附錄 2

筆者參與研討會場次之簡報資料



Observatory of automated metros MISSION & MEMBERS





Laurent DAUBY - UTIP
Ramon Malla - TMB - Barcelona



and relevant knowledge about automated metro lines with a crosscutting approach in all business areas

UTT TTE

Observatory of automated metros

MISSION & MEMBERS























Worldwide group & experience

New members from different geographical zones

Observatory of automated metros DISSEMINATION ACTIVITY







1st Google entrance

Observatory of automated metros

DISSEMINATION ACTIVITY - WORLD REPORT ON METRO AUTOMATION



● Fligh capacity Ener, more than 700 passengers per train ■ Medium capacity Ener, 300 to 700 passengers per train ■ Low capacity Ener, under 300 passengers per train

Observatory of automated metros

DISSEMINATION ACTIVITY

SIECE





Observatory of automated metros

DISSEMINATION ACTIVITY - WORLD REPORT ON METRO AUTOMATION

SILÇE

World Report on Metro Automation

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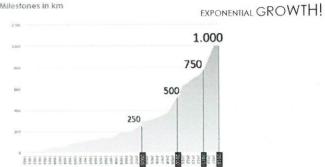
1003 km

63 lines

Fully Automated today

19 countries

42 cities









Beyond Automation: Benefits and Challenges of autonomous metro

Dr Ahmed Miske EL HADRAMI Technical Director & Chief Engineer - THALES - SINGAPORE





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Beyond Automation: Benefits and Challenges of autonomous metro

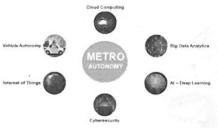
- · Emerging Technologies: New Opportunities
- Automation vs Autonomy
- Grade of Automation vs Level of Autonomy
- Next Train Control Generation
- Autonomy Benefits
- Autonomy Challenges





ELA-HIP Straggers International Transport Congress and Exhibition 9-11 July 2018 | Straggere

Emerging Technologies: New Opportunities







CIA-UEP Singapore International Transport Congress and Editional Vision (Congress and Edition (Congress))

Automation vs Autonomy







LTA-HTP Singapore International Transport Congress
4-11 July 2018 | Singapore

Grade of Automation vs Level of Autonomy









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Next Train Control Generation



TRAIN WITH VISION AND BRAIN : AWARENESS AND SELF DRIVING



LTA-UIE Singapose International transport Congress and Exhibition 9-11 $\rm My\ 2018\ I\ Singapose$

Next OCC Generation







Large Queen (mg) Lump

Lamp

HA-UIIP Tingapore Informational Transport Congress and Editablion 9-11 July 2018 I Singapore

Autonomy Benefits









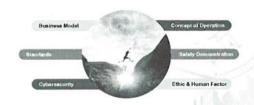






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Autonomy Challenges





What digitalization brings to Light Rail passengers and operators

Que E TE Limp

Christoph KLAES, Head Siemens Light Rail Vehicles, Siemens AG, Germany

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What digitalization brings to Light Rail passengers and operators









- > Passenger Experience
- Maintenance and Operations Optimization
- > Driver Assistance







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What digitalization brings to Light Rail passengers and operators > Passenger Experience



Improve the experience and happiness of customers using public transport services:

- Get the basics right Safe public transport
- Provide passengers with all the tools they need Trip and neighborhood information, Wi-Fi, etc.
- Communicate in real time with passengers -Use different channels and platforms.
- Listen to your customers. Receive feedback -Fnow and map your customers





Indiana Quanta (E) Lamp

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> Passenger Experience

Example: Smart Tram Frankfurt Public Transport Authority VGF













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Passenger Experience **Example: Intelligent CCTV**













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What digitalization brings to Light Rail passengers and operators

> Maintenance and Operations Optimization

Railigent® – smart data monitoring, analysis and prediction:

- Automatic data collection, transmission, analysis and visualization in one application.
- Application of intelligent algorithms to assess degradation and identify faults before they occur.
- Access to all relevant information to initiate early corrective actions and extend preventive intervals.
- Realistic savings up to 10%





LEA-HIF Singapore International Transport Congress and Chilition 9-11 July 2018 | Singapore

> Maintenance and Operations Optimization Example: Visualization by Railigent® for Avenio in The Hague

Bottleneck Monitoring

- · Analysis of speed over time and station dwell
- · Enables to detect areas of improvement in infrastructure setup.

Q ump





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> Maintenance and Operations Optimization Example: Visualization by Railigent® for Avenio in The Hague

Energy Monitoring

- Analysis of tram energy consumption and grid voltage distribution.
- Helps to optimize e.g. catenary system and power supply







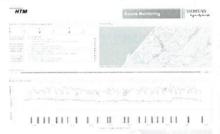
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Maintenance and Operations Optimization Example: Visualization by Railigent® for Avenio in The Hague

Events Monitoring

- · Analysis of failures and operational events, e.g. collision warnings of Tram Assistant System.
- Allows to identify correlations to location or environmental conditions.

Quantity (III) Jump





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What digitalization brings to Light Rail passengers and operators > Driver assistance

Our vision is the autonomous tram:

- Driver Assistance Systems are state-of-the-art in the automotive world.
- Siemens transfers this technology to LRVs.
- Development approach: Siemens conducts a running test lab together with our development partners Bosch and city of Ulm.
- first development step is a collision avoidance system. The "Siemens Tram Assistant"







SITCE

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> Driver Assistance

Example: Siemens' test lab for assisted and autonomous driving in Ulm



Tram Assistant - Collision avoidance system:

Driver warning and automatic braking.

Evaluation Kit - Development/test platform

- Evaluation of field test results to help optimize system performance and validate new use cases
- Analyses of traffic situations for future development





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Driver Assistance

Operators' feedback to Siemens Tram Assistant



Tram drivers show behavioral change:

- Awareness of supervision: conscious attempt to minimize system interference (incentive ?)
- Higher focus on potential collision situations

Customers embrace the new technology:

- Becomes standard due to fast ROI: a tram-to-tram accident can cause damage of > 1" EUR
- Ordered by Ulm, The Hague, Bremen, Copenhagen







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What digitalization brings to Light Rail passengers and operators







> Passenger Experience 75% of users in Frankfurt rated the content helpful or very helpful, 80% want to use it regularly

Maintenance and Operations Optimization

Realistic savings up to 10% through optimized maintenance and operation planning

Driver Assistance

Each prevented fram-to-fram accident with structural damage means savings of > 1' EUR



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AGENDA

Introduction

- 1. Transparent Track Task
- 2. Predictive Maintenance & Technical Control Centre
- 3. Multiple Measure Management

Conclusions

Digitalisation, a way to improve urban rail and ensure sustainable quality of life in Cologne













Digitalization, a way to improve urbanicall and ensure animerable quality of He in Colocure

INTRODUCTION

ensuring sustainable quality of life in Cologne

- fast growth of population (+10% till 2025) facing the absolute traffic gridlock
- threat of ban on diesel cars in the city centre

ambitious masterplan

- support LRV-services (backbone of public transport)
- Light Rail Vehicle purchase programs
- further implementation of E-Busses
- infrastructure enhancement

quality of service

- availability
- performance







1. TRANSPARENT TRACK TASK

construction

- · routing specific design
- materials target geometries

condition monitoring

- inspection
- measurement
- documentation

severity of use

- · number of axles axle loads
- speed acceleration







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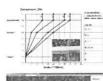
1. TRANSPARENT TRACK TASK

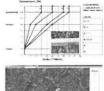
forecasts of condition and remaining asset lifetime

- big data
- assessment routines
- · intelligent algorithm

decision support (short-, mid- and long-term)

- · simulation of different scenarios
- maintaining activities
- · replacement investments







Eligitation, a way to improve unban rail and ensure sustainal 4s and literature. Be in Catago Dipl Ang Christian Burk, MBE – Köher Verkehrs-Betriebe AG

2. PREDICTIVE MAINTENANCE STRATEGY / TECHNICAL CONTROL CENTRE

demand - vision

- raise quality of service (performance, availability, comfort)
- decrease total costs of ownership (TCO)
- → infrastructure (railway track technical equipment)
- → vehicles (rolling stock busses)

strategy

- · avoid unplanned downtime (number date duration)
- · being faster than the faults/errors
- · planning efficient maintenance activities and replacement investments







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2. PREDICTIVE MAINTENANCE STRATEGY / TECHNICAL CONTROL CENTRE

concept - milestones

- applying suitable sensors/loggers open interfaces
- data transmission and central storage bia data
- live-information for working teams on mobile devices
 - · equipment related historical memory
 - assistance for effective and efficient maintenance
- live-information in <u>Technical Control Centre</u>
 - system related knowledge monitoring
 - · warning of critical conditions (machine vs. deep learning)
 - precise prediction of scenarios (planning tool)





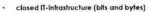
Dial Ing Christian Burk, MBE - Kölner Verkehrs-Betriebe AG

2. PREDICTIVE MAINTENANCE STRATEGY / TECHNICAL CONTROL CENTRE

challenges

do the right things and do the things right!

- · choose the right sensors and install them right!
- · formulate the right algorithm and train it right!
- identify/combine the right information and act right!



- evaluate internal protocols vs. open interfaces (4) (e.g. electronic interlocking systems)
- cyber security
 - anything, anywhere, anytime but not for anybody!







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2. PREDICTIVE MAINTENANCE STRATEGY / TECHNICAL CONTROL CENTRE

- · planned projects (decrease costs, raise quality of service)
 - · detailed weather information (snow, storm, heavy rain)
 - implement "IoT" for temperature monitoring (switches)
 - equip up to 300 lifts and escalators with separate sensors
 - run detailed track measurement campaigns regularly run tests with drones (e.g. inspection overhead powerline)
 - · run tests on electronic interlocking systems
 - · run tests on switch point machines
 - run test with divers vehicle telemetric systems
 - bring all data together in a Technical Control Centre







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(STATUS QUO)

3. MULTIPLE MEASURE MANAGEMENT

singular operational optimised maintaining activities (track, signalling, energy, platforms, buildings, fire protection, ...)

- minimise operational breakdowns
 - working in nightly breaks in operation on weekdays only
 - · rare total line blocking on holiday periods only
- · refused night-time permissions (residents, authority)
- · problems to contract external companies
- → needed works getting inefficient, delayed, up to impossible
- → mid-to long-term risks on assets condition with decreasing. ... performance ... availability ... comfort of urban railway







albation rasway to improve orbanitori ensure tust divalble quality of life in Cologie Diol-Ing. Christian Burk. MBE - Kölner Verkehrs-Betriebe AG

3. MULTIPLE MEASURE MANAGEMENT

(TARGET)

synchronised maintaining activities in operational useful sections (track, signalling, energy, platforms, buildings, fire protection, ...)

- complex coordination procedures in planning and execution
- long-term planning depends on long-term condition forecasts (transparent track task, predictive maintenance strategy)
- intensive public relations to inform about technical need, procedure, operation restrictions or replacement services
- → requires and offers liability and reliability to ...
 - ... customers, residents, public ... contracting parties ... budget







Digitalisation, a way to improve urban rail and ensure sustainable quality of life in Cologne Dipl.-Ing. Christian Burk, MBE - Kölner Verkehrs-Betriebe AG

(APPROACH)

3. MULTIPLE MEASURE MANAGEMENT concept - milestones

- allocate all infrastructure assets to operational clusters (matrix)
- identify/predict all needed measures for the next years
- synchronise multiple measures to managed revisions
- · internal project manager to coordinate needed permissions, technical, operational, commercial, public relation division
- adopt maintaining activities to agreed remaining asset lifetime additional chances
 - small maintaining activities are non fundable costs
- large renewal activities are potentially fundable investments





Dispitalisation, a way to in prove urban real and answe surtainable wealth of Ele in Cologna Disping, Childian Bulk, MSE-Köher Verkehrs-Betiebe AG

CONCLUSIONS

To ensure sustainable quality of life in metropoles, electric public transport is the key for the urgent needed energy-, mobility- and climate-changes.

