

Occupational Safety and Health Webinar : Risk management on railway protection

20 Apr 2021

HKARMS 香港風險管理與安全協會
Hong Kong Association of
Risk management and Safety





Contents

- Interactive Part A will focus on aligning the concept of risk management and its application in general railway protection
 - Risk management
 - Start from the basic
 - why and how we do it, I think
 - Railway protection
 - Vehicle intrusion risk control
 - Takeaway
- Part B will be a discussion/Q&A session with railway safety expert





Before we start...



Occupational Safety and Health Career Starter Programme

- The Programme is initiated by IOSH Hong Kong
 - Cover student members (IOSH, HKOSHA and SRSO) graduated from IOSH accredited Occupational Safety and Health full-time programmes in Hong Kong
 - Subsidise the first two-year membership fee after graduation
- Objective
 - Lowering applicants' financial hardship during their early years in OSH
 - Enabling applicants to benefit from professional support while pursuing IOSH Chartered status, a world recognised high OSH standard
 - Motivating young safety graduates to develop their professional competence and stay in connection with professional institutions
 - Enabling them to build the best possible workplace environment for Hong Kong

The Programme is 100% funded by generous corporations and individuals in Hong Kong



We would like to express my sincere thanks to our donors

(In an alphabetical order)

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Individuals and organisations are welcome to support the Programme to benefit both the safety profession and the society in Hong Kong
Please contact IOSH (HK) for details



Measuring safety

- Polling-A: Does your organisation measure safety by the number of accidents reported or accident rate?
 - Yes, been doing that for years
 - Yes, but we also use other safety performance indicators
 - No, we use something else

The lack of accident does not necessarily indicate the presence of safety

- Accident statistics are past events – lagging indicator
 - They may not capture rare events and accidents not yet occurred
 - Can be biased due to limited data or lack of reporting
 - Cannot support new systems or those with little operating experience
 - May lead to ineffective allocation of resources

“...we have zero LTI; we are safe...”

- Deep Water Horizon Syndrome



How should we measure safety ?

- How about we also measure the potential for recurrence of past accidents and near misses, and accidents that have not yet occurred?
- Let's call these undesirable events, which cover both “realised risk” and “unrealised risks”

Safety cannot be directly measured; we can measure safety by measuring the degree of “unsafe”–
The potential of undesirable events occurring



What is risk management?



- We want to attend to every undesirable event, but obviously that is not practical



Do everything
\$\$\$\$\$\$



Do nothing
\$\$\$\$\$\$\$\$

Which one should we address first? How much should we spend?

- We should put resources on those hurt us the most, and more often
- We need a sliding scale with a unit to register the criticality of the undesirable events so that we can compare and rank-order them
- This unit is “RISK”; if the risk of an undesirable event is high, you will attend to it faster with more resources
- Typically, Risk = Likelihood x Consequence; many other forms exist
- ISO 31000: Risk is “the effect of uncertainty on objectives”, whether positive or negative

Risk is subjective and relative

Confusing terminology

- Polling-B: Which one is correct?



Risk registers the level of unsafe (or benefits) of an activity, operation, or business objective, it itself is neutral

- Other terms that have been incorrectly used interchangeably with risk
 - Hazard: source of danger
 - Consequence: impact, harm, injuries, damage, end state

$$\text{Risk} = \frac{\text{Hazard}}{\text{Safeguards}}$$

We should use these terms properly in the context of risk management



Railway risk management

- Are they hazard, consequence or risk?
 - Polling-2: Train collision
 - Polling-3: Train collision resulting in 20 persons injured once in 20 years
 - Polling-4: Road vehicle sitting on railway track
 - Polling-5: Construction site near railway tracks

Which one is “easier” to manage?

