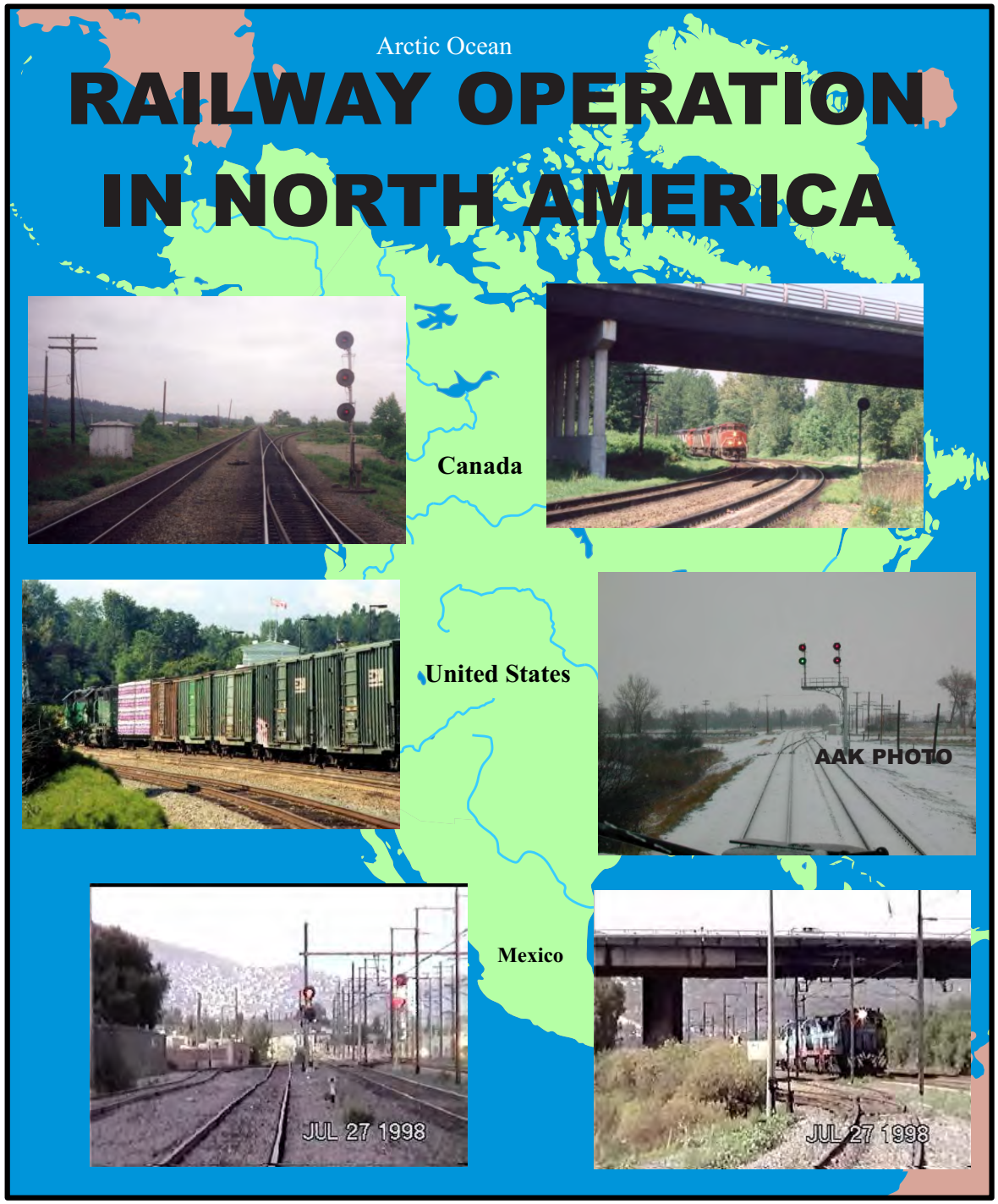

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Montag, 1. Februar 2021

North American operating practices have evolved over a period of 150 years.

Practices are closely related to political economic and regulatory conditions.

Some aspects may be relatively easily portable to other parts of the world.

The success of some aspects requires a specific set of conditions and may not be easily adapted to another part of the world.

Some aspects of North American railway operation are not necessarily the best choice, even for North America.

CONDITIONS THAT AFFECT NORTH AMERICAN RAILWAY OPERATIONS DECISIONS

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The railways of the three countries of North America (Canada, United States, Mexico) comprise a single network.

All are standard gauge (1435 mm).

All rolling stock is interchangeable (couplings; air brakes; location of handbrake, steps, ladders, and handholds; loading gauge all standard).

All use similar signal systems and operating rules.

All share a common car movement data system.

All share a common revenue collection and disbursement system.

Any shipment may move in a single car on a single movement bill between any two points on the continent.

Uniform standards for the continent are developed and maintained by Association of American Railroads. Membership includes the railways of all three countries.

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The two major railroads of Canada were once a private corporation and a Crown corporation. Both are now private.

All US railroads except the Alaska Railroad have always been private corporations. The US government took control of the railroads from private owners during World War I, leaving the property under private ownership. The government returned operating control to the railroads shortly after the war.

Mexican railways were privatized in 1997. Mexico retains ownership and supervision but has divided the network into 4 concessions. Each concession functions as a private railroad, responsible for its assigned segment of the infrastructure.

Canadian-owned railroads operate in Canada and the US.

US owned railroads operate in Canada, the US, and Mexico.

Mexican-owned railroads operate in Mexico and the US.

North American railways are successful transportation businesses, depending upon the measurement used to determine success.

ECONOMIC REGULATION AND GOVERNMENT COMPETITION

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Railways were considered in the late 19th and early 20th Centuries to be the ventures of greedy and evil capitalists.

US railroads were regulated by the Interstate Commerce Commission (ICC) for over 100 years, ending in 1980.

ICC set rates and dictated service, generally with no regard to the financial viability of the railways.

Government began competing with railways in the early 20th Century in the form of extensive highway construction, providing greatly improved operating conditions for competing trucks and automobiles.

Government competition also included lock and dam systems on major rivers, and the St. Lawrence Seaway, which allowed ocean navigation to reach the Midwestern US (for example, Chicago).

Railways were taxed in the 1940s and 1950s to provide the capital for the airways and interstate highway systems.

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The most effective North American railway research falls predominately into two categories:

Increasing carrying capacity without increasing infrastructure (heavier cars, longer trains, track to withstand both),

Reducing cost by eliminating labor (automation).

Reducing car handling (switching, classification) through more efficient blocking and scheduling is an occasional subject of study as is automated train dispatching.

There is virtually no work toward structured / scheduled operations. The last significant work toward increasing infrastructure utilization and service reliability ended in 1993 after two years (failed because of software deficiency and impossibility of overcoming culture).

Software vendors work on the development of simulation software, but there is no significant capacity research.

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Railways once employed an apprenticeship training system for labor and management.

A training period without job responsibility was followed by extensive supervised experience.

There was little formal railway science education.

1980s deregulation brought a change from railway-experienced senior management to senior management from other industries. They were generally not familiar with the capabilities and limitations of railways.

This situation gradually extended into middle management.

Substantial force reductions in the 1980s as part of the 'rescue' process in the industry eliminated most of the experience that provided the training.

‘The old ways’ of railway operation were considered to be part of the problem that railways had to be rescued from by new management.

Training methods deteriorated to limited on the job training followed by responsibility for a position.

There is now relatively little knowledge of railway science in the industry.

There is still very little formal railway science education.

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North American railways are profitable, but...

