



# Human Factors Performance in the Overall System and Use of the Ten Incident Factors

Mark Kenwright – Alstom

EMR – Ian Beck

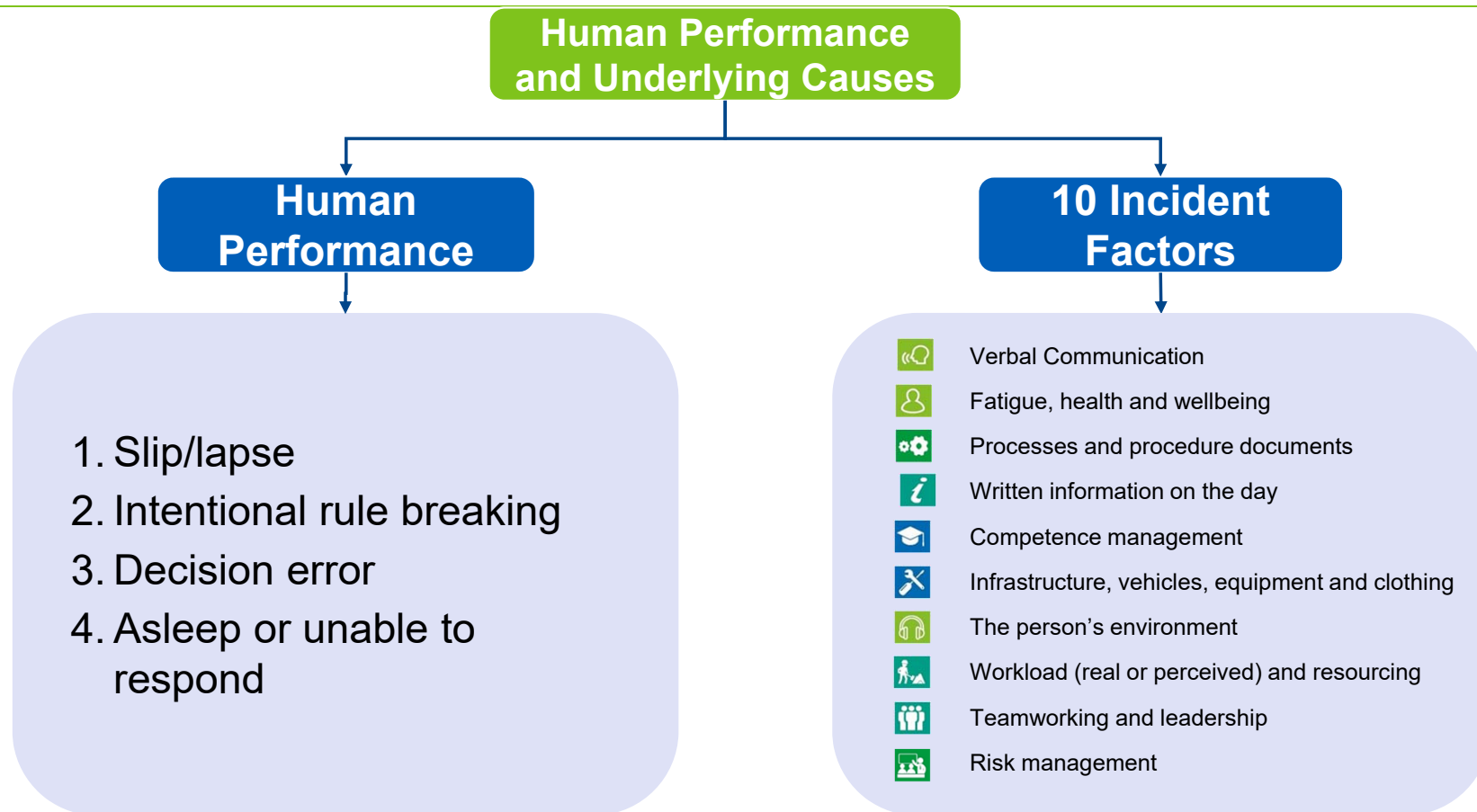
Huw Gibson - RSSB

# Overview

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- Human Performance and the 10 incident factors in industry
- Alstom use of the 10 incident factors to set strategy
- EMR SPAD investigation

# Human Performance and the 10 Incident Factors



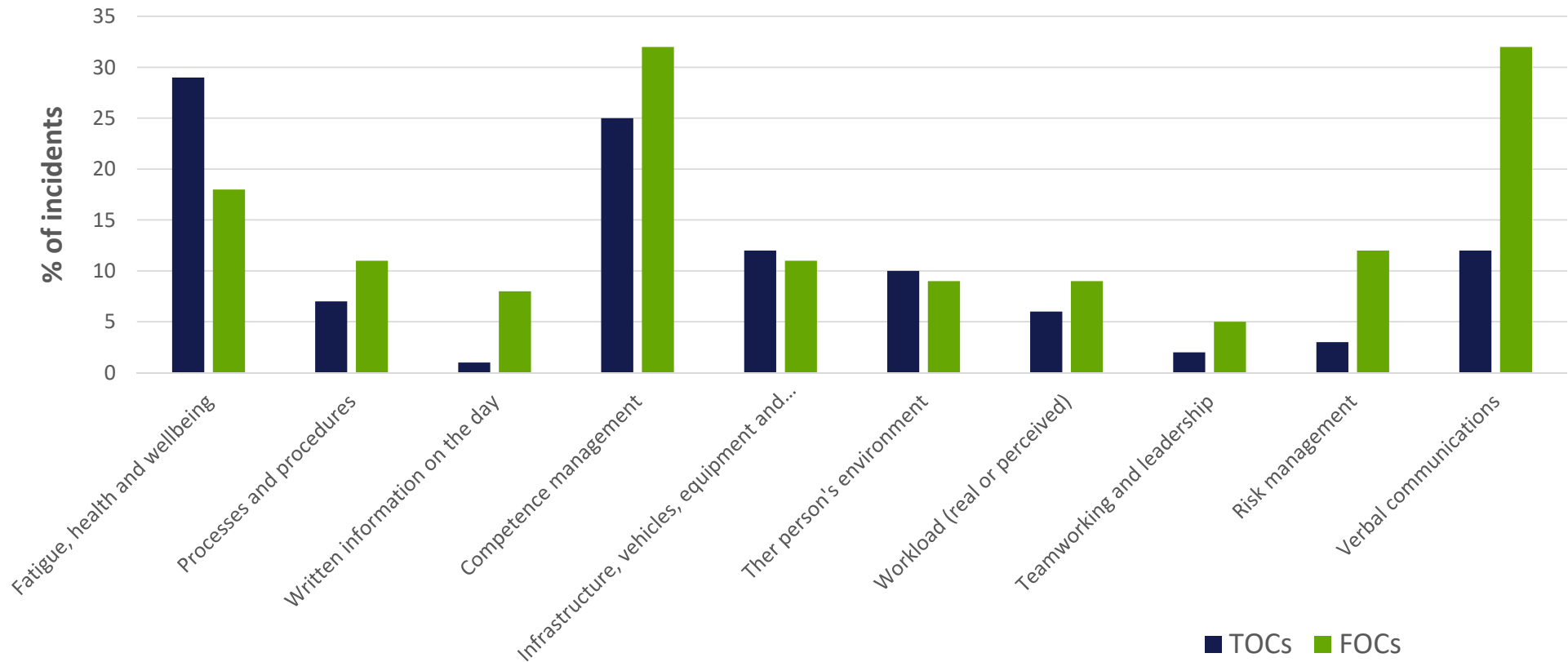
# Aims

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- A consistent, usable agreement on types of human performance and types of underlying cause
- Rail Industry Standard for Accident and Incident Investigation RIS-3119-TOM (issue 2)
- Review and analysis across incidents

