



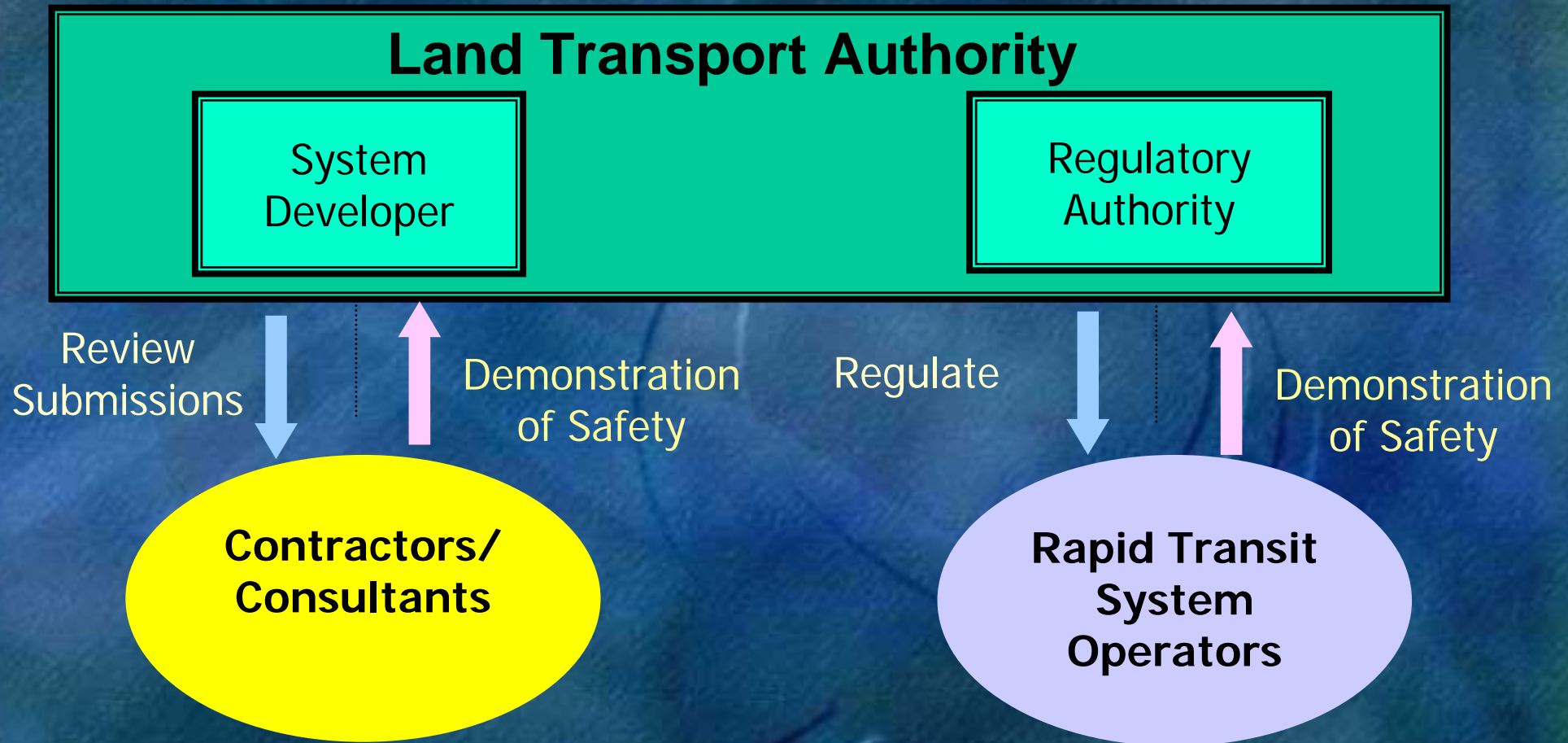
Safety Certification Process for Rapid Transit Systems in Singapore

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Content

- Roles of Land Transport Authority (LTA)
- History of safety certification
- Why adopt Project Safety Review (PSR) process?
- Overview of PSR process
- Types of safety submission
- Problems, challenges & lessons learned
- Recapping the main points
- Conclusion

Roles of Land Transport Authority (LTA)



History of Safety Certification

- Rapid Transit System in 1980s
Her Majesty Railway Inspectorate (HMRI) of UK carried out the final audits
- Woodlands Line in 1996
An external safety consultant conducted the final audits
- Year 1996, a self-certification process was explored
- Year 2000, Project Safety Review (PSR) process was launched
- Since then, the PSR Process has been applied to all new systems and major modifications to the existing systems

**Why Adopt
Project Safety Review (PSR)
Process?**

What is the PSR Process?

