MAINTENANCE MANAGEMENT

FUTURE READY - DATA DRIVEN - DIGITAL MAINTENANCE

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DIGITAL MAINTENANCE THAT CREATES VALUE

The **Maintenance Management Module** of Downer's TrainDNA product suite is a digitised change for asset maintainers and asset owners. Bringing smarts to innovate and automate maintenance management.

Developed over 15 years from deep industry experience and engineering expertise, this module combines consulting skills and the benefits of industry leading applications to optimise your maintenance management.

Accelerate the move to a digital world and keep pace with the growing and changing travel demands. This module is designed specifically to increase train availability, reliability and safety while reducing operational cost through digital maintenance practices.

BENEFITS

Lower costs and enhanced efficiency across all maintenance activities and related workforce planning:

- Reducing supply chain costs.
- Reducing the cost of maintenance.
- Providing the right maintenance at the right time.
- Minimising time out-of-service.
- Optimising workforce utilisation.

Provided a 51% improvement in fleet reliability

Enabled a 2 fold extension in the routine periodic maintenance interval

Enhanced efficiency in maintenance delivery allowing for a 21% growth in fleet, with minimal increase in workforce requirements

To ensure an easy and successful adoption of the Maintenance Management Module, Downer offers consulting services and step change implementation services typically after the provisioning of selected SOROS module applications.

TrainDNA

WHAT IS TrainDNA?

A full suite of rail and transit system asset management services, designed to provide class leading performance and improve passenger outcomes. Upgrade to next generation, asset management technology and provide the industry's most **reliable, available and efficiently** run trains. **TrainDNA takes you on a transformational journey to a digitalised and improved maintenance management system.**

OUR CONSULTATION SERVICE

Leveraging 150+ years of experience, Downer's has a deep knowledge, expertise and best practice approach for maintenance management. Through the provision of consulting services, customers can receive guidance and support with implementing the process changes required for successful digital maintenance management of rollingstock assets.

Our approach is simple. Start with an initial assessment, then identify the priority areas for improvement and implement step changes to enhance maintenance management.

These areas may include:

- Optimising maintenance plans.
- Implementing condition-based maintenance.
- Leveraging data-driven insights from analytics.
- EAM configuration and data modelling.
- Adopting one or more of the associated SOROS modules such as SPA or TrainTrax.

THE MODULES

Flexible, scalable and agile, TrainDNA is comprised of five standalone and inter-operable modules. Reap the benefits of one module, or add and combine multiple modules at any stage of operational maturity. The data, capability and knowledge of each module is proven to shape successful business decisions and improvements.

Maintenance Management	Operational Intelligence	Asset Intelligence and Analytics	Robotics and Automation	Sustainability
Asset management, maintenance activities and the related workforce planning.	Real-time data, integrated from many sources (trains, maintenance facilities, operators).	The process of analysing data and producing insights and findings.	Remove manual tasks that are prone to human error, difficult to perform and time consuming to complete.	Optimising real-time power consumption, work practices and track sustainability benefits.

Downer

MAINTENANCE MANAGEMENT

THE APPS

SOROS

An industry leading, cloud based SaaS platform that improves co-ordination between operations and maintenance, SOROS is an industry leading maintenance and operations management system, available today.

With a visually appealing user interface, SOROS increases train availability, reliability and reduces the cost of maintenance. Gain fingertip access to critical operational fleet level data.

Soros is made up of many modules with the core maintenance management modules being SPA and TrainTrax.

OTHER MODULES INCLUDE:

- Safety.
- Communications.
- Engineering.

FEATURES

- Integrates with existing asset management systems via bespoke two-way integrations.
- Fast implementation with minimal training.
- Presents data concisely via a user-friendly web-based interface.
- Mobile first, cloud-based access.
- Specifically designed for the rail industry.

SOROS

CUSTOMER WORKFORCE REQUIREMENTS
Pre-SOROS = **1,920 FTE**
Post-SOROS = **1,485 FTE**

45% of savings across FTE and man-hour overheads reduced.

South Eastern Trains UK saved 41% of maintenance expense.

"Downer TrainDNA provides excellent visibility for train maintenance opportunities in the context of the daily railway operation. It gives the Maintainer and Operator greater insights into the potential implications of day-to-day decisions, enabling efficient synchronisation and delivering synergies.

