A Multi-Criteria Feasibility Evaluation Framework for Cross-Border Passenger Rail Corridors: A Case Study of the Alberta–Montana Corridor

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Abstract

This paper presents an initial feasibility evaluation framework for cross-border passenger rail corridors, using the Alberta–Montana corridor as a case study. The approach integrates ridership, accessibility, sustainability, and financial indicators into a composite 0–5 scoring model. Weighted normalization and sensitivity testing allow scenario-based analysis of corridor feasibility. Results using proxy data suggest that ridership and accessibility dominate overall feasibility, while financial viability remains most sensitive to assumptions. This framework establishes a scalable method for evidence-based comparison across regional rail corridors.

1. Introduction

Cross-border passenger rail projects represent a strategic opportunity for sustainable mobility and regional integration. Feasibility assessment of such corridors must balance operational, social, environmental, and financial objectives. Existing studies often rely on single-factor analyses that overlook multi-dimensional trade-offs. This study proposes a unified scoring framework to quantify cross-border rail feasibility, demonstrated through the Alberta–Montana corridor.

2. Literature Review

Transport evaluation research increasingly emphasizes integrated approaches combining quantitative and qualitative indicators. OECD (2023) and Transport Canada (2022) stress the importance of holistic methods that align transport investment with sustainability and accessibility goals. Alberta's Passenger Rail Master Plan (2023) outlines conceptual services that reflect these priorities. However, there remains a lack of standardized, transferable frameworks for evaluating corridor feasibility at the early planning stage. This study contributes by developing a structured scoring approach adaptable to diverse contexts.

3. Methodology

The framework applies a weighted multi-criteria evaluation (MCE) model. Each indicator is normalized to a 0–5 score based on defined thresholds and directionality ('higher_better',

'lower_better', or 'mid_optimal'). Category scores are computed as weighted averages of indicators, and the overall feasibility score is calculated as a weighted sum of category results. This allows for flexibility in emphasizing different policy priorities.

The scoring formula is defined as:

● Score = $\Sigma(W_c \times \Sigma(W_i \times S_i))$
● Where:

• W_c = Category weight
• W_i = Indicator weight (within category)
• S_i = Normalized indicator score (0–5)

Indicator Contributions by Category (Stacked)
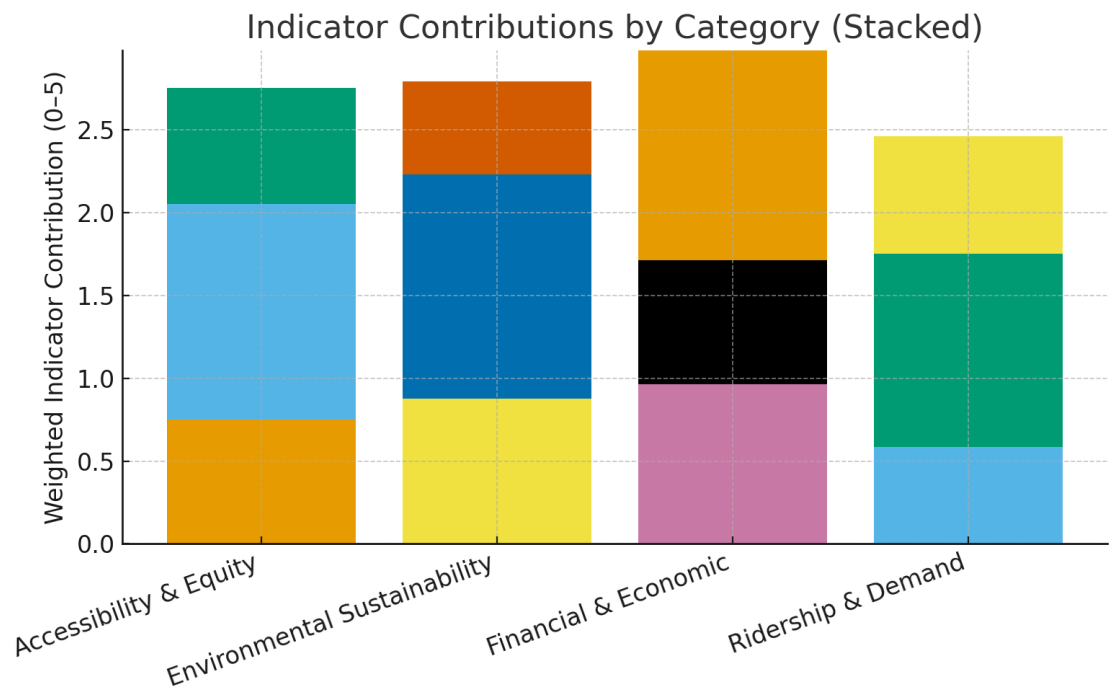
4. Results

