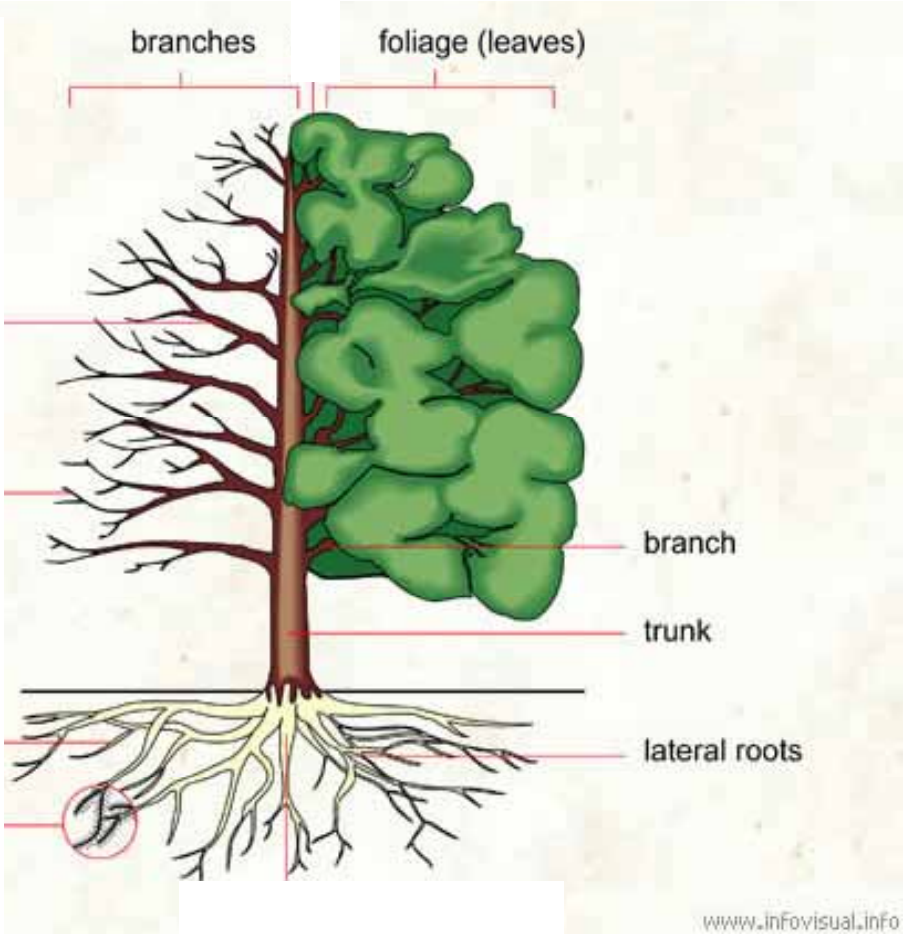
Application of Risk Tree in enhancing Transportation Safety

Nelson Ng
General Manager – Safety & Quality
31 August 2012

caring for life's journeys

What is a Tree ?



Younger Trees

Older Trees

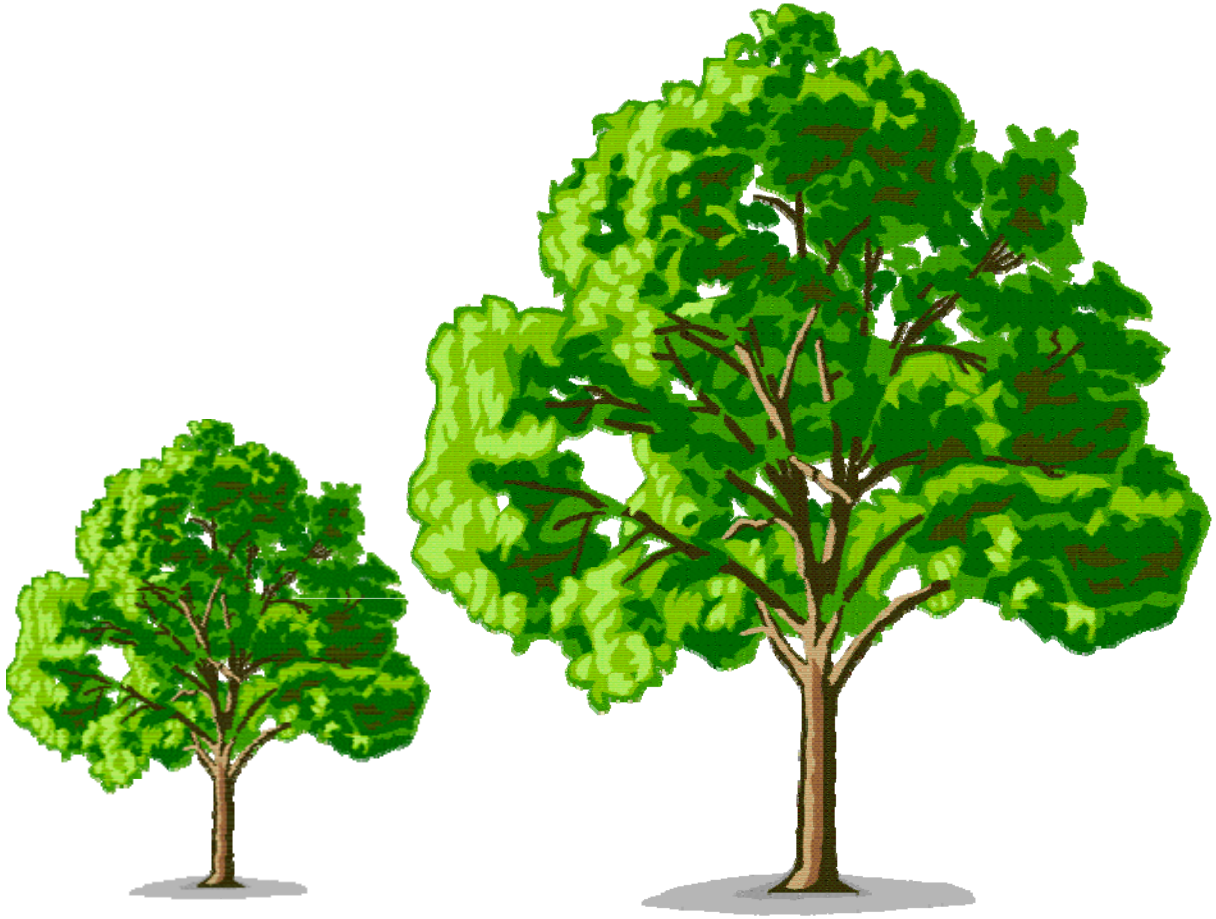
Tree with Fruits

Fallen Tree

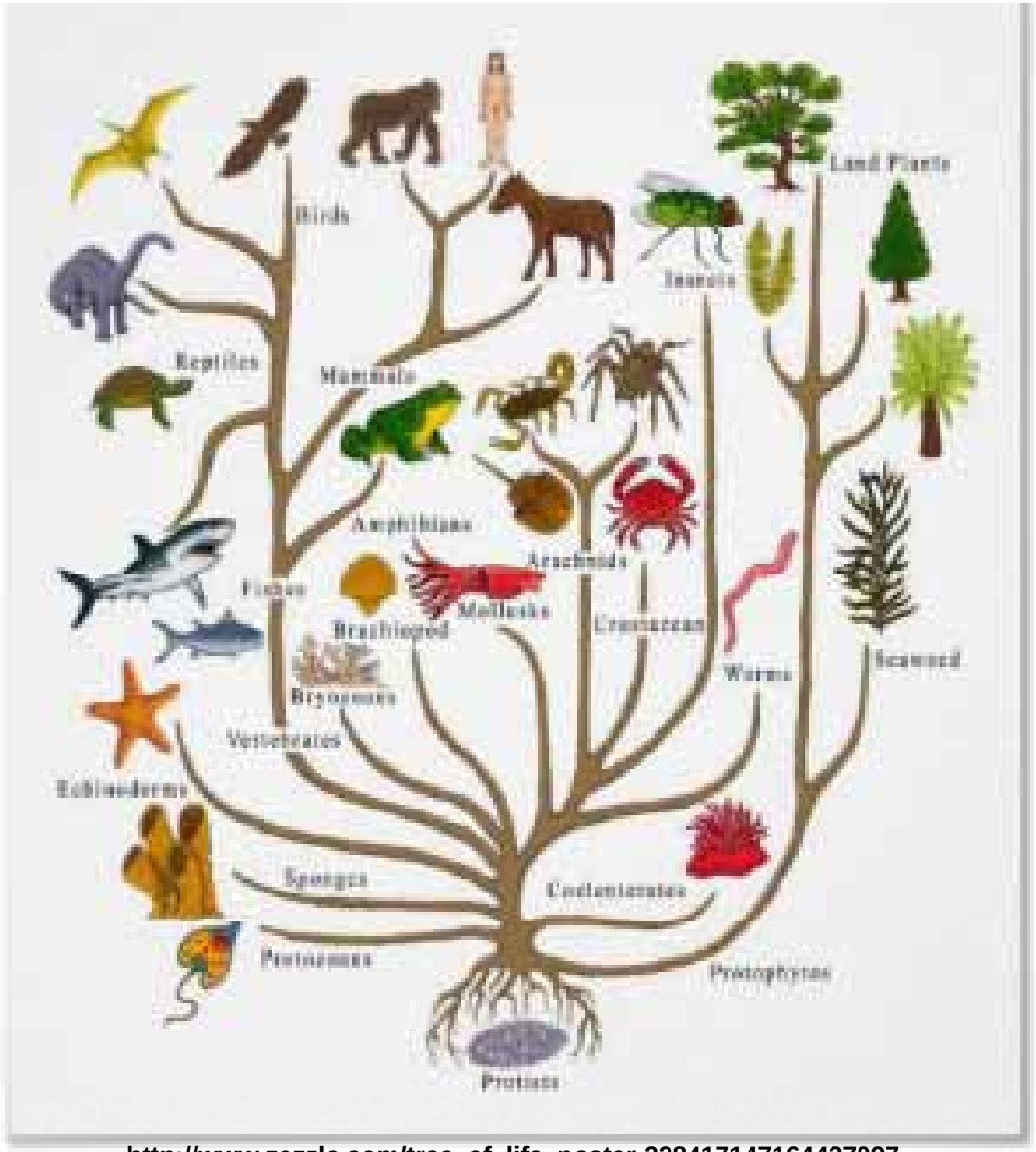
The Most Adaptive Tree

Characteristics of Trees

- It grows day by day, and year by year
- It grows with the same structure
- It responds and adapts to environment
- However, it fails without proper care