Objective of the PSR Process

- To provide a staged check-and-balance process on safety assurance

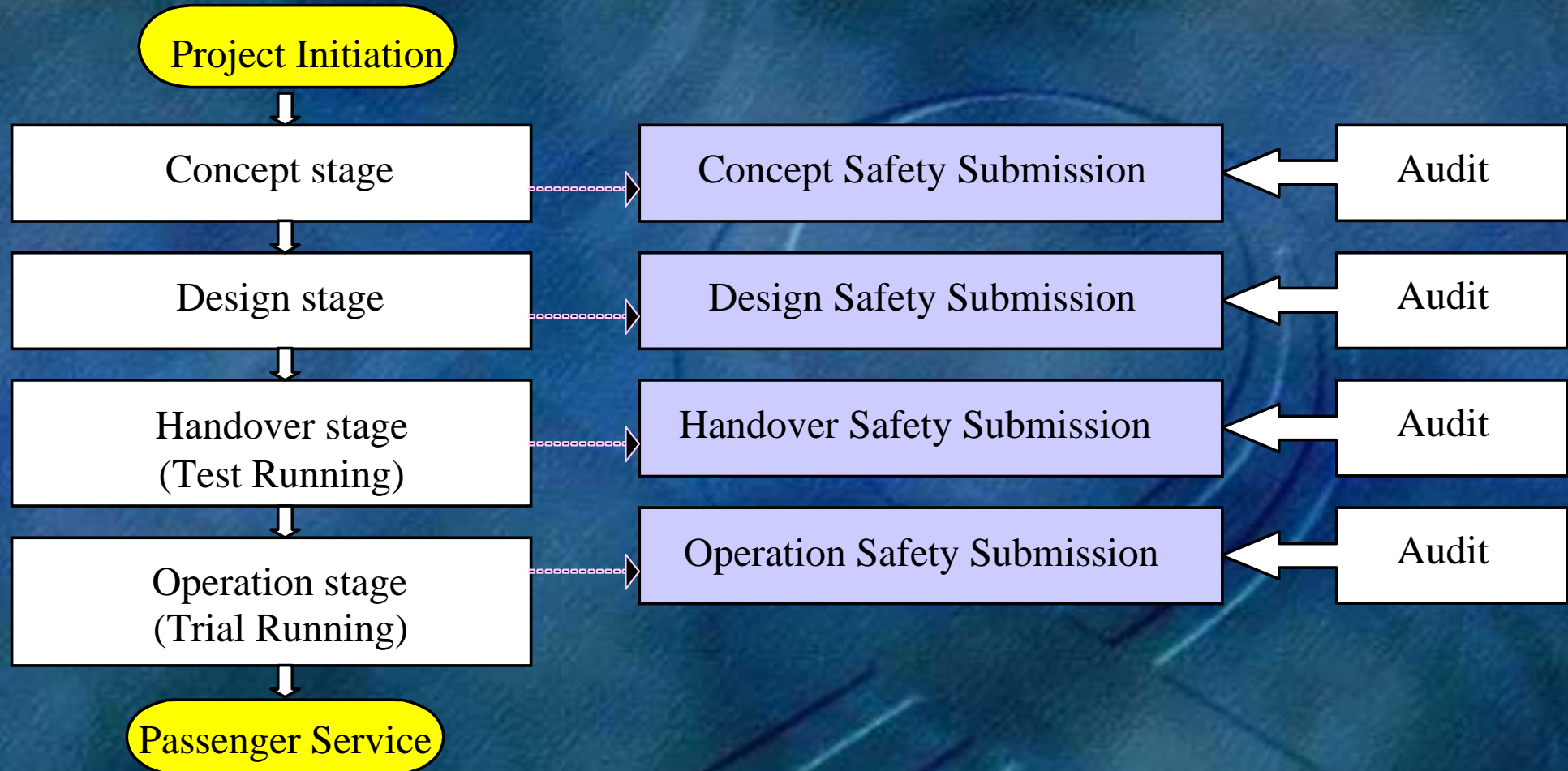
Importance of the PSR Process

- To facilitate the certification of the overall system for a RTS project

Strategy of the PSR Process

- 4-stage safety self-certification process, namely concept, design, handover and operation

