

The Canada Line

- › *AQTr Conference*
- › *November 22nd, 2018*



Agenda- Overview

- Overview
- GoA 4 & Benefits
- Safety Systems
- O&M
- Mobilization
- Asset Management
- Innovation
- BIM/BLM



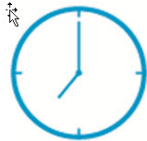
Overview



Since operation began in 2009

99.90%

System Availability



99.75%

Punctuality

aprox.

400 million

Passengers since 2009



Average Weekday Ridership

150,000

2.05 billion
p3 project (2005 dollar)



Delivered over
3 months
ahead of schedule

30 years
of O&M



P3 Model

- P3 – SNC Lavalin - Partner on the Canada Line
- Provided design, build, finance services;
- Operates and Maintains the Canada Line under a long term contract - 2040
- 215 FTE employees deliver services – Self Perform
- Multitude of Contractors



Project Alignment

Bored tunnel

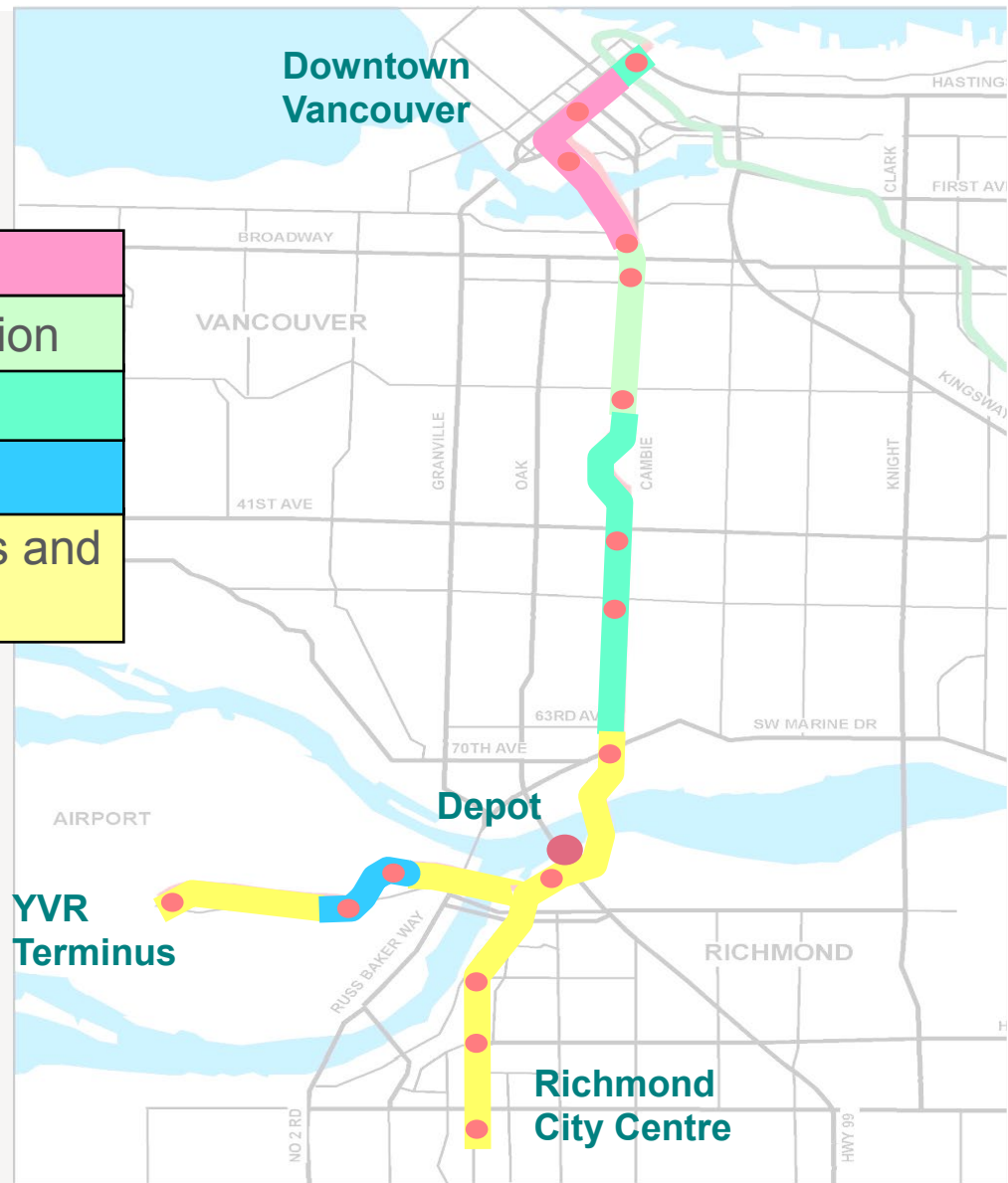
Cut & cover tunnel, stacked configuration

Cut & cover tunnel, side by side conf.

