Fleet Management Good Practice Guide: The Twenty Point Plan

AMENDMENT RECORD

<table>
<thead>
<tr>
<th>Issue</th>
<th>Dated</th>
<th>Notes</th>
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<tr>
<td>13</td>
<td>December 2017</td>
<td>Section 2 audit protocol updated to meet Engineering Council requirements</td>
</tr>
<tr>
<td>13</td>
<td>December 2017</td>
<td>Inclusion of new Section 9: On-Depot Fault Finding</td>
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<td>13</td>
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<td>Updates to Section 13: New Trains Introduction</td>
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<td>13</td>
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<td>Inclusion of new Appendix K: Performance Measure Indicators</td>
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<td>13</td>
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<td>Section 2.1.1 “The operating TOC is accountable for fleet reporting to RDG but that for subleased fleets the lessor and lessee should agree between them who is responsible”</td>
</tr>
<tr>
<td>13</td>
<td>December 2017</td>
<td>Clause 2.1.3.3 ‘train prep’ to be considered when declaring train fit for service</td>
</tr>
<tr>
<td>13</td>
<td>December 2017</td>
<td>General document sections restructure</td>
</tr>
<tr>
<td>13</td>
<td>December 2017</td>
<td>Gary Cooper’s foreword updated</td>
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Fleet Management Good Practice Guide: The Twenty Point Plan

Foreword

Our industry’s customers are consistent and have been since the birth of railways. They give us a very simple message whether they are passengers or businesses that send freight by rail. The message is ‘run my train on time’. Added to this there is a strong correlation between customer satisfaction and punctuality and in turn customer satisfaction has a strong correlation with rail businesses’ revenues. It is important therefore to all of us that we do run punctual trains.

The industry’s National Task Force (NTF) brings together TOCs, FOCs, Network Rail, the DfT and the ORR with the purpose of agreeing and then delivering levels of punctuality that meet or exceed customers’ needs. Fleet has a major role in this, at the time of writing, 1 December 2017 it causes as an MAA, 17% of all industry delays.

TOCs, FOCs, RoSTCs, and their suppliers, large and small, were instrumental in the years of national PPM improvement from 2002 – 2012, but since then punctuality has declined each year. In 2013 the NTF set, and the fleet community accepted, a national passenger fleet performance challenge of 11 500 MTIN for the years 2014 – 2019 and improvement in reliability over the five years of 20%. The reality is that we are likely to deliver 10 200 MTIN and, with shortfalls in planned performance in other parts of the industry, we continue to fail our customers and funders.

Changes to the electrification plans for the country and changing rolling stock cascades present a reliability challenge as does the significant introduction of new fleets. This means that the national fleet reliability performance remains a top priority to improve.

The 20 Point Plan remains, as originally conceived, a member content driven tool to help businesses deliver improvements in their rolling stock performance through willingly sharing hard-earned knowledge. The continued evolution of the Plan is a visible demonstration of the will that differing businesses have to collaborate in the challenge of providing reliable punctual journeys for customers, be they passengers or those consigning Freight by Rail.

Focusing on both reducing incidents further and faster, how to reduce their impact when they do occur, are both necessary to meet our customers’ needs on our increasingly busy railway. The Fleet community, through prediction and prevention, and having good information when something does go wrong has continued opportunities to improve the most basic and consistent need expressed by our customers: ‘run my train on time’.

Gary Cooper

Director: RDG Planning, Engineering and Operations
Meeting the Challenge

The Fleet Reliability Focus Forum (ReFocus) was introduced by Engineering Council in November 2010 and was tasked with identifying best practice and sharing knowledge amongst rail industry partners such as TOCs, OEMs, RoSCos, Network Rail and others. This forum has successfully contributed to the fleet delivery over this time and continues to provide an evolutional good practice guide to support the industry.

ReFocus captures this knowledge through peer groups who are experts in the area of discussion, this knowledge is then transferred to the Fleet Management Good Practice Guide.

ReFocus has developed new sections of the guide and has revised sections already contained within it. Sharing this knowledge and best practice ultimately allows TOCs and their partners to deliver a reliable and on time service to its customer.

However, the railway still faces many challenges. With the increase in demand and society’s expectations continually evolving, more and more customers and businesses are being attracted to use the railway. This creates significant challenges, with historic methods of delivering continuous improvement only able to provide marginal benefits. A more holistic view covering not only the technical aspects but the people and culture aspects will need to be explored and captured in the guide. Integrating new technology, data, people and process all together to allow for more trains to run on an increasingly busy network.

ReFocus has made progress in tackling some of these problems by working with industry partners and not just in a fleet centric group. This allows ReFocus to examine generic railway issues from an holistic perspective by working with its operational colleagues and Network Rail as well as other industry partners such as the OEMs and the RoSCos. Collaborative working enables ReFocus to deliver new or revised sections of the Fleet Management Good Practice Guide which reflect today’s thinking.

ReFocus also takes a holistic view of society and cultural challenges to drive change, it looks at technology and innovation which allow new processes and practices to be developed and it also looks at the gaps where clear value can be added. This knowledge is used to inform other industry strategy groups such as ‘Fleet Challenge’ and RDG’s ‘Supply Chain Forum’ of gaps and shortfalls which may need addressing now or in the near future.

Other industries face similar challenges to the railway with an ever increasing demand from users and the constant need to move forward and deliver a reliable and safe service. By benchmarking with other industries members have opportunities to transfer knowledge gained and incorporate it within their own business.

Mark Johnson

Fleet Reliability Focus Forum Chairman
Engineering Director, Southeastern Railway
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What is this document?

The Twenty Point Plan (20PP) is the current industry view of the activities required to maximise the reliability of the UK national rolling stock fleet. Where helpful, it includes examples of best practice.

Who is it for?

Train Operating Company (TOC) Engineering teams, new Engineering Directors and Fleet Managers and other rail partners, so they know:

- what issues to concentrate on in their own organisation; and
- who to visit to see best practice; so that they can
- develop their own ways of managing their fleets to increase reliability, and
- develop relationships and partnerships

Who owns it?

The Fleet Reliability Focus Forum (ReFocus).

What / Who is The Fleet Reliability Focus Forum?

ReFocus is a voluntary group of railway engineers who have accountability for rolling stock; membership includes The National Task Force (NTF), TOCs, Rolling Stock Leasing Companies (ROSCOs), the Railway Industry Association (RIA), Original Equipment Manufacturers (OEMs), Network Rail’s Rail Vehicle Interface Engineers and the Department for Transport (DfT).

What does The Fleet Reliability Focus Forum do?

ReFocus seeks to improve train performance through better understanding and sharing of knowledge. A number of activities are undertaken, such as:

Collating and Sharing of National Data – consistently produced to independently audited agreed criteria.

Fleet Comparisons and Benchmarking – understanding reliability differences and challenging delivery where appropriate.

Spreading Best Practice – 20PP implementation follow up, site visits and annual seminar (usually in October).

Simplifications:

Different parties are involved in the UK rail industry and there are different divisions of labour between them. The typical model at privatisation of a TOC with a soggy lease from a ROSCO is generally used to simplify the writing and reading of the 20PP. Similarly, references to DfT include the Welsh Assembly Government and the Scottish Executive as appropriate. The principles apply irrespective of which party is actually undertaking each activity.
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1. Summary

This document has been developed by fleet engineers for fleet engineers to help improve rolling stock performance. This issue has been updated to improve guidance on Common Reliability Data (Section 2) and New Train Procurement (Section 13). Guidance on On-depot Fault Finding (Section 9) has also been added. The document has been reformatted to tidy up the sections.

This issue contains:

- Common Reliability Data (Section 2) – Miles per 3 Minute Delay, Miles per Trust Incident (MTIN) and Delays per Incident (DPI).
- Management for Improvement (Section 3) – principles, methods and examples to motivate sustained improvement, including Day-to-day; Monitoring and Feedback; and Change Management; Risk Evaluation.
- Seasonal Management (Section 4) - To maximise the level and consistency of fleet performance during seasonal variances both operations and engineering need to work together to produce robust and effective management plans. This section is intended to promote a structured approach to seasonal planning and operations.
- Train Preparation (Section 5) – This section emphasis on Plan, Do, review process to ensure fleets safety, reliability and presentation.
- Delivering the Service (Section 6) – engineering, operations and planning need to understand each other and pull together: depot planning and train planning (e.g. Rules of the Depot); faults and failures (e.g. 2-way communications); measures of fleet performance. Working together on Seasonal Preparedness is vital.
- The Depot (Section 7) - the key frontline resources of fleet maintainers: depots (design, capacity and capability), their management and staffing, including motivation, training, skills development and competence assessment; the High Performing Depot Specification.
- The Vehicles (Section 8) – the core activities of fleet maintainers: collecting and using data (Failure Mode Analysis, condition monitoring, analysing trends); managing repeat defects, deferred work and configuration control; developing the maintenance regime; understanding availability
- On-Depot Fault Finding (Section 9) – This section explores good practice for on-depot fault finding especially around No Fault Found, also the best procedure in establishing robust fault finder with an organisation.
- The Infrastructure (Section 10) – how to manage the engineering interfaces between vehicles and infrastructure (relationships, preventing problems before they start).
- Managing Fleet Incidents (Section 11) - Incidents which occur on the railway will impact on the whole system; this impact is usually measured in train delay minutes. This section includes guidance on how Fleet Incident Management is best implemented.
- Spares and Suppliers (Section 12) – having the right parts when and where you need them (spares holding, floats, measures, link to risk, change control, obsolescence, forecasting), and improving the quality of the parts through effective closed-loop relationships (Unipart Rail, ARTTT, RISAS).
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- New Train Procurement (Section 13) – how to buy a new train fleet to get the best “out-of-the-box” service performance, risks associated with whole fleet behaviour following introduction.

- ROSCOs (Section 15) – how ROSCOs can facilitate reliability improvement throughout vehicle lives, including Fleet Management Plans; User Groups; common bits and common issues; optimising for Duty Cycles.

- Overhaul Management (Section 16) – there is a recognised risk that vehicle re-entering service post overhaul suffers from a reduction in reliability; this section aims to address the issues which cause fleets reliability decline.

- Outsourced Maintenance (Section 17) – best practice in TOCs managing outsourced maintenance, connection to training and development of “in-house” skills and competences (principles are also relevant to TOCs which do most of their work in-house).

- Business Continuity Management (Section 18) – how any business can prepare and implement the strategic and tactical capability of the organisation to plan for and respond to incidents and business disruptions in order to continue business operations at an acceptable pre-defined level.
2. Common Reliability Data

This section specifies the common fleet reliability and performance measures used by the fleet community. It clearly defines the principle measures which are reported to ReFocus, describing what should and should not be included in the data submitted to ReFocus.

The two key measures agreed by Engineering Council and National Task Force and reported by ReFocus are:

1. Miles Per Technical TRUST Incident [Number] (MTIN), and
2. Primary Delay Per Incident (Primary DPI)

The first is a measure of the reliability of fleet, the second is a measure of the effect of fleet failures on train delays. The underlying data for these two measures are provided to ReFocus at individual-fleet level, and reported back each industry period.

In addition to these two key measures, data is also collated from fleet engineers to record:

1. Number of AWS/TPWS Technical TRUST incidents
2. Number of GSM-R technical TRUST incidents
3. Total Number of Non-Technical TRUST Incidents

Each of these three measures are reported to ReFocus at TOC level only.

2.1 Miles per Technical TRUST Incident

2.1.1 DEFINITION

A measure of the engineering reliability of trains expressed as the average mileage between incidents and reported for individual fleets. A 3 Minute Delay (TIN) is counted when a fault on a train causes a total primary delay of 3 or more minutes at any point on one journey for a single root cause, where the root cause is a technical or maintenance defect on the train. This relies on a precise common definition of miles and 3 Minute Delays (TINs). The measure is produced by RDG from data provided by TOCs with operational control as shown in table 3.

2.1.2 SOURCE OF UNDERLYING DATA

The mileage is derived from actual fleet unit/trainset mileage as recorded in GEMINI or equivalent. Note that an HST trainset counts as 1 unit, not 2 power cars and x trailer cars separately, and so the unit miles equate to the train miles. Two 2-car 150/2 sets working in one train count as two units and therefore its unit miles are twice the train miles.

Information relating to 3 Minute Delays is derived from TRUST, COMPASS, Control Logs and/or BUGLE. All sources need to be scrutinised for the relevant fleet codes as appropriate for each TOC.