To match the challenges of these changes new potent tools are needed.

Digitalisation is the basis for tools like ...

... transparent track!

... predictive maintenance!

... multiple measure management!



Oxpetalisation, a way to improve urban rail and ensure ruslainable quality of life in C. Layer.
Dipting: Christion Bull. MBE – Kölner Verkehis-Betriebe AG

CONTACT

Dipl.-Ing. Christian Burk, MBE Division Manager "Urban Rail Infrastructure" Kölner Verkehrs-Betriebe AG Scheidtweilerstr. 38 D-50933 Köln (Germany) +49 221 547 3460 christian.burk@kvb.koeln







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Operations and Safety Measures -Innovation and practice on accident analysis









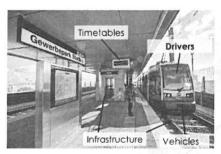
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Innovation and practice on accident analysis

- 1. Institutional and operational context
- 2. Communication as an important key to Safety
- 3. Technical innovations and safety measures
- 4. Standardization and future perspective



Integrated service provider

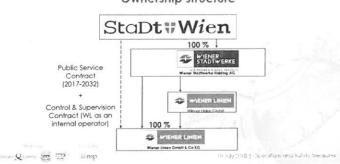


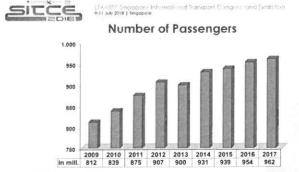




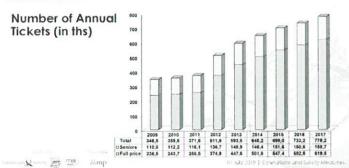
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Ownership structure





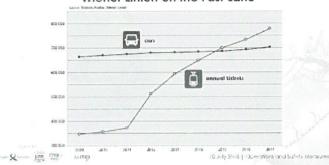




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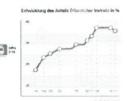
Wiener Linien on the Fast Lane





Modal Split









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Facts and figures: tram operation











Operational characteristics













Flexity Vienna









10 July 2018 | Operations and Safety Measures



Innovation and practice on accident analysis

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UITP Light Rail Committee, WG Safety publications



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Accident prevention - Key points

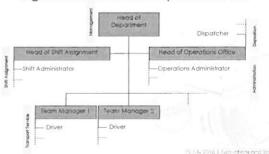
- 80-90% of the accidents are caused by third parties*
 Major accident cause: traffic rule offence
- Theory of probability cannot be applied for human misbehaviour → too many variables
- · Public space and distributed responsibilities





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Organizational structure operational unit



SICE Strangere International framework Co. 941 July 2018 | Singapore

Provide information, focus & goals

- · Continuous preparation and communication of data Task of superior departments
- Accident data acquisition essential element of accident prevention

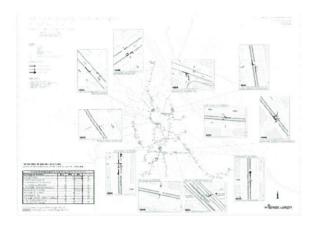




Communication within the team

- "Teammeetings" enable bottom-up communication
- · Safety-oriented discussions in regular driving staff meetings
- · Monthly newsletter by each department
- · Regular update of accident hotspot map









Direct communication

- Regular coaching during safety-oriented observatory trip
- Direct feedback after positive or negative incident
- Annual performance rating and review of employee
- Individual re-training of driver with noticebale behaviour









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Culture of constructive criticism

- Emphasis on individual and direct feedback
- "How to possibly avoid the same mistake again?"
- Speaking from experience → Pass on experience
- Bonding new employees to the corporation in the long-term
- Express expectations from the corporation
- Documentation, defined workfllow and processes





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Innovation and practice on accident analysis

- 1. Institutional and operational context
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Safety measures, vehicle and infrastructure





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Alarm system for parking



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Application of Lane Lights



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10 July 2018 1 - Sciendform and Safety Siersun



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Advanced Driver Assistance Systems: speed monitoring



- Combination of GPS tracking and predefined route data
- Pre rollout phase: viusal and acoustic warnings



 Roll out (2019): combined with brake engagement

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Advanced Driver Assistance Systems: collision avoidance



- Advantage: reliable in any track layout (curves etc.)
- Rollout: combined with speed monitoring system
- Future rollout: car detection



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Driving simulator: Improved training possibilities





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Accident trend

Accident rate (2010-2017)
[per 1.000 km run, tramway operation, Vienna]



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Innovation and practice on accident analysis

- 1. Institutional and operational context
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- Standardization and future perspective

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European standardization « Urban Rail », railway applications

Current proposals in context of traffic safety:

EN15227 « Crash Norm »

→ Passive Safety for driver and passengers

EN16186-5: visibilty for tramways

→ Increase active safety

wi750: vehicle end design for trams and light rail vehicles with respect to pedestrian safety

→ Increase passive safety for third parties



(0.3 dy 2/16.) Operations and Safety Meas



Future perspectives and challenges

- Continue intensive communciaton and leadership work
- · Continuous analysis, evaluation of implemented measures
- · Generate experience with ADAS, push state of the art
- · Improve data acquisition (classification of accident type)
- · Representation of operators in standardization process









16 July 2013 | Operations and Safety Assaure





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Use of Trenchless Technologies and Methods in Singapore's Thomson-East Coast Cross Islands Line MRT Construction



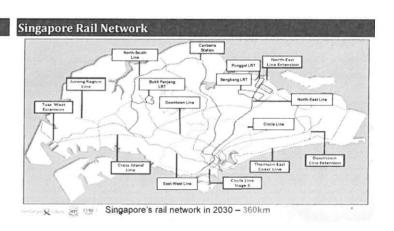


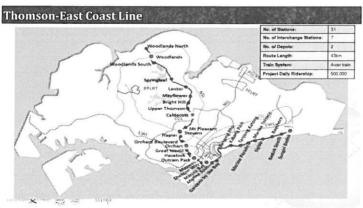


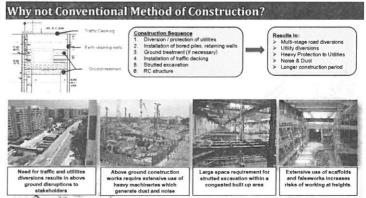
Mr Henry Foo
Land Transport Authority,
Deputy Group Director, Thomson-East Coast Line



Content 1. Introduction 2. Conventional Methods of Construction 3. Overview of Trenchless Construction 4. T219 Orchard Station - Internal Inter-locking Pipes and Retractable mTBM 5. T213 Caldecott Station - Twin Arc Mined Tunnel 6. T221 Havelock Station and T216 Stevens Station - Rectangular Box Jack TBM 7. T226 Marina Bay Station - Ground Freezing 8. Comparison of Trenchless Methods 9. Conclusion







Overview of Trenchless Methods



Bored Tunnelling

method to excavate circula

tunnels, typically in between stations

Was in The Limp





Driving of horizontal steel

pipes using

repeated

percussive blows







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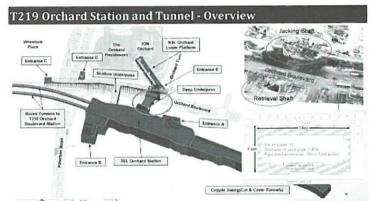


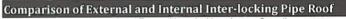


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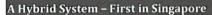
T219 Orchard Station -Internal Inter-locking Pipes and Retractable Micro Tunnel Boring Machine (mTBM) fitted with **Extension Kit**



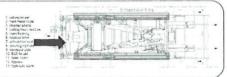




Differences between Internal and External Inter-locking pipe configurations External Inter-locking Pipe Internal Inter-locking Pipe

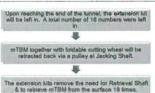








The first combined retractable mTBM fitted with extension kit and internal inter-locking pipes system in Singapore



Completion of the Pipe Roof



SITCE 2018 Technical Site Visit to T219 Pipe Ro at Orchard Station Date: Thursday, 12 July 2018 Time: 9.00am to 12.30pm



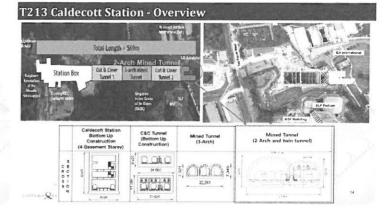


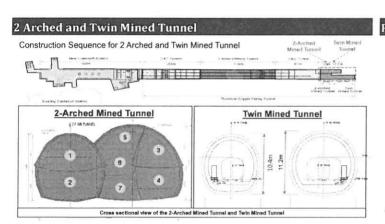


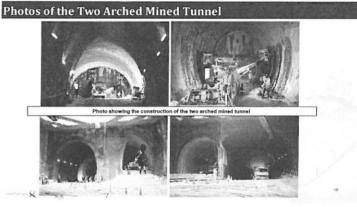
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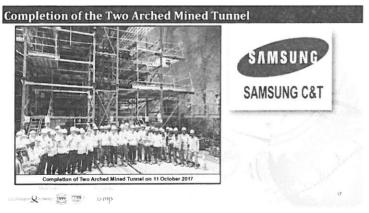
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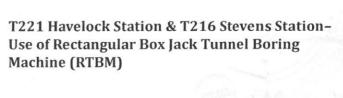
T213 Caldecott Station – Two-Arched Mined Tunnels in Mixed Ground







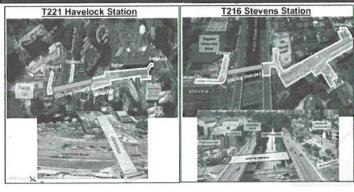




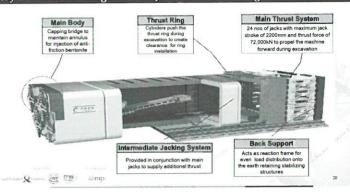
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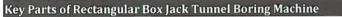


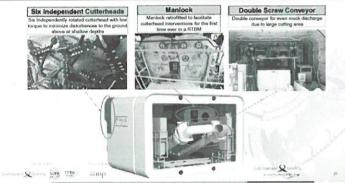
T221 Havelock Station & T216 Stevens Station - Overview



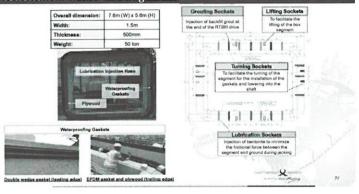
Key Parts of Rectangular Box Jack Tunnel Boring Machine