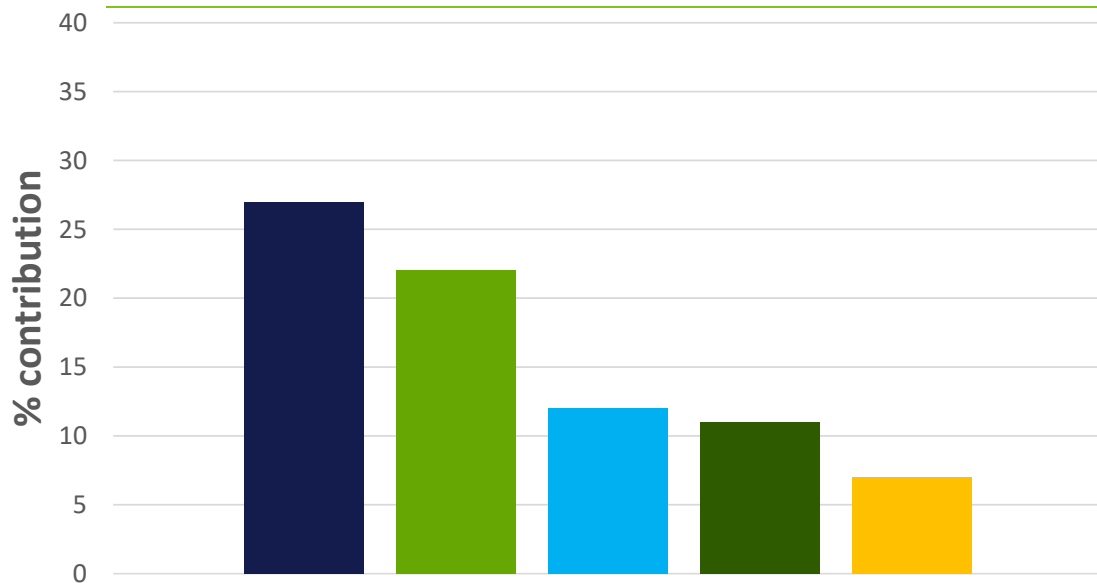
## TOCs – Fatigue, health and wellbeing

## FOCs – Competence management and verbal communication



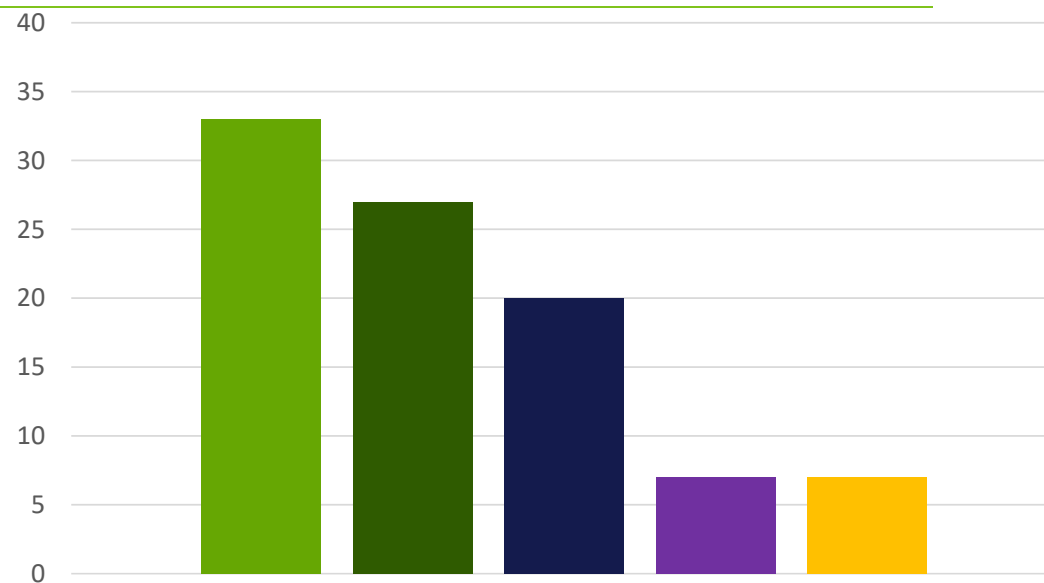
10 Incident Factor Profiles for TOCs and FOCs

# SPAD underlying causes related to fatigue



TOCs SPAD underlying causes related to fatigue

- Factors outside of work
- Mental or emotional health affecting performance
- Physical health affecting performance
- Worked a poor shift/roster approved by organisation
- Fatigue (physical or mental) - higher level category



FOCs SPAD underlying causes related to fatigue

- Mental or emotional health affecting performance
- Worked a poor shift/roster approved by organisation
- Factors outside of work
- Other wellbeing issues
- Fatigue (physical or mental) - higher level category

## Key Activities

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- Provision of accident investigation training to support implementation of the RIS
- Some companies using the 10 incident factors including: Freightliner, DB Cargo, Alstom, EMR, Network Rail
- Application to investigate the Period 3 peak in SPAD incidents
- Developing accident investigation process functionality in SMIS and develop industry capability in accident investigation aligned to SMIS system
- Application for driver, signaller and trackside staff task research



## Alstom Railway Safety – Use of 10 Incident Factors

Mark Kenwright, Head of Railway Safety  
UK&I

13<sup>th</sup> November 2019

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# Agenda

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Alstom UK&I “Railway Safety” Performance.

- Root Causes Analysis

10 Incident Factors Indicator

- Conclusions

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Alstom UK&I “Railway Safety”  
Performance.

