Feasibility Methodology for Intercity and Tourist Rail Corridors: Modeling Framework Applied to the Wenatchee - Oroville Corridor

Aakarsh Verma

Theoretical Frameworks for Ridership Forecasting in Hybrid Corridors

The discipline of ridership forecasting is often bisected into two distinct schools, the utilitarian approach used for commuter transit and the experience-based approach used for leisure travel. Developing a robust feasibility study for a hybrid corridor requires reconciling these two opposing methodologies into a unified model.

The Limitations of Utility Maximization in Leisure Rail

Standard transit modeling is predicated on the theory of utility maximization, where a traveler chooses the mode of transport that minimizes the "generalized cost" of the trip. Generalized cost is a composite metric combining out-of-pocket expenses (fares, fuel, parking) and the value of time (in-vehicle time, wait time, access/egress time). In this framework, slower modes are penalized heavily.

For a corridor like Wenatchee-Oroville, currently operating at Class 2 freight speeds (approx. 25 mph), a utility maximization model would forecast near-zero ridership. The travel time by rail from Wenatchee to Oroville would exceed 5 hours, compared to 2.5 hours by private automobile on US-97. If the feasibility study relies solely on software like STOPS, the project will appear flawed.

However, research into tourist behavior demonstrates that for leisure travelers, travel time is not solely a cost to be minimized, it can be a benefit to be maximized if the quality of the time is high. This "positive utility of travel" is the economic foundation of the excursion rail industry. Passengers on the Rocky Mountaineer or the Napa Valley Wine Train are paying specifically for the duration of the experience. Therefore, the "best" model for this feasibility study must invert the traditional time-penalty coefficients used in commuter forecasting.

The Gravity Model for Interregional Demand

To establish a baseline for travel demand between the population nodes along the corridor, the feasibility study should employ a calibrated Gravity Model. This model posits that the volume of travel between two nodes is directly proportional to their "mass" (population or economic size) and inversely proportional to the "friction" (distance or cost) between them.

The standard equation is expressed as:

$$T_{ij} = K \frac{P_i P_j}{f(d_{ij})}$$

Where:

- T_{ij} is the trip volume between node $'i'$ (e.g., Wenatchee) and node $'j'$ (e.g., Chelan).
- P_i and P_j are the respective populations.
- $f(d_{ij})$ is the friction factor based on distance or time.
- K is a proportionality constant derived from calibration.

Adaptation for Tourism in a standard application, P_j would be the resident population of the City of Chelan (approx. 4,000). This would yield a negligible trip generation forecast. To accurately model the corridor's potential, the feasibility study must substitute the "Effective Service Population" for the resident population. For Chelan, the effective population during the peak summer season swells to 25,000, with an annual flux of 2 million visitors.

Furthermore, the friction factor $f(d_{ij})$ must be adjusted. In intercity rail modeling, the "Reverse Gravity Model" is often employed to estimate flows from origins to stations. For the tourist segment, the friction of distance is non-linear, it increases until a certain threshold (e.g., 4 hours) when the trip becomes too long even for leisure. The feasibility model must determine this "decay function" through Stated Preference surveys.

The TEAR Model: Quantifying Intangible Assets

While the Gravity Model estimates the *potential* volume of people moving between nodes, it does not account for the *attractiveness* of the rail alignment itself. To solve this, the feasibility study should integrate the **Tourist Evaluation of Abandoned Railways (TEAR)** model. Developed to assess heritage rail revitalization in Europe, TEAR provides a scoring matrix across four domains:

1. **Natural Values (NV):** The visual quality of the landscape (rivers, canyons, mountains).

2. **Anthropogenic Values (AV):** Human-made attractions along the route (wineries, historical bridges, tunnels).
3. **Tourist Attractions (TA):** Proximity to established destinations (resorts, museums, parks).
4. **Functional Values (FV):** Connectivity to other transport modes (Amtrak, airports) and track quality.

By assigning quantitative scores to these qualitative assets, the TEAR model allows planners to generate an "Attractiveness Index." This index effectively serves as a multiplier in the ridership forecast. A high TEAR score justifies a higher "Market Capture Rate," allowing the model to predict that a specific percentage of regional tourists will divert to the train.