2.1.3 DETERMINING THE NUMBER OF TECHNICAL INCIDENTS

In all cases a 3 Minute Delay is defined as a train incident which results in a delay of 3 or more primary minutes to that train where the root cause is a technical or maintenance related defect on the train. Any such incident which results in a cancellation or part cancellation is also included.

2.1.3.1 TRUST incident reasons
Table 1 lists all the TRUST incident reason codes which should be included as a technical incident.

**Table 1 – Technical Incident reasons “701D”**

<table>
<thead>
<tr>
<th>Incident Reason</th>
<th>Incident Reason Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0 (zero)</td>
<td>Confirmed Train cab based safety system fault.</td>
</tr>
<tr>
<td>M1</td>
<td>Confirmed Pantograph ADD, shoe beam or associated system faults including positive PANCHEX activations.</td>
</tr>
<tr>
<td>M7</td>
<td>Door and Door system faults.</td>
</tr>
<tr>
<td>M8</td>
<td>Other technical failures above the Solebar.</td>
</tr>
<tr>
<td>M9</td>
<td>Reported fleet equipment defect – no fault found.</td>
</tr>
<tr>
<td>MB</td>
<td>Electric loco failure, defect, attention.</td>
</tr>
<tr>
<td>MC</td>
<td>Diesel loco failure, defect, attention.</td>
</tr>
<tr>
<td>MD</td>
<td>Other technical failures below the solebar.</td>
</tr>
<tr>
<td>ME</td>
<td>Steam locomotive failure/defect/attention.</td>
</tr>
<tr>
<td>MF</td>
<td>International/Channel Tunnel locomotive failure/defect/attention.</td>
</tr>
<tr>
<td>ML</td>
<td>Wagons, coaches and parcel vehicle faults.</td>
</tr>
<tr>
<td>MN</td>
<td>Brake and brake systems faults; including wheel flats where no other cause had been identified.</td>
</tr>
<tr>
<td>MP</td>
<td>Rail and or wheel interface, adhesion problems.</td>
</tr>
<tr>
<td>MR</td>
<td>Sanders and scrubber faults</td>
</tr>
<tr>
<td>MT</td>
<td>Confirmed train borne safety systems faults.</td>
</tr>
<tr>
<td>MV</td>
<td>Engineer’s on-track equipment failure outside possession.</td>
</tr>
<tr>
<td>MW</td>
<td>Weather – effect on T&amp;RS equipment.</td>
</tr>
<tr>
<td>MY</td>
<td>Coupler and Coupler system faults.</td>
</tr>
<tr>
<td>NA</td>
<td>On train TASS failure</td>
</tr>
</tbody>
</table>

The following is a summary of the changes between the previous data and that which is now being distributed by the Delay Attribution Board. **NB** – includes both Technical and Non-Technical.
Table 1a: TRUST Delay Code Changes

<table>
<thead>
<tr>
<th>Deleted code</th>
<th>Abbreviation</th>
<th>Mapped to code</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA</td>
<td>ELEC BRAKE</td>
<td>MN</td>
<td>BRAKES</td>
</tr>
<tr>
<td>MG</td>
<td>COACH BRAKE</td>
<td>MN</td>
<td>BRAKES</td>
</tr>
<tr>
<td>MH</td>
<td>COACH DOOR</td>
<td>M7</td>
<td>DOORS</td>
</tr>
<tr>
<td>MI</td>
<td>COACH OTHER</td>
<td>ML</td>
<td>WAGONS</td>
</tr>
<tr>
<td>MJ</td>
<td>PARCEL VEH</td>
<td>ML</td>
<td>WAGONS</td>
</tr>
<tr>
<td>MK</td>
<td>DVT PCV</td>
<td>MD</td>
<td>BELOW SB</td>
</tr>
<tr>
<td>MM</td>
<td>EMU TRAC</td>
<td>MD</td>
<td>BELOW SB</td>
</tr>
<tr>
<td>MO</td>
<td>STOCK LATE</td>
<td>MU</td>
<td>DEPOT</td>
</tr>
<tr>
<td>MQ</td>
<td>ELEC OTHER</td>
<td>MB</td>
<td>ELEC LOCO</td>
</tr>
<tr>
<td>MX</td>
<td>DIESEL BRKE</td>
<td>MN</td>
<td>BRAKES</td>
</tr>
<tr>
<td>N1</td>
<td>TRS OTHER</td>
<td>MD</td>
<td>BELOW SB</td>
</tr>
<tr>
<td>N3</td>
<td>DIESEL OTHR</td>
<td>MC</td>
<td>DIESEL LOCO</td>
</tr>
<tr>
<td>N4</td>
<td>EMU BRAKE</td>
<td>MN</td>
<td>BRAKES</td>
</tr>
<tr>
<td>N5</td>
<td>EMU DOOR</td>
<td>M7</td>
<td>DOORS</td>
</tr>
<tr>
<td>NG</td>
<td>EMU OTHER</td>
<td>MD</td>
<td>BELOW SB</td>
</tr>
<tr>
<td>NB</td>
<td>TASS NFF</td>
<td>NA</td>
<td>TASS/TLT</td>
</tr>
<tr>
<td>NC</td>
<td>DEP FIRE</td>
<td>MU</td>
<td>DEPOT</td>
</tr>
<tr>
<td>ND</td>
<td>ETCS</td>
<td>M0[zero]</td>
<td>CAB SYS</td>
</tr>
</tbody>
</table>

Note: Where you would normally attribute to M2, please now attribute to the most relevant delay cause. E.g. - security alert in depot – MU.

It should be noted that the Delay Attribution Guide should be used as the authority for this information as updates are provided at different intervals to this document. The above is updated according to relevant guidance at the time of publication.

2.1.3.2 Clarification on what should be included as a 3 minute incident:

a) Incidents caused by the technical failure of a train component or system. This is regardless of whether that component or system is under any warranty.

b) Incidents on Empty Stock Moves caused by the technical failure of a train component or system, regardless of whether or not a passenger service has been affected.

c) Incidents caused by the failure of a component or system caused by poor maintenance instructions or regime or by a maintainer incorrectly following the correct procedures.

d) Incidents where delay has been exacerbated by operational error or inaction but where the root cause was technical or maintenance related.

e) Incidents caused by technical failure even in the event of adverse weather or other conditions.

f) Failures to Stop Incidents resulting in part or full cancellation or delay should be included if the root cause is the technical failure of a train component or system.

2.1.3.3 Clarification on what should be excluded as a 3-min incident:
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- Train incidents caused by human vandalism.
- Train incidents caused by proven infrastructure defects.
- Train incidents caused by any external cause as per the Delay Attribution Guide i.e. unrelated to a technical or maintenance related train fault (for example, brake defect due to equipment damaged by suicide), or extreme contamination
- Operational problems associated with stock availability i.e. provision of the wrong stock type or short-formed services) should be excluded, unless the operational problem has been caused by rolling stock that has become defective after having been declared fit for service to Operations, (i.e. a diagram has been allocated) or are restricted train formations (i.e. multi-only operations).

2.1.3.4 Clarification on merging incidents:
- Where multiple incidents have been created in TRUST, they should be counted as a single incident provided that there has not been an unsuccessful attempt to rectify the defect and that the merged incidents did occur for the same root cause, to the same stock over the next 24 hours. Otherwise each incident must be treated separately.
- Merged incidents must have their delay minutes aggregated.

2.1.3.5 No Fault Found

Where a reported defect is ‘No Fault Found’ the 3 Minute Delay (TIN) will remain, even if the particular problem has not been definitively understood or resolved. However, 3 Minute Delays (TINs) should not be counted where it has been possible to prove beyond reasonable doubt that the defect did not occur. Evidence from OTMR, TMS or similar analysis carried out with traditional fault finding is acceptable.

2.1.3.6 Disputing Incidents

Where Fleet believe an incident should be disputed and there is no initial evidence on first examination of the fault log to indicate the incident was due to a technical casualty. It is worth bearing in mind two factors:

- The purpose of delay attribution is primarily to do with collecting data on asset failures and would your dataset be better or worse without the incident?
- Can any other responsible manager better deal with the incident than Fleet?

A flow chart was developed by a subgroup of Fleet Reliability Focus Forum members in the review of issue 10 of the 20pp and is provided in Appendix A to aid decision making.

2.2 Non-Technical TRUST Incidents

This is a measure of the depot reliability reported at TOC level. A delay is counted as Non-technical trust incident when an incident associated with fleet/depot causes a total delay of 3 or more minutes at any point for a single root cause where the root cause is a Non-technical issue associated with the fleet.
Non-Technical should not be used for incidents apportioned to staff competence. See Section 2.1.3.2.

Any such incident which results in a cancellation or part cancellation is also included.

The number of incidents summed over all fleets of trains and depots that were impacted along with the delay minutes.

The incident reasons attributed as non-technical are shown in Table 2

Table 2 – Non-Technical incident reasons “701A”

<table>
<thead>
<tr>
<th>Incident Reason</th>
<th>Incident Reason Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS</td>
<td>Unplanned stock change or replacement by slower vehicles (all vehicle types)</td>
</tr>
<tr>
<td>MU</td>
<td>Depot operating problem</td>
</tr>
</tbody>
</table>

3 minute delays should exclude:

- Train incidents caused by vandalism.
- Train incidents caused by proven infrastructure defects.
- Train incidents caused by any external cause, i.e. unrelated to a technical or maintenance related train fault (for example, brake defect due to equipment damaged by suicide).
- This measure will only be reported at TOC level

2.3 Delay Per Incident

Delay Per Incident is a measure of the average delay impact on the network per incident. Delay is the TOC-on-Self total (Primary and Reactionary) delay minutes of technical and Non-technical fleet incidents.

More information on Primary and Reactionary Delay can be found in the Delay Attribution Guide available from Network Rail.

This measure will be produced by each TOC as shown in Table 3.

2.3.1 Primary DPI

This section is identical to section 2.3 above but for Primary delay only.

More information on Primary Delay can be found in the Delay Attribution Guide available from Network Rail.

This measure will be produced by each TOC as shown in Table 3.

2.4 Data Submission

RDG contacts fleet operators at the beginning of week 2. Requesting the data required to complete table 3 by the end of week 2 (Friday). Each TOC submits data for every vehicle they operate.
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2.5 Data Resubmission

No formal process is in place to refresh data post TOC submission. However, amendments can be made at RDGs discretion. All amendments must be put forward to the RDG data analyst for approval. Resubmissions must be of significance to avoid continuous changing of TOC reports.
Table 3 – example of TOC report containing the new measures

<table>
<thead>
<tr>
<th>FLEET DATA ENTRY FORM</th>
<th>Period: 1</th>
<th>Year: 2013/14</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOC: TOC name</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enter fleet data in yellow cells.

**FLEET**

<table>
<thead>
<tr>
<th>Class 185</th>
<th>Class 250</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Units/Trains</strong></td>
<td><strong>Total Number of Vehicles</strong></td>
</tr>
<tr>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>50</td>
<td>15</td>
</tr>
<tr>
<td><strong>Number of Technical Casualties</strong></td>
<td><strong>Unit Mileage</strong></td>
</tr>
<tr>
<td>6</td>
<td>70,000</td>
</tr>
<tr>
<td>15</td>
<td>300,000</td>
</tr>
</tbody>
</table>

**Requirement from 2010/11**

<table>
<thead>
<tr>
<th>TECHNICAL Incidents</th>
<th>PRIMARY TOC-on-Self Delay Minutes</th>
<th>NON-TECHNICAL Incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Incidents</td>
<td>PRIMARY TOC-on-Self Delay Minutes</td>
<td>No. of Incidents **</td>
</tr>
<tr>
<td>670</td>
<td>6</td>
<td>200</td>
</tr>
<tr>
<td>958</td>
<td>22</td>
<td>150</td>
</tr>
</tbody>
</table>

**Requirement from 2011/12**

Record of TOC level only.

**Number of TPWS/AWS Trains: 5**

**Number of GSM-R Trains: 1**
2.6 ReFocus Data Review Protocol

2.6.1 On behalf of ReFocus, RDG contract an independent contractor for Common Reliability Data Audits. The plan is for the contractor to perform audits on a sample of three TOCs per year. The criteria for selection is shown below:

2.6.1.1 Appointment of new senior management
2.6.1.2 Re-Franchising
2.6.1.3 Significant change in the performance data returned from an operator
2.6.1.4 Significant difference in the data provided by one TOC from others within a Class(es) grouping(s)

Based on the above RDG will recommend three audits and Engineering Council will agree its audit priorities and instruct the auditor to proceed accordingly.