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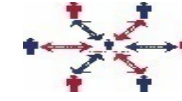
# Alstom UK&I Long Term Trend – Product Safety Issues / Incidents Raised



Fasteners & Lubricants initiatives



10 Incident Human Factors initiatives



Collaboration initiatives



Precursor & NTS initiatives

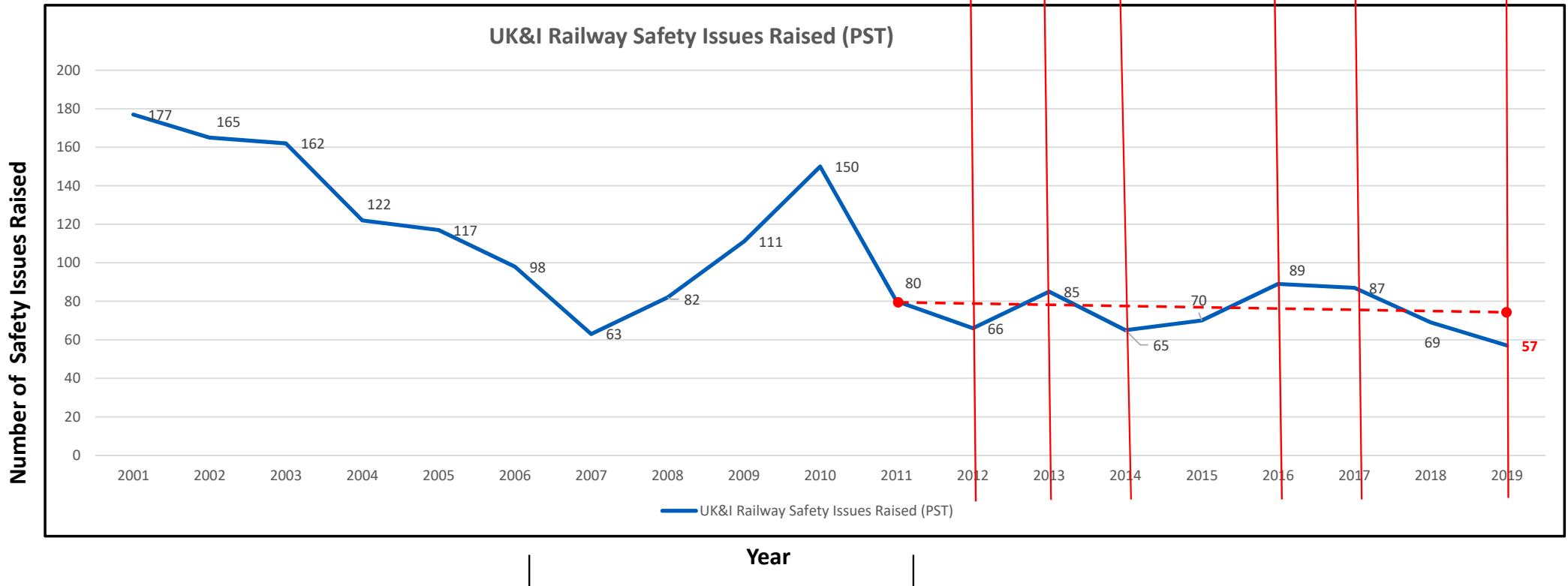


Practices & Processes and Communication initiatives



Communication Timeline initiatives

● - - - - ● Forecast/Trend over 9yr period



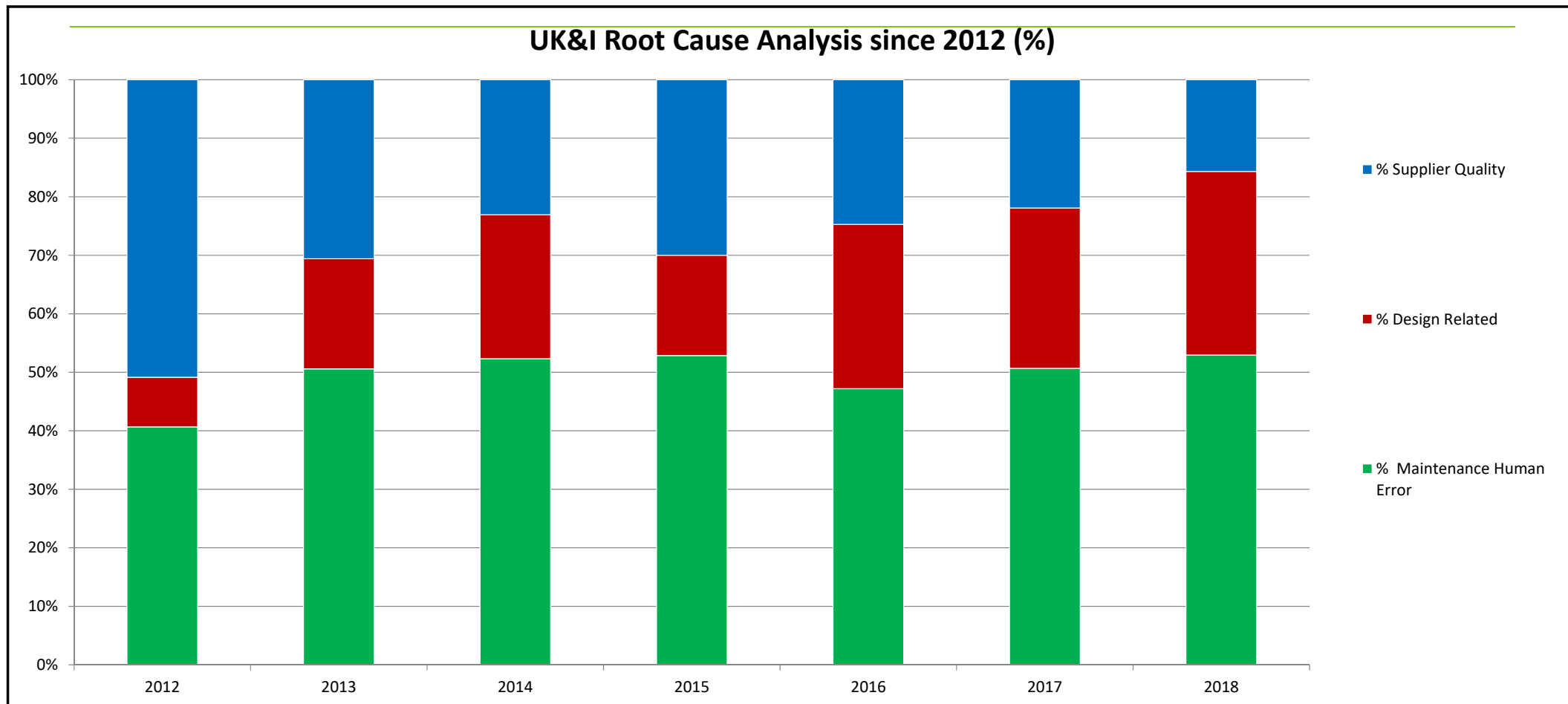
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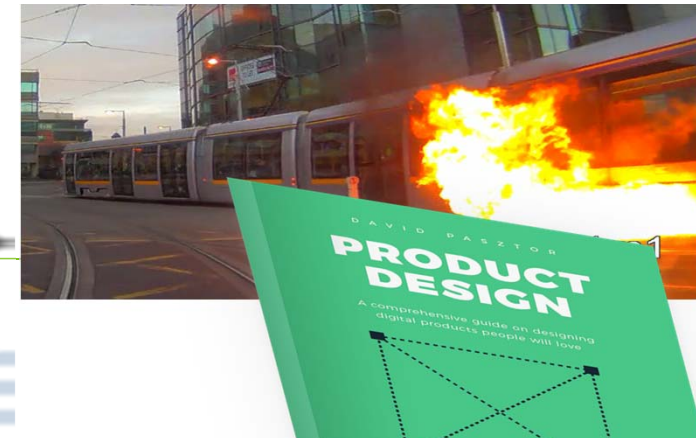
## Root Causes Analysis