- Rob Clayton, Director, IPEX Global Rail Experts

SET PLANNING & ANALYSIS (SPA)

Set Planing and Analysis (SPA) provides comprehensive forward planning of all maintenance activities, allowing you to respond to the demands of your network. SPA helps you make data-driven decisions, streamline maintenance schedules and maximize resource efficiency so to maximize fleet availability to the operator and maximize resource efficiency.

BENEFITS

- Minimizes time a train is in for maintenance.
- Increases overall train availability.
- Helps deliver against your KPI regime.
- Improves fleet reliability.

TrainTraX

TrainTRAX

TrainTrax is a visual, user-friendly depot management application showing what trains are where and what is happening on each train while in the depot. Views drill down from site level to yard level and to road level, showing what maintenance work is scheduled, in progress and completed with planned movements.

BENEFITS

- Provides a digital single source of truth of all trains, works and movements in the depot.
- Real-time view of the fleet serviceability status.
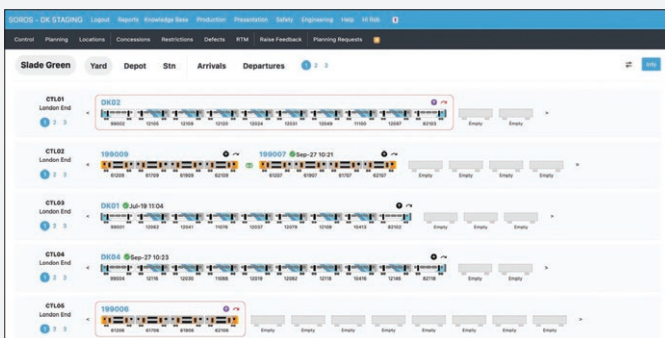
TrainTrax: showing what trains are in what roads in the stabling yard.
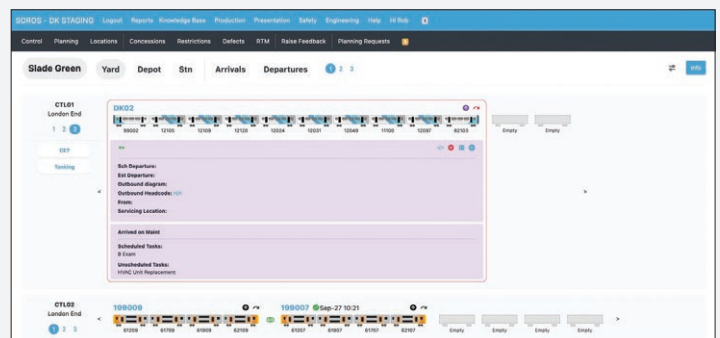
TrainTrax: showing the run in and run out information, what diagram/run the train is allocated to and any maintenance work that is planned and if its in maintenance.

Talk to one of our TrainDNA specialists and find out more about our modular approach.
✉ **TrainDNA@downergroup.com**

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OPERATIONAL INTELLIGENCE

CLEVER INSIGHTS · REAL-TIME DATA · HOLISTIC VIEW

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GAIN UNPARALLELED VISIBILITY OF YOUR ASSETS ON THE NETWORK

Imagine an operating platform that is the 'eyes and ears' of your fleet of rolling stock. Introducing the **Operational Intelligence Module** – an intelligent system that is utilised by both asset maintainers and operators. It gathers and analyses telemetry data in real-time from the rollingstock assets and turns this into useable information, pro-active alerts and actionable insights as events happen out on the network.

Developed over 15 years from Downer's deep industry experience and engineering expertise, Operational Intelligence optimises real-time operations of rollingstock. By transforming telemetry data into actionable insights and rapidly identifying and prioritising emerging issues of rollingstock on the network, operators and maintainers can make informed decisions in real-time to ultimately maximise trains and tram reliability and passenger experience.

Operational Intelligence integrates into your asset management system and timetable system, allowing timetable, run, maintenance and asset data to be viewed as alerts and actions are assessed. Corrective Maintenance work orders and changes to the maintenance plan can be actioned from within this module.

