

Project Proposal: Developing a Multi-Criteria Decision Analysis (MCDA) Tool for Prioritizing Street Interventions Based on Traffic Danger

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Introduction

The safety and well-being of vulnerable groups such as pedestrians and cyclists crucial in urban planning and transportation management. City authorities often grapple with limited resources and budgets, making it challenging to prioritize which streets need urgent interventions to mitigate traffic-related hazards. This project introduces the development of an advanced Multi-Criteria Decision Analysis (MCDA) tool. Designed to support decision-makers, the MCDA tool facilitates systematic evaluation and prioritization of street interventions using a range of criteria related to different transport issues.

The MCDA tool is vital for engaging various stakeholders, offering a structured and transparent decision-making framework (Marleau Donais et al., 2019). It integrates both quantitative and qualitative data and can draw on expertise from diverse fields such as traffic engineering, urban planning, and community input, ensuring a well-rounded analysis of potential interventions (Macharis & Bernardini, 2015). By simulating different scenarios, the tool promotes informed discussions among stakeholders, enabling them to visualize outcomes and collaborate effectively. Furthermore, it aids in prioritizing interventions by objectively assessing their effectiveness based on multiple criteria. This capability is essential for resolving conflicts and aligning resources with solutions that have the highest impact.

Through this structured approach, the MCDA tool enhances communication, fosters consensus, and ensures that the decisions made are robust and widely supported.

Objectives

The primary objectives of this project are:

1. Identify relevant criteria for: 1) the assessment of traffic danger; 2) the prioritization of places for intervention; and 3) choosing appropriate intervention. This requires a thorough review of existing literature and to engage with stakeholders to identify the key criteria that should be considered. In the context of prioritizing street interventions, such as collision rates, traffic volume, pedestrian/cyclist activity, road infrastructure conditions, and socioeconomic factors. The final criteria are determined through consensus with the stakeholders.
2. Develop the MCDA Framework: Design a robust MCDA framework that integrates the identified criteria and allows for the systematic evaluation and prioritization of street segments based on different transport issues and/or The City of Westmount's mandates.

3. Implement the MCDA Tool: Develop an application that implements the MCDA framework, enabling city authorities to input relevant data, analyze the streets, and generate prioritized recommendations for intervention.

4. Validation: Conduct pilot testing of the MCDA tool, gather feedback from participants, and refine the tool to ensure its accuracy, effectiveness, and ease of use.

5. Dissemination and Capacity Building: Provide training and documentation to support the adoption and implementation of the MCDA tool by city authorities and transportation planning agencies.

Methodology

Phase 1: Data Preparation and Education

1. Data Preparation

- Descriptive Summary Reports for Westmount: This phase assists in preparing all necessary data regarding Westmount, including public surveys, collision data, and existing traffic measures.
- Data Review and Update: Ensure that all collected data are current and relevant for incorporation into the next phase of the project.

2. Education and Stakeholder Engagement

- Workshops: Conduct one or two workshops aimed at explaining the objectives and processes of the MCDA to enhance stakeholder understanding and engagement.
- Practical Application of MCDA: Discuss how the MCDA tool can be applied to various city mandates, focusing on practical aspects tailored to the specific needs of Westmount.
- Presentation of Existing MCDA Model: Present the current MCDA model to stakeholders to evaluate its suitability and gather feedback on necessary adaptations for Westmount.

Phase 2 Development and Adaptation of the Traffic Danger Assessment Tool

The research team at Polytechnique Montréal led by Professor Owen Waygood is developing a tool for assessing traffic danger at intersections and segments separately. A collaborative process was used to develop this tool by different stakeholders and experts. The outcome has been applied and validated for the City of Montreal with local and external experts. With the help of the City of Westmount experts, it is possible to consider adapting this tool in the following ways:

- Consider if there are any changes in the criteria list based on the stakeholder feedback.
- Adapt the MCDA tool based on the available data, update some variables, and visualize the new model.
- Validate the traffic danger index with the stakeholders.
- Prepare a final report for this phase.

Phase 3: Prioritization Index

In prioritizing transportation projects to address different issues (here, crash risk), it is vital to integrate multiple factors that impact the effectiveness and necessity of each intervention (Castillo & Pitfield, 2010). As an example, regarding the “Safe Route to School” project, The Traffic Danger Index (described above) provides a critical input to measure risk assessment for roads or specific locations, but it is only one of many considerations. Given the complexity of the issues, collaboration with diverse experts is necessary to ensure a thorough evaluation. Factors influencing this prioritization include not only the

Traffic Danger Index but also demographic and infrastructural elements such as the number of schoolchildren, priority destinations like schools and parks, proximity to educational institutions, and the condition of existing active transport infrastructure. Experts from various fields contribute specialized insights, enhancing our understanding of the most critical areas for intervention.