2.6.2 RDG will monitor data provided by TOCs for audit purposes and provide the information to the contractor to aid their audit.

2.6.3 The contractor will contact the TOC and request a data audit and list the information required which is basically all of the information required to populate table 3 in section 2. If the data provider is agreeable they shall be asked to provide three random periods of information selected by the contractor from the last 13 periods. The information requested will require the rationale for the decision to attribute incidents from the sample as technical or not, as the case may be. The TOC will also be asked to provide data from TRUST for this period so that this can be compared to the Common Reliability Dataset.

2.6.4 Once the contractor has reviewed the data they will request a meeting. The contractor will ask the TOC to provide representatives for the meeting who have experience of the end to end process for the production of the Common Reliability Data. The meeting will be used to discuss the information provided to RDG and compare decision making on attribution to what is recommended under section 2.

2.6.5 Where there is significant deviation to the 20pp, The Contractor will raise this in the meeting and agree with the TOC further corrective actions either for the TOC or RDG as appropriate.

2.6.6 The contractor will manage the close out of CARs

2.6.7 Common Reliability Data Review - Lessons Learned. The contractor will report on an annual basis to ReFocus and engineering Council the findings of the Data Review process and any specific good practice or anonymised lessons learned. In Principle, the reports from the three audits will also be shared amongst Council Members but the contractor shall seek to agree this with the TOC prior to and after auditing.

Extensive voluntary tools have been developed to help better understand the drivers of fleet performance and assist in identifying areas to make improvements. See Appendix K
3 Management for Improvement

This Section provides: Guidance for designing effective management systems; A risk-based approach to inform all aspects of improvement management, particularly prioritisation of workstreams; Day to day management objectives to achieve specified standards consistently; Monitoring and feedback techniques as motivators for change; Change management recommendations in the fleet engineering context.

It is supported by:

- Section 8, which includes more details on Maintenance Plan controls and elements of Monitoring, Analysis and Feedback;
- Section 7, which gives more detail and best practice on Depot capacity and capability, staff resources requirements, training and competence, data; And
- Sections 12, 15 and 17 which include supplier relationships.

3.1 Principles

Sustained reliability improvement is closely associated with structured management processes. Ideally, these processes form a framework within which individual activities are guided, focused and coordinated to achieve maximum benefit. To assure success, franchise obligations and business objectives should be used as the primary focus for developing initiatives. Best practice views management for improvement in three phases:

a) Design – to establish long-term sustained progress
b) Change – implement design changes through projects
c) Sustain – where monitoring, analysis and feedback predominate, motivating further improvements.

A) Management process design should:

i. Evaluate depot/facility capacity and capability to ensure engineering objectives can be fulfilled
ii. Evaluate short and long-term staff and resource requirements to match commitments and plans
iii. Specify skills and competences required by staff to support current and future obligations
iv. Develop a data structure capable of measuring both process and vehicle performance
v. Specify Maintenance Plan controls
vi. Establish appropriate relationships internally and with suppliers of spares and components, ROSCOs and any other maintenance services
vii. Identify the management routines through which each element of the design will be implemented or employed to achieve maximum benefit

B) Change projects should:

i. Ensure all staff are fully aware of changes, participate in them and are competent to perform new roles where required
ii. Ensure all risks and cross-functional links are identified and appropriately managed
iii. Be coordinated to ensure that the extent and pace of each one does not put overall performance (or that of other change projects) at risk

C) Sustaining processes should:
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1. Establish, integrate and analyse all data sources, including measuring the effectiveness of change projects.
2. Identify where and how to further change and improve process design.

In summary, a structured management process framework for reliability improvement can look like:

3.2 Risk Evaluation

It is often difficult to work out how to apply a management process framework. It should be led by business priorities, with an underpinning engineering risk assessment to inform decision-making and hence achieve timely and effective improvements. TOCs need to understand the relationship between operational performance and the work done on vehicles.

An example methodology is set out in 3.2.1. below. Whatever method is used, the outcome should:

- Identify the most important maintenance tasks (including intrusive tasks e.g. component exchange and overhauls - which are major risk sources)
- Review and restructure internal training and competence development techniques to minimise risks
- Inform decisions on procurement of any maintenance and/or design services
- Motivate relationships with suppliers of services, especially overhauls and any contracted out maintenance work
- Inform the analysis of engineering design changes

Note: The Railway Undertaking is accountable for controlling the same risks, whoever performs that work on the vehicle. This document is not the place to discuss procurement decisions (as we reiterate in Section 17), but the management of underlying engineering risks is crucial to performance and hence an essential element in every robust decision-making process.
3.2.1 Risk Evaluation Examples

In this approach, a model of the vehicle/train is the foundation for all subsequent work. Firstly, using a familiar approach, all recognisable components are identified uniquely and collected together into systems, such as air, brakes and doors. However, each system encapsulates all the components required for it to perform its specified functions, regardless of the components’ specific characterisation. As a result, the system may contain a complex combination of mechanical, electrical, pneumatic and other types of component. This approach leads to crisp system boundaries and clear unambiguous function definitions.

Operational events are then associated with the degradation of systems and their constitutive components, identifying especially those that pose the greatest potential risk to operational safety and reliability. It is helpful in this work to use the RSSB publication “Profile of Safety Risk in UK Mainland Railway”, as a basis for systematically identifying a comprehensive and realistic set of failure scenarios. One immediate consequence of this technique is that a single outcome may arise from many potential root causes.

Components may be ranked according to their propensity (when degraded) to lead to specific operational hazards and events. For example, in terms of safety related risks, a single point component failure leading to a catastrophic consequence would naturally rank more highly than a minor hazard requiring the simultaneous and serial degradation of a combination of components.

To complete the analysis, the Maintenance Plan should be reviewed in order:

- to identify possible omissions;
- to rank all tasks in relation to their potential to affect the vehicle risk profile; and
- to identify the impact of internal and supply chain activities.

See below for some worked examples.
## Defect Condition

<table>
<thead>
<tr>
<th>Defect Condition</th>
<th>Failure Effect</th>
<th>Hazardous Consequence</th>
<th>Principal performance improvement factors to be considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel pan casting defect, notch or other similar condition affecting mechanical integrity</td>
<td>Crack propagation leads to fragmentation of wheel</td>
<td>Vehicle derails Collision with infrastructure Collision with other rail vehicle Flying debris impacts adjacent infrastructure and, or staff and customers</td>
<td>Single point failure with potentially catastrophic consequences All tasks associated with the manufacture and maintenance of wheelsets are critical Internal training and staff competence are critical Supply chain relationships and competences critical Training and competences internally and in supply chain must include importance of adherence to standards and consequences of poor compliance At Level 4 instructions required specifically to assist identification of degraded conditions</td>
</tr>
<tr>
<td>Brake actuator slack adjustor mechanism failure</td>
<td>Actuator fails to apply brake on one wheel</td>
<td>Marginal affect on braking performance</td>
<td>A single point failure with little potential to cause significant risk.</td>
</tr>
<tr>
<td>Multiple brake actuator slack adjustor mechanism failures</td>
<td>Many actuators fail to apply brake causing significant loss of brake force</td>
<td>Station overrun SPAD Collision with infrastructure or other rolling stock</td>
<td>The simultaneous failure of many components is required to produce a significant consequence This could be associated with accumulating unnoticed degradation of equipment over time requiring a review of level 4 maintenance tasks, training and competence arrangements This could alternatively be associated with overhaul standards requiring review of supply chain relationships, application of maintenance tasks and use of appropriate competences</td>
</tr>
<tr>
<td>Combined power brake controller internal component loose, degraded, worn</td>
<td>Power demand cannot be removed without recourse to emergency override device Brake cannot be applied without use of emergency override device</td>
<td>Station overrun SPAD Collision with infrastructure or other rolling stock</td>
<td>Single point catastrophic failure affecting whole train brake, mitigated by emergency override device but dependent upon driver response Status of component therefore critical Design standards and materials used for controller components are critical Manufacturing process control critical to operational reliability of component Maintenance and overhaul standards and supply chain relationships are critical</td>
</tr>
<tr>
<td>Threaded fixings of incorrect grade or surface finish used to assemble bogie</td>
<td>A single component failure likely to lead to cumulative failures of others. Performance of affected major components compromised Potential for major component to come adrift Structural integrity of bogie at risk</td>
<td>Loss of brake system functionality Derailment Detached component strikes adjacent infrastructure or staff and passengers Vehicle strikes infrastructure or other rolling stock Loss of traction system performance</td>
<td>A single point failure possessing the potential unless detected to degrade performance and safety All maintenance tasks requiring use of threaded fixings are critical Work control for this type of task is critical Material management activities, kitting and access/availability of material are critical Both logistics and maintenance services supply chain are critical Training and competence must include guidance on the identification of degraded components and failure mechanism to mitigate risk of compromised performance and structural integrity</td>
</tr>
</tbody>
</table>

### 3.3 Day to day processes

Reliability improvement is delivered by sustained, rigorous attention to detail and compliance with published standards, with ownership of all issues. Robust management:

- ensures that routine maintenance tasks are always performed in accordance with standards;
- ensures that defective equipment conditions and remedial actions are always recorded;
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- asks repeatedly, “Why?” to get to a real root cause of an issue. Once you get the real root cause, you can address it i.e. really fix the issue.

It is common knowledge that typically half TOC fleet root causes are not about modifying the train, but other issues:

- Maintenance quality (which may relate to staff morale, training, facilities);
- Defect Management (to get to root cause, e.g. including Train Drivers in closed loop processes);
- Management of contingency and redundancy (including robust plans and feedback on performance to these plans).

**Maintenance quality and defect management** should be measured and trended e.g. % maintenance “own goals” (errors, failures to remedy all issues so repeat defect arises).

Example: Northern undertakes routine “in process” audits of equipment condition and evaluates the findings using a rigorous condition-based quantitative assessment. The results are linked to compliance with maintenance standards. Trends over time are used to tackle poorly performing system and components. The data is being developed to assess staff competence too. Feedback is used to review: maintenance standards, material & component quality and staff training programmes.

Example: South West Trains keep asking “Why?” through their defect management process and classify every incident into 10 difference cause codes. These go beyond naming the failed parts to assigning management responsibility. Each cause code (including No Defect Found) has an “owner” in fleet management, who has to reduce its number of incidents. In the below sample, at this best practice TOC, maintenance own goals are 11%.

<table>
<thead>
<tr>
<th>Fleet Incidents by Cause Code</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 Material Quality / Supply</td>
<td>1%</td>
</tr>
<tr>
<td>8 External / Passenger</td>
<td>0%</td>
</tr>
<tr>
<td>7 External / Network Rail</td>
<td>0%</td>
</tr>
<tr>
<td>6 Traincrew Error</td>
<td>2%</td>
</tr>
<tr>
<td>5 Climatic / Railhead</td>
<td>2%</td>
</tr>
<tr>
<td>4 Maintenance (Non) Compliance</td>
<td>11%</td>
</tr>
<tr>
<td>3 No Defect Found</td>
<td>24%</td>
</tr>
<tr>
<td>2 No Fleet Awareness</td>
<td>1%</td>
</tr>
<tr>
<td>1 Confirmed Technical Fault</td>
<td>42%</td>
</tr>
<tr>
<td>0 Asset / Heavy Maintenance</td>
<td>18%</td>
</tr>
</tbody>
</table>

Significant improvement can often be made without changing the train itself.
Example: Class 333 reliability doubled without any modifications. This was achieved by joint effort between Northern Rail, Angel Trains and Siemens, involving high level buy-in (Steering group attended by 3 Directors), plus Project Manager for each company, working groups and team ethos.

The same maintenance quality and defect management principles apply equally to specific systems as well as to whole fleets.

Example: recommendations from the sliding door comparison, made across several fleets. To get good sliding door performance you should:
- Cultivate good train reporting
- Not attempt to rectify door faults in service – lock them and label them out of use until they can be properly rectified
- Remember the importance of staff training, and the benefits of having only competent staff maintaining and repairing doors
- Ensure there is sufficient time allowed for door maintenance, to encourage attention to detail, and to find and rectify faults
- Consider the benefits of increasing the content and frequency of door mechanical jobs and door pocket cleaning
- Avoid extended time between door overhauls

Example: TPE were seeing 10-12 flat battery incidents on Class 185 per period. Battery discharge was compared with design capability and changes made to maintenance, cleaning and traincrew practices (e.g. using shore supply) to better suit battery capability. The revised train disposal arrangements are checked through periodic TMS downloads which identify potential problems. The incidence of flat batteries is now so low that a technical modification is not considered necessary.