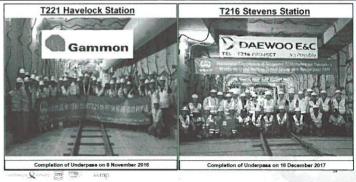
Monolithic Precast Box Segments



Photos of the Rectangular Box Jack TBM



Completion of the Underpass



Actual Construction using a Rectangular Box Jack TBM

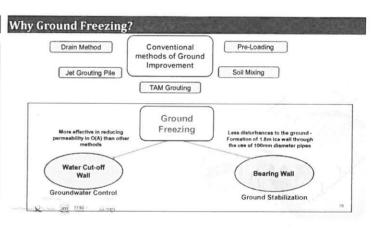


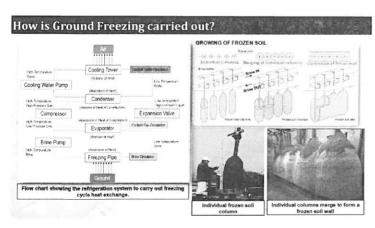


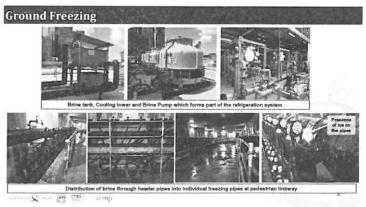
Pre-Treatment for Trenchless Construction: T226 Marina Bay Station - Ground Freezing



T226 Marina Bay Station - Overview To Marina Sode Station Lambdag of 77.55 Tall to Sherica Nay Station Amp







Ground Freezing







SITCE 2018 Technical Site Visit T226 Marina Bay Station Date Thursday, 12 July 2018 Time 9 00am to 12 30pm



(1A-title Singuinote International Transport Compless and Exhibition 9-11 July 2018 | Singapore

Comparison of Trenchless Methods of Construction



Comparisons of Trenchless Construction









Contract	T219 Orchard Station	T213 Caldecott Station	T221 Havelock Station	1 T216 Stevens Station
Methods	Internal Inter-locking Pipes and Retractable mTBM	Two Arched Mined Tunnel	Rectangular	Box Jack TBM
Length of Underpass	50m	62m	150m	62m
Dimension of Underpass	15m by 7.6m	23m by 13m	8m by 6m	
Ground Condition	G(VI) and G(V) (WSM and TAM grouting)	G(VI) and G(V)	Marine & Peaty Clay (JGP & DSM carried out) G(VI)	 Marine Clay & Fluvial sand Mixture of JGP, DSM and horizontal grouting along entire underpass
Overburden	18m	35m	5 – 7m	7 – 10m

Comparisons of Trenchless Construction - Benefits



Methods Internal Inter-locking Two Arched Mined Tunnel





Rectangular Box Jack TBM



	Pipes and Retractable mTBM			
Benefits:		No surface Minimal noise a Eliminated the need for ut		
Productivity Increment	47%	26%	30%	
Duration Savings	25% (7 months vs 9 months using Cut and Cover)	50% (21 months vs 42 months using Cut and Cover)	83% (6 months VS 36 months using Cut & Cover)	94% (1.5 months VS 24 months using pipe roof)

Comparisons of Trenchless Construction - Technical Advantages | Comparisons of Trenchless Construction - Challenges



unplanned cutterhead intervention















Contract T219 Orchard Station T213 Caldecott Station T221 Havelock Station T216 Stevens Station Methods Internal Inter-locking Pipes Two Arched Mined Tunnel and Retractable mTBM

Rectangular Box Jack TBM

Contract T219 Orchard Station T213 Caldecott Station T221 Havelock Station T216 Stevens Station Rectangular Box Jack TBM

Other

Better alignment control

Advantages Reduced likelihood of

Do not require column or wall at cross over track

Pilot project – open opportunities for future projects to explore alternative construction method in mixed ground condition

- Enhanced triple waterproofing system High quality of workmanship due to use of precast box segments
- Possibility of pipe distortion due to need to slit the pipes to install internal interlocking
- Limited by capacity of thrust system and the earth retaining structures (ERSS) at the launch shaft than conventional mined
- tunnel Alignment leads to big asymmetric 2-arch tunnel, potential tunnel distortion and settlemen
- Ground improvement may be required to support the permanent structures, and in fluvial layers to improve permeability



Elimination of soft eye due to equipping of mTBM tools for cutting diaphragm wall





Comparisons of Trenchless Construction - Future Improvements



Increase lubrication/grout ports due to presence of sticky clay.

To change roller disc cutters to scrappers after cutting through the D-wall to facilitate cutting through sticky clay

X Imp





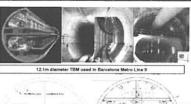


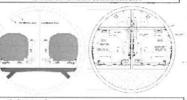
Contract T219 Orchard Station T213 Caldecott Station T221 Havelock Station T216 Stevens Station Rectangular Box Jack TBM

Internal Inter-locking Pipes and Retractable mTBM Two Arched Mined Tunnel

- Effective fore-poling with multi-stage injection grouting to minimize the scaling and subsequently the thickness of temporary shotorete lining.
 To provide multiple Intermediate Jacking System for longer tunnels
 To introduce a manlock within the RTBM to perform cutterhead intervention in lieu of Singapore's uncertain ground condition.
 To cast the segments on site due to longer tunnels.
 - To cast the segments on site due to logistics challenge in transportation of the bulky monolithic segment boxes

Moving Forward- Single Large Diameter TBM









12m Single Large Diameter tunnels with cross over separated by a centre wall

Conclusion

Mathoda

- 1. Innovative trenchless alternatives to the conventional cut & cover methods for underground works
- 2. Attractive solutions in densely built-up cities with growing demand for underground developments.
- 3. Trenchless construction methods benefit the residential and commercial stakeholders in the vicinity by minimizing the disturbances to the ground surface.
- 4. Productivity improvement in reduction of manpower; aligned with Singapore's National Construction Productivity Drive.
- Lessons learnt such as project challenges encountered and measures implemented will serve as a good database for implementation of future project.





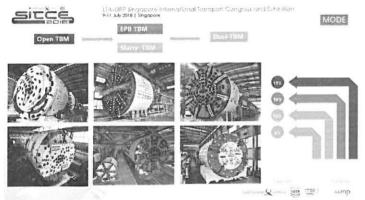


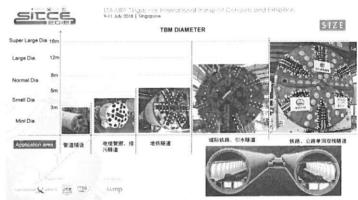




Prof. WANG KUN Tunnelling Expert & IPMA assessor VP OF China Railway Group Limited(CREC) International Division

Prof. KUN, is one of the first users of hard rock and EPB thms in China; one of the first team involved in the R&D of china's TBM technology. He has delivered more than 50km tunnels as the project Manager. After managing the group's overseas business, he delivered successfully the first part of MTR project in Kula Lumpur, Malaysia, first Rectangular tom project in Singapore, the longest tunnel in Eurasia countries. He also execute the first LRT project in Tel Aviv, Israel .smoothly up to now. Some of Projects have been award national and IPMA Prize winner.





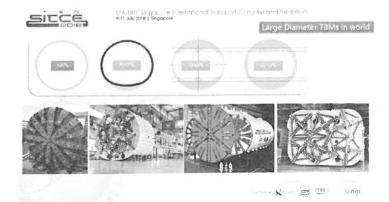


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	II.	arge Diami	eter TBMs using	in World
Project	TBM Die. / Type	TBM manufacturer	Nation	Cotest aures
Silberw aid Highway Tunnel	14.2m / Mixed shield	Herrenknecht	Moscow Russia	2004
Shangzhong Road Tunnel	14.87m / Slurry TBM	NFM	Shanghai China	2004
Bund Tunnel	14.27m / EPB TBM	Mitsubishi	Shanghai China	2008
Waterview highway connection	15.43m / EPB TBM	Herrenknecht	Auckland New Zealand	2008
Xiangjiang River Tunnel at Nanhu Road	11.65m / Slurry TBM	CREG	Changsha China	2010
Caltanissetta highway tunnel	15.08m / Slurry TBM	NFM	Italy	2013
Caltanissetta highway tunnel	15.08m / Slurry TBM	NFM	Italy	2013
Ton Fron - Chek Lop Nok Judian By Teny Ir S	17-ya - Mimos chielo	HAMEDIAN	Hong Kong Skina	2010
Su'aı Tunnel	15.10 / Slurry TBM	CREG	Shantou.China	2017
Tai'xi Tunnel	12.14 / EPB TBM	CREG	Talyuan , China	2017
Chunfeng Tunnel	15.78 / Slurry TBM	CREG	Shenzhen China	2018
Boso Tunnel	11.7 / Slurry TBM	CREG	Hangzhou, China	2018
	Road tunnels (c	fia > 14m) approx	20	

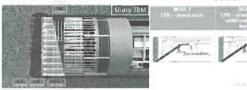


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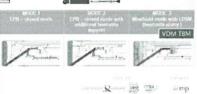
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Selection Suggestions on Enclosed-type TBMs











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◆ Whole Industry Chain Support



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Key Points & Core Technology for Manufacture of Large Diameter TBM

Design Considerations

Technical specifications Construction arrangement

Transportation
Job site assembly and disassembly

Segmental cutterhead & shield

→ Accessible cutterhead

Technology

TBM Cutterhead Design









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Features and Tech Difficulties of Large Diameter TBM Constructi

















Mmp



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Features of Large Diameter Slurry TBM

Large Diameter TBMs are more often of Slurry TBM, for its significant advantages in situations of rich water, high water pressure, complex surrounding environment and long distance weak-stratum construction. However, it has certain disadvantages in long distance rock-stratum and sticky-clay stratum, including difficulties in excavation, slow speed, sticky paste jam in cutter head, muck discharge stagnation, pipe line abrasion, injecting-grout waste, etc.











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Location	Belling, China	
Year	2010	
	Pathery Turnel	
Tunnal Langth	3,700 m	
Gaclogy	Silty clay, day, silt, fine sand	
Client	China Railway Tunnel Group	

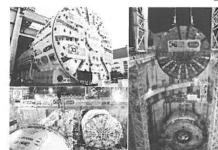
High Water Pressure: 4.36bar

. Long distance cross throuth Clay and silty clay

* Settlement control in built-up areas (Airport rapid Railw

TEM	CREC2675298
Type	2×Sharry TEM
TBM Dumoter	10.9 m
Settlement control (Through Phallway)	0.85mm

SILČE



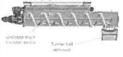








LTA-UITP Singapore international Transport Congress and Exhibiting 9-11 July 2018 | Singapore Large Diameter EPB - Tayyuan South



Segment Transport + Parallel Invert Casting



Tunnel Length: 2.8km;Adopted Φ17.45m "Betha" EPB TBM, being Super-large Diameter TBM. Multiple shutdowns happened and huge difficulties encountered.







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- Long distance excavation
- Excavation under complex stratum
- Docking under complex stratum situations
 Muck separation of Slurry TBM
 Whole-course belt & vertical muck discharge of EPB TBM















North Street

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Technology Breakthrough for Equipment Manufacture

Design of accessible cutterhead & cutter configuration technology





Almp











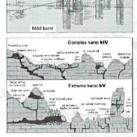
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Conclusion

- After massive construction applications in recent years, technology for large-diameter TBM construction and manufacture has been largely improved, and the construction technology is gradually mature and improving quickly. Considering the actual situations of all parties and Singapore is stratum features, it is conceivable that great demands exist for Large-diameter TBMs in the future, and Singapore is also suitable for large-diameter TBM's application and promotion, which brings a bright prospect. Integrating with the stratum features of Singapore's high-speed railway: the Karst geological condition is neither terrible nor featful, and thus, we suggest the shurry TBM, of which Dual-mode or variable-density TBM are for selection, and EPB TBM is also an option.











