



機電工程署
EMSD



23

ETY COUNCIL

strial World

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IRSC 2023

INTERNATIONAL RAILWAY SAFETY

"Reconnecting and Reshaping railway

CAPE TOWN, SOUTH AFRICA

Ms Coe CHIU
Electrical and Mechanical Services Department

Adoption of AI Technology to Enhance Effectiveness of Railway Regulatory

HONG KONG

Part 1

Railway Safety Regulator in Hong Kong

Part 2

Adoption of AI Technology to Enhance Effectiveness of Railway Regulatory

Part 3

Smart Planning for Safety Critical Item Inspection

Part 1

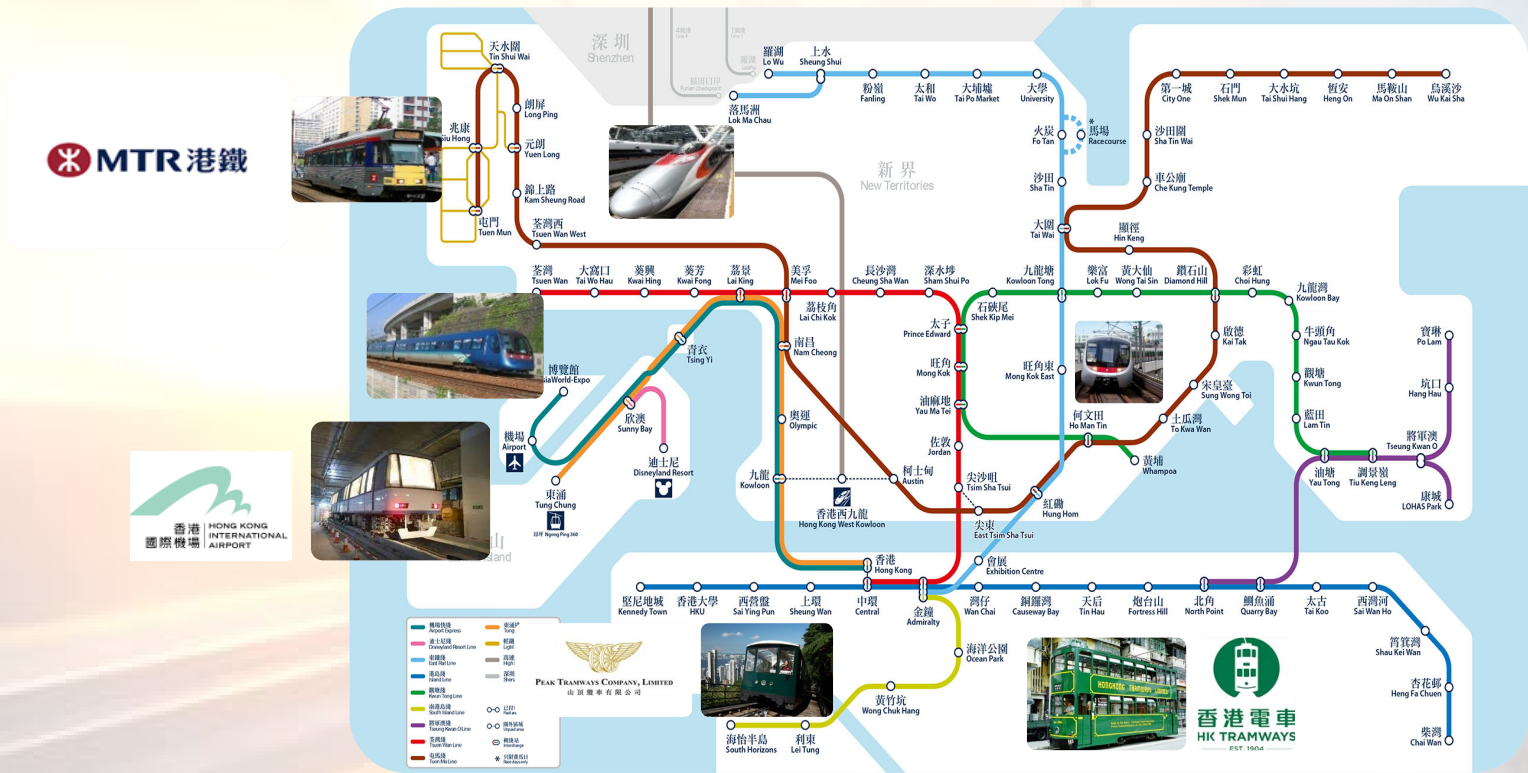
Railway Safety Regulator in Hong Kong

Railway Safety Regulator in Hong Kong

Railways Branch, **EMSD** is the railway safety regulator in Hong Kong



Railway Safety Regulator in Hong Kong



Improving Safety Performance Through Digitalisation



Railway Safety Regulator in Hong Kong

EMSD is the “**Innovation facilitator**”, who supports and facilitates the application of innovative technologies by bureaux & departments to improve services and support smart city development.