CAPABILITIES

- Visualisation of the trains on the network, showing real-time asset performance in a single view with alerts identifying where issues exist.
- Pro-active detection and notification of potential failure events.
- Correlation of real-time telemetry data to generate automated in-sights leading to shortened diagnosis periods.
- Prioritisation of events based on impacts such that rapid decisions can be made on what action is needed.
- Ability to emulate the driver cabin controls and dashboards to see what the driver is seeing from any location.
- Ability to allocate trains to the required runs/diagrams at any time.

Essential to the Operational Intelligence Module, Downer capabilities includes smart train enablement including Operational Technology (OT) and telematics on the train, system integration and ship to shore system implementation.

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ACCESSING DATA TO BOOST EFFICIENCIES

Upgrade to next generation asset management technology and provide the industry's most reliable, available and efficiently run trains.

> *Love the software, efficient, clean, straight to where you want to be*
> **Eddie Patterson,**
> **London North East Railway.**

THE MODULES

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Operational Intelligence
Real-time data, integrated from many sources (trains, maintenance facilities, operators).

Asset Intelligence and Analytics
The process of analysing data and producing insights and findings.

Robotics and Automation
Remove manual tasks that are prone to human error, difficult to perform and time consuming to complete.
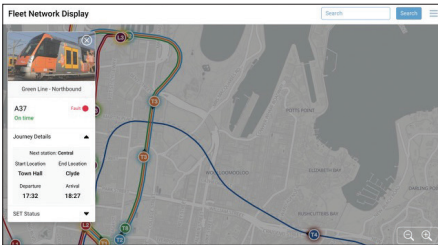
Sustainability
Optimising real-time power consumption, work practices and track sustainability benefits.

**Downer**

THE APPS

Downer has developed a rail specific set of applications to create the **Operational Intelligence Module.**

Fleet Network Display (FND)

A centralised and visually data-rich application, FND provides a bird's-eye-view of every fleet across the network. This comprehensive overview helps to track the movement of the fleet with real-time information on the asset performance, location and status. Through the visual map, we can drill down on any asset with integration back to the asset management system to see asset information, work order history, previous alerts, and any planned maintenance. Dashboards can be tailored to suit customer requirements and alerts and notifications for critical events can also be configured. Train allocations to runs/ diagrams can also be managed in FND.

FND is all about providing the right, meaningful information to your operations center in a simple and useable way.
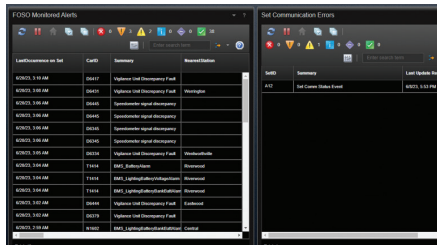
Alert Management System (AMS)

AMS is an advanced event correlation capability that processes 1,000's of data points coming off every train and tram every minute. It processes these messages, decides if there is an issue that requires attention, prioritises this and raises it as an alert. Downer, from our 15 years of experience, will implement the data models and business rules for this process.

From AMS, the operations center can then further investigate and decide what action is necessary including raising a corrective maintenance work order directly from AMS into the asset management system if necessary. Each alert and action is tracked to completeness.

Train Crew Display Emulator (TCDE)

Providing a replicate view of a real-time train environment, from a fleet-wide perspective to a single train, TCDE enables more visibility of the train cab than seen by the train crew.

TCDE allows the operations center and the engineering teams to understand exactly what is happening on the train out on the network by emulating the various train dashboards control systems and driver views. Uses include issue investigation, driver assistance and driver training.

Provided a 51% improvement in fleet reliability

Enhanced efficiency in maintenance delivery allowing for a 21% growth in fleet, with minimal increase in workforce requirements

Enabled a 2 fold extension in the routine periodic maintenance interval

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ASSET INTELLIGENCE & ANALYTICS

INTEGRATED SYSTEMS – DATA SCIENCE – OPTIMISED MAINTENANCE

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CONVERTING DATA TO MAINTENANCE DECISIONS

The module with the 'smarts' of Downer's TrainDNA product suite is the **Asset Intelligence and Analytics Module**, designed and purpose built by Data Scientists. This module supports fleet engineers to solve the most challenging problems ranging from defect investigations, optimising maintenance regimes to predicting failures.