Using data readily available from the United States Surface Transportation Board (STB) as an example:

Statistics for all North American Class 1 railways for 2007 show an industry-wide return on investment of 8.59%.

The STB makes a judgement for each year of the revenue adequacy of railways in the US.

The last available decision reflects year 2005.

6 of the 7 Class 1 railways in the US made return on investment of 5.89% to 10.32%.

One Class 1 railway made return on investment of 13.21%.

When compared to the cost of capital, (12.2% for the industry in 2005), only one railway was declared revenue adequate by STB.

Most North American railways have been bankrupt at least once in their history.

US railway industry was rescued by deregulation; rail transportation was not.

Change was brought about by crisis - the simultaneous collapse of almost all of the railway companies in the Northeastern US.

Financial instability led to two government-owned railway companies, Conrail and Amtrak.

The same conditions led to city or state ownership of commuter rail services.

The current configuration of North American railways is a result of numerous acquisitions, mergers, and bankruptcies. The process included elimination of all possible ‘redundant’ infrastructure (route abandonment, sale of routes to short line operators, single tracking of multiple track lines, elimination of passing loops and yard trackage).

Short line railways created by line sales during rationalization are generally connected to only one trunk railway, the previous owner. Short lines survive at the whim of the connecting carrier (provision of cars for loading, frequency of connecting service, reliability).

Stock Market influences operation through

Affect on capital decisions,

Affect on expense decisions,

Affect on strategic planning horizon (generally about five years).

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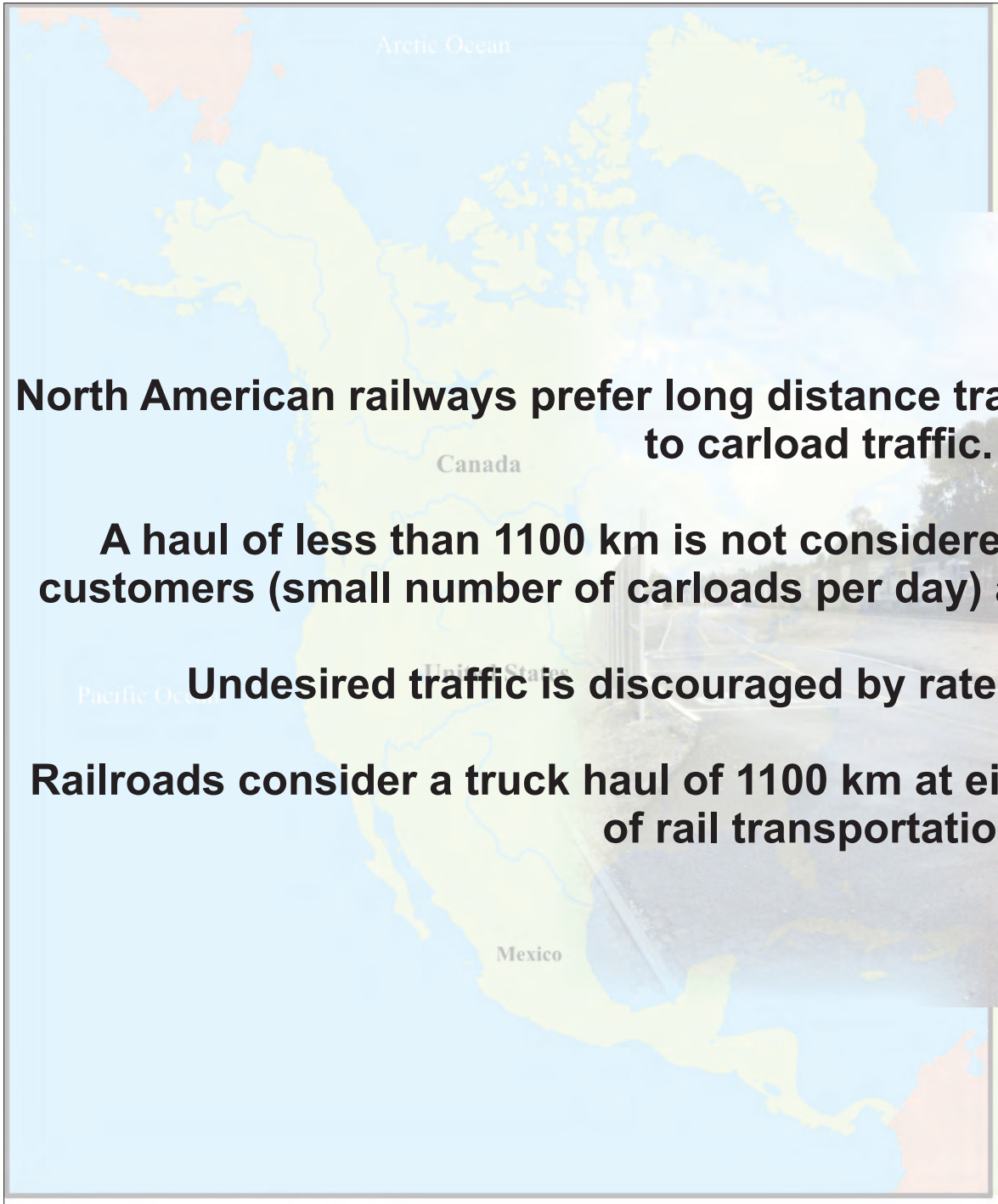

North American railways prefer long distance traffic and prefer unit train traffic to carload traffic.

A haul of less than 1100 km is not considered profitable. Small volume customers (small number of carloads per day) are not considered profitable.

Undesired traffic is discouraged by rates or quality of service.

Railroads consider a truck haul of 1100 km at either end to be an integral part of rail transportation.

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The number of trains originated (Train Starts) is a common measurement of cost-effectiveness.

Train starts are eliminated when possible by

Canceling trains that are 'not big enough' and saving cars for the next day's train to that destination.

Consolidating trains - combining trains for different destinations.

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A Typical North American freight train is 5,700-12,300 tonnes and 2-3 km long.

Train length is regularly more than yard track length, requiring doubling in and out of yards.

Train length may exceed the length of some or all passing loops on a line.

Distributed Power Units (DPU), a radio-controlled locomotive at the back of the train, operated by the engineer in the leading locomotive, are used to facilitate the operation of long and heavy trains.

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Typical maximum speed of freight trains is 72-97 kmph.

113 kmph is allowed in some areas of the Western US.

Actual maximum speed is dictated by locomotive assignment, type of cars, and weight per operative brake.

Locomotive assignments for all but the most important, time sensitive trains provides only 24-32 kmph on the maximum grade of a line and often limits speed to 48-64 kmph over significant distances.

Curvature generally restricts speed to a greater degree than might be expected because superelevation is often limited to 5 cm or less to reduce maintenance cost.

Average freight train speed in the US is between 32 and 40 kmph.

Average terminal dwell for a shipment is about 27 hours

Average rail freight shipment speed is approximately 8 kmph.

Average intercity passenger train speed in the US is between 104 and 128 kmph.

Average commuter train speed in the US is 48 kmph.

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Construction and maintenance cost is the prominent factor in infrastructure decisions.

Infrastructure configuration is the minimum essential to support operation.

Single track lines

Typically have a single passing loop at each station.

