Progress Rail
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Heavy-Haul Train Automation

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Caterpillar Automation

FLEET analyzes operational and equipment data up and down your value chain—so you can run a leaner operation and improve everything from equipment scheduling and material movement to fuel monitoring and cycle times.

TERRAIN gives you and your operators guidance tools and live feedback to boost utilization, reduce variability and work according to plan—so you can drill, dig, load and grade more safely, accurately, consistently and efficiently.

DETECT helps prevent collisions and increase operator confidence—so you can send people home safely and reduce the costs of lost time and damaged equipment.

HEALTH delivers machine condition data for your fleet—so you can head off small problems while they're still small, run machines as efficiently as possible for as long as possible and keep unplanned downtime to a minimum.

COMMAND lets you apply the right level of automation, from operator assistance and remote control to semi- and full autonomy—so you can keep your people safe, your operation efficient and your equipment running.

CAT® MINESTAR™

Milestone achieved in 2018 – 1 billion tons hauled with Autonomous trucks. Number of deployed trucks > 400 in 2020.

Progress Rail Offerings

ROLLING STOCK

LOCOMOTIVES
- New Locomotives
- Locomotive Parts & Service
- Power & Marine

TRANSIT
- New Passenger Locomotives
- Transit Maintenance

FREIGHT CAR
- Wheels, Axles, Bearings & Parts
- Freight Car Repair
- Leasing

INFRASTRUCTURE

TRACK
- Trackwork & Fasteners
- Rail Welding
- Maintenance-of-Way & Vegetation Equipment

SIGNAL
- Signal Engineering
- Signal Infrastructure

Advanced Rail Technologies
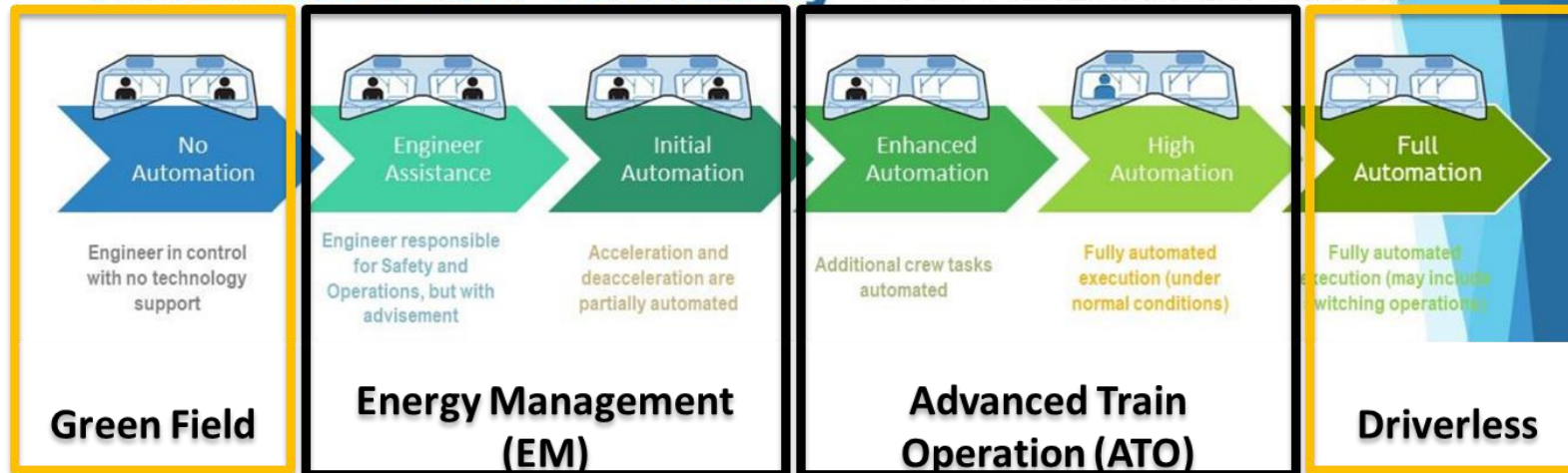
Recycling

Rail Automation Overview

Advanced Train Operation (ATO)
- Attended Automation of EM, Air Brake, and stop to stop.
- Eliminates operation variability and increases network velocity.
- Provides a platform for additional ATO ecosystem technologies e.g. network planning/optimization.
- Requires safety overlay and advanced signaling functions.