Analogous Case Study Analysis (Reference Class Forecasting)

The final pillar of the theoretical framework is Reference Class Forecasting. This method mitigates "optimism bias" by comparing the proposed project to a reference class of similar completed projects. For the Wenatchee-Oroville corridor, the feasibility study must be benchmark against systems that share their morphological characteristics:

- **Segmented Markets:** Systems that serve both high-end tourists and locals (e.g., the Grand Canyon Railway's role in park access vs. luxury domes).
- **Rural Context:** Lines operating in low-density environments (e.g., Verde Canyon Railroad).
- **Wine/Culinary Focus:** Lines integrated with viticulture (e.g., Napa Valley Wine Train).

Data from these reference classes provide the "priors" for the Bayesian inference used in the ridership model, specifically regarding operating costs, capture rates, and ticket price elasticity.

The Target Corridor: Profile of the Cascade and Columbia River Railroad

To produce a realistic feasibility report, theoretical models need to be based on the hard physical and operational realities of the corridor. The CSCD has its unique set of variables that will dictate the inputs for the ridership model.

Physical Infrastructure and Route History

The CSCD runs on 131 miles of track laid originally by the Great Northern Railway in 1914 to connect Wenatchee with the Vancouver, Victoria and Eastern Railway in British Columbia. This is the kind of historical pedigree that would be important in applying the TEAR model's "Anthropogenic Value" score to the line, as it contains several significant engineering works dating from the early 20th century.

Key Infrastructure Assets:

River Alignment: From Wenatchee, the route travels north along the Columbia River, then at Brewster shifts into the Okanogan River valley, and finally, near Oroville, it follows the Similkameen River. This continuous river frontage maximizes the "Natural Value" score.

Bridges and Tunnels: The line has a 137-meter tunnel east of Oroville and major bridges over both the Methow and Okanogan rivers. These are "hero" features for marketing a scenic train.

Right-of-Way: The right-of-way is intact and actively managed for freight, avoiding the immensely costly procedures of reassembling abandoned corridors.

Operational Constraints: The line is currently a short-line freight operation that is owned by Genesee & Wyoming (G&W). It is likely maintained to FRA Class 2 standards, which limits freight trains to 25 mph and passenger trains to 30 mph.

Impact on Modeling: A 30-mph speed limit equates to a travel time of 4.5 to 5 hours for the full 135-mile run. In effect, this would disqualify the "commuter" or "business travel" segments from the ridership forecast, making a model reliant almost exclusively on the leisure and transit-dependent markets.

Upgrade Costs: The feasibility study shall model the CapEx required to upgrade key segments to Class 3 (60 mph passenger) service. If the full-line upgrade cost is prohibitively expensive, a "Segmented Service" scenario shall be tested by the model whereby only the Wenatchee-Chelan segment is upgraded.

Operational Environment and Interference with Freight

Feasibility is not just about demand; it's about capacity. CSCD hauls timber products, limestone, and other commodities. Passenger service cannot disrupt these revenue-generating operations.

Single Track Constraints: Most of the lines are single track. The feasibility model needs to contain a "Pathing Analysis" to identify whether there are adequate existing sidings for passenger trains to pass and meet freight trains. Temporal Separation: Many short lines use temporal separation, operating passenger trains during the day and freight at night. This minimizes the need for expensive forms of CTC signaling systems but does reduce freight operator flexibility. The study should address G&W's willingness to accept this type of restriction. Liability and Insurance: Carrying passengers on a freight line introduces significant liability. The cost of insurance, generally $200M+ coverage, must be factored into the OpEx model and will greatly influence the break-even ridership target.

Reference

"Statewide Rail Capacity and System Needs Study" https://wstc.wa.gov/wp-content/uploads/2019/09/Rail-TM1-1-A-WashStateFreightRailsys.pdf

"HAPPY PASSENGERS TRAVEL MORE: How to measure and improve Customer Experience by Rail" https://uic.org/IMG/pdf/20241215_cemp2-report-final_maj.pdf

"ST3 Regional High-Capacity Transit System Plan Transit Ridership Forecasting Methodology Report" https://www.wsdot.wa.gov/partners/erp/background/ST3%20Draft%20RidershipForecastingMethodologyReport_6March2015.pdf

"Travel Demand Forecasting, The Gravity Model" https://www.princeton.edu/~alaink/Orf467F12/The%20Gravity%20Model.pdf

"HSIPR Best Practices: Ridership and Revenue Forecasting" https://www.oig.dot.gov/sites/default/files/2023-11/OIG-HSR-Best-Practice-Ridership-and-Revenue-Report.pdf