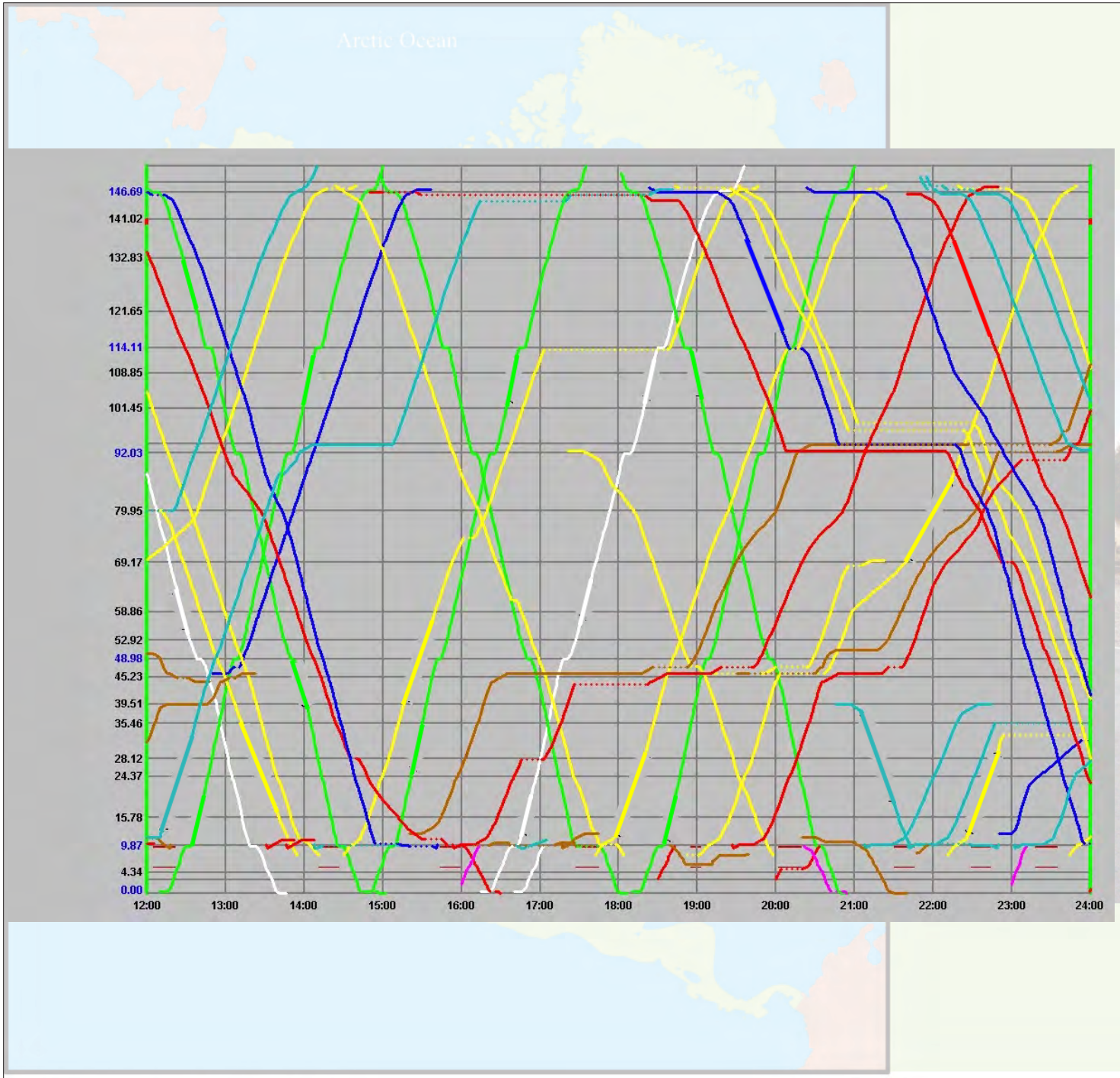
Loops are typically 20-30 minutes apart.

Loops than can accommodate any train may be 40-60 minutes apart.

Double track lines

Typically do not have passing loops.

Overtaking is accomplished by bi-directional signaling or not at all.



Trains generally enter and leave yards directly from or to main tracks at 16 kmph.

At many yards, trains must occupy a main track while doubling in or out.

Most en route stations do not have a track that can accommodate a train clear of the main track. Trains set out and pick up cars while occupying the main track.

OPEN ACCESS - THE BUSINESS ASPECT

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Customers are constantly pressuring government for re-regulation (there has been some success in Canada) and open access in order to improve service and control rates.

Railroads fight open access to protect their investment in infrastructure and land from private operators that would take the most profitable traffic (bulk commodities and marine containers).

Railroads, citing the oppressive regulation of the Interstate Commerce Commission of the 1870s-1970s, maintain that re-regulation and forced competition will cause the collapse of rail transportation.

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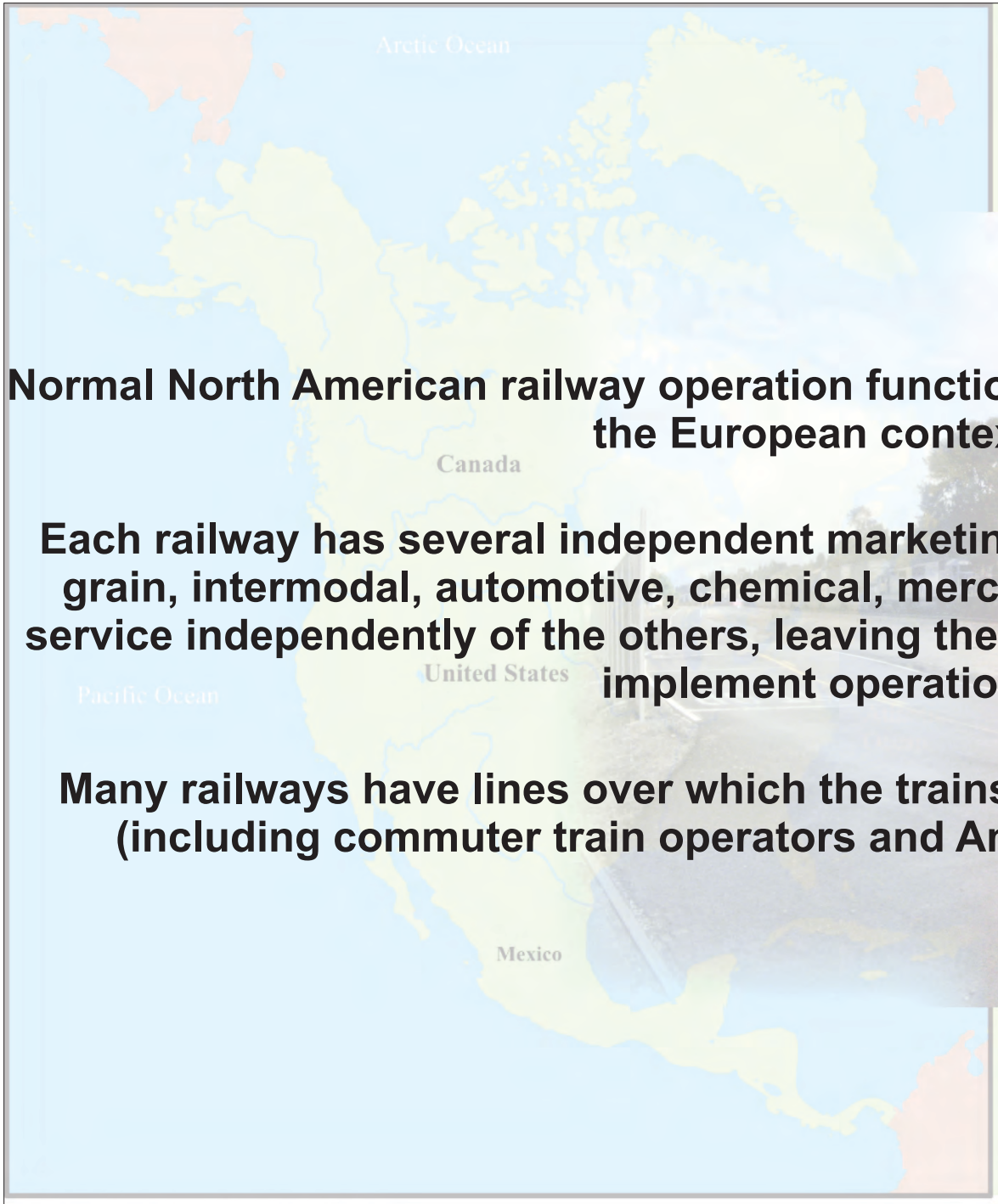

Normal North American railway operation functionally similar to open access in the European context.

