



DELIVERING SAFETY AND RELIABILITY THROUGH INDUSTRY COLLABORATION

SARS LONDON BRANCH/YRP

3RD JUNE 2020

The Safety & Reliability Society is now a Licensed Member of the Engineering Council for direct CEng and IEng Professional Registration



YOUNG RAIL
PROFESSIONALS

SaRS SAFETY
AND
RELIABILITY
SOCIETY

PROGRAMME

- Introduction to YRP / SaRS and our Speakers
- Presentations
- Q&A/Panel session
- SaRS/YRP items
- Feedback form





INTRODUCING SARS

The Safety and Reliability Society is the professional body for safety, reliability and risk management practitioners. We provide our members with a direct path to professional registration for CEng and IEng as well as providing them with opportunities for cross-industry learning, CPD and networking.

We are internationally recognised as the leading body for domain expertise through our branch technical seminars, journal, knowledge base, webinars and membership.

The Young Rail Professionals is the professional association for young people in the railway industry. Our mission is to:

Promote



the rail industry as a great place to work.

Inspire



the next generation of railway talent.

Develop



and connect the future leaders of the industry.



YOUNG RAIL
PROFESSIONALS

Chair and presenters



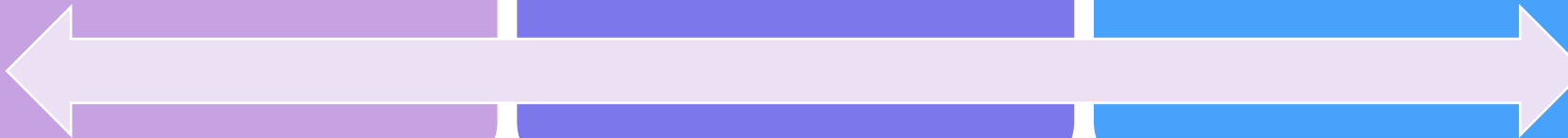
John Stringer
Abbott Risk Consulting
Chair



Fotios Zapantis
Safety Intelligence
Analyst, RSSB
Presenter



Giulia Lorenzini
Senior Partnership and
Grants Manager, RSSB
Presenter



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Delivering a reliable railway through industry collaboration and innovation

Presented by Giulia Lorenzini
Senior Partnership and Grants Manager
R&D Programme

Rail as a complex system

Complex systems:

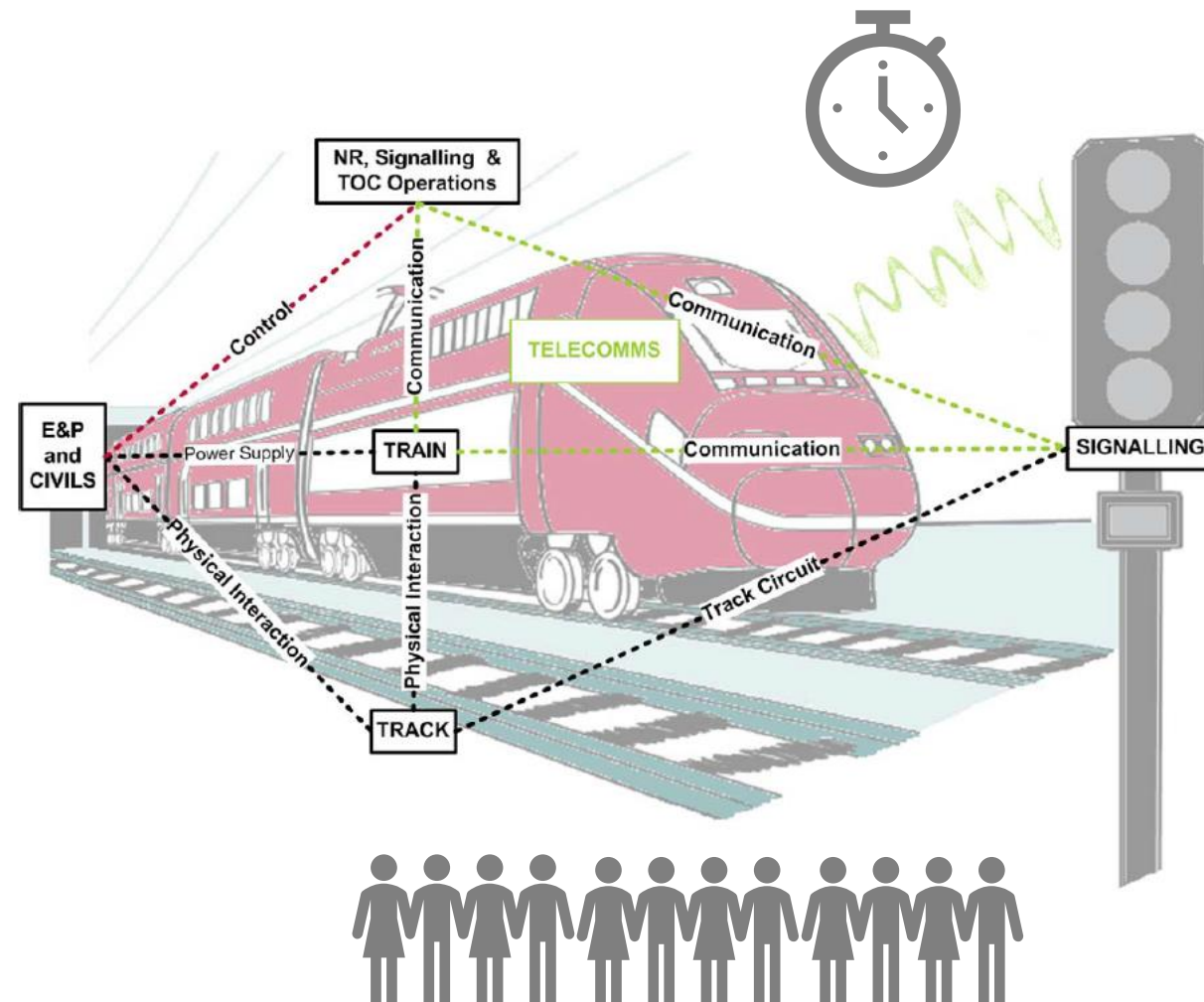
- many diverse, interacting components
- non-linear and non-proportional interactions between the components
- components adapt/ learn in response to change



A 'reliable' complex system

- Whole-system approach
 - Technical sub-systems
 - Interfaces between sub-systems
 - Passengers
 - Human behaviours etc.

- The system as a whole could achieve higher reliability at a lower cost than the sum of its parts



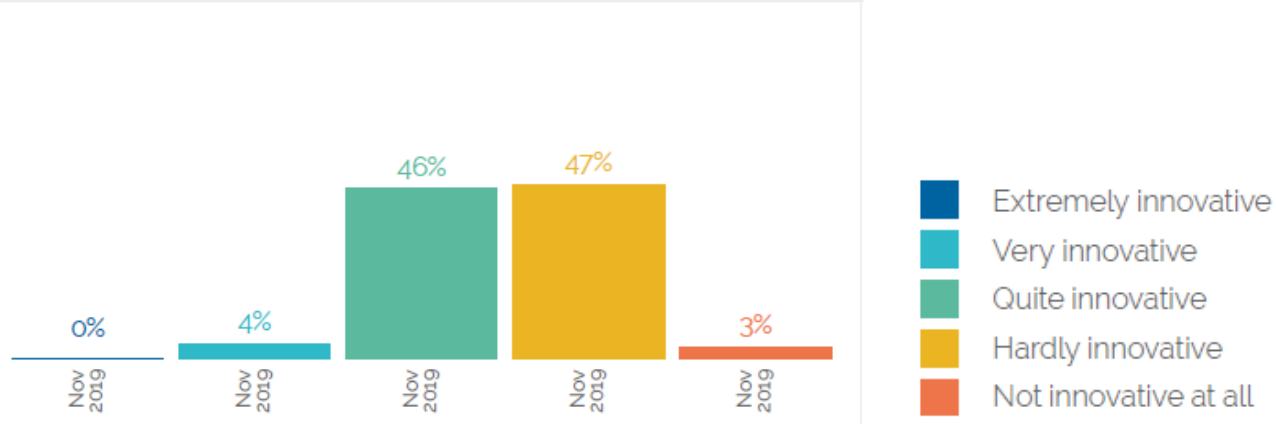
Current Challenges

“The rail industry no longer possesses the same ability or incentive to innovate”

(Keith Williams, February 2019)

- Increased passenger numbers
- Complex timetables
- Restricted maintenance opportunities
- Limited resources
- Lack of a joined-up approach
- Public pressure to deliver

Q2. How innovative, if at all, do you believe the GB railway industry is currently?



