Washington State Transportation Commission

Statewide Rail Capacity and System Needs Study

Task 4 – Rail Operations: Strategies and Improvements

Technical Memorandum

prepared for

Washington State Transportation Commission

prepared by

HDR, Inc.
Transit Safety Management

August 2006

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■ Summary

Recent increases in intermodal rail traffic through Washington's ports have caused considerable congestion on the State's rail system, highlighting how fragile the rail network is within Washington. For shippers and the railroads to accommodate the forecasted rail traffic growth in (through) Washington, operating practices must be improved and greater efficiencies realized from the existing rail network. Operational changes alone will not be able to meet the forecasted demand; they will need to be incorporated as a balanced system of improvements.

Nowhere is the impact of operating practices more evident than on the joint Burlington Northern Santa Fe Railway (BNSF)/Union Pacific Railroad (UP) main line between Vancouver, WA and Centralia, WA. Based on locomotive availability and other factors, BNSF makes tactical decisions almost daily about whether to divert a number of intermodal trains south to the Columbia River rail corridor between Vancouver, WA and Pasco, WA versus routing them over the more direct Stevens Pass route.

Adding intermodal traffic to a line heavily used by unit grain and general merchandise trains has significantly increased congestion on the I-5 rail corridor between Vancouver, WA and Tacoma, WA. In theory, this signalized double-track rail corridor should have more than enough capacity to handle the current train traffic. However, this line has traditionally been operated as a single-track railroad, with work events occurring on the main track adjacent to the grain terminals. The grain terminals lack properly sized leads to arrive trains at higher speed. The line also has a significant bottleneck in Vancouver, WA, where the line connects to the Columbia River rail corridor. Due to the operating practice of using one main line to service the grain terminals in Kelso, WA and Longview, WA, and with BNSF diverting intermodal trains to the corridor, a significant portion of this line's capacity is consumed, and trains die on the main lines because there is no place for them to go or enough time left for the crew to get there.

Both the BNSF and UP have stated that this I-5 rail corridor congestion has been and continues to be their biggest issue regarding rail congestion, chokepoints, and their ability to reliably operate freight service. Are there infrastructure improvements identified to relieve this congestion? Yes; Washington State, as part of its intercity rail program, is funding projects at Vancouver and Kelso-Martins Bluffs. Are there operating strategies that can be employed to reduce this congestion? Yes; but to succeed, these strategies must be supported by balanced infrastructure improvements throughout the system if we are to realize the full capacity of the I-5 rail corridor; otherwise, trains will continue to be parked

on the line. The root cause of this congestion is limited east-west capacity to accommodate the increased traffic.

Operational strategies to increase the capacity of the system, such as increasing train lengths and velocities or diverting intermodal trains to Stampede Pass, must be considered carefully when developing a balanced solution; otherwise, it is possible that the only achievement will be creating the need for additional infrastructure improvements at newly created bottlenecks before the operating benefits are realized.

It is important to note that locomotive availability is an important factor in deciding whether intermodal trains are routed via Stevens Pass or the Columbia Gorge route. Thus, locomotive availability will be a significant consideration if Stampede Pass is improved. Regardless of infrastructure improvements, trains may continue to be routed via the Columbia Gorge route if locomotive availability is not addressed.

Objective

This technical memorandum documents operational strategies currently being considered by the State's rail carriers, and identifies other strategies that can be employed to increase capacity. The objective of this technical memorandum is to identify operating strategies that will enable Washington State to achieve the projected growth in rail traffic, while optimizing the return on the investment required for providing reliable rail service.

Rail Operating Strategies and Improvements

What Operating Strategies and Improvements Are Being Considered by the Railroads?

"Velocity" is the term that is increasingly used to define and measure capacity on a rail network. Locomotives, general merchandise, and agriculture railcars are measured in miles per day; unit coal trains by cycle index; and intermodal by transit days (cutoff to availability). Speed, yard dwell time, availability and distribution of locomotives and railcars, length of trains, and the utilization of equipment determine velocity. Strategies that the Class 1 railroads are using for improving the train velocity and increasing capacity are summarized below and include the following:

- Longer trains;
- Consolidating primary switching locations;
- Consolidated dispatching center;
- Carrier and routing alternatives;

- Scheduled point-to-point service;
- Improved intermodal terminal production;
- Reducing/eliminating main line work events;
- Co-production;
- Switching zone agreements;
- Rationalizing carload network:
  - Truck/rail transloading facilities,
  - New carload gathering/distribution centers, and
  - Remarketing of unprofitable traffic.

Can the Operational Changes Accommodate the Forecasted Rail Growth?

Cargo forecasts by Global Insights project international intermodal cargo to grow by 129 percent by the year 2025. This growth will account for the majority of the increased rail traffic over the State's rail network. In a technical memorandum entitled, *Task 3 Rail Capacity Needs and Constraints*, cargo forecasts by Global Insights were converted into train volumes based on information provided by BNSF. Assumptions used to convert forecasted tonnage to average daily train volumes included:

- Intermodal train lengths will increase to 8,000 feet and railcar utilization (slot utilization) will increase from 93 percent to 100 percent. This will increase the capacity of each intermodal train by 56 percent.
- Seventy percent of all Port of Tacoma trains will travel over Stampede Pass and the balance will travel down the I-5 rail corridor and along the Columbia River rail corridor.
- All of the Port of Seattle and domestic intermodal trains will travel over Stevens Pass.
- The number of peak day intermodal trains running east-west between Spokane and the Ports of Seattle and Tacoma will be 19 in 2015 and 28 in 2025.
- General merchandise trains will all consist of 108 60-foot railcars.

Table 1 illustrates the change in average daily train volumes from 2006 to 2025 based on increased train lengths and equipment utilization. Passenger train volumes were based on the *Draft Long-Range Plan for Amtrak Cascades* (Washington State Department of Transportation (WSDOT), February 2006) and Sound Transit's current service plan. Increasing the carrying capacity of intermodal and general merchandise trains significantly reduces the number of trains required to handle the forecasted growth. Washington State's yards and sidings, largely constructed in the early 1900s, are not sized to accommodate these longer trains.

