BIM-AM-RS

Adopting Building Information Modelling - Asset Management to Enhance Railway Safety

Mr. Chris Ho- Senior Engineer
Electrical and Mechanical Services Department
The Government of Hong Kong
Special Administrative Region

CONSTRUCTION INDUSTRY COUNCIL 建造業議會

22 May 2019

機電工程署 EMSD

Railways EMSD

EMSD - Regulator

- Regulatory authority on Railway Safety in Hong Kong

- Regulatees include
  - MTR
  - Automated People Mover at the airport
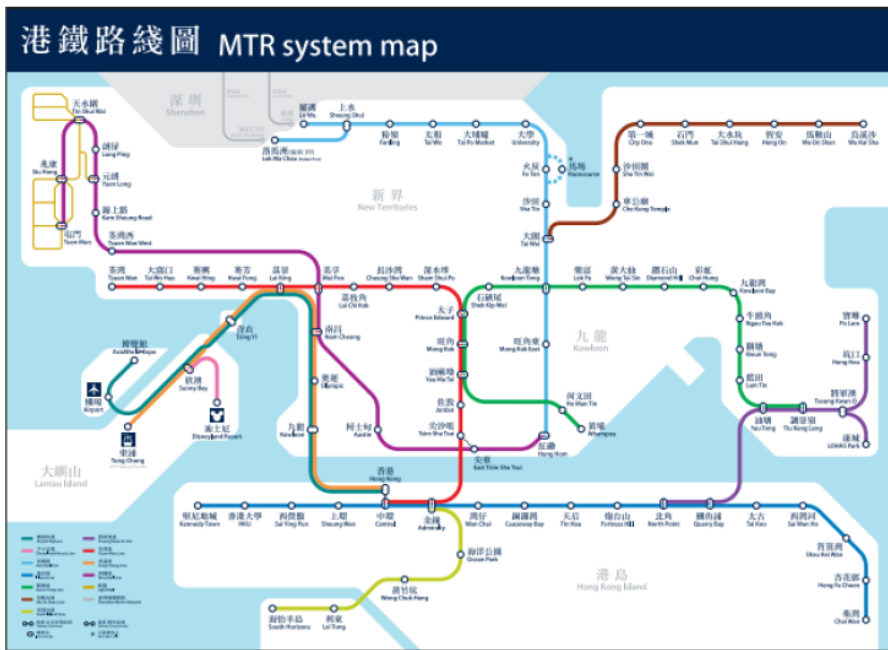 - Tramway
  - Peak Tramways

MTR - Operator

MTR 港鐵

港鐵路綫圖 MTR system map

■ Heavy Rail

- ➢ 11 lines
- ➢ Route length: 194.7 km
- ➢ 93 railway stations
- ➢ 2,006 train cars 9 depots

■ Light Rail

- ➢ 12 routes
- ➢ Route length : 36.2 km
- ➢ 68 stops + 1 depot
- ➢ 141 light rail vehicles

• Carrying over 5.8 million people every weekday

• Managing over HK$200 billion of asset

• Spending over HK$8.6 billion on asset maintenance, replacement/ upgrades in 2017

Railways **EMSD**

High Speed Rail in Hong Kong

- Length 142km (26km for HK Section)

- Max. Speed 300kph (200kph inside HK)