Each railway has several independent marketing departments (such as coal, grain, intermodal, automotive, chemical, merchandise) that each schedule service independently of the others, leaving the control center to develop and implement operation.

Many railways have lines over which the trains of other railway companies (including commuter train operators and Amtrak) operate as tenants.

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Traffic approaching capacity limits the success of completely improvised operation

Service for many types of traffic is slow and unreliable.

Railways prefer high revenue traffic such as double stack containers, bulk commodities, and some domestic intermodal.

Railways discourage undesired traffic through limiting car delivery, high rates, undesirable service, advertisements and other methods of directly or indirectly telling undesired customers to go away.

One carrier contracted trucks to haul part of its intermodal traffic because it could not meet the haulage contract requirements.

Highway congestion is increasing and public wants greater rail transportation utility (get the trucks off the road, handle more passengers). The public's transportation needs are not usually consistent with corporate needs and goals.

Current conditions demonstrate the difference between railway corporations and railway transportation.

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North American railways have been improvising operation for over 140 years.

Original concept was ability to mitigate effects of delay in scheduled operation.

Improved communication and traffic control along with increasing skill level allowed extensive improvisation.

Successful improvised operation depended upon substantial control of operation by train dispatchers and chief dispatchers.

By early 20th Century, operation developed into structured improvisation, much like Germany's schedule reservation a few hours in advance.

Such structured improvised operation was dismissed as being too restrictive, limiting the flexibility railways needed to compete with trucks.

Deregulation and the associated changes in management in the 1980s, accompanied by changes in communication technology, brought about completely improvised operation.

Train dispatcher and chief dispatcher control of traffic entering the system was generally eliminated and some of the management of traffic en route was limited.

With the very high capacity to traffic ratio of the early 1980s, successful fully improvised operation was easy to accomplish.

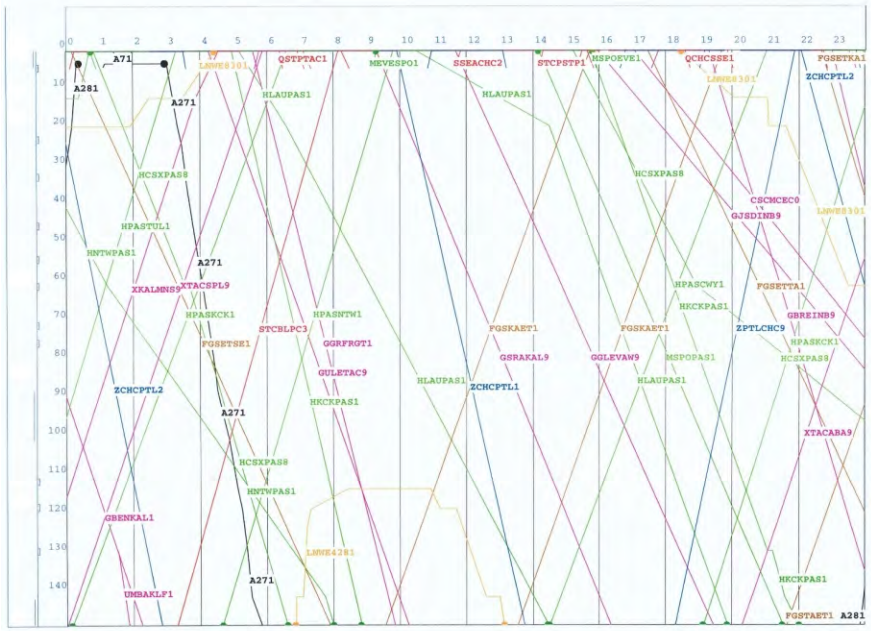
Railways reduced all possible capacity during the 1980s, eliminating sidings, interlockings, second and third main tracks, yards, signals and other capacity-producing facilities and equipment.

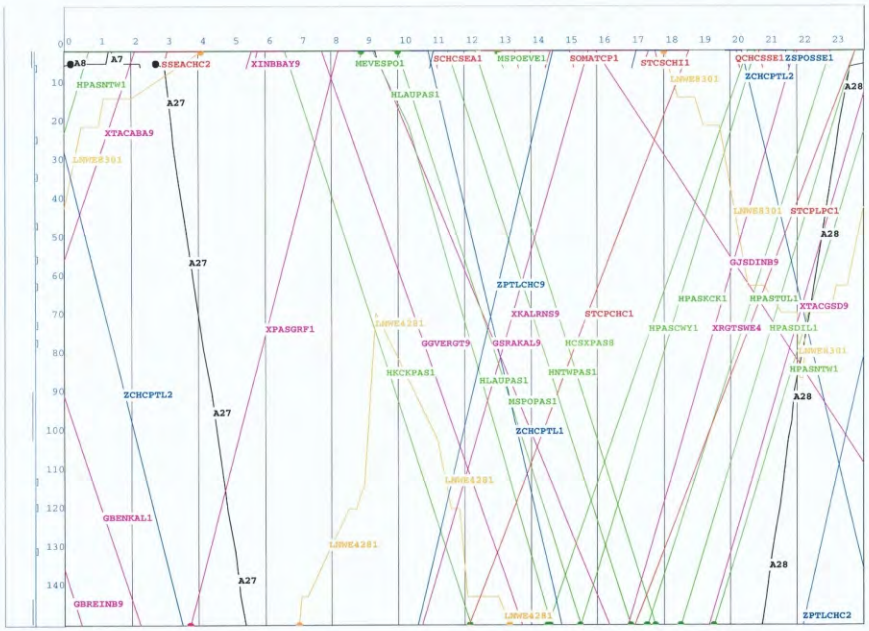
Traffic has increased significantly since the early 1990s.

The ratio of traffic to capacity is now high on most major routes.

Successful improvised operation is no longer easily accomplished and is often not possible.