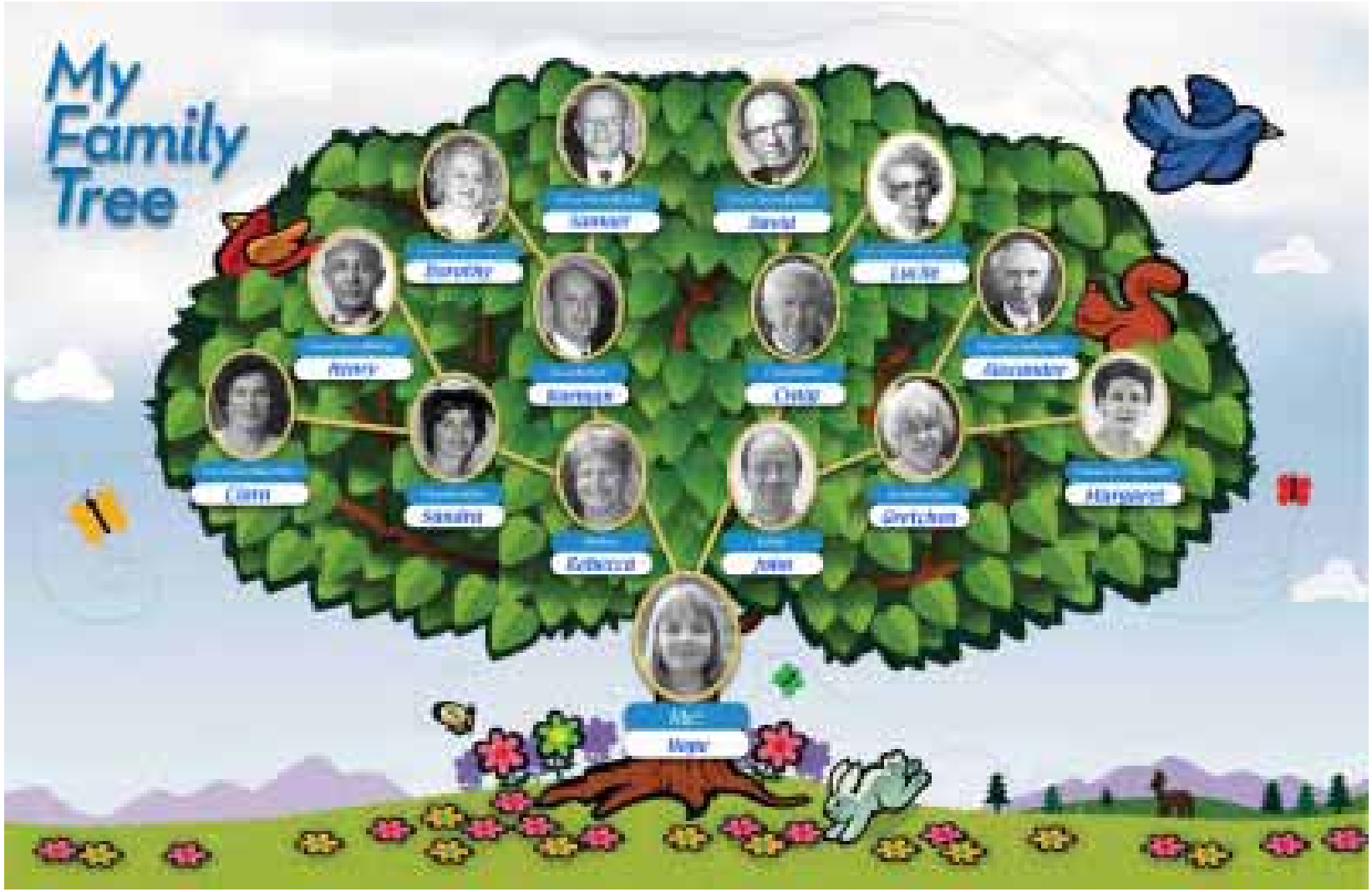


A Tree of Life



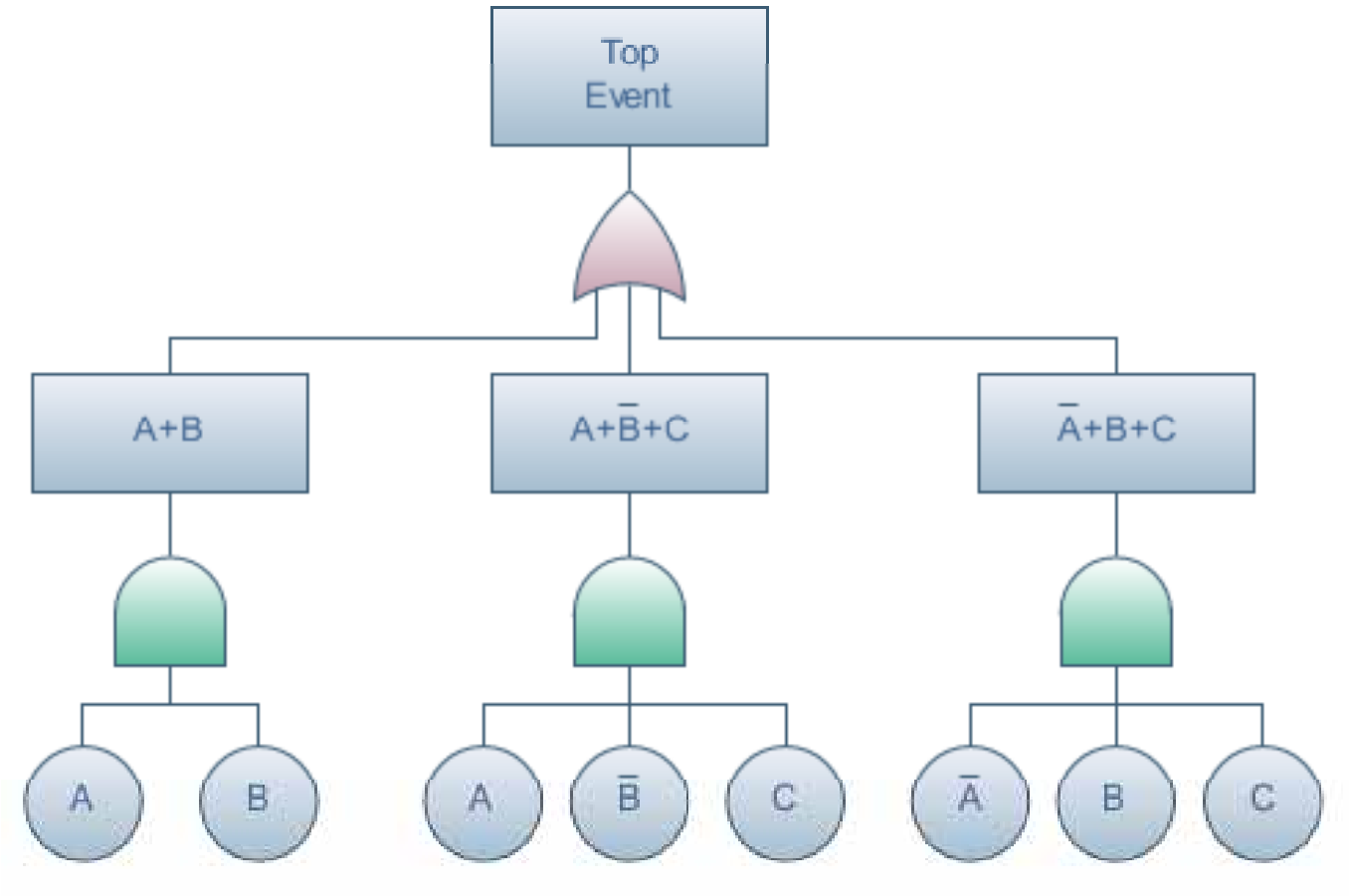
http://www.zazzle.com/tree_of_life_poster-228417147164427097