- 47 minutes to Guangzhou

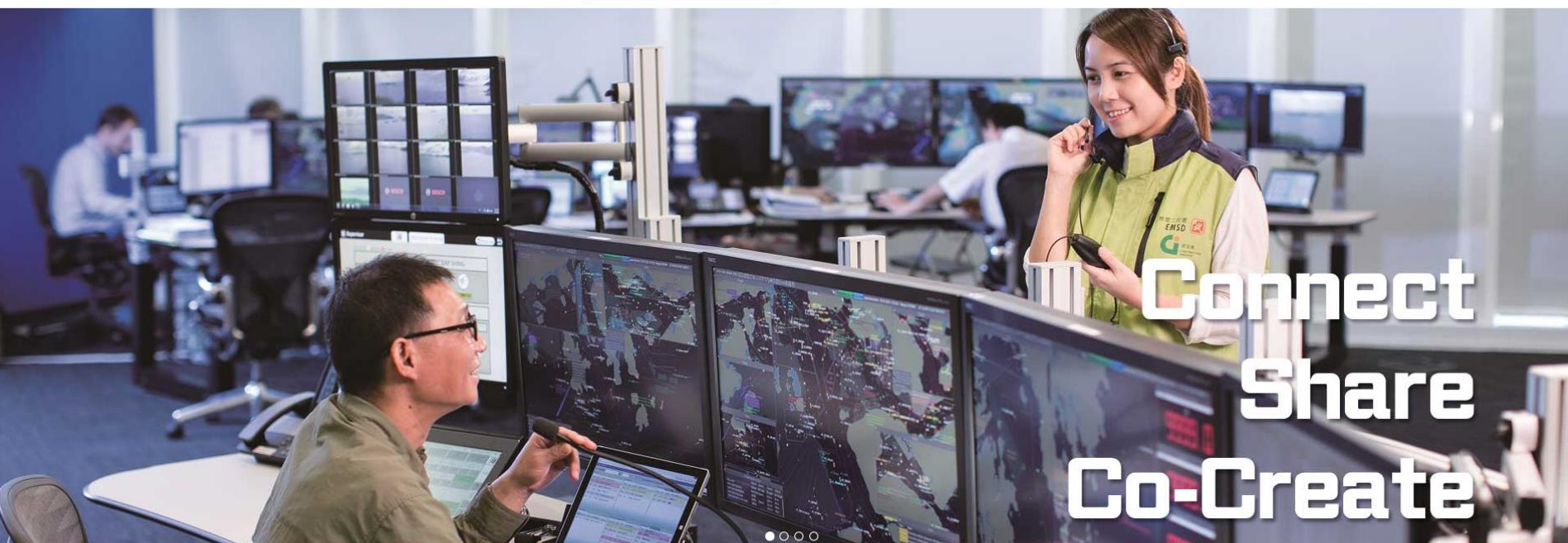- Less than 9 hours to Beijing and Shanghai

Additional Roles

- Facilitator & Promoter

- Promote adoption of new technology

- Apply Innovation in Railway Safety

- E&M InnoPortal

  https://www.emsd.gov.hk/minisites/inno/index.html

Railways EMSD

E&M InnoPortal

Home I&T Solutions I&T Wish List Success Cases Highlights More ▾

機電工程署 EMSD

T | T | T   Eng | 繁 | 简

Connect
Share
Co-Create

E&M InnoPortal

In line with the directive of 2017 Policy Address on development of Innovation and Technology (I&T) in Hong Kong, EMSD launches E&M InnoPortal which is a platform for I&T collaboration and maintains a list of the technology development needs of various government departments, public bodies and the E&M trade. We warmly welcome universities and start-ups etc. to provide E&M related innovation and technology for putting on the platform for matching. We will provide venues for trial of suitable projects, conduct prototype testing and pilot project in a collaborative way, and upload validated performance reports of trial cases to the platform for sharing with the public with a view to jointly promoting and driving the R&D and application of E&M related innovation and technology.
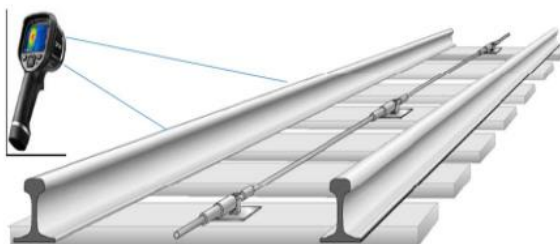
Railways EMSD

