Mgr in. Paweł Górniok

Dissertation title: **Modelling Sustainable Freight Flows in Urbanised Areas**

English summary of the dissertation

The basic research problem of the dissertation concerns the modelling of cargo flows taking into account the assumptions of sustainable development in urbanised areas. The following research questions were formulated for such a research problem:

Q1: What is the essence of freight flows taking into account sustainability assumptions?
Q2: What are the determinants of sustainable freight flows?
Q3: What is the spatial structure of freight flows in urbanised areas?
Q4: Which point infrastructure elements enable sustainable freight flows in urbanised areas?
Q5: What is the role of the freight flows in urbanised areas?
Q6: What technologies available should be used to achieve the objectives of sustainable freight flows in urbanised areas?
Q7: What is the sensitivity of the input variables of the proposed model to the effect of sustainability of freight flows in the selected urbanised area?

Based on the above research questions, the main objective of the dissertation and the specific objectives were specified. The main objective is to **develop a model for sustainable freight flows in urbanised areas**.

The dissertation is contained in a total of 169 pages, including 152 pages of the dissertation text, excluding the bibliographical index, list of tables, figures, and appendices. It consists of five main chapters.

The first chapter is devoted to the characteristics of urbanised areas and urban agglomerations, which constantly expand their territories, in terms of the logistical processes that take place in them. A typology and spatial models of these areas are presented, which can be observed in the era of ever-changing processes in these areas. Problems occurring in connection with the progressive urbanisation of individual territories, such as the depletion of resources, the impact on the quality of life and the environment, the continuous exploitation of traditional energy sources and traditional means of transport, are indicated. The function played by large agglomerations is discussed, not only from a social point of view, but also from a production or political-administrative point of view. The technical and economic infrastructure and transport systems of urbanised areas are discussed in relation to their functioning in accordance with the concept of sustainable development.

The second chapter is devoted to the management of cargo flows of urbanised areas. It brings together issues in the organisation of the cargo flows of these areas and presents the essence of sustainable flows of these cargoes and their determinants. The necessary point infrastructure for the flows is also discussed. The main problem of cities and their centres, which is the organisation of traffic, its inconvenience to residents, and the problem of environmental pollution, is characterised. The widespread problem of the lack of coordination of various independently operating actors that attempt to create and influence flows of goods and cargo is discussed in some way.

The third chapter presents research assumptions for modelling cargo flows in urbanised areas. A model was developed to assess the validity of pursuing sustainable freight flows in urbanised areas. The assumptions focused on identifying the determinants of sustainable freight flows, the structure of freight flows, and identifying the key stakeholders of sustainable freight flows in urbanised areas.

Chapter four presents the selection of solutions and technologies to achieve the objectives of the sustainable cargo flows in urbanised areas. The available technical solutions needed to achieve the assumptions of sustainable last mile cargo flows in an urbanised area are discussed. The concept of powering point infrastructure elements in the sustainable load flow model with photovoltaic systems with energy storage and cooling and heating of point infrastructure elements is presented in the sustainable load flow model based on heat pump technology.

The fifth chapter focusses on conducting a scenario analysis with elements of sensitivity analysis using RETScreen software, a system for benchmarking projects using sustainability assumptions. Three sample scenarios are presented, making specific assumptions to enable the infrastructure and processes necessary to achieve sustainable logistics flows in the study area. Social, environmental and economic issues are confronted in relation to the costs incurred in a dynamically changing environment and market conditions. The RETScreen system used in this chapter enabled potential projects to be identified, assessed, and technically and financially optimised, allowing projects to be planned, implemented, monitored, and reported using sustainability assumptions.

The dissertation concludes with general and utilitarian conclusions, as well as suggestions for directions for further research.