



## Review of the Dissertation Thesis

This review was prepared following my appointment as the dissertation reviewer by the chair of the "Transport Technology and Management" committee at the Jan Perner Transport Faculty, University of Pardubice, on January 16, 2026.

### Identification data

<b>Title of the Dissertation</b>	Multi-Criteria Decision-Making Methods in Last-Mile Delivery
<b>Author's Name:</b>	MSc. Sara Jovčić
<b>Field of Study:</b>	Transport Technology and Management;
<b>Degree-Awarding Institution:</b>	Jan Perner Transport Faculty, University of Pardubice
<b>Supervisor:</b>	doc. Ing. Libor Švadlenka, Ph.D.
<b>Specialist Supervisor:</b>	Ing. Daniel Salava, Ph.D.
<b>Dissertation Reviewer:</b>	prof. Ing. Radovan Madleňák, PhD.
<b>Reviewer's Affiliation:</b>	Faculty of Operation and Economics of Transport and Communications, University of Žilina

### Assessment of Individual Criteria

#### Relevance of the Topic

The thesis explores last-mile delivery (LMD) through multi-criteria decision-making (MCDM), a topic that is increasingly important due to the growth of e-commerce, urbanization, traffic congestion, and environmental concerns. The author demonstrates that LMD involves balancing several competing factors, such as cost, service quality, reliability, environmental impact, and operational constraints, making MCDM an ideal tool for decision support. A review of existing studies shows that MCDM is commonly applied to decisions such as transportation modes, facility placement, and provider selection in LMD, but there has been limited research on evaluating delivery areas based on multiple criteria. By tackling this understudied issue, the thesis aligns practical challenges with a robust research methodology.

**Evaluation: excellent**

#### Methods and Procedures Used

The thesis employs standard scientific methods and established MCDM benchmarks, including TOPSIS, ARAS, WASPAS, and MARCOS. Its focus is the new AROMAN method, which integrates linear and vector normalization (via  $\beta$ ) and an exponential ranking function (via  $\lambda$ ) to improve ranking robustness. Applied to data from 12 delivery zones in Novi Sad using six criteria, AROMAN ensures computational transparency and includes thorough parameter sensitivity and benchmark comparisons. However, it uses equal weights across all criteria, thereby limiting the evaluation of weighting approaches such as expert opinion, entropy, or CRITIC.

**Evaluation: very good**



## **Fulfilment of the Thesis Objective**

The core objective, to introduce a new MCDM method for urban LMD and validate it empirically, is outlined clearly and followed through methodically, from analysing the problem to designing AROMAN, applying it, and benchmarking its effectiveness as a practical tool. Sub-objectives such as identifying criteria and assessing robustness are decomposed logically and addressed sequentially. The empirical case study reinforces the main goal by demonstrating how AROMAN can be applied to real-world urban logistics scenarios.

***Evaluation: excellent***

## **Results, Contribution, and Originality**

The thesis's main contribution is the AROMAN method, which offers a normalization-adaptive, robustness-focused approach to MCDM by integrating two normalization techniques and employing an exponential ranking function with a  $\lambda$  parameter. This gives decision-makers greater control over how cost and benefit criteria affect outcomes and allows them to examine how rankings respond to different normalization choices, a consideration often overlooked in established methods. When applied to Novi Sad, the method produces rankings consistent with standard benchmarks and has been cited in other fields, indicating its broader relevance. Its computational transparency and adjustable parameters make it easy for practitioners to reproduce and adapt, enhancing its practical appeal beyond theoretical contributions.

***Evaluation: excellent***

## **Practical and Scientific Impact**

From an operational perspective, AROMAN provides logistics professionals with an accessible method for ranking delivery zones based on factors such as cost, time, reliability, and emissions. This enables well-informed decisions regarding route optimization, staff allocation, and district restructuring. Academically, the thesis makes a notable contribution to MCDM studies by directly addressing issues of normalization and robustness through parameterized controls, drawing on a comprehensive survey of LMD applications and highlighting the wider adoption of AROMAN in other research fields. Nonetheless, its validation is limited to a single city (Novi Sad) and a single operator, thereby reducing its applicability to other urban settings, different operator models, and regulatory frameworks. The author sensibly suggests this as an avenue for future work involving multi-city and multi-operator scenarios, as well as addressing fuzzy or interval data.

***Evaluation: very good***

## **Publications Related to the Thesis**

The author has published numerous peer-reviewed articles in respected journals directly related to AROMAN and its applications in transport and logistics, exceeding typical PhD expectations in both quantity and quality. These works demonstrate a clear progression from methodological development to practical implementation in real-world scenarios. Independent citations by other researchers confirm the method's recognition and broader impact in the field.

***Evaluation: excellent***

## **Formal Presentation**

The thesis is thoughtfully structured with a logical flow, clearly separating sections such as the theoretical background, state-of-the-art analysis, objectives, methodology, introduction of a new method,



implementation and validation, key contributions, and conclusion. Readability and transparency are enhanced by comprehensive lists of figures, tables, and abbreviations, as well as detailed appendices, which are especially helpful for understanding computational aspects.

Overall, the English is clear and technically accurate throughout, with consistent terminology and appropriate presentation of figures, tables, and mathematical expressions. While some sections may be slightly verbose, this does not compromise the work's readability.

***Evaluation: excellent***

## **Overall Assessment**

### **Overall Assessment and Questions for the Thesis Defence**

The thesis titled “Multi-Criteria Decision-Making Methods in Last-Mile Delivery” addresses a highly relevant and complex topic at the interface of urban logistics and decision-support. It proposes a new MCDM method, AROMAN, and convincingly demonstrates its usability and robustness using a real-world dataset from a last-mile delivery context. The author demonstrates a solid command of the literature, methodological creativity, and the ability to design and conduct an empirical study.

While the theoretical analysis of AROMAN could be further developed, particularly regarding formal properties under varying weights and criterion sets, the empirical results, sensitivity analyses, and comparative studies provide strong evidence that the method is sound and practically applicable. The publication record associated with the thesis confirms that the work has already had an impact beyond the dissertation itself.

### **Questions:**

1. How would you design an empirical validation of AROMAN across multiple cities and operators?
2. What adaptations would you make for fuzzy data in normalization and the ranking function?
3. How do  $\beta$  and  $\lambda$  parameters affect ranking stability under varying criterion weights?

### **Recommendation**

Based on the above assessment, I consider that the thesis meets the requirements for the award of the Ph.D. degree in the field of “Transport Technology and Management” at the University of Pardubice. It presents an original and useful methodological contribution and applies it realistically to a relevant last-mile delivery problem.

As a result, **I recommend that the dissertation be accepted for defense.**

Žilina, February 12, 2026

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**prof. Ing. Radovan Madleňák, PhD.**  
*Reviewer*