The Asset Intelligence and Analytics Module integrates data from multiple sources (asset records, work orders, inspection records, train telemetry, wayside equipment, operator systems, environmental sources) and transforms this into a single accessible data source. Through the process of analysing data, building predictive models and applying machine learning we are able to provide a range of outputs that optimise asset maintenance and minimise service disruption.

Unprecedented changes in our environment are changing transport demands. Digital transformation underpins an organisation's ability to respond to these changes. Developed over 15 years from Downer's deep industry experience and engineering expertise, the Asset Intelligence and Analytics Module allows you to rapidly generate value from your data by turning this into insights to optimise your maintenance practices.

BENEFITS

The benefits gained from this module include faster investigations, compliance validation to KPI regimes, increased conditional maintenance, increased predictive maintenance and optimised maintenance plans.

UNIQUE FEATURES

- Data models established to store data from multiple sources such as your Asset Management System, Operator/Wayside system, Telemetry data and Weather Bureau.
- Pre-established dashboards, reports and analytics to provide speed to value.
- Pre-established business logic and engineering change processes to move to condition-based maintenance.
- Transforms and conforms data in real-time to be stored in the data warehouse to allow processing and reporting.
- Stores data in a Data Lake in native form, to allow analytics, use in predictive models and machine learn post event for specific investigations and other unplanned use cases.

TrainDNA

WHAT IS TrainDNA?

A full suite of rail and transit system asset management services, designed to provide class leading performance and improve passenger outcomes.

ACCESSING DATA TO BOOST EFFICIENCIES

Upgrade to next generation asset management technology and provide the industry's most reliable, available and efficiently run trains.

Case Study: Electrical Auxiliary Power (EAP) Supply Failures

The cleanliness of an air filter affects the EAPS performance.

EAPS can fail if there is poor air quality. Data Science was be used to correlate data, including the weather forecast, to predict if and when a failure will occur.

THE MODULES

Flexible, scalable and agile, TrainDNA is comprised of five standalone and inter-operable modules. Reap the benefits of one module, or add and combine multiple modules at any stage of operational maturity. The data, capability and knowledge of each module is proven to shape successful business decisions and improvements.

Maintenance Management
Asset management, maintenance activities and the related workforce planning.

Operational Intelligence
Real-time data, integrated from many sources (trains, maintenance facilities, operators).

Asset Intelligence and Analytics
The process of analysing data and producing insights and findings.

Robotics and Automation
Remove manual tasks that are prone to human error, difficult to perform and time consuming to complete.

Sustainability
Optimising real-time power consumption, work practices and track sustainability benefits.

**Downer**

ASSET INTELLIGENCE & ANALYTICS

Figure 1: Downer's Integrated Operational Centre

HOW IT WORKS

With over approx 100 messages every 60 secs coming of each train, the Assest Intelligence and **The Asset Intelligence and Analytics Module** is a simplified approach to managing the vast amounts of data, systems and applications used in train operations and maintenance. We analyse your current state data, applications, and system integration landscape, introduce capabilities immediately and develop a roadmap for your applications, systems, and data architecture to bring on additional capabilities over time.

Downer recognises that every train has differences. By having a standard data model and transforming data, existing reports, analytics models, and business logic can be applied with minimal change. Where required, our experienced Data Scientists can tackle the more challenging investigations including, condition based decision models and predictive models.
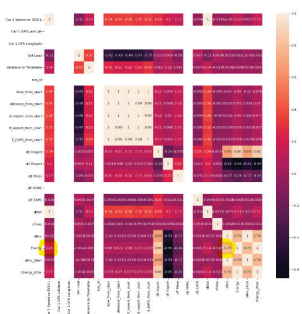
Python correlation matrix for signals against energy usage.
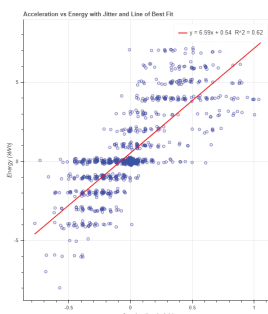
Using ER data to plot 5 second KWh consumption vs accel for one set one run.
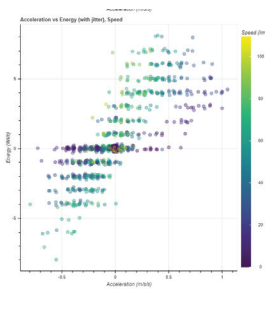
Same data overlaid with current speed, colour coded.