At-grade section on airport lands

Elevated in Richmond, on airport lands and in Vancouver to 63rd Ave.

- 18.5 km fully automated system
 - 7.6 km elevated
 - 1.8 km at-grade
 - 9.1 km underground
- 16 stations (6 elevated, 2 at-grade, 8 underground)
- 3 water crossings (2 bridges, 1 tunnel)



Canada Line is GoA 4

| Grade of Automation | Type of Train Operation | Setting Train in Motion | Stopping Train | Door Closure | Operation In Event of Disruption |
|---------------------|-------------------------|-------------------------|----------------|-----------------|----------------------------------|
| GoA 1 | ATP With Driver | Driver | Driver | Driver | Driver |
| GoA 2 | ATP and ATO with Driver | Automatic | Automatic | Driver | Driver |
| GoA 3 | Driverless | Automatic | Automatic | Train Attendant | Train Attendant |
| GoA 4 | UTO | Automatic | Automatic | Automatic | Automatic |

ATP= Automatic Train Protection

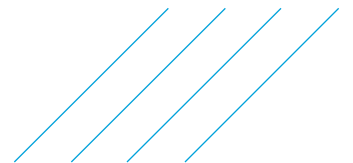
ATO= Automatic Train Operation

UTO= Unattended Train Operation



Benefits

- Optimization
 - Speed
 - Headways
 - Dwells
 - Staffing
- Flexibility
 - Better use of assets
 - Reduction of service
 - Injection – Surge Demand
- Safety & Reliability
 - Safer Operation
 - Decreased Wait Times
 - Staff Availability at Stations



Safety Systems

ATC – Automatic Train Control System

GIDS – Guideway Intrusion Detection System

WIDS – Walkway Intrusion Detection System

CCTV – Closed Circuit Television

PESB – Platform Emergency Stop Button

CESB – Central Emergency Stop Button

ETEL – Emergency Telephone System

PAA – Passenger Assistance Alarm

PIP – Passenger Intercom Panel

BLS – Blue Light Station

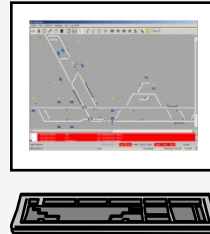
OMC – Closed Perimeter Security System



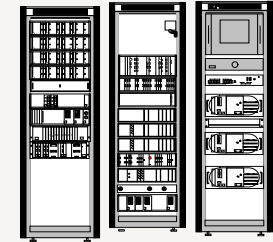
Safety Systems – Automatic Train Control (ATC)