Development of TEMS -Tunnelling and Excavation Monitoring System





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- Underground construction is getting more complex
 Today, it is common in our projects to tunnel underneath live traffic below roads, in close proximity and below existing buildings, and even undercrossing live MRT tunnels
- Important to put in place rigorous monitoring and control systems for tunnelling and excavation works, and use of advanced technology is continually identified to mitigate construction risks



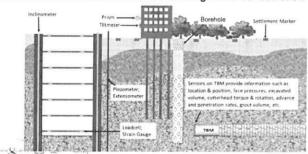






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Different Data Collected to Monitor Underground Construction

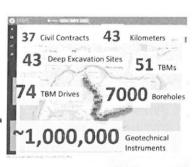




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Why TEMS?

- ☐ One-stop centralized platform to consolidate, view and evaluate large amounts of data
- ☐ Web-based monitoring platform anytime,
- ☐ Generate monitoring graphs, analysis and summary reports
- ☐ Enhance construction safety: access to data for quicker interpretation & assessment







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Overview of TEMS









Project & User Management

- ☐ Controlled user access to read, write, upload, perform analysis of data, depending on their roles in various contracts
- ☐ System administrator maintains user roles & user accounts, assigns function to user roles & users to accounts, view user access & audit trails











Marrie & Company (mg T0)

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Web-based application system

- ☐ Internet based system allows ubiquitous and 24x7 access
- ☐ Availability on mobile platform allows closer monitoring and field response
- ☐ GIS-based system allows TEMS monitoring data to be presented in context of the surrounding environment





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Data Collection, Management, Monitoring & Analysis





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Data Collection, Management, Monitoring & Analysis

- ☐ Up-to-date information from various sources – soil data, instrument monitoring data, TBM monitoring data, etc. presented on a single platform
- ☐ Integrated analysis of construction impact in relation to the surroundings
- ☐ Trend analysis and correlations between parameters gives better understanding of







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Data Collection, Management, Monitoring & Analysis

☐ Analysis of construction activities in relation to soil and tunnelling instrumentation enhances understanding of construction progress









13A-BIF Singapore Infernational fearing-ort

Proactive Alert System





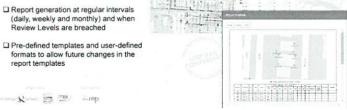




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Report & Information Distribution

- ☐ Management reports for tunnelling operations, for instrumentation monitoring readings & status, for managing instrumentation contracts, etc
- ☐ Pre-defined templates and user-defined formats to allow future changes in the



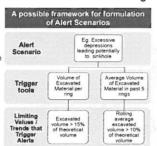


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Future Enhancement (a): Scenario-Based Alert Monitoring

- ☐ Current monitoring based on a single value (AL, WSL, PDL) for each instrument is passive
- ☐ Can we look at cluster of instruments to determine if there is a risk to construction
- Monitoring system based on failure scenarios would be more pro-active in pre-empting construction risks

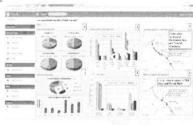


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Future Enhancement (b): Enhancing Data Visualisation

- ☐ Large amount of data collected for megainfrastructure projects → need to communicate information clearly and efficiently to users
- By presenting data in pictorial or graphical format, enhancing data visualisation enable decision makers to gather insights and identify patterns for construction monitoring





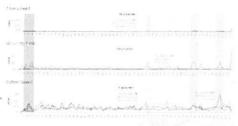


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Future Enhancement (c): Learning from past for incident prediction

- Learning from past data and performance, to develop prediction scenarios for incidents
- ☐ Signature and pattern recognition, trend analysis, multi-variable correlations
- Machine learning, such as decision tree, neural networks, deep learning, etc.

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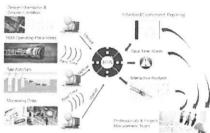




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Conclusion

- One-stop, integrated analysis of various sources of information / data enhances risk management of underground construction
- ☐ Enhancements in ICT has improved the timeliness in responding to construction effects
- ☐ Data Analytics offers new exciting opportunities to elevate construction monitoring to the next level



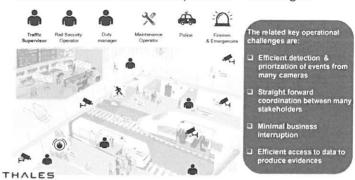
Safety of tunnelling works is of paramount importance – continual efforts and improvements such as TEMS to mitigate risks and ensure safe underground construction







Videosurveillance in rail transportation - Challenges



Video Content Analysis - Definitions

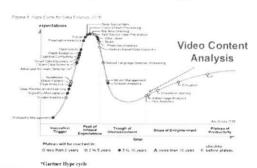
What does Video Content Analysis mean? « The automated extraction of information and knowledge from video footage »





THALES

Video Content Analysis - Technology state



THALES

Video Content Analysis - Focus on public transport



>76%*

of public transport operators agreed that passengers and staff would feel even more secure with surveillance systems used proactively (real time video detection).*

Video Content Analysis

Artificial Intelligence Revolution of deep learning



Already in use today*

- · INTRUSION DETECTION
- PERIMETER BREACH DETECTION
- · RAIL TRACK ACCESS DETECTION

Situational awareness

SECURITY BROW

Future interest

- GRAFFITTI BEHAVIOR DETECTION*
- · LEFT LUGGAGE DETECTION

FACE RECOGNITION

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Video Content Analysis – Benefits for transport operators



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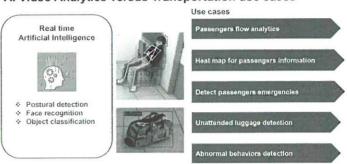
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Video Content Analysis: Methodology & Best practices

« We promote the proof of concept methodology for Video Content Analysis. »



Al Video Analytics versus Transportation use cases



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THALES THALES

Al Video Content Analysis state for public transport

Public transport environment is complex Human insights still more efficient to detect abnormal situations On-site experimentations are required Al Technology is very promising New benefits for the End-user

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Railway Systems: How to deal with cyber threats Agenda



Lovan Pushparatnam
Director, Tramway Systems and Telecoms D
Pierre-Henri Marillet

SYSTIA

July 11, 2018









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Agenda

Overall approach

Requirements

Security case

Overall approach

property of the second

Examples of cyber vulnerabilities

- · Interconnected information systems:
- San Francisco fare collection system (2016)
- German railways passenger information (2017)
- · Insufficiently protected control systems:
- 4 derailed trams in Lodz, Poland (2008)
 South Korea (2016)
- · Wi-Fi security protocol hack (2017)
- · Use of default passwords:
- Light rail control centre equipment (2018)





Railway systems

- Variety of on-board and ground infrastructure
- Mix of old and new
- · Safety critical and business systems
- Passenger services
- Mix of bespoke and off-the-shelf equipment
- · Common communications bearers



Categories of vulnerabilities

- · Technical:
 - · equipment and systems not adequately protected
- · Contractual:
 - * equipment delivered today is only as secure as you specify it...
- · Organisational:
- railway systems are designed, built and operated by many stakeholders with different approaches to security (if any)



Categories of vulnerabilities

- · Technical:
- equipment and systems not adequately protected
- · equipment delivered today is only as secure as you specify it...
- · Organisational:
 - railway systems are designed, built and operated by many stakeholders with different approaches to security (if any)

Sponsor

Designer

Integrator

Supplier

Installer

Maintainer

Overall approach to cybersecurity

- The best results are achieved when cyber security is treated as part of an overall security policy that addresses:
 Technical aspects (equipment specifications, system architecture)

 - Operating procedures (management of incidents, recovery)
 - · Continuous assessment and measurement
- Cybersecurity is not about protection it is about preparation



Overall approach to cybersecurity

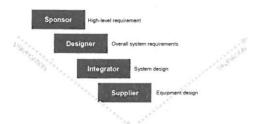
- Incorporate the requirements into the design of new systems.
- · Carry out a risk assessment to obtain a classification of the system or project (critical or non-critical)
- · Carry out audits:
 - Technical (design, penetration tests) Organisationa
 - Contractual
- · Put in place disaster recovery plans
- · Implement continuous assessment and measurement
- Develop a security case

Requirements cascading



Requirements

Requirements cascading



Categories of requirements





Categories of requirements





Examples of technical requirements



Examples of technical requirements

- · Files are to be encrypted

- All equipment is locked
 Login via ID card
 Access for maintainers is limited to backup log files but not to the live system
 Remote access to files is not permitted
- Only install components that are necessary for
- operations
 Default installation prohibited

Organisational requirements

- A security advisor shall be identified and independent of the project team. He/she will be in charge of verifying the specifications and conduct audits on the final system before commissioning.
- They shall integrate the company's general security policy as

- Comply with security requirements:
 On recognised best practice (e.g. for software development, architecture...)
 Relating to non disclosure (if needed) (e.g. do not promote or publish sensitivi information about the project.)



Examples of organisational requirements

Examples of organisational requirements

Asset owner	Integrator	Supplier
Cybersecurity management system	Cybersecurity assurance (tracability of requirements)	Sub-system/product requirements
Impact assessment framework	Architecture	Product assurance
Reference architecture	Cybersecurity level: target	Cybersecurity level: capability

Examples of contractual requirements

- Ensure that all equipment is fit for purpose
- Many suppliers continue to deliver poorly configured equipment with very weak administrator passwords e.g. the name of the project
- * Ensure that software is supported throughout the life of the system
 - Operating systems are not always up-to-date, either because the supplier doesn't have the time to do it or, they don't want to do it as the supplier can no longer guarantee the functioning of the system

Security case

Security case

- * A security case is analogous to a railway safety case
- Demonstrate that the system is acceptably secure
- Work on the security case needs to commence at the beginning of any project
- All relevant stakeholders need to contribute

Security case

- High-level requirements need to be defined.
- The security case needs to demonstrate that these are then cascaded down into system and sub-system design
- * Acceptance testing results also need to be fed into the security case
- Residual risks that remain after the system has been tested must be incoporated into the safety case
- E.g. use of an operating system that is vulnerable to future virus attack
- The security case needs to be signed-off prior to bringing into service

Summary

Additional points to note

- Awareness and training is essential for all stakeholders at all levels
- A continuous programme of monitoring is necessary so that immediate action may be taken for new threats
- Level of security will decrease over the life of the system either through modification/upgrades or new vulnerabilities that appear
- Security has a cost (investment and operational) but by treating it at the beginning of a
 project its impact may not be significant

Summary

- Railway systems are more and more interconnected with increased complexity and interfaces
- * Vulnerabilities are not just technical, they are organisational and contractual too
- A robust process must be put in place and followed by all stakeholders
- A security case needs to be produced prior to a new system going live



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Thank You







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Keeping Railway System One Step Ahead of Potential Cyber Attacks

Mr. H.W. Chan Communications & Control Engineering Manager MTR Corporation Limited, Hong Kong



"Traditional" vs "Cyber" Attacks





Itan's nuclear centrifuges (2010 Jun)
- Stuxnet ruined 1/5 nuclear centrifuges





Ukraine's Power Outage (2016 Dec)

- Outage of workstation & SCADA Complete power loss for 30mins

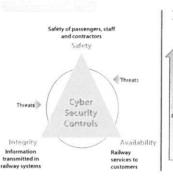




Ukrainian Cyber Gaog (2018 Mar) - Targeted 100 financial

- institutions worldwide Hacked to 50 Russia's banks Over C1 billion stolen

Cyber Security Landscape & Attributes



More prevalent & complex Cyber threats More severe Damages – prolonged service outage, leakage of sensitive information



CTA-UTIP Singapore International Transport Congress and Exhibition 9-11 July 2018 | Singapore Most prevalent cyber attacks - Ransomware

Computer malware that encrypts files and demand a ransom payment to decrypt them $% \left(\mathbf{r}_{\mathbf{r}}^{\prime }\right) =\mathbf{r}_{\mathbf{r}}^{\prime }$



User opens malicious attachment/ link in email/website

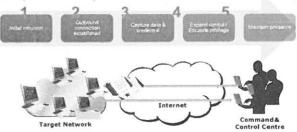
Ransomware starts to encrypt files in local drives and other accessible drives



Ransom message displayed, demanding money for decryption key

Most prevalent cyber attacks - Advanced Persistent Threat (APT)

Cyber attack that uses advanced techniques and multiple phases to break into a network, avoid detection, and harvest valuable information over the long term.





