and considering resources provision, thus the mobility of the population will be significantly improved
- streamlining the route system, making it possible to reduce the number of routes while reducing daily volume of buses;
- increasing speed of public transport connection by 10–15 %;
- decreasing fuel consumption of passenger transportation by 25 % and reducing emissions of harmful substances into environment by 15 %.

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