Table 1. Forecasted Average Daily Train Volumes

	2006 (Base)	2015		2025	
Line Segment (Owner)	**Freight[a]/ Passenger**	**Freight[a,b,c]/ Passenger**	**% Increase**	**Freight [a,b,c]/ Passenger**	**% Increase**
Vancouver-Seattle, WA (BNSF)					
Vancouver-Tacoma	45/8	36/16	-20%/100%	43/26	-4%/225%
Tacoma-Auburn	45/14	23/34	-49%/142%	30/44	-33%/214%
Auburn-Seattle	45/14	22/34	-51%/142%	27/44	-40%/214%
Tacoma-Tukwila, WA (UPRR)	14	13	-7%	16	14%
Seattle-Everett, WA (BNSF)	40/10	26/14	-35%/40%	32/16	-20%/60%
Everett, WA-New Westminster, BC (BNSF)					
Everett-Burlington	14/4	20/4	43%/0%	21/8	50%/100%
Burlington-Ferndale	10/4	16/4	60%/0%	17/8	70%/100%
Ferndale-New Westminster	10/2	11/4	10%/0%	12/8	20%/100%
Everett-Spokane, WA (BNSF)	25/2	20/2	-20%	25/2	0%/0%
Vancouver-Pasco, WA (BNSF)					
Vancouver-Wishram	31/2	40/2	29%/0%	52/2	68%/0%
Wishram-Roosevelt	29/2	38/2	31%/0%	50/2	72%/0%
Roosevelt-Pasco	25/2	29/2	16%/0%	36/2	44%/0%
Auburn-Pasco, WA (BNSF)					
Auburn-Yakima	6/0	11	83%	17	183%
Yakima-Pasco	6/0	13	116%	19	216%
Pasco-Spokane, WA (BNSF)	33/2	36/2	38%/0%	48/2	50%/0%
Pasco (Wallula)-Spokane, WA (UP)	7	12	71%	13	86%
Spokane, WA-Sandpoint, ID (BNSF)	46/2	58/2	26%/0%	75/2	63%/0%
Spokane, WA-Sandpoint, ID (UP)	8	11	38%	12	50%

[a] Average daily trains for March 2006.

[b] Intermodal trains – 28 cars – 270 feet per 5-well double-stack cars 100 percent utilized.

[c] Solid waste trains – 80 cars per train at 72 feet per single well double-stack cars.

[d] General merchandise trains – 108 cars per train at 60 feet per car.

By increasing the capacity of intermodal, solid waste, and general merchandise trains, the Tacoma to Auburn, Auburn to Seattle, and Seattle to Everett line segments show a significant reduction in train volumes for 2015 and 2025. The Everett to Spokane segment shows modest reduction in 2015, but by 2025 the line is again operating at capacity.

The existing State rail network is not sized for 8,000-foot-long trains. Table 2 identifies rail corridor segments within Washington State where peak-day train volumes (8,000-foot trains) will exceed practical capacity of the line by 2015 and 2025 based on current siding lengths and locations. Please note that, while there appears to be adequate capacity along the I-5 rail corridor, individual bottlenecks exist that also must be addressed to alleviate operational problems, as well as new ones created by the longer trains. Without the increase in train capacity and corresponding reduction in train volumes, congestion will be worse.

Table 2. Locations Where Main Line Capacity Is Exceeded for 8,000-Foot Trains

2015	2025
Everett-Burlington	Everett-Burlington
Burlington-Ferndale	Burlington-Ferndale
Ferndale-New Westminster	Ferndale-New Westminster
Everett-Spokane, Washington (BNSF)	Everett-Spokane, Washington (BNSF)
Vancouver-Wishram	Vancouver-Wishram
Wishram-Roosevelt	Wishram-Roosevelt
Roosevelt-Pasco	Roosevelt-Pasco
	Pasco-Spokane, Washington (BNSF)
Pasco (Wallula)-Spokane, Washington (UP)	Pasco (Wallula)-Spokane, Washington (UP)
Spokane, Washington-Sandpoint, Idaho (UP)	Spokane, Washington-Sandpoint, Idaho (UP)
Auburn-Yakima	Auburn-Yakima
Yakima-Pasco	Yakima-Pasco

What Will Be Required to Implement the Strategies and Improvements Being Considered by the Railroads?

Significant capital investment within Washington is required in order to expand sidings, yards, and terminal access to accommodate the strategy of operating fully loaded 8,000-foot-long trains. The current carload logistics network will also need to be simplified and consolidated. Existing facilities will need to be expanded and new ones constructed that are specifically designed for the operating strategies that each rail carrier adopts.

Longer Trains. The amount of freight (but not the number of trains) that can be handled by the main line infrastructure can be increased by increasing the length of the trains. Longer trains may not mean increased capacity without the necessary infrastructure in place to support them.

Longer trains may be a more effective capacity increase on a single-track line (Columbia River, Stevens Pass, or Stampede Pass) than on a double-track line. The capacity of a single-track line is dependent upon the running time between sidings, which is often substantial. The capacity of a double-track line is dependent upon the headway allowed by the signal system.

For example, the increase in train length from 7,000 to 8,000 feet (a 14 percent increase) is the equivalent of reducing the headway on one of the tracks of a double-track line from 10 minutes to 8 minutes and 25 seconds, but without the benefit of increased utilization of equipment and labor (assuming that traffic is available for a train of either length and that crew and equipment utilization is not affected by additional time required to accumulate and assemble longer trains).

On a single-track line with 20 minutes running time between sidings, the same 14 percent capacity increase requires a reduction in running time of 2.5 minutes between sidings. For 50 mph freight train operation, 3 miles of siding extension is required for each intersiding segment in order to achieve the necessary running time reduction between sidings.

Conversely, sidings of the same length as the trains require trains to begin to slow to yard speeds almost immediately after entering the siding, effectively increasing running time between sidings. The train may be moving at 10 mph or less as the last 500 feet of the train. Thus, the gain in freight capacity achieved by longer trains can be offset by slower operations into the siding. For example, if the 14 percent increase in freight capacity achieved by longer trains is offset by a 14 percent increase in running time (2 minutes and 48 seconds), the gain of 1,000 feet of length per train is offset by the loss of 5 trains per day of capacity, an aggregate loss of 4,000 feet of train length.

Achieving the desired capacity benefits from operating long trains will require lengthening main line sidings to a minimum length of 8,000 feet in the clear. Sidings 9,000 feet in length will allow the trains to exit the main line at allowable turnout speed, improving clearing times. The following issues and improvements have been identified.

Auburn – Pasco. Operation of 8,000-foot-long trains reduces the capacity in trains from 10 trains per day to 4.5 trains per day (TPD). Restoring capacity to 10 TPD requires extension of sidings at Lester, Pomona, and Byron to more than 8,000 feet.

Vancouver – Pasco. The capacity for 7,000-foot-long trains between Wishram and Pasco is greater (51 TPD) than the capacity between Vancouver and Wishram (36 TPD). If 8,000-foot trains are run, the capacity between Vancouver and Wishram (36 TPD) remains the same, while the capacity between Wishram and Pasco is reduced from 51 to 28 TPD (assumes Hover siding is extended from 7,932 to 8,000+ feet; otherwise, capacity is 22 TPD). By constructing siding extensions at Maryhill, Bates, McCredie, Paterson, Berrian, and Hover, the capacity between Wishram and Pasco can be increased from 28 to 51 TPD.

To increase the capacity between Vancouver and Wishram, BNSF is constructing a new siding at Lyle (between Bingen and North Dalles) to accommodate 8,000-foot trains. This siding alone will increase capacity by 4 TPD. The running time between McLaughlin and

Washougal imposes the next capacity limit after the Lyle siding reduces the running time constraint between Bingen and North Dalles. Reducing the running time between McLaughlin and Washougal by approximately 5 minutes, either by extending the second main track at McLaughlin east and/or the Washougal siding west or constructing an intervening siding, will increase the entire Columbia River rail corridor capacity to 51 TPD. This compares favorably with the 2025 forecasted train volume of 50 TPD. Part of the running time reduction can be achieved by eliminating Washington Utilities and Transportation Commission (WUTC) -imposed speed limits.