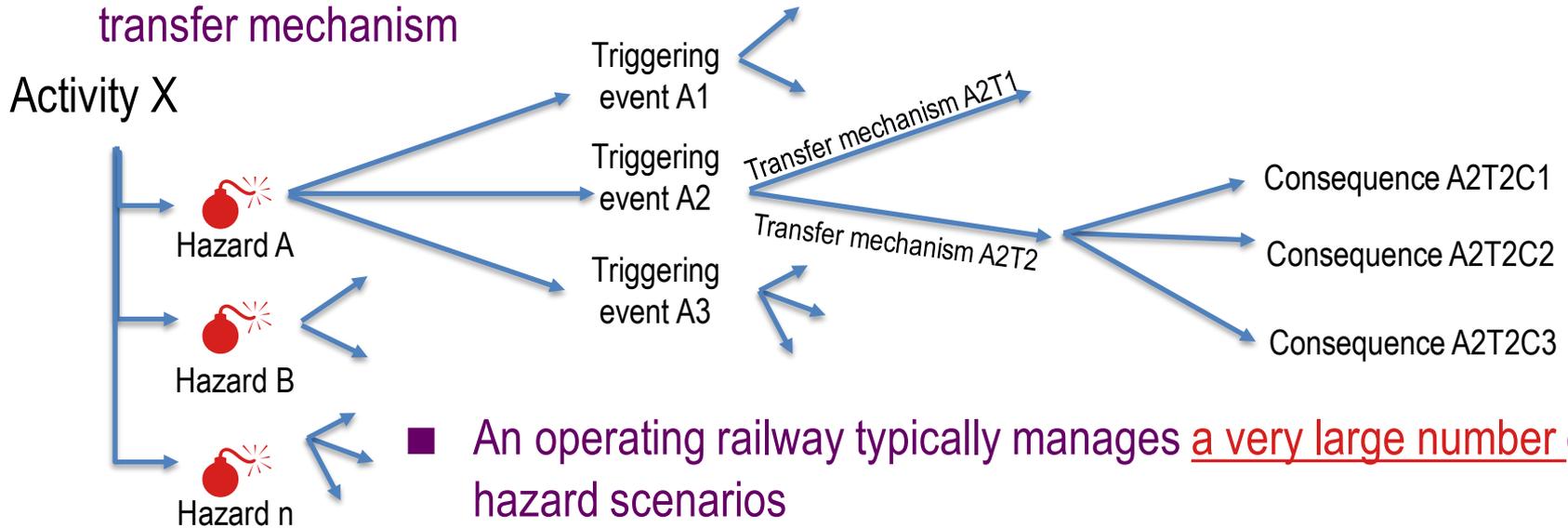
- Polling-D: Are accidents preventable?
 - Yes, all accidents are preventable
 - No, accidents are accidents, they just happen
 - Only some accidents are preventable

If we can identify reasonably foreseeable hazards,
can we control their risk?

Hazard scenarios



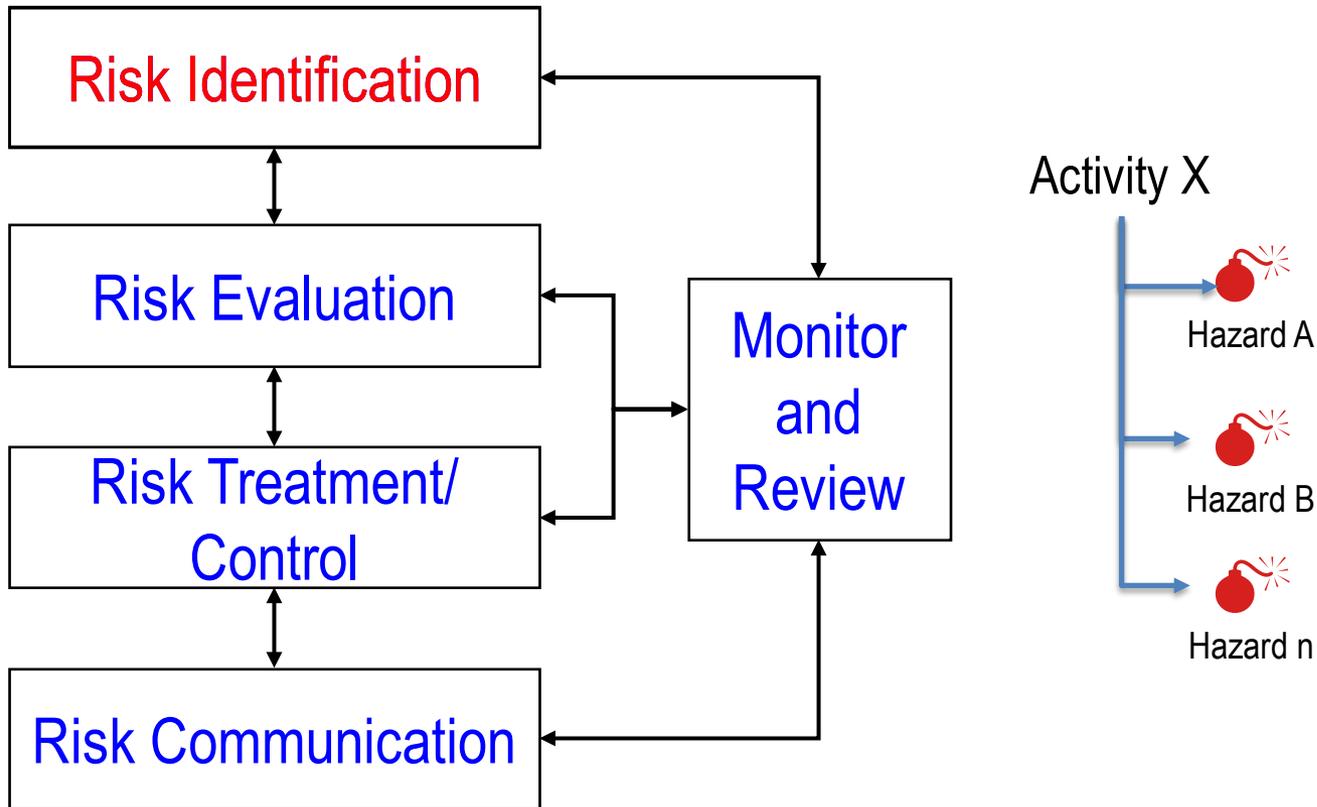
- Almost all activities or events come with multiple hazards
- Each hazard may be activated by different triggering events
- Each triggered hazard may end up with different consequences due to different transfer mechanism



