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**Development of Railway Terminals Within the Context of
Precision Scheduled Railroading (PSR) Principles**

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Introduction

The Supply Chain – fragile system

- Reliant on multiple modes of transportation
- Disruption or delays in any link can disrupt the entire chain



PSR - why does this matter ?

- Rail transportation supports domestic and international supply chains, driving Canada's economic growth
- Local disruptions to rail traffic translates into extensive delays over thousands of kilometers congesting rail lines, yards, and terminals
- Delays translate into higher demand for resources (railcars, locomotives, and crews), driving up costs, and causing more congestion
- Recovery from short term delays locally require extended timeframes to re-establish fluidity across the network

Introduction

PSR - what is it ?

- A set of principles to guide Railway business and operating practices
- The goal is excellence in rail service through safe, efficient, predictable, and reliable operations
- Reliability of efficient and fluid railway networks rely on seamless interface between rail yard/terminal operations, and rail line operations
- Industry plant/terminal designs and operations need to be developed through the lens of PSR

PSR - why is it important ?

- Recent disruptions to national railway service highlight the importance of rail service to the supply chain, health of our economy, wellbeing of our nation
- PSR benefits translate to a competitive advantage in global and domestic marketplaces, lower costs for goods, and opportunities for sustainable growth
- PSR benefits everyone (producers and consumers), not just Railways

PSR - A Railway Perspective

Objectives - safe, cost-effective, efficient, and timely rail service

How does it work ?

- Controlling costs, maximizing asset utilization, highly precise operations planning, and synergy across all processes
- Optimizing the rail network from a comprehensive end to end perspective
- Focus on the carload (customer shipment) rather than the train
- Scheduling trains which run on time to meet customer commitments (as opposed to waiting to fill the train)
- Optimizing every process effecting on-time delivery, and constantly fine tuned (plan–execute–monitor– analyze–revise)

Guiding Principles:

- Safety
- Timely Service
- Cost Control
- Asset Utilization
- People – basis for all other principles

PSR - A Railway Perspective

Service Design Principles - balance key, too much focus on one negatively impacts others

1. Optimize Car Asset Utilization

- ↓ no. cars >> ↓ car dwell in yards/terminals; ↓ car cycle; ↓ terminal space; ↓ terminal switching; ↓ cost

2. Optimize Fuel Efficiency, Power Requirements, and Train Builds

- Over-powering creates more waste than productive speed – right-size power to load
- ↑ train length >> ↓ train starts; ↓ locomotives; ↓ crews; ↓ fuel; ↓ network congestion; ↓ costs

3. Manifest and Unit Train Service (includes intermodal)

- PSR promotes mixed traffic >> ↓ train starts; ↓ locomotives; ↓ crews; ↓ fuel; ↓ network congestion; ↓ costs
- Unit Train efficiency: 7 day/week operations; 100+ car train length; single O/D pair

4. Optimizing The Service Plan (network performance)

- Multiple traffic outlets: ↑ operating flexibility; ↓ operating risk; ↓ network congestion
- Balancing traffic in both directions: ↑ reliability; ↓ terminal dwell; ↓ network congestion; ↓ costs

PSR - A Railway Terminal Perspective

Industry Rail Terminals : interface between Industry and Railways

Terminal Production Basics

- Product transported
- Product properties (density, solid, liquid, gas)
- Production rate (annual, weekly, daily)

Daily plant production / Terminal planning:

- Railcar type and capacity
- Type of rail service – manifest or unit trains
- Frequency of rail service
- Number of cars to be loaded and shipped
- Number of loading stations, speed of loading, equipment/resources for loading
- Number and length of rail terminal tracks
- Material and railcar storage requirements
- A daily rail terminal operating plan

PSR - A Railway Terminal Perspective

Railcar Fleet - minimize number of railcars

- Largest GVW permitted with largest load capacity
- Shortest railcar length to minimize rail terminal track lengths and maximize useable space
- Allowances for bad-order repairs, maintenance, transit delays
- Location - avoid weight & speed restricted lines (↓ no. cars; ↓ car cycle; ↓ space; ↓ switching; ↓ cost)

Fleet (Asset) Management

- Railcar utilization data
 - Service time, distance traveled, % loaded/unloaded
- Asset health data
 - Repair history, maintenance schedules
- Railcar monitoring data (sensors)
 - Track location; measure load status, brake status, wheel and bearing performance, and hatch or door securement
- Amsted Digital Solutions tele-metrics platform:
 - Collects accurate, real-time data which can generate actionable and predictive intelligence
 - Can optimize fleet performance and number of assets required, improve safety, and reduce costs, while delivering the required level of service