This route currently has a wide variety of train types and train speeds (freight trains 35 to 60 mph and passenger trains 70 to 79 mph). The range of speeds and train types results in a relatively greater number of overtaking situations, which consume the calculated capacity per train at greater than a 1:1 ratio. This issue will also need to be addressed by assigning the proper power to every train, or constructing the additional infrastructure required to accommodate the overtaking while maintaining capacity.

The next incremental increase in capacity beyond involves a significant amount of construction to reduce the running time between all sidings. For example, to increase capacity to 60 TPD requires the construction of 1.5 miles of track per siding to reduce running times by 1 to 4 minutes between Washougal and Skamania, Skamania and Stevenson, Bates and Roosevelt, Berrian and Yellepit, and Yellepit and Hover.

Everett – Spokane. To operate 8,000-foot-long trains and retain the current capacity in trains, it would be necessary to extend the sidings at Trinidad, Edwall, Espanola, and Lyons to longer than 8,000 feet.

Everett – New Westminster. Longer trains can be accommodated with no change in the (currently inadequate) capacity for train movement. Additional capacity is still required for this line.

Pasco – Spokane. Longer trains can be accommodated with no change in capacity. However, if the 8,100-foot sidings are lengthened to 9,000 feet, higher train speeds entering the siding could increase capacity by about 10 percent.

Consolidating Primary Switching Locations

Consolidation of carload traffic at existing yards requires careful consideration of the yards' constraints. Longer trains may require holding carload traffic in yards for a longer period while traffic is accumulated. This requires additional yard tracks to mitigate the effect of the longer accumulation time. Longer arrival/departure tracks may be needed for the assembled train to avoid conflicts with ongoing yard or main line operations. If the longer train require a greater number of yard tracks to assemble (e.g., three tracks instead of two), the process of assembling or disassembling the train will take longer than it would for a 7,000-foot train. Train length, whether the currently typical 7,000 feet versus 8,000 feet, is a very important consideration in almost every yard in Washington State. The yards described below have limited arrival/departure capabilities, which will need to be addressed if they are to be used as primary switching locations.

Delta Yard (Everett). All of the tracks in Delta Yard are about 3,500 feet long. It would take approximately 50 percent longer to assemble a train of 8,000 feet than a train of 7,000 feet. This reduces yard dynamic capacity because assembling trains interrupts yard operations, as well as other arriving or leaving trains.

As part of the Amtrak *Cascades* program, WSDOT is funding 3 new yard tracks, each about 6,500 feet long. The primary purpose of these tracks is elimination of train storage on the main track. The use of the main track for train storage was of no consequence to BNSF before Amtrak *Cascades* because it had no through traffic. All trains originated or terminated at Delta Yard. The length of the new yard tracks allows many of the current trains to be assembled in one track rather than two, and facilitates assembly of longer trains.

The longer yard tracks will reduce, but not eliminate, main line work events. Under the current configuration, it is still necessary to use the main tracks to move cars between the classification yard and the new long tracks. The amount of time that yard operation must use the main track may increase as a result of the construction of the longer tracks. BNSF has a master plan to construct a new yard lead extending south from the south end of Delta Yard and to reconfigure the north end of the yard. These changes would allow 8,000-foot freight trains (as well as the current 7,000-foot freight trains) to double into or out of yard tracks without occupying the main track. The changes may also reduce the degree to which trains that are doubling interfere with yard operation.

Balmer Yard (Interbay). Only one yard track will accommodate an 8,000-foot-long train. That track is the former west main track, which was converted to a yard track in the 1950s. Train movements between the yard and this track must use the main track, consuming capacity needed to operate through trains.

The effect of short tracks at Interbay can be mitigated by extending a lead north to the south end of the Ballard Bridge, and reconfiguring the south end to provide a running track or lead between Galer Street and North Portal in addition to the two main tracks. Long trains may still affect other arriving or departing trains, but would have less direct effect on the main tracks, reducing the operating considerations that must be given to yard track length.

Tacoma/Fife. The difficulties associated with operating an 8,000-foot train to or from the BNSF yard in Tacoma are the same as those for the current 7,000-foot trains. The yard tracks are 3,500 to 3,600 feet long. Likewise, the tracks in the UP yard at Fife do not accommodate a 7,000-foot train, so the problems associated with an 8,000-foot train are similar.

The construction of the third main track through Tacoma as part of the Sound Transit program and the third main track between Reservation and Puyallup as part of the WSDOT program will mitigate the effect of trains too long to be accommodated in the yard, but will not cure it. The Port of Tacoma is currently developing a master rail plan to address port access and switching requirements as it expands its intermodal marine terminals.

Vancouver. The longest train that can be assembled without occupying a main track and/or blocking yard operations is about 5,700 feet. A typical 7,000-foot (or 8,000-foot) train arriving/departing the yard occupies the main track for an extended period of time. This process consumes the capacity for as many as 5 through trains.

In addition to the congestion related to long trains and short yard tracks, some of the congestion at or caused at Vancouver is associated with the movement of trains between the Seattle Subdivision north of Vancouver and the Fallbridge Subdivision east of Vancouver. Each train must use a single-track line (that is shared with yard operation) between the two subdivisions at 10 mph. Each train must also stop for 5 minutes or more during the movement to change crew. The congestion caused by this operation is not related to train length; however, the solution of this problem will also contribute a solution to the congestion caused by train length.

The WSDOT passenger program, Vancouver Bypass Project, is proposing construction of two tracks that will be dedicated to movement of Seattle Subdivision –Fallbridge Subdivision trains and the stop for changing crew. As part of the construction for these tracks, it will be possible for a train of 8,000 feet to double out of the north end of Vancouver Yard onto the main track, while two tracks remain available for Seattle Subdivision through trains. The project is currently undergoing a joint value engineering review by WSDOT and BNSF that may eliminate one bypass track and build a new segment of third main track. This will significantly reduce construction costs associated with high retaining walls, while maintaining the operational benefits.

Consolidated Dispatching Center

A consolidated dispatching office for the Pacific Northwest has been suggested informally, both in the context of the Portland I-5 study and the WSDOT passenger program. The concept, while sound, is not as easy to implement as constructing a facility and moving personnel into it. If implementation is ineffective, it will not produce the desired result.

A consolidated regional dispatching office may improve operations in Washington State, but only if it is carefully planned and executed. Recently, a rail planning center was established for the Port of Tacoma.

A regional office handling both BNSF and UP trackage and utilizing a combination of employees from the two railroads may be needed to overcome the problem of union and non-union personnel holding the same positions. In the other joint BNSF-UP dispatching centers, this is overcome by maintaining effectively two separate facilities in the same building. The same arrangement is found in the joint Belt Railway of Chicago/CSX Transportation/Indiana Harbor Belt facility near Chicago.

