Smart Infrastructure Innovative asset monitoring

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Smart Infrastructure

- Why do we need it?

- How do we do it in Amey?

- Smart bridge example

Why do we need smart infrastructure?

Information   Insight   Impact

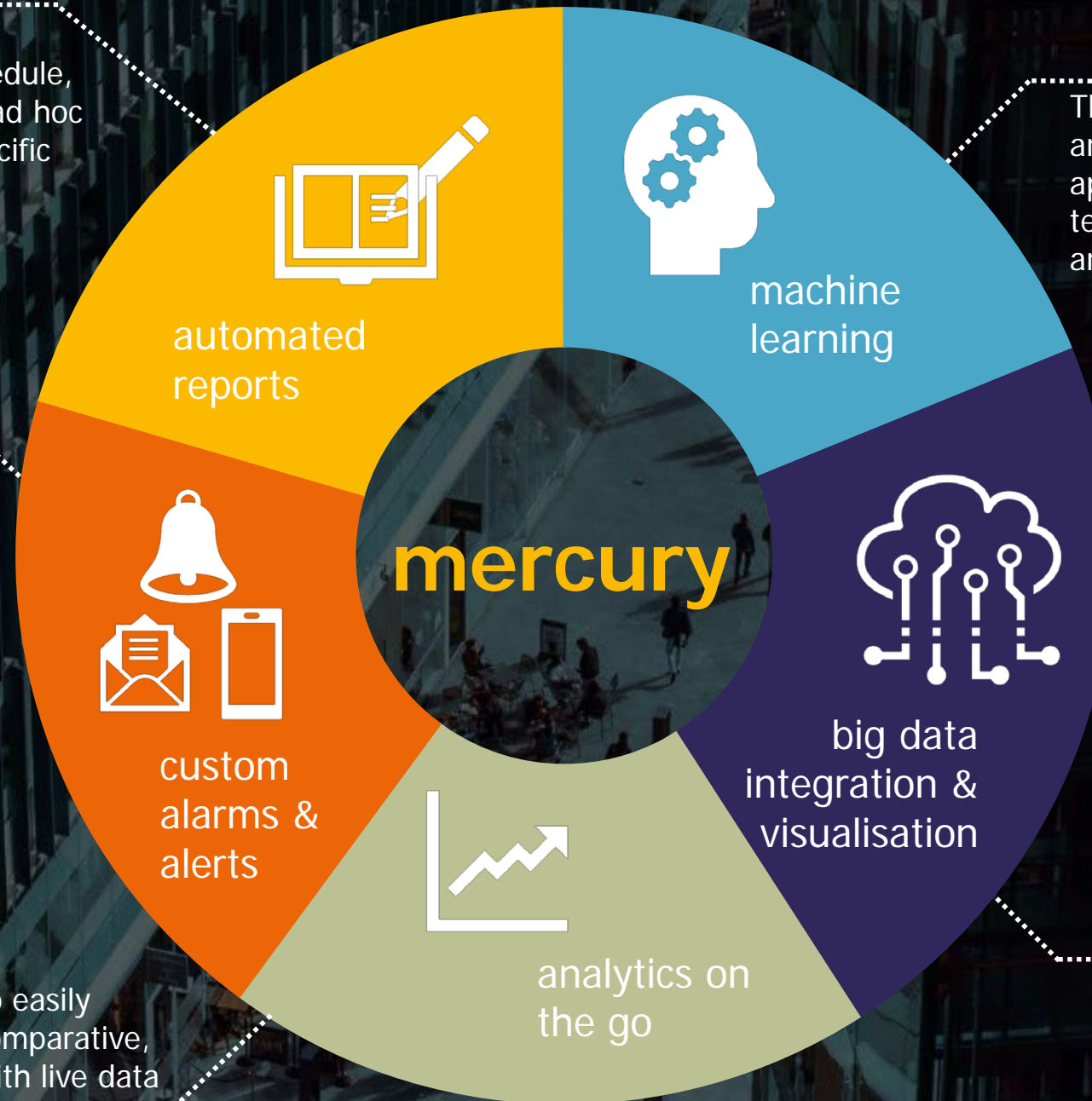amey**consulting**

How do we do it in Amey?