SINGLE TRACK LINE

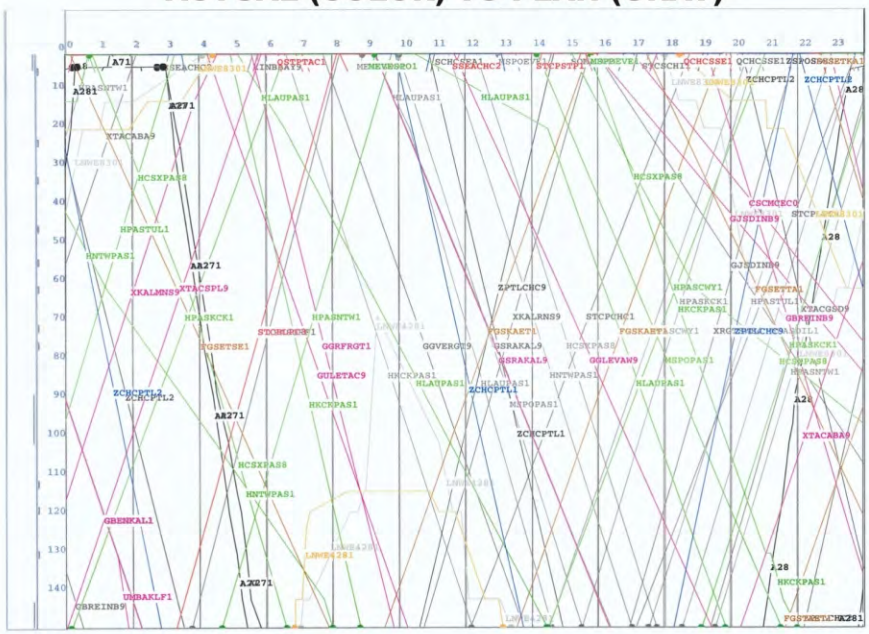




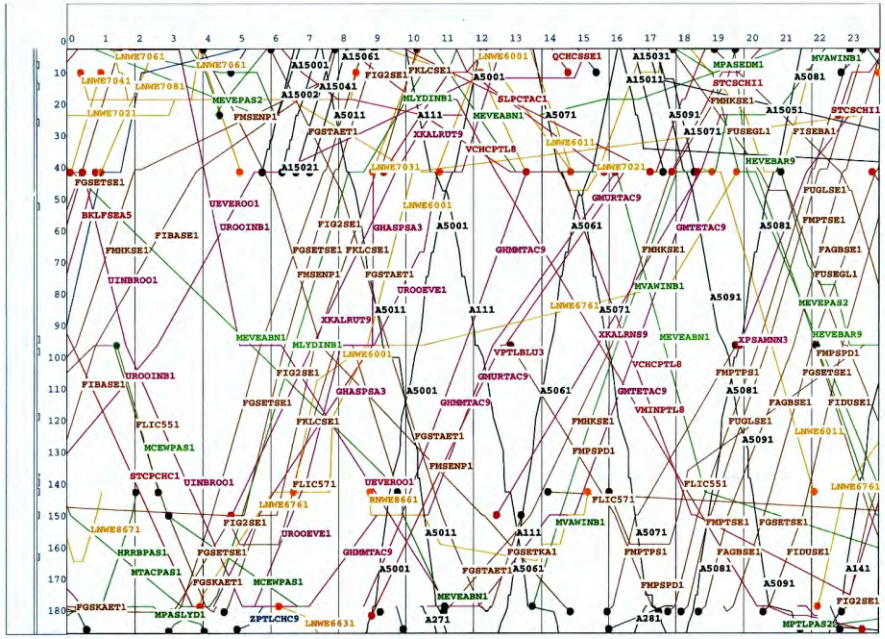
ACTUAL (COLOR) TO PLAN (GRAY)

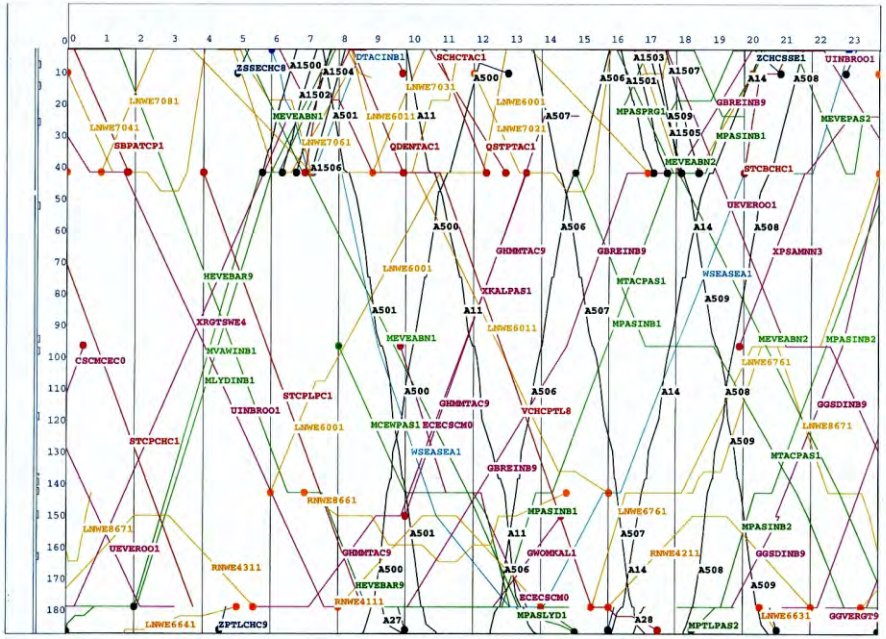
ACTUAL

PLAN



DOUBLE TRACK LINE





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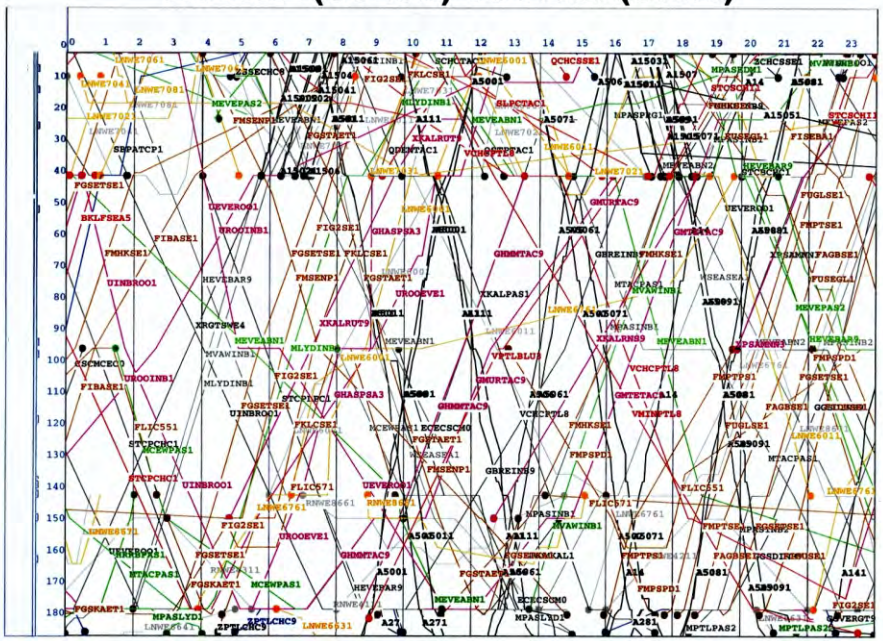

PLAN

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Crew fatigue is an important subject of discussion in North America - particularly in the US.

Fatigue is considered to be a contributing cause of many incidents.

Example of a crew considered to be rested:

Crew arrives at the away from home terminal at 10:45, their train is due to leave at 21:30.

At 20:30 the train is due to leave at 00:30.

At 22:45, the train is due to leave at 01:30.

At 01:00, the train is due to leave at 03:30.

At 03:00, the train is due to leave at 04:30.

At 05:00, they are called to come on duty at 06:30.

At 06:30, the train is not ready.

It leaves at 09:00.

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Priority is generally the basis of improvised operation.

Time is generally not considered (trains of less priority will still be delayed for a high priority train that is early).

Railroads generally sell premium intermodal service that has the shortest schedule running times and the highest priority.