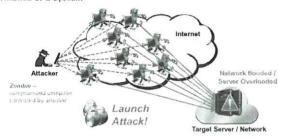






Most prevalent cyber attacks - Distributed Denial-of-Service (DDoS)

Multiple compromised systems used to attack and bring down / degrade the performance of a system





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Cyber Security Governance in MTR Operating Railway

MTR data networks carry data of mission critical systems Cyber attacks can cause service impact to railway operations

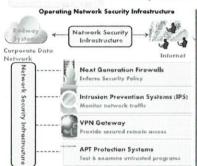
Corporate Cyber Security
Committee Docur Information Security Management Committee Design Standard

Security Plan

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Security Protection Measures



aged Security Services Provider (MSSP)

- 7 x 24 security monitoring of networks and systems
- Incident response with on-site
- Rapid detection and response to cyber attacks



LTA-UTTP Singapore International Transport Congress and Exhibition 9-11 July 2018 | Singapore Case Sharing - WannaCry



- · Ransomware files in infected machines will be encrypted
- · Exploits a vulnerability in the Microsoft Server Message Block 1.0 (SMBv1) protocol
- Spread quickly through network
- Do not need user action





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Case Sharing - WannaCry Immediate Actions Taken

- SEP Signature Updates Nanayed clients: Latest signature updates pushed to managed clients
 Unnanaged clients: Download link sent to OSSIG members
- · IPS Signature Updates
- AFC UTM Signature Updates
- · Internet Firewalls & VPN Policy
- Microsoft Windows Security Patch For supported Windows (MS17-010) For de-supported Windows
- · Disable SMBv1
- · Tightened USB Usage Control



I.TA-IJTP Singapore International Transport Congress and Exhibition 9-11 July 2018 | Singapore Case Sharing - WannaCry Follow up Actions

- Anti-virus update (Managed Clients / Unmanaged Clients)
- · Windows security updates
- · USB Port Blocker deployment
- · Protection for Unmanaged Clients



















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Upcoming Challenges

Operations	Si	ifety,
availability	&	integrity

6	î	Network	re	lying
	S	ystems		

Signalling Upgrade to	
Communications Based	
Train Control (CBTC)	

X = E TB) Jump

Category	(Example)	Safety	Service	Revenue	Service
Signalling Systems	• свтс	1	1		
Politing Storia Systems	Train Management System	1	1		
AFC Systems	AFC Systems			1	1
Station Control Systems	- Main Control System				1
E&M System	· Environmental Control System				1
Communication Systems	• Radio		/		1
Passeniger Information Systems	· PA & PIDS				1
Supporting Systems	· cctv				1

System

Risk Areas

Signalling Upgrade from traditional to Communications Based Train Control (CBTC)

Conformance to International Cyber Security Standards

- Conformance to International Cyber

 - Conformance to International Cyper Security Standards

 1. IEC 62443 on Industrial Automation and Control System Security

 2. IEC 62243 on Railway applications Communication, signolling and processing systems Safety related communication in transmission systems systems.
- Cyber Security Management and Controls
- Controls

 1. Cyber security organization to oversee Cyber security (Stitus)

 2. Security regions

 2. Security represent built in product lifecycle (design, implementation and TRC)

 3. Provintly for exbirmal interfaces

 4. Encoypium for all wireless transmission

External Security Assessments

- · Gap analysis and benchmarking
- · Compromise assessment
- · Penetration tests



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Being one of the leading railways in the world...

- Up-keeping cyber security to ensure safety, service and efficiency
- Increasing effort in Corporate cyber security Stralegy & protection measures for Railway Operation according to unique individual system features
- Moving on in pace with global environment & industry trend



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Thank you!

Q&A



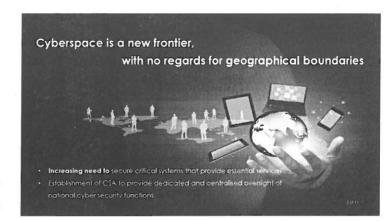




Fostering a cybersecurity mindset

Lim Thian Chin Deputy Director
CSA CII Division
CGEIT, CRISC, CISM, CISSP, CISA, SABSA





Digitalisation in rail industry

Rail industry is at the forefront of this digitalised revolution



Triffic Smargar SMRT taps predictive technology to prioritise maintenance



cybersecurity threats

e.g. Advanced crowd-sensing system e.g. Train and Track Condition Monitoring system

While digitalisation offers great opportunities, it also presents new

Cybersecurity Act commences in 2nd half of 2018



1 Protection of Critical formation infrastructure (CII) Investigation of Cybersecurity Threats and Incidents

Cybersecurity Act - 4 Key Objectives

1 Protection of Critical



protection of Clis against cyber-attacks.



Authorise CSA to prevent and respond to cybersecurity threats and incidents.



framework for sharing cybersecurity



Establish a light-touch licensing framework for cybersecurity service providers.

11 critical sectors providing essential services



Instead of a compliance mind-set, organisations should reframe and view cybersecurity governance as a risk-based approach

Cybersecurity is investment, not Cost Center

Dermark's largest frem operator hil by service crippling DDoS attack



Another day, another DDoS attack causing passengers a great riest of trouble

The sequent learn operating exception in Debbase. Despite Basic years (Bit R in Square), Steen Rainwage) softened a national bland educk (Stethourse Goods of perhaps on Sunseacestral period Residence in more the operation.

- Cyber attacks on rail services can delay operations, disrupt commuters' daily routine and affect organisation's reputation
 - e.g. DDoS attack conducted on DSB in May

Cybersecurity is investment, not Cost Center

- Generally lesser costs to invest in cybersecurity than to remediate or clean up our computer systems after a cyber breach
- A trusted cybersecurity posture can create a competitive edge for businesses
- According to PwC, 74% of executives in Singapore have reported increased spending on cybersecurity as a result of digitalisation
- Cybersecurity act as an important enabler for organisations to confidently connect, interact and drive innovation

7 01 11

Sect 1

Adopt a Security-by-Design mindset

Why adopt Security-by-Design?

- Multiple new initiatives are carried out for smarter rail systems
- $\star\,$ In most cases, heterogeneous IT technologies and software solutions are used
- * Protection of such environments become increasingly complex
- * Adopt a security-by-design mindset to combat new cybersecurity threats

Adopt a Security-by-Design mindset

How to implement Security-by-design?

- * Assess, build and configure our systems with security in mind from the start
- Check for intrusions after implementation, dispose assets securely at the end of their life span
- Educate end-users to be cyber-smart
- Avoid piecemeal security implementation and the need for costly and often ineffective retrofitting

"Security is a process, not a product"—Bruce Schneier, CTO of IBM Resilient

FU 11

10 of 11

Conclusion

- Cybersecurity deserves attention at the highest level of every organisation
- Consequences of a cyber breach can be dire, ranging from high costs of resolution to loss of credibility and damaged reputations
- Cybersecurity should be regarded as a board room issue
- Adequate attention and sufficient resources should be allocated to ensure cybersecurity measures are deployed to protect critical systems and networks



Artificial Intelligence in Mass Public Transport: What is the future for artificial intelligence in public transport systems?

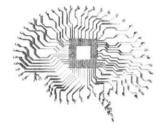
Gayang Ho

Senior Manager, UITP Asia-Pacific; Research & Policy Development Lead, UITP Asia Pacific Centre for Transport Excellence (AP CTE)





- UITP Asia-Pacific Centre for Transport Excellence for Sustainable Urban Mobility was established in 2012 as joint efforts between Land Transport Authority of Singapore and UITP.
- The mission is to advance sustainable public transport in Asia-Pacific region.
- In 2016, UITP and LTA expanded the work programme to ensure research activities farm the centre of our commitments.

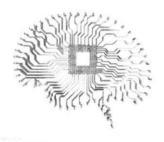


Why should public transport care about AI?

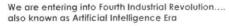
How is AI changing our industry?

What steps we need to take to successfully deploy AI into PT operations?

What is the future of AI in PT?



Why should public transport care about





t* Industrial Persolution STEAM Stowth of Seast ensures med in Seast of



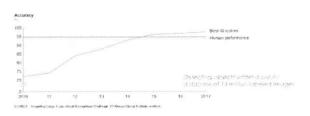
5º Industria Revisiance AUTOMATION The start of finally Resolution growth si



Our environment is fostering the growth and maturity of AI technologies

Machine learning in image recognition

The ability of Atsystems to recognise objects has improved to exceed human performance



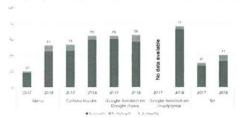
Natural language processing

Significant improvements in machine translation reaching close to homen's level of accuracy.

TRANSLATION QUALITY (% of accordey)	Phrase-based machine translation	Google Neural Machine Translation (GNMT) *Infroduced in 2016	Human	Perfect
English > Chinese	67%	77%	83%	100%
Chinese > English	63%	70%	77%	100%
English > French	83%	86%	92%	100%
French > English	83%	88%	88%	100%

Voice recognition in virtual Assistants

Virtual assistants are improving in their ability to answer denend questions and quality of answers.



Source: Stanz Temple, 2017 & 2018

At is already integrated in our daily lives.....

















Al is predicted to multiply economic gains



Economic impact of AI will increase global GDP will by 14% in 2030 - US\$15.7 trillion

44% of executives (out of 203) believe delaying Al implementation will make their business vulnerable to new, disruptive tech start-ups. (Economist Intellment Unit, 2017)

All GAM figures and supremod to market exchange rate prime.
SE-GAM figures are imported as mad one- grown, CAM handles from



Quantitative Survey 48 companies across PT sector

Expert Roundtable in Karlsruhe 28 PT Experts in IT, Innovations, Product R&D

(non-P1 background)

2 Ideation Workshops (Hong Kong & Singapare)

Civer 40 PT Experts and IT Experts

17 in-depth case studies (contributions from organisations & CTE research)

7 experts blog entries (expression of views and apinions)

The term 'Artificial Intelligence' is subjective, debatable and confusing.

It is the science and engineering of waising intelligent and chines, especially intelligent computer programs. It is It is the science and engineering or invaring interligent machines, especially intelligent computer program related to the similar task of using computers to understand human intelligence, but Al does not have to confine itself to methods that are biologically observable. (Professor John McCarthy from Stanford University, founded field of Artificial Intelligence, 2007)

A subfield of computer science, artificial intelligence (Al) develops computers that can do flyings traditionally done by people. Its solutions can sense or perceive the world and collect data; understand the information collection; and act independently – all underpinned by the ability to learn and adapt over time. (World Economic Forum)

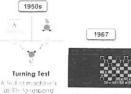
Artificial Intelligence refers to methods and approaches that imitute biologically intelligent behaviours to solve problems and can be divided into two broad categories: [a] symbolic At, which facuses on the development of knowledge-bosed systems (RBS); and (b) computational intelligence, which includes such methods as neural networks (NN), fuzzy systems (FS), and evolutionary computing, which is one-step full ter than set algorithms for (Transport Research Board, 2007)





(1)

The expectation and competency of AI evolves with time.