Managing Washington State's high-density rail traffic, consisting of differing types and levels of importance over congested routes and through congested terminals, is a challenge. This challenge is not easily met by merely changing the location of the dispatching center. Implementation of a consolidated dispatching/operations center allows for employment of local staff, instead of a systemwide dispatching center located out of the area. This results in fewer turnovers of personnel, making the staff more knowledgeable of the territory and, thus, more effective.

Cooperative Routing Agreements and Route Alternatives

Cooperative routing agreements between carriers are becoming more common. Canadian National (CN) and Canadian Pacific (CP) have entered into cooperative agreements that allow the trains of either carrier to use the best route in the Vancouver, BC terminal area and through southern British Columbia regardless of track ownership. BNSF operates trains directly into and out of the CN yard at Thornton (in Surrey), instead of moving traffic by way of the double handling through an intermediate interchange point. BNSF is the minority user of this line between New Westminster and Vancouver and is turning operation over to CN, the majority user. CP and UP have entered into joint marketing and operating agreements for 'Can-Am' corridors, including traffic moving between Canada and the western U.S./Mexico through Eastport and Spokane. The integrated operating practices include the assignment to the corridor of locomotives specially equipped for U.S. and Canada regulations.

Implementing route sharing alternatives to make the best use of the available infrastructure between competing railroads is more difficult than it may appear. Such changes involve corporate rivalry, real or perceived gain or loss of competitive advantage, and labor agreements. Thus, an arrangement that appears to make perfect sense may be difficult or impossible to implement.

Stampede Pass/Stevens Pass Route Alternatives. East-west capacity can be significantly increased by operating trains directionally on Stampede Pass (eastbound) and Stevens Pass (westbound). Single direction traffic on each of two routes has the effect of creating a double-track railroad.

The traffic on Stevens Pass would be almost exclusively westbound. Directional running combined with signal and ventilation improvements within the Cascade tunnel can double the practical capacity of the line. The capacity over the Stampede Pass line will need to be increased by lengthening sidings and improving the signal system to equal the capacity of the Stevens Pass line. The tunnel will also need to be crown mined to clear double-stack intermodal trains. The limited westbound carload traffic moving from Pasco to northwest Washington/British Columbia will need to be rerouted to the Columbia River rail corridor to eliminate conflicts with eastbound intermodal trains. Amtrak's Empire Builder might need to be rerouted to the Stampede Pass line as well.

Fuel consumption and crew hours are important factors to consider when evaluating the benefits of directional running. The distance between Seattle and Spokane via Wenatchee is about 330 miles via Wenatchee versus 399 miles via Stampede Pass and Pasco. Locomotive fuel consumption rates are determined by gross tonnage, throttle position, and grades. Since the terrain is similar on the two routes, the power requirement (number of locomotives) should also be similar, so fuel consumption can be compared on an order of magnitude basis for each route by approximating running time between Seattle and Spokane. The running time between Seattle and Spokane via Wenatchee is roughly 9.5 hours. The running time between Seattle and Spokane via Ellensburg and Pasco is roughly 12 hours. Assuming 3 locomotives consuming an average of 100 gallons per hour (full power on steep grades and less at other times), each train operating via Stampede Pass will consume about 1,200 gallons more fuel than its counterpart on Stevens Pass. If the Seattle-Spokane via Stampede Pass and Pasco route is used for 18 trains, the extra fuel consumption will be approximately 13,500 gallons per day and 4.9 million gallons per year.

The longer route via Stampede Pass may require an additional crew versus Stevens Pass. With a normal running time of almost 10 hours between Seattle and Spokane, it may not be possible to use 2 crews for this segment. Determining crew requirements involves careful analysis of running times; factoring in the time required to obtain, read, and understand the day's operating instructions; increased running times due to bad weather conditions; and the time to complete the required recordkeeping at the end of the trip. The analysis may also identify potential capacity projects required to minimize the number of crews.

Crew Assignments/Territories. Train crews are assigned to handle a train over a specific territory between their home terminal and an away terminal. Generally, they take a train from the home terminal to the away terminal, stay at a hotel at the away terminal, and then return to the home terminal with a train. Crew assignments for directional operations will need to be restructured. One possible scenario is a circular rotation in which each crew works from Seattle to Ellensburg, then Ellensburg to Spokane, then Spokane to Wenatchee, and then Wenatchee to Seattle on consecutive days. Any potential operating change of this magnitude requires modifying existing labor agreements.

Ellensburg-Lind Cutoff. Restoring the ex-Milwaukee Road line between Ellensburg and Lind would reduce the distance from Seattle to Spokane from 399 miles to 314 miles, and would be similar in time and distance to the Spokane-Wenatchee-Seattle route. Crew and fuel costs would remain appreciably unchanged. Traffic would continue to flow eastward from Lind, bypassing Pasco, Kennewick, Richland, and Yakima. The grade on this segment is generally light in both directions, except for 10 miles of 1.6-percent grade ascending eastward between East Kittitas and Boylston and 18 miles of 2.2-percent grade descending eastward between Boylston and Beverly Junction. The ruling eastward grade on the Stampede Pass line could be reduced to a 1.6-percent compensated grade by constructing a 15.2-mile line change, including a new 4.1-mile-long tunnel that would connect to the Iron Horse Trail (ex-Milwaukee Road line) at Whittier, and then to BNSF approximately 4 miles east of Martin[1]. This would reduce running times, fuel consumption, and the number of locomotives needed for eastbound trains.

Pasco-Spokane. Identifying the advantage of directional operation of the BNSF and UP lines between Pasco and Spokane is elusive. The UP line has roughly the same alignment as the former SP&S line of Burlington Northern Railroad (BN). The SP&S/current Pasco-Spokane line was used by BN for single-directional running until it was abandoned in the

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[1] *Old Milwaukee Road Line Restoration, Lind to Ravensdale, Burlington Northern Railroad*, prepared by HDR Engineering, September 16, 1994.

1980s. Since then, BNSF (formerly BN) has invested heavily in the remaining route, installing Centralized Traffic Control (CTC) and constructing 10 sidings over 8,000 feet long, double track east out of Pasco, and 12 miles of double track west out of Spokane.

The BNSF-UP route between Pasco and Spokane is 25 miles longer than the BNSF route. The grades on the UP route are not as severe as the grades on the BNSF route; hence, there may not be a significant fuel consumption penalty for directional running using the UP line.

Any advantages that can be achieved will require infrastructure investments. Even on a single-direction railroad, properly designed sidings are required for overtaking and parking disabled trains. The eastern 60 percent of the UP line between Wallula and UP Junction (BNSF connection between Cheney and Spokane) do not have sidings of sufficient length to accommodate a typical train. Also, 83 percent of the UP line do not have CTC, which would be essential for conducting track maintenance under a directional running scenario that significantly increases joint BNSF/UP traffic flow.

Given the projected traffic volumes for each railroad in this corridor, it may be more economical for each railroad to separately invest in its lines as traffic grows and develops versus pursuing directional operations. Detailed analysis of operations, competitive issues, and the economic benefits of directional running is beyond the scope of this study.