Train dispatcher's handling instructions for high priority trains include for example, 80-160 km clear in advance of the train, 5 or more consecutive CTC control points lined up in advance of the train, no lower priority trains arriving at a terminal within 1 or more hours of the arrival of a high priority train.

Early arrival of a high priority train is considered success, regardless of the effect on other traffic.

The priority level of a low priority train may increase as delays increase likelihood of hours of service expiration of the crew.

Passenger trains are required by law to have priority over other traffic but often do not.

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Completely improvised operation creates a constant condition of chaos and makes predictability impossible.

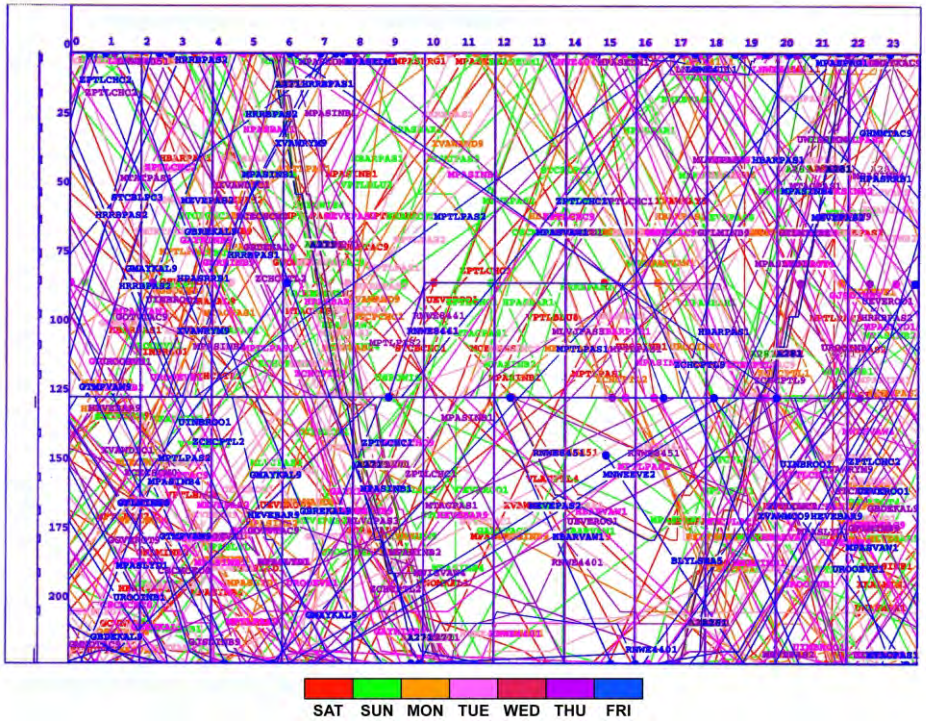
Customers see the result in poor service quality and low reliability.

Maintenance of Way sees the result in low productivity.

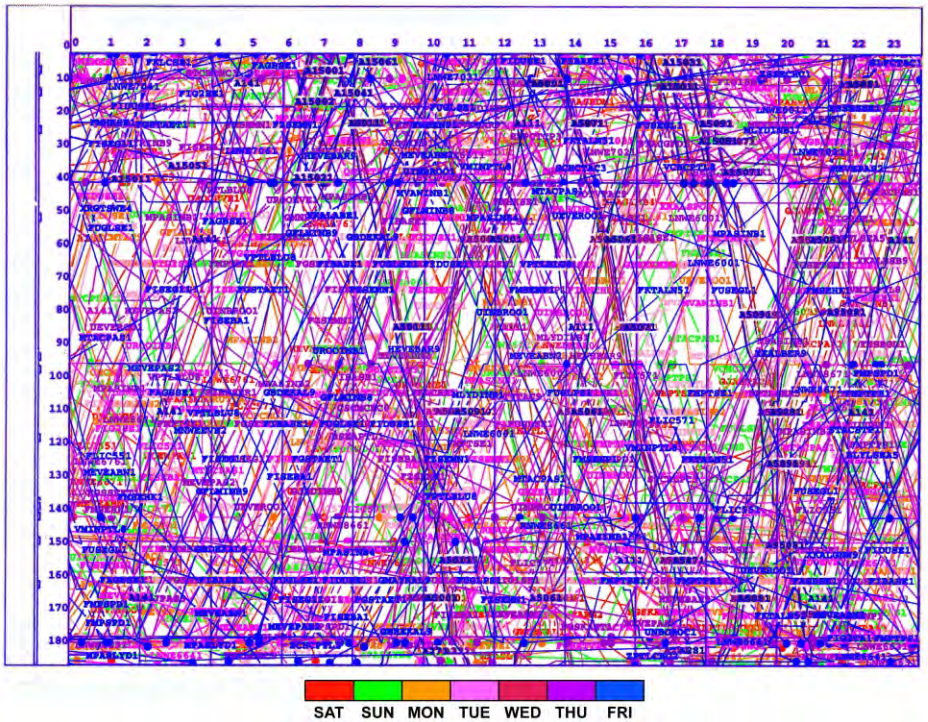
Train and engine crews see the result of chaos in long on duty times, unpredictable length of off duty time, and unpredictable time for the beginning of the next duty period.

Train dispatchers see the result in workload.

EXAMPLE OF 7 DAYS OF NORMAL OPERATION



SINGLE TRACK LINE



DOUBLE TRACK LINE

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US Hours of Service law requires train and engine crews no more than 12 hours on duty in any period of 24 hours. Canada depends upon union contracts rather than regulation to limit hours of service.

Many crews cannot make the assigned trip within the limit

Crew called on duty when train or locomotive not ready,

Initial terminal congestion prevents doubling out and leaving,

Main line congestion and/or priority traffic causes delay,

Final terminal congestion prevents entering the yard.

When crews reach their hours of service limit, trains park on main tracks or passing loops until a relief crew reaches the train.

Relief crews are often not called to come on duty until the time of the crew to be relieved is about to expire.

Railroads have standing contracts with van services to drive crews to and from trains when hours of service limitations expire. These van services also move deadhead crews between terminals

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Train schedules generally consist of arbitrarily determined times at terminals.

Conflict-free schedules are not used.

An attempt to make a traffic diagram of schedules often demonstrates that it is not possible to operate all trains on time simultaneously.

Car scheduling is the primary scheduling method. If each car is on the correct sequence of trains between origin and destination and arrives on the correct day (and sometimes the correct hour or window of several hours) at the destination customer, the car is on time. If a train leaves a terminal with all cars that have been scheduled to move on that train, the train is on time.

Passenger train schedules are generally based upon typical running time and some arbitraryadditional amount for traffic.

CONTROL CENTER

The train dispatcher is the lowest level of traffic management. Above the train dispatcher are generally titles such as chief dispatcher, corridor manager, corridor superintendent.

Train dispatchers often do not have decision making authority and must consult with and defer to higher ranking managers.

The control center may also include transportation managers for the various commodity groups (such as coal, grain, vehicles, intermodal, passenger).

Generally, locomotives, crews, rear end telemetry devices, maintenance of way, car distribution, terminal operation, and traffic management are handled separately (a carryover from the 'profit center' orientation adopted from Japanese manufacturing business management of the 1980s).


DISPATCHING

Train dispatchers are the main element of improvised operation.

Train dispatchers generally receive about 24 weeks of training between having no railway experience and responsibility for a territory.

Employment turnover is very high.

Each train dispatcher, except in some crowded terminal areas with heavy traffic, has a territory of generally 500 - 1600 km.

Terminals operate trains as convenient for the terminal.

Terminals refuse entry to trains that cannot be accommodated on arrival.