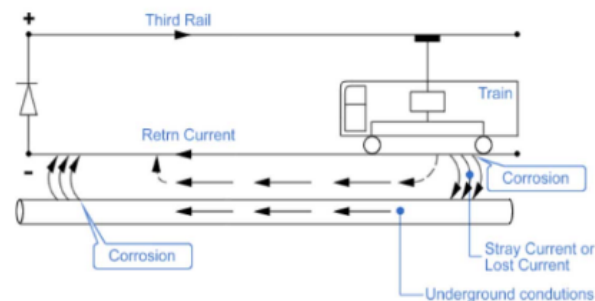TO ENHANCE ESCALATOR SAFETY

ON-LINE MONITORING OF CONDITION OF TRAIN PANTOGRAPH AND OVERHEAD LINE

ON-LINE MONITORING AND DETECTION OF RAIL WIDTH TO PREVENT DERAILMENT

AUTOMATIC DETECTION OF RAIL CRACK TO ENSURE PASSENGER SAFETY

SMART DC STRAY CURRENT MONITORING AND REDUCTION IN RAILWAY SYSTEM

BIM - Asset Management - Railway Safety (BIM-AM-RS)

- Extend BIM usage in railway industry from **construction** stage to **asset management** stage

- Visualise the result of **Artificial Intelligence** data analytic of **historical** and **real time** data on BIM platform
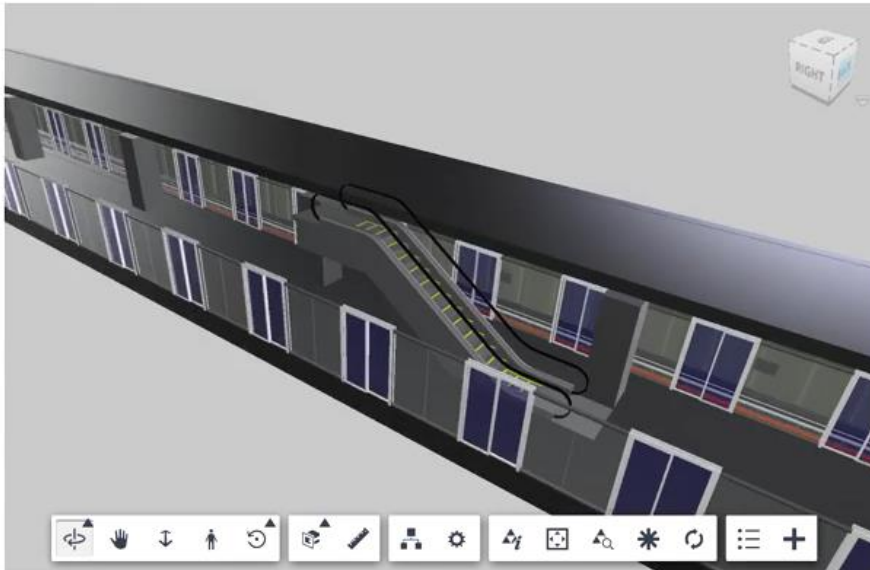
- **Predictive maintenance** and **enhance training**

Historical Data

- Hong Kong railway reportable incidents ~1,100 reported incidents/ year (90% passenger behaviour related, 5% **equipment failure** related (including external factor), and 5% **human factor** related)

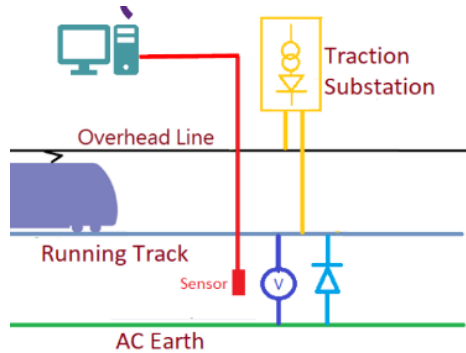## Equipment failure
(Predictive maintenance)
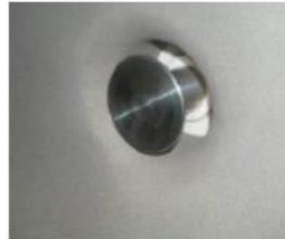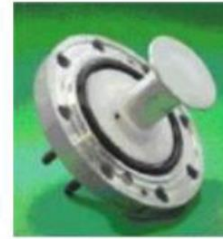

Human factor
(Enhanced training)