Overview of the PSR process



Roles in the PSR Process

System Safety

Project Safety Assurance Committee

- **Oversee the project's safety assurance activities**

System Assurance & Integration Department

- **Review and Integrate the contractors' system assurance submissions with its own safety assertions**
- **Prepare Concept, Design and Handover Safety Submissions**

Operation Safety

RTS Operator

- **Prepare Operation Safety Submission**

Roles in the PSR Process

Safety Audits

**Safety
Department**

- Conduct audits on the safety submissions

Endorsement/Acceptance of Safety Submissions

**PSR Committee
(RTS)**

- Endorse/accept the safety submission or otherwise based on the audit findings reported by Safety Department

**Corporate Safety
Committee**

- Arbitrate if the submitter does not accept the decision made by the PSR Committee (RTS)

Benefits of PSR Process

Project Safety Review For Rapid Transit System Projects

Procedure Manual

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- Check-and-balance
- Structured demonstration of safety
- Avoid costly late-stage design change
- Greater confidence in safety assurance

Types of Safety Submission

Objectives of Safety Submission

Concept Safety Submission

- **Identify and assess major risks**
- **Translate safety requirements into design requirements**

Design Safety Submission

- **Demonstrate that the design meets the safety requirements**
- **Major safety issues have been mitigated by designs**

Handover Safety Submission

- **Demonstrate that the system has been successfully built, tested and commissioned**

Operation Safety Submission

- **Demonstrate that the necessary organisational structure has been set up and processes have been established to operate and maintain the system safely**

Highlights of the Safety submissions

Concept Safety Submission

- Definitions of safety targets and requirements
- Definitions of significant design constraints and safety features
- Establishment of a safety assurance plan

Design Safety Submission

- Findings of analyses and safety assertions made
- Design compliance with safety requirements, principles and standards
- Achievement of safety targets

Highlights of the Safety submissions

Handover Safety Submission

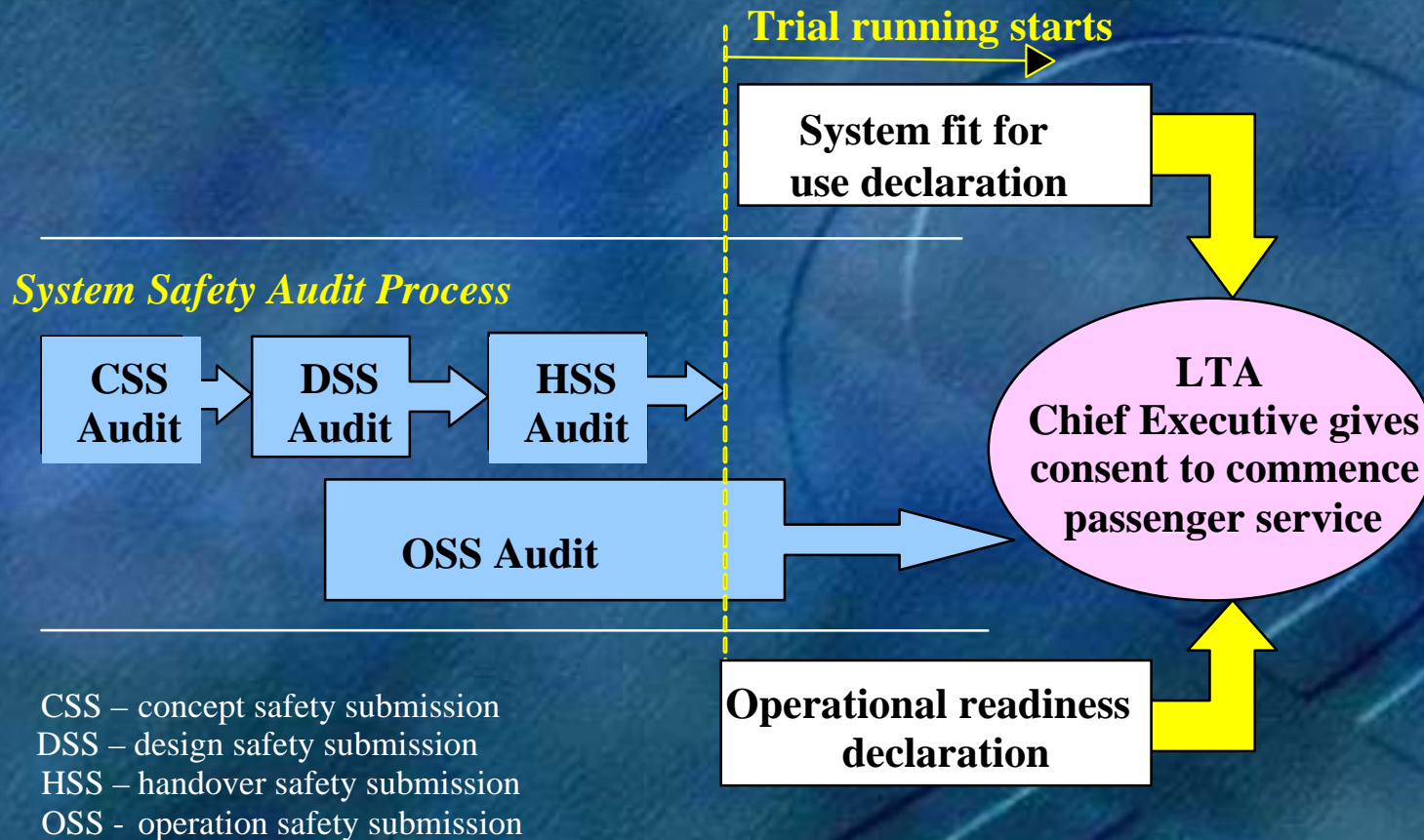
- Testing and commissioning results especially on degraded mode operation
- Specific safety-related tests
- The transfer of operation and maintenance (O&M) hazards to the operator