Scheduled Point-to-Point Service

In January 2006, BNSF implemented a plan to change Pacific Northwest (PNW) intermodal services. Prior to this date, BNSF ran daily trains that were made up of cars with miscellaneous destinations. After January 2006, BNSF began running solid train loads of traffic straight off of the marine terminals in proper blocking order. This operational change eliminates switching requirements at origin points, such as on the Tacoma Rail, as well as at intermediate points along the main line. The trains are loaded for only one destination, as is the case with the St. Paul train; or, there can be multiple destinations such as Chicago proper traffic with Chicago interchange traffic blocked properly for furtherance to Eastern Railroads.

BNSF's January 2006 plan accomplished the following:

- Simplified Tacoma outbound train blocking.
- Released intermodal and support tracks in Kansas City, Missouri for other business opportunities.
- Added additional PNW to St. Paul train operations, thereby, allowing for fully profiled Chicago trains out of the PNW.
- Eliminated miscellaneous blocked trains out of PNW, thereby, releasing Tacoma Rail for making up the St. Paul trains and increasing efficiency of port switching.

- Eliminated service between South Seattle and Kansas City. Seattle to Kansas City traffic was loaded in the Cicero block and drayed from Cicero to Corwith for loading to Kansas City.

- Eliminated service between Portland and Kansas City. Portland to Kansas City traffic was loaded in the Cicero block and drayed from Cicero to Corwith for loading to Kansas City.

- Increased the Logistics Park Chicago trains from two per week to four per week serving the Port of Tacoma.

The plan simplified operations at the Ports by reducing the number of different destinations on each train. This reduction in destinations on each train slightly increases the time some containers not destined for Chicago (such as those destined for St. Paul, Minnesota; Kansas City, Missouri; and Denver, Colorado) wait on the terminal to be loaded on a train.

Another form of a scheduled service is the UP and CSX joint venture carload perishable service, called Express Lane. The service involves the movement of carload perishables from Washington and California origins to East Coast destinations with a no-contract published rate. Interline cooperation extends beyond CSX and UP to a short line operator at one and/or both ends of many shipments. This requires seamless integration of shipment information among the carriers, including the short lines. The short lines must not only present or accept Electronic Data Interchange information for the shipments, they must participate in the trip scheduling for each car.

Improved Intermodal Terminal Production

BNSF is converting its intermodal facilities from rubber-tired gantry cranes (RTG) and side loader operations to rail-mounted gantry cranes in order to increase the capacity of existing facilities. BNSF is currently converting Seattle International Gateway north storage intermodal yard to a rail-mounted gantry crane lift facility. When completed, the expanded facility will have a capacity of 600,000 lifts per year. The Ports of Tacoma and Seattle are also developing plans to expand their intermodal facilities.

Reducing/Eliminating Main Line Work Events Co-Production

Co-production may increase efficiency and reduce traffic in some areas. A simple co-production arrangement involves relatively modest changes in operation associated with changes in the use of existing infrastructure. This type of co-production generally involves railroads pooling infrastructure for the purpose of optimizing traffic flow. There are no changes in business arrangement other than the trains of one railroad operating on the tracks of another railroad. This arrangement could occur between Tacoma and Seattle, for example, if ongoing negotiations between UP and BNSF are successful. As part of the Sounder Commuter operations, co-production currently occurs on 7 miles of BNSF and UP between Tukwila and Argo. Other potential co-production locations include the BNSF and UP main lines between Pasco (UP via Wallula) and Spokane.

Switching Zone Agreements

Another form of co-production involves a change in business practices. Multiple railroads serving the same facilities may elect to share the work and reduce duplication. This type of arrangement usually involves each railroad serving the customers for both railroads for alternating periods, or by dividing industrial areas into zones.

Rationalizing Carload Network

U.S. railroads have structured themselves to be wholesale carriers. They specialize in moving large quantities over great distances. To that end, they have sold and abandoned branch lines, and discontinued or discouraged service to small quantity and short-haul shippers and consignees. Such small quantity and branch line shippers and consignees are not necessarily incompatible with rail transportation, but rather are incompatible with current rail operational structures. The qualities that make rail transportation effective (e.g., vehicle size, personnel to vehicle size, fuel consumption, and emissions) apply to the small and short-haul shipments just as they do to large shipments. The practice of operating only large trains from consolidation points is not fully compatible with small and short-haul shipments given the current carload networks.

Railroads have addressed the branch lines with the practice of selling them to short line operators (such as the many short line operations in Washington State) or contracting with a short line operator to handle freight for them (e.g., Tacoma Rail for BNSF). The trunk railroads must still furnish the cars to and collect the cars from the short line operator at outside points (e.g., Connell and Cheney), defeating some of the advantages found in selling the branch lines. There may be some significant advantage to both the short line operator and the trunk line railroad to have short line carriers deliver to and pick up from the railroad's major consolidation yards (e.g., Pasco and Spokane). The same principle might apply to other consolidation facilities, such as logistics centers or regional grain elevators. It might also apply to small shippers and consignees along trunk line routes between major consolidation points. This will require granting short line carriers trackage rights.

Short lines may also consolidate separate shipments before presentation to a trunk carrier. For example, with the cooperation and coordination of shippers and consignees, a short line may collect cars from several intermediate or branch line grain elevators and combine them into a unit train for movement over a long distance by a trunk line railroad. It may be possible that the cars would not have a single destination; rather, they could be bound for a deconsolidation destination somewhere across the country. The BN Explode-A-Pool rate of the 1980s could serve as an example. A broker south of Portland on the BN branch between Portland and Eugene, OR purchased feed grain in trainload lots and sold it in carload lots to small volume dealers throughout western Washington and Oregon. The unit train movement to the broker's facility was expensive for the railroad, requiring a very large number of locomotives and two extra trains to move the cars to the broker's track, only to then bring the cars back down the same grade en route to their new destination. The Explode-A-Pool rate gave the broker unit train rate from origin to Pasco and carload rate beyond as long as the forward instructions were made available to BN before the train arrived in Pasco. Similarly, small shipments collected by a short line may be distributed by a short line at the distant end of the trip.

Granting main line trackage rights to short line carriers to access the trunk carrier's consolidation points and/or to serve smaller customers off the main line may require additional capacity improvements. However, the capacity needed to accommodate shorter and perhaps faster trains differs somewhat from the capacity needed to accommodate 7,000-foot to 8,000-foot trunk railroad trains. The sidings need be one-half the length or less than those needed to accommodate the trunk carrier trains. Single-track capacity depends upon running time between sidings. A short line train en route to or from a railroad consolidation point, having only traffic for the short line's customers, may be powered to run faster than the through freight trains, reducing the running time between the sidings needed as additional capacity for such operation. Short line carriers serving a small intermediate customer off the main line are less likely to block through traffic because a shorter train is better able to clear the main line while switching an intermediate customer.