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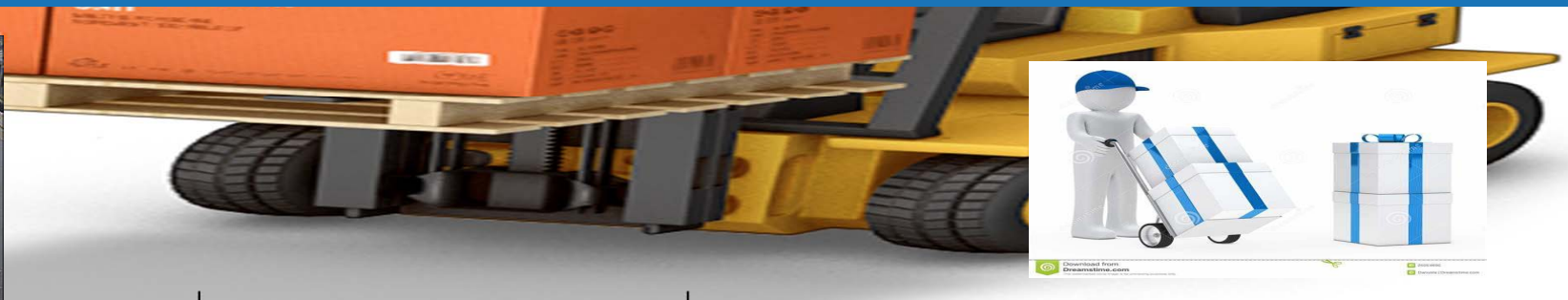
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# Railway Safety Root Causes Analysis






“ Approximately Half of all Railway Safety Issues raised could be linked to the Design and or Supplier Quality. ”




## Maintenance Human Error (Examples)



A significant number of Railway Safety Issues raised involved fixings incorrectly supplied, stored or fitted



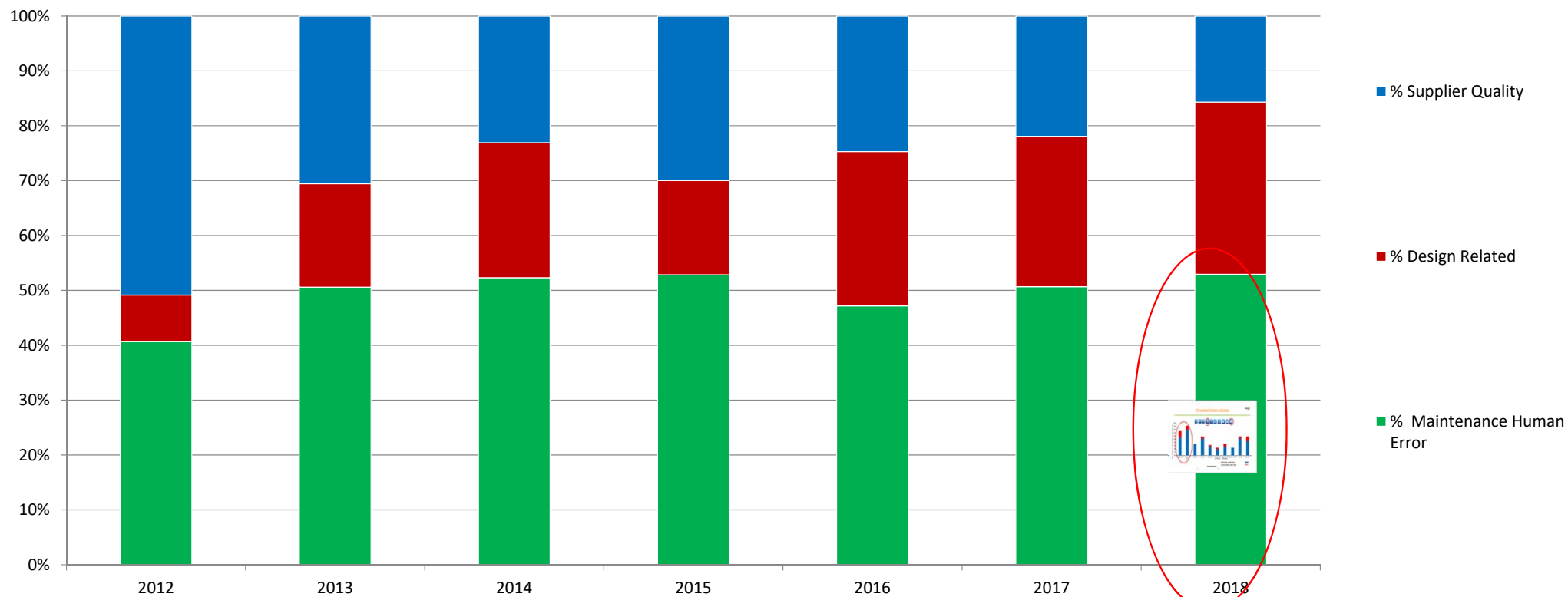
Kitchen Ceiling light Panel



Final Drive Gearbox Drain plug

# Railway Safety Root Causes – UK&I 2018

UK&I Root Cause Analysis (%)





# 10 Incident Factors Indicator



# 10 Incident Factors



## Communications

How we relay **verbal** information to each other in context of safety critical information.



## Practices & processes

**Written** rules, standards, processes and methods of working which guide and structure activities undertaken.



## Information

Additional new or ad hoc information used to support an activity or task.



## Knowledge, skills & experience

A factor if the individual(s) involved did not have the appropriate knowledge to perform the activity safely.



## Personal

The collection of influences which can affect attention, fatigue and focus of an individual at work.



## Workload

Workload is affected by the task, its context and the individuals who carry out the activity.



## Work environment

Contains potential stress factors such as lighting levels, noise, temperature and vibration.



## Equipment

This refers to any equipment that is used to undertake or support an activity.



## Supervision & management

Can be the underlying reason for an incident due to decisions made about budgets, work allocation and planning.



## Teamwork

Factors that influence this are number of people in a team, structure, stability and leadership.

