Bowtie Analysis of Overspeed Risk at Irish Rail

Nora Balfe[1], Ken Byrne[1], Ron McLeod[2]

[1] Iarnród Éireann, Irish Rail

[2] Ron McLeod Ltd.

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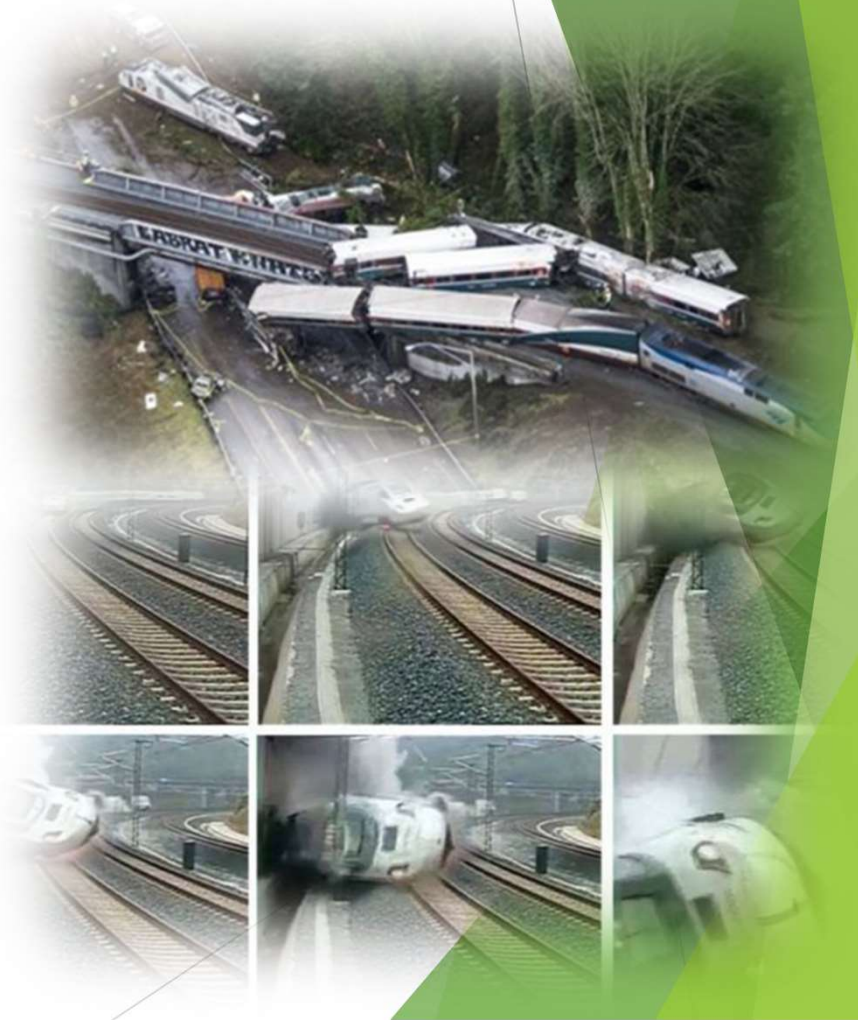
Introduction – Overspeed Risk

- Excess speed is a major hazard in the rail industry
- If train speed exceeds that permitted for the track, the train can derail
- Several recent railway accidents have featured overspeeds, e.g.
  - Tacoma, Washington (2017)
  - Santiago de Compostela, Spain (2013)



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Overspeed Risk in Irish Rail

- Overspeeds are routinely monitored
  - Traditionally by speed gun
  - Increasingly automatically between points
- Approx 17 million train kilometers run each year
- Despite the relatively low numbers of overspeeds (compared to train kilometres), we wanted to better understand the risk and the controls around overspeeds

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Bowtie Analysis

- Internal investigation of overspeed events has tended to focus on human error
- Bowtie analysis offered to opportunity to look at the problem from a systems perspective
- Our approach followed a white paper on applying Bowtie Analysis by the UK Chartered Institute of Ergonomics and Human Factors
- Facilitated by an external expert on BTA