A robust risk management system is needed to manage all these scenarios and control their risks



Risk management system – typical steps



Which step is most important? Why?



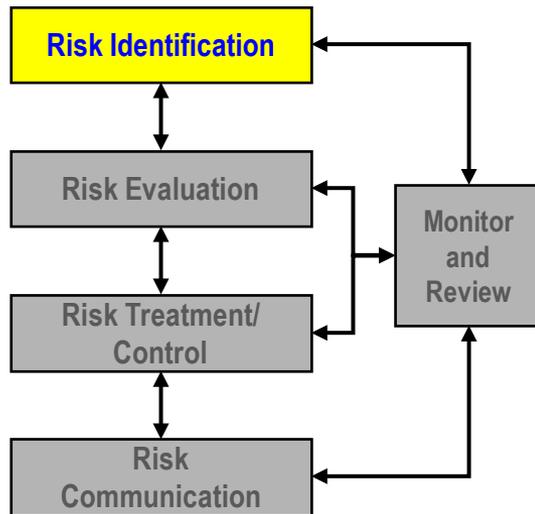
When to do a risk assessment



We should proactively risk assess undesirable events and embed risk management into procedures and work culture

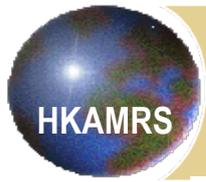


Risk identification – the process of finding, recognizing and recording what can go wrong



- Keep an open mind with sharp eye
- Commonly used tools
 - SWIFT, HAZOP, FMEA, ETA, FTA, etc.
 - Investigation of accidents and near misses
 - Audit and inspection
 - News, references, review of incidents occurring elsewhere
- Polling-E: Does your safety department regularly scan for worldwide accidents related to your operations and look for improvement opportunities?

What if these accidents occur under your watch?



Examples of world wide accident scanning

Worldwide Rail Incidents Alert – 17 December 2020 to 23 December 2020



1. [India, 21 December 2020: Investigation concluded deadly train derailment caused by tongue rail fracture](#)
2. [Kuala Lumpur, 24 December 2020: Monorail train on fire caused by rubber tire fire; no injuries](#)
3. [Taiwan, 26 December 2020: New requirement to install in-cab CCTV cameras and audio recorders for all railways](#)
4. [Malaysia, 26 December 2020: Train derailment caused by soil erosion after continuous rainfall; no injuries](#)

Media Gist

1. India, 21 December 2020: Investigation concluded deadly train derailment caused by tongue rail fracture

Type:	Train Derailment
Incident:	<p>The Commissioner of Railway Safety (CRS) has attributed the 2017 derailment of Hirakhand Express in Andhra Pradesh that left 40 dead* to a fracture of a tongue rail, three years after the National Investigation Agency (NIA) stated that it suspected sabotage as the reason behind the derailment.</p> <p>The CRS report says while the Civil Engineering Department of the East Coast Railway was "blameworthy", there was no official or any other person either "Primary Responsible" or even "Secondary Responsible" for the accident. The CRS report also states that its investigation could not establish if the fracture of the tongue rail happened because of material failure or out-lived codal life.</p> <p>*The derailment occurred at around 11pm on 21 January 2017. The train was travelling from Jagdalpur to Bhubaneswar at 82km/h carrying 600 passengers. Forty people were killed and 68 others were injured.</p>
Date:	Saturday, 21 January 2017 (Incident); Monday, 21 December 2020 (update)
Place:	Andhra Pradesh, India
Source:	https://economictimes.indiatimes.com/news/politics-and-nation/railway-probe-finds-rail-fracture-caused-2017-andhra-train-derailment-nia-had-suspected-sabotage/articleshow/79842868.cms https://indianexpress.com/article/india/hirakhand-express-2017-train-accident-nia-suspected-maoists-riy-probe-finds-faulty-part-7112735/
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Source: The Economics Times

