



## DISSERTATION EVALUATION

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**Title of work:** MULTI-CRITERIA DECISION-MAKING METHODS IN LAST-MILE DELIVERY

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The submitted dissertation, comprising 100 pages without appendices, deals with the area of optimization and multi-criteria decision-making in the delivery of shipments to end users, i.e., the last mile delivery (LMD).

Given the long-term growth in demand for these services and considering the numerous limitations and sustainability issues associated with transport services in urban areas, this topic remains highly relevant and requires ongoing systematic research.

The thesis formally contains all the necessary elements. The syntax and semantics are of a good standard. The overall structure of the thesis is logical, from the introductory theoretical sections on the concept of urban logistics and the theoretical basis of multi-criteria decision-making. Then continues to a description of the current state of the art, a definition of the dissertation's objective, and a description of the methodological apparatus. Finally describes to the actual proposal of a new modified method of multi-criteria decision-making with implementation and verification using data from real delivery operations.

Moving on to the expertise and content aspects. I was pleasantly surprised by the theoretical section's presentation of the LMD transport modes used, with pictures and their descriptive characteristics, which I, as a reader, subsequently expected to see in the multi-criteria decision-making process. However, the actual use of the method concerned other criteria, such as the number of planned shipments per day, picked up from the customer's address, actually delivered shipments, etc.



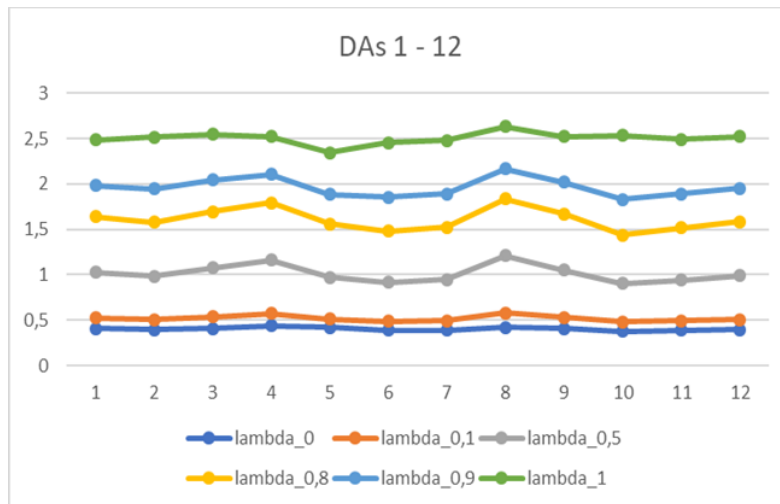
The methodological approach outlines general research methods that have been the subject of numerous publications over many years; in my opinion, it was not necessary to include them in this detail in the thesis. On the other hand, it can be said that the thesis is very comprehensible even for readers who are unfamiliar with this domain.

I fully agree with the author that it is very important to determine the correct normalization technique, as it influences further calculations in the decision-making process. The author presented her "adaptive approach," where the technique can be "selected" in the sense of determining and setting the beta parameter between two normalization techniques (linear and vector).

Personally, I believe that the normalization technique should be determined according to the nature of each relevant data series, i.e., different normalization techniques often need to be used for different criteria.

Proposed AROMAN ranking formula implements coefficient of the criterion type that powers (with complementary variables lambda and 1 minus lambda) SUMs of min/max weighted and normalized values with and finally computation their difference in exponential function. The thesis presents and discusses the reasons for this ranking function proposal, but I did not find their verification in some artificial data example.

Chapter 6 presents implementation and verification of the AROMAN method by means of comprehensive calculations in clear tables and graphs for assessment the delivery areas in the territory of Novi Sad. It is performed Sensitivity Analysis and Comparative Analysis, also recommendations for private postal operator.



For a clearer view, it would be more appropriate to show Figure 27 as a line graph rather than a bar graph. Personally, I would again perform sensitivity analysis on



artificial data; the stability presented here suggests that the lambda parameter is rather unnecessary.

The last part of the thesis before the conclusion is devoted to summarizing the author's contributions and responses from the scientific community. As an opponent, I am really very pleased with the amount of interest in this method, but I do not think that the text of the scientific response should be part of the dissertation itself.

To clarify the complex solution to the problem, I would ask the author to explain the following topics during the defense:

- 1) Have you tested your MCDM method AROMAN on artificial model data?
- 2) Could you explain Equation (32)?
  - a) Why the ideal case for integrated normalization can be 0,5 for beta parameter?
  - b) Is interpretation of this equation in the Figure 21 AROMAN flowchart correct?
- 3) Explain how do you would approach normalizing a criterion that is inherently nonlinear?
- 4) Explain the reasons behind the construction of your proposed Ranking Equation?

Despite the aforementioned shortcomings, I consider the objective of the thesis to have been fulfilled and the thesis to be very good, demonstrating not only the author's theoretical knowledge, but also his ability to apply it in practice in his field of specialization.

In my opinion, the work under review fully meets the requirements for a dissertation, and I therefore recommend its acceptance and that the author be allowed to defend it for the award of a Ph.D. degree.

In Prague, February 16, 2026

doc. Ing. Pavel Hrubeš, Ph.D.