THE USE OF MATHEMATICAL MODELS FOR LOGISTICS SYSTEMS ANALYSIS

Baiba Zvirgzdiņa, Jurijs Tolujevs

Transport and Telecommunication Institute
Lomonosova str. 1, LV-1019, Riga, Latvia
E-mail: baiba.zvirgzdina@inbox.lv

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A mathematical model is a description of a system using mathematical concepts and language. The process of developing mathematical model is termed mathematical modelling. Mathematical models are used in logistics systems analysis. A model helps to explain a system, study the effects of different components, and make predictions about behaviour. Mathematical models can take forms such as dynamical systems, statistical methodologies, differential equations, queuing theory, mathematical programming, and others. Mathematical models can be divided into two types: analytical and simulation models. Analytical models are used, when the structure of the system is relatively uncomplicated and there exists analytical form in what systems structure can be written. Most of cases simulation models are used when the systems can't be written in an analytical way. Simulation is used to study situations characterized by uncertainty. Mathematical modelling gets more and more important for logistics systems analysis as systems gets complex and there is a need for a tool that helps to understand the systems and to give the desired answers to questions in time as short as possible.

There are literature sources that describe how mathematical models are applied for logistics systems analysis. Peruvemba (2005) gives a brief overview of mathematical problems in logistics. The last forty years have been very important in logistics development field, from its concentration on a company's physical processes to a holistic process and customer oriented management instrument. That also meant a continual change of the mathematical challenges in logistics (Möhring and Schenk, 2010).The importance of mathematical methods for logistics systems analysis confirms separate sections of international conferences or even ongoing individual conferences of this theme.

The International Symposium on Mathematics of Logistics took place at Tokyo University of Marine Science and Technology (2011), where scientists and practitioners had opportunities to attend lectures on theory and practices of mathematical methods of logistics. There are institutions that provide services for logistics performance improvements, for example, in Australia there is the Centre for Industrial Modelling and Optimisation (CIMO), which specialises in industry-focused research and training, it offers consulting services in applying optimisation, operations research and statistics to industries such as transport. There are many challenging optimisation problems in the design and operation of transport and logistics networks. The activities of the research are applied to vehicle routing and scheduling for long and short haul operations; optimal fleet sizing, composition, maintenance and replacement; optimal warehouse operations; supply chain management; and a wide range of logistics issues.

Daganzo (2005) in his book classified optimization methods to one-to-one distribution, one-to-many distribution, one-to-many distribution with transhipments, many-to-many distribution. Simchi-Levi et al. (2014) book focuses on the application of operational research and mathematical modelling techniques to logistics and supply chain management (SCM) problems. Takai (2009) mentioned that SCM problems are important because of structural changes in the nature of supply chains and more advanced functional requirements.

This paper will review the contributions of mathematics to logistics and illustrate how the use of new mathematical insights and procedures will ensure the potential for continued successes in logistics.

References

1. Daganzo, C. F. (2005) *Logistics Systems Analysis.* 4th ed. Springer.
2. Peruvemba, S. R. (December 2005) Understanding the Mathematics of Supply Chain Management. *Logistics Quarterly Magazine*, 11(5).
3. Möhring, R. H., Schenk, M. (2010) Towards More Intelligence in Logistics with Mathematics. In *Production Factor Mathematics*. Springer.
4. Simchi-Levi, D., Chen, X., Bramel, J. (2014) *The Logic of Logistics. Theory, Algorithms, and Applications for Logistics Management Series*. Springer.
5. Takai, E. (July 2009) The Role of Operations Research towards Advanced Logistics. *Quarterly Review, Science & Technology Trends,* 32.
6. *International Symposium on Mathematics of Logistics: Theory and Practices.* (2011) Tokyo, Japan: Tokyo University of Marine Science and Technology. [Online]. Available from http://www.youtube.com/watch?v=hc1U7P3CcSA