A Family Tree



A Fault Tree

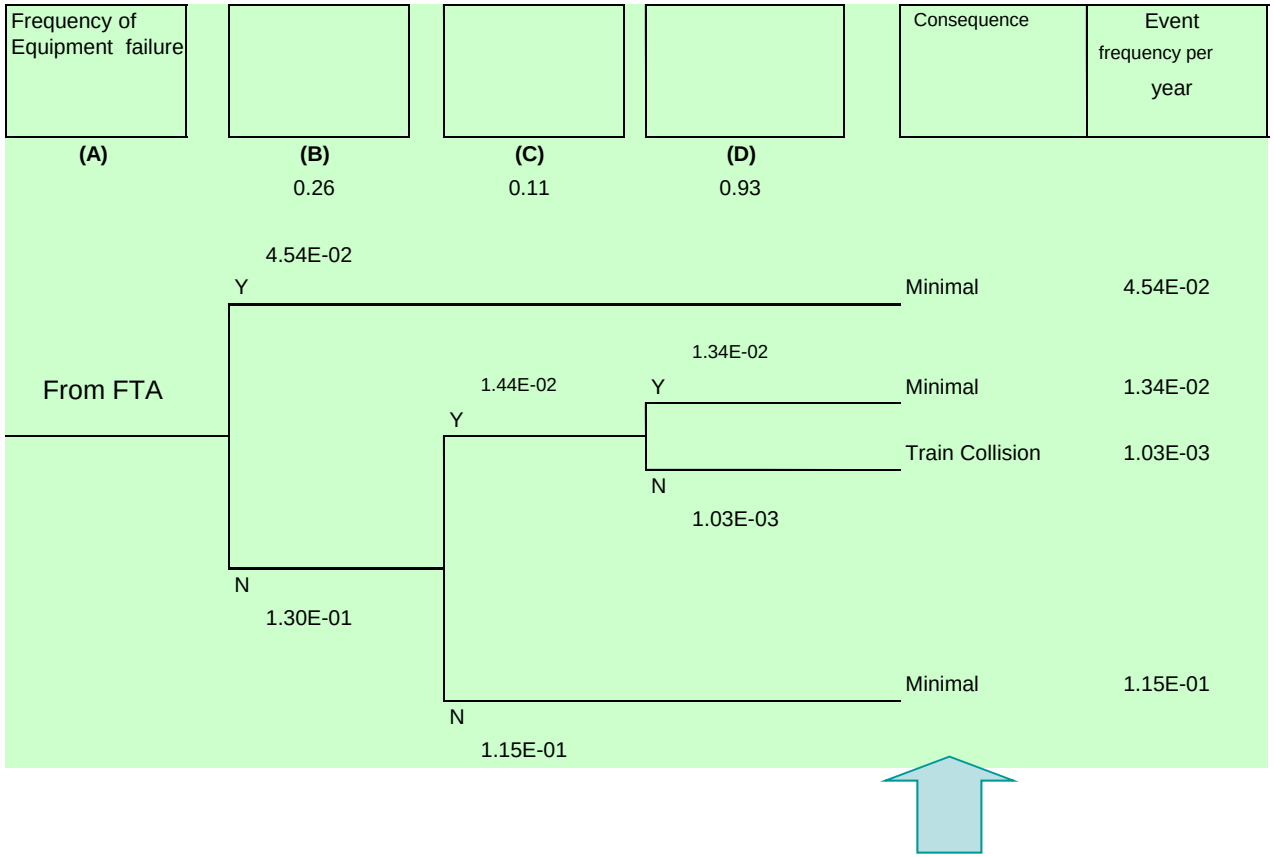
All possible causes



An Event Tree

All possible subsequent events

Top Event



Consequence types

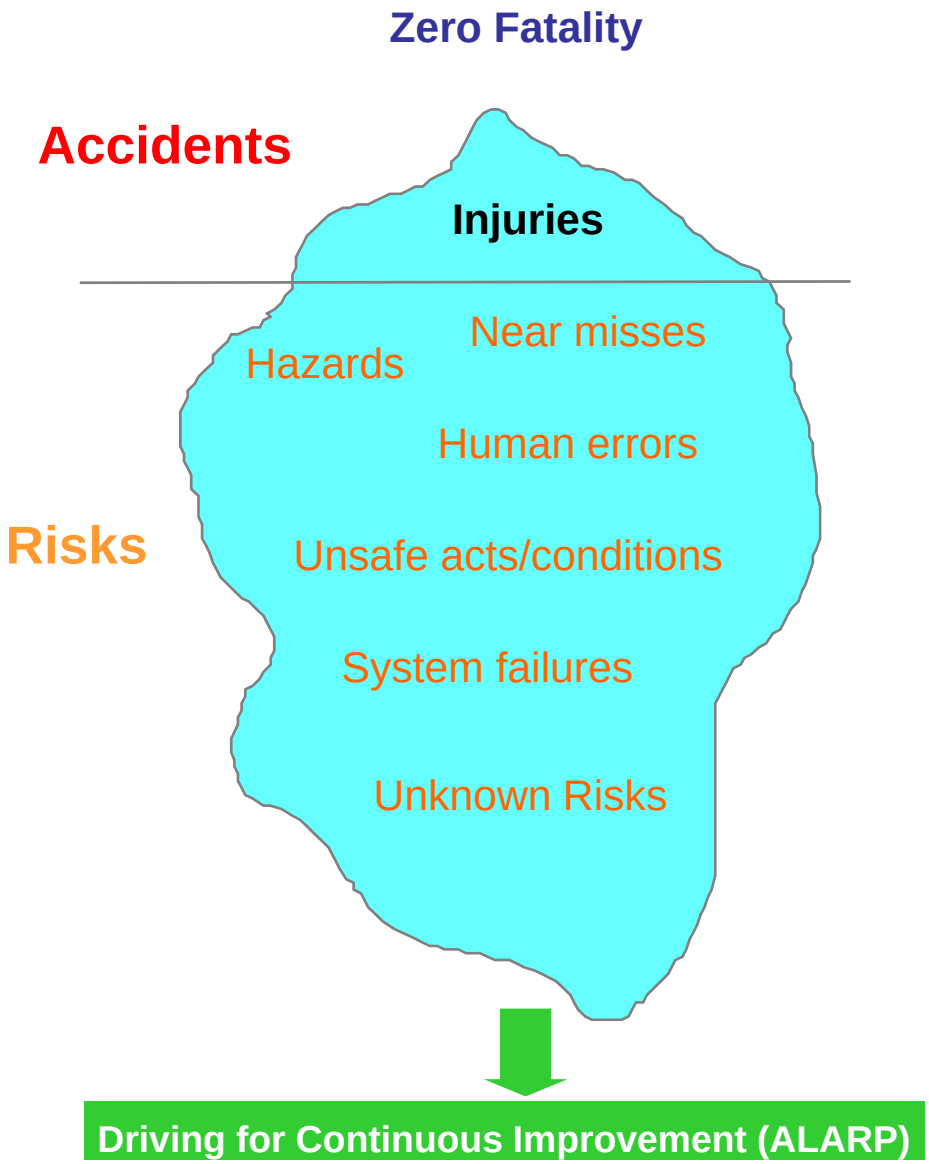
Our Journey to Building Risk Trees

Risk

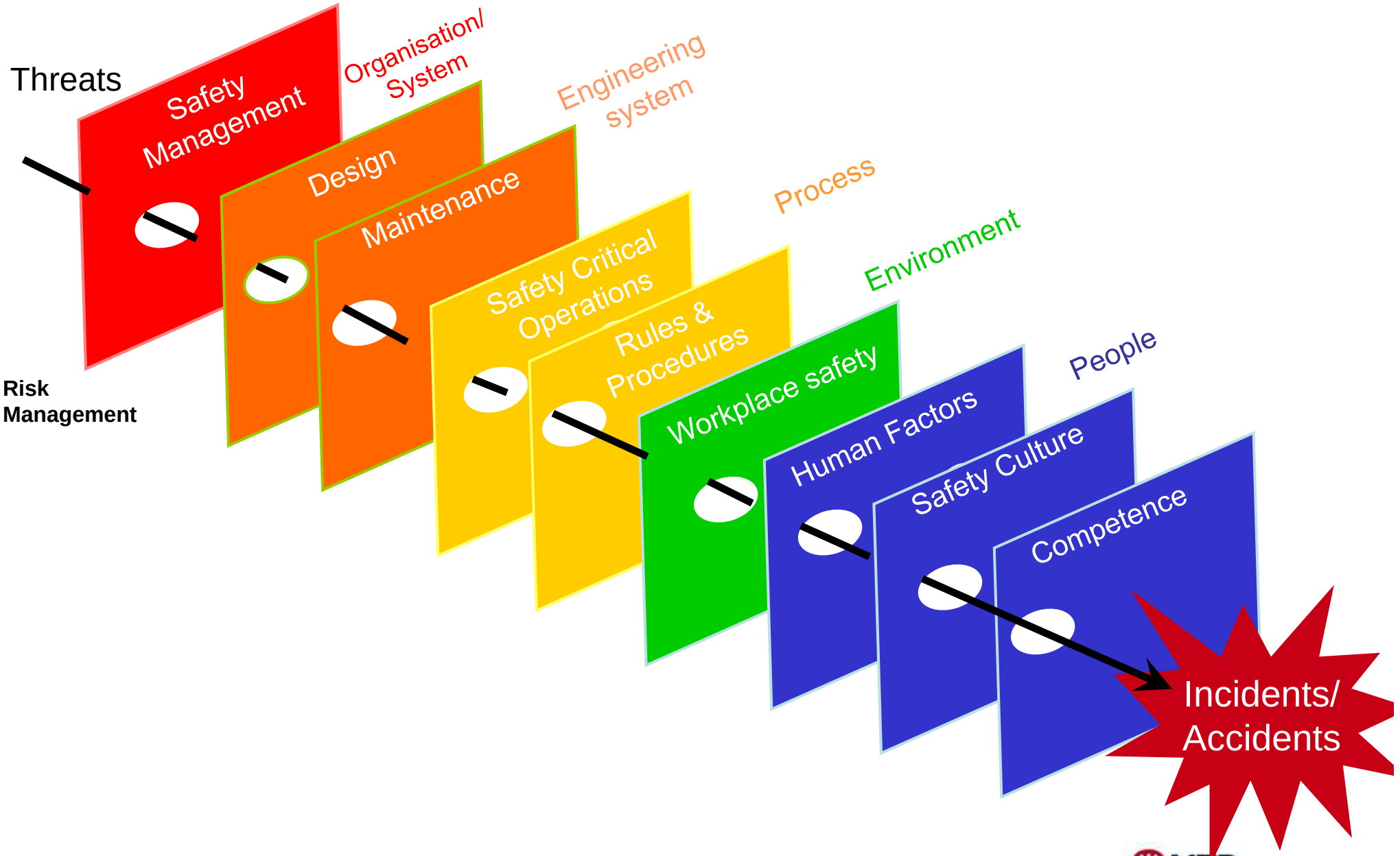
- A hazard with a consequence
- Measurement
  - Frequency (/year) + Severity (injuries/fatalities)
  - i.e. rate of occurrence of the hazard resulting in that consequence

What is Safety ?

What is Risk Management ?



How Safety Management System prevents Incidents



The MTR Business

Heavy Rail

Airport Express

Intercity

Light Rail

Bus

Disneyland Resort Line

NP360 Cable Car

MTR Network 2012 in Hong Kong

- MTR keeps 4.9 million people on the move every weekday
- MTR services run for 19 hours a day (19.5 hours for EAL and MOL)

Heavy Rail

- 10 lines (incl. AEL)
- Route length: *218.2* km
- *84* railway stations
- 1,786 train cars (+new trains)
- 8 depots

Light Rail

- 11 routes
- Route length : 36.2 km
- 68 stops + 1 depot
- 141 light rail vehicles (+ new vehicles)

Bus

- 14 routes
- 143 buses
- Feeder service to the metro network

Growth in China & Abroad

Mainland China

- Beijing Metro Line 4 – opened Sept 2009
- Shenzhen Metro Line 4 – took over Phase 1 in July 2010, opened Phase 2 in June 2011

International

- London Overground: since November 2007
- Melbourne train network – since November 2009
- Stockholm Metro: since November 2009

  (operations and/or maintenance franchises)

What are the changes to MTR (from 2000 to 2012)

In Hong Kong

- From 2M to 4.9M passenger journeys per day
- From 541 to 979 escalators
- From no PSD/APG on MTR stations to only 20 stations on East Rail Line and Ma On Shan Line to be fitted

From a Hong Kong based company to a multi-national company with presence in Mainland China and Overseas