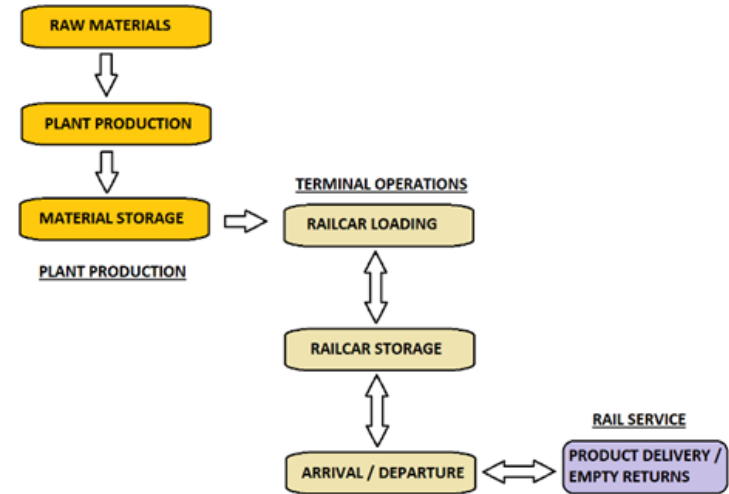
PSR - A Railway Terminal Perspective

Rail Terminal Operations (integrated processes)

- Disruptions in one can impact the others
- Storage required to compensate for day to day variations in production and unplanned disruptions
- Storage requirements requires a risk assessment - often measured in days of production

Material Storage:

- Excess > waste of assets
- Insufficient > risk to plant operations, no risk to rail terminal



Railcar Storage:

- Excess > waste of assets
- Insufficient > risk to plant, rail terminal, and rail service operations

PSR - A Railway Terminal Perspective

Rail Terminal Operations

- PSR promotes a 7 day/week operation
- Assuming no service disruptions, railcars will cycle as planned and not generate additional railcar storage in the terminal
- 7 day operations promotes reliable rail service due to a consistent and predictable level of service:
 - Steady demand for locomotives and train crews
 - Balanced 2-way traffic – less rail line congestion
 - Reduced terminal/yard dwell time – less terminal/yard congestion
- 5 day/week operation will create imbalances in railcar flow:
 - Some railcars will arrive on weekends, requiring storage and additional resources to receive them
 - Some days of production will not have returning railcars, requiring cars from storage
 - Some days will see two (2) cuts of railcars arriving, requiring storage for at least one
- Unit trains every other day:
 - Requires additional storage for extra days production
 - Imbalanced 2-way traffic – congestion
 - Irregular demand for locomotives and train crews

PSR - A Railway Terminal Perspective

Rail Terminal Operating Technologies

Remote Control of Railcar Moving Equipment

- Belt-Pack Control; Rail Terminal Control Centers

Remote Control Turnouts

- DTMF Control; Rail Terminal Control Centers

New Rail Yard Hazard Detection Systems

- ZoneGuard - electronic hazard protection system protects workers from active rail bound equipment
- Loram area monitoring system automatically detects objects in the path of track mounted equipment

AEI Railcar Tracking

- Electronic railcar recognition system captures the consist of a train entering and departing a yard
- Provides real-time railcar location information as railcars move within the terminal

Custody Transfer Systems (scales/meters)

- Accurate measurement of physical substances being transported from one party to another
- Generation of a train manifest prior to departure, including identification of dangerous commodities

PSR - A Railway Terminal Perspective

Rail Service

- Railcar trip plan – origin / destination
- Potential service delays:
 - Mechanical repairs
 - Missed connections due to network delays (congestion, cold/hot weather slow orders, track condition, etc.)
 - Classification yards maybe congested

Railcar Tracking Systems

- Know where railcars get hung up, why, and what is being done to get them moving again
- Develop a recovery plan at the terminal, with updated delivery information

PSR - A Railway Terminal Perspective

The Digital Railway (complex supply chains)

- Multi-faceted end-to-end, seamless, digital platform - real-time connectivity using state-of-the-art technologies
- Transparency and alignment between rail service and terminal operations through access to Railroad real-time data
- CN's Track and Trace API:
 - APIs allow effective transmission of real-time data between computer systems
 - Real-time GPS tracking
 - Status reports – ETAs at interchange points, rail destinations, and customer site
- Cando Quasar Technology:
 - Multi-purpose platform which utilizes leading edge IoT technology to create a digit twin of the customer's supply chain
 - Asset management, real-time railcar tracking, shipment management, yard/terminal management, and transportation cost management
 - Performance metrics, predictive and prescriptive analytics

Conclusions

The reliability of efficient and fluid railway networks relies on the seamless interface between Industry terminal and Railroad operations – benefits include:

- Faster and more reliable transportation service, lower transportation costs, overall supply chain stability, competitive advantage in global and domestic marketplaces, lower costs for goods, and opportunities for sustainable economic growth

PSR has taken the railroading industry to a higher standard of performance and a higher level of success - these concepts and principles will continue to evolve (PSR 2.0)

The true potential of PSR:

- When operating practices between competing railways, customers, ports and other supply chain entities, become standardized, generating closer collaboration and alliances, resulting in greater benefits (service) for customers, regardless of the route or the carriers engaged

The future success of PSR:

- Is dependent upon innovation and the ongoing development and implementation of new technologies through the evolution of the Digital Railroad while improving safety, reliability, efficiency, and utilization of assets, while managing costs, and delivering superior service

Acknowledgements / References

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Q&A Session