Central Equipment

**System Management
Centre (SMC)**



**Vehicle Control
Centre (VCC)**

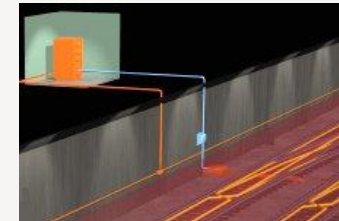


Wayside Equipment

**Inductive
Loops**



**Station
Controllers (STC)**

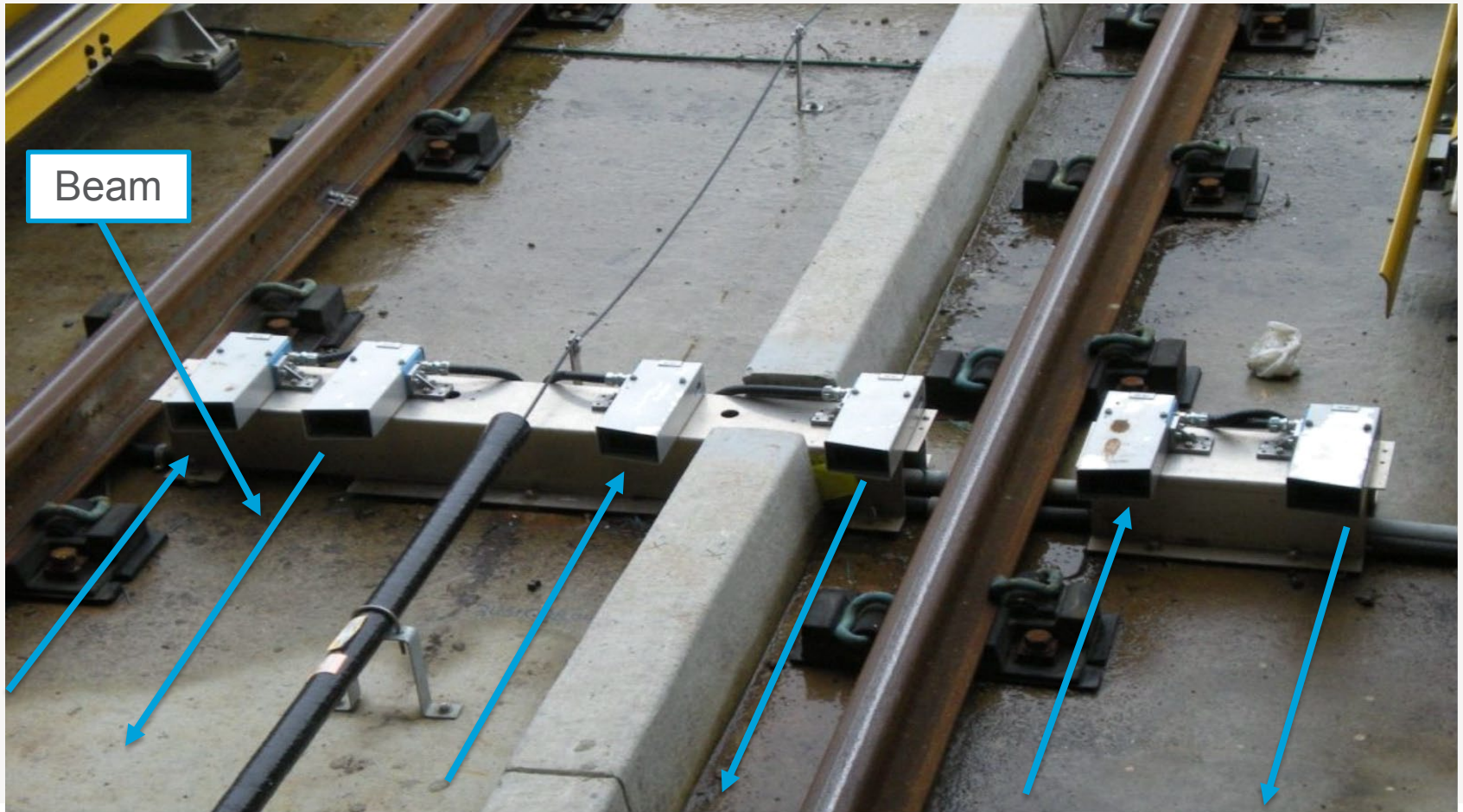


On-Board Equipment

Vehicle On-Board Controller (VOBC)

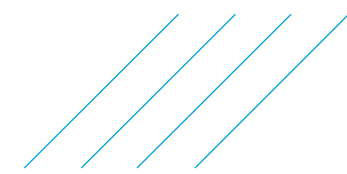
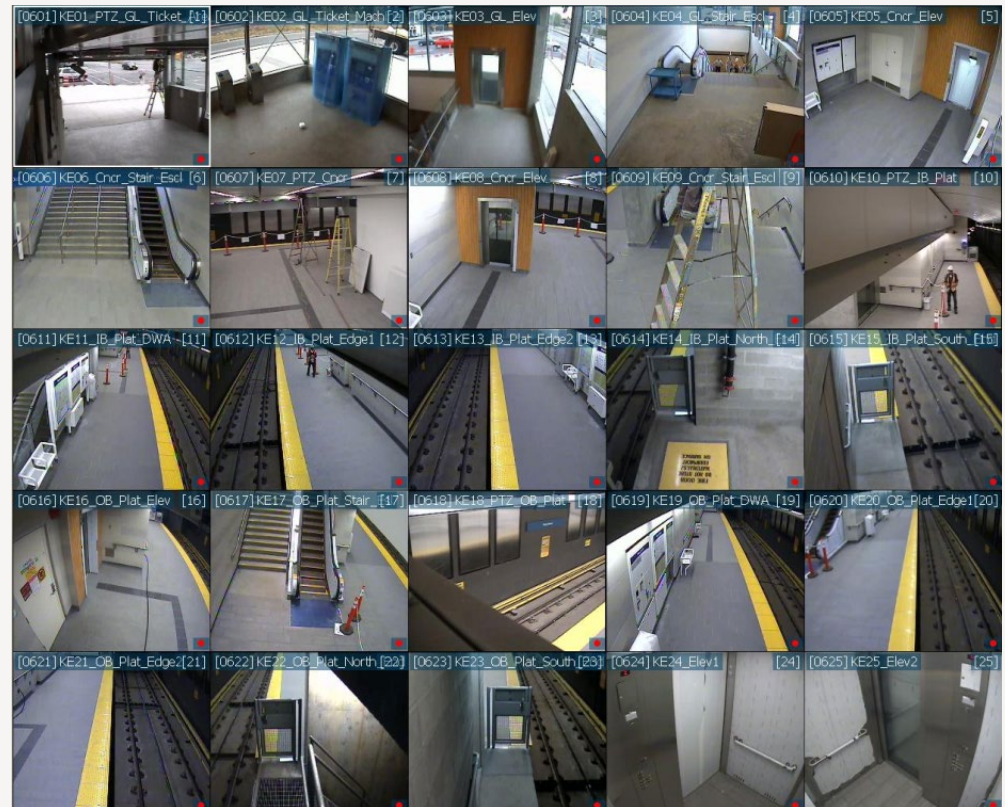