2. Kuala Lumpur, 24 December 2020: Monorail train on fire caused by rubber tire fire; no injuries

Type:	Train Fire
Incident:	<p>At around 7:24am on 24 December 2020, a fire broke out on a monorail train at Maharajalela Station while the train was heading in the direction of KL Sentral. The driver's cabin and one of the coaches of the train were on fire. Fire fighters arrived and put out the fire at around 8:56am. No one was injured in the incident. The train operating company, Prasarana, told the media that the incident was caused by a fire of a train rubber tire, and the investigation is on-going.</p>
Date:	Thursday, 24 December 2020
Place:	Kuala Lumpur, Malaysia
Source:	https://www.thestar.com.my/news/nation/2020/12/24/fire-breaks-out-on-monorail-coach-at-maharajalela-station https://www.orientaldaily.com.my/news/central/2020/12/24/382767 (in Chinese)
Ref Num:	2020/192
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Source: BOMBA KL

3. Taiwan, 26 December 2020: New requirement to install in-cab CCTV cameras and audio recorders for all railways

Type:	Others
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Derailment of Passenger Train, Taiwan, 2 April 2021

The Incident

On 2 April 2021, Friday, at 09:28, a Taroko Express train (太魯閣號) operated by the Taiwan Railways Administration (TRA) derailed in a tunnel in eastern Taiwan, killing at least 50 people and injuring at least 200 others.

At the time of the accident, the train was carrying 494 passengers. At north of Hualien City (花蓮市), there was a construction truck fallen down a slope onto the track. The eight-carriage train derailed after colliding with the truck, and then came to a rest after hitting the wall of the tunnel. The underlying causes of the accident are being investigated.

The accident is the deadliest train crash and second-deadliest rail accident in Taiwan, surpassed only by a train fire in 1948 which have killed up to 64 people.



Safety reminder based on 5C

We will not go into this accident.

Our sincere condolences go to all involved

Competence
Only competent staff should be allowed to operate equipment in construction sites and RP inspectors should monitor and identify any dangerous / non-compliance situation.



Communication
Construction company, contractor, authorized person with MTR RP, and subsequent communications between MTR RP with O&M teams in the approved mitigation measures are crucial to ensure railway safety.

Culture
Foster Safety First Culture to ensure all safety requirements are strictly followed.