Operation Safety Submission

- Understanding of system constraints and restrictions in developing the operating and maintenance procedures
- Staff competency
- Emergency preparedness

The Handshaking Process

Handshaking Process for Commencement of Passenger Service



Problems, Challenges & Lessons Learned

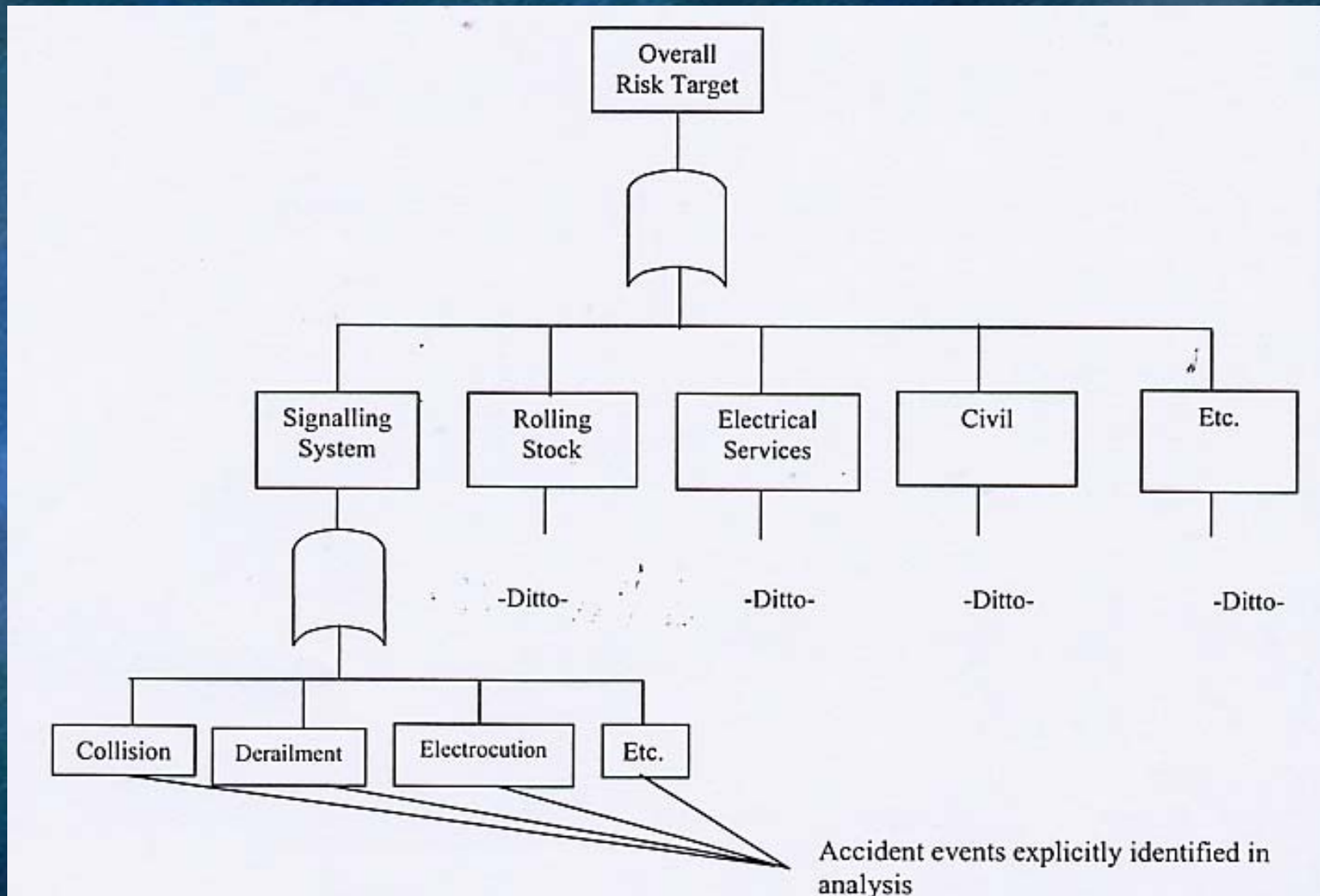
Problems, Challenges & Lessons learned

Setting of Safety Targets for Circle Line (CCL) Project

- Limited comparable systems
- A benchmarking exercise was conducted
- Engagement of a safety consultant
- A set of targets comparable to UK Jubilee Line Extension was used
- Apportionment of targets into each system

Problems, Challenges & Lessons learned

Demonstration of the Achievement of Safety Targets



Problems, Challenges & Lessons learned

Management of Common Hazards

- Repeated hazards from 5 different sections of CCL Project
- Consolidation of common hazards through a process called Common Hazard Analysis Integration Review (CHAIR) by LTA

Recapping the Main Points

- 4-stage safety certification process