SMART MOBILITY

SMART LIVING

SMART ENVIRONMENT

SMART PEOPLE

SMART GOVERNMENT

SMART ECONOMY

Part 2

Adoption of AI Technology to Enhance Effectiveness of Railway Regulatory

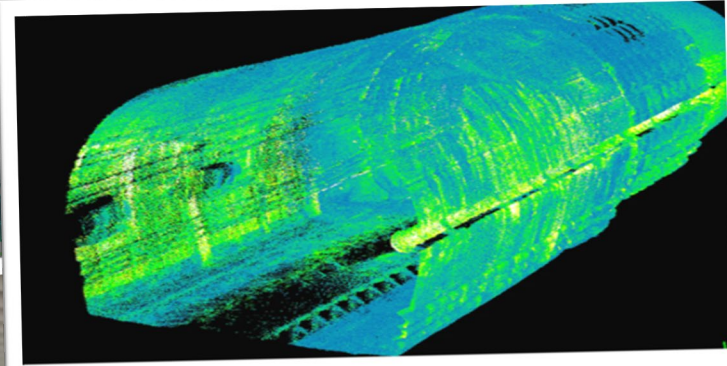
Pilot Projects Initiated by EMSD



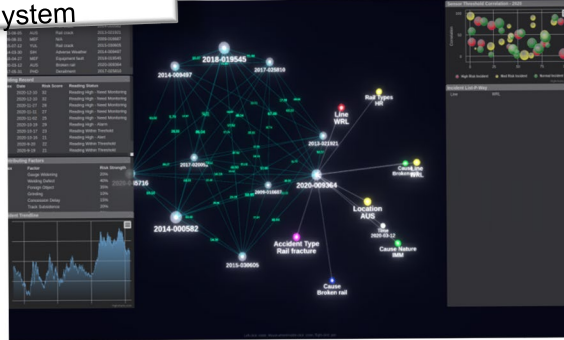
Derailment and Collision Prevention System



Smart Driver's Assistant System



Train-borne Railway Infrastructure Inspection System



Semantic AI System

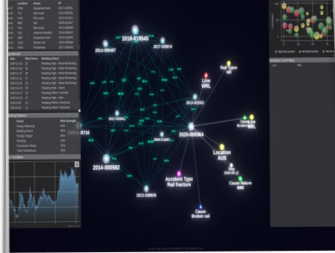
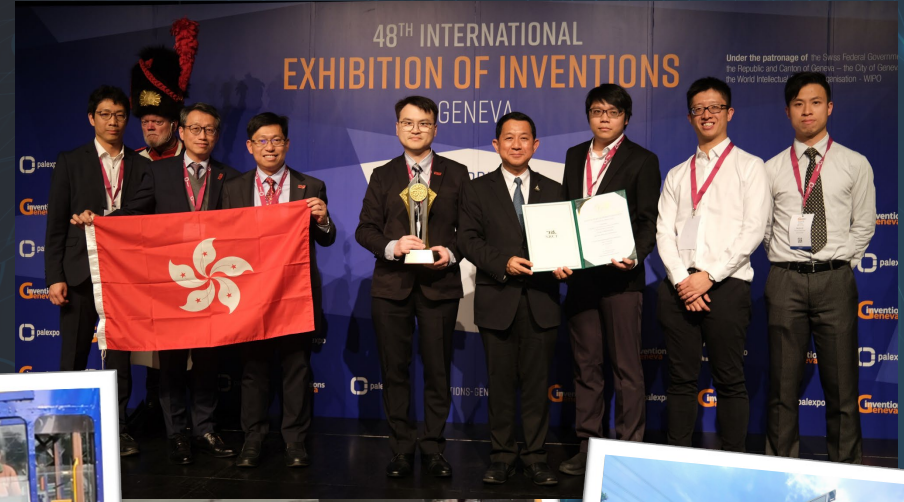


