Warszawa/*Warsaw*, ...29. SEP. 2025.....

(data/date)

Mgr Ahmed Eliwa
Ahmed Eliwa, MSc.
(tytuł zawodowy, imię i nazwisko osoby ubiegającej się o nadanie stopnia doktora/ *professional title, name of the applicant for doctoral degree*)
Wydział Transportu, Zakład Budowy i Eksploatacji Środków Transportu; Szkoła Doktorska PW
Faculty of Transport, Division for Construction and Operation of Transport Means; WUT Doctoral School
(Wydział/Katedra/Zakład/ *Faculty/Department*)
Politechnika Warszawska
Warsaw University of Technology
(Uczelnia/ *University*)

ABSTRACT OF THE DISSERTATION

„*Urban Transportation Poverty: A Model for Assessing Transportation Poverty in Metropolitan Areas*"

dissertation supervisor: dr hab. inż. Mariusz Kostrzewski, prof. uczelni
assistant supervisor: -

Transportation poverty has become a major issue in urban development, affecting social fairness, accessibility, and economic inclusion. Urban transportation poverty is a growing yet often overlooked issue that affects the quality of life in metropolitan areas. It refers to limited or inadequate access to affordable, reliable and efficient transport, which disproportionately affects low-income and marginalised communities. As cities continue to grow and become more urbanised, it is crucial to understand and address transportation poverty to promote social equity, economic opportunity and sustainable urban development. This thesis analyses transportation poverty using a structured framework that includes literature reviews, planning processes, conceptual and mathematical models, and simulation-based modelling and testing. Chapter 1 of the dissertation begins by defining terms of transportation poverty in comparison to other, similar terms as accessibility poverty, exposure to transport externalities, mobility poverty, transport affordability, identifying risk indicators, and analysing assessment methods for affordability, mobility, accessibility, and exposure to externalities. To develop a methodology of transportation poverty assessment also the existing transportation poverty measurements had to be discussed, including measures of affordability, measures of mobility, measures of accessibility, and measures of exposure to transport externalities.

A brief Chapter 2 present the aim, objectives, scope and thesis of the dissertation including sub-goals undertaken to fulfil the exposed thesis. While Chapter 3 focus on planning, building, and connecting the city to other ones, taking into account transportation poverty problem. The study then delves into transportation infrastructure design, emphasizing the need of data analysis, stakeholder participation, and effective execution while also evaluating the hazards of inadequate planning. Potential solutions are investigated, including enhancements to public transportation, novel technologies, infrastructure investment, and supportive policies.

Chapter 4 focuses on a conceptual model, which is developed as the fundament of formal modelling, i.e. mathematical model for assessing transportation poverty in metropolitan areas formulated in detail in Chapter 5, and finally transformed into a simulation-based model created to simulate transport dynamics, which includes trip production, distribution, mode selection, and network assignment, as well as accessibility analysis and feedback mechanisms. The way of its constructing, developing and verifying is given in Chapter 6. This thesis uses a simulation-based methodology to analyse transportation poverty using the PTV VISUM software. The study assesses PTV VISUM's methodological potential in social equality

research and investigates how its findings might help influence policy and structural recommendations.

Chapter 7 presents application of a formal model for assessing transportation poverty in metropolitan areas in simulation-based environment, and especially the obtained outcomes are discussed there. The results of using a model are discussed with special interest in transportation poverty situation in Warsaw city. It is significant part of the dissertation and consequently the research is directed by three important questions, the answers of which can be found there. These questions are as follows:

(1) How can transportation poverty in Warsaw be assessed by simulations and established indicator frameworks?

(2) To what extent is PTV VISUM useful for equity-based transportation analysis?

(3) What suggestions can be offered to alleviate transportation poverty in vulnerable districts?

To address these issues, a mathematical model (thus a formal model) is created to estimate transportation poverty. Implementation of a formal model for assessing transportation poverty in metropolitan areas in the case of Warsaw, allowed to develop a simulation which carry out with indications such as traveling times, waiting times, service frequency, and travel distance. The findings illustrate temporal changes between peak and off-peak hours, revealing spatial and social inequities. The findings highlight the importance of PTV VISUM and simulation-based approaches for identifying vulnerabilities and driving effective, equity-oriented transportation rearrangements. Both the formal model and its implementation can be applied as a decision support tool for decision-making analysis related to the reconfiguration of transportation in urban transport systems aiming to lower the problem of transport poverty.

The dissertation is concluded highlighting topics such as the cognitive relevance (theoretical aspects) and utilitarian significance (practical aspects) concerned during the work, the following realizations, methodological insights, policy implications, broader implications, future research directions, and finally concluding statement.

Ahmed

[własnoręczny podpis doktoranta/ *handwritten signature of the doctoral student*]