Visit : [Railway Safety UK & Ireland Intranet Page](#) for further information

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Conclusions

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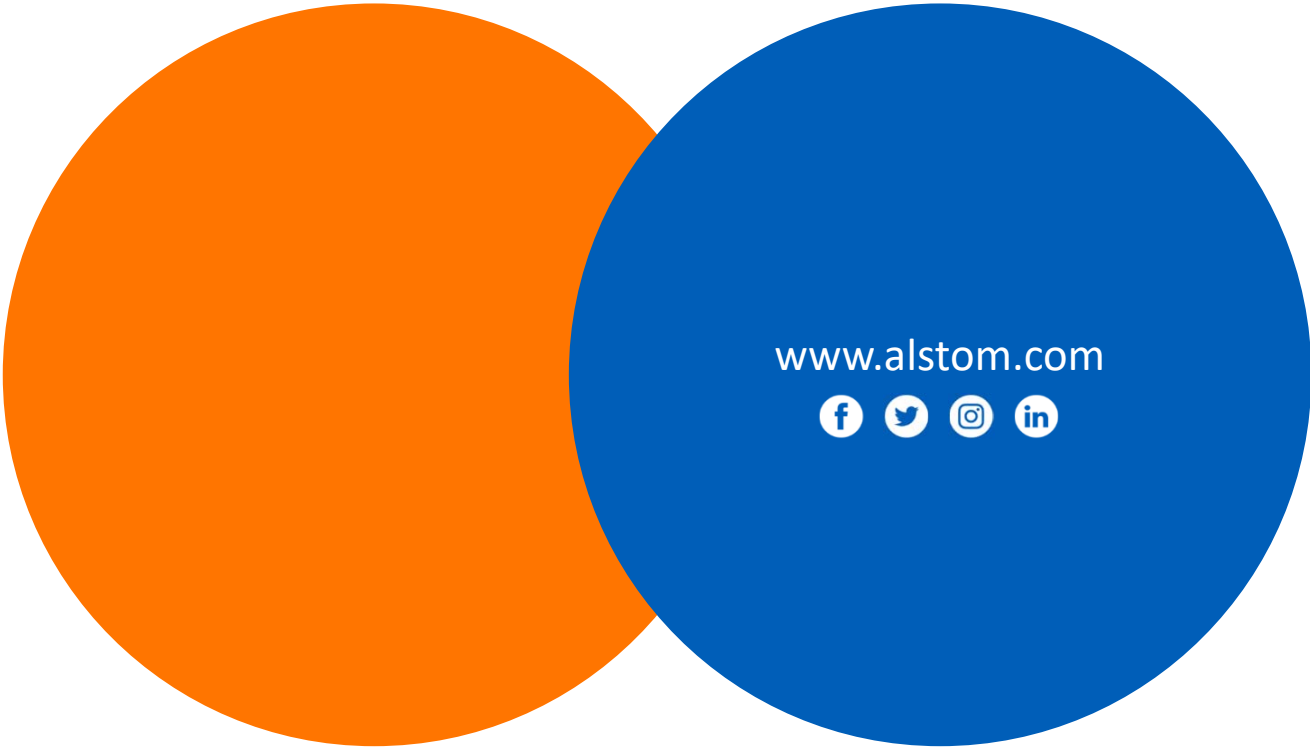
## Conclusions

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- Around 75 Product Safety incidents have been raised per year for the last 9 years.
- Supplier related incidents have been steadily decreasing.
- Design related incidents have been steadily increasing.
- Approximately 50% of the incidents raised relate to Human Error during Maintenance:
  - Communications and Practices & Processes are the dominant contributory factors.
- Initiatives Identified :
  - Raise awareness of the “dominant” Contributory factors of incidents raised.
  - Deliver & support the introduction of NTS within the business.

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# Our approach to Incident Investigation – Human Factors

The logo consists of the letters 'E', 'M', and 'R' in a bold, white, sans-serif font. Each letter is contained within a dark purple rectangular box. The boxes are arranged horizontally and are slightly offset from each other, with the 'M' box being the tallest and the 'E' and 'R' boxes being shorter and positioned lower.

**E M R**

# EMR

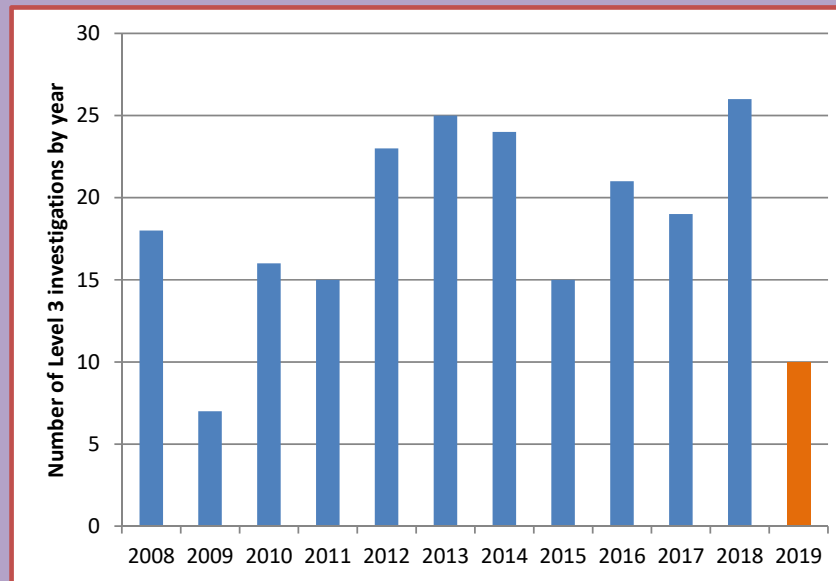
- Formed in 2007 from former Midland Mainline franchise, part of Central trains franchise and part of Maintrain organisation, then East Midlands Trains.
- Operated by Abellio Group since October 2019.
- Operate approx 470 trains per day, the SFO for 90 stations,
- Mainline services from Leeds, Sheffield, Nottingham to St Pancras
- Long distance local services from Liverpool to Norwich
- Local services in East Midlands and Lincolnshire.



# Incident investigations

- East Midlands Railways has four levels of investigation:
  - Level One – minor investigations
  - Level Two – investigations to a standard remit
  - Level Three – investigations to a remit set by the Designated Competent Person following an event review
  - Level Four – Formal inquiries, externally led investigations

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# Who carries out Level 3 investigations?