Source: RIA & Network Rail – Unlocking Innovation in the Rail Sector Pulse, Nov 2019

Still a long way to go, but...

Lots already happening:

- Augmented reality
- Thermal and visual imaging equipment
- Digital twin models
- Internet of things
- Graph analysis, Artificial Intelligence and Machine Learning

...more to prove and to achieve!



Towards a reliable railway

INVESTMENT



**CULTURE CHANGE
& MINDSET**



COLLABORATION



Towards a reliable railway

INVESTMENT



**CULTURE CHANGE
& MINDSET**



COLLABORATION





Investment opportunities to stimulate innovation

- RSSB's R&D competitions and various Research Councils (i.e. EPSRC)'s initiatives and grants
- InnovateUK FOAK SBRI opportunities for rail
- Suppliers innovation and UKRRIN network
- Rail Innovation Network (engagement with tech start ups)
- Catapults (cross-sector fertilisation)



Towards a reliable railway

INVESTMENT



**CULTURE CHANGE
& MINDSET**

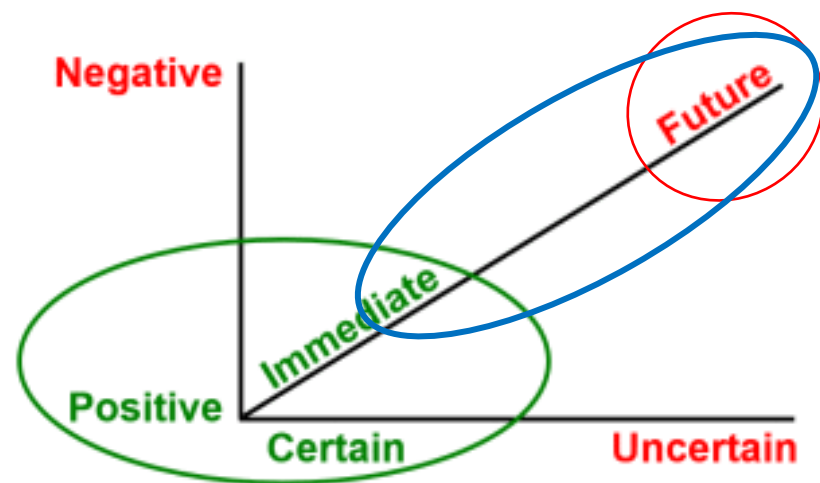


COLLABORATION





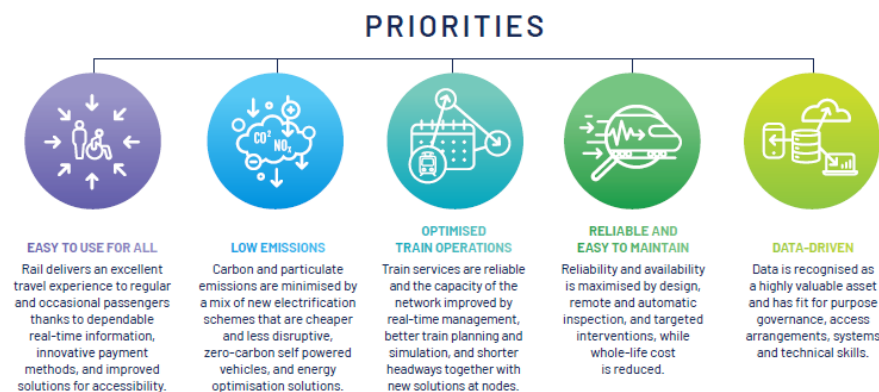
Mindset: now vs. future



Rail Technical Strategy

Innovating across Britain's railway

DRAFT - to be
launched in Sept 2020



ENABLERS



BUSINESS DRIVEN INNOVATION
Collaborative research & innovation pulled by industry that leverages academic and supply chain expertise

RAPID BENEFIT REALISATION
Streamlined, reliable and timely deployment of novel solutions driven by sound long-term planning

DIGITALLY TALENTED WORKFORCE
A highly technologically literate and diverse workforce across the industry that advocates and embraces digital solutions

OUTCOMES



For more information on the
Rail Technical Strategy,
please email:

rts@rssb.co.uk

Towards a reliable railway

INVESTMENT



**CULTURE CHANGE
& MINDSET**



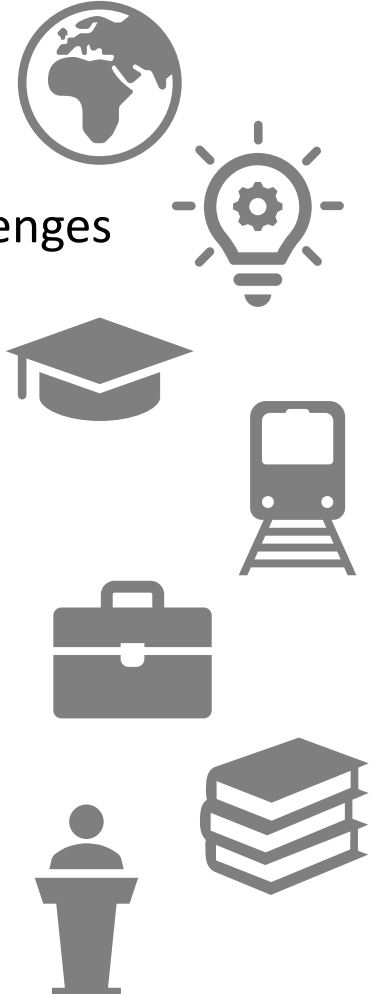
COLLABORATION



Collaboration: 'All aboard!'



- International partners (RTRI, JR East, SNCF, Trenitalia) > knowledge sharing
- Academia (University of Huddersfield; University of Sheffield; ITS Leeds) > specific challenges
- UKRRIN > cross-industry collaboration to support research and innovation
- Duty holders i.e. Train and Freight Operating Companies; ROSCOs; Network Rail etc.
- Small and Medium Enterprises (SMEs) and larger organisations working in rail
- Other industry bodies such as RIA, Rail Alliance, NSAR etc.
- Research Councils (EPSRC) and government bodies (InnovateUK, KTN etc.)
- Professional Institutions



Collaboration: 'All aboard!'