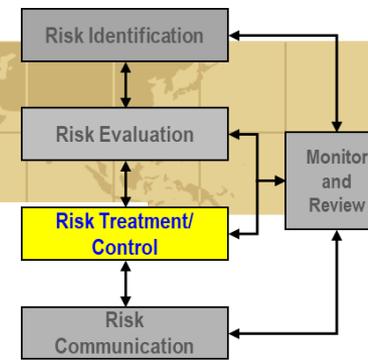
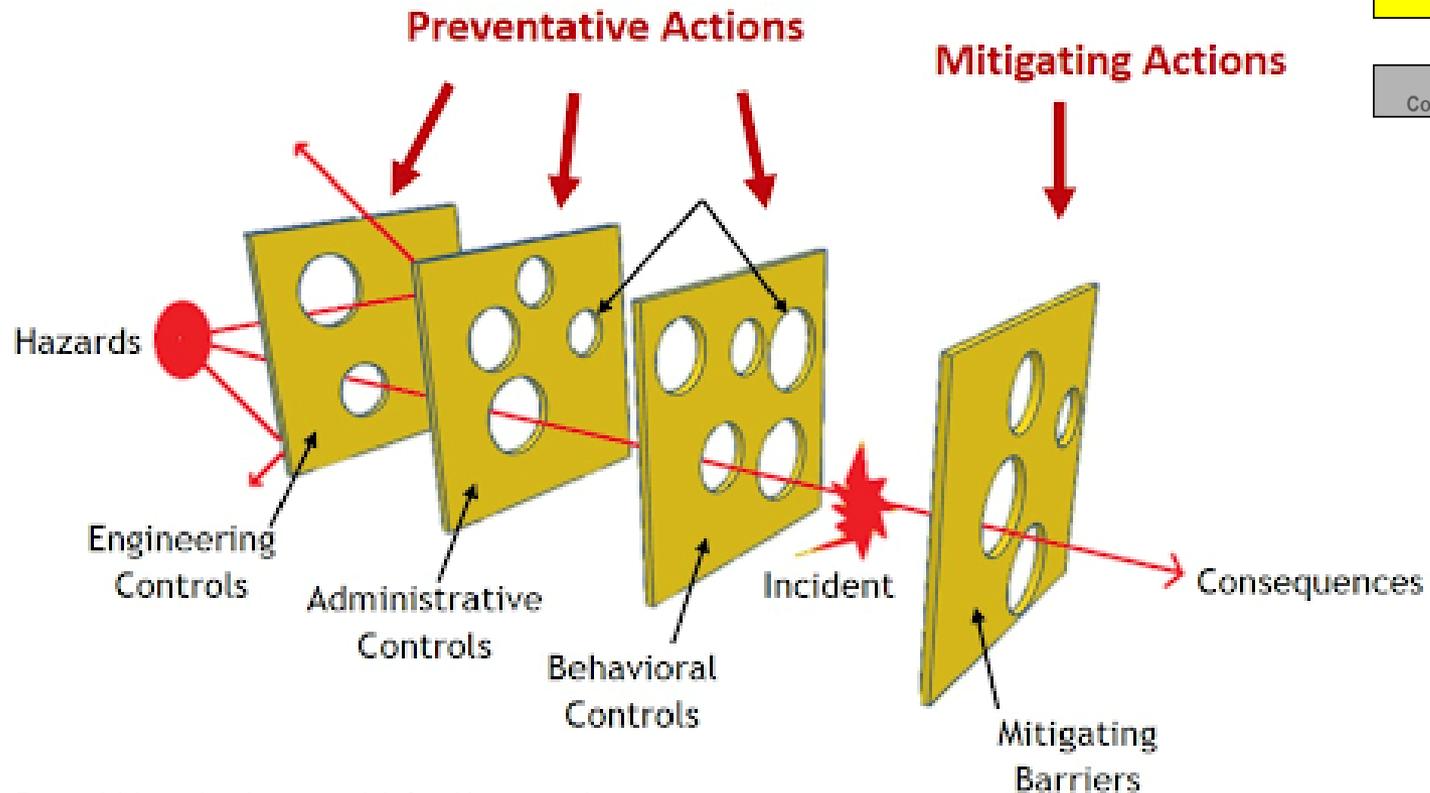
Key Safety Message

Staff should always be vigilant on construction activities along the railway line.

Risk controllers should review relevant worldwide accidents to proactively identify risk control actions for these undesirable events

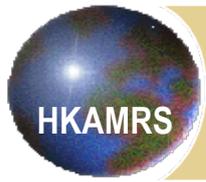


Risk control



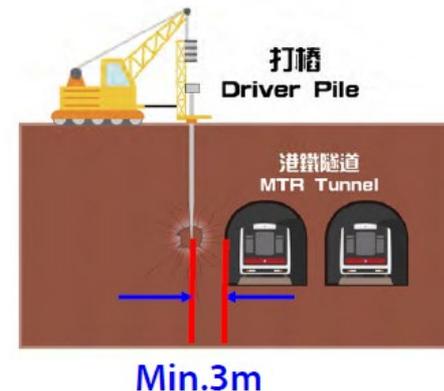
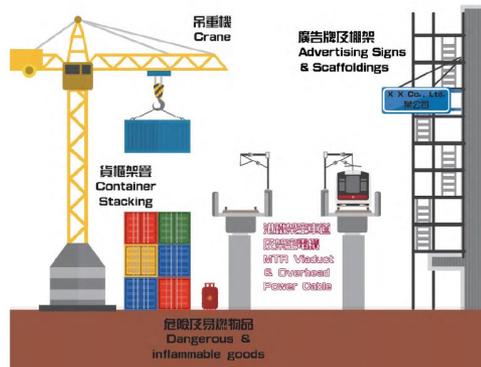
James Reason's' the swiss cheese model of accident causation

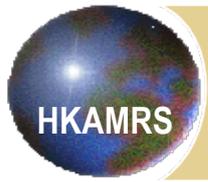
Railway operators plan and take as many risk control actions as necessary with multiple Lines of Defence to control the risk



Railway protection

- One of the many layers in controlling risk to maintain safe operation
- Mainly to provide safeguards so that all operating railway structures and installations are protected from the effects of external construction works carried out above, below or adjacent to the railway
- Can extend to cover possible intrusion from landslide, falling trees, road vehicles intrusion, etc.
- Focus on the railway protection boundary (RPB), typically
 - set at 30m from the outer surface of railway structures. (e.g., tunnel walls, railway fence/wall, parapet wall of railway viaduct)
 - Establish clearance requirements for underground structure