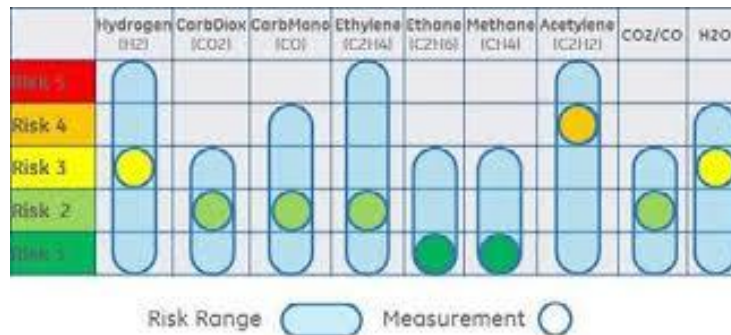# Real Time Monitoring (being developed)
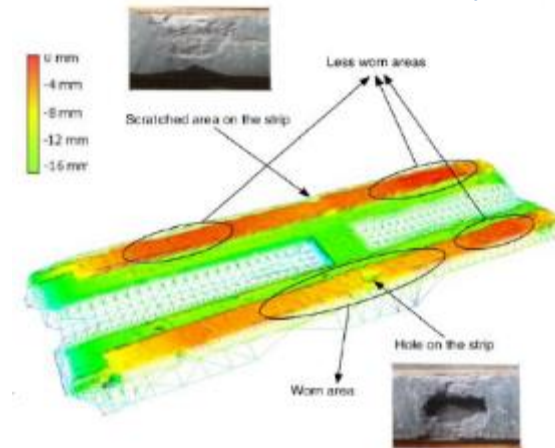

Stray Current

Partial discharge

Rail Crack Monitoring using Fiber Optic based Ultrasonic Guided Wave (UGW)

Dissolved Gas Analysis (DGA) Monitoring

Pantograph Monitoring
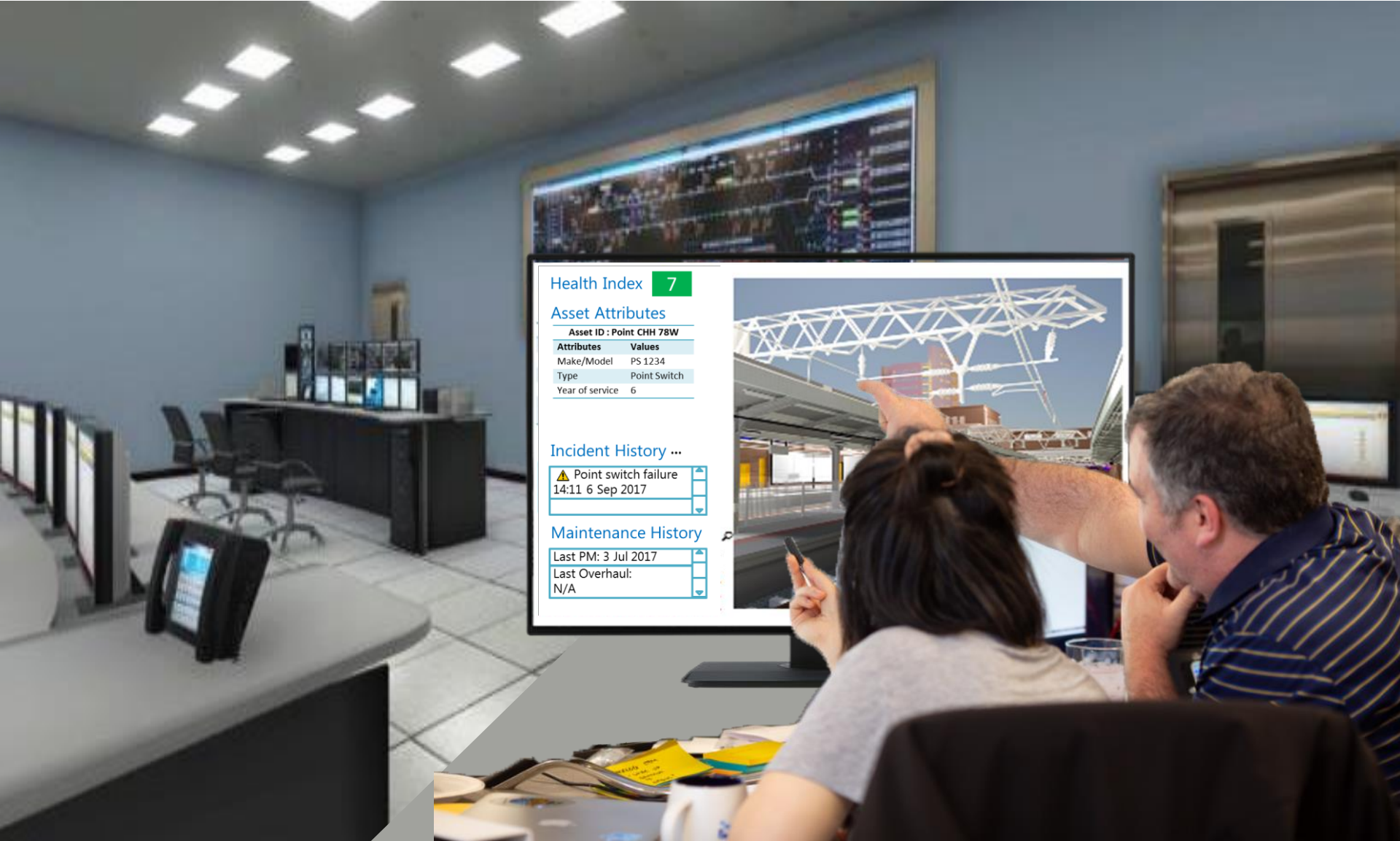
BIM Model Construction for Existing Buildings