mercury

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Reports are generated automatically either on schedule, after an extreme event, or ad hoc and are based on client specific templates

The Mercury teams analyses data and identifies opportunities to apply machine learning techniques to detect anomalies and perform predictive analytics

Custom email and SMS alerts when sensors pass bespoke thresholds

Remote monitoring and cloud integration compiles data from various sources and uploads them to the UI for an holistic view of asset and system performance

Functional UI allows users to easily conduct various analyses (comparative, time scale, histogram etc) with live data

automated reports

machine learning

mercury

big data integration & visualisation

custom alarms & alerts

analytics on the go

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Mercury on the Forth Road Bridges

For Vehicles

- **4 Million** vehicles in 1964
- **25 Million** vehicles in 2017
- **860 Million** vehicles since opening
- **70 Million** HGVs since opening

For People

- **100,000** people a day use bridges to get to work or to go about their business
- **1.2 Billion** people used bridges since opening
- **Resilience** from 2 Bridge Strategy

For the Economy

- **£1 Million** a day contributed to the Scottish Economy
- **Over £10 Billion** since opening

A Critical Piece of National Infrastructure

A Large and complex group of assets

Scale & Complexity

- 30,000+ elements to look after and keep track of

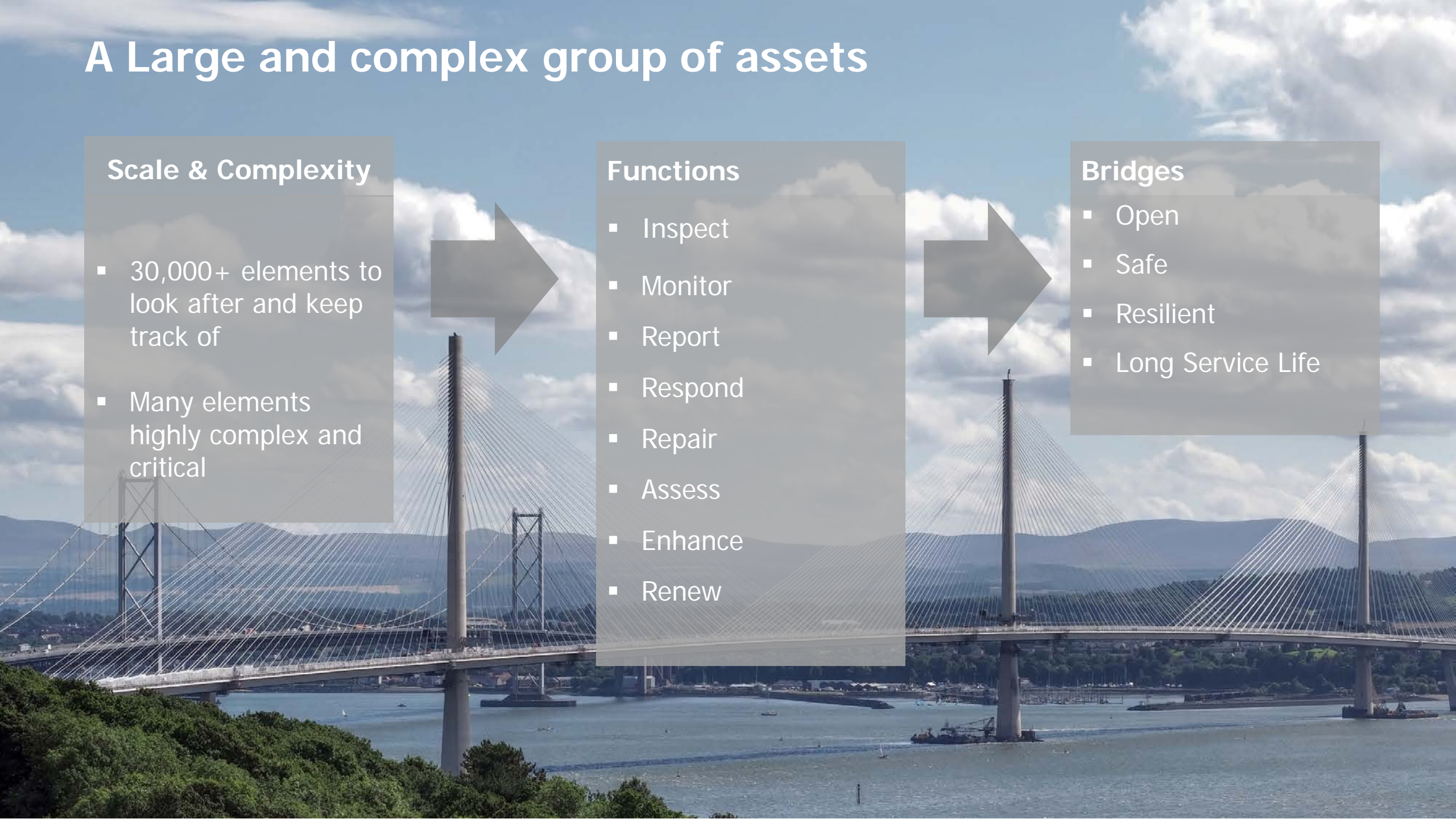- Many elements highly complex and critical