**Contingency management** includes robust planning processes where the benefits (e.g. of having sufficient trains to have enough time to maintain them properly) are weighed against the costs (e.g. of leasing additional stock). Significant, cost-effective improvements can be made through timetabling and clever use of the timetable.

Example: Chiltern have some short diagrams that return to Aylesbury depot on which units with hard-to-identify faults can be deployed. This reduces the risk of service disruption and enables in-service monitoring with full rectification later.

**Redundancy management** includes feedback to understand whether levels are correctly set.

Example: Virgin Trains West Coast/Alstom used OTMR/TMS to count how many more amber signal lights trains actually see, compared to theory. With the high number of amber lights on certain routes, trains cannot run to timetable if one traction pack is out. As a result, they revised their redundancy plan accordingly – and are working with Network Rail to resolve the root cause.

**Collective Sharing.** Improvement is also made by learning from the successes (and failures) of others and through pooling data and combining efforts e.g. User groups, ReFocus meetings and visits, best practice sharing.
3.4 Periodic review and Feedback

Diligent day to day activities support routine periodic review of operational performance and process KPIs. Periodic reviews should use quantitative evidence to verify that the design analysis of depot capacity, resource levels and production planning arrangements continue to be adequate. Use the results to revisit underlying assumptions, assess the effectiveness of change projects and as a basis for further improvement projects.

Routine activities are performed within a designed environment (see 3.1 above). It is important to realise that even the most competent frontline manager will be overwhelmed by over-optimistic availability targets, insufficient resources or inadequate depot capacity. Section 7 looks at this in more detail.

3.5 Change management

Key elements of change management include: cross-functional, senior level commitment; involvement from all staff; working to a common project structure; planned and staged implementation of individual projects; sufficient resource and feedback.

Robust Day-to-day management can be undermined by inadequate change processes.

Industry best practice includes overall:

- Strategic analysis of objectives to identify and prioritise processes/ activities which need improvement
- Early engagement of all relevant stakeholders at a sufficiently senior level
- Publishing a structured plan showing the staging and implementation of all projects (to prevent detrimental impact on day-to-day routines
- A risk-based approach, covering both technical and soft issues, as well as cross-functional links
- A clear and common template for all projects
- Recognising the link between technical and process change, simplifying management controls and training requirements
- Configuration controls for vehicles, Maintenance Plan and supply chain

and for every project:

- A clear and achievable remit and timescales
- An appropriately skilled project manager supported by a suitable team
- Sufficient resources
- Strong involvement of staff whether directly associated with the project or not

Example: Northern Rail has developed a comprehensive set of organisation business objectives and identified the management processes that it wishes to improve in order to achieve them. This means focusing on inputs in order to achieve fundamental and sustained output improvements. Using this structure, a standard change implementation plan has been developed to ensure that each project is fully resourced and can be completed on time without imposing significant risk to day-to-day service delivery. All projects follow an identical template so that managers and staff can easily monitor progress.
Example: Class 350 new train introduction. Siemens Northampton’s major project mobilisation involved training both maintenance staff and drivers in Germany many months before start of service.

Example: Northern Rail trains staff with the relevant skills required to participate fully in change projects – and to understand what is happening when they are briefed on progress and impact.
4 Seasonal Management

4.1 Introduction

Seasonal ambient temperature variations and weather can adversely affect the performance of traction and rolling stock and rail head conditions, if it is not recognised and planned for. It is likely that different types of rolling stock may be affected in different ways, so it is important to gain a thorough understanding of seasonal effects on your particular rolling stock, and have processes in place to minimise these effects.

Plans need to take into account the time of year, so a ‘Weather Calendar’ or ‘Seasonal Preparation Plan’ may be developed which should be visible at all levels within the company. Progress against target should be monitored and KPIs developed which can allow for future analysis. It should be recognised that any plans and processes which are in place to manage seasonal changes must be controlled through a constant review cycle, the plans in place for seasons management should also recognise that seasons will start at different times of the year, plans must be flexible enough to accommodate such variances.

The guidelines below are intended to promote a structured approach to seasonal planning and operations. Individual TOCs and Maintainers should review with key stakeholders the guidelines in the context of their own operations and take measures they feel appropriate to meet their business needs.

To maximise the level and consistency of fleet performance during seasonal variances both operations and engineering need to work together to produce robust and effective management plans.

Seasons management should be viewed as a normal part of your processes, change management, maintenance cycle and normal performance improvement. Seasons management should be treated as the norm and not as an additional function / process which is added to the exam cycle.

Some examples of common processes irrespective of the seasonal variances which may need to be considered are given below, though this is by no means exhaustive.

4.2 Common Seasons Processes:

4.2.1 Analysis of previous data

| Review changes from previous years | Design specification changes |
| Think about design changes | Process changes |
| Modifications | Maintenance actions / cycles |
| People competencies | Depot Infrastructure |
| Trains | MPC (Miles Per Casualty) |
| Performance | MTIN (Miler per Technical Incident) |
| DPI (Delays Per Incident) | PPM (Public Performance measure) |
| Cancellations | Delay Minutes |
| Seasonal variances in stock levels | Material usage |
| Kill frost (did it perform at the desired temperatures?) | Supplier performance |
| New replacement products available | Product development with suppliers |
| Doors open in traffic | Safety review |
| SPADS and location | Station over runs |
| NIRs | Poor braking and location |
| Passenger and Train Crew | |
Environment condition | Air conditioning / heating when a train is in a failed state
Lighting conditions | Frozen footsteps
Slips Trips and falls |

4.2.2 Preparing for a common seasons approach

<table>
<thead>
<tr>
<th>Staff</th>
<th>Briefings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence</td>
<td>Strategic deployment</td>
</tr>
<tr>
<td>Staffing levels (up or down)</td>
<td>Equipment</td>
</tr>
<tr>
<td>Materials</td>
<td>Cradles</td>
</tr>
<tr>
<td>Lifting gear</td>
<td>Depot Equipment</td>
</tr>
<tr>
<td>PPE (warm clothing etc)</td>
<td>Telephones</td>
</tr>
<tr>
<td>Staff equipment</td>
<td>Correct tools and kit for the season</td>
</tr>
</tbody>
</table>

Ensure adequate seasonal items are available and planned for:

<table>
<thead>
<tr>
<th>Wheelsets (Autumn)</th>
<th>Gritting of walking routes in winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance plans to reflect seasonal changes and not undertaking special tasks.</td>
<td>Ensure depot infrastructure is fit for the season</td>
</tr>
<tr>
<td>Documentation</td>
<td>Killfrost (Winter)</td>
</tr>
<tr>
<td>HVAC (Summer)</td>
<td>Utilities protection (water, electrical cabling etc)</td>
</tr>
<tr>
<td>Depot maintenance tasks do not hamper seasons management</td>
<td>Station footpaths and platforms</td>
</tr>
<tr>
<td><em>Example:</em> Wheel lathe being maintained during height of leaf fall</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Seasonal preparation as a day to day item (not special checks)</td>
</tr>
<tr>
<td>Staff briefings</td>
<td>Daily conference updates (war room plans)</td>
</tr>
<tr>
<td>Technical Bulletins</td>
<td>Intranet</td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
</tr>
</tbody>
</table>
4.2.3 Implementing common seasons management

<table>
<thead>
<tr>
<th>People</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasons maintenance to be treated as just another type of exam</td>
<td>Radiator cleaning (Summer)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure maintenance documentation / balanced exam sheets reflects the correct season</td>
<td>WSP Check (Autumn)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Killfrost application (Winter)</td>
<td>Communications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common season issues discuss and reviewed at daily management meetings</td>
<td>Exceptional seasons management war room</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasonal KPIs</td>
<td>Feedback from maintenance staff and train crew</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily briefing update to all staff</td>
<td>Materials</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchasing plan must be in line with seasons maintenance plan to ensure</td>
<td>Materials available on time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials available at the correct location</td>
<td>Sufficient quantity of material is available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider contingency material when weather forecasting indicates the need</td>
<td>Storage facility for material is available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheelsets (increased usage in autumn)</td>
<td>HVAC Units (increased usage in Summer)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgets may need to be amended to ensure levels of material usage can be maintained at the desired level to ensure a reliable service can continue to be delivered</td>
<td></td>
</tr>
</tbody>
</table>

4.3 Planning for Winter

The following section addresses planning issues for winter and has been extended in scope to consider prolonged periods of extreme weather conditions.

To ensure good service reliability and availability going into the winter period, efforts should be made to ensure that fleet condition and service continuity can be sustained given inevitable degradation of fleet condition and deferral of maintenance arising from extreme winter weather, as such efforts should be made to reduce demand / outstanding work prior to winter operation.

This section comprises six sub- sections:

- **Standard Winter Preparedness**: tasks within this section have a focus on preparing fleets for standard winter operation. Standard winter operation tasks are additional to standard exam tasks and should be in place prior to winter operation.

- **Extreme winter preparedness**: tasks within this section focus on prolonged periods of extreme weather conditions. The elements within this section should be planned for and implemented when certain trigger levels are reached. Trigger levels should be defined in the plan and offer a co-ordinated approach in partnership with operations and frontline staff and other key stakeholders.

- **Response**: tasks within this section focus on the implementation of plans and activities which are designed to respond to extreme conditions and ensure that service levels are maintained during actual operation of the fleet. The critical element of response is continued feedback of information to ensure that measures which have been planned and implemented are effective.
• **Extreme Winter Recovery:** previous winters have shown that extreme conditions can have a damaging effect on fleet condition and that full recovery post winter operation can take some considerable time. Plans should be in place to allow continued flexibility for fleet repairs to take place and deferred work situations to be recovered.

• **Post winter review:** this section concentrates on reviewing information which has been captured during winter operations. It is critical to have a complete review of all information and data gathered to ensure continuous improvement can be maintained and effective plans for future operations developed.

• **Other Considerations:** this section looks at areas of winter operation which could be considered outside of the day to day running of fleet. In undertaking these assessments, it is critical that consideration is given to extreme scenarios where trains may become stranded for a prolonged period of time whilst passengers are on board. Contingency plans must be in place with all stakeholders.

### 4.2.1 Standard Winter Preparedness

Initial winter preparedness is largely based around enhancing the Vehicle Maintenance plans to ensure that an acceptable level of winter operation can be maintained. This should only be used as an initiator for winter planning. Vehicle maintenance plans may not cover all areas which are critical to maintaining service during winter. The guidance within this section of winter planning should be used to enhance winter operations of fleet.

As part of preparing for winter operation key risk areas must be considered to ensure effectiveness of any plans which have been developed and are in place. This list is not exhaustive and should be adapted to meet your specific business needs.

Vehicle Maintenance undertake an annual review and look ahead process. This should consider how effective the standard winterisation tasks have been and what needs to be incorporated into exams going forward to minimise performance risks. Examples of the areas which may need consideration are pip equipment, lagging, horn trace heating, air system pre-treatment, pre-filtration of electrical machines etc.

Differentiate between what should be classified as winterisation and what should be included in standard maintenance tasks - ensure that winterisation is aimed at specific winter preparedness and not used as an opportunity to catch up on previously deferred work, for example to get heating systems working again post summer operations.

Development of specific winter exams (ensure that these tasks are not ‘lost’ within general exams).

**Stock holdings**

A key material stock holding review should be conducted well in advance of the winter period – deployment of critical spares to strategic locations should be planned and implemented to support the operational requirements of the fleet

Understand train availability drivers to develop stock holdings of critical materials and consumables such as traction motor brushes, fuel, pan heads etc to ensure a service can be maintained during material usage peaks

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Winter ‘survival kits’ – i.e. phone chargers, appropriate clothing, tools, local support networks need to be defined and allocated within the winter plan

Depot & Infrastructure

Winterisation checks on key plant and equipment such as wash plants, fuel, CET, etc should be conducted.

Gritting rosters etc

Ensuring a supply chain is in place to support the availability, potentially at short notice-, of critical plant, i.e. space heaters etc

Ensure that materials planning is conducted thoroughly, paying particular attention to critical stock holdings of kilfrost and thaw granules etc

Contingency plans – alternative suppliers should be identified to support where possible your existing supply base

Review depot based risk assessments to ensure the adequacy of mitigation arrangements which are specified

Ensure availability and preparedness of road vehicles etc (snow chains, availability of 4x4’s)

Ensure availability of equipment for local deployment, i.e. shovels, rock salt etc

Operations Planning

Review of Business Continuity Management plans

Consider depot & infrastructure facilities – is access to the depot clear?