- Investigator identified at the Event Review
- Inexperienced investigators normally assigned a mentor
- Investigators have a range of skills, experience and competencies.
- EMR provide investigator training (from external providers) together with additional support regarding use of non-technical skills / human factors
- Includes support on building competency development plans with individuals involved
- Use of 10 incident factors build into latest version of our procedure

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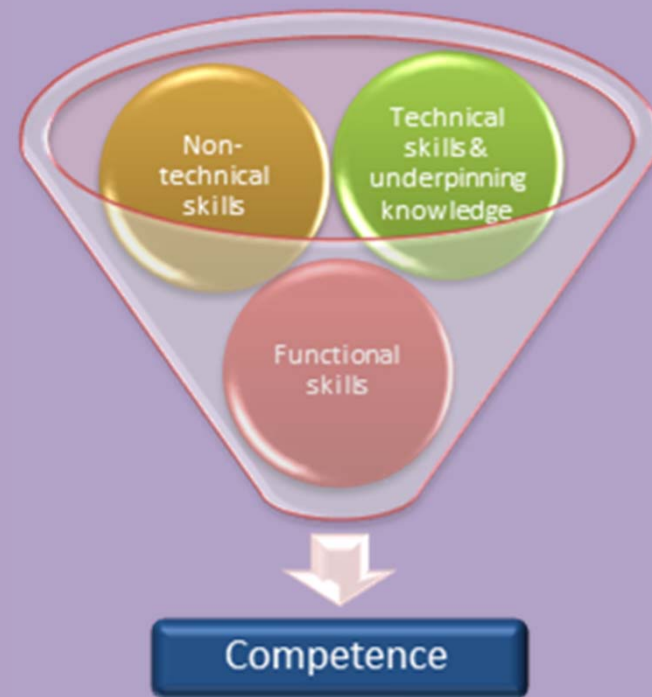
# Live Investigation

## • CAT A SPAD

As Investigators we look at;

- Competence,
- Rules and Procedures
- Infrastructure
- Equipment
- AND Human Factors / NTS

**E M R**



# NTS and Human Factors

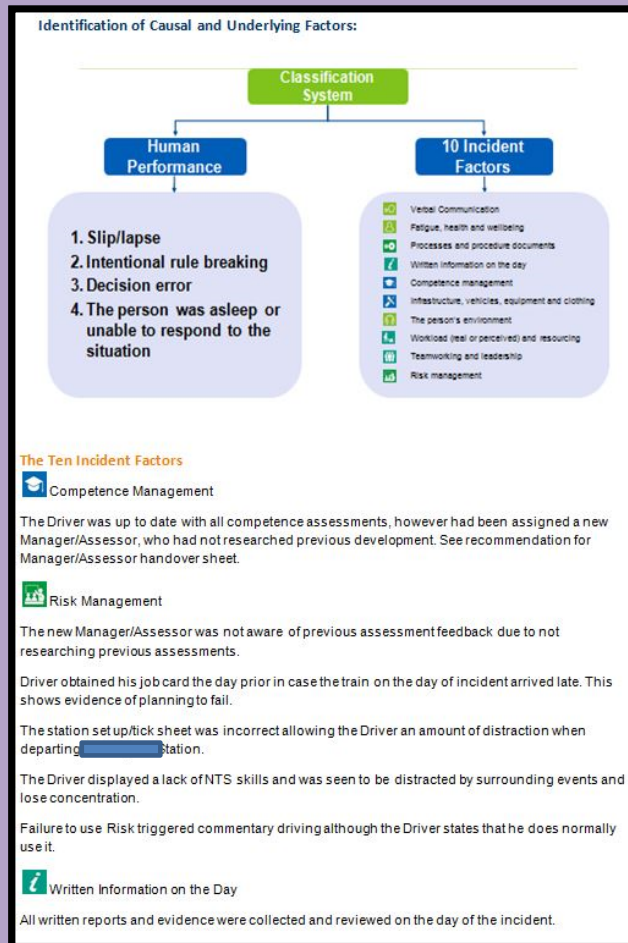
## Within the Investigation

### The Basics;

- The Driver booked on at approximately 08.30.
- Then walked over to Platform 1 to locate his train which was to form the 08.55 service.
- The service was indicated to be departing from platform 1A but the only train platformed was in 1B which the Driver ascertained was his train after speaking to the guard.
- The platform starting signal cleared to a signal yellow which was displaying an X route indication.
- As the service departed the station the Driver sounded the warning horn for track workers and then for a Look-out a short distance after.
- The Driver had observed a green signal on Y line to which he focused his attention, only realising his mistake when he again looked for his signal and observed X line's signal to be displaying a red/danger aspect.
- The service came to a stand after passing XXXX signal at danger without authority by approximately one coach length.

# 10 Incident Factors

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**Team working & Leadership**

The Operations supervisor is responsible to complete the Station set up/tick sheet, ready to give to the Platform Assistants. This sheet was incorrect and therefore allowed risk to enter the process. Should the Platform Assistant not observe the error then the potential is that customers board the wrong train or miss the service completely. This also allows distraction and concentration interference to the Driver and Train-crew.

The new Manager/Assessor of the Driver failed to observe feedback from previous assessments and therefore could have not developed the Drivers risk areas.

**Infrastructure, Vehicles, Equipment & Clothing**

Not a factor in this investigation.

**Fatigue, Health & Wellbeing**

Not a factor in this investigation but worth noting that he had worked eight consecutive days prior to the incident.

**Verbal Communications**

The investigation has shown that the reporting of this incident was not completed in full, by not informing the EMR Duty Route Control Manager (Local). The Driver wanted to leave the GSMR equipment free to enable the Signaller to contact him.

GSMR voice recordings were problematic in reviewing because of the new GDPR requirements and EMR's computer software.

The Driver did not reconfirm the Signallers instructions when he changed ends to return into [redacted] Station.

**Process & Procedure Documents**

The Station set up/tick sheet was seen to be completed with an obvious error, this need to be reviewed and a censor check completing prior to issue.

Manager/Assessor handover sheet (Recommendation) should be completed to avoid development feedback and Driver history being missed.

The Driver failed to inform the EMR Duty Route Control Manager (Local) of the incident.



#### Workload & Resourcing

Not a factor within this investigation.

Although it was noted that [REDACTED] was the Drivers very first part of his diagram.



#### The Person's Working Environment

Not a factor within this investigation.

### Human Performance

#### Slip/lapse

There was a lapse of concentration on approach to signal [REDACTED] where the Driver failed to identify the caution aspect.

#### Intentional rule breaking

Not a factor within this investigation.

#### Decision error

The Driver approached signal [REDACTED] incorrectly, thinking he was approaching a proceed aspect.

The Driver incorrectly target fixed signal [REDACTED] which is located on the same gantry.

#### The person was asleep or unable to respond to the situation

Not a factor within this investigation.

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# Conclusions

## Summary of Conclusions

### The Immediate Cause

The Driver of [REDACTED] failed to apply the train brake in sufficient time on the approach to signal [REDACTED] which was displaying a stop (danger) aspect and bring the train to a stand prior to the signal.

### Underlying Causal Factors

#### Failure to comply with the EMT Train Driving Policy when approaching a signal at danger.

Operate Trains in Service section 6, 6.2 Route Risks, 6.4 Common Causes of SPaD's, 6.5 Automatic Warning System (AWS), 6.6 Approaching Signals at Danger, 6.8 Approaching and Stopping at Signals at Danger.