London

Stockholm

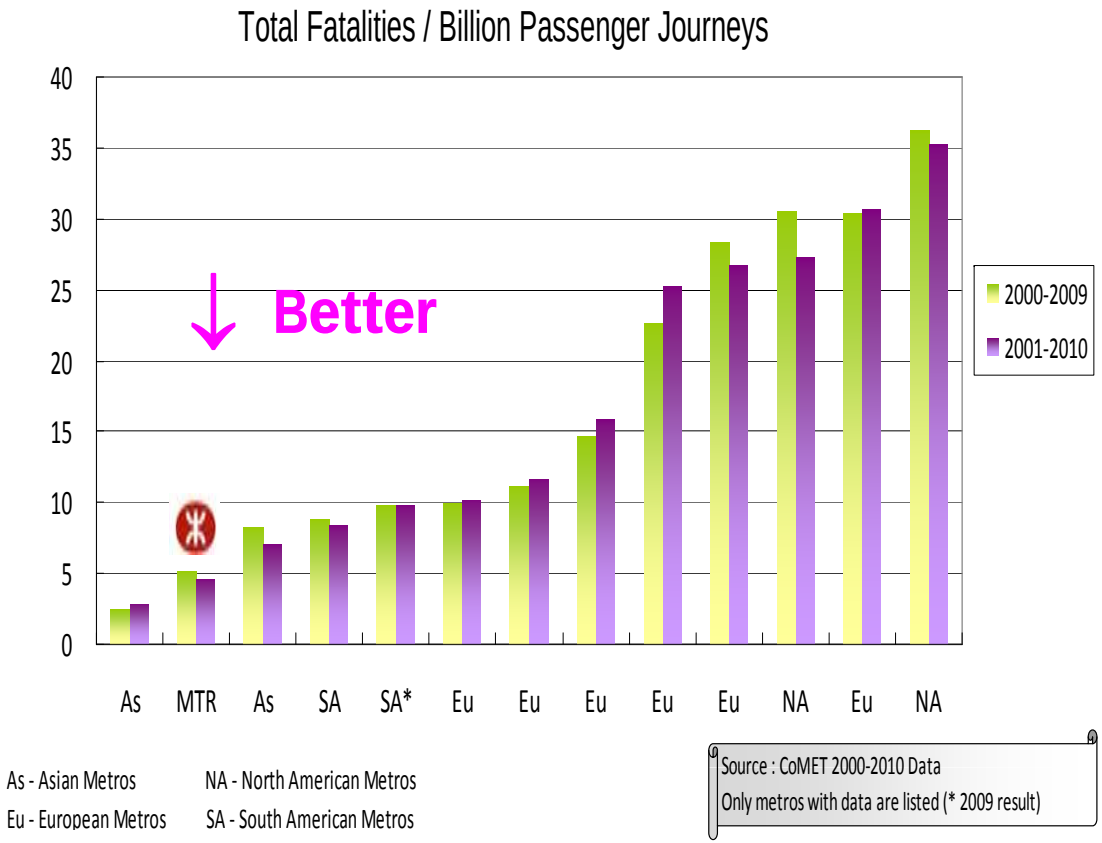
Beijing

Melbourne

Shenzhen

Our Safety and Reliability performance is among the very best in the world

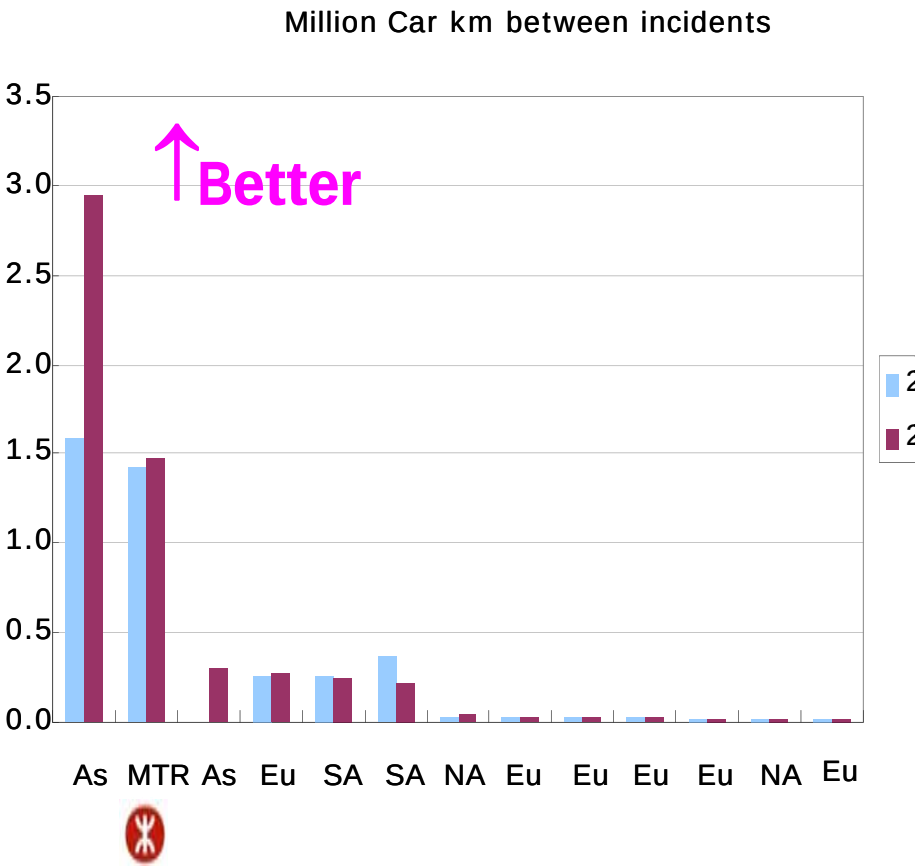
Safety



As - Asian Metros
Eu - European Metros
NA - North American Metros
SA - South American Metros

Source : CoMET 2000-2010 Data
Only metros with data are listed (* 2009 result)

Train Reliability



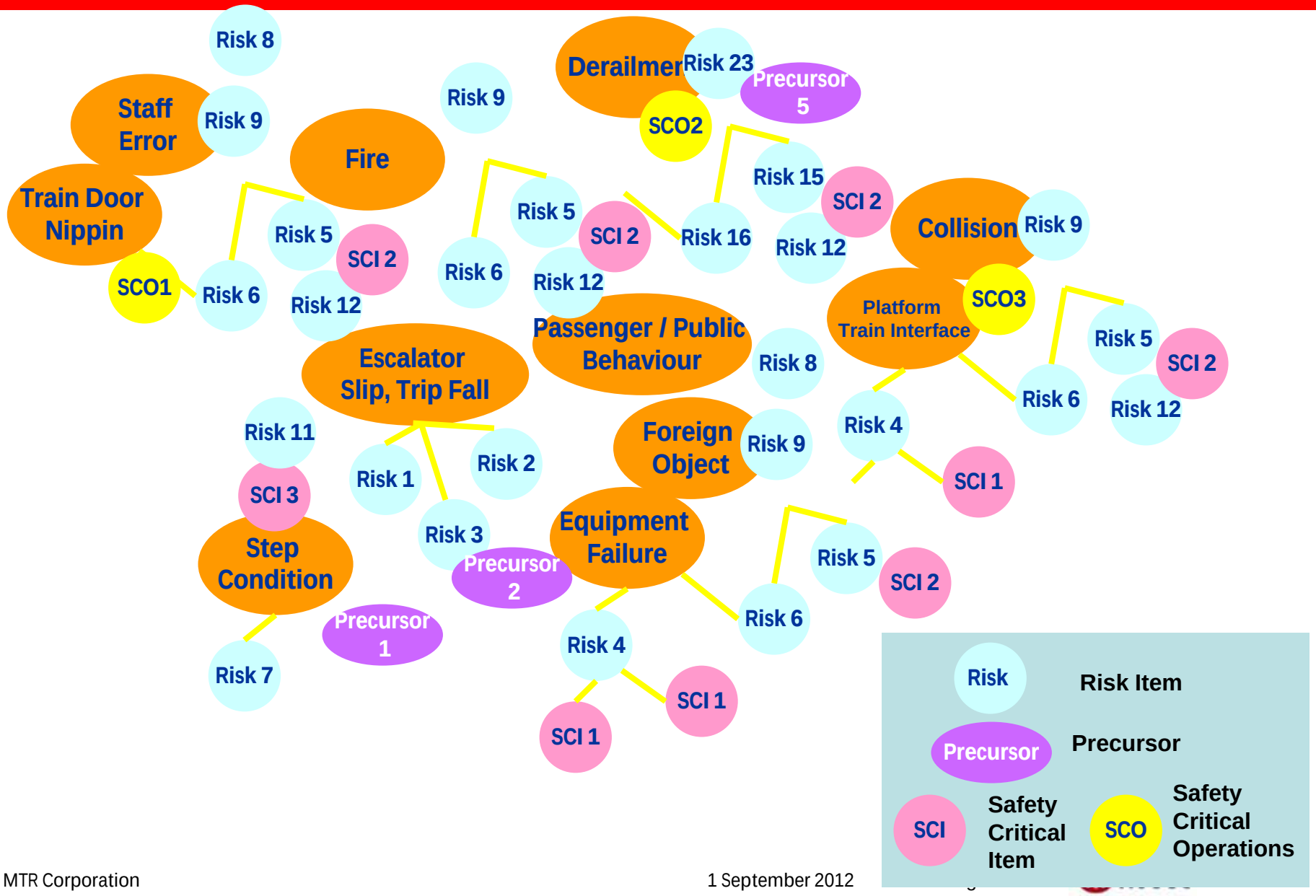
MTR Risk Management Challenges

- Increasing number and complexity within an expanding network
- Too many types – Safety, Financial, Reputation, Legal, Business, Environmental, etc.
- Multiple dimensions – system, people, location, external/internal, strategic/operational/projects
- Different culture - sharing risks across all business units
- Different mindsets – matured workforce and new joiners
- Lack of new ideas to improve-

Emerging Risk - Changing Passenger Demographics

- More elderly passengers and people with disabilities
- Additional station facilities, better signage and station manpower
- Listening and Responding Programme

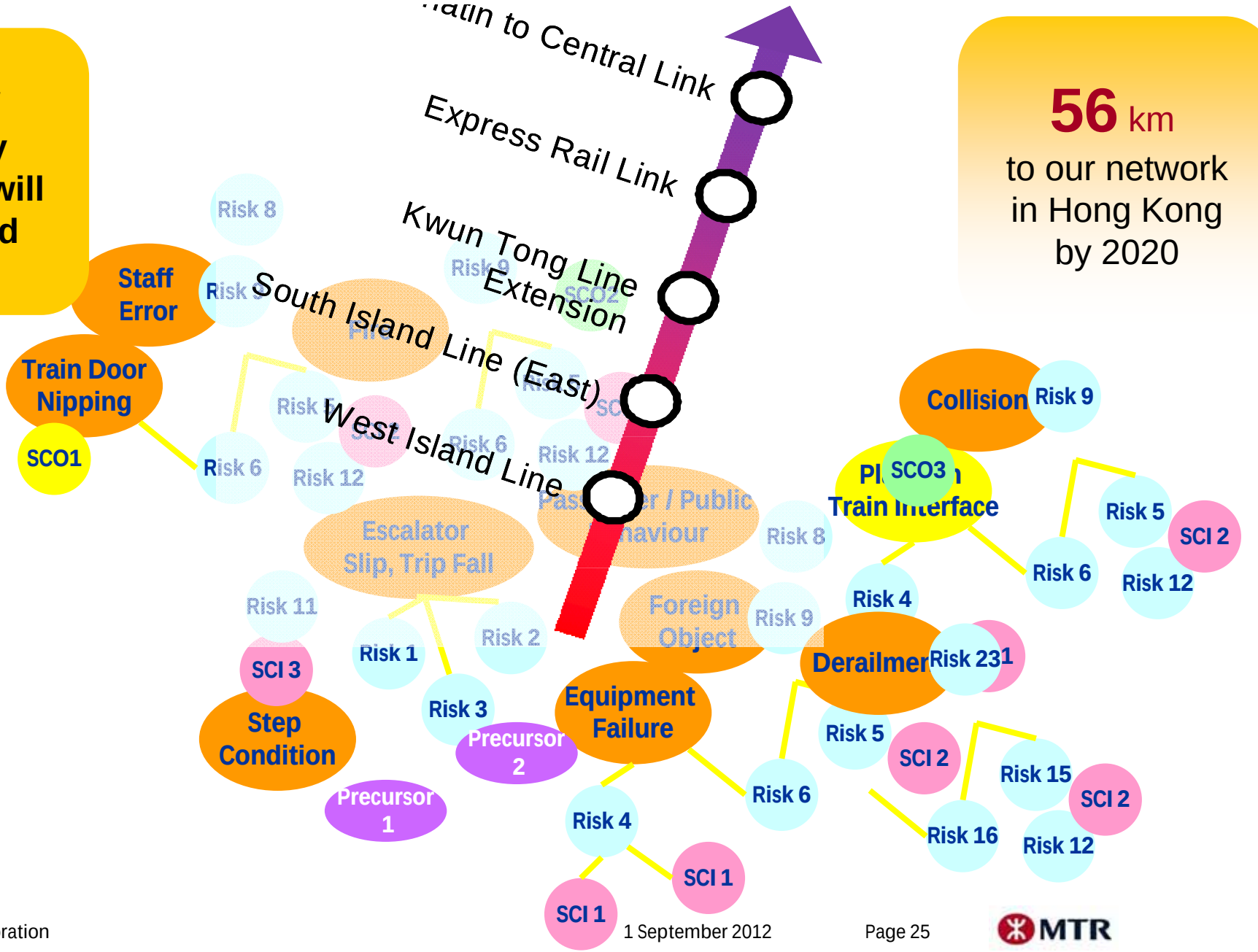
~3000 Railway Operations Safety Risks



New Lines, New Risks

5 New Railway Projects will be added

56 km to our network in Hong Kong by 2020



I need a risk management tool which can help me:

Read across

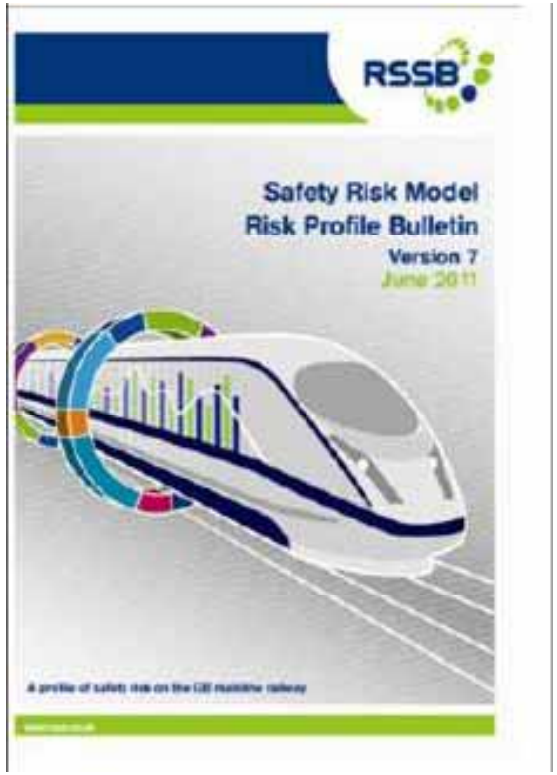
Intelligence

Sensitivity

Know-how

Risk Modelling vs Risk Tree

- UK RSSB Safety Risk Model (SRM)
  - Risk quantification (based on ETA/FTA)
  - Validated with accident figures
  - Well-established structure for benchmarking by operators