Operational restrictions and trigger events – clarify what triggers will move the business to the next level of winter management and how these instructions will be communicated within the business

Consider a cut and run policy review to ensure disruption is minimised

Consider staff deployment at local stations and other key locations to allow the service to be maintained

Winter competence development – ensure that clear roles and responsibilities are defined. Where appropriate develop a training plan to reflect the requirements of the organisation

Weather forecasting management

Ensure that 28 day, 7 day and 24 hour planning horizons are being considered

Extreme Weather Advisory Team (EWAT)

Key decision makers defined – contact list circulated to required parties

Fleet management responsibilities defined

Trigger events for fleet condition change (i.e. when extreme weather forecast is predicted)
Is everyone using the same forecasting tool – ensure consistency of communication media for all stakeholders

[www.nrws.co.uk](http://www.nrws.co.uk) – Network Rail weather forecasting facility

Delay attribution

Consider negotiating with the Infrastructure Manager temporary measures that allow for recovery of delay re-attribution (allow time to investigate thorough attribution of delays whilst 7 day rule is in place)

4.2.2 Extreme Winter Preparedness

Tasks contained within this section are looking at periods of sustained extreme conditions, trigger levels and co-ordination of response. Extreme winter measures may be short term and may require increased flexibility from all stakeholders to allow positive reaction to changing plans and emerging trends.

Trigger events should be clearly defined so that a clear plan can be produced when extreme prolonged weather conditions are forecast. Different fleets and route diagrams will be subject to different trigger levels so it is critical to understand the different levels of activity for trains and the environments in which they will be operating. Plans should be in place to ramp up or down trigger events due to the restrictions which can be placed upon or removed which will affect the level of service being offered. Co-ordinated fleet / operations management plans will need to be developed to manage trigger events.

What are the trigger events for initiation of extreme winter operation?

Trigger events will take many forms, but will be based around changing conditions for operation such as:

- Changing weather conditions (snow, snow and wind etc)
- Moving to different diagrams / operations
- Decision criteria for operational restrictions (reducing line running speeds etc)
- Step up of Vehicle Maintenance/Fleet Management activities
- Clear definition of extreme winter maintenance measures for respective fleets
- Identification of critical operating parameters – go/no go criteria for trains
- Passenger information systems, heating, lighting (step up maintenance)
- Consideration of revised maintenance plans – deferral of non key elements to create capacity for additional key system checks (ballast damage, broken seals, de-icing etc)
- Development of catch back plans for deferred / outstanding work
- Contingency roster cover (more staff on nights – less work on days?)
- Development of a key competency matrix for specific extreme weather tasks supported by risk assessment
- Management of vehicle dispersal.
This is critical to manage maintenance schedules and to reduce the amount of deferred work which will hinder any recovery programme post winter operations.

Stabling plans for dispersed units maintenance and start up

Cleaning and servicing strategy

Consideration of winter response teams which may be dispersed to units in service to address key systems (couplers and doors etc)

Deployment of winter kits – key supplies for keeping the trains running (de-icers etc) for use by nominated winter response team

Failure Review and forward planning meetings.

These should be held at regular intervals to ensure clear instructions are in place to manage the fleet and personnel.

At least every 24 hours – what issues are emerging, what containment plans are required (short and medium term mitigations)?

Data downloads to be collated and reviewed from relevant data sources (OTMR, defect analysis tool and other sources of relevant data)

Ensure capture of issues for future continuous improvement

Depot & Infrastructure maintenance.

Absolutely critical to keeping the fleet running.

Ensure contingency plans are in place to ensure critical routes are clear to gain access into and around depots and key service points (access for fuel trucks, staff, emergency vehicles or temporary conversion of depot facilities (mess rooms or offices))

Review staff welfare provisions in the event that they are stranded at work or away from home (block reservations at local hotels/inns etc)

Maintenance planning for extreme weather on depots – continuity of utilities etc

Depot yard maintenance (points, conductor rail, walkways, car parks etc)

Ensure that extreme weather risk assessments for depot management are up to date, conduct staff briefings to promote awareness of the arrangements that are to be employed

Operations Planning

Train preparation contingency planning

Support for drivers at dispersed locations, earlier start up for drivers

Train disposal and mobilisation techniques – in severe weather leave train live/powered up/engines running
Communications strategy.

This is a key element to managing extreme conditions and ensuring a service level can be maintained. A clear communication strategy will ensure clear paths of communication are maintained and understood.

Definition of key roles and decision makers

Delegated authorities

Media management

Passenger communications (CIS) and Internet

Standard Ops review agenda (identification of key staff numbers etc)

Definition of review and governance structure

What reviews take place & how often?

4.2.3 Response

Whilst plans have been put in place to allow for extreme winter operation actual implementation of plans and contingency measures must be monitored and reacted to. To ensure an effective response to potentially dynamic conditions response monitoring arrangements should be in place.

Extreme Winter Operation

It is critical to ensure a service can be maintained and clear plans are in place which allow flexibility to react to changing conditions during operation of fleet. Clear lines of communication must be in place which allows feedback from frontline staff. This will allow for analysis of emerging trends, which in turn will assist effective planning.

Timetable flexibility

to allow for proactive response to extreme weather

Co-ordinated response from engineering and operations

TRUST updated to reflect timetable changes

Public awareness of timetable changes

Poster at stations to show timetable changes

Website updated at regular intervals

Pre-printed schedule cards for operational staff

Pre-printed messages for on board train crew

PIS updates

Service Running
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High level monitoring and review team to co-ordinate feedback from critical sources of information (train crew, fleet managers, station managers, control staff etc) for stock availability / reliability, train crew availability, local weather conditions, passenger levels etc

Preserving the service during operation

De-icing and removal of snow from critical systems / components at pre-determined locations which have been supplied with sufficient resource to carry out critical tasks. Some examples are listed below, but this is not a definitive list:

Tail Light visibility

Horn functionality

Door operation and removal of grit from door tracks

De-icing door tracks and door gear

Greasing of door gear and rubber seals (silicone grease)

Coupler de-icing and bagging

Wiper check (frozen to the screen)

Get information from the driver (meet and greet)

De-ice both passenger and driver tread plates

Horn covers / bags

Consider utilising non-frontline staff for preservation tasks

Recovering / Preparing the service for operation during extreme weather (overnight)

To ensure availability of stock is maintained for service extensive recovery plans should be in place which allow for overnight maintenance of key systems. This may require the deferral of non safety critical maintenance tasks

Consideration should be given to dispersing available resource to the train at pre-determined locations which allow access to critical systems

Risk assessments, reflecting the requirements of the winter contingency arrangements should be developed

Removal of packed ice on the under frame of the stock can be very difficult and consideration should be given to special tools which allow access to restricted locations for its safe removal

Where possible keep the stock in a warm condition and consider keeping units powered up continuously

For Diesel units and to preserve resource (fuel etc), as an example; implementation of a 1 in 4 rule (run for one hour in every four) should be considered

Consider battery management on diesel stock where infrastructure allows for safe access and charging
Pre-service start up conference call

Joint review between, engineering, operations and control to determine the level of stock availability which can realistically be achieved to deliver a reliable service. This conference call will determine the level of flexibility of your timetable.

Levels of degradation of rolling stock should be considered, i.e. reduced traction power in extreme circumstances in multiple only operation. These decisions should be agreed by all parties after giving due consideration to the associated risk to service.

Lessons learned and feedback from previous service should be considered and plans adapted where appropriate.

4.2.4 Extreme Winter Recovery

Fleets can suffer from extensive damage during extremes of weather. The guidance within this section of winter planning should be used to plan for winter operation recovery. Flexible recovery plans should be in place to allow for continued operation of service while fleet repairs and recovery activities are carried out.

Recovery Planning

Review of fleet position and dispersal vs. maintenance plans and diagrams

Maintenance recovery plans should allow the fleet to enter back into its cycle of maintenance at the earliest opportunity

Deferred work recovery plans should be put in place to manage the most critical deferred maintenance and defects first

Post extreme winter checks should be considered for all vehicle systems potentially affected by extreme weather i.e. door set up, electrical connectors, tilt systems, axle damaged from impact of ice balls containing ballast etc

Repair recovery plans may be longer term as material and spares may be at a reduced availability, such as traction motors, wheel sets etc. This may then lead to the development of maintenance containment plans to be put in place to increase inspection of key known degraded components, this may allow an extension to operational life until sufficient spares become available

Business Needs

To enable the delivery of a service a full understanding of the business needs and the actual availability of fleet should be planned. This will enable priority to be set which are realistic and achievable

An example of this process is AGA chose to minimise impact in service of the Class 317 fleet by prioritising traction motor changes so that at least 50 of the available 60 units were operating on full tractive power. At this point the units on degraded power did not influence or degrade the operation of the service

To reduce the recovery time of the fleet, consideration should be given to temporarily increasing the resource available or sub contracting to approved suppliers to carry out recovery tasks
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An example of this is Southern, who utilised Bombardier technical staff to remove and temporarily repair defective ACM modules which previously allowed snow ingress due to poor sealing arrangements. This allowed the fleet to resume service until a permanent solution could be developed.

Maintenance facilities

Depot facilities (fuel station, CET plant, wash stations etc) are susceptible to extreme winter conditions and plans should be put in place which will allow for recovery from winter operations.

Deferred work recovery plans should be in place to manage the most critical deferred maintenance and defects first

4.2.5 Post Winter Review

As part of the winter review process using the above guidelines, a period should be allowed for formal reflection on, and documentation of, successes and failures. This is an opportunity to learn lessons and implement changes to plans for future events of extreme weather. Some areas for consideration are shown below, but this is not an exhaustive list.

Consideration of vehicle sustainability in changing climate.

Maintenance strategy review (post winter checks (drying out water ingress etc, winterisation exam improvement))

Overhaul strategy (either improve upon or return to original build condition)

Modification strategy (horn relocation, horn heating, improved IP rating)

Revised materials and logistics plans with key suppliers (incl. ROSCO’s)

Be imaginative with respect to emerging climate trends when developing cost benefit argument for winter modifications

Challenge the established norms

Do not ‘accept’ known winter failure modes. This is not sustainable for future operational performance

Traction motors can draw in moisture from snow and cause earth faults and flash over. Long term solutions should be developed where possible such as ducting systems

3rd rail icing/de-icing is a common issue during winter operations but with co-ordinated planning with Network Rail mitigations to minimise disruption should be available to put into effect should the situation warrant it

Horn failures can be reduced by appropriate and timely dosing of the horn sock with anti-freeze.

Availability of key materials.

Particularly those associated with higher attrition of key systems

(e.g. DC traction motors)

Review potential for quick repairs as opposed to full overhaul when returned for snow damage
Review ROSCO and/or Maintainer stock holdings

Staff occupational and operational health and safety

Planning of extreme winter operations and maintenance should be an overarching principle of fleet operation and management. Risk assessments should be carried out for all non-routine activities which are expected to be carried out

A post winter operation review of maintenance facilities should be conducted

Delay attribution

Segregation of winter failure modes (within BUGLE?) to enable post winter review and planning for subsequent years.

4.2.6 Other Considerations

Although outside of the day to day running of fleet, consideration should be given to areas which may become of concern in the future. This is not an exhaustive list.

Train procurement specification

Lessons learned from extreme winter operation should be captured and used when procuring new trains. This is particularly critical due to the levels of climate change and the extremes of conditions in which rolling stock is required to operate

At-risk passengers

Consideration should be given to passengers who are at risk of the elements during times of extreme winter weather.

Blankets

Refreshments

Priority passenger alighting

4.3 Planning for Summer

High temperatures can also affect the comfort of passengers and traincrew and also the functionality and performance of the rolling stock.

Air conditioning, including cab air conditioning and any driver cooling fans fitted, must be fully serviced and functional prior to the onset of high temperatures. It should be remembered that the temperature variance within the summer months can be quite dramatic and this can affect the functionality of many systems within the rolling stock.