Site Survey: Exterior of the Building

In this project, we adopt 3D laser scanners for site survey, analysis and recording
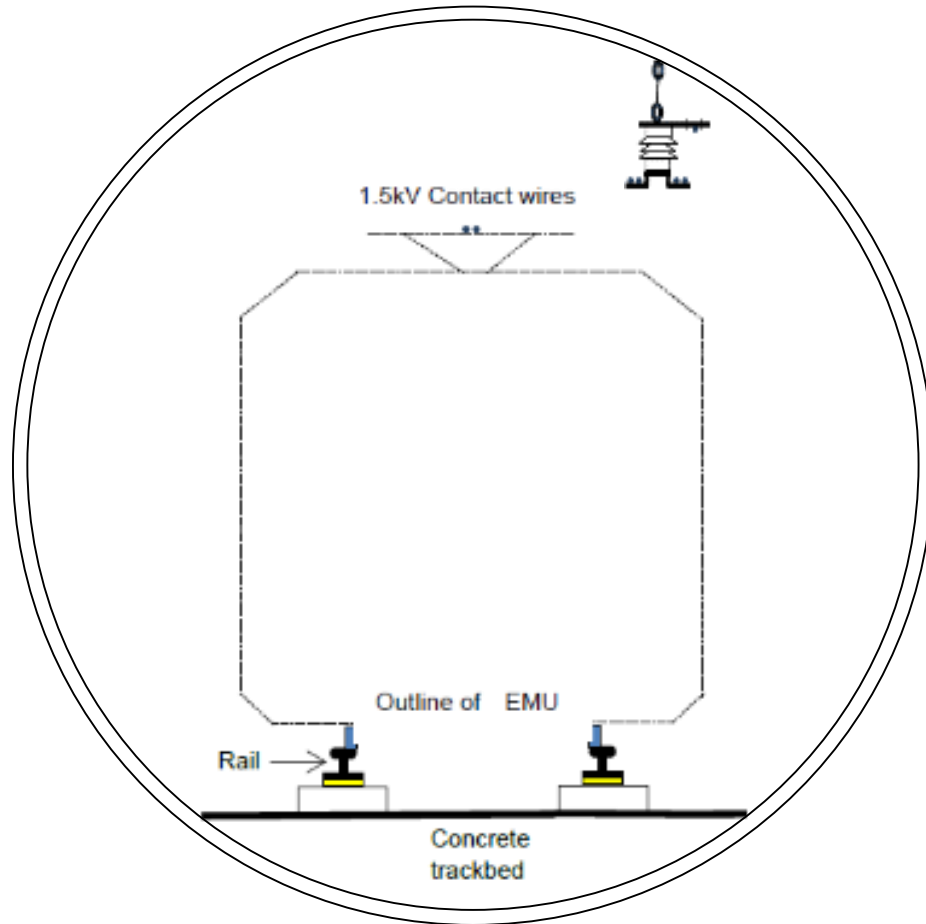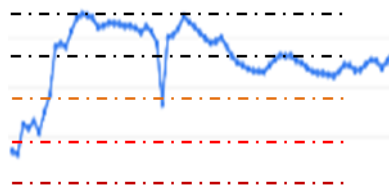
Predictive Maintenance