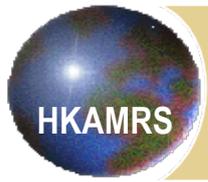
Typical requirements



Off-site trial of proposed lifting operation

- Projects intruding the RPB would need to submit engineering assessment, work method statements, risk assessments, preventive measures, proposals, etc. for operator's approval
- May carry out joint assessments for railway protection requirements and develop contingency plans
- Typical safeguards may include combinations of
 - Site hoardings, barriers & fences capable to withstand vehicle / construction plant collision load
 - CCTV / trip wires / impact detection system for prompt response of any intrusion accident
 - Implement “Permit-to-move” systems for vehicle / construction plant
 - Regular and unannounced inspection check

All construction sites near railway should be risk-assessed and install safeguards to control the risk

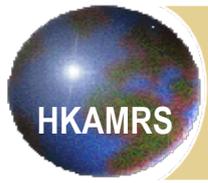


Hazard: road vehicle intrusion into railway

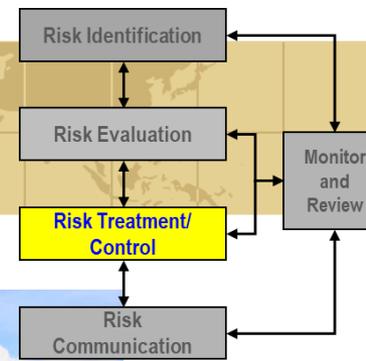
- Level crossing is the number one killer
- Train vs car, no winner



Level crossing – a preventable accident that has taken many lives



Principle of risk control



- Risk elimination
- Risk avoidance
- Risk transfer
- Risk reduction
- Risk absorption



Most effective is elimination at source – grade separation.
But this may not be considered reasonably practicable in some cases

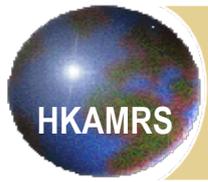


Selby rail disaster - 28 February 2001



- Caused by a Land Rover towing a loaded trailer came off a motorway bridge and landed on the train track below, at Great Heck, near Selby in North Yorkshire
- Great North Eastern Railway's 4.45am Newcastle to London service was partially derailed when it collided with the Land Rover at high speed, and the passenger train then crashed head-on with a 1,800 tonne freight train
- 10 people, including three rail workers were killed; 82 other people were seriously injured

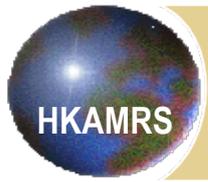
The worst British rail disaster of the 21st Century



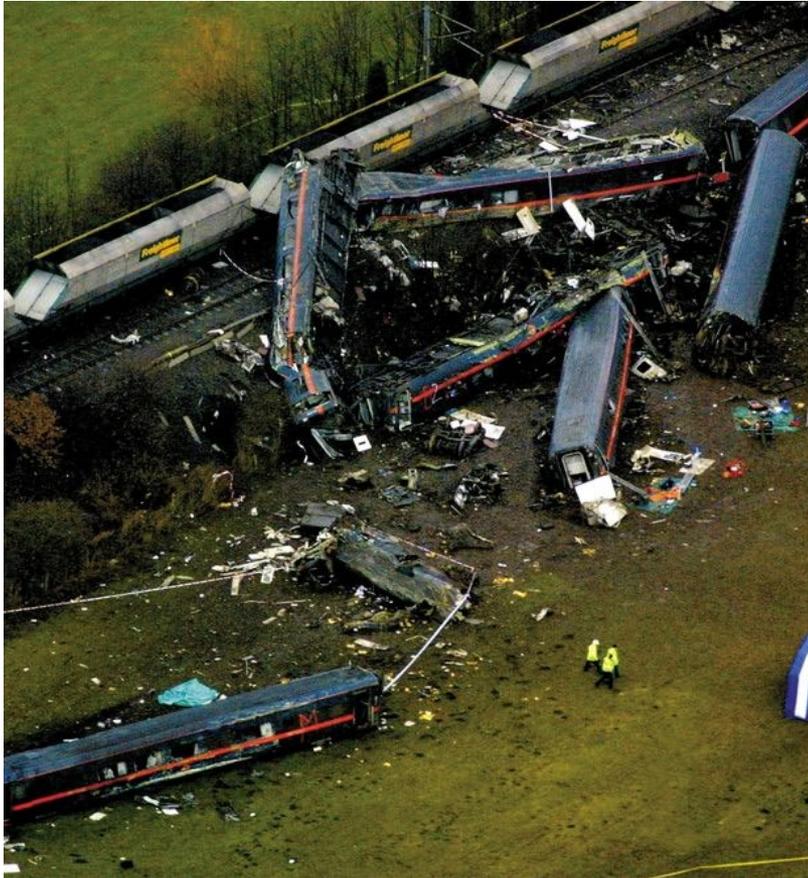
Causal factors

- The level of fatigue in Land Rover driver
- The ability of the Land Rover to overcome the roadside barrier designed to stop vehicles getting on to the railway
- The time available to remove the vehicle or stop the trains via signalling
- The crashworthiness of the passenger train

