ON LINKAGE OF TRANSPORTATION THEORY AND LOGISTICS

РАЗВИТИЕ МОДЕЛИРОВАНИЯ СВЯЗИ ТРАНСПОР - ЛОГИСТИКА

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Abstract: *Three areas of modelling in the logistic chain are specified in the article: the theory of transportation – the technology of transportation – logistics. Several directions of the modelling of links between the transportation technology and the quality of transportation are shown with respect to environments that are distinguished by deterministic, stochastic or non-linear data entries.*

KEYWORDS*: THEORY OF TRANSPORTATION, TECHNOLOGY OF TRANSPORTATION, LOGISTICS, MODELLING*

1. Introduction

The initial theoretical platform which provides for the advancement of logistics systems consists in the development of the theory of transportation which is based on the examination of movements of an intangible transportation element within a defined transportation network in a technical, a technological and an economic reality. This theoretical basis also provides a platform for the transportation technology (organization of transportation) which explores the movement of means of transportation and transportation units in a technically defined transportation network comprising all technical types of transportation and their combinations, and which aims at its optimization in a system concept.

2. Prerequisites and means for solving the problem

This represents the fundamental pillar of the technological reality: theory of transportation – technology and management of transportation processes – logistics, in which:

- **the field of the theory of transportation** forms a methodological basis for the development of intensifying functions of relocation processes. The modelling concerns mainly the following areas:
  - fundamentals of the theory of transportation , the exact apparatus used for its management
  - prioritization of transportation networks
  - intersections of transportation networks on a horizontal basis (as for multimodal transportation) and a vertical basis (as for regional, national and international levels)
  - distribution of transportation (traffic) flows during their movement in transportation networks
  - throughput capacity of transportation networks and their sections in the deterministic and the stochastic regime of movement of transportation units, bottlenecks and solution of their impact on coherent networks
  - theory of relocation process quality

- **the field of technology and management of transportation processes** focuses on applications of the basic examination of the theory of transportation as for conditions of individual technical types of transportation and their combination within multimodal transportation systems. The modelling concerns mainly the following areas:
  - transportation organization and management within a transportation network in the deterministic and the stochastic regime of operation (origination of transportation requirements, entering of the transportation unit into the transportation network)
  - optimization (distribution of defined transportation flows in a transportation network according to optimization criteria, collection of transportation and traffic elements in order to create transportation and traffic units, balancing of transportation units in transportation networks)
  - system combination of technical types of transportation and creation of transportation and traffic systems in passenger as well as freight traffic
  - minimizing the occurrence of bottlenecks and transportation congestions in the transportation network
  - transportation as well as traffic and transportation system ecologisation
  - application of telematic systems in transportation process management

- **the field of logistics** focuses on two basic branches, i.e. the branch of fundamentals and general principles of logistics incl. the management of logistics systems, and the branch of transportation logistics which relates the transportation as a carrier of material flow to an integrated management of logistics systems. The modelling in the branch of general logistics fundamentals concerns mainly the following areas:
  - disciplinary fundamentals of logistics incl. applied methods of exact and heuristic optimization and methods of artificial intelligence
  - logistics marketing methods, logistics marketing strategies (in the globalization era)
  - stock and stock management, storage and handling systems in logistics chains
  - macrologistics and industrial logistics, assessment of contributions of logistics according to international methodology
  - corporate logistics, logistics reengineering, business logistics
  - logistics information systems, special supporting information technologies logistics chain management

The modelling in the branch of transportation logistics concerns mainly the following areas:

- management of circulatory and relocation processes from the point of view of material transportation chains or the regional perspective of transportation chains
- transportation as a supporting phenomenon of intensification of material flows and logistic chains, the role of transportation as a state economic forming capacity
- organization of information flows in logistics chains, their utilization in order to optimize intensities of transportation flows
- logistics technologies based on distribution processes and optimum information flows
- quality of transportation as a critical factor of the offer of transportation services in the logistics chain, incl. the offer of multimodal transportation systems
- logistics system development prognoses
- interactive effects of changes in market mechanisms on the development of new logistics technologies based on distribution processes and information flows

3. Results and discussion

From the perspective of the transportation system it is necessary to regulate the traffic with regard to:

- optimum distribution of work among individual transportation types as to provide for the logistic transportation request
- optimum transportation quality
- minimizing costs of actual relocation process as well as circulatory processes as a whole

The complex of transportation system properties and the properties of individual types of transport based on a technical background and transportation technology can be referred to using an integrating term of "transportation functional effectiveness".

Some characteristics of transportation functional effectiveness are objectively given; i.e. they are not influenced by the transportation organization, on the contrary – these characteristics influence the organization of the actual relocation (ability of the transportation to create networks, capacity to transport any required quantity, easy reach of transportation means etc.) as well as characteristics which are directly dependant upon the organization (technology) and which contribute, to a certain extent, to the transportation quality (the transportation speed, degree of reliability, and the security of the transportation capacity).

Issues arising due to these characteristics can be handled by means of technological models of transportation system performance. In order to provide for the functional identity of the system and its model, other theoretical bases have to be employed. E.g. the models can be classified according to the data entry character as:

- deterministic, i.e. their data entries are uniquely determined (they repeat periodically – e.g. fixed timetable model)
- stochastic, i.e. their data entries range within specific values around a mean value and the model is then determined by a system of mean values and their probability characteristics (use of the queuing theory armamentarium). With the use of stochastic models, two factors concerning transportation in relation to the traffic quality can be defined – assessment of the risk that the output conditions will not be observed, especially as regards the speed and reliability characteristics, and a possible assessment of the probability of the occurrence of bottlenecks and their consequences.
- models with entries characterized by a system of nonlinear differential equations (describing situations when the system is affected by interferences which can cause chaos, the diversity of chaotic situations in the sphere of transportation is not particularly high, however their frequency is substantive, which largely impacts the traffic as well as transportation quality). The nonlinear differential equation system solution is very complicated and often has to be replaced by iteration methods or other approximate methods. The solution can be effectively substituted with a simulation of the performance of one section of the transportation network

4. Conclusion

Modelling and solutions to problems, which arise in situations when the choice of an appropriate transportation system or an appropriate logistic technology depends on the possibilities of predicting the transition from order to chaos and vice versa, will also be elaborated when developing the research project called Development of Transportation Infrastructure and Optimization of Transportation Network Operation at the Faculty of Transportation Sciences, Czech Technical University in Prague. It can be assumed that the solution will be also contributed to by a gradual application of transportation telematics. However, the enhancement of optimization procedures in the situation of a constantly increasing transportation network load will have to be based on nonlinear system modelling.

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6. References

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