Mac Hack V

Pi I nowledge-based ches claying program to beat human in a public fournament. The Luter version on at 460,000 instructions per second

1991 DART (Dynamic Analysis and Replanning Tool)

Used in Gulf War to generate a plan (which took hours arsupposed to weeks for furning) for logistics planning and scheduling.

IBM Deep Blue

1997

lst chess computer program to defeat the world chess champton search more than 100 million chess positions passed on the second

2017



techniques, including rentorcement learning and search algorithms, started with only basic rule as most such a despite a date. After 3 days of self-playing it learnt to beat it older version AlphaGo, and offer 40 days, it became arguatily the

Our PT experts say.....

Artificial intelligence should consist of the following qualities:

- Ability to learn
- Ability to adopt
- To mimic as well as exhibit creativity
- · To fulfill its purpose to Improve existing process

Most current efforts in AI may be attempting to mimic human behaviour at specific task but the true potential of AI will only be unlocked when computers can start to become creative by themselves.

We had 4 key areas of focus...



Customer Excellence: the deployment of AI for achieving better customer service and intelligence amongst authorities and operators:



 $\label{thm:continuous} Operational \ \ \textit{Excellence: the use of Al brings system and operational efficiencies through optimisation}$



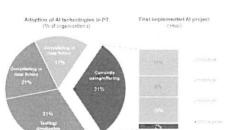
Engineering Excellence: inventory & asset management and predictive maintenance



Security and Safety Prevention: the AI applications providing the solutions for improving operational safety and security measures, this includes offences involving revenues and property.

How is AI changing our industry?

All is increasingly being adopted by PT...



Over 60% public transport stakeholders, predominately industry providers, are involved in AT lechnologies projects and solutions.

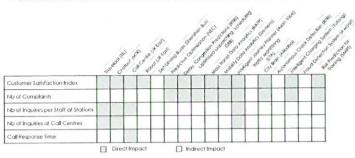
Majority of them started investing in At in the last 3 years.

Top 6 current Al applications in PT



Application of AI will have the greatest impact on **Customer Service KPIs**

17 collected case studies have direct or indirect positive impact on Customer Service KPIs



Al empowers customer service staff to provide an attentive and efficient service

Use of Natural Language Processing (LEP) & Pattern Recognition to improve service quality.

Digital Assistants					
Chatbot / Integrated into Facebook Messenger	Chatbot / Integrated into MTR Mobile App	In-station Communication Robot	Call Centre Support		
6		0	R Watson		
Tfl. TravelBot	Chatbot on MTR Mobile App	Multilingual customer service robots in Tokyo station	Call Centre Support via IBM Watsons		
Transport for London	MTR Corporation	JR East	JR East		

Low hanging fruits: Chatbots

Fast Time-to-Market

Low Psychological Barrier & Ease of use

Ease of access to ready-made solutions

Readt, available distilled saleting.
The challest can also be easily integrated into existing platforms a gift is leaveled.

Relatively Low Technology Investment stanging from EUP 7uK = Hardware & development of EUR 1101 (SGD 11 24 - 1791)

- Chatbot, He all Affectinologies, rugure a learning corre. Infatuse of Chatbol will have exists or limitations and can drive users away.
- Itoming data supplies are available but a spect and plan for internal resources to enrich the database because no one will know your customers' inquiries more than your customer service team.
- Undergo a robust stress test Chatbot is likely to receive an abnormal high volume of inauties at the events of service disruption or inclaents, financing platform can support sudden influent users.

Al gives operators a better understanding of mobility patterns.....

Using Machine Learning to improve customer analytics.



...leading to operational and cost efficiencies

Initial Problem to Solve:

Origin-Destination (GDI) surveys are not precise enough to understand the passenger journey experience.



OUTCOMES

- et d'ardy analy a attarent denorial thexago simulation and predictions diving disciption events.
- regions researce, and so that Discourse (which adminded for a proced-EUR 5% to EUR IXX to kega retwise).
- where the training pertilling set of its by discretaing the fish of delays, with better operation and planning
- increases acres by a 10% of peak with the some number of trans in Carabbarios

and better mobility planning of the city. Project objective

SIEMENS



live from data collected when passengers request llineraries in transport operator's journey planner app.

Project status
Under commercial pilots and further developments with duep learning technologies

via input: Training on <u>historicate planning data</u> from "Hafar" mobile application (the requests, top suggestions and information about Gelay...

Outcome: To surport operational staff and placeners by:

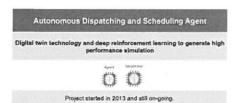
- effective models discharged detections (includes)
- quantifying the ingloct);

 list mile/last mile analysis,

 visualization of history demand and quality of interconnections.

Al will allow PT operations to become more agile and $\mbox{\tt dynamic}\dots$

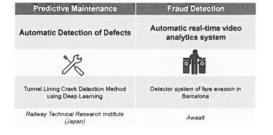
Using Deep Peinforcement Learning for autonomous dispatching and scheduling.



Swiss Federal Railway (SBB)

Al can improve the efficiency in safety & security management.

Image recognition for responsive and efficient detections.



A robust data ecosystem is the key enabler to deployment of Al

Top 5 challenges faced by PTAs and PTOs



Data Quality



Data Volume



Data Privacy





Knowledge & capacity in Al

Commitment from top management ...meaning railway operators can react quickly to customers' needs, disruption events, etc.

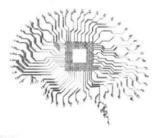
Initial Problem to Solve:

To efficiently and offectively manage dispotential on a rativaly redwark with over 3,000 km, 35,000 kg and over 20,000 kg has dispotented per day to accommodate the proving notifity demand (#30,40% on Selfzerland radway system).

Project Expectations

- Simulations time in the real note of about recision speed, allowing 389 to efficiently reach to the evochanging topology and traffic situation.
- Cestican first care space it assists ough smulations
- Allowing two yoperations learn and ingrame trust fall actions a via a serior of ill trough smutation which utilized by realing redway redway antitionality.
- Ability to meet 'rors' but there had amily at well a scenarios variations into simulation for better incident communication.





What steps we need to take to successfully deploy Al into PT operations?

Develop long term data management strategy for AI



- Public transport operators have a lot of data trapped in multiples legacy systems.
- Data are complex to interpret and visualize
- 1 Create sound immersion for data generation, a cited from and storage because AI technologies require robust and high-quality data.
- 2 Set up start real starts transverse to protect automer privacy and autoin access to data (compliance from data owner; will become the norm, i.e. EU GDPR)
- 3 Prepare for comprehensive data culterations (internal & external sources). At is only going to be stronger with robust quality data.
- 4 Share diala between stakeholders for a greater gain in the future.

Deployment of AI is a collaboration process



More than

of PT stakeholders who deployed / provided AI technologies through COLLABORATION with third party stakeholders

Adopt multi-stakeholder collaborative approach

- · Nature of At generates wire-win partnerships
- Build an swort working groups (Internal and/or eiternal stakeholders) on Al projects to encourage politisation of travel shill be because impach of Al will extend beyond one department or one team.
- Commitment from all parties at every stage working towards a common goal.

Adopt an innovation mindset: do not be afraid to fail

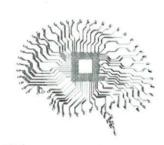
- 1. Be experimental, adopt a piloting philosophy and grow incrementally, trial and error method
- 2. Reform tradificial procurement process to accommodate time it takes to commercialise AI outcomes.
- Consider new howness models to support the specific requirements of ALE, g RATP Deviand Deutsche Bahn launch pad for start ups.
- 4 Ensure lead-tenthip of log management commits to exploring At technologies, and embraces the tunproductive" trial and error early phases and uncertainty of results during miniaturity stage.
- Innovation ≠ million dollar investments: rationalise expenditor
 - take advantage of open-source Alsoftware libraries.
 - simpler yet efficient At algorithms, existing platforms • seel for additional sources of funding for R&D (e.g. institutional funding such as European Commission grants)



Build a tech-oriented business culture



- Establish a data-driven reaking cultures invest in visualisation tools to bring greater access of data to stall at all levels.
 - Better business insights = efficient & confident decisionmaking process.
- See All as a focus and/or part of a wider solution to respond to Clause and at problem statements.
- Engage employees from the beginning, include them on the journey because they are likely to first impacted. Inspire
- Petrain and upwill staff as well as the experime to adapt to skillest of tomorrow. At will take up lower life a and repolitive trace, empowering staff to lake up creative and valueadded roles.



What is the future of Al in PT?

In the next 5 years Al will lead to.....

los: et lota à masse-durat-mole: ?

has of controllin operations?

exerciting will be that ble, personalized, context-based, contail in-based and demand responsive?

all customer interactions can be personalized and handled by neachings?

Mass redundancies → NO Loss of repetitive and simple tasks → YES

NO

At will provide more creative options & solutions that human may not have thought of before

POTENTIALLY YES post maybe not in 5 years time)

YES & NO

Alis capable of handling <u>simple</u> and <u>compagn</u> inquiries & interactions.

At a NOT capable to hate till complex situations and interactions that regular reading customers' ampainly and emotions (e.g. distributions) or passengers who are less articulate such as children or mental tillness.

"We don't have a computer that can function with the capabilities of a six year old, or even a three year old, and so we revers for four approach in temperate."

Oren Etzioni, CEO of the Allen Institute for Artificial Intelligence in Seattle

Our PT & IT Experts believe in 5 years time ...

"Al is about recognising pattern. In a 5 year time. Al will recognise more patterns than it currently does"

"Al is taking away tasks, not jobs"

"Al will create more (job) profiles . it will unlock other jobs"

"Everyone will take part and have responsibility to the train AL because AL is like a child"

"Al will be incorporated into every industry"

"Grow of AI may not be growing at the exponential rate as expected or even be slowed down because of privacy concerns there will be more regulations on AI."

"Governments have responsibility to set a framework for data sharing to encourage the growth of At".

Possible future concepts for PT

All to be search still inliquated into infractinature for real-time monitoring and empower us to be dynamic in our operations.

"we have to change from now on... in the past, it's the manufacturing driven... the future, it's not about the competition of knowledge, it's the competition of creativity, competition of imagination..., it's not knowledge driven, it's the wisdom driven,

Jack Ma, founder of Alibaba, Hong Kong University Honorary

experience driven...[and] creativity driven"

Graduation Speech 2018



- Dimension and advance with video recognition and analytic schemes and platform screen door indicating capable from the posterior and analytics are seen and advance with video recognition and analytics.

 Bernets on platform screen door indicating capably of train cap



- Efficient in Identifying pain oxiats of the network
 Approach customers and rectify problems willhout having to learn object their opinions insough rodal media, surveys and consciously.