Health Index   **2**

Asset Attributes

Asset ID : 00168	
Attributes	**Values**
Make/Model	Dummy 456
Type	Rail Insulation Pad
Year of service	9
Location	KTL Down Km 107.360

Incident History ···

No record

Stray Current 🔍

1.5kV Contact wires

Outline of EMU

Rail →

Concrete trackbed

Health Index **3**

Asset Attributes

Asset ID : 00123

Attributes	Values
Make/Model	RailSteel 234
Type	
Year of service	
Chainage	

Incident History

⚠ Rail Crack
15:14 19 Oct 2

⚠ Rail Crack
13:37 05 Jul 2

⚠ Rail Crack
16:25 22 Mar 2018

Rail Crack Incident #24

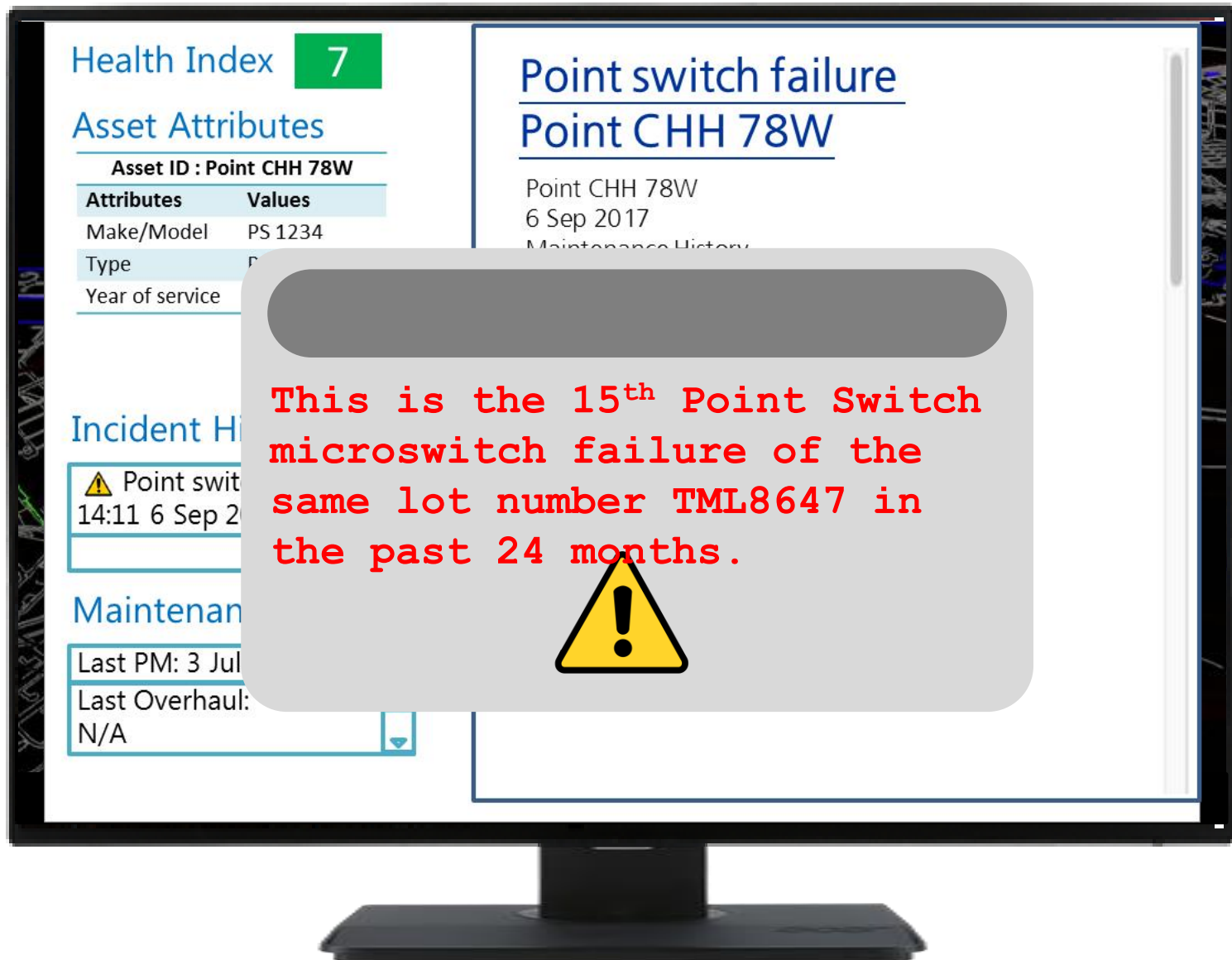Hand: LHRR
Radius: Transition curve of radius 350m
Cant: 12.5mm
Leg: Low Leg