Safety Systems – Guideway Intrusion Detection



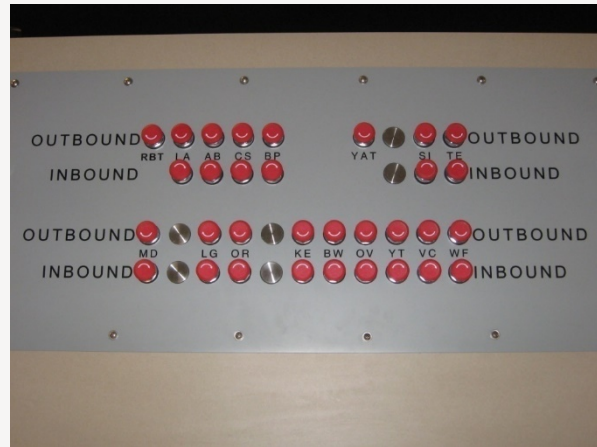
Safety Systems - CCTV

- Over 500 Cameras
- 2 Per Platform Edge
- SALVO
- PTZ



Safety Systems - PESB / CESB / ETEL

Central Emergency Stop Button

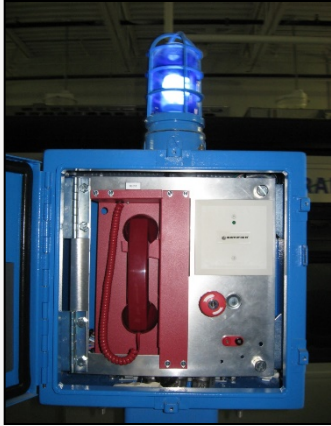


Platform Emergency Stop Button



Emergency Telephone

Safety Systems



← **BLS: Blue Light Station**



← **PIP: Passenger Intercom Panel**

PAA: Passenger Assistance Alarm



O & M - Operations

- Consists of 70 Canada Line Attendants and Supervisors
- Canada Line Attendants (CLA's) provide front line customer service on station platforms and on trains
- CLA's are highly trained and provide customer assistance and field response services