Possible future concepts for PT

And ultimately allow us to be better prepared and deleversafes and triph quality sensors





(TA-HTP Singapore into national transport Congress and Exhibition 9-11 July 2018 | Singapore



THANK YOU

Gayang Ho

Senior Monager, UTP Asia-Pacific: Persanch & Policy Development Lead, UTP Asia Pacific Centre for Transport Excellence (AP CTE) s: gayang.ho@utip.crg







Parallel session 15: Artificial Intelligence for Railways and Beyond

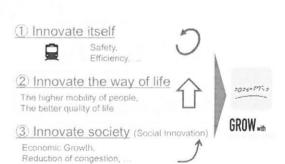


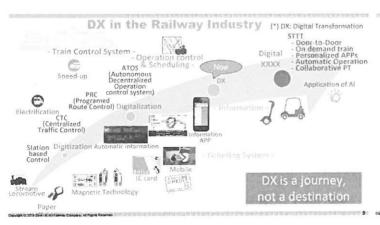
Masaki Ogata
Vice Cherman, East Japan Railway Company
Honorary President UTR

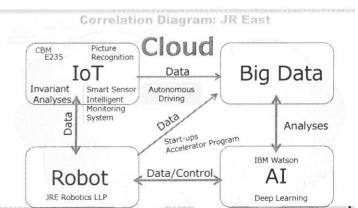
- 1. Overview/Strategy of Innovation in JRE
- 2. Driving forces for AI
- 3. Process/decision for deploying AI in the railways
- 4. Application of Al: Examples

PT Innovation

1. Overview/Strategy of Innovation in JRE







Advanced ICT Fits Public Transport Well Public Transport fits Advanced ICT well

Public transport issues	Advanced ICT		
Safety	IoT, Sensor	导倒零	loT
Security for crimes	Graphic Recognition		
Various issues to optimize	Al		
Numerous equipment & devices management	loT, Sensor, Big data	997	Big Data
Huge user datasets	Bìg data	A A	3
Real time information for customers and employees	Mobile Device	Robo	ot
Face-to-face guidance	Robot	10000	1
Danger, Dirty, Difficult(3Ds)	Robot	- P	CE V

2. Driving forces for AI

Open Innovation of Mobility

♦PT must lead MaaS by Open Innovation

Creating platform for mobility

3. Process/decision for deploying Al in the railways

Establishing Eco-system together with partners

"Mobility Innovation Consortium"

Established in JRE in Sep/2017

121 partners of various field

Mobility Innovation Consortium

Different perspectives from outside Idea Creation

Speed, flexibility, collaborative relationship

Agile Development

Partnership: Alliance Type

Door to Door WG

Smart City WG

Robot Application WG

JR East

Partner

Partner

Partner

Partner

Partner

Partner

Partner

Partner

Partner

JR East

4. Application of Al: Examples

Example (1): Customer Guidance Robot

July-Aug / 2016@Utsunomiya Station May-Aug / 2018 @Tokyo Station



Robot guiding how to use a ticketing machine for self-purchasing



Additional learning cycle by Pepper and supporting staff

Example (2): Chat Bot on SNS

- · Information provided
 - Transportation status

operation

- Locker availability in stations



- · Automatic response
 - Automatic answer to the customer's questions



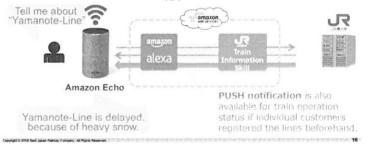
Example (3): Call Center Support System

- · Call center support system using Al
- Shorten the time to answer the inquiries
 - √ Standardize & enhance the response quality.



Example (4): Amazon Echo

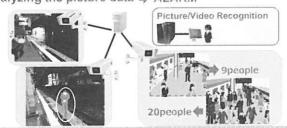
JR East Information X Amazon Platform (Alexa) API



Example (5): Image Recognition for Incident Prevention

Security monitoring cameras

- detecting people at the platform edge / suspicious objects
- counting numbers of people
- Analyzing the picture data h ALARM



Example (6): Future Challenges of ATOS using Al



Utilizing the implicit knowledge & experiences of experts.

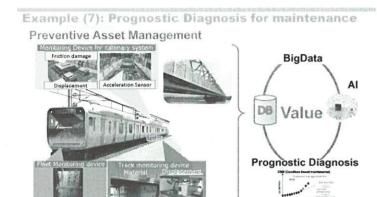
Complicated through-operation

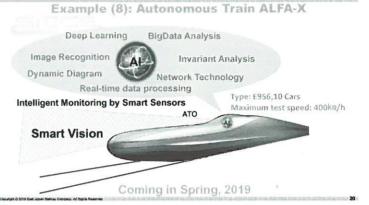


Smooth and Smart turn-around

Automatic proposal system after disruption:

- Proposed train diagram including smart turn-around
- Fleet & crew scheduling after disruption.







Al in Railways and Beyond

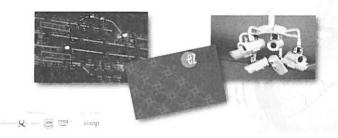
Presented by Dr Yu-Xi Lim Lead Data Scientist 1 TERALYTICS



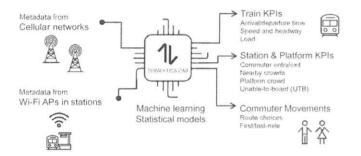


UTA-UTIF Sing process Indemnational learness of Congress and Edublish 2018 | Singapore

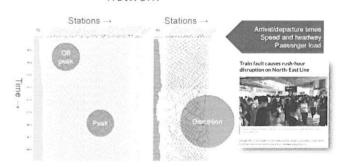
It's 10pm, do you know where your trains and commuters are?



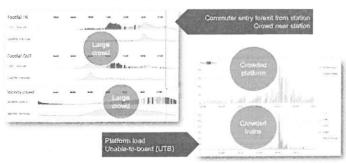
Introducing the Commuter Analytics System



Tracking train movement in the network



Seeing demand at and around the stations



Getting more people to use the subway



Bringing cutting edge tech to the government



- Big Data technologies
 Real-time stream processing architectures
 Data Science (R&D)
 Data Visualization (R&D)



Where to next?

- More subway lines
- · More users in LTA
- · Early warning of disruptions







ITA-UIIF Singapore international in report Congression of Exhibition 9-11 Aly 2018 | Singapore

RAILWAYS AND ITS INTERFACES TO THE CITY AND THE LOCAL MOBILITY SYSTEM

Mr. Jean-Pierre LOUBINOUX, General Director of UIC







SICE ITA-UITF Lingapore International Transport Congress and Exhibition 9-11 Adv 2018 | Singapore

International Union of Railways (UIC), The Worldwide Railway Organisation



1921 Intergovernmental (diplomatic) conference in Portorose, Italy

and Queen in the case with the case

LIA-IIIP Strigatoris International Barmoul Congress and Ethibition 9-11 July 2018 | Seganore

International Union of Railways (UIC) today

200 members in 95 countries	4,000 billion passenger kilometres		1 million kilometres of lines
7	Cooperation	700 UIC Leaflets – New International Railway Solutions (IRS)	65
million rail	with over 100		conferences
personnel	institutions		workshops

Inflamed Queen (mg ring) Ump



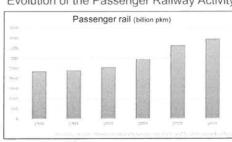
LTA-BIF Singapore international learneset C

UIC Members all around the World



LTA-SIEP Singapore International Transport Congression States (Singapore Singapore Sin

Evolution of the Passenger Railway Activity



- Increase in mobility demand / needs
- Demography & urbanization

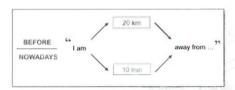
- - More affordable





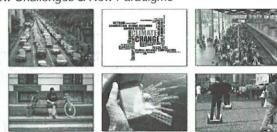
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Shift from the traveled distance to the travel time model



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New Challenges & New Paradigms



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UIC's commitment to the New Challenges





















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Train Stations, railway interface with various functionalities





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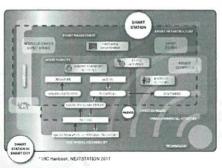
Stations at the heart of the mobility « web »

- Station as the interface between various modes of transport
- · Station as multi-dimensional hubs where modern meet historical
- Station can represent a dream of future mobility, for the smart mobility
- 2018 Memorandum of Understanding between UITP and UIC.





LiA-JIIF Singapore International Transport Congress and Exhibition 9-11 July 2018 [Singapore $\,$



Smart Stations in Smart Cities

- 2017 UIC NEXSTATION international event
- UIC defined what is a Smart Station:
- Smart Management
- · Smart Design & Infra
- · Smart Mobility





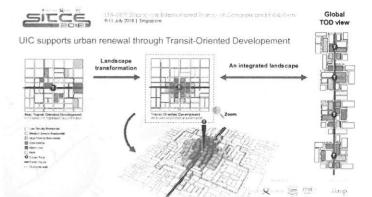
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Smart Mobility: the people at the heart of digitalization

- · Smart mobility as key for the new intermodality
- · Mobility as a service for shared mobility solutions
- Digitalisation ticketing system









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UIC Conclusion

- * National scale turns into regional and regional becomes local
- Digitalization on the mobility aspect will modify deeply the behavior of travelers
- New travel experience adapted to the digital era's standards
- Smart Stations are boosting new forms of local mobility system
- * To make us dream, to dream of the smart mobilities of tomorrow, by inviting younger generations to dream even higher and smarter than the heritage our forefathers left us

www.uic.org







#UlCrail



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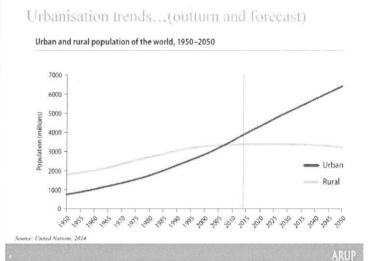
Rapid urbanisation creates a need for innovative local and regional transport development to deliver connectivity and economic growth

TC Chew FREing Director, Global Rail Business tc.chew@arup.com

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ARUP

Megatrends are the game-changing forces that will shape the world in the future



The increasing pace of urbanisation will place added stress on already straining city systems and infrastructure

Global consumption of resources will nearly triple to 140 billion tons per year by 2050





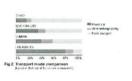




Constraints on available resources and high and volatile prices, may limit economic growth. In the UK it is estimated that congestion costs the economy $\pounds 20 bn$ a year

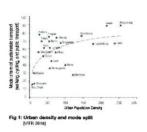
In densely populated areas, per capita emissions are lower, due to the viability of mass transit and non-motorised transport





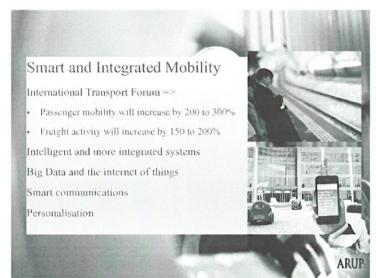
In Los Angeles a study by the Texas Transport Institute estimates that hours lost per year to peak congestion have almost tripled between 1982 and 2000

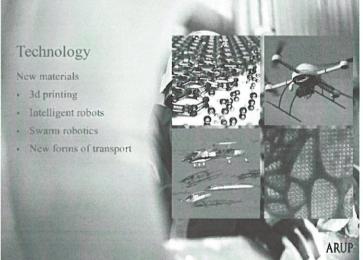




ARUP

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The relationship between infrastructure investment and economic growth has historically been strong

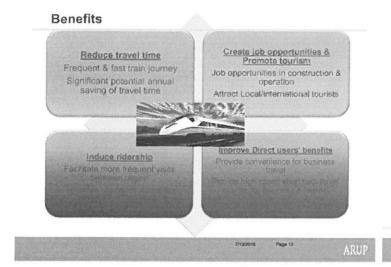
Transport investment, under the right circumstances, can drive economic performance



Butter transport connectivity and accessibility can improve access to jobs, increme the number of customers that businesses can reach, and reduces barriers to trade and connection

ARUI

ARUP



Economic Benefits

- Enhance social and economic integration with connected regions
- Increases mobility → job opportunities / options
- Promotes service industry commerce, tourism etc.
- Fosters development and regeneration of cities
- Improves efficiency of the city
 - alleviate road congestions
 - release airport capacity for long hauf flights



ARU

Environmental Benefits

- · Environmental friendly mode of transportation
- Reduce gas emission and noise nuisance as well as minimise traffic volume
- Reduce traffic congestion and road accidents
- · More fuel efficient than other modes of transportation

Page 16

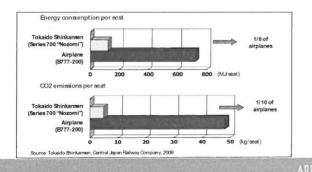
Indirect Benefits - Economic

- Enhances social and economic integration with connected regions
- Increases mobility → job opportunities / options
- Promotes service industry commerce, tourism etc.
 Examples: Lyon in France, Zaragoza in Spain
- Fosters development and regeneration of cities
 Examples: Lille in France, Koln in Germany
- Improves efficiency of the city
 - alleviates road congestions
 - release airport capacity for long haul flights

ARIII

Page 17 Indirect Benefits – Environmental

- •Most environmental-friendly mode of transportation
- •Reduced green-house gas emission and noise nuisance
- •Reduce petrol consumption and road maintenance cost



What does this mean for future local and regional railways?