Energy Management (EM)
- Ability to model the train operating environment to build an optimal control strategy.
- Automation of Throttle and Dynamic Brakes.
- Limits operation variability.
- Improves fuel/energy consumption.

Automated Rail Taxonomy - AAR Automation Levels

No Automation	Engineer Assistance	Initial Automation	Enhanced Automation	High Automation	Full Automation
Engineer in control with no technology support	Engineer responsible for Safety and Operations, but with advisement	Acceleration and deacceleration are partially automated	Additional crew tasks automated	Fully automated execution (under normal conditions)	Fully automated execution (may include switching operations)
Green Field	**Energy Management (EM)**		**Advanced Train Operation (ATO)**		**Driverless**

Progress Rail is building the **Next Gen Train Automation** enabling better and faster **EM and ATO deployments**

Initial projects
Descriptive & Predictive Analytics

Challenges to deployment of train automation

- **Data acquisition**

- **Signal conditioning**

- **Communication links**

- **Freight operation** traction and braking complexities

- **Locomotive variability** display & control

- **Operation Variability** - weather, trains, track conditions, etc.

- **Labor relations** & change management

IOT for all locomotives types

Fully Automated

Semi-Automated

Prompting

Predictive Analytics

Descriptive Analytics
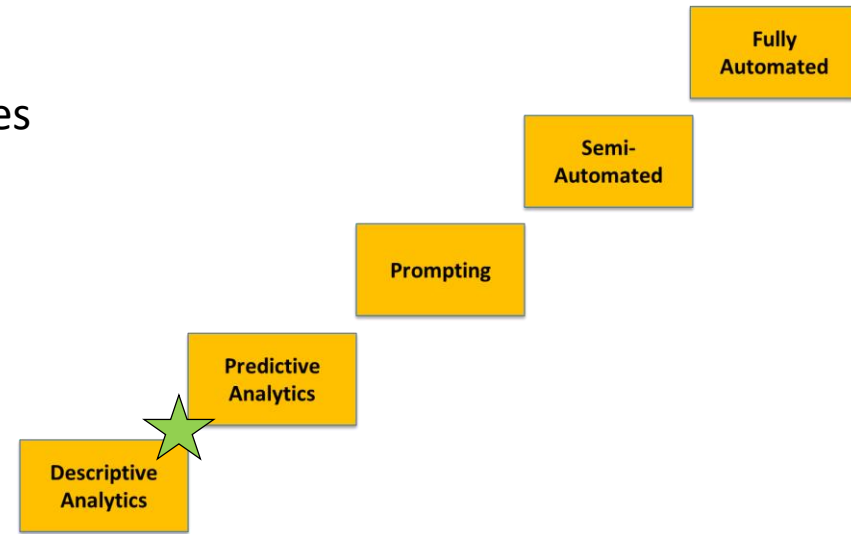
Early 2000s

Initial deployments focused on providing train physics information about ITF, AB, Train Location, Track Profile

Operation Complexity
Traction & Braking

Passenger Trains Automation Milestones:

- The first line to be operated with Automatic Train Operation (**ATO**) was London Underground's Victoria line, which **opened in 1967.**