ADHESION



NETWORK PERFORMANCE



AIR QUALITY



TRAIN DESIGN



ROBOTICS



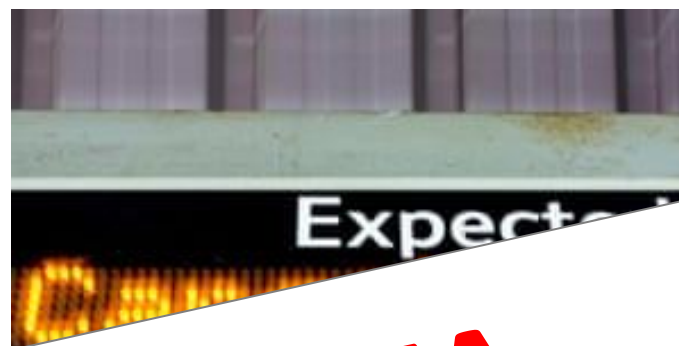
DECARBONISATION



Collaboration: 'All aboard!'



ADHESION



QUALITY



TRAIN DESIGN



ROBOTICS



DECARBONISATION

37% passengers satisfied with how well train company deals with delays (Transport Focus, 2018)



Rail passengers face further chaos due to timetable changes and engineering works, report warns

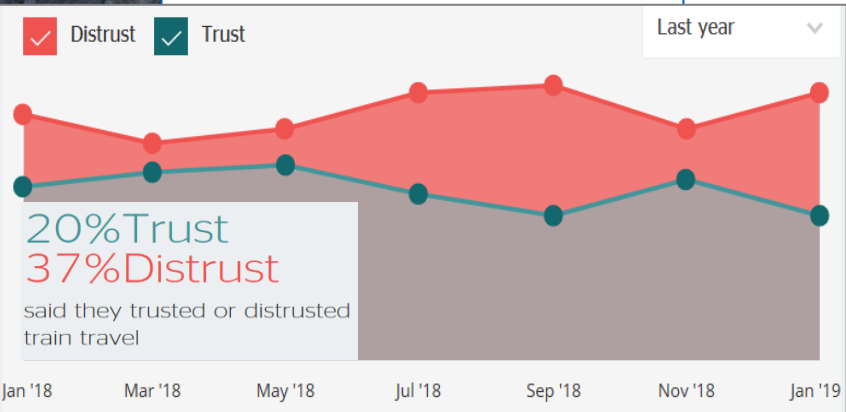
NEWS CAREERS TRAVEL WHAT'S ON

LATEST Greater Anglia, GWR launch Delay Repay 15

Posted 21st February 2019 | 2 Comments

Performance is still falling back

Rail delays are the 'worst for 12 years'

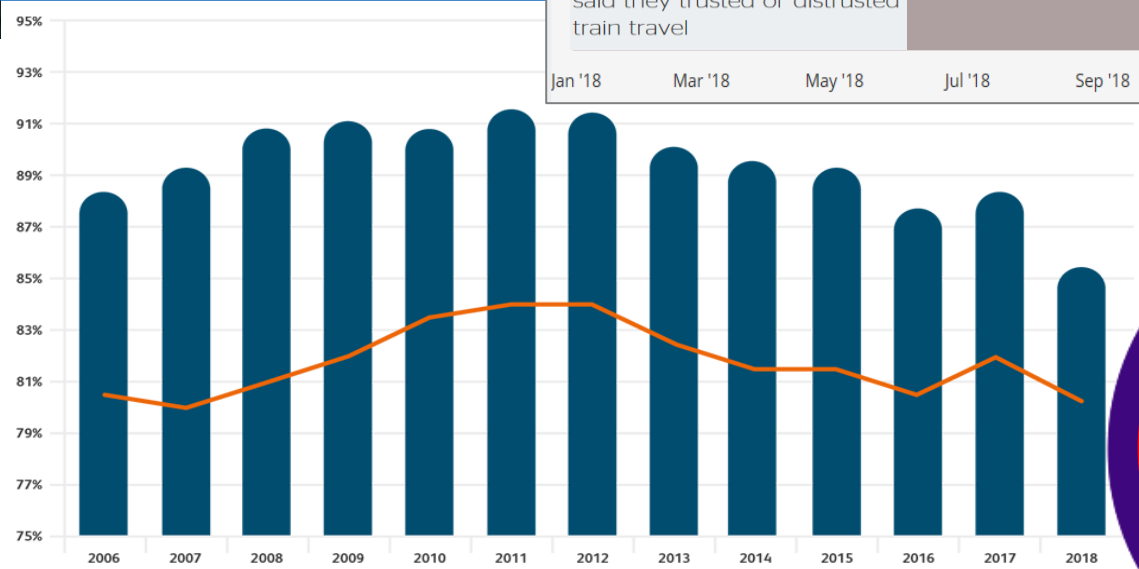


NEWS

Home UK World Business Politics Tech Science Health Family

Business Your Money Market Data Companies Economy

Rail user satisfaction at 10-year low

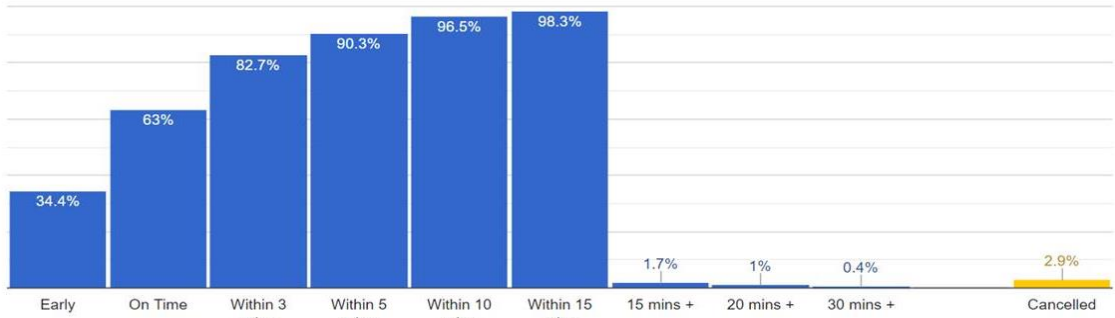
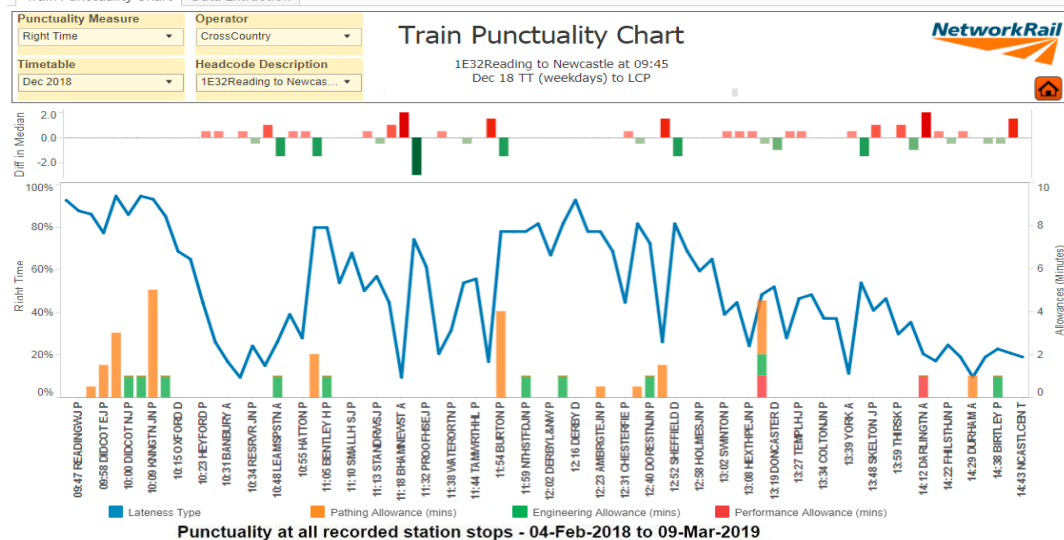


% of trains meeting PPM % satisfied with overall journey (NRPS)

14.8m 2017/18

15.6m 2018/19

Delay minutes



'One team one look' at Victoria station saw a 13% increase in passenger satisfaction

Data Sandbox: successful collaboration to make rail more reliable

STAGE 1



Summer 2017: Data Sandbox platform was built –
powerful example that data from across the industry
can be made available...