Functions

- Inspect
- Monitor
- Report
- Respond
- Repair
- Assess
- Enhance
- Renew

Bridges

- Open
- Safe
- Resilient
- Long Service Life

The problem

The solution: digitally enabled smart asset management

Collect Data

- Collect appropriate data via multiple streams
- Automatic collection by remote sensors
- Effects on bridge – wind, vehicles, temperature etc
- Response of bridge
- Bridge condition – inspectors with digital capability

Build Understanding

- Ingest & Analyse multiple big data sets
- Harness full power of cloud computing
- Integrate, analyse, visualise
- Investigate correlations
- Evaluate historic patterns, trends, events
- Understand relationships & behaviours
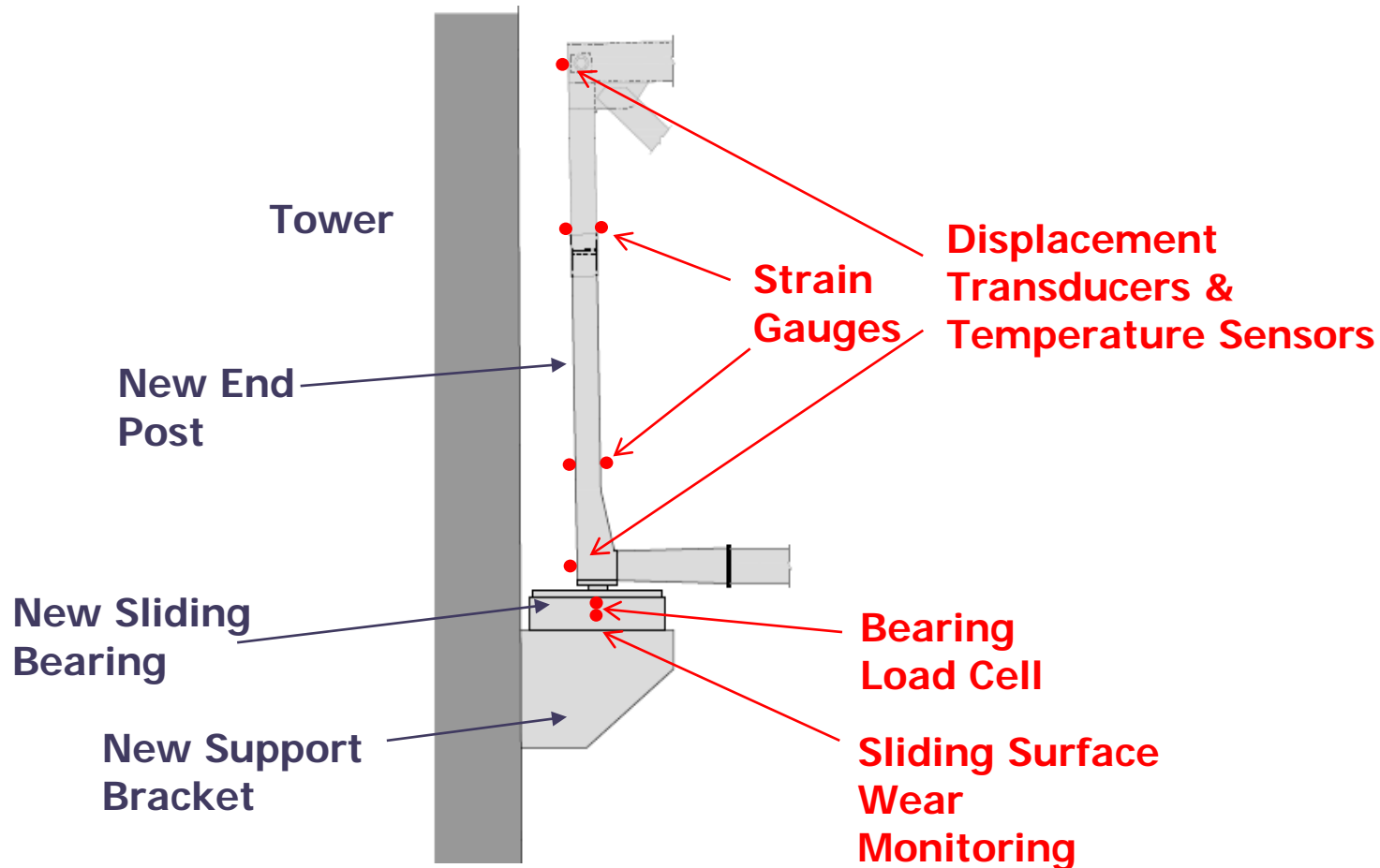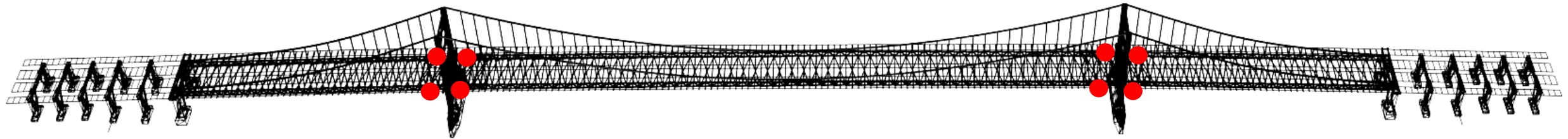
Monitor & Predict

- Real time monitoring
- Harness power of Machine learning
- Prediction of future behaviour
- Automated predict review, feedback, refine – build body of learning
- Automated alerts
- Trigger levels/alarms defined, refined, "learned"
- Automated reports