Passenger Misbehaviour Detection System

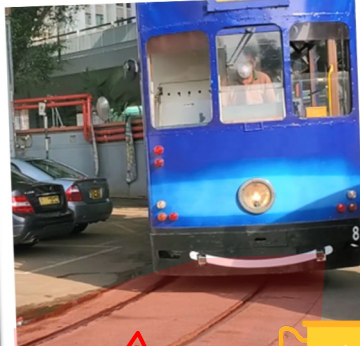
Improving Safety Performance Through Digitalisation



Sharing with the Global



Semantic AI System



Derailment and Collision Prevention System



Passenger Misbehaviour Detection System



HK eToll



Train-borne Railway Infrastructure Inspection System



Improving Safety Performance Through Digitalisation

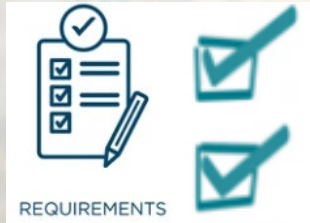


Part 3

Smart Planning for Safety Critical Item Inspection

Safety Critical Items

- Safety Critical Item (SCI) is an engineering item whose integrity is critical to the safe operation of the Railway.
- Failure to perform its functions could lead to an accident involving passenger injuries.



Stringent Maintenance Controls such as Independent checker
Precise Selection of SCI for Regulatory Inspection

Smart Planning for Safety Critical Item Inspection

Current practice is to adopt **risk-based approach** for identifying high-risk SCIs (from over 1,100 nos. of SCIs) by **manually devising an annual inspection schedule**.

How can we enhance the effectiveness of our SCI inspections using AI technology?

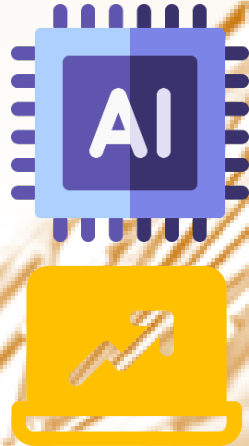


Smart Planning for Safety Critical Item Inspection

Objectives:-

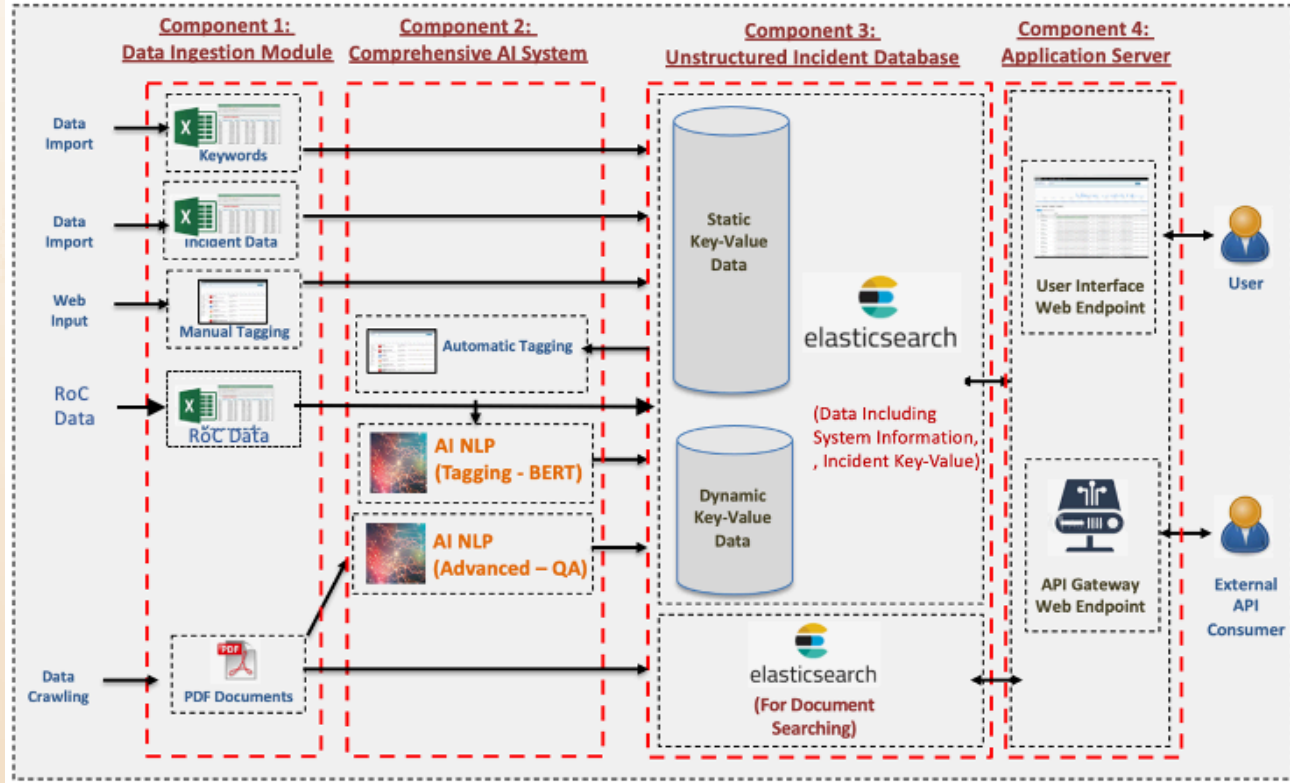
To explore the feasibility of using **Artificial Intelligent (AI) predictive approach** to streamline the process of SCI inspection planning.