ARUP

The link between transport investment and economic growth is clear. Local and regional railways must evolve to enable growth



Future drivers of rail demand - long-term

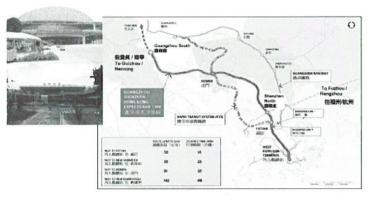


Source: Trends identified through desktop research and stakeholder workshops undertaken by Arup; Arup analysi

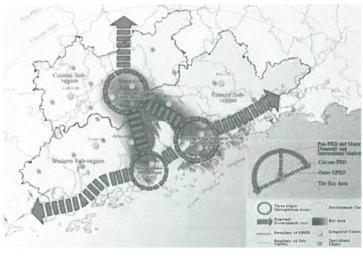
ARUI

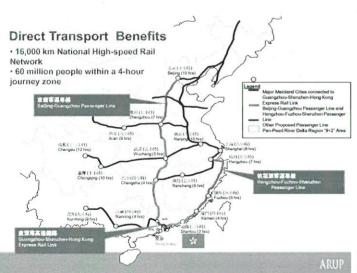
ARUP

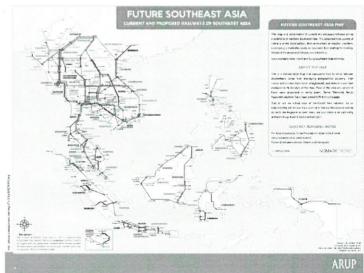
Guangzhou-Shenzhen-HK Express Rail Link



ARUI







The increasing pace of urbanisation creates a need for innovative local and regional transport development to deliver connectivity and economic growth

Thank You

TC Chew FREng tc.chew@arup.com July 2018

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The Implementation of High Speed FAO System - New Airport line of Beijing Regional Railway

He Chen 2018.07.11





- 11 Introduction of Beijing New Airport Line
- **12** FAO System in the Regional Railway
- 03 Innovation



01 Introduction of Beijing New Airport Line

The new airport line is a rapid regional railway with the 160 km/h high speed and fully automatic operation







A Rapid Regional Railway - Beijing New Airport Line

- . Approximately 41km; Inter-connect to the Beijing urban transit network, to realize the "half-hour" non-stop ride.
- Advanced PPP mode: "Civil Construction + Facilities + Operation",
- Total investment is 41 billion RMB around.
- Two phases: south part and north part
- Kick off in 2016 Dec, and revenue service in 2019 Sept.



Beijing New Airport Line - Rolling stock

The rolling stock of Beijing New Airport Line is optimized for the high speed FAO system and combine the advantages of metro and railway:

- High Passenger Volume
- High Speed
- Fast Start and Stop
- Comfortable
- Convenient









Operation Sover distrikm to

1.535 passengers



02 FAO System on The Regional Railway

The FAO system in Beijing New Airport Line will show some differences, such as GoA level and integration level.





-With deeply integration between different syste nis, to realize automatic interactions for emerge ncy handling and multiple professionals cooper ation.

-Deeply integrate the operation related systems. such as SIG, RST, SCADA, PIS, CCTV, PSD, ACS, eic.

Beijing New Airport Line - A New FAO Operation Mode

The definition of FAO from UITP

GoA3+, the new definition of FAO. The automation grade is improved and customized for Chinese operation requirements.

Automation Grade	Train Operation		Marcal dissers	Springers Alfor Manual starret	Fully Auto Operation	
GoA1	Non-sufficial operation(Net					Convention
GoA2	Semi-linto tirun operation (STO)	Cross	GoA1	GoA2 ATO + manual asterno		hee
GoA3	Manual driverless train operation : DTO 1	Fram attendant (not in driving car)		ShA! Marriad 21's Arth	GoA3+ Monned DTO with	
GoA3+	Manned driveriess bein operation			description of the	fully sutomation	Addressio
GoA4	Unmanned dryodous train operation (UTV)	No orew			GoAt Unmarried with fills automation	hne

Beijing New Airport Line and Beijing Airport Express

The New Airport Line - A Sampling project for the future Regional Railway - with the application of new technology, operation performance will be improved.

	Baijing New Airport Line	Beijing Airport Express
Integration Level	Cloud platform based multiple system integration	Conventional ATS
Value-Added Service	Luggage system interaction	NA NA
Rolling Stock Type	Customized inner city trains (8 cars)	Linear Motor trains (4 cars)
Operation Speed	Max. 160km/h	Max, 110km/h
Headway	4 mins.	8 mins. (Peak hour)
GoA Level	GoA4	GnA3
Wireless Communication	LTE-M	WLAN
Interoperability	Support	Not support
Cyber Security	Classified Level 3	NA

03 Innovation

More systems will be integrated, and new construction mode, multiple carrying communication and new interactions will be deployed.

Innovation - More systems will be deeply integrated to Train integration Automation system (TIAS)

Integration method 1

- Unified SW
- Same servers and databa
- Unified Backbone

Integration method 2

- Unified SW and HMI
- Unified Backbone

14 systems will be integrated togetheri



Innovation - new construction mode to build a FAO system



CEC MANA

become the leader and integrator of FAO system

· Signaling system supplier

Supported by RST, ISCS,

PIS, FAS, CCTV, etc.

HollySys 测发电气

Innovation - LTE-M based Multiple carrying communication for FAO system

Advantages:

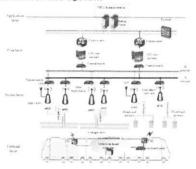
- Wide bandwidth
- Perfect 005
- high-speed supporto-200Km/hi
- Molüple carrying capacity;
- Easy maintenance.

LTE-M Carrying :

CETC Emergency info

ETC leximatory has been applied in 40+ CETD to FAO line ton China.

- Briting Yenfang Liver (GrAA), In service);



Innovation - Luggage Transport interaction with Airport

The check-inforflight and luggage delivery can be handled at Regional Railway station,

In future, we believe that based on big data. Al. Cloud and 5G tech, EAQ system will make the regional railway more convenient, more intelligent and more better!



Thanks'

For Better Rail Transportation!









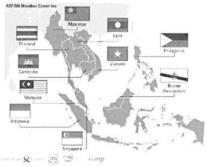
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ASEAN'S RAIL CONNECTIVITY AS A CATALYST FOR REGIONAL GROWTH

SESSION 16 Impact of Railway on Regional Connectivity and Economy

AZMI ABDUL AZIZ CEO Rail Division, YTL Malaysia





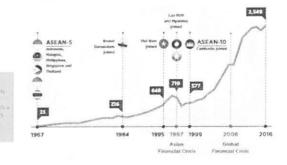
ASEAN ociation of South East Asian countries



Q = 10 mp



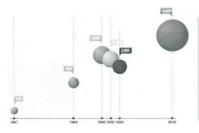
EVOLUTION OF ASEAN'S GDP





EVOLUTION OF ASEAN GDP PER CAPITA

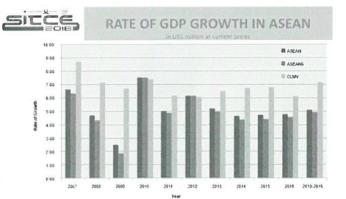
In USS at current prices



Robust economic growth in ASEAN has steadill raised the standard of living, even in the lead developed ASEAN member state:

ASEAN average GDP capita increase significantly from US\$122 at its establishmen in 1967 to US\$4,021 in 201

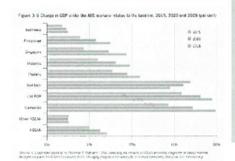
Source ASSAN Societarial



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ASEAN GDP

Vill be 7,1% higher compared to baseline by 202



GDP in the ASEAN region

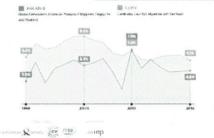
- 5.0 % higher than the baseline in
- 6 3 % higher in 2020.
- 7.1 % higher in 2025.

However, gains differ substantially by country:

- Cambodia: stands to benefit t
- The lower-income ASEAN Member States in general see the largest increases in GDP relative to the
- Indonesia and "Other ASEAR" the least 2.5%



CLMV COUNTRIES EXPERIENCE RAPID ECONOMIC GROWTH



The evolution of CLMV real GDB excepts (%

Since 1995, CLMV countries have consistently experienced real GDP growth of over 6.3%, peaking at 9.6% in 2005.

While the CINIV countries recorded higher GDP growth than the ASEAN+6, GDP per capita in ASEAN-6 was still 2.7 times the GDP per capita in CLMV countries in 2016. USS4,816 compared to USS1,803



SINGAPORE-KUNMING RAIL LINK



First proposed to 1999

Would connect up to 7 ASEAN member states by rail to China

Depending on alignment, would span up to 6,690km

An efficient and economical mode of cross border cause

ansportation

- Challenges,
- 1. Ecoponi
- 2. Technica

هنانه

EOIET



THE CHALLENGE OF CONNECTING ASEAN

- CONNECTING...

 MORE THAN 600 MILLION PEOPLE; ANALYSIS AROUND 9% OF THE ENTIRE EARTH'S POPULATION
- *A LAND AREA COVERING OVER 4.46 MILLION CUBIC KILOMETERS. AROUND 3% OF THE EARTH'S LAND MASS.
- CONNECTING AN OCEAN AROUND THREE TIMES LARGER THAN THE LAND.



THE MASTER PLAN ON ASEAN CONNECTIVITY IS THE ROADMAP TO ACHIEVE THIS WITH A FOCUS ON THREE KEY DIMENSIONS:





PHYSICAL CONNECTIVITY



INSTITUTIONAL

PROVIDING THE TRADE, INVESTMENT AND REGULATORY FRAMEWORK TO ENABLE OPTIMAL ECONOMIC GROWTH AND PROSPERITY



PEOPLE-TO-PEOPLE CONNECTIVITY

DIPANDING EDUCATIONAL OPPORTUNITIES AND PROMOTING HIMAN RESOURCE DEVELOPMENT, PRESERVING ASIAN CELTURE, AND PROMOTING INCREASED TOURISM ACROSS THE REGION.



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THANK YOU

azmi.aziz@ytl.com.my