Anomalies of rail at CH 102.395 detected.

Railways 🦅 EMSD

Health Index 7

Asset Attributes

Asset ID : Point CHH 78W

Attributes	Values
Make/Model	PS 1234
Type	
Year of service	

Incident Hi...

⚠ Point swit...
14:11 6 Sep 2...

Maintenan...

Last PM: 3 Jul...
Last Overhaul:
N/A

**Point switch failure
Point CHH 78W**

Point CHH 78W
6 Sep 2017
Maintenance History

This is the 15th Point Switch microswitch failure of the same lot number TML8647 in the past 24 months.

⚠

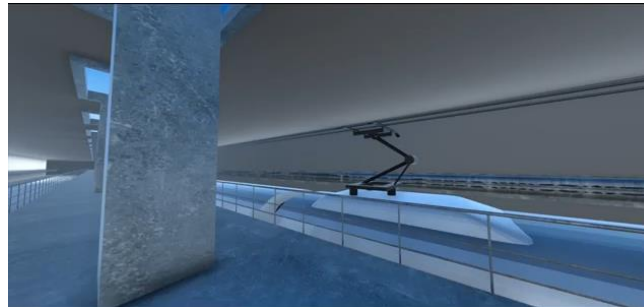Railways 🦅 EMSD
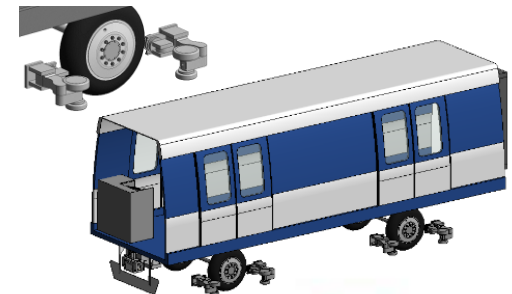
Enhanced Training

Simulate past railway incident cases

Promote enhanced training to operator
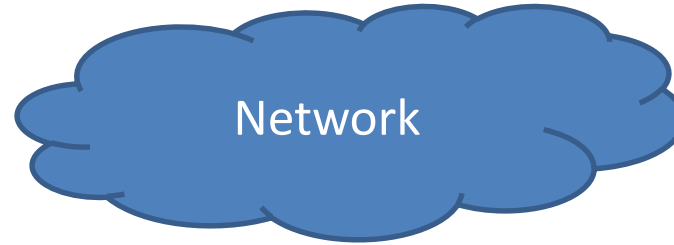
Training VR image