	HE No.	Hazardous event description	Individual Risk (Probability of a fatality per year)					
			Passenger	Passenger Train Driver	Freight Train Driver	Infrastructure workers	Other PT crew	Other staff
3	HET-01/02/03	Collision between two trains resulting from a: passenger train Cat A SPAD; runaway train; misrouted train; or WSF	1.95E-07	6.02E-06	1.67E-05	3.86E-07	1.37E-06	7.99E-07
4	HET-06	Collision between two passenger trains in station (permissive working)	6.97E-10					
5	HET-09	Train collision with buffer stops	6.02E-09	4.49E-07			1.40E-07	
6	HET-10	Passenger train collision with road vehicle on level crossing	6.68E-08	3.78E-06			1.18E-06	
7	HET-11	Non-passenger train collision with road vehicle on level crossing	5.14E-10	1.72E-07	1.78E-06			3.88E-08
8	HET-12	Derailment of passenger train	4.19E-07	1.12E-05			3.49E-06	
9	HET-13	Derailment of non-passenger train	7.51E-08	1.81E-07	2.15E-05	1.42E-06		1.42E-06
10	HET-17	Fire on passenger train	1.33E-08	3.04E-07			9.46E-08	

Accident Category NB: POS = Possession	FWI/year	Fatalities/ year	Major injuries/ year
Train Accidents (excl POS)	8.1	6.1	15.0
Movement Accidents (excl POS and Trespass)	21.4	11.2	56.8
Non-movement Accidents (excl POS and Trespass)	54.2	5.8	317.3
Inside possession (POS)	8.6	2.0	50.8
Trespass	48.6	45.7	27.0
Total	140.9	70.7	466.9

RSSB: Rail Safety and Standards Board

UK RSSB Safety Risk (SRM) Model

Overview of the SRM-RPB – Version 7

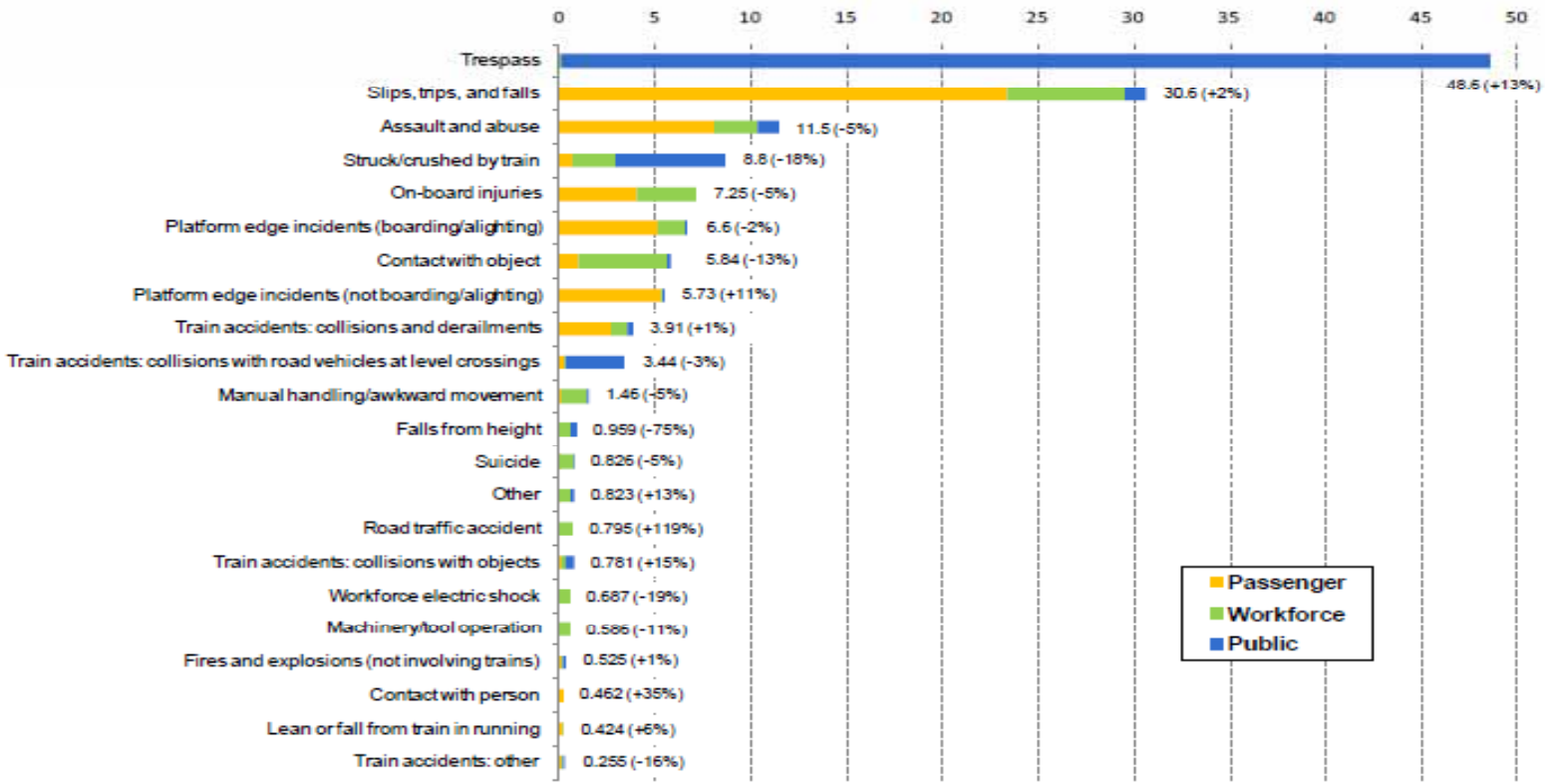
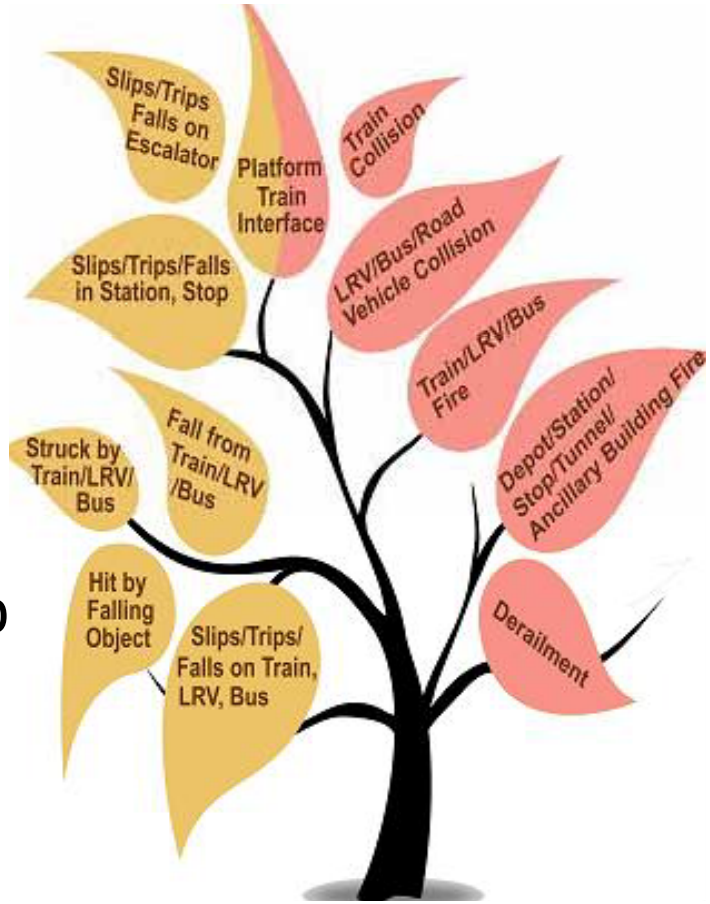


Chart 3: Risk profile for the hazardous events categories

Note: The direct risk from suicide and attempted suicide has been excluded, however all secondary risk associated with suicide has been included

Risk Tree

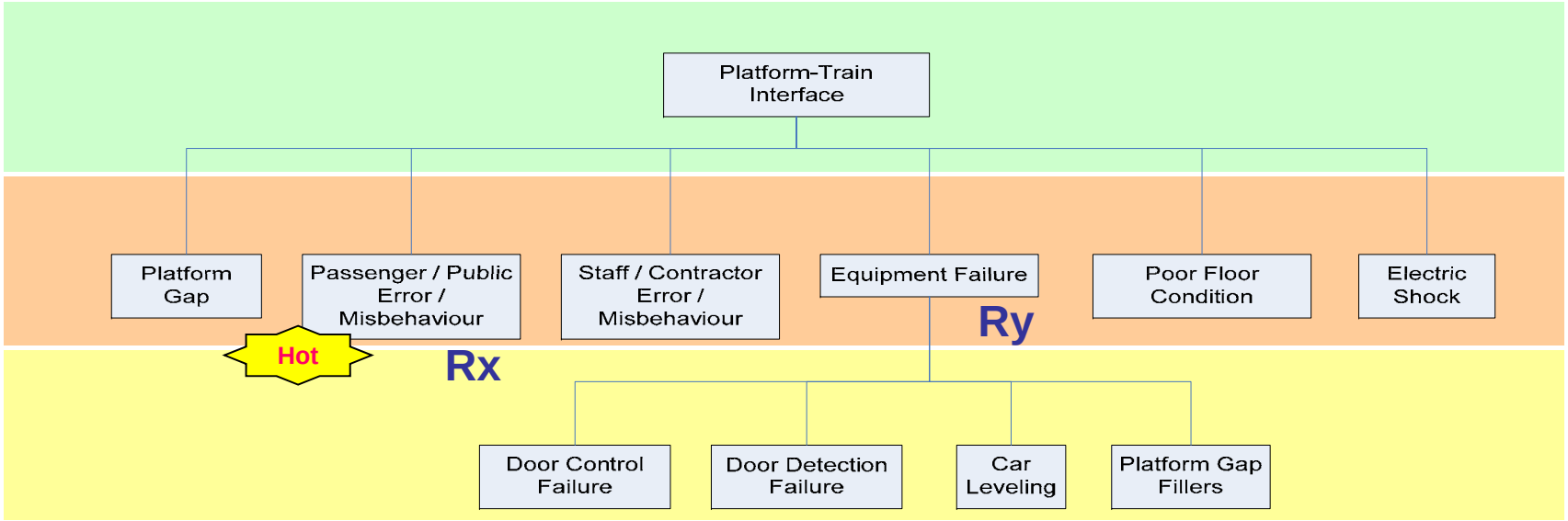
- "Tree" applications in safety industry
  - Analysis of causes (Fault Tree)
  - Analysis of consequences (Event Tree)
- A Risk Tree
  - Focused on one major risk scenario (an event)
  - Looks at all underlying causes
  - Depicts risks interrelationship and relevant information