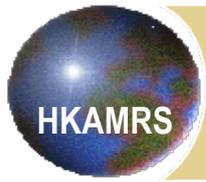




Key lessons learnt

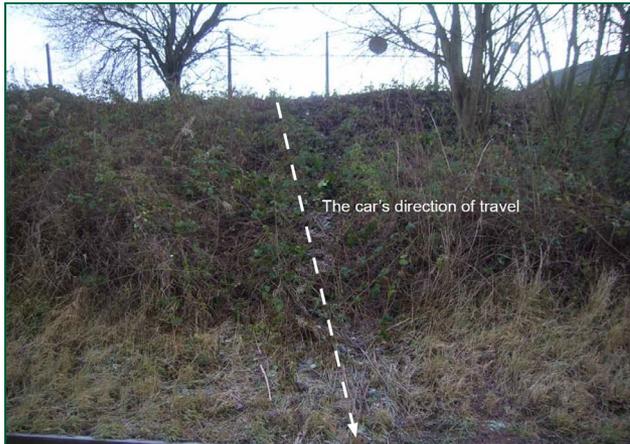


- Very little was known about the bridges carrying roads over railways and whether they had sufficient barriers and defenses to help prevent road vehicles encroaching the railway
- The accident prompted a long-term survey and led to a better understanding of the risk of encroachment, so better targeted investment on defenses
- The accident led to an improved method of understanding the risk of road vehicles getting on to the railway and the risk posed to the railways by road vehicles, and improvements to the barriers designed to keep them off



Did we really learn from the lessons?

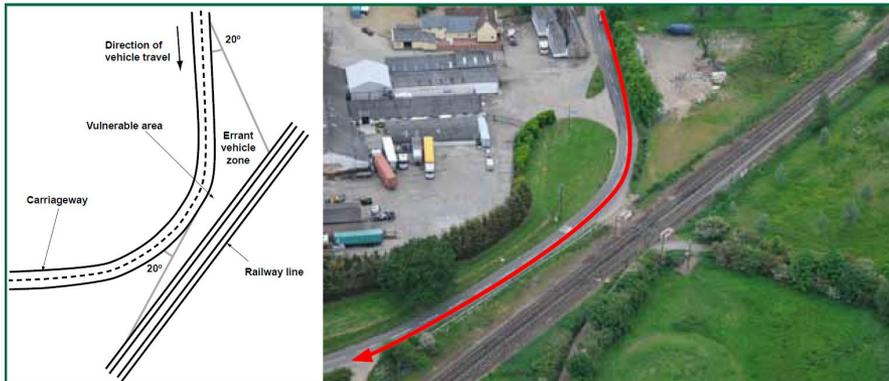
■ Collision and derailment of a passenger train at North Rode, between Macclesfield and Congleton, 18 December 2008, train driver injured



- A train struck an unoccupied car, derailed, and came to a stop as a train passed in the opposite direction. The passing train struck debris from the collision before it braked to a stop
- The car had rolled onto the railway from a car park after being left inadequately braked on a gradient (the car park is owned by UPS, a package delivery company)
- The car park fence was neither designed nor able to prevent the car's incursion
- The railway controller was not alerted to the presence of the car on the track in time to stop trains
- Network Rail had not considered the risk of vehicle incursion from adjoining private land
- UPS had not identified the risk of vehicle incursion onto the railway from its car park.

Did we really learn from the lessons?