Maintenance of Way employees call for authority to work with no advance notice.

Scheduled Maintenance of Way windows are generally accommodated by not calling crews on duty during a specified period.

The train dispatcher invents a new operating plan for every change in train or Maintenance of Way traffic.

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Of the 214,000 Class 1 railway route km in the US:

109,500 km have no signal system,

29,000 km have Automatic Block Signals (signals are not movement authority),

4,800 km have cab signals (signals are generally not movement authority),

70,800 km have Centralized Traffic Control (signals are movement authority).

The US has recently completed equipping 91,000 km of track with Positive Train Control (PTC).

Almost no towers and local interlockings remain. The few that remain are in the process of being converted to dispatcher-controlled remote operation.

Main track switches do not require power operation or interlocking, but position of non-interlocked switches is checked by block signal systems.

Track circuits are used almost exclusively for detection. DC track circuits for non-electrified lines were standard but are being replaced with coded track circuits to facilitate pole line elimination.

Signaling equipment is generally consistent throughout North America.

Generally, Canadian and Eastern US railroads use speed signaling, Mexican and Western US railroads use route signaling.

US railroads prefer 3 aspect signals with blocks long enough to accommodate the stopping distance of freight trains (3-7 km).

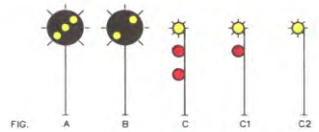
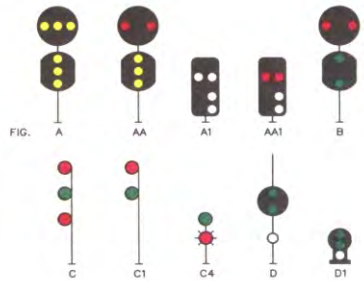
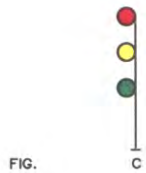
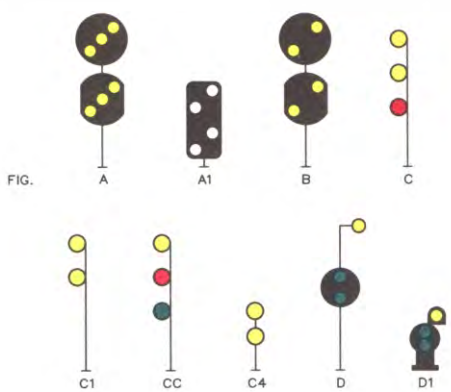
Because of the frequency of collisions involving passing a signal at stop or not restoring a main track switch, train crews in the US maintain a written record of the indication of each signal and a written record of each hand throw switch used. Some railways require train crews to make a general announcement on the radio of all signal indications less favorable than proceed announcing the train identification, direction, location, and signal indication.

A wide variety of signal aspects and indications exist in the US as a result of many mergers and still-existing signal systems dating to as early as the 1920s.

Aspects and indications are not uniform on various segments of a single railway company.

Semaphore signals are rare, position light and color position light signals are gradually being replaced with three light color light signals.

Canada and Mexico have standardized signal aspects and indications throughout the country.

Rule	Aspects
282a	
283	
283a	
284	

Rule	Name	Indication
282a	ADVANCE APPROACH	Proceed prepared to stop at the second signal. Trains exceeding Limited speed must begin reduction to Limited Speed as soon as engine passes the Advance Approach signal.
283	MEDIUM CLEAR	Proceed at Medium Speed until entire train clears all interlocking or spring switches, then proceed at Normal Speed. In CSS territory with fixed automatic block signals, trains not equipped with operative cab signals must approach the next signal at Medium Speed.
283A	MEDIUM APPROACH MEDIUM	Proceed at Medium Speed until entire train clears all interlocking or spring switches, then approach the next signal at Medium Speed. Trains exceeding Medium Speed must begin reduction to Medium Speed as soon as the Medium Approach Medium signal is clearly visible.
284	APPROACH SLOW	Proceed approaching the next signal at Slow Speed. Trains exceeding Medium Speed must begin reduction to Medium Speed as soon as the engine passes the Approach Slow signal.

(Some Railways)
RESTRICTING
Proceed at Restricted Speed until the entire train has cleared all interlocking and spring switches (if signal is an interlocking or CP signal) and the leading wheels have:
1. Passed a more favorable fixed signal,
or
2. Entered non-signaled DCS territory.

OR

(Other railways)
DIVERGING APPROACH
Proceed on diverging route not exceeding prescribed speed through turnout; approach next signal preparing to stop, if exceeding 30 MPH immediately reduce to that speed.

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North American railways used a single standard rule book from the late 19th Century through the early 1980s.

New traffic control and communication technologies combined with the non-railroad corporate management that accompanied deregulation generated a movement to simplify and de-standardize operating rules.

Canada has a standard set of operating rules (Canadian Code of Operating Rules) for all railways.

Mexico has adopted one of the US rulebooks, General Code of Operating Rules, as the national standard.

US has two rule books that are each standard among a large group of railways. Two railways maintain their own operating rule systems of their own development.

The rules among the US railroads are sufficiently similar to allow train crews of one railroad to operate on the lines of another (with appropriate qualification on the rules of each railway).


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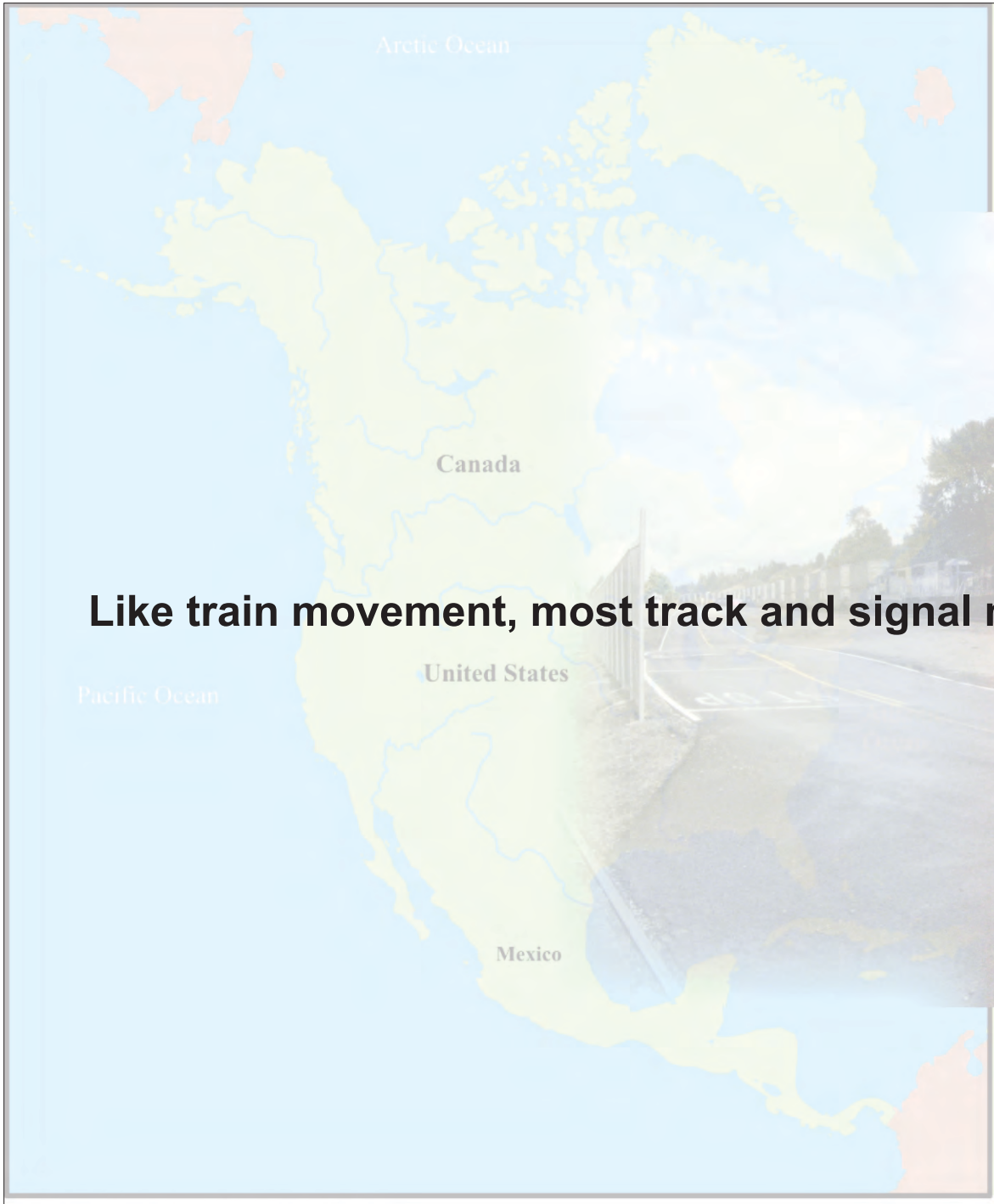
MAINTENANCE OF WAY