Oct 2017: £500K 'call for research' launched

- 5 projects awarded funding
- Great collaboration from NR + TOCs

STAGE 2



2019

- Enhanced Sandbox repository
- April 2019: £1.3m 'call for research' launched in collaboration with Network Rail

Purpose / scope:

- Increased understanding of industry data
- Improved consistency of rail performance from reduced dwell time fluctuation
- Improving disruption management through better recovery from reactionary delays

**= OPERATIONAL SAVINGS +
IMPROVED CUSTOMER EXPERIENCE**

Data Sandbox (cont'd)

INVESTMENT



£500K for the initial competition (RSSB) and £1.3 million for the second one (RSSB and NR)

COLLABORATION



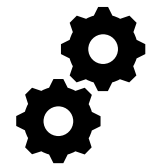
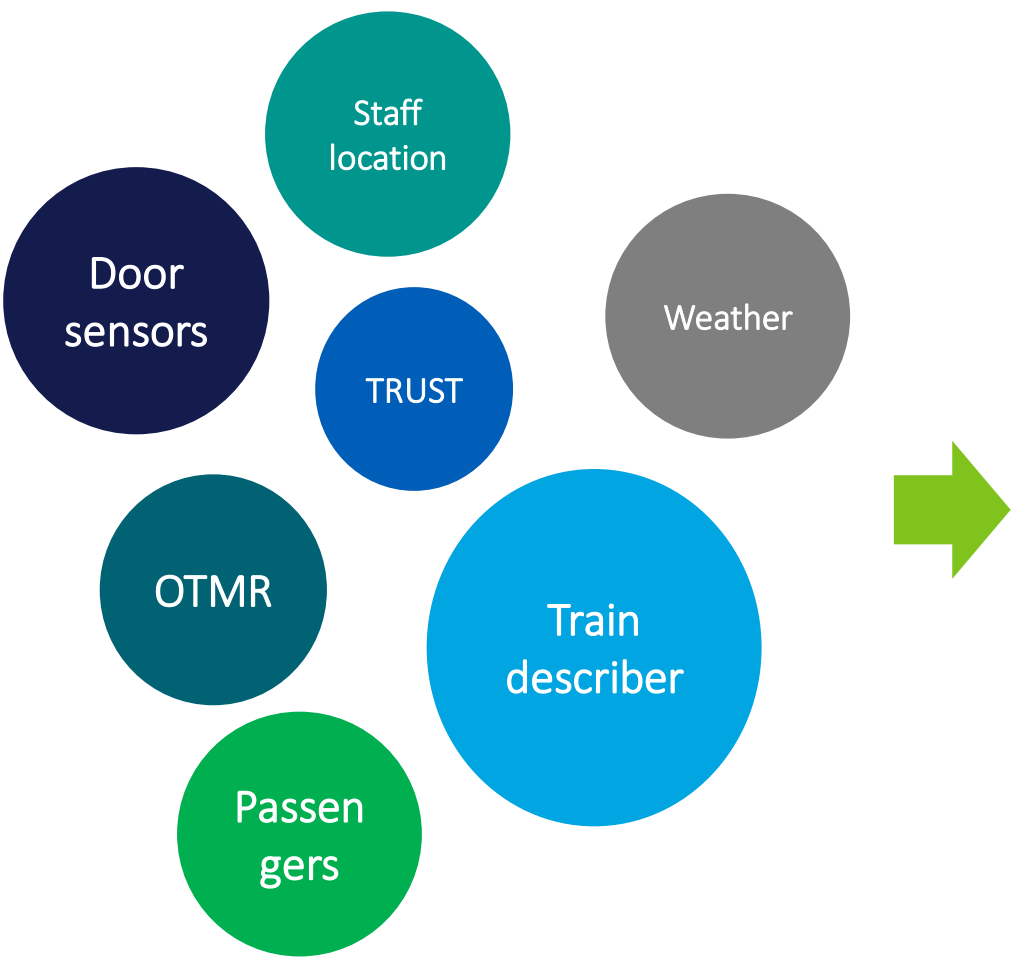
CULTURE CHANGE & MINDSET



Leveraging data
Machine Learning, AI, data
analytics techniques...