- Road vehicle incursion and subsequent collision with a train at Stowmarket Road, 30 November 2011, no injury



Figures 7a and 7b: Images of the accident on 27 January 2010, at the same location as the accident on 30 November 2011

Figures 6a and 6b: Diagram of typical 'kiss' bend (left) and aerial view of the B1113 Stowmarket Road 'kiss' bend location (right) (image courtesy of Suffolk Police air support unit)

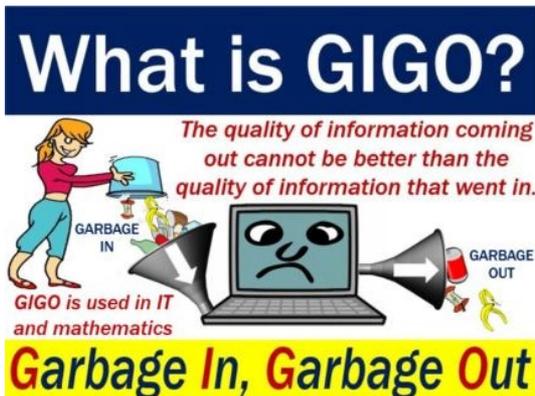
- A crash in which a car left a road and was hit by a train was partly caused by safety barriers not being improved, accident investigators have ruled
- The rail accident investigation said the county council assessed the road in 2005 but measures were not taken
- The council said a barrier was being designed but was not installed in time

Safety measures had not been put in place: too many hazards to manage or inappropriate risk ranking?

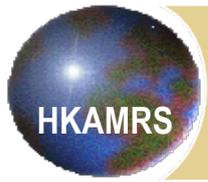


Why repeated occurrences?

- North Rode 2008: Network Rail's process for assessing the risk of road vehicle incursion, NR/GN/CIV/000125, is based upon the Department for Transport report 'Managing the accidental obstruction of the railway by road vehicles. **Neither document considers the requirement to assess the risk of incursion** from adjoining private land, so the foreseeable risk of incursion from the UPS depot was neither identified nor assessed
- Stowmarket 2011: Network Rail had **no process in place to monitor the actions** of local highway authorities after RVI risk assessments and assumed that Suffolk County Council was taking action to address the risk of vehicle incursion identified in 2005, and Network Rail's knowledge of road vehicle incursion incidents at sites other than bridges was limited

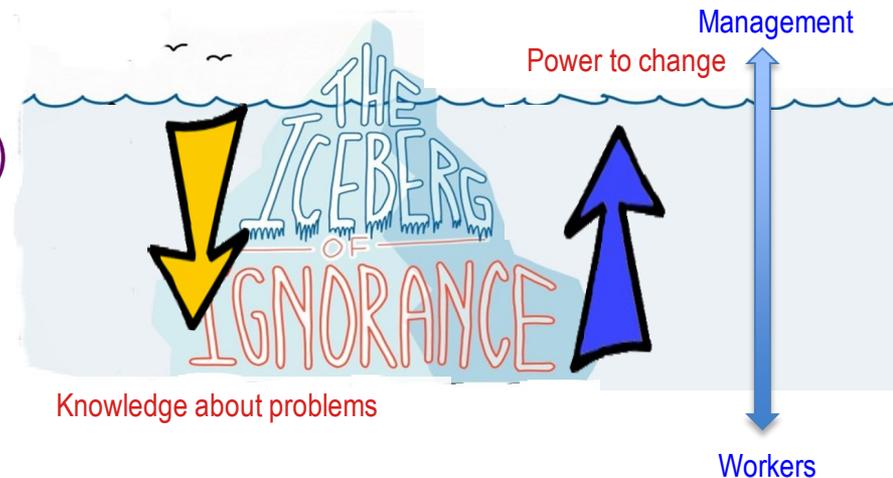


Risk management is not a magic bullet, it will not solve problem by itself
It is a thinking process, and still can be garbage-in and garbage-out



Preventive safety culture

- An accident-free working environment requires a joint effort between management and all stakeholders
 - Committed to a preventive culture
 - Management buy-in
- We need a process to help organisation preventing accidents (serious accidents) by implementing the planned risk control actions



The work culture dictate the effectiveness of a risk management programme



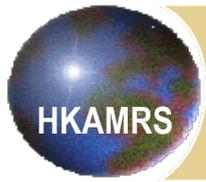
What is your work culture?

- Your attitude defines your behaviour
- Your behaviour defines your work culture
- Polling (no more polling I was told) : Will you follow the crowd to cross the street against red hand signal?



- Will you cross against red hand when there are no cars or in midnight?





In summary -takeaway

- Risk registers the level of unsafe (or benefits) of an activity, operation, or business objective, it itself is neutral
- An operating railway typically manages a very large number of hazard scenarios
- We should proactively risk assess undesirable events and embed risk management into procedures and work culture
- Risk controllers should review relevant worldwide accidents to proactively identify risk control actions for these undesirable events
- All construction sites near railway should be risk-assessed and install safeguards to control the risk
- Risk management is not a magic bullet, it will not solve problem by itself. It is a thinking process, and still can be garbage-in and garbage-out
- The work culture dictates the effectiveness of a risk management programme



End