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Bowtie Analysis

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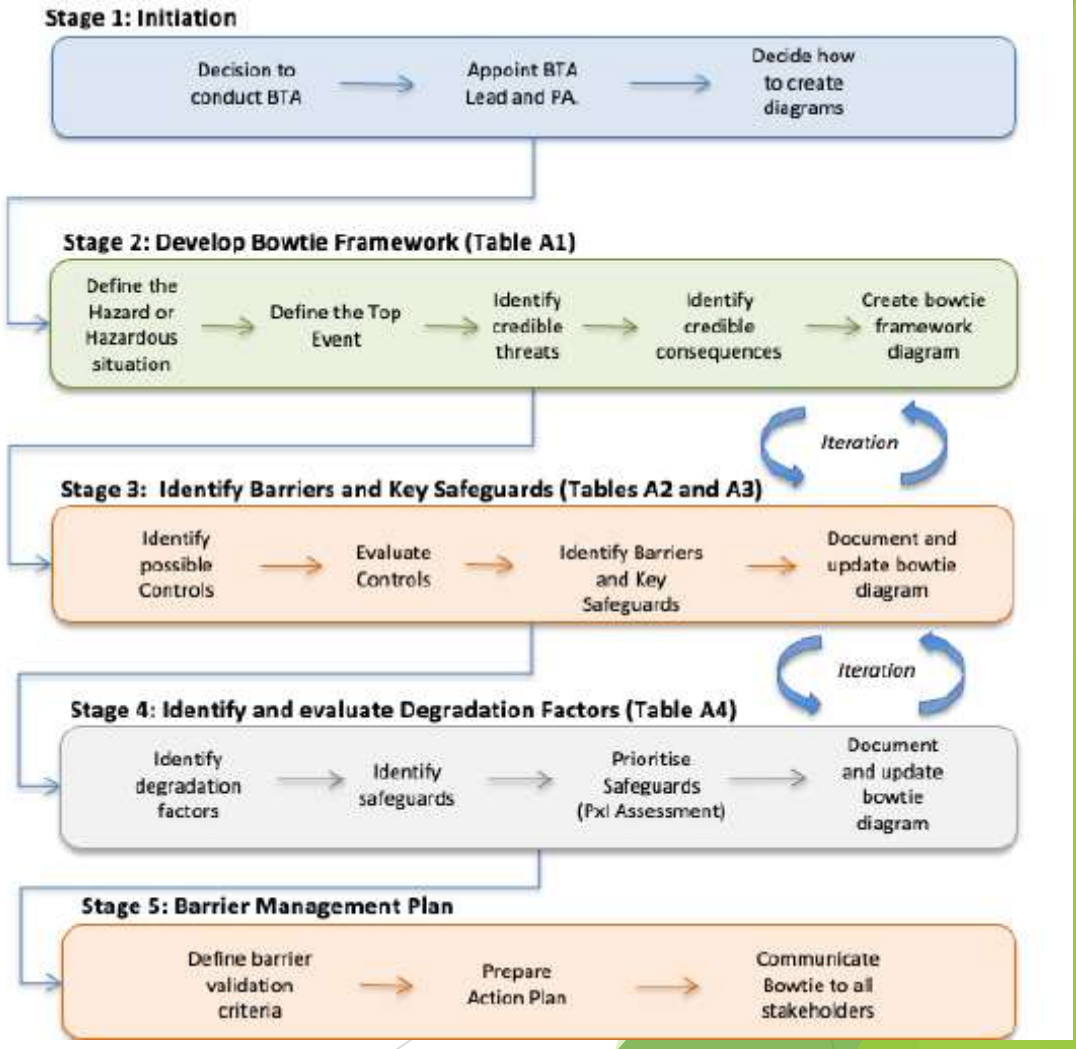
Analysis Method