- The first fully automated **driverless mass-transit** rail network is the Port Island Line in Kobe, Japan **opened in 1981.**
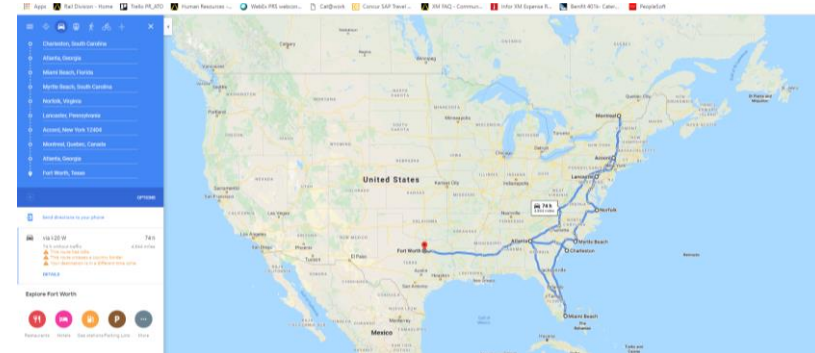
Locomotive engineers manage the tractive and braking energies of the train to minimize in-train forces while meeting operational objectives.

Energy Management
AutoControl

Challenges to deployment of train automation

✓ **Data acquisition**

✓ **Signal conditioning**

✓ **Communication links**

✓ **Freight operation** traction and braking complexities

✓ **Locomotive variability** display & control

▪ **Operation Variability** - weather, trains, track conditions, etc.
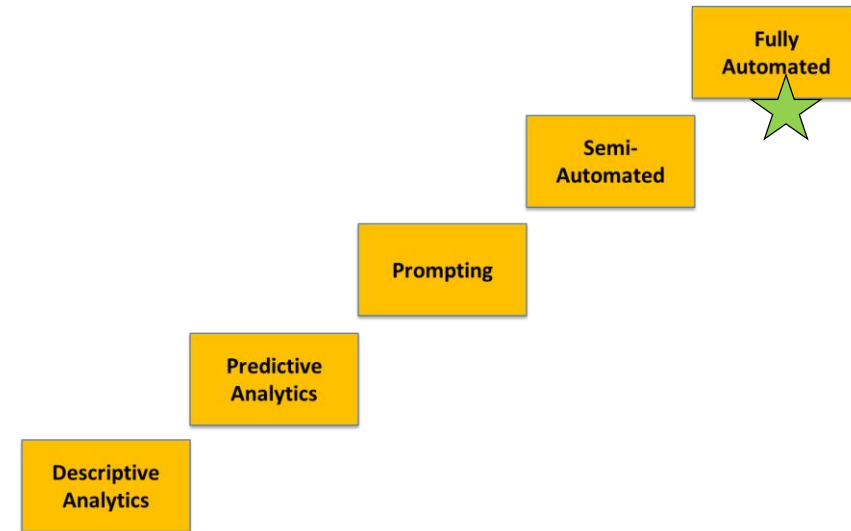
▪ **Labor relations** & change management

IOT for all locomotives types

Fully Automated

Semi-Automated

Prompting

Predictive Analytics

Descriptive Analytics

2013-2020

Industry harmonization: Locomotive Command and Control interface, Locomotive Interface gateway, train models.