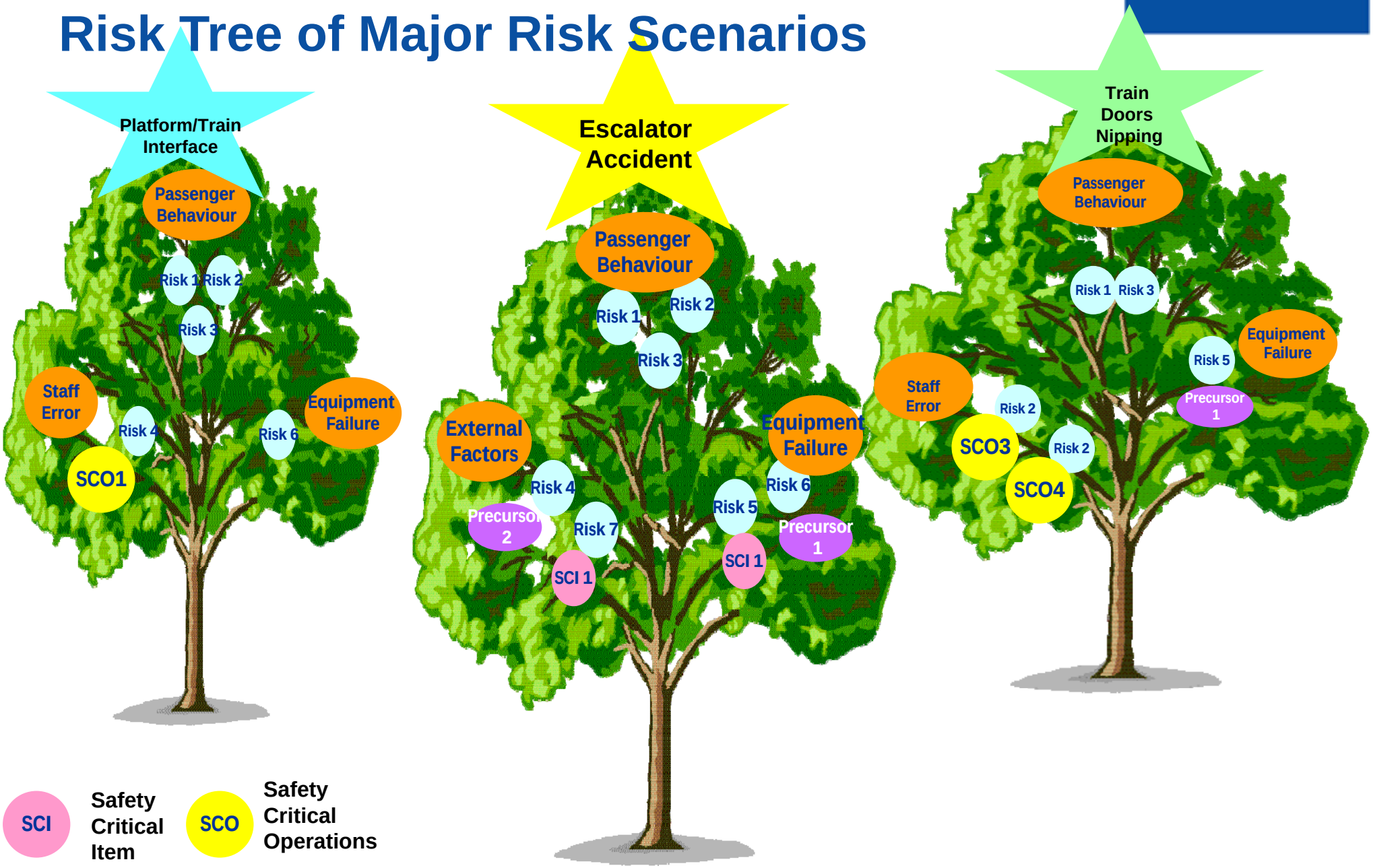
Twelve Major Risk Scenarios

MTR Risk Tree Approach

- A thinking tool for systematic risk management
- Highly structured – consistent hierarchy
- Multi-dimensional – expandable branches
- Systematic visual analysis by:
  - Type / Line / Risk Rating / etc.

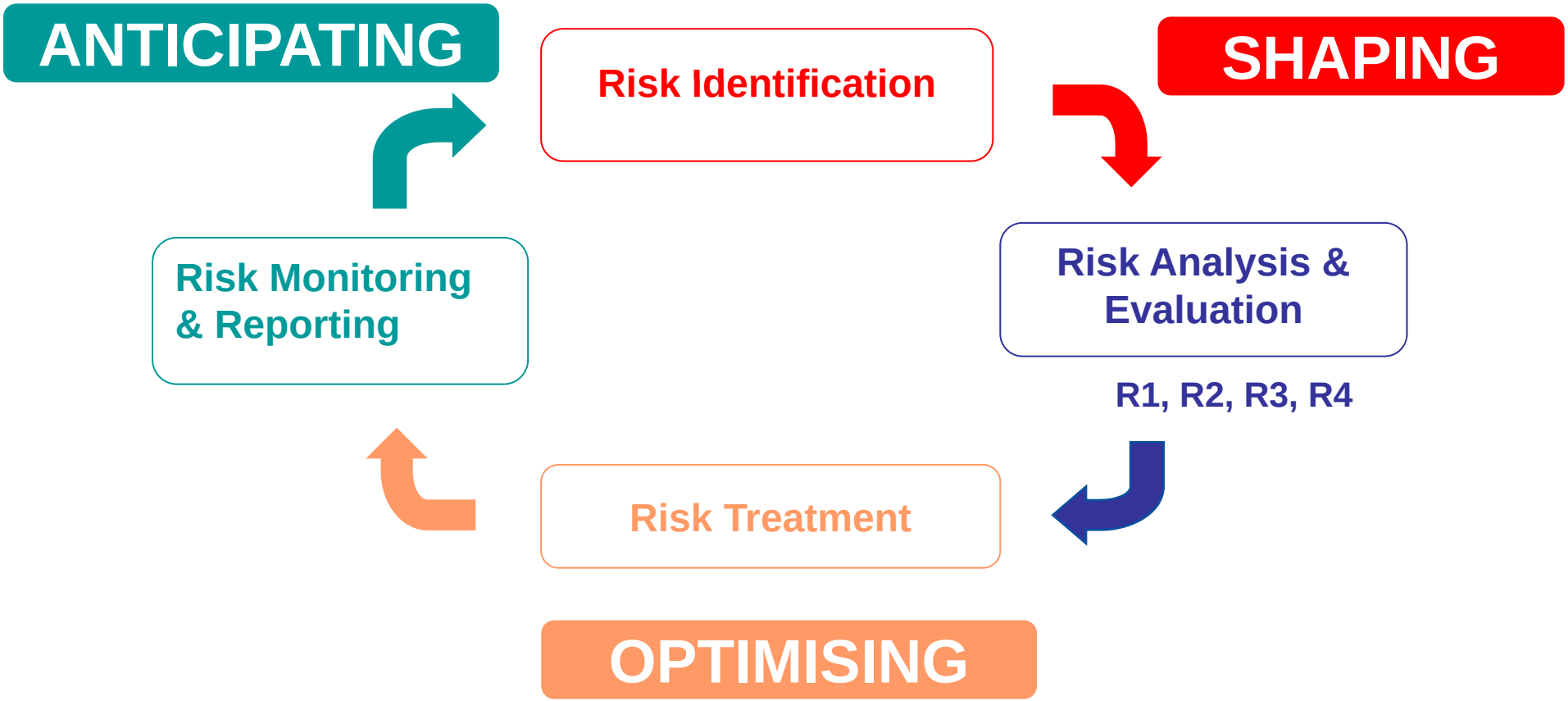


Risk Tree of Major Risk Scenarios



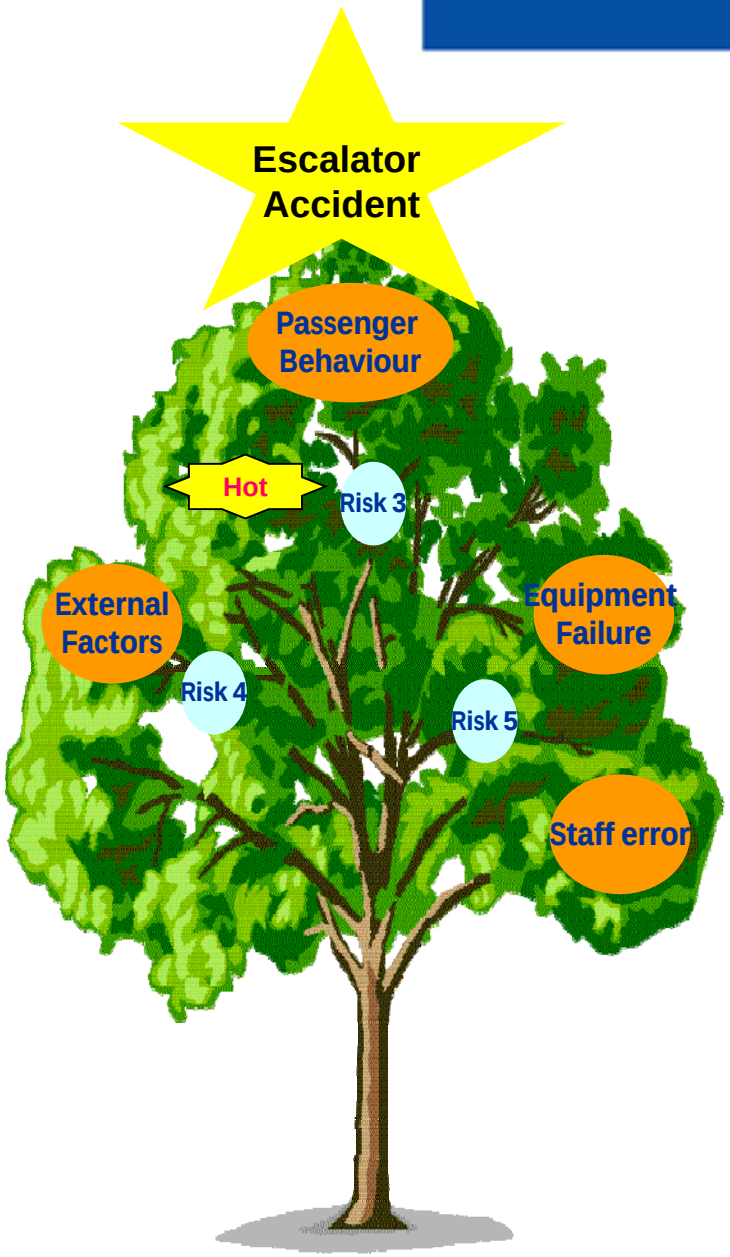
Benefits of Risk Tree

- Enriching the risk management PDCA process



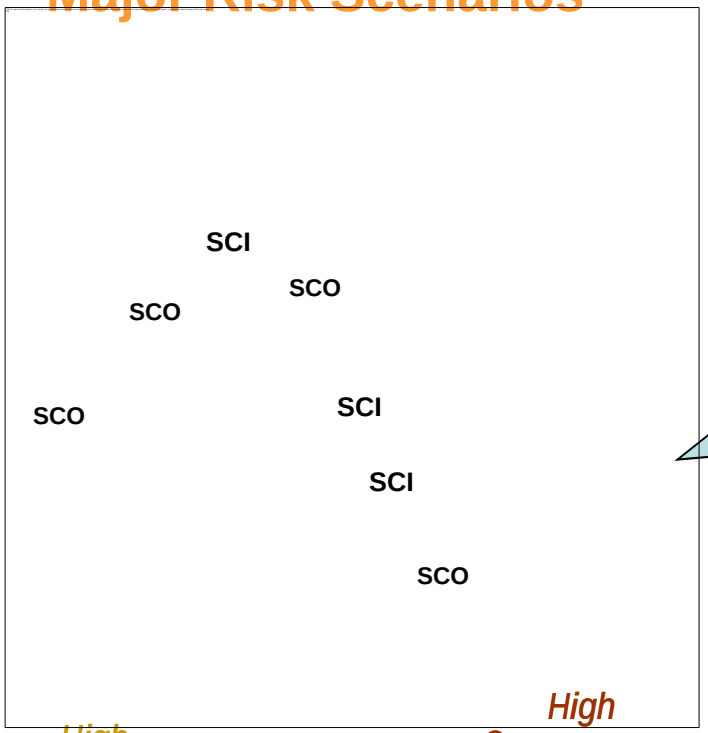
SHAPING

- Depicting the risk elements – equipment, people, process and external factors
- Showing the big picture and risk exposure by aggregating similar risks
- Showing risk dynamics - where are the hotspots and trends
- Allowing risk integration in a structured and coherent manner