- Working group
  - Facilitator
  - Operational expertise
  - Civil engineering
  - Safety managers
  - Human Factors specialist
- Applied a five stage process from initiation to developing a barrier management plan



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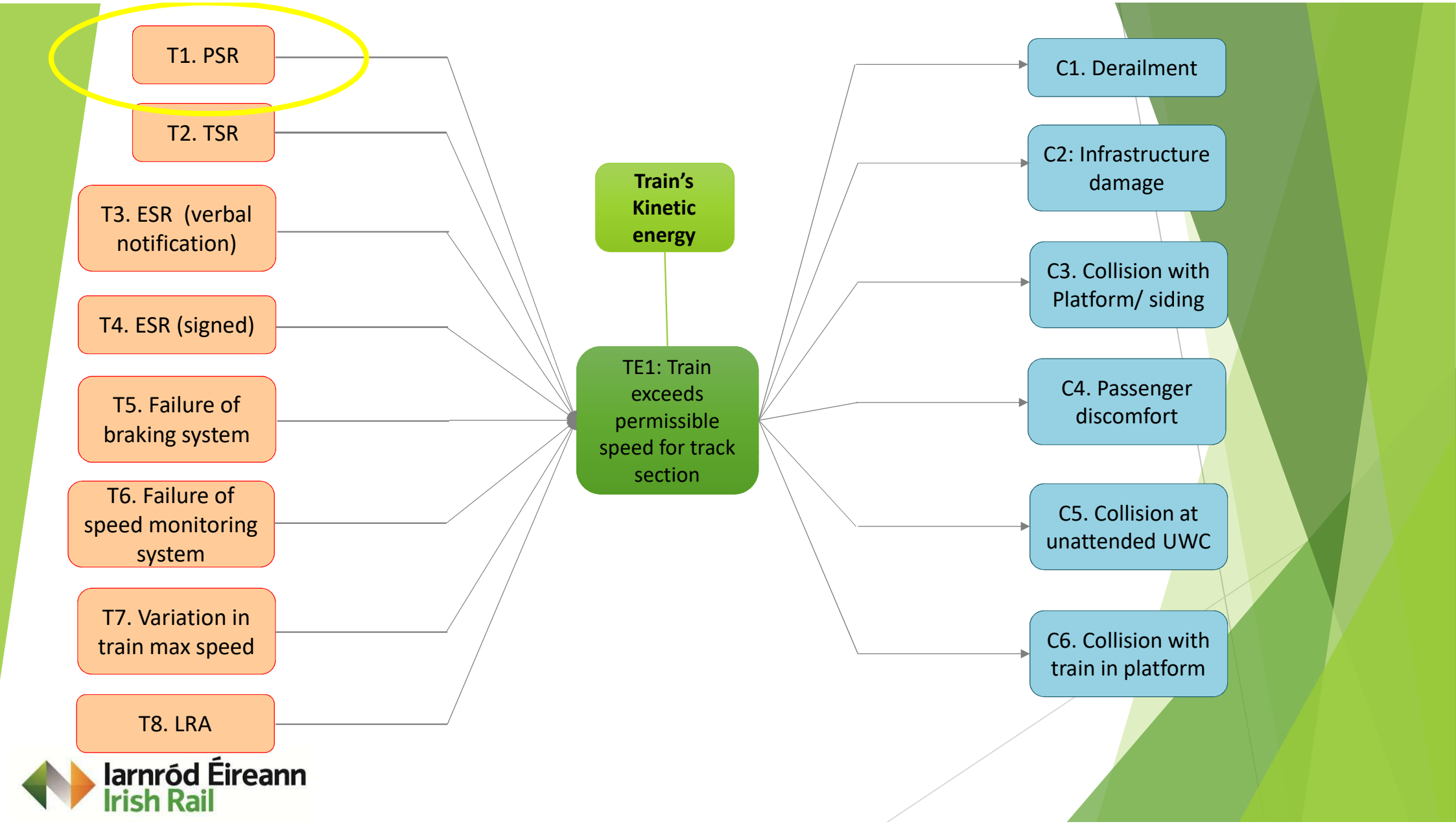