- ✓ Transform current practices **from manual approach to systematic approach and AI predictive approach**
- ✓ Target to precisely and effectively identify the **high-risk railway assets**
- ✓ **Prioritize the resources** for high-risk railway assets
- ✓ **Improve the overall operational efficiency in RB**



Smart Planning for Safety Critical Item Inspection

AI System



Smart Planning for Safety Critical Item Inspection

Extraction of **relevant information** (i.e. Time, system, equipment, location, SCI item, etc) from **free-text** in historical data

For examples:-

Free Text in incident reports	Output from AI
Replacement of the defective ATW Ch6976 of Track MR2L RH in Junction MJ20 was requested by MM PW	System: Permanent-way Equipment: Aluminothermic Welding (ATW) SCI related: SCI-0419: Flashbutt weld + Thermit weld Location: Light Rail, Junction MJ20, chainage of MR2L
...EAL DT TAP to UNI P6002 LHSW Km 120.582	Location: East Rail Line, Down Track, chainage KM120.582, Equipment: Point Machine P6002

Smart Planning for Safety Critical Item Inspection

Selection of SCI for regulatory inspections

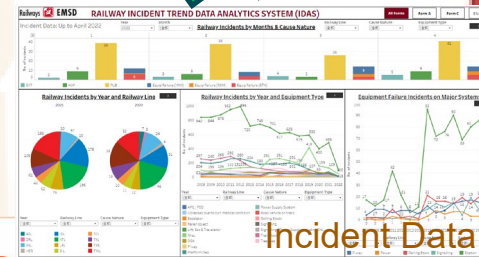
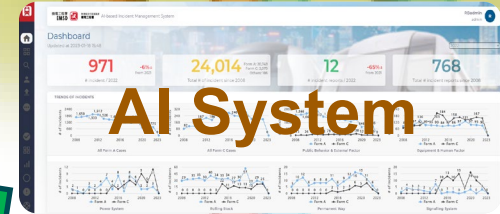
- Based on analysis result of historical railway incident data and Release of Concession (RoC) data in AI System by AI Natural Language Processing (NLP)
- New application to calculate risk score of SCIs by AI deep learning
- Risk-based approach to prioritize RB SCI Inspection

Risk Score of SCIs

A	B	C	D	E	F
SCI Number	SCI Owner	System	Sub-System	Equipment	Description of SCI
1	SCI-0001	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Proving Circuit (proving rails, switches and P&ID contacts) (SCI Number EMU-0-001)
2	SCI-0002	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-000)
3	SCI-0003	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-001)
4	SCI-0004	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-002)
5	SCI-0005	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-003)
6	SCI-0006	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-004)
7	SCI-0007	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-005)
8	SCI-0008	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-006)
9	SCI-0009	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-007)
10	SCI-0010	CYMA KIDESHSD	EMU - Unit Group Rail trains running in DRL only	Door (DRL UGR Train)	Door Close Switch (48V) (SCI Number EMU-D-008)

New AI Application for SCI Inspections

AI System



Incident Data

[illegible]