#### The Driver had numerous Non Technical Skills failings (Appendix J).

- Situational Awareness
- Workload Management
- Anticipation of Risk
- Overall awareness
- Global Awareness
- Effective, Timely decisions
- Checking
- Maintain concentration
- Systematic and thorough approach
- Multi-tasking and selective attention
- Prioritising
- Confirmation bias
- Strong but Wrong

#### Confirmation bias and Strong but wrong

The Driver made an assumption that signal [REDACTED] was displaying a green proceed aspect, when he had incorrectly target fixed signal [REDACTED].

#### Target Fixing

The Driver failed to identify signal [REDACTED] and subsequently target fixed the incorrect signal T[REDACTED]. As his priority changed to sounding the warning horn and observing track workers once he had seen the incorrect green signal displayed at T[REDACTED] and failed to check the approaching signal on further approach to it.

#### No positive action taken on approach to [REDACTED] signal.

Confirmation bias led the Driver to incorrectly approach T[REDACTED] signal, as the Driver believed he was approaching a proceed aspect.

The Driver took power whilst observing and sounding the train warning horn for track workers, understanding his error when he received the AWS warning for signal [REDACTED], which leads the investigator to believe that the Driver believed he had a clear signal aspect at signal [REDACTED] because he had misread the green aspect displayed at signal [REDACTED].

#### Read across.

The Driver incorrectly identified [REDACTED] signal [REDACTED] as his own instead of [REDACTED] signal [REDACTED] which was displaying a danger/stop aspect. These signals are located on a gantry with two other signals but all four signals are identifiable due to being fitted with line identification boards and labelled A[REDACTED] (right to left)

#### Distraction / concentration issues.

The Driver failed to maintain concentration through various distractions, observing and sounding the warning horn for track workers, Look-out and a distraction caused by leaving customers on the platform at [REDACTED] Station.

#### Risk Triggered Commentary Driving

The Driver failed to use RTCD (Risk Triggered Commentary Driving) on the approach to signal [REDACTED] when departing Nottingham Station or when observing track workers and the Look-out.

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# Recommendations

## Recommendations

### 1. Change of Competence Assessor/Manager Handover Form.

Reason(s): To create a handover form to document and provide feedback to the new Competence Assessor/Manager to afford visibility/concerns/development with the Driver concerned, allowing the new Assessor/Manager to target those areas and provide a consistent standardised assessment approach to the Driver.

Owner: Head of Operations Standards – East Midlands Railway.

Timescale: Within 3 Months of this investigation.

### 2. Voice Communication Review.

Reason(s): To ascertain during ongoing review meetings if all voice recording equipment is operative and working correctly. This will also include if the communications are obtainable and be able to be reviewed when requested by the Investigators post incident (including GDPR restraints and software issues). Updates can then be addressed and actions can be taken away by Network Rail and reported on prior to subsequent review group meetings. Included within the meetings, Network Rail are to sample voice recordings to ascertain if the GSMR recording equipment is functioning correctly and report back to the group.

Owner: Chairperson Voice Communication Review Group - for East Midlands Railway.

Timescale: Ongoing.

### 3. Running Brake Test Reminder.

Reason(s): Drivers are to be reminded of the EMR Running Brake Test rules and the potential for previous mental models and distractions at certain locations where combining this action and signal identification could be an issue.

Owner: Driver Safety Engagement Manager – for East Midlands Railway.

Timescale: Within 3 Months of this investigation.

Recommendations

### 4. The Driver is to be placed on a suitable Competence Development Plan.

Reason(s): The Driver is to be placed on a competency Development plan (CDP) to address the factors identified within this report and attend a Non Technical Skills awareness course / training to help support the CDP.

Owner: [REDACTED] East Midlands Railway.

Timescale: Prior to the Driver returning to his substantive duties.

### 5. Station set up sheet censor check form.

Reason(s): To enable the Station set up sheet to be completed correctly, minimising mistakes for Customers, Drivers/Senior Conductors and platform staff, enabling visibility to all with no confusion.

Owner: Lead Operations Manager - for East Midlands Railway.

Timescale: Within 3 months of this investigation.

### 6. Reporting Procedure Reminder.

Reason(s): The reporting of incidents and significant events is to be placed on an EMR Notice for display in the Notice cases of all EMR booking on points, to reaffirm the requirements of reporting such events.

Owner: Driver Safety Engagement Manager - for East Midlands Railway.

Timescale: Within 3 months of this investigation.

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# Attention to interview to highlight Human Factor / NTS failings.

Do you use RTCD  
A. Occasionally yes

Did you on this occasion  
A. No

Why  
A. I believe i didn't because i was fresh, use it when i'm tired, to remain focused, don't know why I didn't, could be because i was just leaving [REDACTED]

What stopped you on this occasion  
A. Possibly all the distractions

Q. You stated previously about singing single ladies, why didn't you do this  
A. Believed there was too many distractions, and didn't focus on what i should have

Q. What were the distractions  
A. Wrong platformed, people on the platform, Pway workers and reading across.

Q. Where is the crossover to [REDACTED]  
A. I knew i was on [REDACTED] didn't focus on the [REDACTED] just on the green.

Q. Where did you see the signal from [REDACTED] and can you see them both together  
A. didn't focus on the signals just the Pway workers, after this when i went past them, looked and saw the green on [REDACTED]

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# BESPOKE NTS Coaching

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## EMR

### Professional Discussion NTS (Non Technical Skills)

#### Master Template

Date  

Prepared by:  

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Title	Page
Non Technical Skills discussed/highlighted/Activities	2
Discuss OUDA STAR and GROW models	3
Key learning stages	3/4
Brain apps	4
Short term long term memory	5
Error management tools	5
Pressure and stress	5
Self reporting	6
Concentration grid activity	6
CDP plan	6
Personal action plan	6
Summary of the day	7
Management Notes	7

Line manager referral notes:

Over-run at Birchwood, was changing sun blind at the time.  
 We have discussed this incident in detail after the NTS grouping task in order for [redacted] to now understand his actions and the causes. Hopefully highlighting the risk for future risk mitigation.  
 You understand that you should always put the brake in before your mind is distracted by other things.

Non Technical Skills discussed/highlighted:

Activity – Put all the 26 sub sections into the right NTS groups  
 Discuss the 7 Non Technical Skills or choose 2 or 3 to discuss in depth  
 [redacted] spoke about the NTS categories and how he can relate these to the job and the task in hand.  
 Discuss the OUDA, STAR and GROW models in depth, link them to their role  
 We discussed the OUDA model and how this relates to your role and you have agreed that it does and when linked to NTS you can see how this can be helpful.  
 Use a selection of videos to show situational awareness etc  
 [redacted] was surprised at the level of information he had not seen and is now aware of the fact he could be blinkered and miss the bigger picture.