- Roles in the PSR process
- Benefits of the PSR process
- Objectives of each safety submission
- Highlights of each safety submission
- The handshaking process prior to the commencement of passenger service
- Lessons learned from the implementation

Conclusion

- PSR process customised for local railway environment
- Impose a check-and-balance process to ensure that the systems are planned, designed, commissioned, operated and maintained safely
- Systematic safety certification through staged safety reviews and audits throughout project lifecycle
- PSR process has reinforced safety culture in LTA as well as the contractors
- Critical factors of success of the PSR process are:
 - Support and commitments from top management
 - Well defined organisational structure and processes

Initial Partial Implementation of PSR Process

Dover Station



**Changi Airport Line
Phase II**



**Changi Airport Line
Phase I**

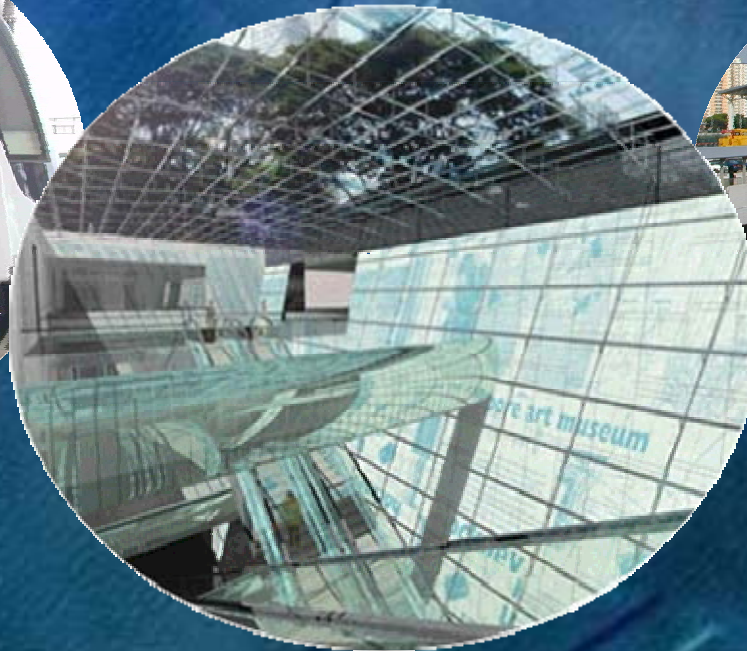


Some Latest Implementation of PSR Process

North East Line



Circle Line



**Sengkang & Punggol
LRT**



Thank You



Independence?