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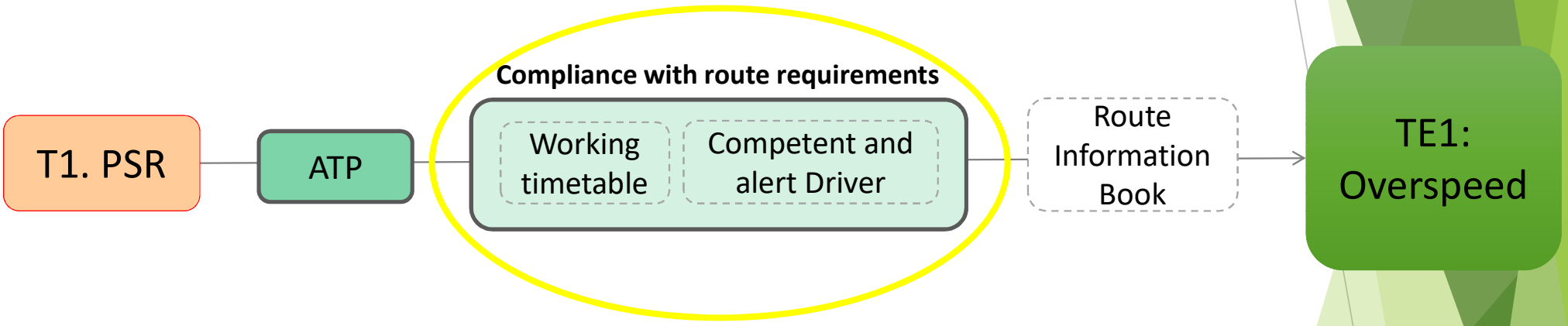

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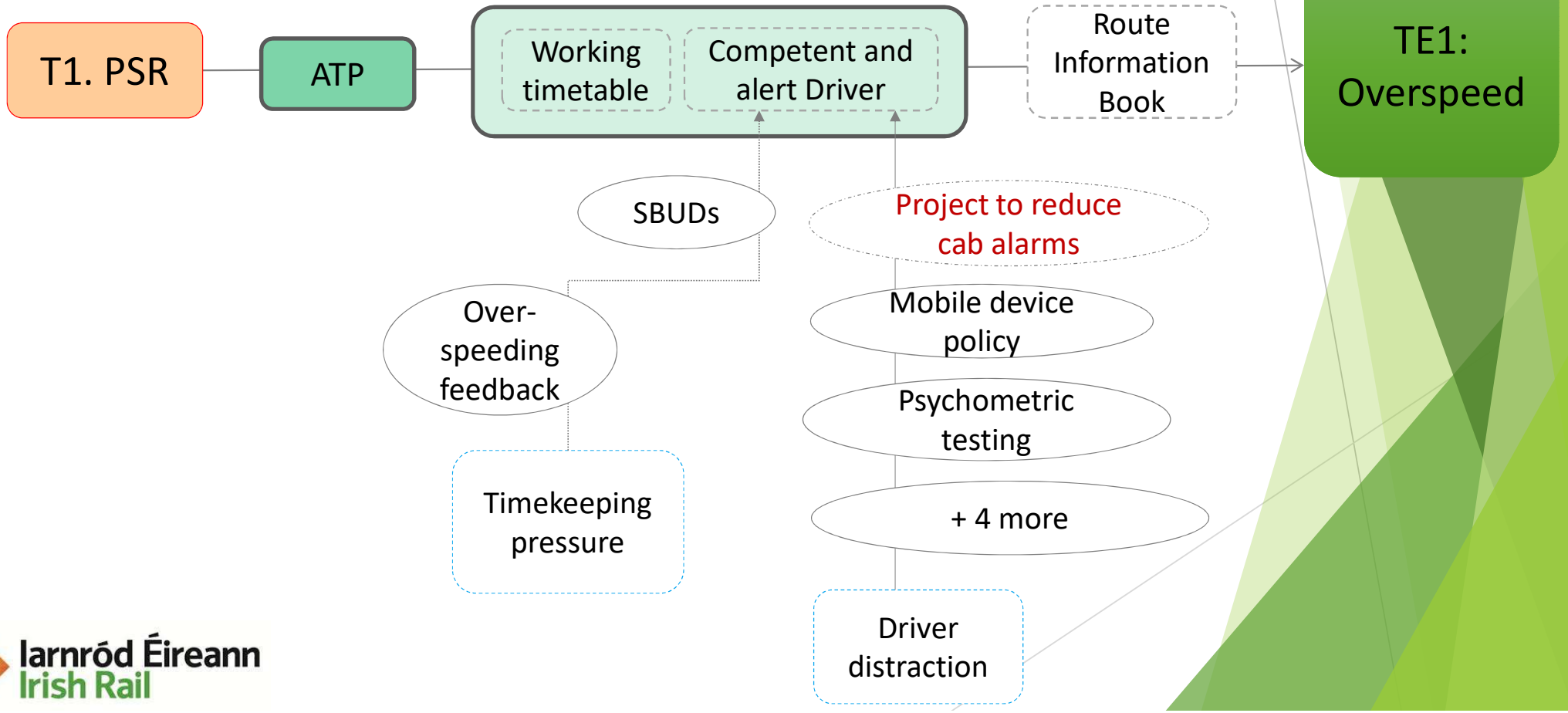
Driver – Example Degradation Factors and Controls



