



Assets, Systems and Safety: a broad perspective

**A personal view of incidents, learning, and the
things we mustn't forget.....**

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Stephen Barber - Introduction and background

- Career in main line and metro railways
 - British Railways
 - privatised successors
 - TfL
 - PWI CEO
- Experience – measured in incidents?
 - Clapham - 1988
 - Hatfield - 2000
 - Potters Bar - 2002
 - Grayrigg - 2007
 - Earl's Court - 2010
 - Wimbledon – 2017
- A career of learning – and passing that learning on.....



Clapham – Collision between 3 Passenger Trains

An Industry wake-up call.....

Direct cause:

- A poorly executed interlocking wiring change caused a wrong side signalling failure (wsf) allowing one train to be driven into another.

Result:

- 35 fatalities, c500 injuries, 69 of which were serious

What went wrong?

- dangerous working practices, poor supervision, testing not to standard, no proper training or competence management system, no briefing system
- no effective resource management system, no controls against fatigue, no effective project control, no design office control
- no effective monitoring of or learning from unprotected wsfs
- reorganisation: under-resourced with no project impact assessment
- ineffective communication up and down the management chain



Photo courtesy of: Clapham immediate aftermath - BBC



Photo courtesy of: Clapham recovery operation – London Fire Brigade



Hatfield – Derailment of Passenger Train Management System Breakdown.....

Direct cause:

- C35m of rail disintegrated under a train travelling at high speed.

Result:

- 4 fatalities, c170 injuries, 4 of which were serious

What went wrong?

- non-compliance with standards and instructions (recognised but not acted on), poor appreciation of risk and no formal assessment, inadequate training and briefing, inadequate inspection, unwillingness to apply control measures (TSRs)
- competence not aligned with responsibilities, incomplete and ineffective audit, incomplete (c30%) and incorrect information in work management system, work backlog
- under-resourced organisation, frequent staff changes, lack of experience,



Photo courtesy of: Hatfield reconfigured rail - HSE



Photo courtesy of: Hatfield damaged vehicle - HSE



Photo courtesy of: Hatfield trackbed - HSE



Potters Bar – Derailment of Passenger Train

Asset Risk Understanding.....

Direct cause:

- stretcher bar maladjustment caused fatigue failure of lock stretcher, allowing switch blade to move, derailling a train at speed.

Result:

- 7 fatalities, c70 injuries

What went wrong?

- inadequate understanding of the system design and its safety limitations, no consideration of operation in degraded conditions, no risk assessment to inform maintenance regime
- no procedure or training for installation and maintenance, no effective task-specific competence management
- weakness in defect recognition, reporting, and work recording system
- absence of “preventative” design and maintenance philosophy

Photo courtesy of: Potters Bar derailed vehicle - HSL



Photo courtesy of: Potters Bar fractured lock stretcher - HSE



Grayrigg – Derailment of Passenger Train

Potters Bar Lessons Learnt?.....

Direct cause:

- stretcher bar maladjustment and failures caused vibration failure of lock stretcher fastenings, allowing switch blade to move, derailing a train at speed.

Result:

- 1 fatality, 28 seriously injured, 58 with other injuries

What went wrong?

- access constraints led to required inspection not being carried out, however erroneous report of inspection completed made
- no procedure or training for set-up and maintenance,
- previous system performance taken as guarantor of low risk level, no systematic investigation of component defects and failures, effect of RSO and FBC on system loading not recognised
- incomplete technical understanding of non-adjustable stretcher bars, no systematic risk-based process for the analysis of design and maintenance requirements
- competence management and effectiveness of audit also questioned



Photo courtesy of: Grayrigg derailed train - RAIB



Photo courtesy of: Grayrigg defective switches - RAIB



Earl's Court – Derailment of Engineers' Train That Management System Again.....

Direct cause:

- The screws holding 5 consecutive chairs to the sleepers fractured allowing the track gauge to widen under the locomotive, allowing a wheel to drop into the fourfoot.

Result:

- no injuries (but a lot of embarrassment)

What went wrong?

- faults not identified/ reported or misclassified, insufficient time for inspections, recorded track geometry gauge exceedances not communicated, total focus on safety threshold ignoring maintenance limit threshold
- ineffective surveillance and audit, concerns identified but not acted on or escalated, under-resourced organisation, extended vacancies in key roles
- difficulty in applying standards particularly for multiple defects

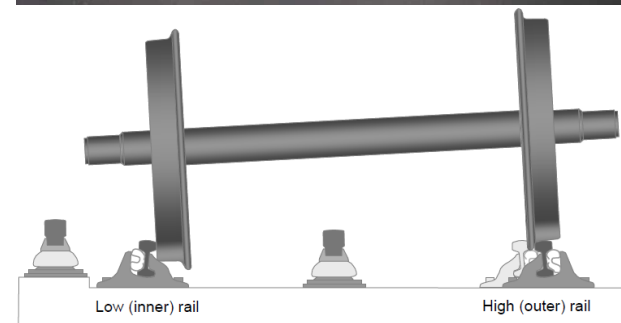


Photo courtesy of: Earl's Court derailment diagram - RAIB



Wimbledon – Derailment of Passenger Train

Unknown unknowns.....