Air Conditioning

Train crew briefed when air conditioning fails

Incorrect usage of the system can cause further damage (having windows open whilst the air conditioning system in operational)
Filters cleaned / serviced
Re-gassed
Electronic racks, traction motors
Filters cleaned / serviced
Air flow paths for cooling are clear of debris
Radiators
Clear of debris to ensure air flow is smooth
Ensure radiators are fully topped up with coolant
Washer bottles
Ensure all washer bottles are operational and topped up for the removal of green fly etc
Windscreen washing
Ensure windscreens are cleaned regularly
Door system
Check bearings and rubber joints for degradation leading to poor open and closing
Summer adjustments to avoid binding of the door system
Toilets
CET Tanks to be emptied on a regular basis to ensure odours and potential germination is minimised
Infrastructure can also become a major issue during times of extreme heat with instances of rail buckling. Close work must be carried out with Network Rail to identify ‘Critical Rail Temperature (CRTs)’ sites and the management of speed restrictions and the potential impact of the train plan.
Depot infrastructure also needs to be considered during extreme temperatures. This includes identifying any potential risks to the depot’s ability to deliver the service.
Critical point work
Increased maintenance during extreme conditions
Management of the environment to ensure depot safety
Infestations
Insects
Vermin
Birds (nests etc)
Waste management

4.4 Autumn

The leaf fall in autumn often causes poor rail head conditions and can affect performance in a number of ways:

Low adhesion extends running times by increasing acceleration time (due to possible wheelspin), and by increasing deceleration times (defensive driving to prevent wheelslide). Many TOCs have developed ‘autumn timetables’, which allow extra time on those routes which are most likely to be affected during this period each year.

Low adhesion significantly increases the likelihood of wheel flats, despite defensive driving. Knowing that all Wheelslide Prevention equipment (WSP) is in good working order prior to the commencement of the leaf fall season is important.

Low adhesion significantly increases the likelihood that wheels will also slip when taking traction resulting in units failing to run to time. It is therefore essential that maintainers are on top of traction system performance. Prior to and during autumn. A particular risk surrounds DC motors where there are supply chain issues.

Low adhesion sites should be reviewed with NR, historic sites in the sectional appendix can change, the reasons for declaring them as exceptional should be clear (freight, traction adhesion, stopping for a platform etc).

Wheel flats require attention, so wheel lathe slots will be required. To reduce the effect on unit availability, it is desirable to keep within the planned number of units for tyre turning, so getting ‘ahead of plan’ with pre-planned tyre turning based on mileage or tread condition prior to the leaf fall season can free up space.

With some fleets, tyre turning may not be possible on all vehicles if the tread thickness is already below a certain size, so wheelsets will have to be renewed. This will require pre-planning and ordering of wheelsets so they are available on site prior to the leaf fall season. It may also mean getting ‘ahead of plan’ with other routine lifting work, to free up space on the lifting facilities, and create fleet availability headroom during this period.

Particularly bad leaf fall conditions can affect a large proportion of the fleet at the same time, despite all the carefully planned arrangements. A contingency plan should be pre-agreed with all concerned within the TOC to cope with reduced fleet availability, should this be necessary.

Rolling stock

Communication to train crew

Driver briefings on defensive driving

Reporting of poor traction hot spots

Autumn surgeries

Opportunity for feedback between drivers, management and Network Rail
Whiteboards within train crew depots to leave feedback on performance related issues

Operations

Network Rail

WSP Systems

Analysis of rogue units

Lathe records

WSP health checks

Dump valves firing in the correct sequence

Blocked valves can vent

Spares availability

WSP system under the most effort during leaf fall

Sanders and sand storage

Health checks

Blocked delivery units

Blocked pipes

Use dry sand only

Ensure sand is stored in a dry place

Use correct grade of sand

Increased use of sand during leaf fall

Sander top ups may be more frequent

Scrubber Blocks

What trains are appropriate to fit with scrubber blocks

What percentage of the wheelsets should be fitted with scrubber blocks

Leaf mulch build up under units

Ensure filters are clear of leafs to ensure proper air flow is maintained

Door pockets

Ensure guides and runners are clear of leafs to ensure smooth operation of door system
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Depot

Wheel lathe

Increased usage of wheel lathe during leaf fall

Ensure availability plan is in place

Maintenance of wheel lathe is carried out prior to leaf fall

Wheelset availability

Increased usage of wheelsets during Autumn

Fleet Wheelset condition check prior to Autumn

At risk units

Units with low wheel life expectancy to be deployed within local geographic location of wheel lathe

Minimises the risk of units running with restriction to wheel lathe

Infrastructure

During the period leading up to and during leaf fall infrastructure management is critical to ensuring the delivery of a reliable service. This should be done in partnership with Network rail to ensure the effective use of all tools available. Examples are given below but this list is not exhaustive.

Effective vegetation management

Programme of vegetation clearance

Station cleaning

Do not sweep leaves onto the line (sweep it and bag it)

Identification of vegetation hot spots (high risk sights)

Rail head treatment

Traction gel applications

Location specific

Joint management and deployment of Rail Head Treatment Train

Contingency for start and finish dates for the Rail Head Treatment Train

Northern Rail have employed the policy of riding with drivers to identify areas within its geographic network of extreme areas at risk of poor performance or safety due to leaf fall conditions. This is done in conjunction with Network Rail to ensure such areas are kept to a minimum. This work stream also includes the identification of areas of high priority for remedial work. This in turn reduces the number of station overruns, wheel flats and wrong side track circuit failures.
In summary

Large fleets take a long time to rectify, so it may be necessary to be planning for the summer hot weather whilst still in the depths of winter, and planning for the winter weather before the effects of the leaf fall have been felt. The use of a ‘weather calendar’ or ‘Seasonal Preparation Plan’ to monitor progress against target at Performance Meetings and/or Exec meetings helps to ensure that the next season’s requirements are not overlooked, whilst still busy dealing with this season’s problems.

It should also be noted that instances of cross seasonal issues may be seen during times of extreme weather. An example of this is when leaf fall conditions have been experienced and this is then followed by heavy snow fall. This can lead to the leaf sap to become frozen and when the snow and ice has cleared poor rail head conditions can return.
5. Train Preparation

A ReFocus sub-group agreed that train preparation (TP) activities are primarily undertaken for three reasons:

- Safety
- Reliability
- Cleanliness / Train Presentation

Train preparation is currently undertaken by the industry in a wide variety of ways, using a variety of personnel. This chapter follows a Plan, Do, Review format.

In many cases, TP is more appropriately performed by drivers. In essence, the message is that each train type and each location dictates who is best placed to carry out TP.

There is a lot of evidence that TP activities are frequently duplicated by maintenance staff and then the train preparer. Two examples are featured below. It is good practice to identify activity duplication activity and eliminate it as far as possible.

Example: In relation to Thameslink Units, GTR undertake a “Berth Check” - a pre-driver check that is undertaken to pre-empt any start time failures. Activities are therefore undertaken for reliability reasons as opposed to meeting a safety requirement.

Example: Two extremes of TP duplication were reported by London Midland:
On one fleet, fuel point exams were enhanced to protect the depot from conductors finding faults.
On this fleet there are 3 checks undertaken:
- Check 1: Maintenance Staff undertake a daily exam.
- Check 2: The shunters undertake the conductor prep.
- Check 3: Depot Driver undertakes Driver Prep.

It was reported that these checks were additionally implemented on Class 323 units, with the introduction of Check 1 improving the reported reliability performance by 25%!
Conversely, on another fleet, manufacturer’s maintenance staff undertake train preparation and hand over a piece of paper to the driver to confirm train is in a fully fit state. The train driver then simply takes the train into service.

N.B. items marked [KTR] are to be considered for inclusion in a future version the Key Train Requirements (KTRs) so as to improve the train preparation process (both in time and ease). The latest edition of the KTRs can be accessed from this link: [http://www.rssb.co.uk/library/groups-and-committees/2014-09-report-key-train-requirements.pdf](http://www.rssb.co.uk/library/groups-and-committees/2014-09-report-key-train-requirements.pdf)

5.1 Plan

Planning for train preparation is as equally critical an exercise as the undertaking of the preparation itself. The following points focus on good practice when considering train preparation, arrangements and examples of current industry practice.

Consideration should be made as to the reasoning behind performing train preparation post-maintenance. Ideally, train preparation should not be used as a catch-all to identify maintenance or cleaning process deficiencies.
The periodicity of train preparation should be kept to a minimum. Good practice would be for a train’s preparation to be valid for at least 24 hours. Some instances occur where units are stabled for extended periods of time, during which two preparations are undertaken. Consideration should be made as to whether the TP periodicity can be extended so as to better utilise staff.

Example: East Midlands Trains’ (EMT) Meridian fleets are prepared by Bombardier as a result of their Train Supply Agreement. This preparation does not have an expiry, therefore once prepared can be left as long as necessary and taken into service without necessity for a second preparation. Conversely, EMT’s 15x units (maintained in house but on the same depot) need to be prepared every 2 hours. This is justified as protecting the depot from start time failures as a result of “drivers arriving late” to report defective cab heat – since the unit has cooled down since the original TP was undertaken.

Example: Virgin Trains West Coast’s (VTWC) Class 390 fleet have a TP validity of 24 hours.

Example: When meeting to discuss this good practice, members discussed that some fleets require physical attention every 24 hours otherwise they shut down. The example cited was a LIM reset on Electrostar Units. This functionality was not considered appropriate [KTR].

On the other hand, some TOCs have instigated depot TP activities to address an “epidemic” of start time failures reported by traincrew. This reduced failures to two in 18 months.

The introduction of new rolling stock has been an initiator of change for TOCs in relation to TP. This can be taken as a good opportunity for TOCs to review TP processes and have a “blank slate” for TP as the adage “this is how it has always been done” becomes irrelevant.

Where trains are frequently prepared on depot, consideration should be made in the event that access to the depot becomes restricted/impossible. Where this occurs, contingency plans should be put in place to ensure early identification of faults and minimise any potential reduction in reliability.

Example: In normal operation, the VTWC Class 390 fleet return to a depot every day. In 2015, the West Coast Main Line was severed as a result of a damaged viaduct. This resulting in a noticeable number of outstanding defects arising across the fleet; a symptom of accessing the fleeting being more difficult.

Preparation can be further complicated at outstations such as Nottingham Station where it is not possible to walk around the exterior of the train. A different TP regime is therefore followed not involving the underframe of the unit. Consideration should be made as to where units are prepared to ensure that units are not consistently prepared at locations without access below the solebar.

Example: Bombardier report that it is not possible to walk around the Class 378 units whilst in their stabling points, therefore below-solebar TP activity it not undertaken at these locations.

5.2  Do

Good practice is considered to be that the preparation of the train is performed by maintenance staff (since they are best able to effect a repair) and is provided in a “fit for service” state to the driver who, upon receipt of formal documentation, will take the train into service. It is accepted that this arrangement is not possible at all locations.
At Gatwick Express (Stewarts Lane), the depot staff produce paper TP Certificates that are left in the driving cabs. GX fitters are also depot drivers for optimisation of resources.

At GTR’s Hornsey depot, their depot staff (including the shunters) undertake TP. At their outstations the traincrew undertake TP.

Where possible, the Train Management System of modern stock could be used to get around the need for a “piece of paper” to demonstrate TP validity, thus reducing the need for physical transport of documentation to the vehicles and any potential loss/damage. [KTR].

Similarly, where possible, the TMS should be used to monitor the status of systems on the train which require preparation, particularly at locations such as outstations.

Example: Govia Thameslink Railway Class 455 Units are on exam more often than the more recent design of Electrostar Units. Therefore, as the Electrostars are more frequently prepared at outstations, the Train Management System Intelligent Display Unit is used by fitting staff during TP.

Example: SWT’s Siemens Northam Depot is not big enough to accommodate their entire fleet. As a result, they make use of remote diagnostics to identify faults; details of which are then used to inform the activities of a “man in a van” repairer.

Where units frequently run through Automatic Vehicle Inspection Systems (AVIS), the case could be made for a reduction in TP activities. These systems are able to report on the state of various external systems on the train (i.e. brake disc and pad presence and thickness, fire bottle level, whether side skirts are left open etc.) and thus if the unit is run via this system on a regular basis, TP can be minimised. It is important to note when the inspection is done i.e. on the way into the depot or on the way out of the depot.

Where possible, keep train preparation uniform between depots. At the time of writing, different depots undertake different TP activities. There is a disparity not just between TOCs but also between depots within TOCs. A significant barrier to this is Industrial Relations (IR), whereby a major change to TP would be difficult to achieve without the support of staff. This issue primarily occurs between staff grades within TOCs.

Train Management systems should, where possible, be used to complete as much of the TP as is practicable. When considering future trains, it is worth investing considerable time and effort thinking about how the system will work and streamlining the TP process. I.e. can the TMS report system status (Healthy / Faulty)? If so, can physical checks be removed from the TP inspection? [KTR]

The reliability of self-tests should be kept at a maximum to ensure that upon start-up, spurious fault messages are not generated which can result in a conflict with diagnostics.