REPORTING AS A SERVICE

This service provides pre-packaged reports, analytic models and dashboards for improved maintenance management in eight areas of focus; and pre-existing dashboards for KPI measures and performance/penalty regimes.

The eight pre-packaged report focus areas are:

1. Maintenance Interval Optimisation.
2. Workforce Utilisation.
3. Reliability Analysis.
4. Energy Efficiency.
5. Failure Prediction.
6. Asset Life Expectancy.
7. Supply Chain Performance.
8. Configuration Control.

PLATFORM AS A SERVICE

A cloud-based data-platform, consumed as a service, with the capabilities to support this module including:

- Unique user interface for ad hoc reporting.
- Data warehousing.
- Data lake with raw data extraction.
- Integration platform that allows access to all data sources.

DATA SCIENCE AS A SERVICE

A resource-based service, it provides data scientists who have 15 years working to solve problems in rollingstock maintenance. Examples include:

- Extending bogie overalls from 1.2M kms to 1.6M kms by implementing CBM.
- Predicting battery failures.
- Predicting door failures.
- Track Data Analysis.
- Component failure investigation such as Traction Inverters.

In addition to ensuring best practise standards, this module also supports organisations transitioning from fixed maintenance (FM), to condition based maintenance (CBM), through to predictive maintenance (PM).

Talk to one of our TrainDNA specialists and find out more about our modular approach.
✉ **TrainDNA@downergroup.com**

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ROBOTICS & AUTOMATION

INNOVATION THROUGH AUTOMATION

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EMBRACING AUTOMATION TO INCREASE QUALITY AND SAFETY

The future of rail; where robotics and automated inspections are becoming part of the industry's maintenance and operational norm. Through a transition to digitisation of repeatable and ergonomically challenging inspection tasks, rail maintainers can increase the quality and reliability of the inspection data they receive. Increasing maintenace capacity by running robots 24x7, freeing up time for the technicians and maintenance engineers to focus on higher value activities. Repetitive and time intensive inspection tasks can be performed safely, efficiently and with greater accuracy.

The **Robotics and Automation Module** adopts cutting-edge robots with advanced sensor technologies. The robot's operation is fully autonomous, working safely and around busy and active maintenance depots. Developed over years of experience and guided by Future Maintenance Technologies (FMT) scientific understanding in providing robotics and automated inspections. Downer's implementation services will prepare your organisation to adopt autonomous inspections and assist you with the transition.

BENEFITS

- Reduction in labor hours to complete repetitive maintenance tasks.
- Redeployment of maintenance staff to higher value activities.
- Reduction in maintenance staff working in unsafe environments and unergonomic conditions.
- Increase in accuracy and consistency of measurements avoiding unnecessary maintenance due to errors.
- Increased maintenance capacity due 24x7 nature of the robots and ability to work autonomously while other activities are occurring in the maintenance depot.

- Increase in accuracy and detail of measurement to determine condition to avoid unnecessary replacement, lowering inventory costs.
- Restructuring of maintenance regimes to increase automated tasks and extend maintenance intervals, lowering total maintenance spend.
- Flexibility to add and change inspections in the maintenance depot without complex site designs typically required by gantry systems.
- Inspection data digitisation and integration into the asset management system to facilitate trending and increased CBM.

DATA INTEGRATION WITH YOUR ASSET MANAGEMENT SYSTEM

With over 15 years experience, Downer has been designing data models, intergrating systems, using inspection data, as well as trends and business logic to support reporting needs and condition-based maintenance.

TrainDNA

WHAT IS TrainDNA?

A cloud based, highly integrated suite of products designed to capture and analyse data for improved performance and enhanced passenger experience.

ACCESSING DATA TO BOOST EFFICIENCIES

Upgrade to next generation, asset management technology and provide the industry's most reliable, available and efficiently run trains. TrainDNA takes you on a transformational journey to a digitalised and improved asset management system. Co-ordinate maintenance and operations activities and benefit from accurate data driven insights.