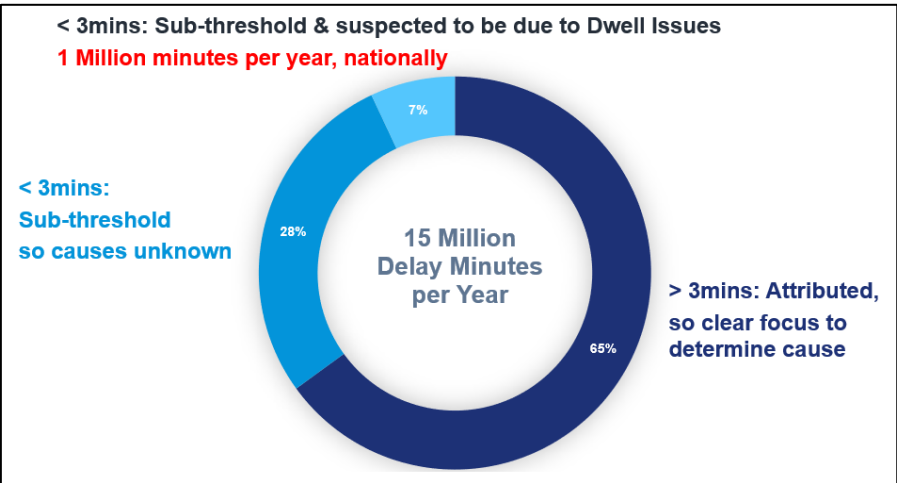
Case study 1: IntelliDwellTime



Apply Analytics to assist with root cause identification



Quantify Benefits to rank improvement plans



Case study 2: Rail performance modelling for strategic decision making



Using industry data to help TOCs and Network Rail improve service performance

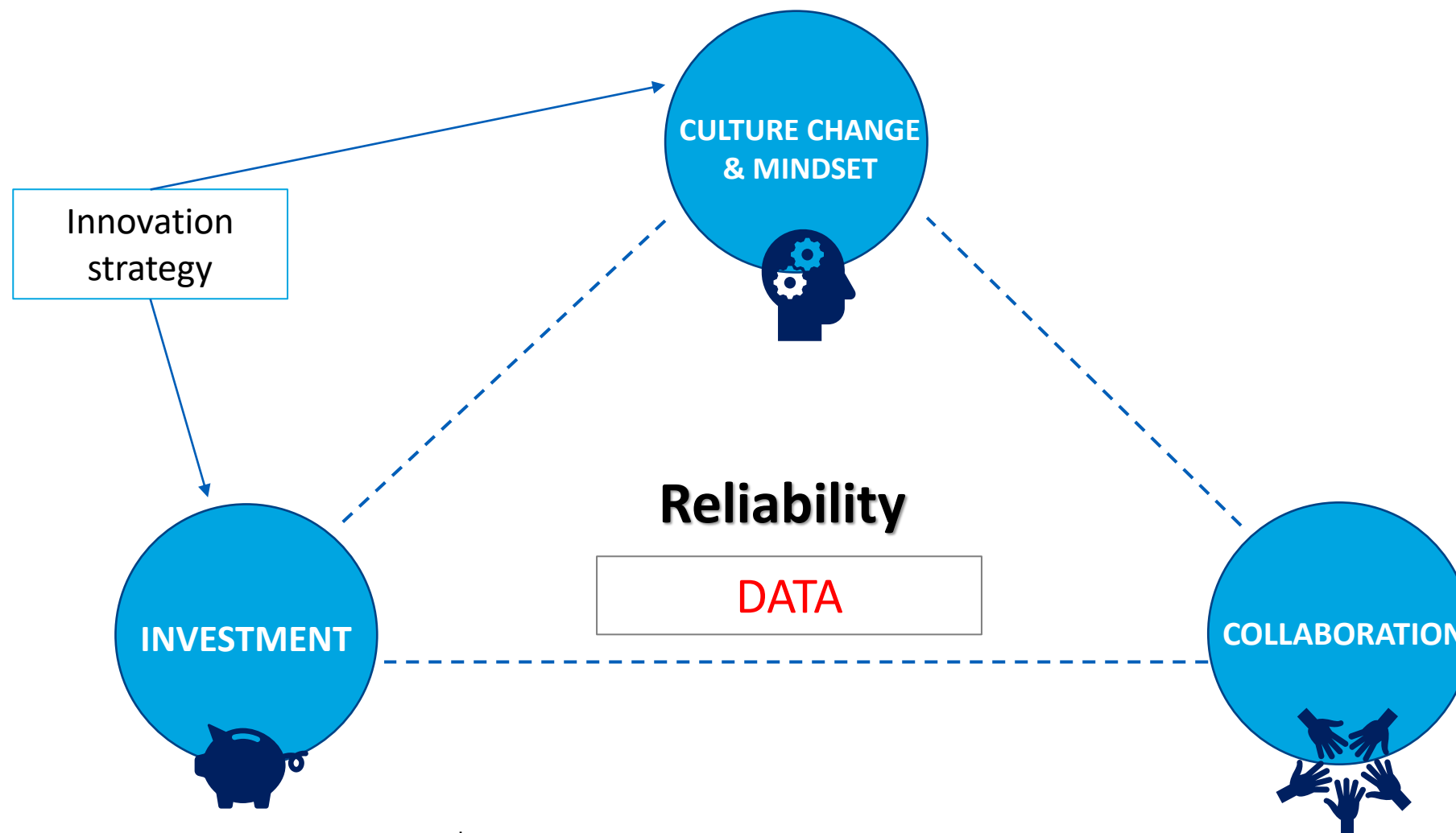


Finding out where to focus effort so it really counts



- 1 Model the interaction of trains, and the reactionary delays resulting from conflicts
- 2 Discover the root causes of poor performance by visualizing the complex interacting delays
- 3 Model interventions designed to remove/reduce the effect of these root causes
- 4 Quantify the benefits of the improved performance to establish the value for money of interventions.

Conclusions





Thank you





Deep Dive into Data Science methods for Rail Safety

Presented by Fotis Zapantis
03 June 2020



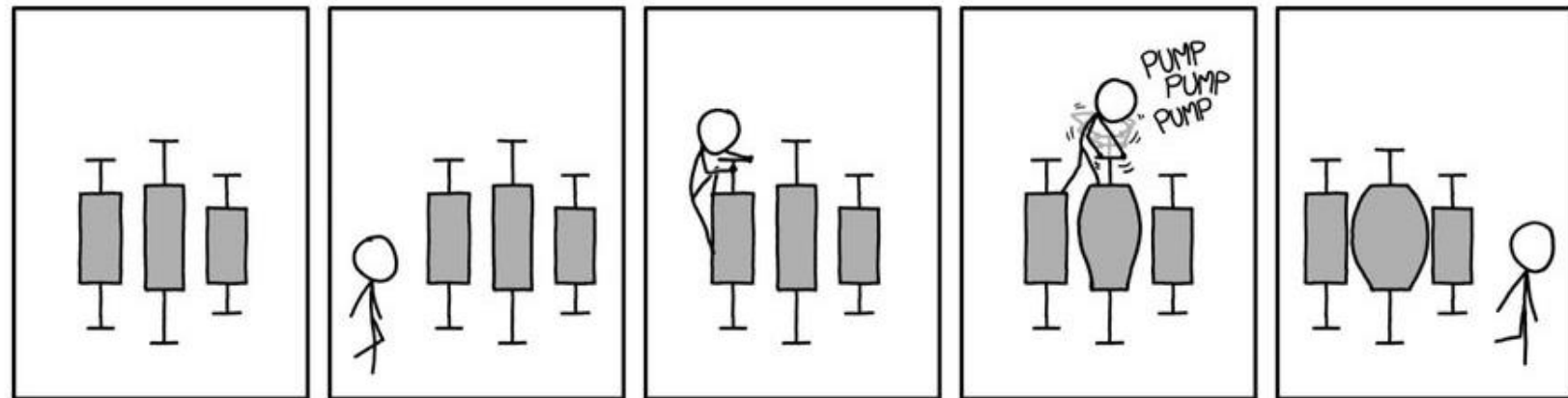
About me



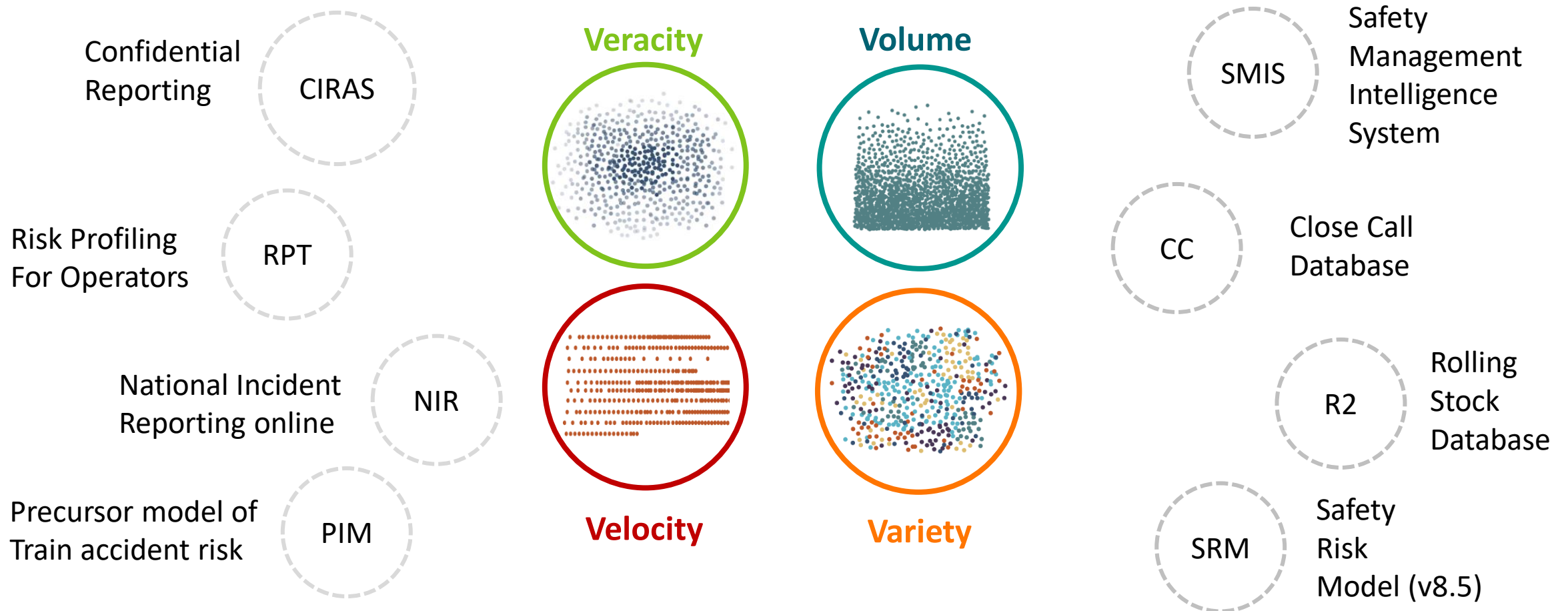
Hi, I am **Fotis**

I work as an Intelligence Analyst at the *Risk and Safety Intelligence department* at RSSB. I help other Risk and Safety Intelligence Analysts build the intuition they need to identify passenger, public and workforce safety risk from operational incidents