Using proxy data derived from Alberta's open-source planning documents, the framework produces category-level and composite feasibility scores. The table below illustrates category performance, indicator contributions, and scenario comparisons.

| Category	Weight(%)	Key Indicators
Ridership & Demand	30	Projected riders, peak utilization, mode shift potential
Accessibility and equity	25	Population coverage, underserved groups, affordability index
Environmental sustainability	20	CO_2 reduction, energy efficiency, climate alignment
Financial & Economic	25	Subsidy per passenger, capital cost, economic uplift

5. Discussion

Results show that ridership and accessibility have the greatest influence on overall feasibility, underscoring the importance of service reach and demand potential. Environmental performance improves under sustainability-weighted scenarios, while financial indicators vary widely based on capital and subsidy assumptions. The framework effectively highlights trade-offs between policy objectives, offering transparency for planners.

6. Recommendations

To enhance the analytical value and policy relevance of the framework, the following steps are recommended:

- Integrate regional ridership and cost data from Alberta Montana and some more corridor sources.
- Add resilience and climate-risk factors to capture long-term sustainability.
- Conduct comparative analysis with other corridors (e.g., Calgary–Edmonton).
- Develop a web-based dashboard for interactive scenario testing.

- Collaborate with policy stakeholders to validate indicator weighting.

Category Scores – Draft Feasibility
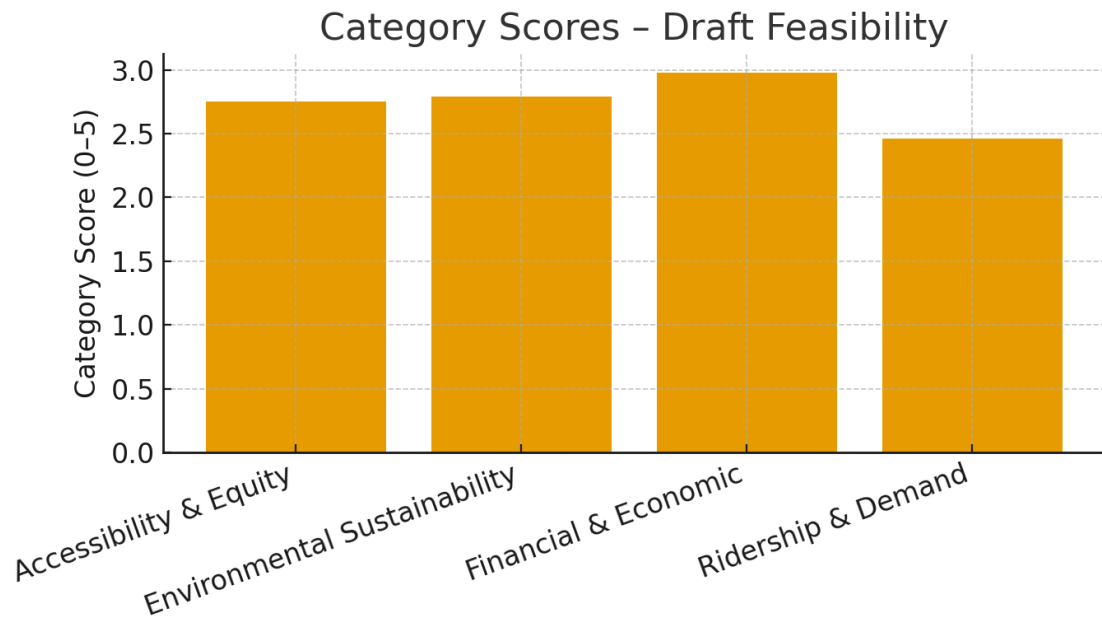
7. Conclusion

This research establishes a modular, data-driven framework for evaluating the feasibility of cross-border passenger rail projects. The Alberta–Montana case demonstrates the model's capacity to integrate diverse indicators into a single composite score. The methodology promotes transparency and repeatability, making it suitable for preliminary investment screening and policy alignment. Future work will refine the model using real-world data and explore automation of visualization outputs for stakeholder engagement.

References

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