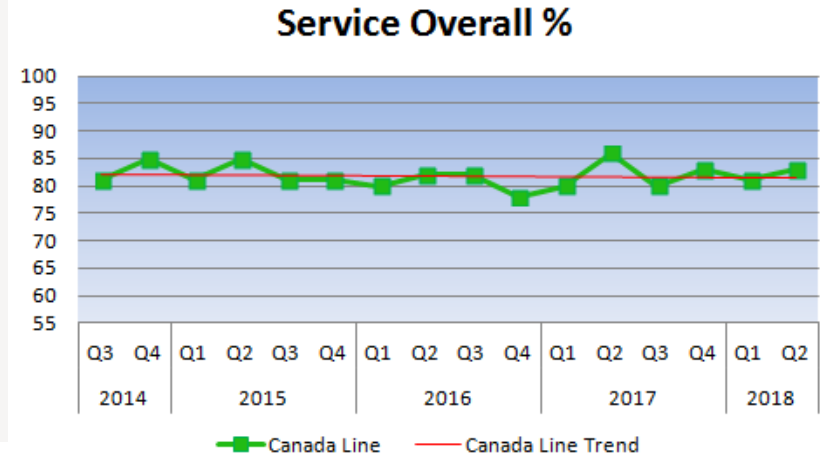
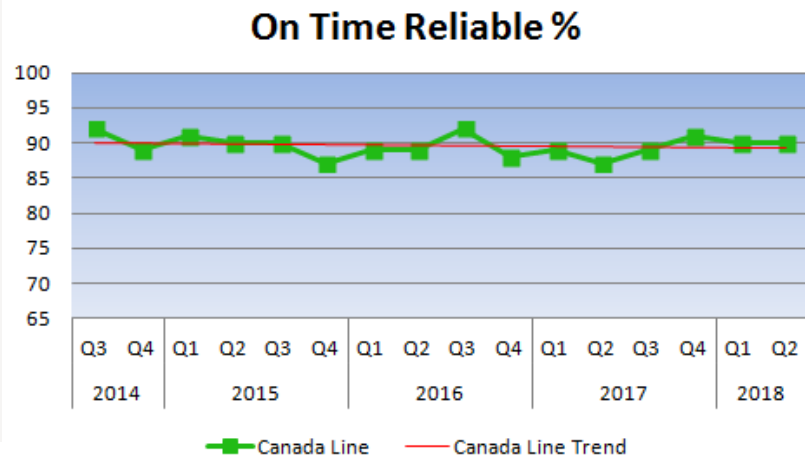
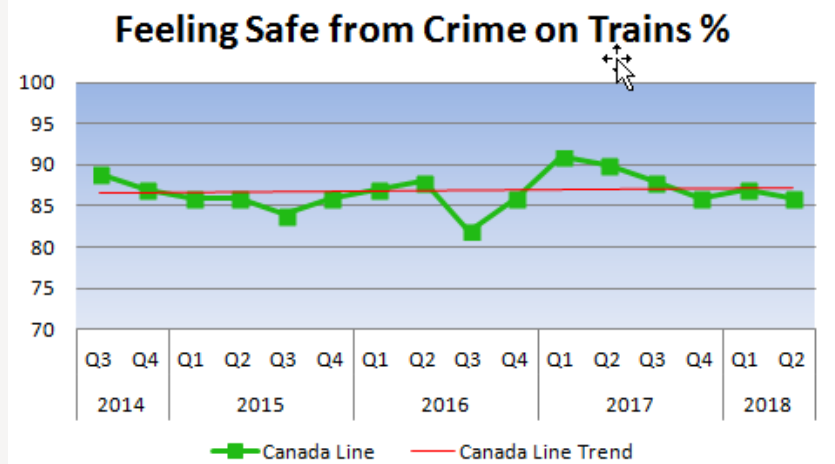
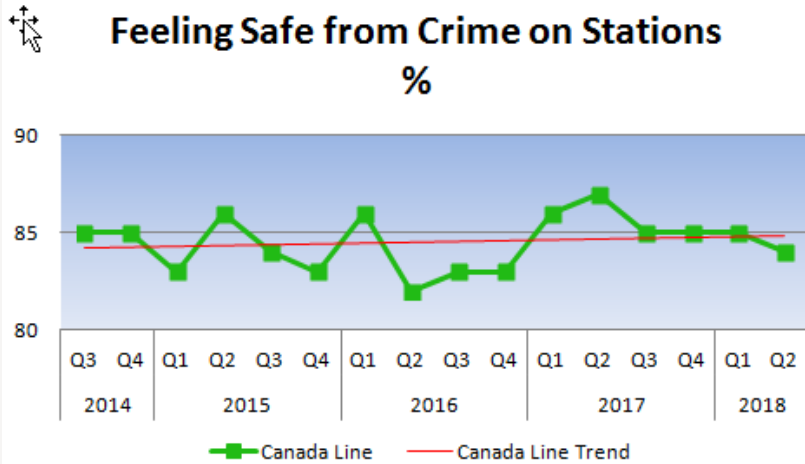


O & M - Operations

- Canada Line Control Room staffed 24 X 7 days per week.
- Oversight of all Operations including Safety and Life Systems
- Over 40 staff trained and certified as Control Room Operators, Communications, SCADA and Fare Gate Control
- Over 500 Security Cameras



Survey



Mobilization Challenges

- Recruiting qualified and experienced staff
 - ATC Qualified
 - Safety & Customer Service Oriented
 - Cost of Living

- Mobilizing for Vancouver 2010 Olympics
 - Highest Single Day of Ridership
287,379 Passengers
 - 100% Reliability