Like train movement, most track and signal maintenance is improvised.

FOR WORK THAT REQUIRES RELATIVELY SHORT POSSESSIONS:

The maintenance employee arrives at the workplace and notifies the train dispatcher of the work to be performed.

The train dispatcher

Develops a traffic plan that will allow the work and issues authority (protected by withholding movement from trains within the work authority limits),

May tell the maintenance worker to call back after a specified time or the passage of a specific train,

May tell the maintenance worker that the requested work cannot be performed today.

Train traffic is not adjusted for this activity. The implementation is left to the train dispatcher as needed.

CTC EXAMPLE

At 1020: Dispatcher, this is foreman Jones. I have 4 hours work between East Station and West Station. I need at least an hour.

(Dispatcher calculates available time. A Westward train will pass West Station at 1130, but it will wait 20 minutes at a station west of West Station for an Eastward train.)

Jones, I can give you 1150. Can you use that?

Yes, dispatcher, that will work.

(Dispatcher checks to ensure that there are no trains between East Station and West Station then uses the blocking feature of the control machine to prevent lining signals into the maintenance authority.)

Permit number 100 to Jones on the main track between the Eastward Controlled Signal East Station and the Westward Controlled Signal West Station from 1020 until 1150.

Jones repeats the authority. Jones must report clear by 1150, but the authority exists until Jones releases it.

ABS / DARK TERRITORY WRITTEN AUTHORITY EXAMPLE

At 1020: Dispatcher, this is foreman Jones. I have 4 hours work between East Station and West Station. I need at least an hour.

(Dispatcher calculates available time. A Westward train will pass West Station at 1130, but it will wait 20 minutes at a station west of West Station for an Eastward train.)

Jones, I can give you 1150. Can you use that?

Yes, dispatcher, that will work.

(Dispatcher checks to ensure that there are no trains between East Station and West Station and that no trains have authority between West Station and East Station, then issues authority in the same manner as for a train.)

Track Warrant number 100 to Jones, check Box 3 on the main track between the Eastward Controlled Signal East Station and the Westward Controlled Signal West Station, check Box 4 this authority expires at 1150.

Jones repeats the authority. Jones must report clear by 1150, but the authority exists until Jones releases it.

FOR FULL DAY POSSESSIONS THAT CAN BE INTERRUPTED:

Train dispatcher issues a movement instruction to all trains that requires trains to notify the foreman in charge of the work when approaching the work area.

The work area is protected by red flags and advance warning yellow/red flags 3.2 km in advance of the red flags.

Trains must not proceed through the work area until authorized by the foreman in charge of the work and must follow the foreman's movement instructions such as speed, proceed prepared to stop, bell and horn to notify workers.

This method is also used to protect workers on a track that is out of service and adjacent to a track on which trains are operating

Train traffic is not adjusted for this activity. The implementation is left to the train dispatcher as needed.

The train dispatcher often does not know in advance the effect that the work will have on a given train. It is often necessary to develop a new traffic plan frequently.

WORK UNDER TRAFFIC EXAMPLE


```
                                 |                                                  |
Item Restrn Form                 |        Restrictions for SCENIC Subdivision       |
 No  Number                      |                                                  |
-*-* -*-*-* -*-* -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
                                 |
                                 |
5    7272    B                   MP       To MP    From Z Date   To    Z Date   Track(s)
                                 -------- -------- ------------- ------------- ----------------------
                                 10.5     5.0      0800 P 06/21  1500 P 06/21  ALL MAIN TRACKS
                                 Yellow/Red flag at MP:            Yellow/Red flag at MP:    3.5
                                 Foreman: BYKONEN                 Gang:            Stop Required
                                 Comment: USE CHANNEL 66
                                 |
                                 |
---- ------ ---- -----------------------------------------------------------------
Track flag at MP     2.0  See Restrn    7405 on SEATTLE SUBDIV
-*-* -*-*-* -*-* -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
                                 |
                                 |
6    7306    B                   MP       To MP    From Z Date   To    Z Date   Track(s)
                                 -------- -------- ------------- ------------- ----------------------
                                 2.0      1.0      0730 P 06/21  1630 P 06/21  ALL MAIN TRACKS
                                 Foreman: BIDWELL                 Gang:            Stop Required
                                 Yellow/Red flag on SEATTLE subdiv at MP    0.9X
                                 |
```

FULL DAY POSSESSIONS

Transportation management personnel (chief dispatcher, corridor manager, corridor superintendent, or other similar titles) determine that maintenance of way work will interrupt traffic.

Instructions are issued to train dispatcher and terminals that trains are to be held either side of the scheduled work between specified hours.

Most trains will be held in terminals.

Some trains may be allowed to leave terminals to be held on line during the maintenance work.

Terminals call train crews on duty as convenient at the end of the restricted period.

The train dispatcher develops the traffic plan as trains are called on duty.

PASSENGER TRAINS

It is difficult to operate reliable passenger service in a chaotic environment.

Passenger service is minimal (a small number of routes and a frequence of one train each direction per day or less) except for commuter service near large cities and on a few intercity corridors.

Most US and Canadian railways actively oppose passenger service.

Most will now consider passenger service in exchange for significant infrastructure construction.

There is often substantial disagreement between railways and public agencies as to what infrastructure is 'required' to support passenger service and what infrastructure is needed to 'keep the railway whole'.

Typical punctuality for intercity service (10 minute schedule tolerance):

75-85% on passenger-only lines,

30-50% on freight railway lines in the US.

Delays of 4-12 hours are common on some routes.

Infrastructure construction in exchange for new or increased service does not guarantee punctuality.


CONCLUSION

Railway science education is extremely important for operating crafts, transportation management, engineers, and business managers.

Good ideas can become bad ideas without this fundamental knowledge.

AND...

North American operation is a result of political and economic conditions unique to North America.

Understanding many of the aspects of the North American railways requires understanding of the conditions that influenced development of the methods.

Some aspects of North American operation work well in the North American context, others do not.

It may be possible and appropriate to adapt some aspects of North American operation for use in other places.