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Automated Train Operation
Attended & Driverless ATO
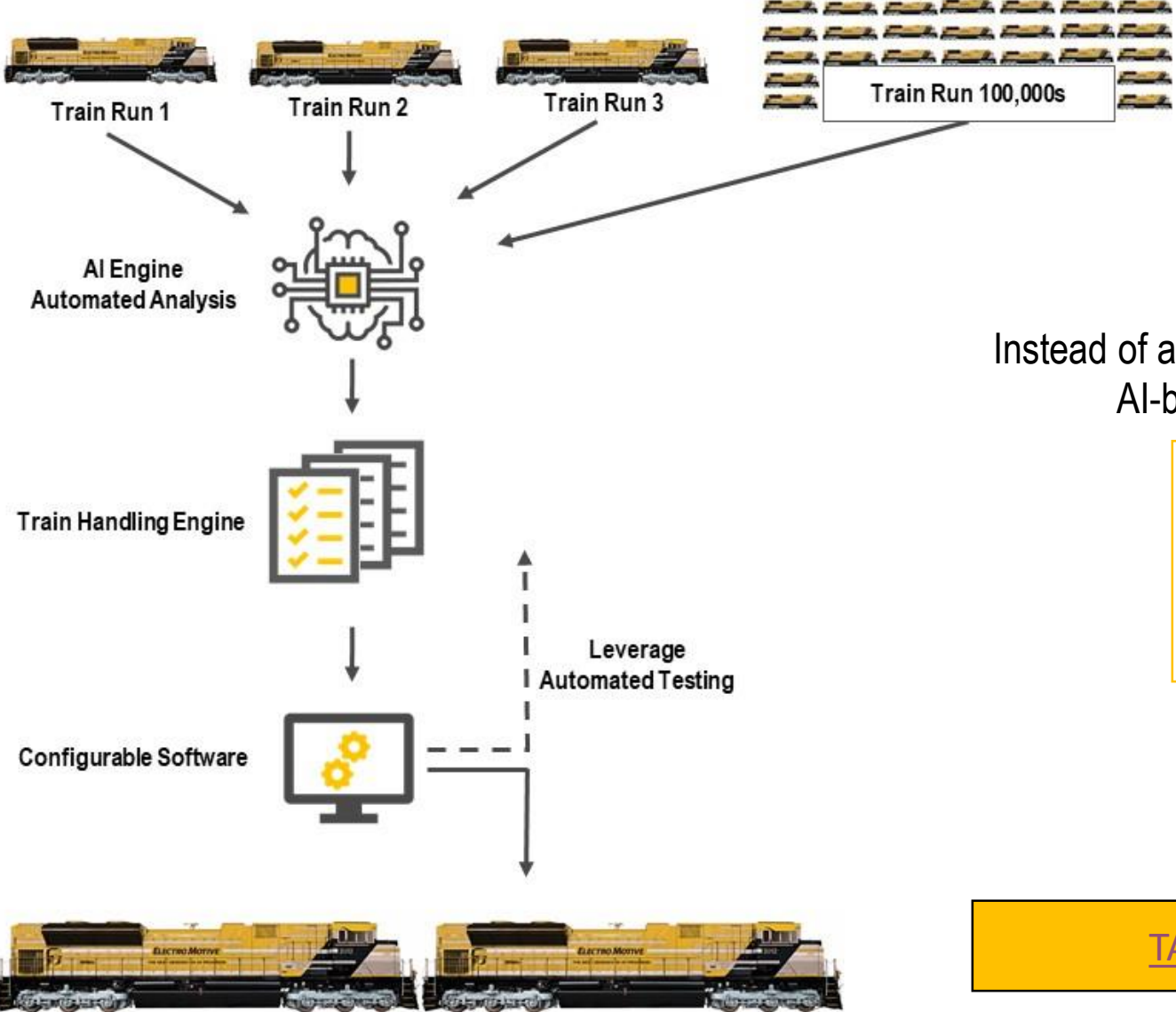
Challenges to deployment of train automation

- **Operation Variability** - weather, trains, track conditions, etc.

- **Labor relations** & change management.

- **Sensor Fusion** (camera, Lidar, radar, etc.)

- **Machine Vision**

- **Safety requirements**

Fully Automated

Semi-Automated

Prompting

Predictive Analytics

Descriptive Analytics

2020s and beyond

Attended ATO is the goal for the Class Is.
Mining are interested in driverless train operation.

Artificial Intelligence Engine

Train Run 1   Train Run 2   Train Run 3   Train Run 100,000s

AI Engine
Automated Analysis

Train Handling Engine

Leverage
Automated Testing

Configurable Software

Instead of a rule-based approach, Progress Rail's AI-based approach excels due to:

- **Automated** system
- Improved **operation**
- **Faster** deployment
- **Adaptable** and **scalable**
- Better **quality** and **safety**