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Analysis of barriers

- 12 full barriers between ‘threats’ and an overspeed
  - 3 technical – ATP and braking systems
  - 1 organisational - Brake test procedure
  - 1 human – communications between signaller and driver
  - 7 combined human and organisational – combinations of different information sources and the driver
- 6 full barriers between an overspeed and consequences
  - 1 human – reporting and inspection following an overspeed
  - 5 human and technical – driver applying brakes

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Controls

- Overspeed prevention
  - Competent and alert driver (11)
  - Working timetable (2)
  - Late notice case (2)
  - Signaller (2)
  - ATP (2)
  - Route information book
  - Weekly circular notices
  - TSR/ESR boards
  - Running brake tests
  - Fail-safe braking system
  - Proactive driver monitoring
  - Scheduled maintenance of train systems
  - LRA countermeasures
- Consequence prevention
  - Competent and alert driver (6)
  - Brakes (5)
  - Compliant road users (2)
  - Track geometry
  - Check rail
  - Signaller
  - CCE inspection team
  - Buffer stop
  - Level crossing decision support system
  - Level crossing signage

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Competent and alert driver

- High reliance on individuals, predominantly train drivers, complying with organisational and operational controls.
- These administrative controls place a significant demand on drivers' cognitive abilities: in particular the ability of individuals to absorb and understand information about changes to daily working practices and to draw on and use that understanding to guide their attention and decision making throughout the entirety of a working shift.
- It is necessary to support human performance through the provision of high quality information, procedures, design, etc.

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Barrier management plan

- The output of the bowtie analysis was translated into a ‘barrier management plan’
- This contained a set of actions to either:
  - Check that existing controls are in place and working properly
  - Assess the feasibility of new controls or improvements to controls

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Example actions in the BMP

- Verification, e.g.
  - Review of driver files before passing out as competent
  - Formal update procedure in place for Route Information books
  - TSR signs are manufactured to the required standards
- Assessment, e.g.
  - Formatting of WTT, WC, and RIB
  - Improving visibility of signs
  - TSR board sighting standards
  - New speed monitoring system

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Conclusions

- The bowtie analysis highlighted our reliance on human and organisational controls to prevent and mitigate overspeeds
- Detailed analysis of the possible degradation of these controls led to a barrier management plan
- The barrier management plan focuses on:
  - Assuring that current barriers are in place and working as designed
  - Assessing the feasibility of improvements to barriers

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Thank you for your attention

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