Decide

- Confirm safety
- Respond to alerts
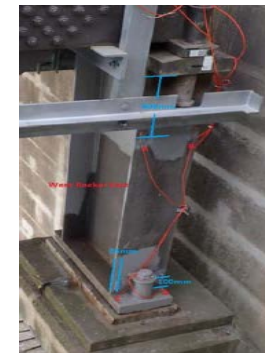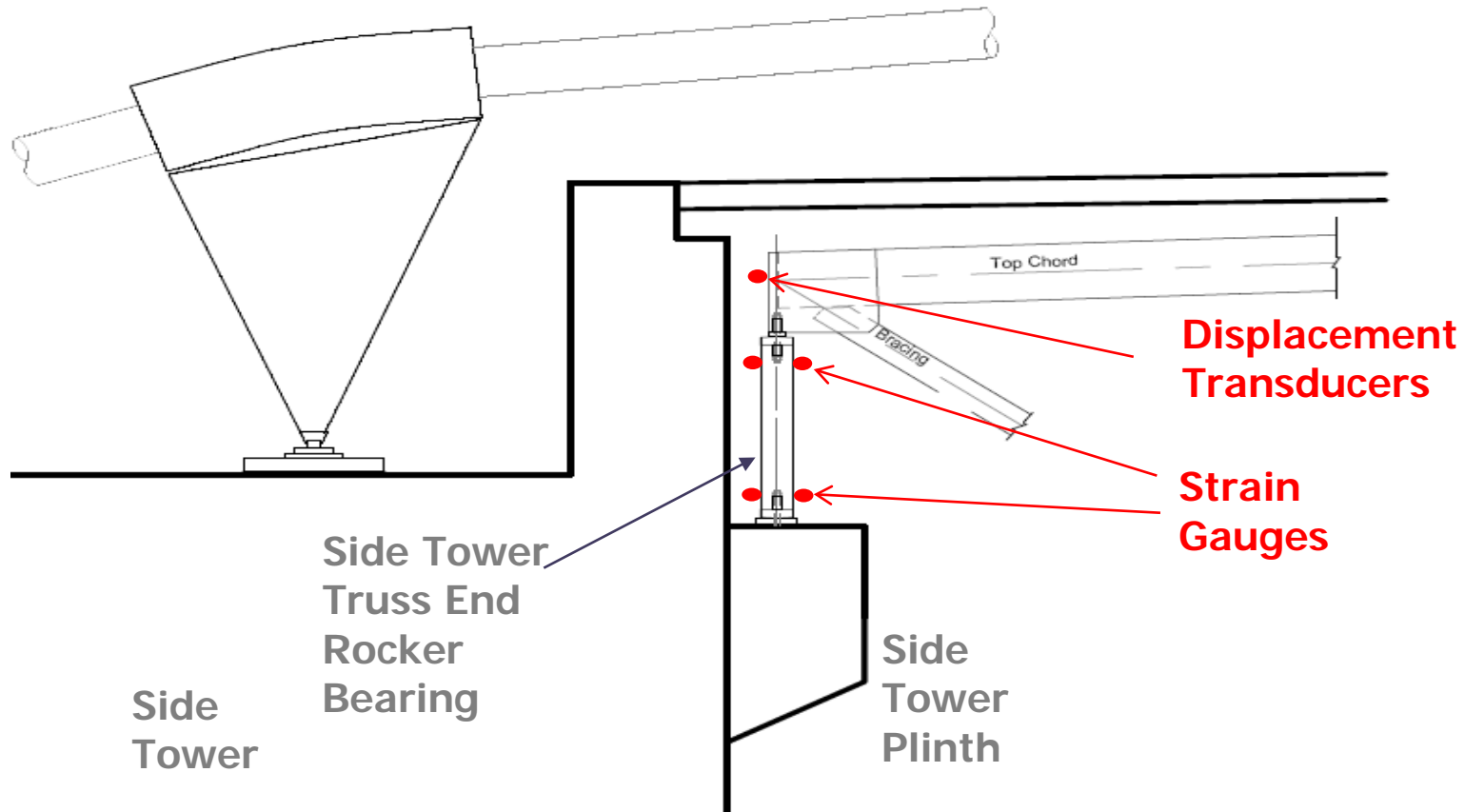- Defect repair & prioritisation
- Budget definition