Consolidated terminal operations can provide operating efficiencies. For example, a single carrier handling all of the traffic in the Seattle-Tacoma area for both BNSF and UP may have operating, infrastructure, and economic advantages, at least from the public viewpoint. Examples of terminal railroads include Belt Railway of Chicago, Terminal Railroad Association of St. Louis, Port Terminal Railroad Association (Houston), and Kansas City Terminal Railroad. There are also examples of publicly-owned operators that were established to ensure equal service to the shippers and consignees of the area, including New Orleans Public Belt, Pacific Harbor Line (Port of Los Angeles/Long Beach), and the Tacoma Municipal Beltline (Tacoma Rail).

BNSF and UP have entered into a similar arrangement for traffic in the Napavine-Woodland area by way of BNSF handling all traffic for both railroads between Longview Junction and Woodland, UP handling all traffic for both railroads between Rocky Point and Napavine, and Longview Switching Company (a jointly-owned switching carrier) handling switching and car movement between Rocky Point and Longview Junction.

Appendix A. Summary of Railroad Operating Practices

■ Background

Railroad operating practices can affect capacity or the utilization of capacity. There are several areas of practice and several ways in which practice can have an effect.

Scheduling and traffic management practices affect how efficiently capacity is used. As traffic approaches capacity, the importance of scheduling and traffic management is critical to maintaining velocity of the system.

In yards and terminals, decisions on train size are important. If a train cannot arrive into or leave from a single track in the yard, it can block the route of other trains arriving or leaving and may limit switching operations. Main line capacity can be affected if a train must use a main track during the arrival or leaving process. This situation exists at every major yard in Washington State to some degree, except at Pasco and Yardley (Spokane).

Decisions made when establishing speed limits or assigning locomotives to a train directly affect capacity, because they affect the length of time that a train occupies a segment of track. For example, if a train must occupy 3 miles of track exclusively (train length plus stopping distance and safety factor distance), the capacity of the line will be 25 percent greater if train speed is 40 mph than if train speed is 30 mph. Locomotive assignment is related to capacity in this manner, because the amount of power assigned to a train is directly related to the speed that can be achieved. If a train can achieve only 30 mph with the power assigned to it, the capacity provided by the 40-mph speed limit is irrelevant. Infrastructure-related improvements such as curve flattening and adjusting signal spacing may also be required to increase speeds.

Some operating practices that affect statewide capacity are historic, related to the carriers that constructed the line and the carriers that currently own segments of the network. These practices are related, for example, to interchange locations, trackage right agreements, and seniority rosters.

Any discussion of operating practices or strategies must include discussion of infrastructure characteristics of the rail network. Infrastructure characteristics, such as siding lengths and locations, curvature, and grades, may directly influence operating practices. For example, a train's weight versus its length is usually the limiting factor in a mountainous region. In order to implement a policy of running 8,000-foot-long trains, distributed power must be provided, as well as lengthening the sidings. Is it better to increase capacity by running longer trains, but fewer of them, or running shorter trains faster?

Implementing a particular operating strategy directly affects the choice of infrastructure improvements.

Operating Practices

What Are the Common Railroad Practices that Affect Capacity or Utilization of Capacity?

Schedules

Railroads are fixed guideway transportation systems. Their distinguishing characteristic is the guideway (the track) that defines the path of the vehicles. Fixed guideway transportation systems have a number of significant benefits (e.g., limited effect of inclement weather, potentially greater transportation per land occupied), but they require significantly more planning and implementation discipline than other modes. Vehicles can pass others only where infrastructure has been provided. Opposing vehicles can encounter each other safely only where infrastructure is provided. Thus, infrastructure design must consider the intended use and operation must consider the infrastructure.

The fixed guideway gives rail transportation some of the characteristics of manufacturing, which offers a good example of the need for scheduling. A printer accepts jobs at 9:00 a.m., 10:00 a.m., and 11:00 a.m. Each job will take 3 hours to complete, but all jobs share the same equipment. The customer who brought in a job at 9:00 a.m. can pick it up at noon. The customer who brought in a job at 10:00 a.m. cannot pick it up at 1:00 p.m., because the equipment did not become available until noon. That customer must be given a completion time of 3:00 p.m. For the same reason, the customer who brought in a job at 11:00 a.m. will be able to pick it up at 6:00 p.m., not 2:00 p.m. The situation is similar in railroad operation.

Operating and Transportation Schedules

North American railroads sometimes make reference to 'scheduled railroad'. There are two types of railroad schedules: 1) operating schedules and 2) transportation schedules. Operating schedules establish a specific allocation of time and resources to each train. Properly constructed operating schedules address delay and congestion in advance. Transportation schedules use an arbitrarily determined amount of time for activities in yards and terminals and for running from one terminal to another. The time allotted represents the amount of time the operation normally takes or should take. Sometimes it represents only a desired amount of time. In the print shop example, a transportation schedule will tell the 3 customers that their orders will be ready at noon, 1:00 p.m., and 2:00 p.m., respectively. The production personnel will face an impossible task. The desk personnel accepting orders will continue to accept orders for that day's delivery, because nothing indicates that additional orders cannot be fulfilled. An operating schedule will tell them that their orders will be ready at noon, 3:00 p.m., and 6:00 p.m., respectively.

The production personnel can achieve on-time delivery and the desk personnel know that more orders cannot be accepted for delivery that day.

Priority Operation

Priority is generally the criterion for operation on North American railroads. Each train is assigned a level of priority and must not be delayed by a train of less priority. Although important trains generally have a schedule, in priority-based operation it is used only as a performance measure. Ahead of schedule is considered successful train handling. In practice, trains are delayed for higher-priority trains that are ahead of schedule.

Generally, for the highest-priority trains, delay is often interpreted to mean operation at less than the speed limit. Delay-free operation of high-priority trains is often accomplished by having all traffic clear an excessive distance in front of an important train. Delay can be avoided by having the line clear slightly more than stopping distance (a function of signal system design, approximately 3 to 5 miles) in advance of an important train. However, transportation managers sometimes insist that there be no trains ahead of an important train for a distance of 50 to 100 miles.

Priority-based operation can impose a severe reduction of capacity. Operations research has shown that time-based operation can better utilize infrastructure than priority-based operation. This does not mean that trains do not have a range of relative importance. The importance of a train should be considered; however, the primary consideration should come when the schedules are developed. More important trains are allocated resources before less important trains. All schedules include recovery time. Recovery time is used to mitigate the effects of unpredictable occurrences (e.g., equipment failure or extraordinary traffic volume). Recovery time is a percentage (usually 5 percent to 8 percent) of the running time needed to accommodate all predictable events. Skillful traffic management utilizes the collective recovery times of the schedules to keep on time trains on time, and either allow late trains to recover or prevent them from becoming later, depending upon the situation. Importance (priority) should become a tactical consideration when it is impossible to resolve a traffic situation without unrecoverable delay to one or more trains.