This phase focuses on prioritizing segments and intersections based on input from the appropriate stakeholders at the City of Westmount. In this process, experts from different fields contribute their expertise based on their understanding of the local context. By convening workshops where these experts can share their perspectives, we ensure that all relevant aspects of potential interventions are considered. This collaborative approach helps in achieving a consensus that accommodates diverse and sometimes conflicting viewpoints. This approach thus establishes an agreed upon methodology of evaluating the street network so that each segment and intersection does not require a renewed debate among the stakeholders.

Proposed steps for this phase:

- **Stakeholder consultation:** Engage with stakeholders to define critical considerations for prioritizing street interventions.
- **Variable identification:** Collaborate with stakeholders to identify and agree on the variables that should influence prioritization, based on the project's objectives.
- **Method selection:** Select the most suitable MCDA method to assess the weight of each variable.
- **Index calculation and visualization:** Calculate the priority index and use visual tools to allow for a spatial understanding (and search) of the current network.

The outcome of this phase will be a clearly defined prioritization of streets and intersections to address crash risk (i.e., traffic danger suffered by residents) based on comprehensive analysis and expert consensus.

Phase 4: Choosing the Intervention

In urban planning and development, selecting projects is a critical concern for municipalities and various agencies. Effective project selection must strike a long-term balance among environmental integrity, social equity, and economic efficiency (Gonçalves et al., 2022). The challenge lies in the "best compromise project," which involves evaluating each potential intervention against multiple, often conflicting criteria—these can be economic, social, and environmental and may include both quantitative and qualitative factors. Not every proposed intervention is suitable for implementation, and multiple aspects must be considered in the decision-making process. In places like the City of Westmount, where collaboration across different groups and departments is essential, the selection of interventions requires thorough discussion among the appropriate stakeholders. Based on this need, the following steps can be proposed:

1. Definition of intervention project:

- **Literature review:** Conduct a comprehensive review of previous and similar projects in comparable contexts, considering all aspects of each project.
- **Brainstorming session:** Engage with local experts and stakeholders (if necessary) to finalize a list of potential interventions based on identified problems.

2. Criteria construction:

- Consider various factors when deciding on an intervention. These factors can be grouped into several categories:

Design Criteria: such as Emergency vehicle access, environmental limitations, etc.

Operational Criteria: Classification, quality, and conservation status.

Financial Criteria: Cost and financing options.

Political Criteria: Commitment from local leaders and potential political impact.

Social Criteria: Public acceptability and support.

3. Decision-making method development:

- Choose and develop a decision-making method to appropriately weight the final list of criteria.

4. Visualization and validation:

- Visualize, present, and validate the final list of interventions with stakeholders to ensure transparency and consensus.

This structured approach ensures that the selected intervention not only addresses the City's immediate needs but also aligns with broader social, economic, and environmental goals. By involving a diverse group of stakeholders in the decision-making process, the chosen interventions are more likely to be supported and successfully implemented.

Expected Outcomes

The successful completion of this project will result in the following outcomes:

1. A robust and user-friendly MCDA tool for prioritizing street interventions based on risk due to traffic danger.
2. Improved decision-making capabilities for city authorities and transportation planners in allocating limited resources to address the most pressing traffic danger issues.
3. Enhanced collaboration and knowledge-sharing among stakeholders, including city authorities, transportation experts, and community members.
4. Increased awareness and adoption of MCDA techniques in the field of transportation planning and traffic safety management which can facilitate and can be used in all mandates which need decision making.

Project Timeline and Budget

The project is expected to be completed within 12 months, with the following tentative timeline:

- Phase 1 - Data Preparation and Education (June 2024-August 2024)
- Phase 2 - Adaptation of the Existing MCDA Model (July 2024-September 2024)
- Phase 3 - Prioritization Index (September 2024- December 2024)
- Phase 4 - Choosing the Intervention (January 2025- May 2025)

Regarding the budget, the estimated total for the entire process is \$22,500. This amount is calculated by multiplying the base unit of \$7,500 by three, which allows for the funding of three internship units through the federal program Mitacs. Each internship must contribute to a research objective that is in line with

the partner's (City of Westmount) needs. In this case, the internships relate to the research objectives of developing collaborative tools to better integrate children's travel safety into transport planning.

Conclusion

The development of a comprehensive MCDA tool for prioritizing and choosing street interventions based on traffic danger will provide city authorities with a powerful decision-making aid to enhance transportation safety and improve the overall well-being of urban communities. By systematically evaluating multiple criteria and generating prioritized recommendations, this project will contribute to more efficient and effective resource allocation, ultimately leading to safer and more livable cities. Based on the multidisciplinary nature of the urban project and the engagement of different groups of stakeholders, the MCDA approach can be a novel way to assess, rank and implement different projects.

Reference

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