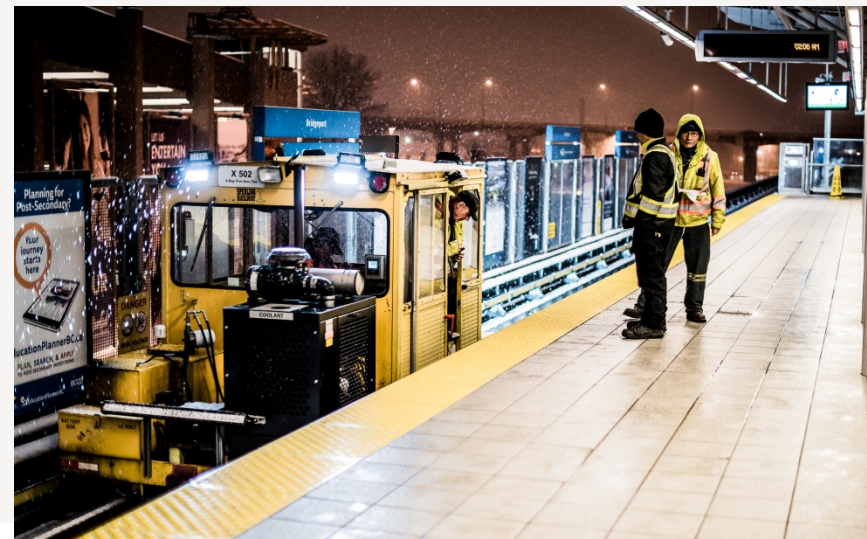
O & M - Maintenance

- Maintenance staff includes ~70 employees, largely self-performing
- Maintenance responsibilities for rolling stock, trackwork, guideway, facilities, train control and communications systems
- Hold complete life cycle responsibility, including day-to-day, major refurbishment and end of life replacement
- Accountable to performance requirements of the contract



Asset Management

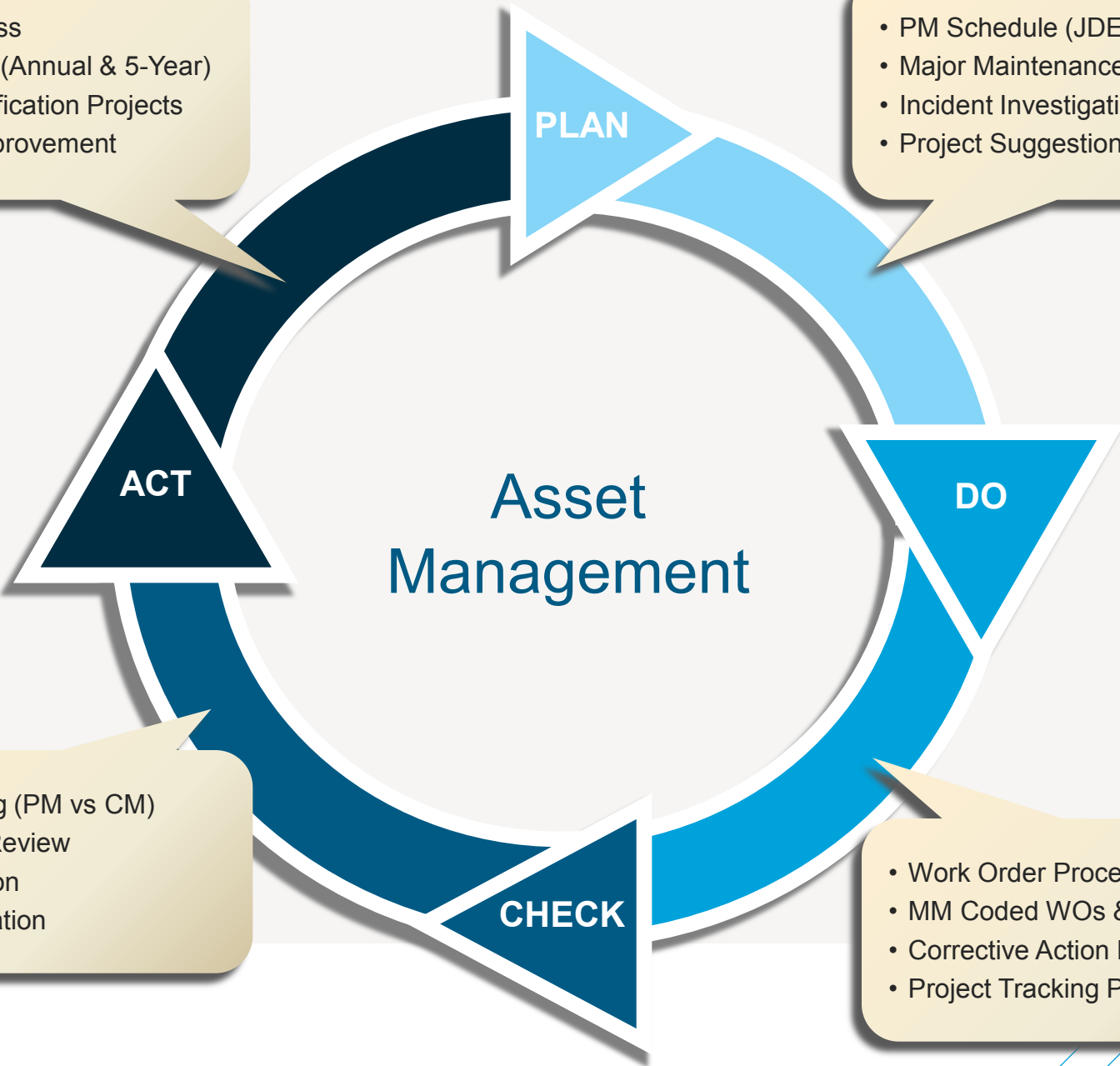
- Highly process oriented, with automated process cycles for:
 - Preventive maintenance
 - Asset replacement/refurbishment
 - Failure response/investigation
 - System improvement/innovation
- Performance metrics
 - Asset Availability & Quality
 - PM/CM Ratio
 - Incident Response Times
 - CPI & SPI – Projects and MM





