Executive Summary

Missouri Freight and Passenger Rail Capacity Analysis

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Study Objective

The primary objective of this study was to develop a prioritized list of rail enhancements that addresses current passenger and freight rail performance on the Union Pacific line between St. Louis and Kansas City in order to improve on-time passenger service and reduce freight delays**.** The MoDOT Tracker performance measure related to this project is the "Number of Rail Passengers" within the performance objective of "Easily Accessible Modal Choices". In this study the key analysis issue is the delay encountered by both Amtrak for passenger and Union Pacific for freight operations. This issue directly impacts the MoDOT Tracker performance measure "Number of Rail Passengers" since it has been found that passenger train delays are directly correlated with the number of passengers utilizing rail service.

Study Approach and Scope

A four step approach was used in this study. First, the St. Louis-Kansas City Union Pacific rail line was assessed using a Theory of Constraints (TOC) approach to determine key capacity restrictions and congestion factors. Second, a simulation model was developed to examine candidate improvement alternatives. Third, a set of rail enhancement alternatives were generated. Fourth, alternatives were analyzed and prioritized with respect to system performance improvement and capital investment requirements.

The Union Pacific rail corridor between Saint Louis and Kansas City is comprised of three Subdivisions. The Jefferson City subdivision between Saint Louis and Jefferson City is mostly two tracks with bi-directional travel (except where the railway has two-way travel on single track bridges over the Osage and Gasconade Rivers). The Sedalia subdivision is single track (with sidings) with bidirectional flow of traffic when there is an eastbound passenger train which currently occurs twice per day. The River Subdivision is a single track (with sidings) with unidirectional flow of several different types of freight traffic.

Study Results and Analysis

The Theory of Constraints analysis identified the core problem as the high level (and increasing) train load, both from a quantity and weight of train perspective. From a train quantity perspective this corridor is handling between 50-60 trains per day which is at the upper limits of capacity for a double track line handling the types of freight that it does. From a train weight perspective this corridor handles a large percentage (roughly 50%) of heavy coal trains. As a result of this core problem there are four issues that ultimately impact the overall level of delay on the corridor.

1. Geographic Conditions – The double track in the Jefferson City Subdivision follows the Missouri River. The sub-grade in this Subdivision requires a substantial amount of maintenance in order to handle the heavy axle loads of a full coal train. Prior to maintenance there are an increased number of slow orders and during major maintenance activities all train traffic is affected due to reduced hours of operation.

2. Maintenance Processes – As a result of the geographic conditions and the high train load level on the corridor, the task of scheduling both routine and major maintenance windows is non-trivial. This is further complicated when combined with the scheduling of signal and track inspections.

3. Crew Scheduling – Increased train load increases the crew scheduling task complexity and has the potential to increase corridor congestion when crews exceed their 12 hours of allowed service and become "dead on hours" before reaching their crew change locations.

4. Amtrak Dispatching Priority – Increased freight load within a high maintenance and partially single track (with limited sidings) rail corridor makes it increasingly difficult to provide passenger train priority.

An analysis of the 2005 Amtrak Delay Reports reveals that the majority of train delay is caused by Freight Train Interference (FTI = 53.38%), Temporary Speed Restrictions (DSR = 15.09%), and Passenger Train Interference (PTI = 9.7%). Figure 1 shows the track segment contribution to overall passenger train delay.

Based on the Theory of Constraint analysis and the delay analysis a set of six primary rail enhancement alternatives (with some having multiple options) were generated, together with potential alternative combinations. The alternatives were generated with respect to minimizing congestion, and therefore delay, within and between freight and passenger trains (i.e. sidings and additional track). This approach is in contrast to improvement alternatives that specifically focus on improving overall train speed (i.e. sealed corridors, track curvature, etc.). However, as congestion and delay is minimized there is a corresponding increase in average train speed. Figure 1 shows the location of these enhancement alternatives.