I am also a **mentor** for the Women in Rail cross-industry mentoring scheme 😊



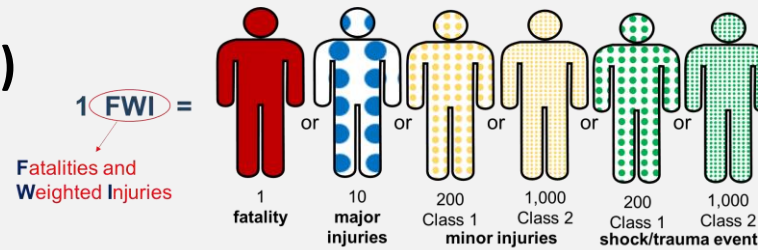
Data properties and Data sources available



Safety Risk Estimation vs Reality (Observed Harm)

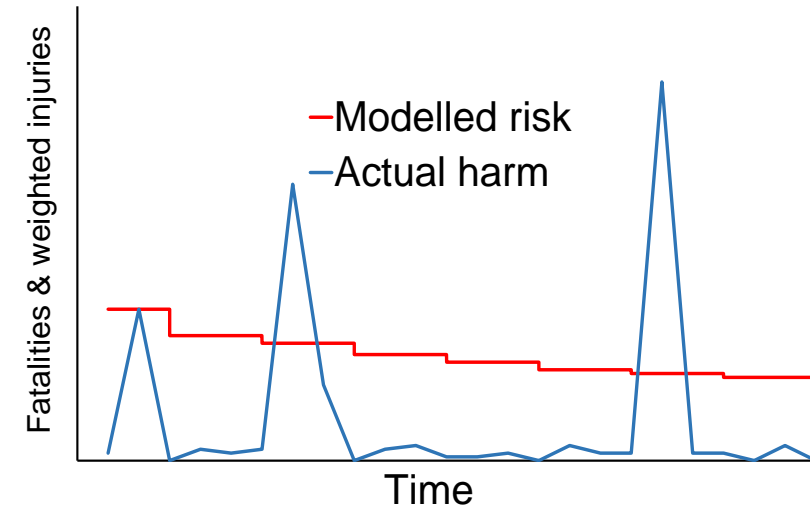
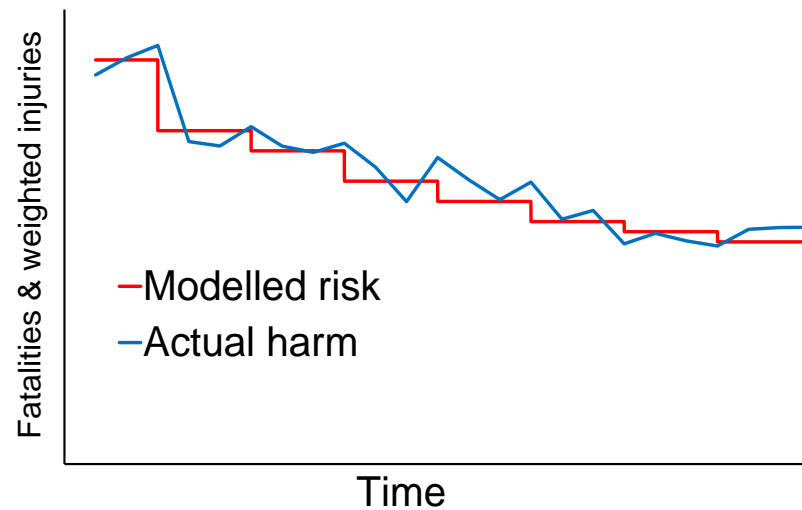
High frequency (events/year)

Low consequence (FWI)



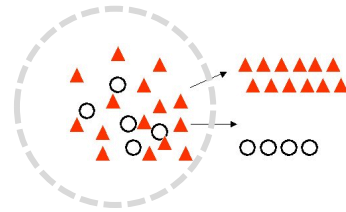
Low frequency (events/year)

High consequence (FWI)

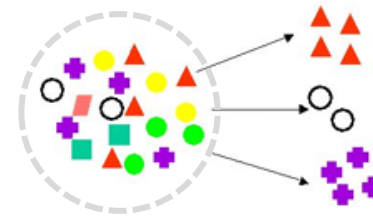


Data Mining Methods (Ancient Methods)