On Siemens Desiro units, the TMS features different pages of information that are presented to the user on the TMS display. It is crucial to ensure that the level of information presented to the driver in relation to faults is sufficient such that they can provide a value added action to rectify the fault. There is a view in this application that there can be such a thing as too much information.

Faults can be classified major or minor. Major faults are those that the driver is aware of and can undertake a timely response to once the fault has been reported. E.g. fault in relation to safety of train. Minor faults are those which do not require the immediate attention of the driver and can be addressed
at a later stage during the day.

There is a danger that additions to TP activities over the years have been to ensure drivers cannot fail trains in order to protect fleet reliability performance reporting.

Different staff can be responsible for TP activities within a TOC. An ideal approach would be for consistency across all depots within the TOC.

Example: East Midlands Trains has a wide variety of combinations of TP staff just within their Etches Park Depot:
- 22X fleet – manufacturer prep (Bombardier).
- 15x – depot driver preparation.
- HST – depot staff prepare power cars; shunters prepare trailer car interiors.

There is little to no requirement for depots or TP to test horns, head, tail and marker lights. This functionality is tested by drivers routinely when vehicles are in service. Members believe that there will be little chance that these components will fail between service and re-preparation.

Due to the increased importance of Service Quality (SQ) and the minimum standard expected by passengers, there may be a requirement for a different type of TP post cleaning. In more recently let franchises, SQ levels are specified measured requirements.

Point of Interest: When comparing the railway to the automotive industry, upon completion of a car service, it is not typical for the customer to walk around the car undertaking an inspection. If this is the case with cars, why should it be accepted in rail? It should be noted, however that aircraft pilots still perform a walk around of their aircraft prior to flight.

Where systems display an analogue dial featuring any potential dubiety, it should be clear as to whether the reading is a clear pass or fail.

Example: Class 15x fire systems feature a dial reading “red, green, red”, i.e. low pressure, medium pressure, high pressure. What it does not tell, however, is that high pressure is not considered a problem when compared to low pressure. Train preparers may, upon seeing a needle in the “red” zone, fail the train without having knowledge on this.

As was mentioned at the start of this section, train preparation activities are often restricted at sidings/outstations, therefore below solebar TP is not undertaken. Whilst this is accepted at outstations, depot train preparation features below solebar TP. Those undertaking this TP activity should consider whether, as this is accepted at outstations, whether it is a necessity to perform at depots.

Good practice when preparing coupled multiple units is seen to involve keeping units in their consist rather than separate to prepare individually. Splitting units is seen to introduce risk and therefore should not be necessary.

Example: Some TOCs reported that units running in multiple are split upon train preparation. This is done to check the functionality of the couplers. This is the only reason for splitting the units and therefore was deemed to be unnecessary and inserting undue risk to the process.

Whilst it may be considered by some to be a belt and braces approach to TP every cab in a train consist, it does represent good practice since it prevents defects subsequently being identified by traincrew.
5.3 **Review**

Analysis should be performed on the causes of TP failures both at a TOC level but also, where possible, at a national level. Both of these will help to understand the systemic issues and, via a pareto based approach, begin to tackle the most frequently recurring failures. This analysis can be broken down further to look at the failures which occur on depot comparing to those which occur at outstations.

Reviews should be held of any incidents which have occurred as a result of improper train preparation. Caution should, however, be taken as if new checks are initiated as a result of every incident then TP shall become ungainly and unwieldy.

TP activities should be routinely reviewed (ideally on an annual basis) to ensure that they are relevant and whether modern practice can enhance the process.

As mentioned in section X.B, in some instances extra checks are being carried out on fuel point exams. To best understand the current state of train preparation, a look into what is being done (and for what reason) on fuel point exams for TP reasons should be undertaken.

Care should be taken to ensure that TP occurs only when it is necessary. Post control jumper change is an example of when TP should not take place. A proper test post repair is what is required, however instances such as NIRs can instigate the implementation of these sorts of checks which can, in less time than one may realise, become embedded in the maintenance plan.
6. Delivering the Service

How engineering, operational, planning and retail functions work together to deliver the service is vital to day-to-day reliability and to on-going reliability improvement. Sometimes these relationships span actual contractual boundaries, but whatever the organisational structure, the functions must still all pull together to deliver the service.

Three areas where there are often the greatest challenges, and the greatest scope for reliability improvements, in terms of numbers of incidents and the operational impact (e.g. minutes lost) of each incident are:

1. Coordination of depot planning and train planning
2. Communications processes around faults and failures
3. Measures of fleet performance and how they are used to improve performance

For each area, we have shared experience and thinking about:

- hard issues, like should there be contracts or internal contract-type relationships (e.g. interface rules set out in requirements documents); and
- soft issues, like culture (i.e. creating a culture of engineers and operators working together to optimise their combined overall delivery).

Most people involved in running a railway set out to try to do the right thing: we need to recognise each person’s expertise and enhance each person’s understanding of the bigger picture to enable them to contribute to better overall decision-making. As with every other area in ReFocus, we need to make the most of on-going experience, using effective feedback loops based on sound analysis of individual incidents and trends to develop and disseminate our overall learning.

In some circumstances, it will be right to do one thing, in others the reverse. For example, if a train develops a fault at a remote location in a low traffic density on a regional railway, it is probably best for the driver to telephone a nominated depot maintenance person for advice, aiming to enable the train to proceed, possibly in a controlled degraded mode. If however the same train develops the same fault on the approach to a busy station at a peak time, it is probably best to declare the train an operational failure and clear the line.

In summary, to optimise the reliability of any railway the people involved need to select the most appropriate approach in each set of circumstances. Setting out some clear plans around hard issues is an essential step to consistently delivering reliability, as is having a culture of people who work together for the best overall service delivery (e.g. departing from these plans in a controlled mutually agreed way when that is the best thing to do). This Section is not called “operator interfaces”, because it’s about developing and making use of an effective combined culture focused on service delivery.

6.1 Coordination of depot planning and train planning (timetable and resources)
TOCs should have a resilient, joined-up plan, to reliably deliver the service. There is a risk that a narrow approach to train planning does not take full account of either operational resourcing constraints (e.g. where on-train staff book-on and off) or diagramming for maintenance requirements (e.g. where facilities, fitters and cleaners are and the time they need to do their work). Some train operators resolve this by co-locating depot planning and train planning teams; others have an engineering planner who sits on the train planning group.

Train planners need to understand Depot Capacity (see 5.2), and the consistently deliverable Availability of all the fleets (see 4.5). This is a good example of hard and soft issue management: we need some hard plans which are owned by each area of expertise (e.g. the depot plan, the train plan, the drivers’ rostering plan). However, everyone needs to remember that we all exist to deliver a service, so these plans must be flexible, which means the soft side – talking to each other, not just making assumptions. There are many examples of train planners who genuinely thought they were being helpful by changing the train plan to increase the number of trains returning to a particular depot at night. However, the impact of this can be to make a depot logistically unworkable.

**Train planners and depot planners** should meet to discuss every timetable change, and ideally more regularly e.g. to review experience, to discuss the frequent diagram changes necessary to accommodate track engineering possessions – and to maintain relationships.

Example: GWR has documented Rules of the Depot which set out minimum requirements e.g. for how long how many trains are required in the depot in order to maintain them effectively. The programme of delivery of units to the depot at Bristol, to feed the relatively short, single road fuelling shed has been carefully worked out. Delivery against this plan is closely monitored, with feedback on a daily basis. Shortage of one driver for instance, leading to coupling together too many units for an empty move to the depot can cause havoc to the operation, and impinge heavily on time available for maintenance.

Example: GWR, ran a series of Diagramming workshops, involving engineers, diagrammers, operators and driver managers enabled all to understand the fuelling, cleaning and maintenance requirements of the different fleets of DMUs, along with operating constraints and the length of time units could be made available at depots for maintenance. The joint aim to optimise maintenance downtimes and on-depot slots resulted in a good working train plan.

Example: ATW Production Manager emails out a daily Report direct to the Operations Director and Head of Drivers, as well as Control and the engineers. This uses traffic lights to highlight how the previous day actually worked, comparing against plan: no. of units to depot before 1800, 2200 and 0001; no. of A and B exams; no. of drivers provided; depot staffing levels. Any shortfalls highlighted in red are discussed and reviewed by the directors, daily if necessary.

Best practice TOCs evaluate the costs and risks associated with changes to service requirements (e.g. changing the timetable, changing the vehicle diagrams), as well as benefits. Engineers should be clear about what is optimal in their area, and also about setting out any costs and risks associated with a proposed change.
For example, TOCs should do a risk assessment on any proposed timetable change in terms of their ability to **reliably deliver the service** (e.g. Is the proposed rolling stock utilisation plan robust? Are turnaround times sufficient? Does the TOC really want to suffer the likely increase in unreliability from having another terminal station stabling point?). Risk assessments should also include issues like ability to **deliver service quality** (e.g. turnaround times required for adequate cleaning, diagramming to enable adequate toilet maintenance).

Example: SWT minimise coupling and uncoupling of units. This means that they run more 8-car sets throughout the day instead of 4-cars, which increases fleet mileage and hence the mileage-dependent maintenance requirement. However, the benefit is reduced risk of failures with huge operational impacts.

Example: C2C’s costs and benefits work out differently, so they cannot eliminate coupling from their service pattern. This means they have taken another approach. They effectively justify an insurance position of having a station fitter at Shoeburyness who can reduce the risk of service impact e.g. by supporting operational staff undertaking coupling and uncoupling, and dealing with emergent technical issues as they arise.

The plan is not just about setting the timetable and letting it run, **feedback loops** are crucial here too. A good way to develop a more robust train plan is to monitor how the service degrades during the operational day. Traditional measures of availability of trains for traffic tend to centre upon a certain time of day (e.g. was the 6am stop position met?), but more frequent measures may be useful to identify risks to service performance, as well as actual service degradation. Then, effort (and resources) can be directed where they will have most effect (e.g. where to put a stand-by set or a terminal station fitter).

### 6.2 Communications processes around faults and failures

Best practice for delivering the service is to go beyond the safety baseline required in a standard contingency plan. TOCs need a cut and run policy - how long (and indeed whether) to support the driver in fault finding and resolution will vary in different operational circumstances. What is important is that the driver knows what approach to take on each occasion – it is usually best for the driver to contact control as soon as possible, to confirm the approach to be taken.

Example: FCC (now GTR) had prior agreement between depot/control/operators on how to react to various common faults e.g. leave in service, swap out before bottleneck (e.g. central tunnel section). A specific problem on Meridian doors was managed through an instruction “if in doubt, lock it out”, much reducing service delays.

**Even if train reliability is “poor”, in the life of any particular driver, train faults will actually be rare events. Hence the driver may need support to work through something which maintenance staff might regard as a common fault, easily mitigated.**

*Drivers may also be in a state of anxiety, such that moral support would be very helpful to them in dealing with incidents where they are on their own in the cab and under pressure.*

Example: SWT has “Phone a Friend” (a dedicated helpline for defect reporting and support) which covers mandatory reporting (e.g. RT3185s) and quality issues (e.g. graffiti or blocked toilets). Southeastern specifically train drivers in fault reporting at driver training school, using simulators for drivers to practice fault rectification.
Example: A small handbook has been jointly developed for drivers, by engineering and operations staff working together at C2C. It is to be carried by drivers as part of their essential kit, with the threat of disciplinary action if they don’t have it. The booklet is subdivided, with colour coding of the page edges, into traction faults, door faults, brake faults etc to ease quick identification. It is updated in the light of experience – a recent change is to amend ‘report as soon as possible’ to ‘report at terminal station’, to save having to stop to report a fault.

Example: On some TOCs, the driver phones the maintenance control centre where the controller works through a computer-based fault chart. This chart ensures a consistent approach to on-train fault finding, and means that depot maintenance staff subsequently knows what was done, making their work easier.

Timely and useful feedback from operational staff to the maintainer (e.g. what happened, what they tried to do to fix it) is notoriously difficult to get. This means that subsequent root cause identification is less efficient than it might be and there is a greater risk of repeat failures. Feedback can be enhanced by closing the loop – some TOCs write to Drivers, thanking them for their report, explaining what was found and maybe suggesting a useful mitigation for them if it should occur again – or letting them know that a permanent technical fix will be developed. This positive feedback encourages more and better quality reporting.

Example: Service feedback can also be obtained automatically without having to wait for drivers reports. Electronic condition monitoring systems (e.g. MITRAC on Bombardier’s modern fleets) enable simultaneous fault information to be transmitted to depots so they can plan in advance the priorities and resources (e.g. expertise and materials) for maintenance that night.