- RCMA Process
- AMP Review (Annual & 5-Year)
- System Modification Projects
- Continual Improvement

- PM Schedule (JDE)
- Major Maintenance Schedule
- Incident Investigation & RCA
- Project Suggestion & Feasibility



- KPI Reporting (PM vs CM)
- MM Activity Review
- CAR Validation
- Project Validation

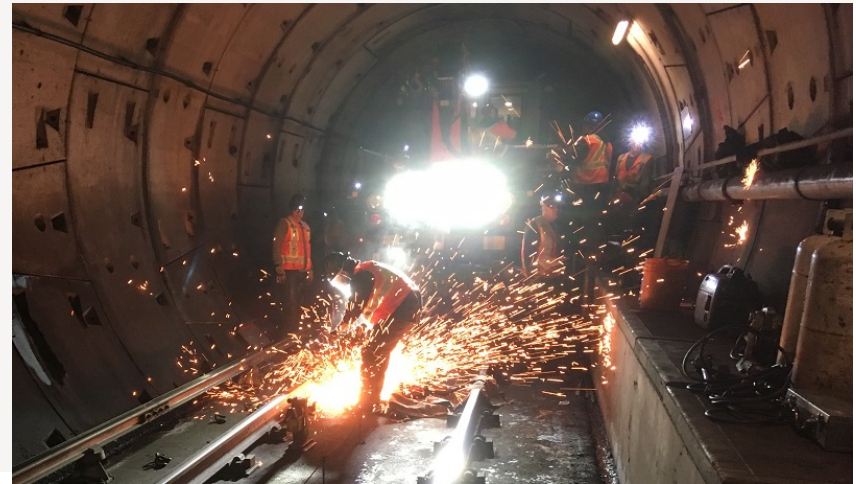
- Work Order Processing
- MM Coded WOs & Projects
- Corrective Action Request
- Project Tracking Process



Maintenance Constraints

- Very narrow system maintenance window:
 - 01:40 to 04:30
 - Occasional partial system shutdowns (single tracking)
- High fleet utilization
 - 19 of 20 train deployed in peak

Plan the work
Work the plan!



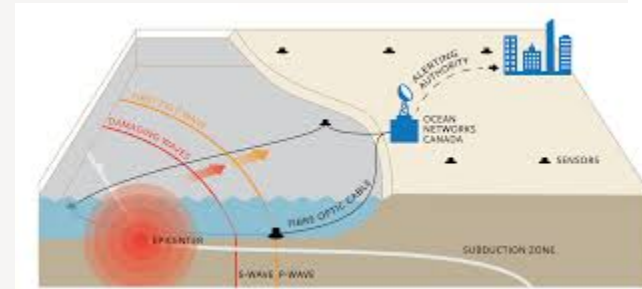
Innovation - Systems

Operations:

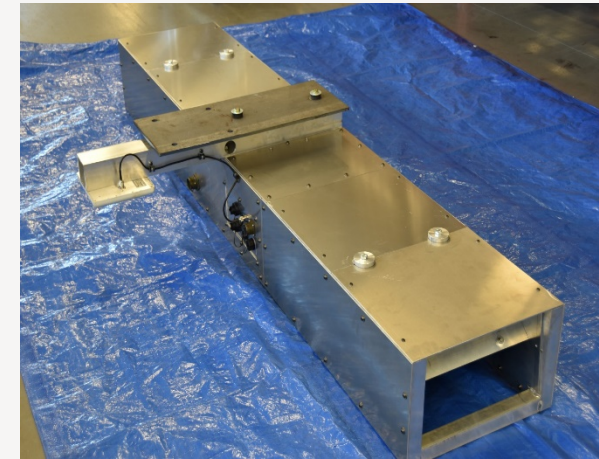
- RFID-based position detection of untracked vehicles
- Earthquake Early Warning System (First in Canada)
- VILMOS - Rail Adhesion Monitoring System
- CATS – Clearance Authorities and Tracking System