Forth Road Bridge SHM – Arrangement at New Truss Ends

Tower

Strain Gauges

Displacement Transducers & Temperature Sensors

New End Post

New Sliding Bearing

Bearing Load Cell

New Support Bracket

Sliding Surface Wear Monitoring

➤ End post stress
➤ Bearing load
➤ Bearing wear
➤ Truss end movement

Forth Road Bridge SHM – Arrangement at Side Towers

Displacement Transducers

Strain Gauges

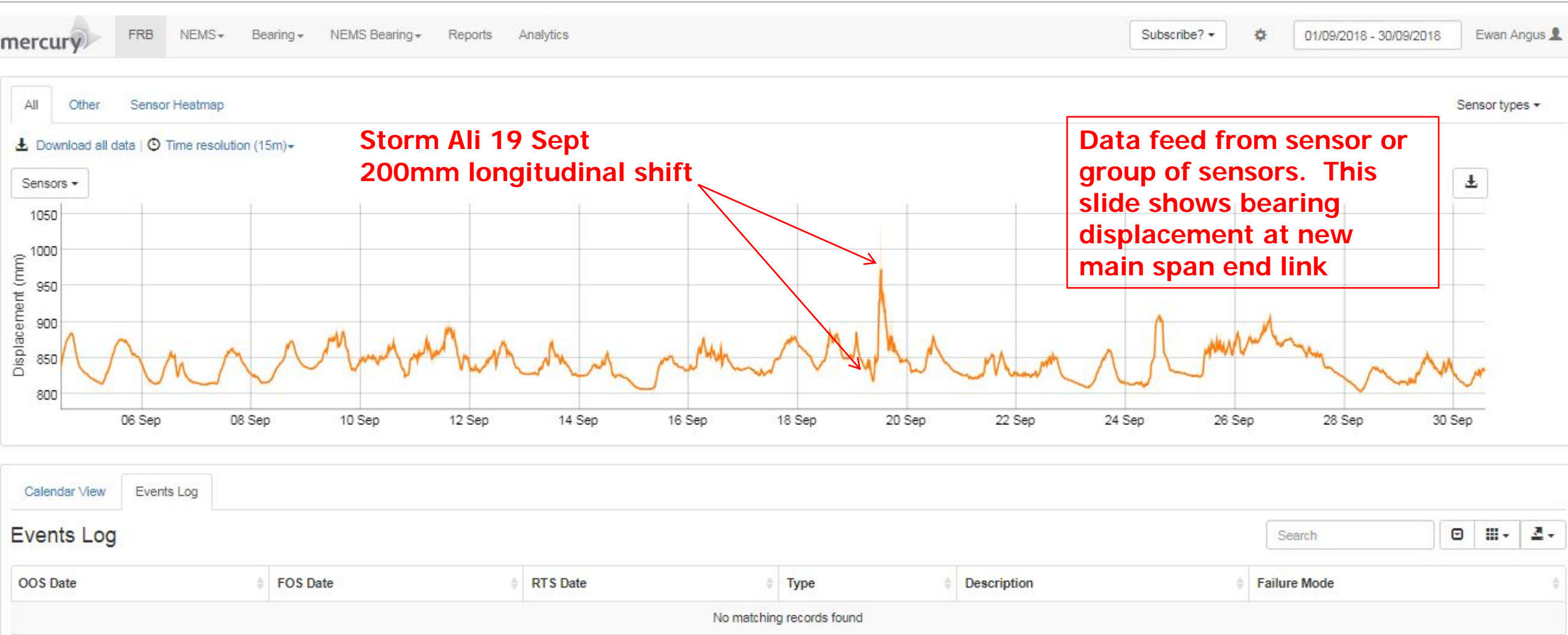Side Tower Truss End Rocker Bearing

Side Tower

Side Tower Plinth

Top Chord

Bracing
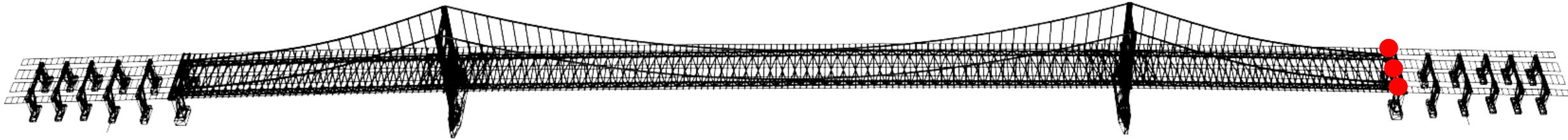
- Rocker rotation
- Rocker stress
- Truss end movement
- Stress in Laterals

