



► Risk Focused Infrastructure Condition Assessment

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Mainland China railway development overview

Year 2010
Year 2020
Year 2030

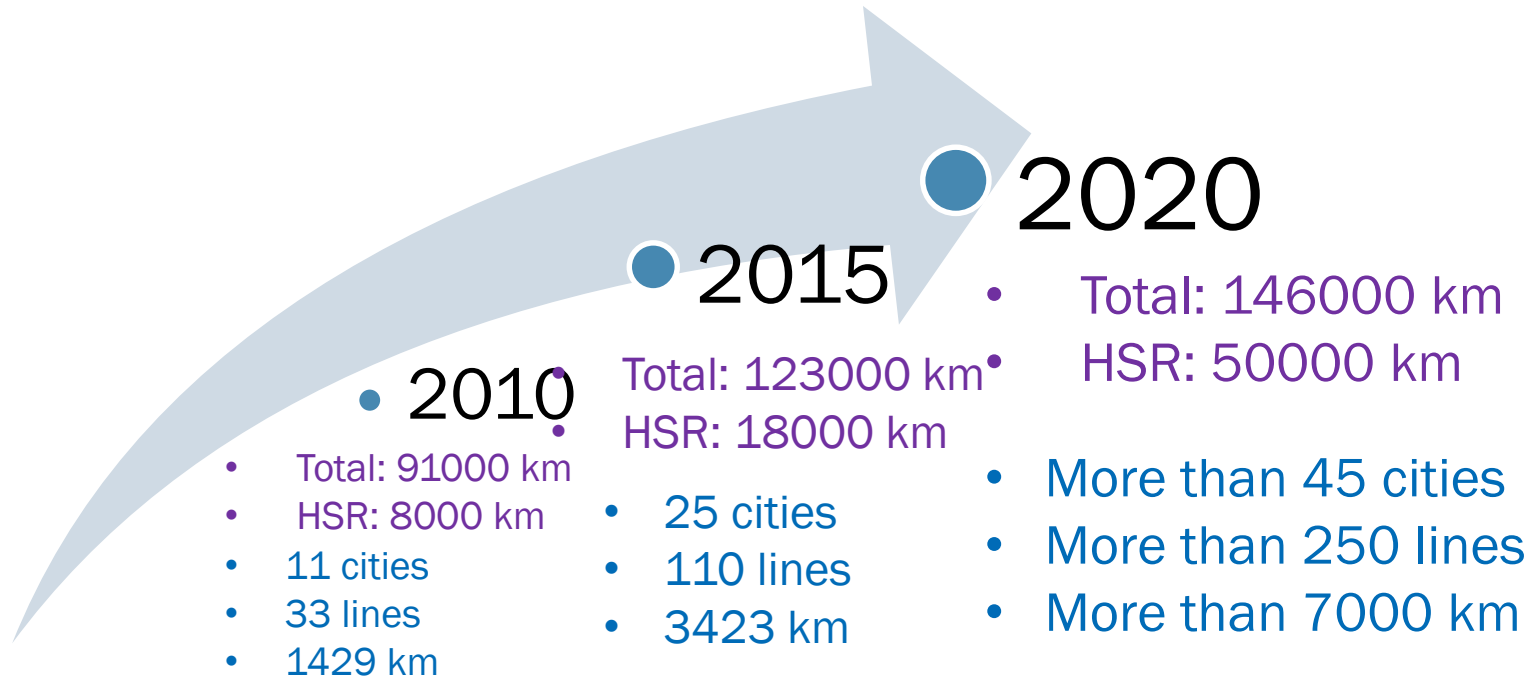


规划图



1 号线	迈皋桥 — 中国药科大学
2 号线	经天路 — 林场站
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Mainland China railway development overview



Purple: National Railway
Blue: Metro
HRS: High Speed Railway

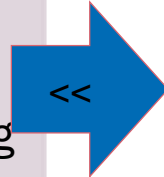
Needs of Operation Safety assessment

More modern railways and metro lines stepped into post-warranty operation stage

Focus change: Engineering safety → Operation safety

Engineering Safety

- Assessing planning, design and construction stages
- Equipment safety and engineering management safety
- EN5012X
- iESM(Yellow Book)



Operation Safety

How safety is the new line operation?
How to approve/assess?

Limitation of traditional assessment method

Traditionally Condition Monitoring: monitoring of the functioning of a system, or the wear and tear of parts

Exemples: SICA (System Infrastructure Condition Assissent)

- ▶ Developed by Lloyd's Register, now Ricardo Rail
- ▶ To address operational asset management issue for Network Rail in UK
- ▶ Endorsed by Office of Rail Regulator
- ▶ Effective for mechanical systems, but not for modern electronic based complex signalling system:
- ▶ failure of electronic system can not be directly inspected
- ▶ Safety performance does not have a linear relationship with its reliability performance

An effective new method

Risk Focused Infrastructure Condition Assessment

- ▶ Developed based on SICA with an objective to perform signaling infrastructure assessment
- ▶ Focus on operation safety
- ▶ Identify the weakest link to support investment decision making