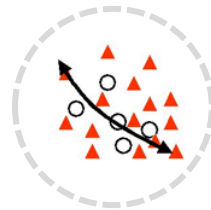
Classification



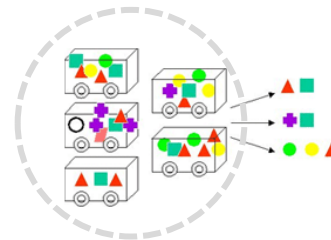
Clustering



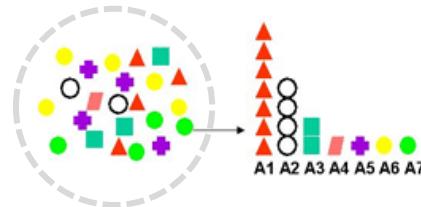
Regression



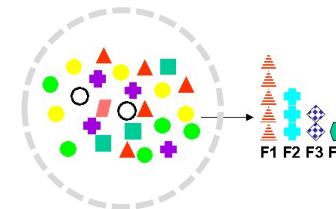
Association Rules



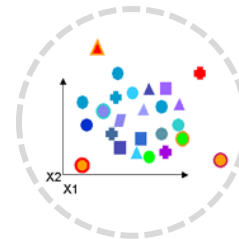
Attribute importance



Feature selection and extraction

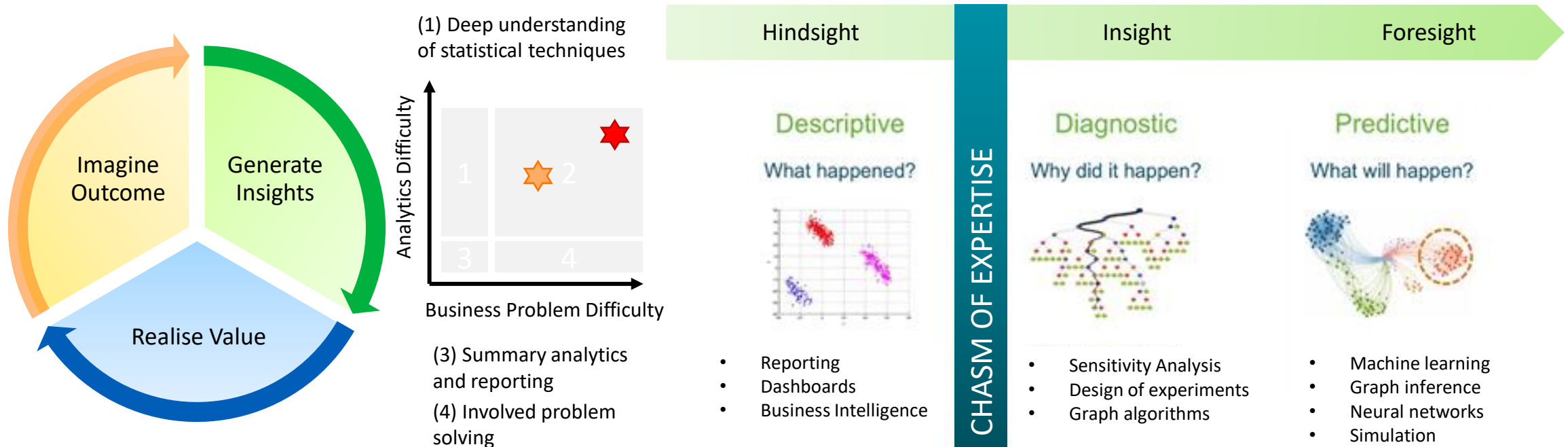


Anomaly detection



Data is useful when it is **Actionable**

Data Science will leverage any tools for extracting as much information as the data contains and comprises mathematics (statistics), logic, algorithms and assumptions for uncertainty.



The presence of uncertainty leads to infer rather than deduce solutions and it is statistics that we rely upon to measure the accuracy and reliability of the extracted information

Comparison of various risk analysis techniques for Complex Systems (the Theory)

Risk Analysis, Vol. 31, No. 1, 2011

DOI: 10.1111/j.1539-6924.2010.01475.x

Fault and Event Tree Analyses for Process Systems Risk Analysis: Uncertainty Handling Formulations

Refaul Ferdous,¹ Faisal Khan,^{1,*} Rehan Sadiq,² Paul Amyotte,³ and Brian Veitch¹

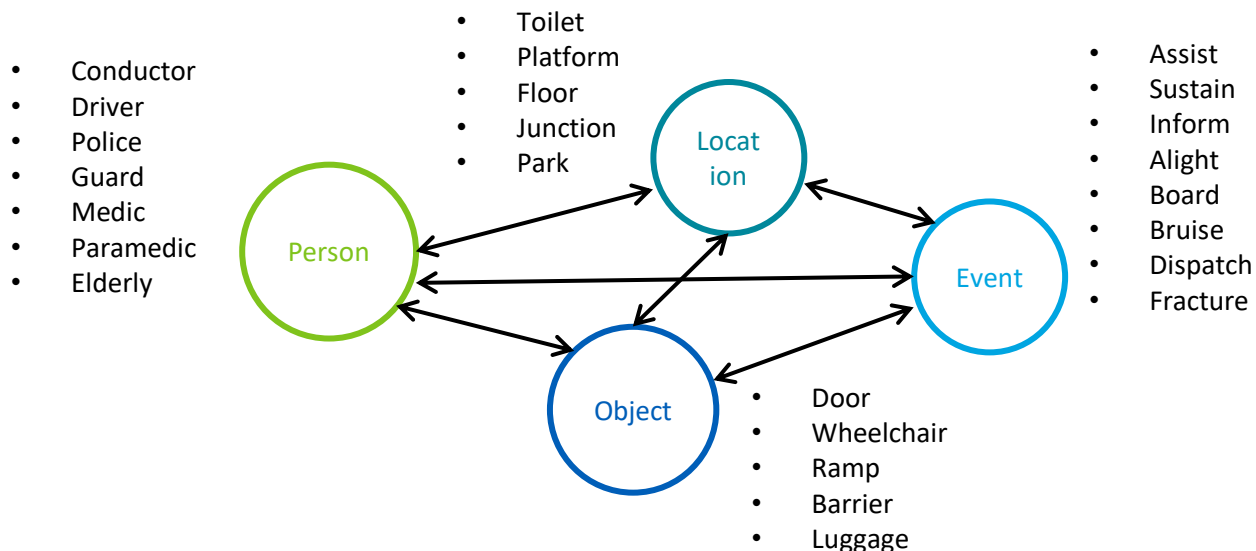
Attributes	Soft Computing Techniques				
	Decision Tree	Fuzzy Rule-Based Models	Artificial Neural Networks	Bayesian Networks	Cognitive Maps/Fuzzy Cognitive Maps
Network capability	N ^a	L ^b	N	H ^c	VH ^d
Ability to express causality	H	M	N	H	VH
Formulation transparency	H	H	N ^e	H	VH
Ease in model development	H	M	M	M	VH
Ability to model complex systems	M	H	VH	H	VH
Ability to handle qualitative inputs	H	H	N	H	VH
Scalability and modularity	VL	L	VL ^f	H	VH ^g
Data requirements	H	L	VH	M	L ^h
Difficulty in modification	VH	H	M	L	N
Interpretability of results	VH	VH	VH	VH	H
Learning/training capability	H	M ⁱ	VH ^j	H ^k	H ^l
Time required for simulation	L	L	H	L	L
Maturity of science	VH	H	H	VH	M
Ability to handle dynamic data	L	H	H	H	M
Examples of hybrid models (ability to combine with other approaches)	H	VH ^m	VH ^m	H	H ⁿ

Case Study 1 - Treatment of Disabled Passengers [Text Mining, Graph Inference]

In order to create reproducible workflows we used

 python™ (v 3.0) via  Orange data mining, an open source tool for data mining and machine learning

POLE (Person, Object, Location, Event) Model



Safety Insights (~1.5K records in SMIS over multiple years):

The process of booking assistance and the level of experience of assistance staff are a major concern for reduced mobility passengers who often need to find their way to the platform/exit in overcrowded stations or in a short amount of time due to train delays – *Hypothetical Action*: Provide different ticketing arrangements for disabled passengers e.g. day tickets

Disabled WC are frequently used by other non-disabled passengers and their general cleanliness is not very well received – *Hypothetical Action*: Only allow access to the disabled toilet via the disabled persons railcard

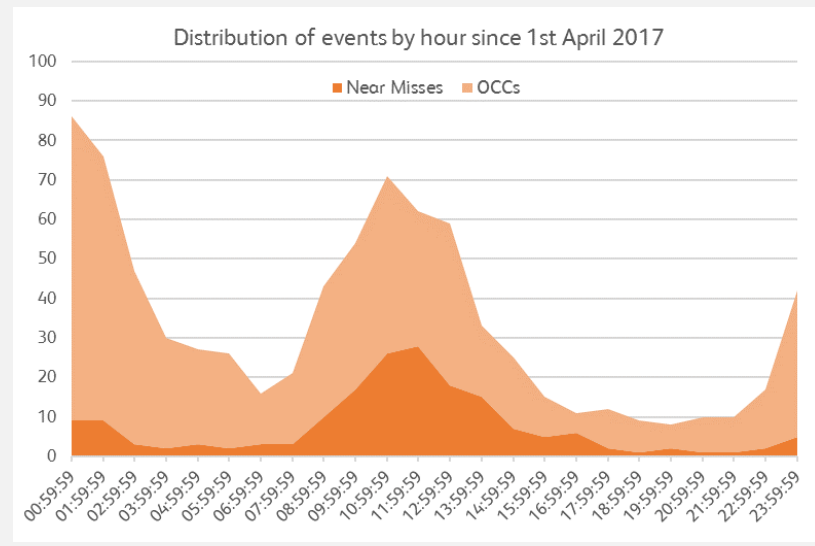
Upper body injuries (shoulder, knee, neck) are more frequently reported as a result of disabled/non-disabled passenger interaction - *Hypothetical Action*: Possibly segregate disabled and non-disabled passenger flows



Case Study 2 - Trackworker Safety, Network Rail Safety Task Force Programme [DoE]

Recent accidents have sharpened the industry focus on track worker safety, particularly the interface between track workers and moving trains. The Safety Task Force formed in July 2019 to tackle this issue with RSSB providing analysis support from available data: Near Misses recorded in SMIS, Investigation reports, Operational Close Calls in SMIS and Close Calls (Safety Insights ~15K records in multiple systems).