Improvised Operation

North American railroads generally improvise all operations. Schedules are generally considered to be no more than a guide or a benchmark for measurement of the performance of important trains. Improvised operations are effective only when there is a substantial amount of excess capacity. Structured operation establishes a conflict-free schedule in advance for all trains. When operation is improvised, the first consideration of other trains occurs when the train dispatcher establishes meeting and passing points. North American railroads perceive the difference between improvised and structured operation to be greater flexibility and a saving of time and effort when operation is improvised. This perception only applies to the effort expended in advance of train operation. Improvised operation is much more labor intensive and less efficient during operation, however.

Delay ratio is the relationship of delay to normal running time, a measure of the quality of the operation. A simple example of the effect of improvised operation uses a 50-mile segment of single-track railroad, 4 trains, and 2.5 hours of operation. By merely changing the times at which the 4 trains run, the delay ratio can be 6 percent (very good), 12 percent (acceptable), and 36 percent (very bad).

Data furnished by BNSF for the *East-West Passenger Rail Feasibility Study: A Preliminary Analysis* (WSDOT, May 2001) indicates a substantial difference between the planned operation between Spokane and Auburn via Pasco and what actually occurred. Similar data made available within the past 5 years has shown a similar situation between Portland and New Westminster.

Important Elements of Structured Operation

First, a disciplined operation requires virtually no attention toward trains that are on time. Traffic control attention is directed toward problems and failures, while other traffic continues to operate normally. When operation is improvised, all traffic requires almost constant attention to the degree that sometimes trains are delayed because of the train dispatcher's lack of time to devote to them. Trains are sometimes delayed only because the train dispatcher does not have time to determine what to do with them.

Second, since improvised operation generally does not consider other traffic when a train is introduced to the system, additional trains may be introduced to an already saturated railroad. This may cause trains to be parked, reducing the capacity of the line and aggravating the effect caused by limited capacity. When traffic exceeds capacity (i.e., congestion occurs), normal operation may not be restored for many hours after the flow of trains has been reduced to less than the capacity of the line.

Third, although it is not entirely a matter of capacity, train crew fatigue has been a problem for many years. Improvised operation contributes heavily to crew fatigue. Train crews never know when they will be called for duty. They are furnished a short-term schedule of operation (lineup), which is intended to provide the information crew members need to structure their off-duty time. The lineup changes frequently. For example, if the lineup indicates that a crew member will be called on duty for a train due 20 hours from now, it would be wise to remain awake for the next 10 to 12 hours and sleep until called to duty. Likewise, if the train the crew is due to handle is expected to run 8 hours hence, it is wise to sleep now and be ready for the trip. Often, such crew members are called to duty before they have had an opportunity to sleep or many hours after they have slept and awakened because the operation has changed. The estimated time of a train on the lineup may change by many hours, trains may operate that do not appear on the lineup, and trains on the lineup may not be operated at all.

Minimum Number of Maximum Size Trains

Simple railroad economics indicate that the smallest number of the largest size trains should be operated. Railroad operating practice generally follows this model, with the number of train starts being an important measurement of efficiency. Increased size occurs in three ways. First, car size has increased. Fifty years ago, a typical car for carload freight was 40 feet long; it is now 60. Intermodal cars for trailers and containers are typically 85 feet long and some multiplatform cars are over 250 feet long. Second, the weight capacity of cars has increased. Fifty years ago, a typical car loaded to capacity with heavy commodities such as grain or coal weighed 100 tons; now it is 143 tons and the lading weighs more than the car and lading of 50 years ago combined. The strength of couplings has increased, making trains of over 8,000 feet long and more than 10,000 tons common.

At first glance, the policy seems to make sense. A train of 200 cars can be operated for the same labor cost as a train of 1 car. Locomotives are designed to be combined as needed to conform to the requirements of virtually any size train. The approach of simple economics may not be the best approach, however. To accomplish maximum train size, railroads typically operate 1 train per day to any destination, accumulating cars until there are 'enough for a train'. If after 24 hours from the last departure to a destination there are not 'enough cars for a train', an effort to 'consolidate' trains will generally be made. Consolidation is coupling trains for two destinations into a single, longer train that will stop at the destination of the first, and then continue to the destination of the second.

There are several consequences that are not often considered when operating the minimum number of the longest possible trains. The first (and most likely to be considered) is an economic cost that is relatively easy to balance against the savings of running the smallest possible number of trains. A shipment can be loaded in a railcar anywhere in North America and remain in the same car to its destination anywhere in North America. If the shipment is in a privately-owned car (e.g., a shipper or consignee with its own fleet of cars or a car owned by a leasing company), the railroad on which it is traveling pays the owner a fee based on mileage traveled. If the car is owned by a railroad, the railroad that owns the car is paid an hourly fee by any other railroad on which the car is operating. Thus, a railroad is paying hourly for cars owned by other railroads while they are being accumulated.

When traffic density is high, there is a second consequence that is not easily translated into the economics of train operation. If sidings are necessary for encounters between trains moving in opposite directions on single track or for overtaking, capacity is reduced by trains that do not fit in the sidings. Capacity can also be reduced when trains cannot be stopped for traffic control reasons at the required locations because they will block road crossings.

Excess-length trains have two effects on yards. First, static yard capacity is consumed by the accumulating cars. Effectively, a yard must have one or more tracks dedicated to cars for a once-per-day train. Second, dynamic capacity is consumed by trains that do not fit in a single yard track. Each train that is assembled from two or more tracks for departure generally blocks access to or from the yard for other trains, yard operations, and sometimes also for trains on one or more main tracks. During the time between the beginning of doubling until the train has left (usually 30 minutes to an hour), the capacity of the affected tracks is reduced to almost zero. An arriving train that must double into two or more tracks has the same effect.

The practice of saving traffic to run the smallest possible number of the largest possible trains can make rail transportation inconsistent with the requirements of some shippers, regardless of the other advantages of rail transportation technology.

Locomotive Assignments

A locomotive can be tailored to the train it will be assigned to pull. The locomotive on a train may consist of a single unit of 2,000 to 6,000 horsepower, but generally the locomotive is assembled from 2 or more units that are connected and operated from the controls of the lead locomotive. Railroads generally assign the minimum necessary amount of power for each train. Some important trains are assigned enough power to operate at or near the speed limit over their entire route. Most, however, receive just enough power to ascend the steepest grade on the route at a few miles per hour above stall speed. This practice can affect capacity when there are 2 or more types of freight trains on a route. For example, an intermodal train between Pasco and Vancouver generally has enough power to travel at the speed limit, 50 to 60 mph. Grain trains en route to Kalama, Vancouver, or Portland generally have enough power to maintain 35 mph. Carload freight trains and grain trains en route to Tacoma or Seattle generally have enough power to travel at 45 to 50 mph (the speed obtained in the Columbia Gorge by the minimum amount of power required to ascend the grade between Vader and Napavine). Thus, overtaking and its associated capacity reduction are not limited to the effect of passenger trains passing freight trains.