Simulate airport APM incident case

Railways **EMSD**
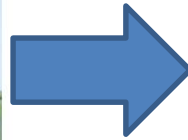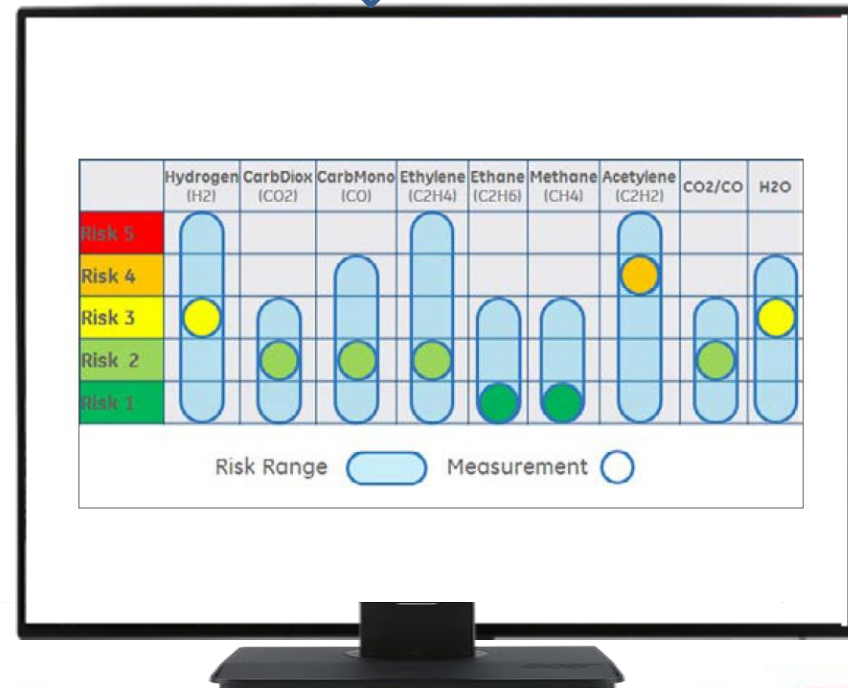
~ End ~

Online DGA Monitoring in

Network

Online DGA Data

GAS	NAME	CONDITION RESULTING IS GAS PRODUCTION
H_2	Hydrogen	Nearly **all fault conditions**, low energy PD
CH_4	Methane	**Oil** overheating between 200 and 500ºC
C_2H_6	Ethane	**Oil** overheating between 300 and 500ºC
C_2H_4	Ethylene	**Oil** overheating over 500ºC, possible formation of carbon particles
C_2H_2	Acetylene	Electrical **arcing**, Oil > 800ºC, strong formation of carbon particles, **metal** melting
CO	Carbon Monoxide	**Paper** insulation overheating
CO_2	Carbon Dioxide	Severe oil oxidation, **paper** degradation
O_2	Oxygen	Oxidation, **leak**

Source: GE Grid Solutions Ltd.

Network

Online PD Data

Health Index: 7
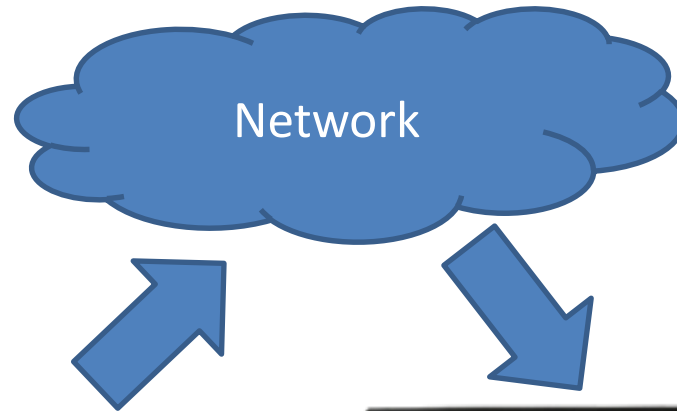
PD Local Monitoring Device

13dB 4mV   0-30dB

Level   TEV

17dB

0/cycle

10dB 3mV   P   0-30dB

PD Sensor

AA Ultrasonic

Source: IPEC Ltd.

Railways EMSD

AI/Data Analytic in BIM-AM-RS

Online DGA & PD Data

Asset Condition

Asset Age

Asset Ageing

Failure Rates

Asset Importance / Criticality
= Cost of Failure

Today (Year 2019)   Future (Year 2023)

Asset Health Index today

Asset Health Index forecast

Probability of Failure

Asset Risk / Importance Index

Source: Siemens Ltd.