Risk Focused Infrastructure Condition Assessment

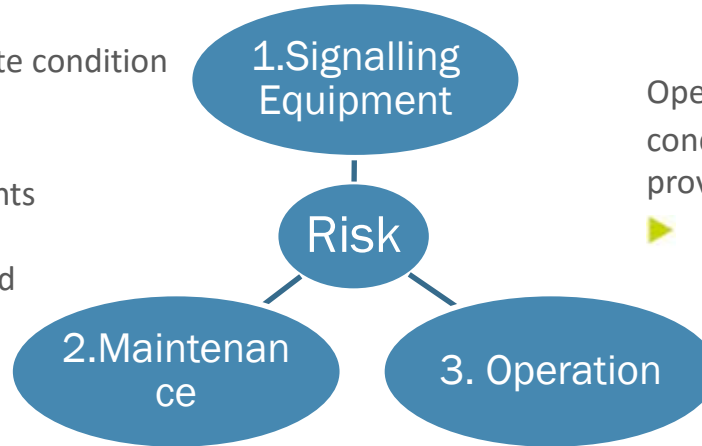
Effective and scalable to:

- ▶ Cover a wide range of signalling application for different operational lines
- ▶ Be adaptable to different signalling technologies, i.e. from traditional mechanism based equipment to modern complex computer based system
- ▶ Enable review of the operation and maintenance of signalling asset to its required performance level
- ▶ Facilitate review of signalling systems which are commissioned in periods with different safety acceptance and system handover regime
- ▶ Allow examination of operators using formal or informal failure data and management systems and processes (e.g. Failure Reporting and Corrective Action System)

Risk based, considering 3 aspects

Equipment: inspect equipment, evaluate condition from 6 aspects (similar to SICA)

- ▶ current condition,
- ▶ maintenance and fault requirements
- ▶ standard compliance
- ▶ modification/change history record
- ▶ Environment
- ▶ trend



Operation: focus on if safety application condition set by the infrastructure provider are met

- ▶ Especially in degraded mode

Maintenance: assess the aspects which can influence the safe condition of the signalling equipment:

- ▶ maintenance strategy and failure management
- ▶ training and competence management
- ▶ structure and resource management
- ▶ spare parts management
- ▶ asset management
- ▶ engineering and works managing
- ▶ change management, etc

Application cases

Been applied in two projects of three metro lines signalling asset condition assessment
Two are in Beijing and one in Shenzhen

Beijing:

- ▶ One line: re-signalled in recent years
- ▶ Another line: in operation for over ten years

Shenzhen:

- ▶ Commissioned in three sections with operation time from 5 to 12 years

Example of equipment assessment checklist

Equipment condition assessment: still a score based system

Point Machine		Score Category					Site & Score			
Ref	QUESTION	EXCELLENT (1)	GOOD (2)	AVERAGE (3)	BELOW AVERAGE (4)	POOR (5)				
C10	How would you describe the condition of the connectors and terminations?	recently installed to current standards	all conform to current standards	good connectors / terminations present	connectors / terminations corroded or dirty	no connectors or crimps provided				
C11	How would you describe the condition of the tail cables?	recently installed to current standards	all conform to current standards	secure and protected	visibly damaged	damaged and/or inaccessible				
C12	How would you describe the level of mechanical damage to the trackside equipment ?	recently installed to current standards	no visible damage	minimal wear and tear or minor damage	visibly damaged or localised damage	Insecure and/or severe damaged				

Example of O&M assessment checklist

- ▶ Document reviewing of maintenance rules and operation rules
- ▶ Interviewing relevant staffs to understand the implementation

Log No.	Key Area / Question	Guidance/ Supplementary Questions	Answers
	Maintenance & Fault Finding Management		
1	<p>What maintenance schedule / prioritisation system is used?</p> <ul style="list-style-type: none"> •Equipment based schedules •Condition-based •Risk based •Reliability centred •Other 	<p>Provide maintenance schedules for equipment.</p> <p>Do schedules for each equipment type have varying service requirements and frequencies? - provide evidence.</p> <p>Are these based on route cause analyses of failure modes and preventative maintenance? – provide evidence.</p> <p>How is critical equipment identified (e.g. high safety or performance impact)? - provide evidence.</p> <p>Does this vary depending on location or service demand (e.g. allocated train delay minutes/ failure)? – provide evidence.</p> <p>Does critical equipment have increased frequency for service requirements? – provide evidence.</p>	

Final assessment conclusion

Final assessment conclusion should consolidating:

- ▶ Equipment assessment scores
- ▶ Relevant maintenance and operation assessment result

The deliverable is usually a report stating:

- ▶ Strength areas and weak areas of equipment, operation and maintenance
- ▶ Recommendation/suggestion where improvement can be made either on improvement of rules, or considering investment to replace equipment, etc

Lessons learnt from the 2 cases

Key challenges and lessons learnt from the pilot application in mainland China:

- ▶ Condition assessment: relying on the experience and judgement by individual assessors → suggest to develop some quantitative criteria into the checklist
- ▶ Operations and maintenance assessment: when identifying the specific asset type of concern using failure data analysis, it is suggested to conduct a vertical slice analysis (VSA) on the operational and maintenance arrangement of this asset

Conclusion

- ▶ This method allows a full evaluation from different aspects, i.e. equipment, operations and maintenance.
- ▶ It can get a conclusion on safety operation of this asset.
- ▶ It is more comprehensive than the original SICA.
- ▶ It could be further enhanced and integrated to allow more objective and structured assessment in future.

Thank you!
Q&A