Capacity is related directly to the time that a train occupies a segment of track. On a single-track line, the running time between sidings is directly related to capacity. Assigning a locomotive that is insufficient for travel at the speed limit reduces capacity. For example, a locomotive assignment of 2.2 horsepower per ton (a 12,000-HP locomotive on a 5,400-ton train) will move a train at about 15 mph from Skykomish to Berne (uphill to the summit of Stevens Pass). Each uphill train uses about 130 percent of the capacity required for a downhill train because of the barely adequate amount of power assigned to the train.

Hours of Service Relief

Federal regulations limit the crew of a train to a maximum of 12 hours of duty in any 24-hour period. A typical crew assignment in Washington State is 150 to 230 miles. During normal operation, train crews should not require relief because of the hours of service regulation; however, congestion is causing relief to be required with increasing frequency. When a crew must be relieved because of the hours of service limitation, the most efficient use of the available personnel involves predicting the need for relief of a crew in transit and arranging relief without more than momentary delay to the train. A train that is stopped awaiting a crew occupies an almost infinite amount of capacity (given that the components of capacity are amount of occupied track and length of time that the track is occupied).

Waiting until a crew is out of time before ordering a relief crew is a common industry practice. It is done in the hope that the relief will not be needed. This can be counterproductive in two ways. First, the train waiting for a crew is occupying capacity that is not available for moving trains. Second, the practice can exacerbate a crew and/or locomotive shortage. When a crew is sitting on a train awaiting transportation, they (and the locomotive on which they are waiting) are not available for other trains, aggravating the effect on crew and locomotive supply and resulting in a trip that is longer than what should be needed.

Frequent need for crew relief because of the hours of service limitation may indicate a problem related to operating practice. For example, a freight train can travel from Interbay yard in Seattle to Vancouver yard in 4 hours and 30 minutes. Stops to pick up and/or set out cars add to that time. In addition, the crew must have time at the initial terminal to register, obtain and read the required operating documents, transport to the locomotive, move the locomotive to the train, couple and test the brakes, and leave. A freight train crew should be able to make a trip from Seattle to Vancouver in less than 8 hours, but many do not.

Traffic Control Support

Since trains cannot divert from their path as needed when they encounter another train, some form of traffic control is necessary to ensure that trains do not encounter each other where there is no infrastructure to support the encounter (generally meaning ensure that they do not collide). Traffic control does not replace scheduling, and unless operation proceeds flawlessly exactly as planned, scheduling does not replace traffic control.

Predicting the future is an essential part of traffic control. Often, important traffic management decisions must be made many hours in advance of implementation. The train dispatcher's decision support tools were once extensive training and a large sheet of paper that was both the real-time model of operation and the official record of operation. Calculations and projections were written in pencil and permanent record information in ink. The North American railroad industry generally replaced the permanent record function with computerized systems without providing a replacement for the planning function. The lack of decision support further aggravates the effect of improvised operation.

Training

The lack of decision support is aggravated by the lack of training in traffic management for train dispatchers and transportation managers. Effective traffic management is a combination of art and science. It heavily involves accurate prediction of the future. The consequences of a railroad traffic management decision may not manifest for many hours after the decision is made.

Railroad operation is a specialized field. Railroad transportation management faces all of the constraints and limitations of the management of any other form of transportation, but it also faces the limitations imposed by the infrastructure. Thus, railroad management is more complex than the management of other forms of transportation. Although it is a complex technical discipline, training in determining consequences of alternative courses of action and making traffic management decisions is virtually unavailable in the U.S.

Several community colleges in the U.S. have rudimentary trade school programs for specialized railroad trades, including train dispatching. These programs cover the fundamentals of the trade with the anticipation that the graduate will then participate in on-the-job training. There are two flaws with this assumption. First, there is a shortage of employees in many railroad trades. Inexperienced and sometimes newly-hired employees are often placed in a position of responsibility because there is no alternative. Second, the instructor's extensive experience, once the basis of on-the-job training, is generally no longer available. When on-the-job training occurs, it often occurs with someone who assumed a position without experience at the outset or who learned on-the-job from someone with that background.

Management personnel learn the railroad business in generally the same way as the trade employees (with the same on-the-job training shortcoming), except without the benefit of the short trade school program. A typical college business or engineering program does not prepare a student for railroad transportation management. There is only one railroad program at a university in the U.S.: the railroad engineering program at the University of Illinois, which consists of four courses.

In contrast to the U.S. situation, Germany, for example, has an extensive railroad engineering and operation program that is available in 11 universities. All engineering students must take a course in railroad construction whether or not they chose a railroad specialty degree. Students may obtain a railroad program degree (the equivalent of a Master's degree in the U.S.) with a minimum of 16 credits in infrastructure planning, track alignment, capacity research and scheduling, and signaling principles and systems. They may also continue their academic work to obtain a Doctorate in railroad engineering or operation. Similar programs are found throughout Europe and in China. There is no equivalent of these programs in the U.S.

Yards and Flow Control

The yards in Washington State have a profound effect on rail capacity. In general, the main lines, regardless of their limitations, have a greater capacity than the yards. The problem is mitigated by trains that do not stop at various yards along their routes. For example, Tacoma yard has limited capacity, but many of the trains that pass Tacoma do not stop there. At Vancouver, many stop only for a crew change (a problem similar to, but not the same, as yard capacity). Thus, yard capacity of less than the line capacity of over 140 trains per day is not a problem if it has no direct effect on main line operation. For example, if yard configuration and track length cause yard operation to use main tracks or interfere with main track operation, the yard may have a direct effect on trains that have no scheduled work at that yard.

Yard capacity can be a line capacity problem if traffic flow is not carefully managed. If a yard can accommodate 2 trains every 3 hours and the trains arrive more frequently than that, the arriving trains that exceed the production rate of the yard will be held out of the yard awaiting accommodation. They will be parked on main tracks or sidings, reducing the capacity available for trains that do not stop at that yard. The parked trains may also have a detrimental effect on the supply of locomotives and crews, which can in turn have a detrimental effect on the dynamic capacity of the yard.

Yard capacity problems can sometimes generate a stalemate in which a train being held out cannot be accommodated until the next train leaves, but the departing train cannot leave because the train being held out of the yard is causing a traffic problem that prevents the train in the yard from leaving. As line traffic approaches capacity, this situation is increasingly likely to occur.

Sometimes a train must leave a yard to make room for arriving traffic, but cannot be accommodated by the yard at its next stop. On-line parking may be appropriate for these situations. The sidings at Kent and Auburn (part of the Sound Transit capacity projects package) and the BNSF-proposed siding extension at Vista are examples of this arrangement. They are not part of the calculated capacity of the line and are, therefore, available for situations in which a train temporarily has nowhere to go. Such facilities do no good if they are not used, with trains allowed to continue until they can no longer move before parking. Planning and frequent communication between train dispatchers and terminal personnel are essential in making effective use of these assets.

Eliminating or mitigating the problem of trains that cannot be accommodated in yards requires sound strategy and tactics along with a significant amount of work. Recent information about current operation as well as simulation results produced within the last 6 years indicate that a new flow control strategy, or at least a flow control strategy better than that currently in place, is needed.