RoC records

Smart Planning for Safety Critical Item Inspection

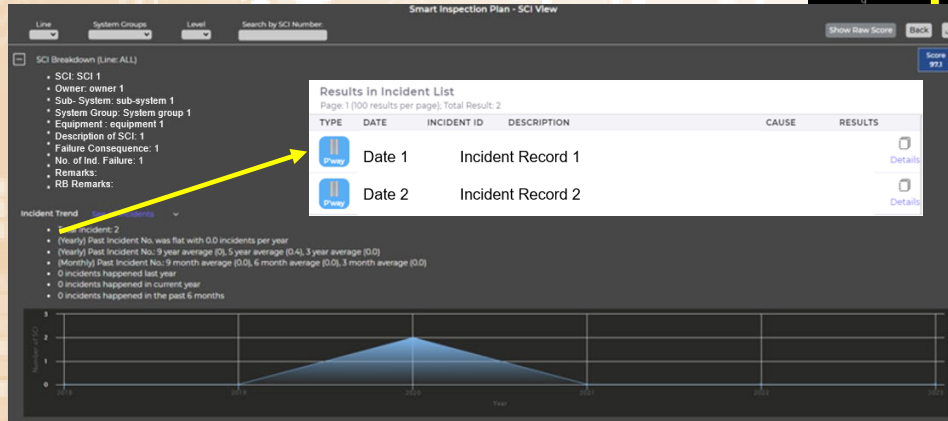
- Risk score of each SCI
- Ranked SCI risk to

High Med Low

Smart Inspection Plan - SCI View

Line: System Groups: Level: Search by SCI Number: Show Raw Score Back ↓

Ranking	Line	SCI Number	System	Sub-System	System Groups	Equipment	Score	
1	Line 1	SCI 1	System 1	Sub-System 1	System Groups 1	Equipment 1	Score 1	High
2	Line 2	SCI 2	System 2	Sub-System 2	System Groups 2	Equipment 2	Score 2	High
3	Line 3	SCI 3	System 3	Sub-System 3	System Groups 3	Equipment 3	Score 3	High
4	Line 4	SCI 4	System 4	Sub-System 4	System Groups 4	Equipment 4	Score 4	High
5	Line 5	SCI 5	System 5	Sub-System 5	System Groups 5	Equipment 5	Score 5	High
6	Line 6	SCI 6	System 6	Sub-System 6	System Groups 6	Equipment 6	Score 6	High
7	Line 7	SCI 7	System 7	Sub-System 7	System Groups 7	Equipment 7	Score 7	High
7	Line 8	SCI 8	System 8	Sub-System 8	System Groups 8	Equipment 8	Score 8	High
7	Line 9	SCI 9	System 9	Sub-System 9	System Groups 9	Equipment 9	Score 9	High
8	Line 10	SCI 10	System 10	Sub-System 10	System Groups 10	Equipment 10	Score 10	Med
9	Line 11	SCI 11	System 11	Sub-System 11	System Groups 11	Equipment 11	Score 11	Med
9	Line 12	SCI 12	System 12	Sub-System 12	System Groups 12	Equipment 12	Score 12	Med
9	Line 13	SCI 13	System 13	Sub-System 13	System Groups 13	Equipment 13	Score 13	Med
9	Line 14	SCI 14	System 14	Sub-System 14	System Groups 14	Equipment 14	Score 14	Med
9	Line 15	SCI 15	System 15	Sub-System 15	System Groups 15	Equipment 15	Score 15	Med
9	Line 16	SCI 16	System 16	Sub-System 16	System Groups 16	Equipment 16	Score 16	Med



- Details of SCIs
- Details of involved incident and RoC

Smart Planning for Safety Critical Item Inspection

Training data: 2021-2022 (2 years)

Validation data: Jan-Jun 2023 (6 months)

Result:-

- ✓ **Successfully build up correlation** among incidents, RoC records and SCIs based on AI NLP technology → **Accuracy >80%**
- ✓ **Successfully rank each SCI** based on risk scores calculated by AI deep learning technology → **The ranking result was assessed as logical**



**Shared this AI system with our regulatees
to facilitate the I&T development and adoption in railway industry**

Conclusion KONG

- ✓ Shifted from a risk-based model to a systematic for SCI inspection planning.
- ✓ Enhanced the detection of high risk railway assets and optimized resources.
- ✓ To further refine and broaden the application of AI for further improvement.
- ✓ To continue in collaborative efforts with our regulatees for the use of AI in the field.
- ✓ To foster an increasingly safe, reliable, and efficient railway system.



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