Assurance during and after major events

Storm Ali 19 Sept
200mm longitudinal shift

Data feed from sensor or group of sensors. This slide shows bearing displacement at new main span end link
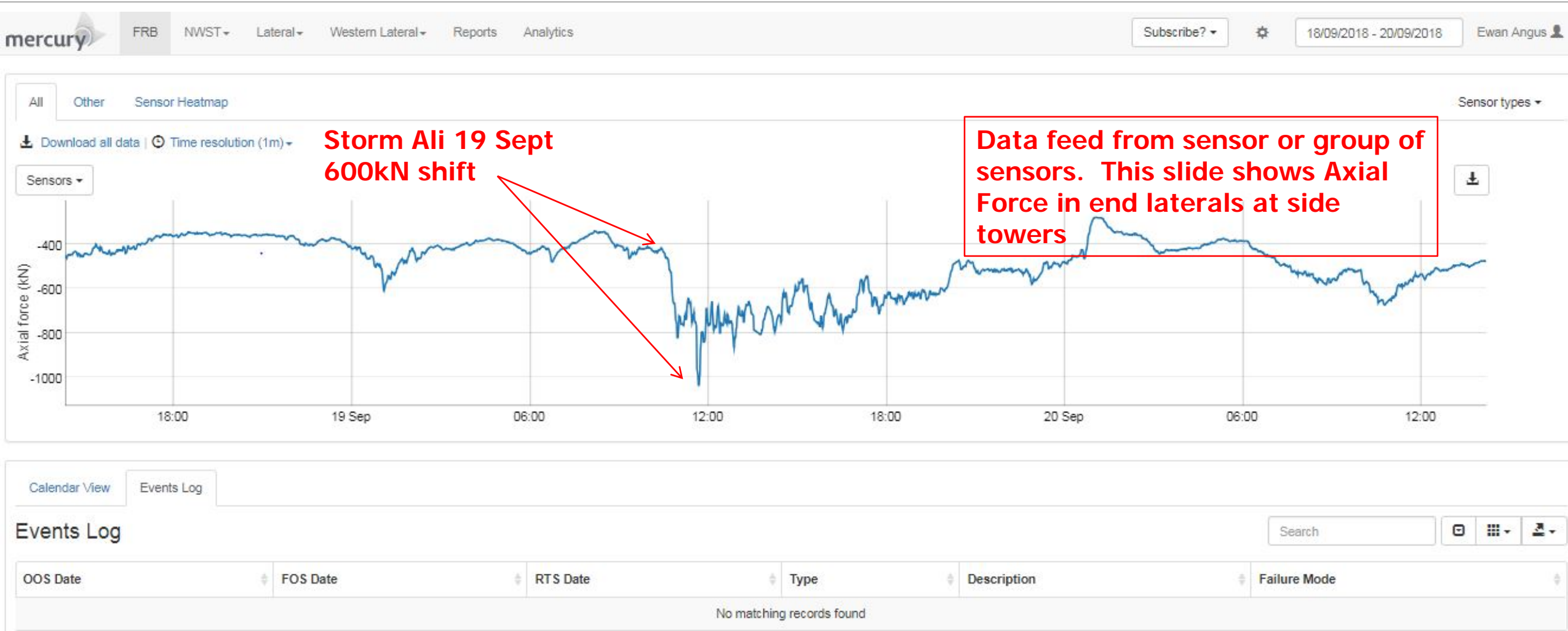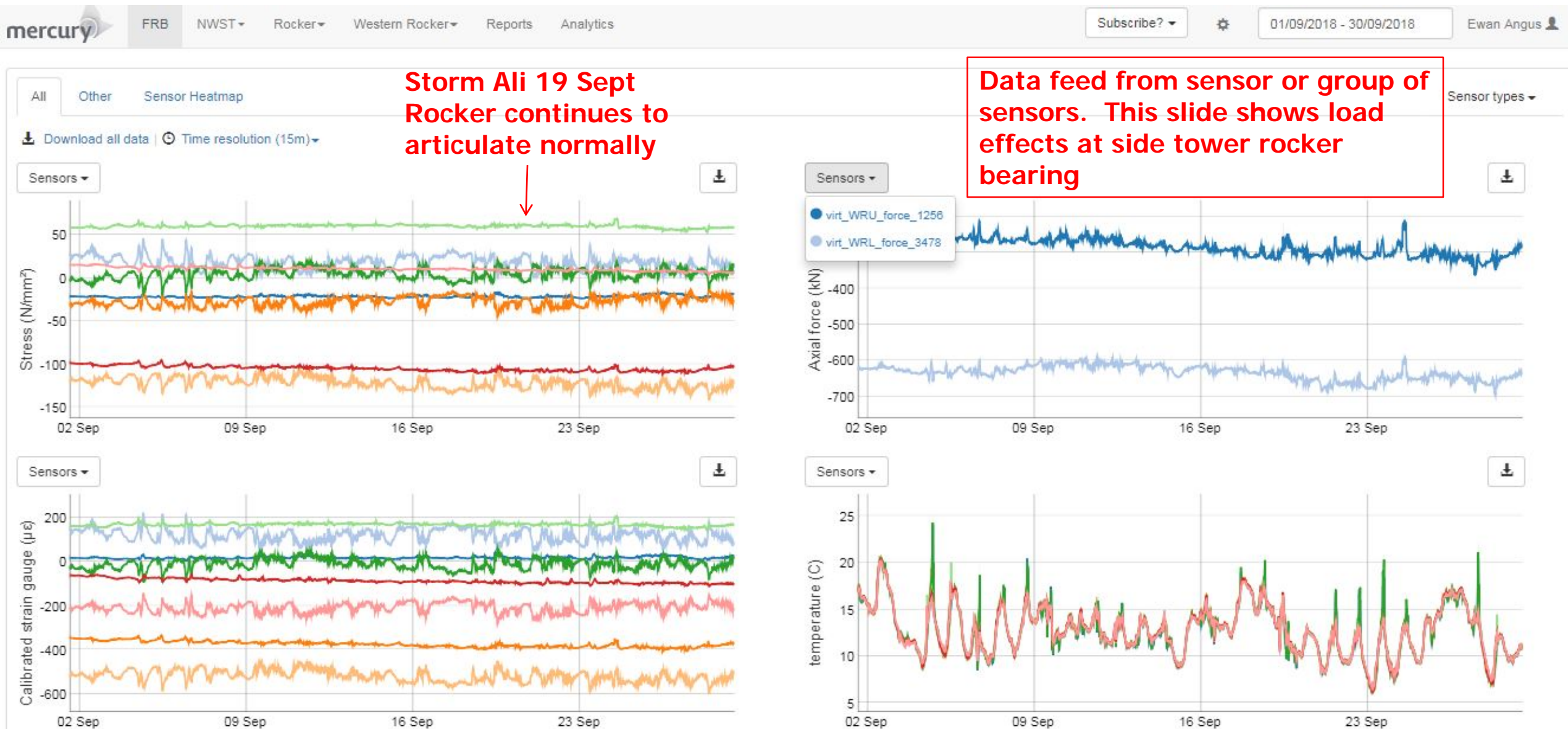
Assurance during and after major events

Assurance during and after major events

Pulling it all together

BRIDGE REPAIRS & MAINTENANCE

BRIDGE INSPECTIONS

Inspectors / Tablet Input
360º Camera
VR/AR

CONTROL ROOM

Real Time Monitoring
Alerts
3D Visualisation

FRB Mercury
FRB Pearl
QC Mercury
QC Pearl

AUTOMATICALLY GENERATED REPORTS

Inspection Reports
Monitoring Reports
Bridge Condition Indices
Maintenance Budgets

SENSORS

Bridge Loading
Wind & Temperature
Bridge Response

BRIDGE INFORMATION

Structural Capacities

As-Built Records
Baseline Conditions

WEB BROWSER

Bridge Operations
Scheduling Inspections/Repairs
Monitoring
Economic Modelling

In Conclusion

➢ This is all about **data**! Lots of assets generate lots of data but many don't make full use of it

➢ The systems we have developed have put these bridges in a world leading position

➢ Resilience and confidence can be increased with proper use of technology and data

➢ Owners of smart assets can make better informed decisions

➢ Integration, automation, and harnessing the full power of data analytics are key to success

➢ Engineering judgement will always be needed but the analytics free up time for this…

Thank you

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