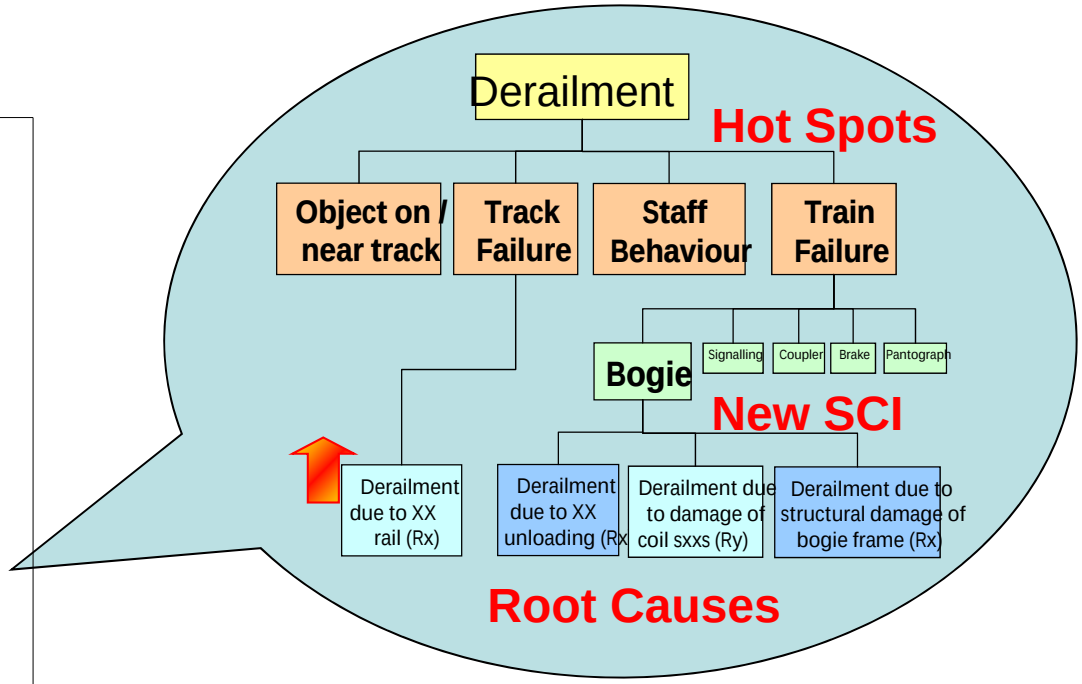


SHAPING

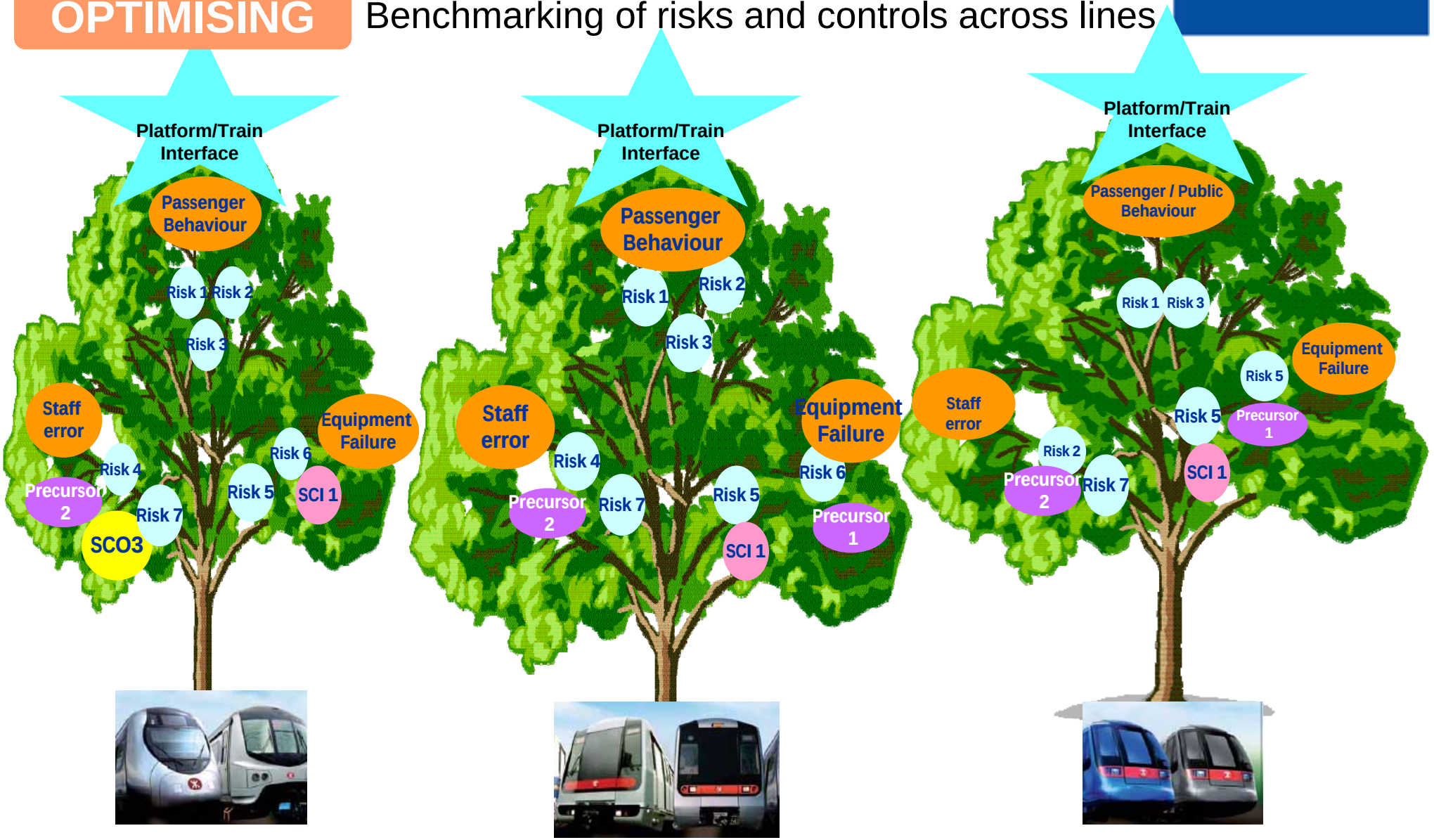
Major Risk Scenarios



Risk Tree



OPTIMISING Benchmarking of risks and controls across lines



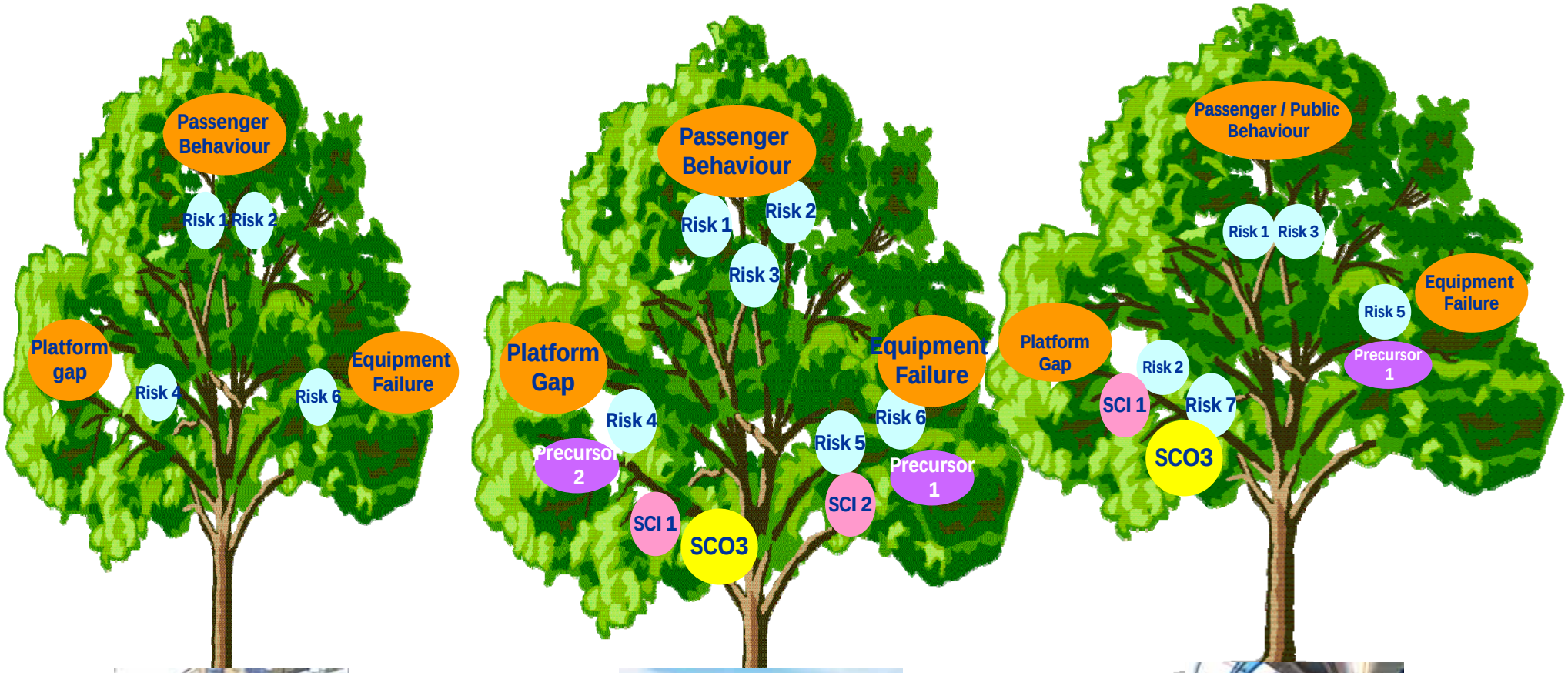
EAL, WRL
(➔ SCL)

TWL/KTL/ISL/TKL
(➔ KTE/WIL)