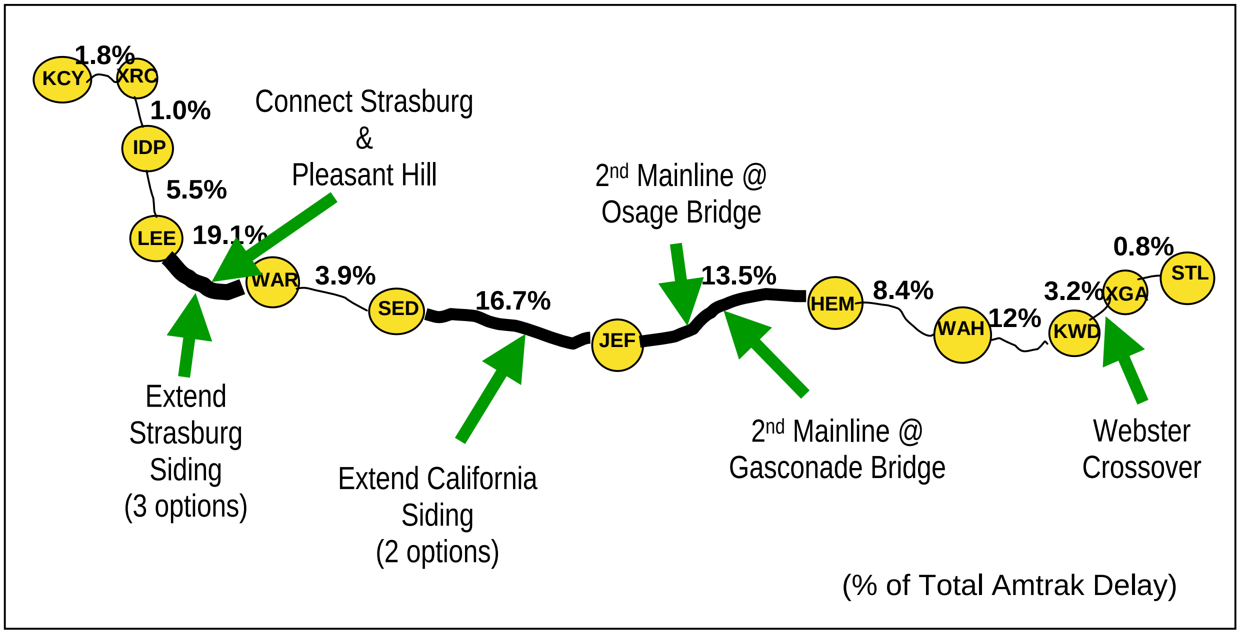

Figure 1: Primary delay locations and associated rail enhancement alternatives

The rail alternatives were analyzed by simulating the reduction in overall time for a train to cross the state of Missouri. The 2005 train volume (approximately 53 freight trains and 4 passenger trains per day) and mix (approximately 7% passenger, 43% commodity, and 50% inter-modal / manifest) was used as the basis of the analysis. The model was developed using Rockwell Automation's Arena simulation modeling software. For this study a performance baseline is assumed based on a scenario where all track from St. Louis to Kansas City is double track (implying that the Sedalia subdivision is double tracked and both the Gasconade and Osage bridges are double track) and then an alternative's overall percentage delay reduction with respect to the baseline scenario for both freight and passenger trains is calculated.

Examining the simulation results revealed two major trends: 1) the Sedalia subdivision alternatives provide more relative benefit with respect to reducing overall delay for Amtrak passenger trains (average benefit of Sedalia subdivision alternatives for Amtrak is 14.4% vs. 6.8% for UP), and 2) the Jefferson City subdivision alternatives provide more relative benefit for UP freight trains (average benefit of Jeff City subdivision alternatives for UP is 20.9% vs. 5.0% for Amtrak). Table 1 presents an analysis of each of the rail enhancement alternatives for both Union Pacific freight and Amtrak passenger rail service with respect to the percentage of delay reduction per million dollars of estimated project cost. Note that the cost used in the analysis is the underlined cost for each alternative (multiple costs for each alternative reflect different implementation options that are detailed in the full project report).

Table 1 - Comparison of Alternatives with respect to % Delay Saved per $M invested

	% UP Delay Savings / $M	**% Amtrak Delay Savings / $M**	**Cost in Millions**
Sedalia Subdivision Alternatives			
S1 - Extend California Siding	1.48	3.97	4 or 2.5
S2 - Extend Strasburg Siding Freight	0.83	0.85	10 or 8 or 2
S3 - Connect Strasburg & Pleasant Hill Sidings	0.01	1.12	10.5
S4 - Both Extend California Siding & Extend Strasburg Siding for Freight	0.90	0.88	14 or 12.5 or 12 or 10.5 or 6.5 or 4.5
S5 - Both Extend California Siding & Connect Strasburg & Pleasant Hill Sidings	0.50	1.62	14.5 or 13
Double Track LEE_JEF (130 miles)	0.08	0.11	260
Jefferson City Subdivision Alternatives			
J1 - Osage Bridge	1.16	0.60	15 or 28
J2 - Gasconade Bridge	0.89	0.26	21
J3 - Gasconade/Osage Bridges	0.76	0.11	36 or 49
J4 - Webster Crossover	8.00	0.56	2.5

The following discussion is based on the objective to maximize the Delay Savings / $M obtained in Table 1. In the Sedalia subdivision alternative S1 (Extend California Siding) clearly dominates all other alternatives as it provides significant benefit with respect to the project cost for both freight and passenger operations. Alternatives S4 and S5 also merit further consideration as they both provide relatively strong benefit; however, S5 tends to provide more benefit to passenger rail service. In the Jefferson City subdivision alternative J4 (Webster Crossover) clearly dominates all other alternatives as it provides a very significant benefit for freight rail operations and a moderate benefit for passenger rail operations Based on the fact that J4 has already been implemented by Union Pacific and J2 is in process of implementation, alternative J1 (Osage Bridge) should also be considered as it provides a significant benefit for both freight and passenger rail operations.

Recommendations

Based on the analysis conducted this study makes the following recommendations to be implemented in the order listed below:

1) Alternative S1 - Extend California Siding - option 2; Estimated cost = $4 million
2) Alternative S3 - Connect Strasburg and Pleasant Hill Sidings; Estimated cost = $10.5 million
3) Alternative J1 - 2nd Mainline on Osage Bridge; Estimated cost = $15-28 million

Additionally, the current Union Pacific Maintenance processes warrant further analysis as they could provide reduction in overall passenger train delay performance without significant investment. Therefore, it is recommended that the scheduling of routine and major maintenance windows, and the scheduling of signal and track inspections, be further analyzed with respect to overall system delay performance.