Direct cause:

- The fastenings holding baseplates to the sleepers fractured allowing the track gauge to widen under the last vehicle of a train causing it to derail.

Result:

- 4 minor injuries

What went wrong?

- inspection boundaries were not contiguous leaving 120m of track uninspected and unmaintained for at least 8 years
- successive revisions of inspection routes did not cross reference base asset information held in other departments
- surveillance and audit regimes did not identify the discrepancy

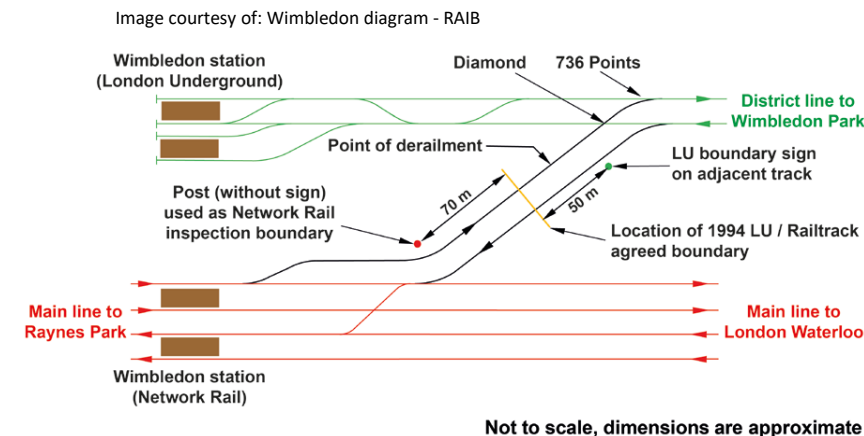


Photo courtesy of: Wimbledon SWT train - RAIB



Grenfell Tower – Fire

Learning from another sector.....

Direct cause:

- A fire in an apartment in a 24 storey block was accelerated and spread by the building's exterior cladding system, burning out the entire block.

Result:

- 71 fatalities

What went wrong?

- cladding materials did not meet the combustibility requirements of regulations guidance, other features did not meet standards, residents' concerns were systematically ignored
- over-complex and unclear system of regulation and guidance left room for shortcuts to be taken, procurement was driven by “quick and cheap”, absence of a regulatory system map meant the system's weaknesses are difficult to locate and understand
- poor change control and quality assurance,
- roles and responsibilities unclear, no clear competence regime, regulations and guidance not read by those who need to, guidance misunderstood and misinterpreted



Photo courtesy of: Grenfell Tower – ChiralJon, Wikimedia



Boeing 737 MAX – 2 Air Crashes

Good systems can be compromised.....

Direct cause:

- A malfunctioning flight control system caused two new aircraft to crash in Indonesia in October 2018, and in Ethiopia in March 2019.

Result:

- 346 fatalities

What went wrong?

- a new but “hidden” automated flight control system, in certain circumstances, repeatedly created unsafe conditions,
- unproven manual recovery procedures were ineffective
- consequences of system failure were not properly assessed and incorrect assumptions about crew response were made, new system was deliberately misrepresented to avoid scrutiny
- manufacturer exerted undue pressure on aircraft inspectors, dismissed employee concerns, prioritized deadline and budget constraints over safety, lacked transparency in disclosing essential information
- engineering flaws, mismanagement, cover-up, and poor oversight also cited



Photo courtesy of: Boeing 737Max in flight - pjs2005 from Hampshire, UK, Wikimedia



Photo courtesy of: Ethiopian Airlines flight crash - Reuters



Overview

What are we getting better at?

Across the examples:

Factors Present in Examples of Serious Incidents									
Year		1988	2000	2002	2007	2010	2017	2017	2019
Causal Factor	Incident	Clapham	Hatfield	Potters Bar	Grayrigg	Gloucester Road	Wimbledon	Grenfell Tower	737 Max
Industry understanding of Asset Risk									
Engineering Safety Management - Systemic Controls									
Industry understanding of Work Management Risk									
Cultural / Ethical Defecit									



Concluding thoughts and questions?

- Asset risk is well understood
 - and we have most, if not all, the data (it's out there somewhere!)
 - why do we still tolerate in-service failure?
- New railways can deploy effective Engineering Safety Management from the outset
- But legacy assets and systems pervade existing networks
 - do we fully understand their failure modes and criticality?
- Defect identification and work management processes and systems remain absolutely critical to infrastructure management
 - all currently rely on human input and interaction (to greater or lesser extents)
 - do we confirm they are robust - and how (HAZOP, FEMECA)?
 - do we understand their performance in QRA terms and how do we improve it?
- Will data quality ever reach the standard required for autonomous operation?
- How is “wrong culture/ wrong ethics” countered?