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The S.T.A.R., OUDA and GROW Model

Key learning stages – There are 4  
 Unconscious incompetence, Conscious incompetence, Conscious competence and Unconscious competence

What do these mean

Stage	Definition
1. Unconscious incompetence	You do not realize there is a learning

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	need. You don't know what you don't know. You are unaware whether your actions are safe or unsafe
2. Conscious incompetence	You begin to drive a train but you are not particularly good at it (Incompetence) and you have to constantly think about what you are doing (Conscious)
3. Conscious competence	You are now competent in Driving (Competence) but you still have to concentrate and verbalise what you are doing (Conscious)
4. Unconscious competence	You are competent in your driving (Competence) but now no longer have to think about what you are doing (Unconscious) as your driving has become instinctive

Going from Conscious competence to Unconscious competence – Known as Auto pilot.

How do you know when you are in auto pilot? – You cannot remember what you have just done

What are the advantages and disadvantages of operating in unconscious competence might be:

Advantages	Disadvantages
Allows a skilled behavior to be performed well most of the time	A resource hungry intensive second task can stop monitoring on the progress of the primary task that is being performed
Frees up working memory and consciousness to perform a second task	If the environment or task being performed is slightly different from the norm it can lead to errors
Ideal when the environment or task being performed is always the same	Strong but wrong environmental cues can lead you to make errors

#### Brain Apps:

It is a mental software programme that your brain develops as you continue to practice a key skill such as train working.

Your brain takes your verbal commentary that you rehearse and use when developing the train skills and converts it into a brain app – A mental software programme that can be run without conscious thought

The more you practice, the more the brain app becomes detailed until the app can be run on its own without conscious thought – Autopilot

Errors that can occur whilst you are running a brain app in unconscious competence mode (Autopilot)

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You leave station A and arrive at station B – All the way along this route you are momentarily scanning but what could stop you making a momentary scan?

**DISTRACTIONS – From this there could be an error**

Short term long term memory:

Discussion took place on what short term and long term memory is and how we get information from short term to long term memory so that [redacted] can remember the information longer for example RTC, risk triggered commentary and ensure this is associated with an action i.e. put brake in.

Error Management/Tools:

A lengthy discussion took place on what tools [redacted] could use to help them within their role. Discussion also took place to understand what drivers are using to help them (yellow bricks, post-it notes, flip charts, writing on job cards).

Does cross of station stops, highlight stops, checks with guard, check job card on approach to braking points and understands that this reinforces his memory retention. Does use RTCD at some locations so we have discussed the benefits for every day use.

[redacted] has taken a list of error Management tools away with them to carry out some research on how these work and what error management tools are around. (This can be discussed with their Manager when they meet to finalise their CDP plan if on one)

The following tools were discussed:

Visual Scan Strategy  
Checks and Mental checks  
Commentary and Verbalisation  
Kinesthetic and Movement  
Short Term Memory Aids

Pressure and Stress coping:

We discussed how important coping with stress is and about using techniques to help [redacted] cope when things get stressed or when he feels he is being rushed. [redacted] is aware that it is so important that when under Pressure or Stress that they take the time to react to this before making a decision.

Breathing  
Time – 2 – think  
Count to ten  
Walk (Not rush)

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Self reporting:

Discussions took place around how important it is that members of staff openly report any issues to their line Manager, this will ensure that all issues are dealt with. We spoke how reporting personal issues is important as this could affect how you drive at work etc inc memory retention.

If you have an incident always report it, signaller, control and fill a report in.

Concentration Grid:

[redacted] was tested on his concentration (document enclosed). The concentration grid is designed to help people improve their powers of concentration.

Before the activity started they are given 60 seconds to look over the grid – Watch how they use this 60 seconds, discuss with them what they did, what did they check for etc

The concentration grid works by the staff member being told to study the grid and that then they would be given a number and then they must then cross off all numbers above and in order, they would have 60 seconds to do the task. The member of staff would state how many numbers they would cross off ([redacted] stated 10). You will see that [redacted] scored only 3 which demonstrated that [redacted] was easily distracted and focused on finding a pattern rather than a number.

When the task started it was my role to distract the staff member by any means possible i.e. by continually talking and by putting the staff member under pressure.

[redacted] fully aware of what is contained within this report and is welcome to a copy should he/she so wish.

CDP Plan:

Does the line manager need to add to/create a CDP plan? They may not be on a CDP plan but you may now think that they should go on one.

When discussing [redacted]'s CDP plan the following should also be looked at:

The actions within the plan and this bespoke was the last action before the plan closes.  
[redacted] thinks the plan was a success and has hopefully taken something from today which will reinforce the actions contained within the plan.

• Personal action Plan:

• At the end of the meeting I gave [redacted] a personal action plan and asked them to fill it in and that this could be used to support their CDP plan, although this is the last interaction on [redacted]'s CDP these actions could be used to help focus and reinforce actions that were contained within the plan and help mitigate future risks to [redacted]

• Handouts:

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- Full list of all the 7 NTS skills with associated sub sections and there meaning
- NTS list and markers – Positive and Negative
- The grow model
- NTS skills using the OUDA model
- NTS skills with description and examples
- Signs and symptoms of stress
- Non Technical Skills development sheets for safety critical workers – Log book

**Summary of the day:**

You completed the NTS skill sorting exercise well and some groupings required a little reorganising, but the main point was that you interacted well and have read and understood the skills and how they can link into groups.

We had a good discussion about the incident and the surrounding circumstances and how this was related to NTS skills. I feel you now have an appreciation for NTS skills and how to apply them in understanding the task in hand and the risks of your actions or no actions.

This will help mitigate future risks for you whilst driving trains.

I think you enjoyed watching the observation videos and realised that blinkering your focus can allow you to miss the obvious staring out at you. This has raised your awareness into global awareness and anticipation of risk.

You openly discussed and participated today well and I feel very positively, hopefully you have opened your mind to NTS and understand the task at hand.

You have various processes in place to keep you safe, but I would state that RTCD is an excellent tool, which we discussed in detail and always associate this with an action.

**Management notes:**

Complete [redacted] CDP as this is the last action – [redacted] was positive throughout today and gave good levels of input where needed.

Signed: [redacted]

Signed: [redacted]

Date: [redacted]

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Mitigate Future Risk and become more resilient to error.

Continue Doing? MARKING OFF STATION STOPS  
HIGHLIGHTING UNUSUAL STOPS.  
CHECKING STOPPING PATTERN,  
WITH CONDUCTOR.  
READ P.I.S. SCREENS.  
KEEP CHECKING JOB CARD  
THROUGHOUT TURN.

**Start doing?**

MORE RISK TRIGGERED COMMENTARY  
DRIVING AND ALWAYS ENSURE AN  
ACTION IS TAKEN.

EMR

**Thank you**

**Any questions?**

**E M R**