Asset Management:

- Remote Switch Condition Monitoring
- ATC Loop Signal Strength Measurement
- ATOMAS - Guideway and Track Inspection

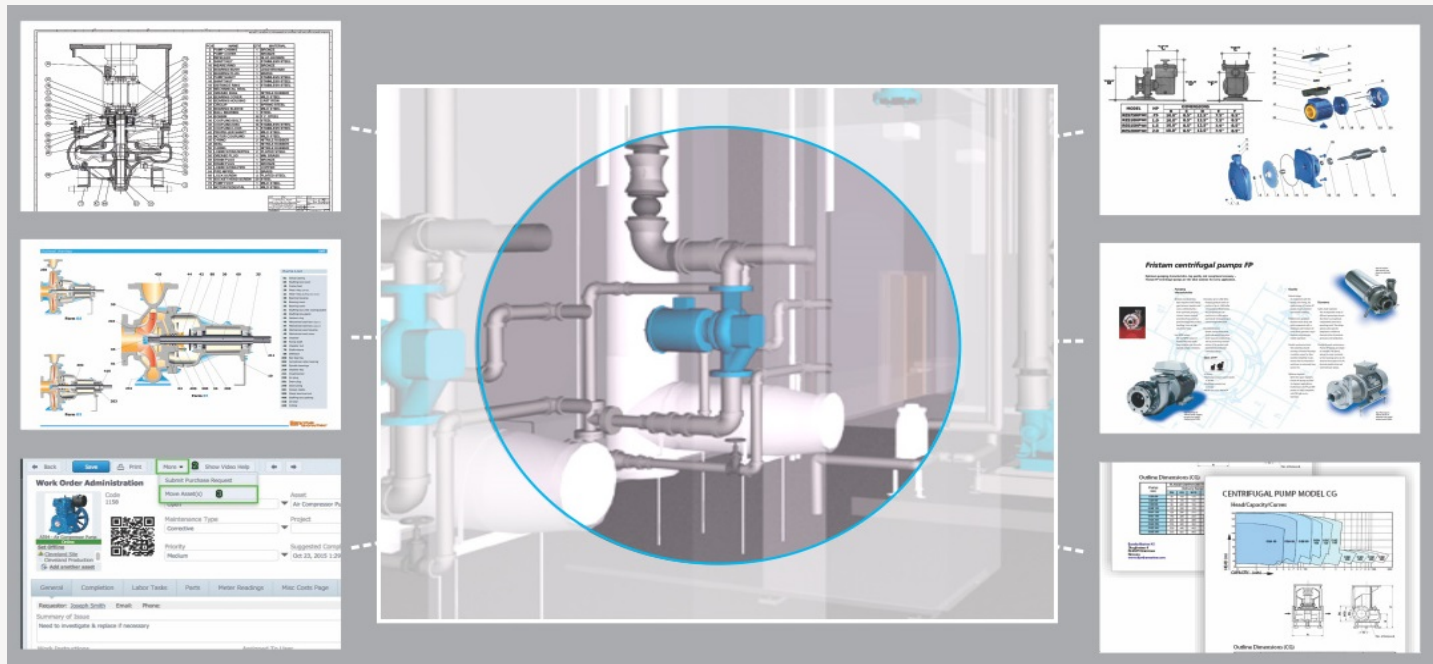


EARTHQUAKE
Mag 7.8 40s



BIM / BLM

- SNC-Lavalin is committed to delivering all new major infrastructure projects in BIM
- Canada Line acting as centre of excellence for O&M and test case from BIM environment



Our values are the essence of our company's identity. They represent how we act, speak and behave together, and how we engage with our clients and stakeholders.

S~~A~~*F*~~E~~*T*~~Y~~

We put safety at the heart of everything we do, to safeguard people, assets and the environment.

I~~N~~T~~E~~G~~R~~I~~T~~Y~~~~~~~~~~~~~~~~

We do the right thing, no matter what, and are accountable for our actions.

C~~O~~*L*~~L~~*A*~~B~~*O*~~R~~*A*~~T~~*I*~~O~~*N*

We work together and embrace each other's unique contribution to deliver amazing results for all.

I~~N~~N~~O~~*V*~~A~~*T*~~I~~O~~*N*~~~~~~

We redefine engineering by thinking boldly, proudly and differently.