FULLY AUTONOMOUS TRAIN CONTROL FOR MAINLINE RAIL SYSTEMS
Rio Tinto granted accreditation for AutoHaul®
1st long-distance driverless Heavy Haul Railway in the world

18 May 2018

Rio Tinto granted accreditation by Australia's Office of the National Rail Safety Regulator approving the autonomous operation of trains at the group's iron ore business in Western Australia.

The AutoHaul® project continues to progress and is on schedule to be completed by the end of 2018.

Rio Tinto will take a phased approach to deploying autonomous trains across the network in the lead up to full commissioning.
A true milestone for the global Railway Industry

Rio Tinto achieves delivery of iron ore with world’s largest robot

13 July 2018

Rio Tinto has achieved a significant milestone with the first delivery of iron ore by an autonomous train in the Pilbara, Western Australia.

The autonomous train, consisting of three locomotives and carrying around 28,000 tonnes of iron ore, travelled over 280 kilometres from Rio Tinto’s mining operations in Tom Price to the port of Cape Lambert on 10 July.

It was monitored remotely by operators from Rio Tinto’s Operations Centre in Perth more than 1,500 kilometres away.

The inaugural journey is a significant milestone for Rio Tinto’s AutoHaul™ programme and follows regulatory approval in May.

AutoHaul™ is on schedule to complete by the end of the year, unlocking significant safety and productivity gains for the business, as well as optimising the company’s iron ore system by providing more flexibility and reducing bottlenecks.

Rio Tinto Iron Ore managing director Rail, Port & Core Services Ivan Vella said “This safe first delivery of ore by an autonomous train is a key milestone for the AutoHaul™ program which will deliver the world’s first autonomous, rail network.”

“This programme shows our absolute commitment to improving safety and productivity, as well as enabling greater flexibility across our operations.”

Managing Director Rail, Ports & Services
Rio Tinto
Ivan Vella
What is AutoHaul®?
1st long-distance driverless Heavy Haul Railway in the world

**Project Scope**

- **AutoHaul® Segment**
- **Communications Infrastructure Segment**
- **Operations Centre Segment**
- **Trainborne Segment**
- **Signalling and Asset Protection Segment**

**Automatic Train Operation (ATO) system** to automatically drive trains on remote 1,500km main line

**On Board, Office, and Wayside systems** to control, monitor and ensure the safe movement of driverless trains

**Key part of Rio Tinto – Ansaldo STS Framework Agreement (RAFA) to support iron ore mining expansion in the Pilbara, Western Australia**
Where is AutoHaul® applied?

AutoHaul® – World’s first long-distance driverless Heavy Haul Railway

Rio Tinto moves iron ore from mine to port via its 1,700 km rail line

Each train has 3 locos + 240 wagons

is 2.5 km long and weighs 28,000 tonnes
AutoHaul® Efficiencies Achieved to Date

- More than 750,000km in fully driverless mode completed safely and successfully
- Over 11 million km in ETCS L2 mode completed safely and successfully
- Six percent speed improvement
  Removal of driver change-over saving 1hr/journey cycle
AutoHaul®’s Benefits for the Customer

Value over Volume

Continuous flow  Schedule real-time  No human interaction

by means of a flexible, sustainable, fully automated Railway compliant to the highest safety standards and the highest productivity (driverless operation and trip optimised)

1. Shifts

2. Efficiency
AutoHaul® System at a Glance
<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive</td>
<td>Drivers run the train, which is protected by the ATP system</td>
</tr>
<tr>
<td>Driver Assist</td>
<td>Advises Driver of optimal driving commands to apply</td>
</tr>
<tr>
<td>Attended</td>
<td>Automatic running with a supervising driver on board</td>
</tr>
<tr>
<td>Driverless</td>
<td>Unmanned</td>
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Initially designed as a “transport” mode for staff, it has become a key part of the deployment and acceptance approach.
AutoHaul® Level Crossing & Asset Protection

Obstruction Detection System (ODS)
Laser based system detects objects within level crossing boundaries

Closed-Circuit TV (CCTV)
Provides surveillance coverage of each end of level crossing
Records vision via Digital Video Recorder (DVR)
Enables remote retrieval/viewing by authorised Operation Centre (OC) personnel

Street Lighting
Provides consistent lighting for level crossing
Turns on each time crossing operates, is obstructed or when staff view live feed from CCTV
Monitoring activities previously performed by the driver while on board the train…

AutoHaul® Remote Loco Monitoring

Locomotive health
Alarms
Videos
(collisions, level crossings, etc)

Now managed via:

Rolling Stock Asset Health Evaluator
Remotely monitors On Board status of assigned trains throughout their journey and Processes all On Board alarms

On Board system
Automatically stops the train whenever an alarm signifies loco may have been damaged
Ansaldo STS successfully delivered into commercial service the world's first fully autonomous long-distance heavy haul rail operation for key client Rio Tinto has been selected for Inspiration of the Year Global Award 2018 “Japan, Korea and Oceania Region” 2nd Prize
Porting AutoHaul® to Freight: North America

PTC provides Authorities and TSRs, but not the following:

**Signalling System**
- Vital Safety Server acting as Office Center
- Integrated Vital Possession Management
- Integrated Level crossings and Level crossing obstruction detection and protection
- Integrated Asset Protection devices
- Virtual & Moving Block

**Onboard**
- ATO
- Collision Detection
- Motion sensors
- Video Monitoring

**Operations Centre**
- Remote locomotive health monitoring
- Video monitoring
- ATO Mission Start/Stop
Porting AutoHaul® to Freight: Europe, Africa, Asia

ETCS provides Authorities and TSRs, but does not currently the following:

- Porting AutoHaul® to Freight: Europe, Africa, Asia
- Remote locomotive health monitoring
- Video monitoring
- ATO Mission Start/Stop

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Signalling and communications system that has equipped a 350km remote privately owned heavy haul iron ore railway for future autonomous operation.

Beyond AutoHaul® - Roy Hill Project (WA)
Beyond AutoHaul® - Roy Hill Project (WA)

A Series of Technical Firsts

- Communication Based Signaling on TETRA IP radio systems in Australia
- Communications Based Signaling (CBS) using SIL4 GPS Localisation
- Train and Hi-Rail with Driver Assist system at SIL2
- SIL4 Moving Block on Freight System
FULLY AUTONOMOUS TRAIN CONTROL FOR MAINLINE RAIL SYSTEMS