TALOS® Overview Video

Automation Business Case

✓ **Network Capacity & Velocity**
✓ Asset Utilization (Track and Equipment)
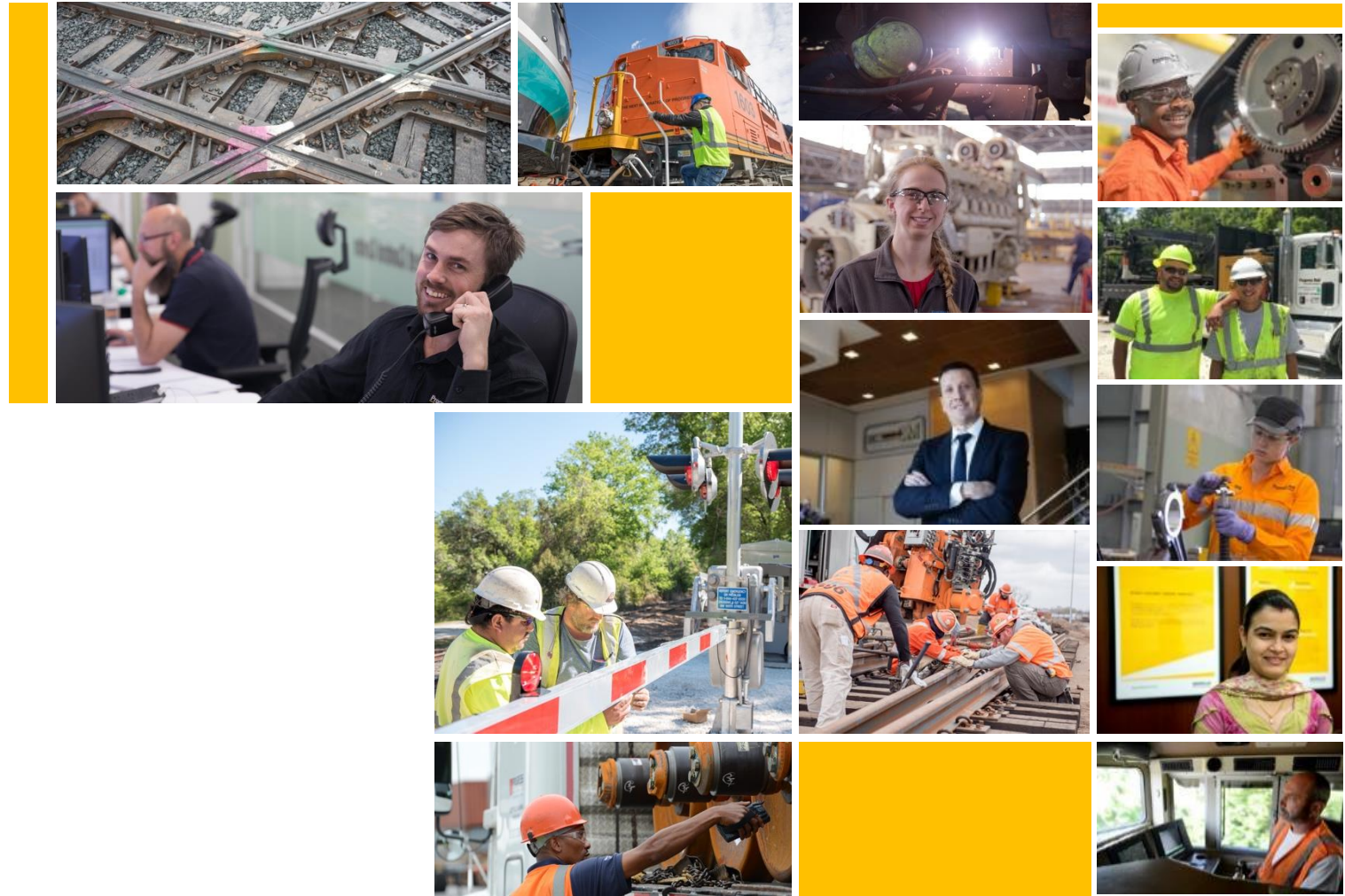
✓ **Fuel Savings**

✓ **Emissions credit**

✓ Ability to meet customer expectation of "owning" the **performance** of our fleets
✓ **Reliability** improvements (reduced operator variability)

✓ Greenhouse gas reduction
✓ **Enhanced Safety**

Rail Automation requires upgrades to the locomotives, the signaling system, and wayside equipment. PR has the technologies and the expertise to fully handle the Automation deployments across all GoA.

THANK YOU

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