TCL/AEL

OPTIMISING

Benchmarking of controls across business units



London

Hong Kong

Shenzhen

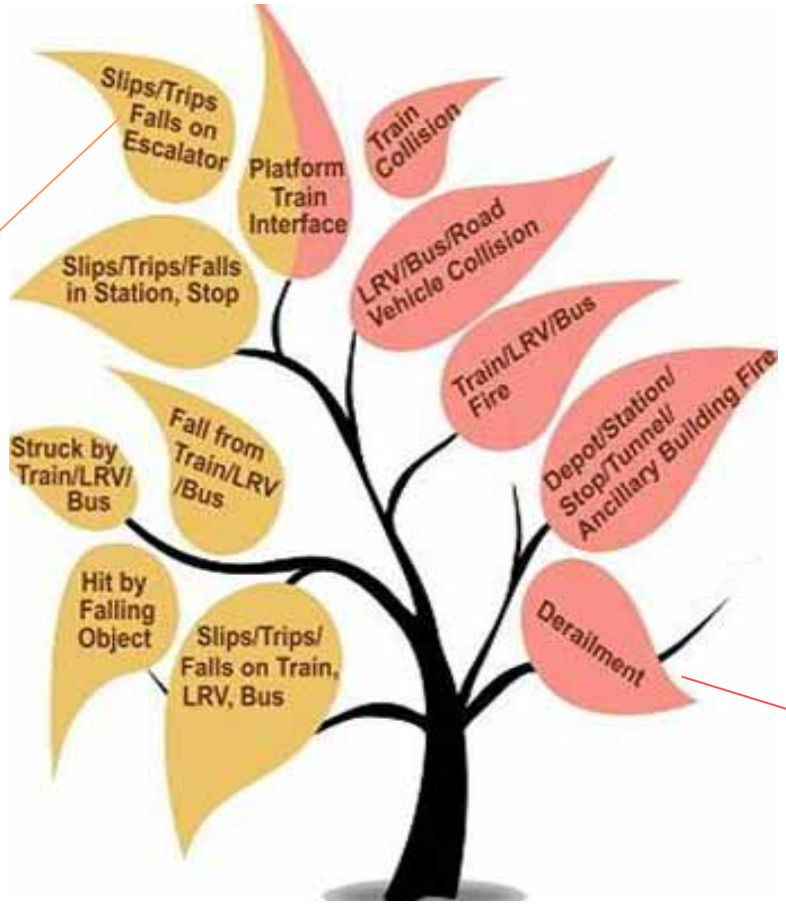
OPTIMISING –Cont'd

Applying Fit-for-purpose Risk Strategy

Separate treatments for High Frequency or High consequence risk

High Frequency

Influence passenger behaviours

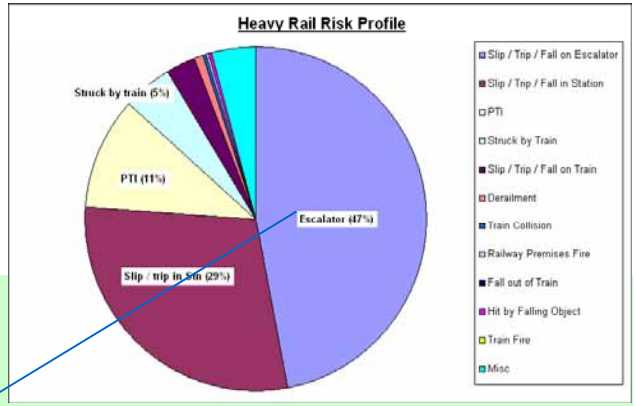


High Consequence

Review robustness of control measures

OPTIMISING –Cont'd

Risk Tree
Slips / Trips / Falls on Escalator



Major Risk Scenario (MRS)

Slips / Trips / Falls on Escalator

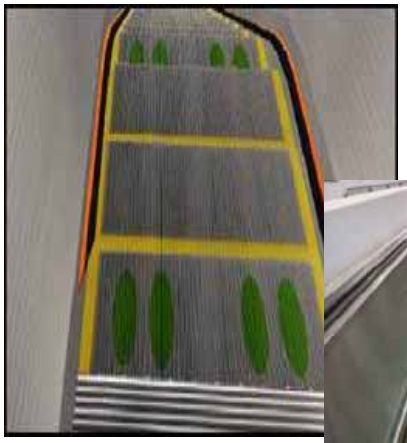
Risk Scenario (RS1)

- Equipment Failure
- Staff / Contractor Error / Misbehaviour
- Passenger / Public Error / Misbehaviour
- Slippery Condition

OPTIMISING – Cont'd

From

To



Influencing Passenger Behaviours

OPTIMISING – Cont'd

- Vigorously reviewing the effectiveness of risk control measures
  - Facilitate questioning of risk controls adequacy and effectiveness
  - Review critical processes (check and balance)
  - Minimise duplicated processes
  - Strengthen robustness of controls – use engineering measure instead of procedure to prevent accident

ANTICIPATING

- Hindsight + Insight = Foresight

- Responding to new groups of passengers and their behaviours

- from SARS to pandemics and business continuity

- from engineering system risks to human factors

Emerging risks

"You don't know what you don't know. You know what you don't know when you know more"

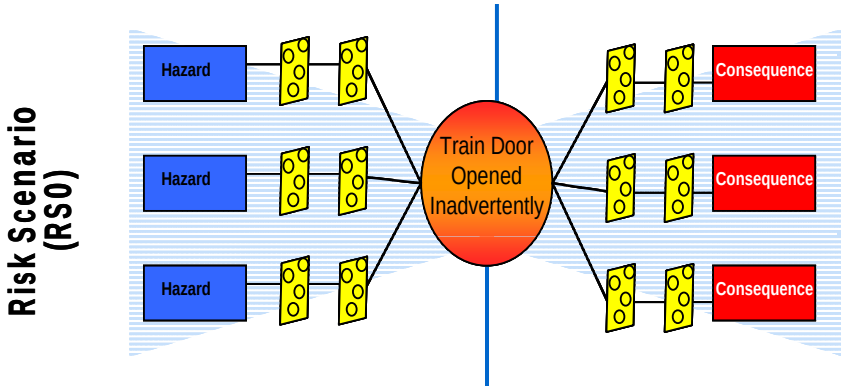
Risk Ownership

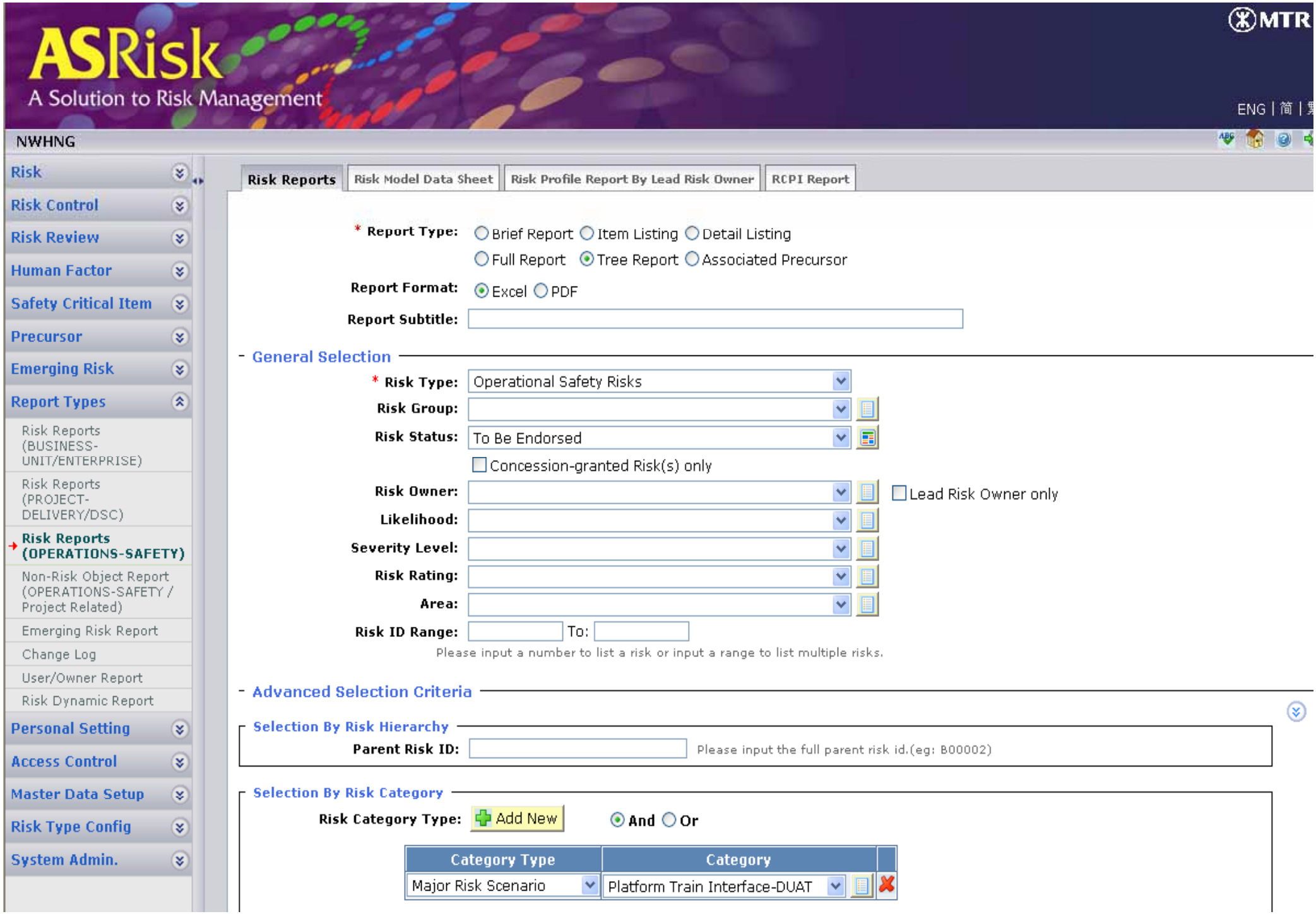
Risk Management Organisation

- Risk oversight by Safety Committee (OSMC-HK)
- Risk Control & Analysis Committee (RCAC) reviews the risk controls and oversees the change in risk profile
- Hazard Review Committee (HRC) of each department reviews all related risks trees and controls
- Promoting Risk Tree ownership
  - Each Risk Tree and major risk scenario is championed by a Department Head
  - Lead the review of risk control measures with related parties and explore better solutions

Sharpen the Saw

- From Excel spreadsheet to Risk Tree diagram
- Risk IT System (ASRISK) – tree view of risks
- Further application - OSSA – leveraging risk tree to examine the robustness of risk controls using a bowtie approach




ASRisk
A Solution to Risk Management
MTR
ENG | 简 |
NWHNG
Risk
Risk Control
Risk Review
Human Factor
Safety Critical Item
Precursor
Emerging Risk
Report Types
Risk Reports (BUSINESS-UNIT/ENTERPRISE)
Risk Reports (PROJECT-DELIVERY/DSC)
Risk Reports (OPERATIONS-SAFETY)
Non-Risk Object Report (OPERATIONS-SAFETY / Project Related)
Emerging Risk Report
Change Log
User/Owner Report
Risk Dynamic Report
Personal Setting
Access Control
Master Data Setup
Risk Type Config
System Admin.
Risk Reports
Risk Model Data Sheet
Risk Profile Report By Lead Risk Owner
RCPI Report
* Report Type:
Brief Report
Item Listing
Detail Listing
Full Report
Tree Report
Associated Precursor
Report Format:
Excel
PDF
Report Subtitle:
General Selection
* Risk Type:
Operational Safety Risks
Risk Group:
Risk Status:
To Be Endorsed
Concession-granted Risk(s) only
Risk Owner:
Lead Risk Owner only
Likelihood:
Severity Level:
Risk Rating:
Area:
Risk ID Range:
To:
Please input a number to list a risk or input a range to list multiple risks.
Advanced Selection Criteria
Selection By Risk Hierarchy
Parent Risk ID:
Please input the full parent risk id.(eg: B00002)
Selection By Risk Category
Risk Category Type:
Add New
And
Or
Category Type
Category
Major Risk Scenario
Platform Train Interface-DUAT

Greatest Challenge in Risk Management

The risks that I don't know ?

Risk Tree can enhance your risk intelligence

- **R**ead across – what is happening elsewhere ? will this happen to me and my situations ?
- **I**ntelligence – synergize knowledge and facilitate sharing
- **S**ensitivity – anticipate emerging risk from new strategy and external changes
- **K**now-how – know how the risk occurred and manifested and how to prevent it effectively


Thank You