"Payback in first two years derived from increased train availability, increased condition based maintenance and increased maintenance capacity."

THE MODULES

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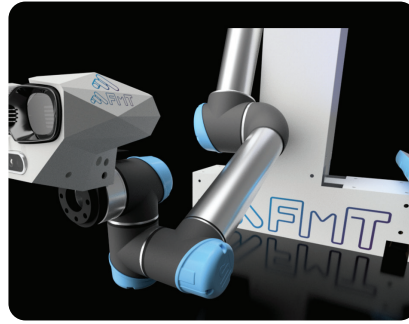The process of analysing data and producing in-sights and findings.

Robotics and Automation
Remove manual tasks that are prone to human error, difficult to perform and time consuming to complete.

Sustainability
Optimising real-time power consumption, work practices and track sustainability benefits.

Downer | FMT

ROBOTICS & AUTOMATION

HOW DOES RFD WORK?

GETTING STARTED

During a **Pilot Program**, we will introduce suitable robots (TRES and RFD) to your maintenance facility site. These autonomous machines, collect raw visuals, data models as well as algorithims to enable customers to establish with assurance a baseline against manual measurements. Outputs typically include a technical report and a business case to demonstrate the financial benefits.

TRAIN EXAMINATION SYSTEM (TRES)

The pioneering technology of TRES combines FMT's sensor technology and autonomous robotics platforms to conduct inspections of rail assets. It comes equipped with the latest Light Detection and Ranging (LiDAR) and state-of-the-art laser and optical technology to conduct highly accurate train inspections.

Some examples of common and pre-built inspections include:

- Rail wheel measurements (profile and diameter)
- Rail wheel surface defects (spalling and cracks)
- Torque mark identification
- Oil gauge level
- Brake pad and brake disc measurements.

RAIL FACILITY DRONES (RFD)

RFD is the result of combining drones with sensor technology, to conduct autonomous inspections of rail assets, facilities and infrastructure. Installed with Machine Learning and Computer Vision Analytics, RFD brings a selection of pre-built inspections:

- Overhead wires (connectors, insulators, tension and temperature)
- Facility (HVAC, solar, guttering and rust)
- Perimeter fence (damage and vegetation)
- High voltage asset condition
- People/intruder detection
- Rolling stock (graffiti, pantograph and roof).

ON-GOING MANAGED SERVICE

As part of the implementation, Downer's Managed service will ensure on-going operations and ability meet service levels and performance requirements. This includes:

- Maintenance of the robots including parts replacement over its life.
- Support in the robot's day to day operation.
- Development and enhancements to existing inspection types.
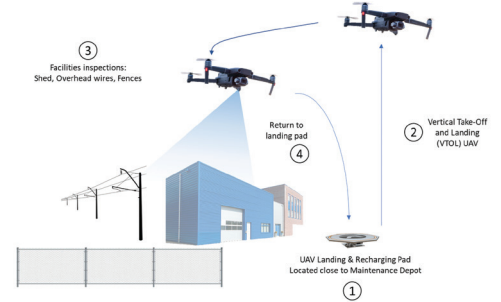- Ability to request new inspection types as required.

Figure (above): Rail Infrastructure Inspection captured in Pakenham, Melbourne, Australia in Dec 2021

Talk to one of our TrainDNA specialists and find out more about our modular approach.
Contact: TrainDNA@downergroup.com

SUSTAINABILITY

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AUDIT READY – SIMPLIFIED REPORTING – INNOVATIVE ESG

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ACCELERATING RAIL FOR A NET ZERO WORLD

Downer is playing a vital role in the transformation of the rail industry. We are pushing to reach net zero carbon emissions targets and want to help organisations do the same.

As an industry leader in developing solutions for asset management systems our solutions have been designed to meet strict sustainability requirements.

The **Sustainability Module** of the TrainDNA product suite, is designed to help our clients answer common questions such as: *How does your energy usage compare to industry averages? Can you view the energy usage of in-flight projects? What is the total energy usage for maintenance assets?*

Together with market-leading software and supported by deep industry knowledge, TrainDNA's sustainability module provides easy control and visibility of critical reporting. Helping to manage and mitigate the increasing pressure that comes with regulatory compliance and fines.