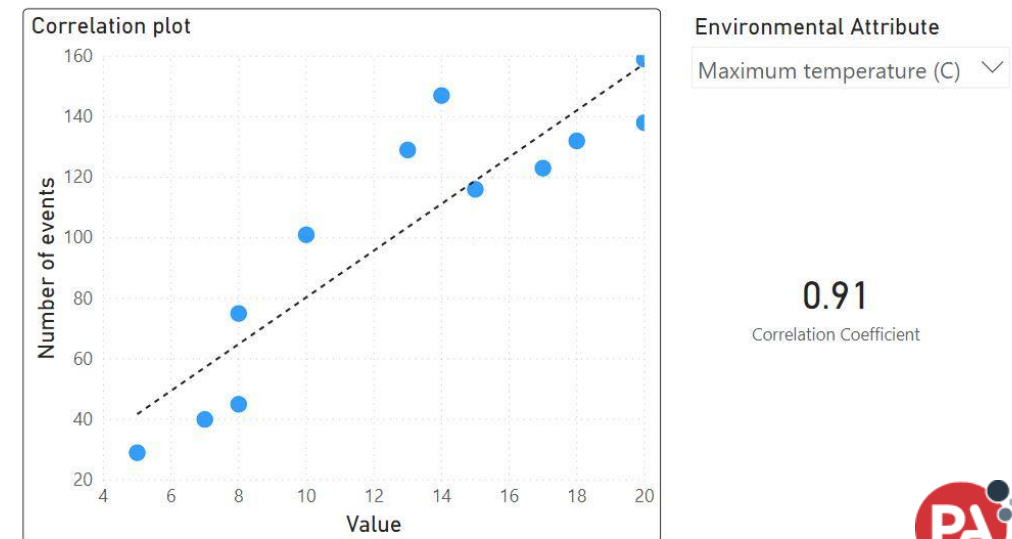
RSSB to work with NR and ISLG to improve the data and metrics for trackworker safety



Top 5 attributes with strongest correlation

Dew point (C)	0.91
Maximum temperature (C)	0.91
Temperature (C)	0.89
Feels like (C)	0.89
Wind chill (C)	0.89

Environmental attribute correlations



Facts don't Lie: However, never be careless in handling, preparing and analysing the data. Do not assume that all the information is in your data (often relevant context information needs to be considered to draw the right conclusions)



Success Criteria

Focus on the business value

- Do's

Define the business value in terms of effectiveness, efficiency and risk.
Determine which process aspects you want to gain insights.

- Don'ts

Don't be overly fascinated with the possibilities of the technology.
There are often multiple ways to get answers for your questions, and sometimes multiple techniques to be combined to get the full picture

Start small, think big

- Do's

Connect the business driver to a specific business domain. Choose a process where the beginning and the end are clearly defined. Check whether this process is supported by an IT system.

- Don'ts

Don't start with the most important core process of the company. That will come later once the first results have convinced people of the approach.

Work hypothesis-driven and in short cycles

- Do's

Connect the business driver to a specific business domain. Choose a process where the beginning and the end are clearly defined. Check whether this process is supported by an IT system.

- Don'ts

Don't start with the most important core process of the company. That will come later once the first results have convinced people of the approach.

Common Pitfalls

- Being too fascinated with the technology itself can lead to an inability to show the added value from a business perspective
- An unrealistic image of the data availability, coming from the promise of Big Data, can lead to overblown expectations
- Due to wrong understanding of what data mining can do, the first project is often too ambitious in scope. Too much is being promised and it takes longer than usual before the first results can be shown

Any Questions?



Thank you



Q&A

Panel discussion – 15 minutes

Questions welcome from audience
via the on-screen chat facility



SARS ITEMS

Accessing the webinars

Joining SaRS

Next Events

Feedback

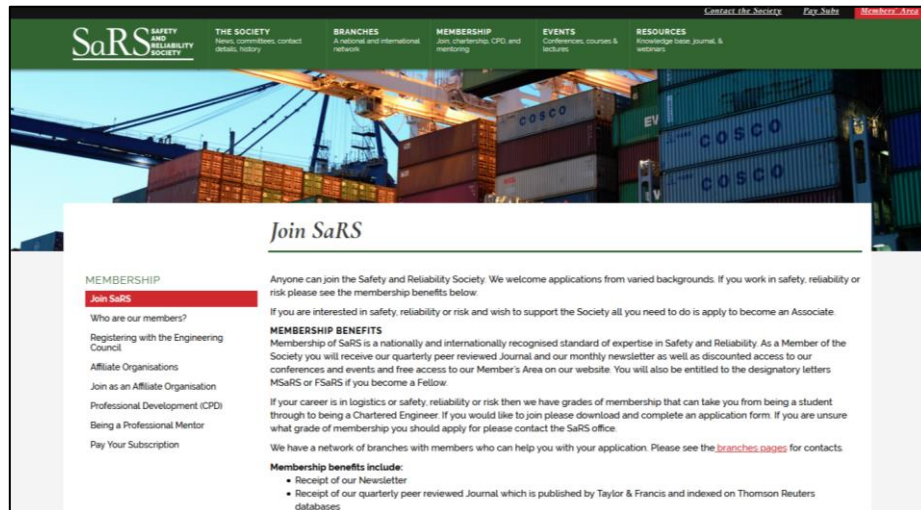
Social event



JOINING SARS

If you aren't a member and have enjoyed this webinar, please join to
develop yourself and the Society

We accept membership applications from candidates from all relevant backgrounds
– membership is open to everyone from students to experienced professionals



We are delighted to announce that the
**Safety & Reliability Society is now a
Licensed Member of the Engineering
Council for direct CEng and IEng
Professional Registration**

More information available at www.sars.org.uk

NEXT WEBINAR

- **Basics of Risk Management – 5. People Placement**
 - 17th June at 1300
 - Register via our website www.sars.org.uk

YRP brings together people from all sectors of the industry and we run a packed programme of collaborative networking and development events throughout the year. Membership is free and our events are free or subsidised to ensure they are affordable and accessible to all.

A playlist of our recent webinars is available on our YouTube channel:

www.youtube.com/channel/UCSfN7ahABNvsTt9h-ByZRrg

or search for “Young Rail Professionals” on www.youtube.com

To sign up to our upcoming events go to our website: www.youngrailpro.com

Date/Time	Event	Description
10 th June 2020 18:00 - 19:30	Rail Quiz Night YRP/Railway Benefit Fund	A fun quiz night raising money for charity and breaking the lockdown lull, hosted by Pete Waterman OBE
30 th June 2020 17:00 - 18:00	Andrew Haines talks to the Next Generation of Railway Workers	Network Rail Chief Executive Andrew Haines addresses young railway professionals on his career journey and the challenges and opportunities in the industry
14 th July 2020 18:00 - 19:30	Disrupting Disruption - improving the customer experience when things go wrong	A panel of industry leaders discusses how the rail industry handles disruption

FEEDBACK

- I am now going to initiate a feedback form
- Please can I ask you to fill it in before you exit the webinar
- The information is vital for us to improve our offering
- Please take two minutes to fill it in and click Submit
- Thank you very much and STAY SAFE



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THANK YOU



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