- Achieved via separate groups not involved in the project under deliberation
 - The internal consultant, System Assurance & Integration Department, refrain from decisions that could directly alter those designs in a specific manner.
 - The safety auditor, Safety Department, is independent from the groups involved in the projects.
- PSR Committee (RTS) reports directly to Corporate Safety Committee (CSC)
- Overall organisational safety by Corporate Safety Committee (CSC)

Independence?

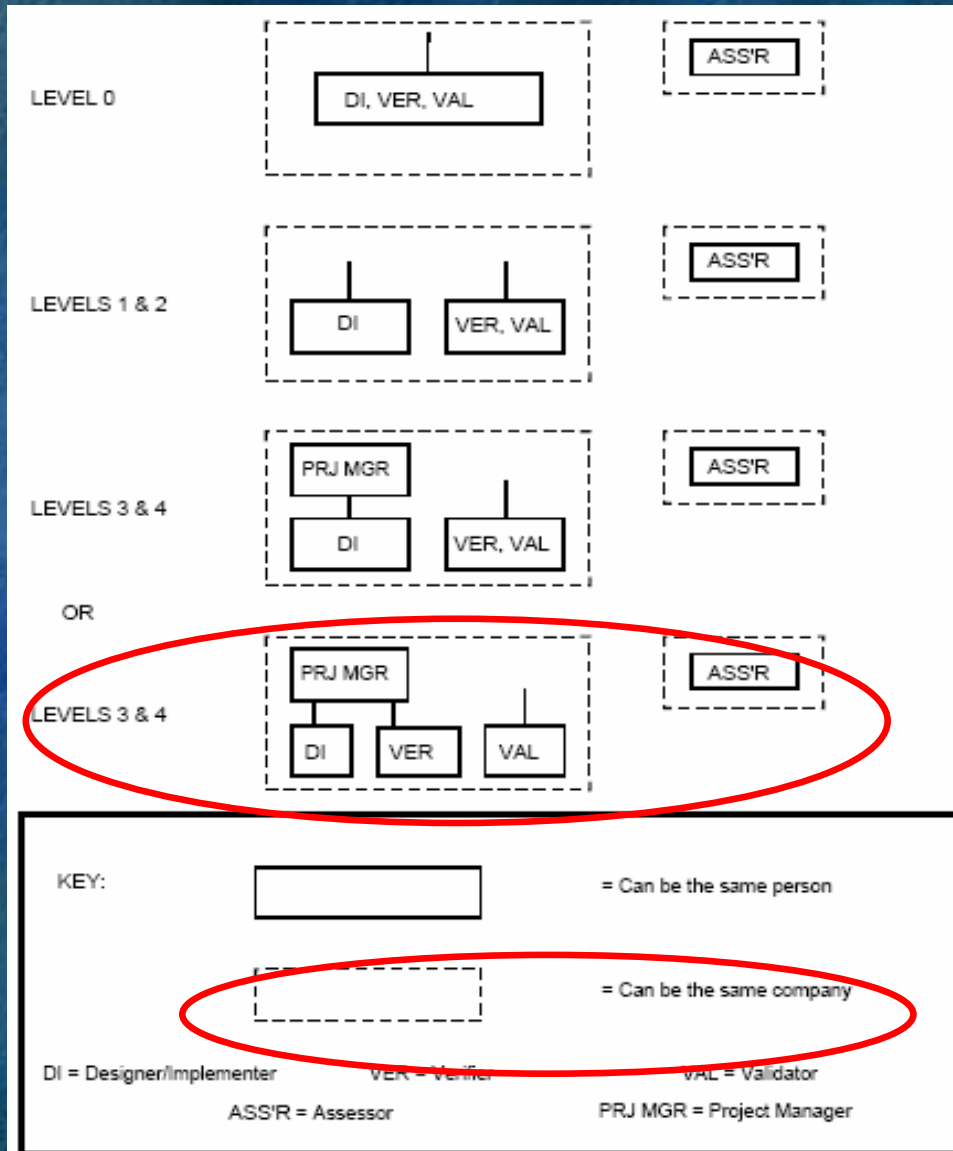
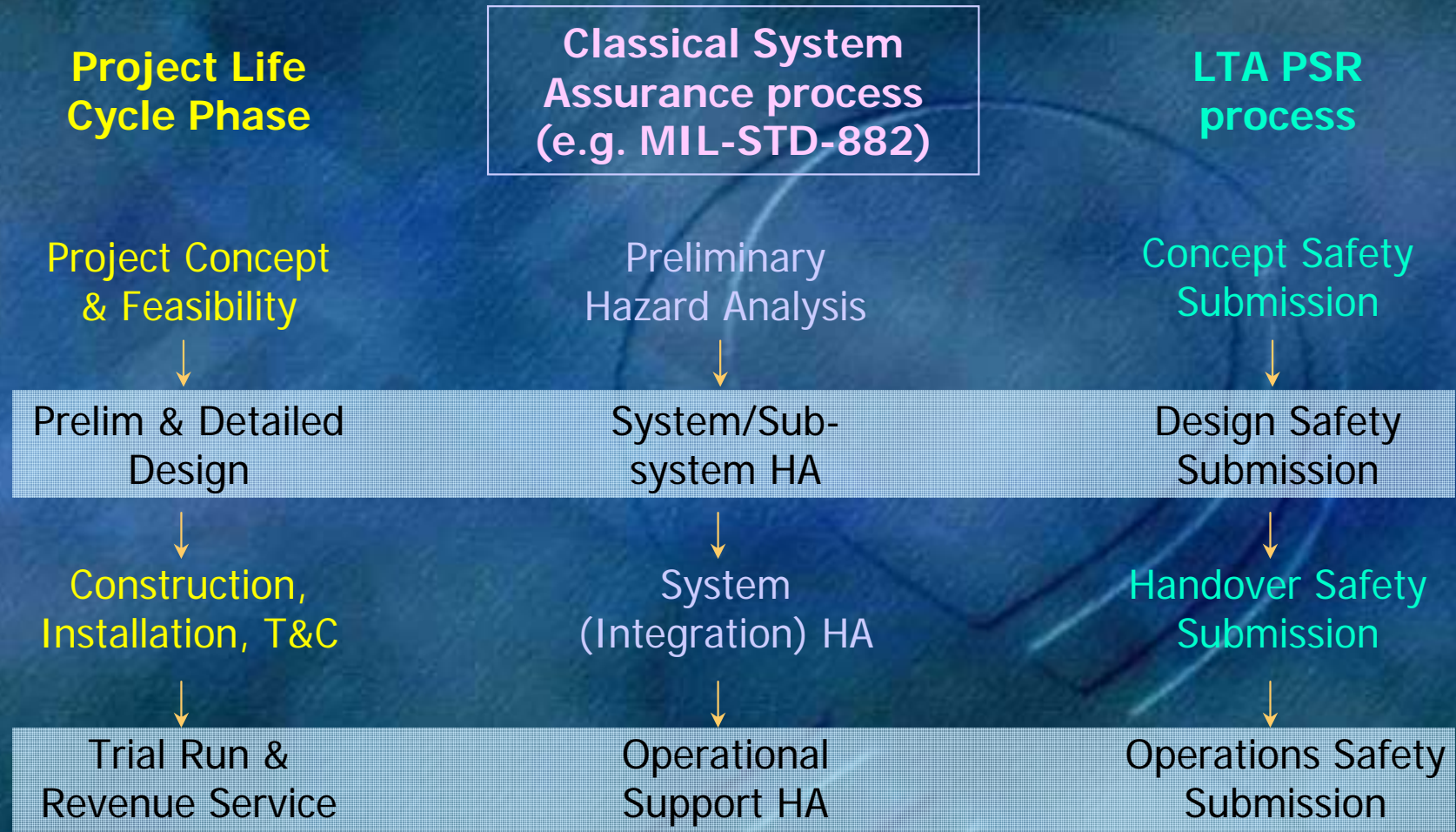


Figure 5 — Independence versus Software Integrity Level

Independence as defined in EN50128 - Software for Signalling/control for Railway.

Under SIL4 (highest safety integrity level), the assessor can still be the same organisation

In-line with Best International Practices?



Independence?

International Practices/Standards