Offering customers, the ability to remove the barriers to accelerating sustainability performance and increase decarbonisation effectiveness.

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BENEFITS

Benefit 1 – Reporting time/cost reduction
▪ Time and effort reduced for manual collation and reporting of emissions data/insights (inc. Consulting Costs)

Benefit 2 – Reduction in cost of credit
▪ Cost savings in being able to obtain cheaper finance – sustainability linked loans

Benefit 3 – Sustainability initiatives, identification and benefit realization
▪ Reduction in investment cost spent on the wrong projects. Benefits realisation tracking for in-flight projects

Benefit 4 – Adherence to regulatory requirements and pressures
▪ Avoiding potential regulatory fines associated with non-compliance

Benefit 5 – Improved tender win rate
▪ Strengthen your bids by including a leading product solution to meet market sustainability demand.

> *Climate change is the number one, greatest threat to humanity. And Downer takes this threat – and our part in preventing it – very seriously.*
>
> *- Nathan Brogden, Group Sustainability Manager, Downer Group*

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Optimising real-time power consumption, work practices and track sustainability benefits

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CIRCULAR ECONOMY IN PRACTICE.

TrainDNA can also be used to draw in data were available, from historical and current maintenance records, and from reviews of the current design models to be able to find and make circular economy recommendations.

Diagnostic data is most likely to be available and useful for assets around Traction engines, Gensets, Doors and HVACs.

Outputs may include:

▪ Remaining Useful Life of important components and ability to determine opportunities to safely extend asset life and reduce waste

▪ Identifying opportunities, through the normal Engineering Change Processes, to increase the recycled content in parts

▪ Identifying opportunities to change the recyclable content in consumables too

▪ Advice on fuel consumption minimisation strategies

MODULES

### CONSULTING AND DATA ANALYTICS SERVICES

Data services:

▪ Collation and processing of customer's data.

▪ Utility providers for electricity suppliers across builds and maintenance

▪ Ongoing report generation

Advisory services:

▪ Insights and identification of sustainability opportunities

▪ Project benefit tracking

▪ Reporting on requirements for Sustainability linked lending

▪ Industry Benchmarking and specific target setting

Benefits:

✔ Cost savings in being able to obtain cheaper finance - sustainability link loans. e.g. 0.5% - 1.5% reduced rate ANZ(AUS & NZ)

✔ Reduction in investment cost spent on the wrong projects

✔ Benefits realisation/ tracking for in-flight projects.
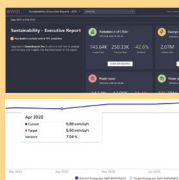
Visualised examples of reporting.

REPORTING

Using a powerful emissions calculation engine and flexible reporting tools to meet strict sustainability requirements. A proven emissions reporting solution.

Report with confidence knowing your ESG data has been captured in a single system of record with audit trails and financial-grade accuracy backed by more than a decade of industry experience.

Emissions data capturing and reporting:

Benefits:

✔ Time and effort reduced for manual collation and reporting of emissions data

✔ Enabling increased frequency of reporting providing better insights

✔ Potential regulatory fines associated with non-compliance

AU example upcoming mandatory reporting seen here.

NETWORK AND ASSET ENERGY EFFICIENCY PERFORMANCE VISUALISATION PLATFORM

Operational visual view of network and assets for customer's defined sustainability targets and operating parameters

Benefits:

✔ Reduction in investment cost spent on the wrong projects

✔ Benefits realisation/tracking for in-flight projects

✔ Allows identification and tracking for operators who are unable to interpret detailed quantitative data

✔ Generates data driven alerts for specific interventions.

Fleet HVAC Overview

Operational visual view of network and assets for customer's defined sustainability targets and operating parameters
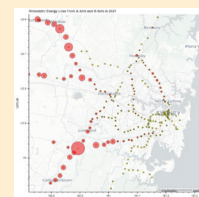
Depot energy alerts can be set and mapped, giving proactive indication of:
• Unexpected trends
• Potential Violations of ISC Ratings

Talk to one of our TrainDNA specialists and find out more about our modular approach.
Contact: TrainDNA@downergroup.com

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