Example: Use condition monitoring systems and communications links between trains and depots to report directly the condition of the equipment. This data can form an invaluable independent source of evidence with which to interpret drivers’ reports. It is possible using such systems to “dial up” the train in real time to investigate and respond to specific reports.

It is vital that the different functions understand each other’s expertise and issues. The fitter needs to know what it feels like to be at the front of a broken train with hundreds of people wanting to get home sitting behind you; the driver needs to understand that it’s very hard to find (let alone fix) a fault when the person who saw it hasn’t taken the effort to describe what happened adequately. Some ways of enhancing understanding and empathy have been described above in the processes for dealing with specific failures, remembering that communications need to be two-way to be effective – drivers fill in fault reports and get feedback on what was found.

Some more good practices are:

- newsletter for drivers – helps drivers understand. Focus on topics that are known to be of interest to drivers e.g. from defect reports, driver managers or after attending drivers briefings
- engineering slot in their drivers’ Safety Update Briefing - enables some face to face two-way discussion of current issues and future developments
- Driver Forums - engineering staff attending driver messrooms, for pre-arranged question and answer sessions, with answers and advice on common faults which are then published (maybe in the newsletter)
Example: At EMT there is an Ops Manager who, as an ex-driver, works as the ‘interface’ between drivers and engineering staff. He attends reliability meetings, and includes relevant extracts in the magazine which is produced for Ops staff. This also includes information on significant incidents, what was found, and what was done about them. There are other ‘keeping drivers in the loop’ items, such as ‘watch out for such and such a unit, it has a new design of cab window – please look and tell us what you think’. He facilitates regular driver surgeries between drivers and fleet staff, and e-mails direct to Engineering with arising driver issues, helping to greatly speed up the process of resolution and feedback.

Example: An EMT ‘coupling’ video has been made, using EMT liveried trains, (and staff with local accents!), to remind all of the standard procedure to be used during coupling and uncoupling sets – ‘The Happy Coupler’. It was also identified how important it is to ensure every regular couple and uncouple is shown in drivers diagram to be done, to avoid last minute problems.

6.3 **Measures of fleet performance** (and how they are used to improve performance)

Sometimes productive time and energy is tied up by different functions within an operator or across a contractual boundary undertaking independent data analysis – and worse still these analyses sometimes get different results and discussing these differences absorbs yet more energy.

You should agree a joint dataset, then focus on reducing the likelihood of failures occurring, plus reducing the impact of each failure. With sound analysis, your effort is more likely to be directed to the areas which will potentially deliver the greatest service reliability improvement per pound spent.

Example: VTEC reduce the likelihood of failures occurring (projects include increasing battery life in case the static converter fails, visual indication of transformer gas detection rather than a power shutdown, improved sander nozzles to prevent spurious dragging brakes reports). They also work to reduce the impact of delays e.g. upping the speed limit of the Class 67 thunderbird light engine running to a failed train from 75 to 100mph.

The ability to produce an agreed dataset is very much to do with the soft issues of building trust, relationships and understanding between different areas of expertise.

Examples: C2C produce common data which is summarised on a one-page document called “Service Affecting Incidents”. This is discussed at performance meetings where actions to drive up reliability are agreed and reviewed. Key to the success of this process is that the actions which different parties are taking are transparent – Operations know that Fleet is developing a long term fix for fault z, so meanwhile they are keen to help mitigate its effect by working round it using procedure y.

Once the dataset and root causes are agreed, different players can feel more comfortable about working together to minimise the impact of any fault. There are often short term operational mitigations which can be very effective in improving reliability whilst a long term engineering fix is developed and implemented.

Example: A new fleet had interlock problems with the exterior bodyside doors for cab access when changing ends. Whilst an engineering solution was being developed and implemented, the drivers agreed to use the saloon doors to access the cab, so that the risk of cab exterior door interlock failure was reduced. This more holistic approach delivered a more reliable service even before the technical improvement could be rolled out.

It is also of course important to capture faults that don’t yet have an effect on the service but reduce the operational flexibility.
Example: C2C measure degraded mode operations where one cab has to be buried inside a train (e.g. because of failed windscreen wipers or inoperative TPWS). They want to understand the nature and level of their operational inflexibility for splitting and turning trains round, because that affects the total resilience of their service delivery. C2C measure trends in these areas even where no delay is experienced in service, because it is a measure of a reduction in their capacity to mitigate any other event which occurs.

**More is better:** There are other examples of expanding the definition of faults in order to capture more issues which should be resolved so they can be addressed before they have an impact on service delivery. Many operators treat a problem which causes a step up internally as seriously as if it had caused a cancellation. In other words, they acknowledge they are making use of the resilience they have built into their diagramming, and make the most of the learning experience. This attitude is also important in prioritising customer issues other than simply getting there on time e.g. cleanliness, functional toilets etc, as mentioned above. Soft issues are critical here in creating a culture where people accept that different functions are contributing to the whole.

**Fewer is better too:** At the other end of the scale, some TOCs have mechanisms which focus on the worst few incidents in each period e.g. those which cause the most delay minutes, or all incidents above a certain threshold of delay minutes. A full cross-functional review of the failure is carried out which identifies real root cause(s) and more effective long term mitigations. This review also often elicits other opportunities for improvement. Actions are typically fed into cross-functional groups and progress monitored by the Performance Manager.

Train service performance has been improved by:

- Focussing people on what is most important to themselves and their internal customers
- Creating indices by which progress can be monitored
- Providing more structure and formality around previously casual arrangements
- Improving cross-functional understanding and organisational learning
- Providing useful quantitative data to assist business cases which address root causes, improve resilience and make mitigations more effective

In summary, TOCs should have a holistic, structured assessment of the measures needed to target improvements. This then needs to be analysed robustly, checking for statistical significance of variations and identifying common cause issues, where concentrating effort on the root cause can eliminate several different failures.
7 The Depot

This Section covers the frontline resources needed to maintain reliable trains:

7.1 Human resources – staff motivation and skills, staffing level
7.2 Depot capacity – sufficient for outputs required, optimal use
7.3 Depot facilities – for the vehicles and for the people

Much of this Section emphasises that the above are part of managerial design. The design process must reflect reality and it must enable frontline managers to perform their day to day duties effectively.

7.1 Human resources

7.1.1 Motivation

As stated in Section 3.1, reliability depends on quality of maintenance and thoroughness of fault finding to address root cause (in addition to various management activities). Direct work on vehicles in turn depends on having sufficient people with the right skills and other resources (see below), but also on the effort of individuals. Rail vehicle maintenance is often carried out in difficult conditions e.g. shifts are designed to suit vehicle downtime, not family life; much work is done at night; even with good depot facilities, access to relevant parts of vehicles is often awkward, compared with working on a bench.

Example: If it is possible to diagram maintenance into day shifts, do so.

Well-established management best practice is evidenced by recent human factors assessments of UK rail vehicle maintenance – people work better if their inputs are appreciated and acted on. For example, local ‘ownership’ of maintenance instructions enables prompt incorporation of feedback from maintainers e.g. to correct for errors and develop where improvements are identified.

Where possible, ‘ownership’ should be extended to painted number of vehicles e.g. this depot (or even this maintenance team) is responsible for these units. This can include: following up what other depots/outstations do/ don’t do to these units; focus on long term repeat intermittent defect resolution; undertaking deferred work.

Example: At Soho depot, they are developing benchmarking of maintenance team performance against KPIs which include the reliability of the trains they have worked on. This is possible with a self-contained fleet of Class 323 units, most of which return home each night.

Techniques such as lean maintenance, Kaizen and 6 Sigma are being adopted, both for the outputs they deliver and for the impact that engaging people in improving their work has on their morale and application. These techniques can help identify and remove frustrating parts of job, such as walking to stores, waiting for parts. (Note that you need a culture of wanting to better use staff, not to cut jobs, for such programmes to be effective. You also need to recognise that this provides incremental continuous improvement rather than big step changes.)

Example: ScotRail used lean techniques at Haymarket to free up a person on each B exam who was now devoted to repairs/ deferred work/ mods.
Example: At Longsight, a full time Kaizen Promotion Manager is backed up by an (almost) full time Kaizen Technician. They have a high quality facility permanently set aside for Kaizen on site at the depot. A 5-year plan of strategic objectives is backed up by a plan of projects for the next 12 months drawn up by the Directors. Each project is supported by a 5 day Kaizen Event, releasing staff from the maintenance teams, involving 2 or 3 people who are familiar with the tasks involved, supported by other groups, such as stores, or even a Director. Experience shows that the more varied the makeup of the team, the better the result. The aim is to hold a Kaizen Event around every 6 weeks. There is a project plan displayed, to show progress against this plan. Actions for improvements arising from the events are carried out within 30 days, by other people. There is a ‘30 Day Action’ list, which shows who is dealing with each one, and when they will be completed. There have been 25 Events so far at Longsight, and each of them has identified at least 30% saving in time, plus 3 or 4 safety improvements. The whole Kaizen process has a very beneficial effect on staff morale, as they appreciate being listened to, and developing their own ideas. Any saving in staff time is re-invested in quicker processing of outstanding repairs, never in staff reductions.

Maintenance work (especially defect management) should be a closed loop process: enabling learning, 2-way communications, and encouraging collective effort focused on shared goals. Best practice is to use Communications rooms (also called Information rooms, Reliability rooms, War rooms). These rooms should be sited somewhere that people actually use 24/7 e.g. mess rooms, booking on points.

These rooms should be used to display up-to-date data and action plans, AND be actively used in start-of-shift staff briefings and management progress meetings.

Typical questions for staff briefing meetings might be:

- how is the fleet performing? (what happened in traffic yesterday? how did maintenance go last night?)
- what are the trends? (is reliability improving? why are trains unavailable?)
- what issues are we keeping an eye on? (rogue units, repeat defects)
- staff issues – training plan, progress with issues raised

A corporate team spirit should also be encouraged: this can be hard work with change of franchise owning group: but can also be seen as an opportunity for a positive step change with an incoming franchisee.

Example: At EMT, the scope of a refurbishment programme for the Class 153 and 156 units was discussed extensively with the staff. The resultant spec was fed back to them, through the drivers reps, and in an Ops Newsletter, which has had articles about the proposed scope of the refresh, inviting people to send in further suggestions.

Some TOCs have staff suggestion schemes, with all engineering suggestions going to the Engineering Director. Best practice is to respond within one week, with a close out in 3 weeks. Small cash awards are then presented every 3-6 months in front of people’s colleagues for the best suggestions received.

7.1.2 Skills

Depot staff has traditionally been provided with skills that are directly related to work on vehicles. It is however now recognised that these skills are vital but not sufficient. For example, effective change projects depend on the contribution and insight of staff throughout the organisation. Hence best practice includes soft skills e.g. quality systems, improvement techniques (such as Kaizen), lean maintenance and the use and presentation of data.

Example: Northern has trained all depot staff in quality improvement techniques. They use these skills daily to improve their production processes and use data rooms to monitor and validate their changes.
Another change from more traditional approaches is to understand and define all the skills and competency needs of all staff. Best practice uses the results of a vehicle/train risk assessment model and includes enabling staff to understand:

- The connection between sub-standard equipment condition and operational performance/risks
- Specific material and component degradation processes and how to identify them on train equipment, particularly on exams
- Vehicle/train system behaviour under normal and degraded equipment conditions

**Example:** Southern now trains its staff specifically in different fixing methods, and the degraded mechanism associated with each type, to ensure structural integrity and performance throughout service life.

Another best practice is to actively develop technicians capable of root cause investigation through structured programmes, rather than hoping talented individuals will develop themselves.

**Example:** C2C are developing a new competence assessment module for staff going out to attend to trains, based not only on their familiarity with repairing the vehicles, but based around understanding what can be done in the minimum time in a failure situation, the effect on the train service, how to communicate effectively with the drivers etc.

Modern vehicles are increasingly complex and this is being recognised in increasing specialisation of skills, rather than asking people to attempt to be “jacks of all trades”. Specialisms tend to be focused on systems e.g. traction, doors.

There is also increasing specialisation in the sorts of work undertaken and where. For example, some depot staff work only on routine exams, others need high levels of fault finding skills to deal with defects arising in service and to really find root causes.

**Examples:** SWT simply says “Don’t dabble with doors at outstations. If there’s an issue, lock the door out of use and report it so it can be planned for later (skilled) attention.” Southern use a core group of people to do fault finding, ‘team technicians’ who support each maintenance team.

### 7.1.3 Training

**Training Content:** Best practice is to create the syllabus necessary for a modern depot workforce, based on a thorough analysis of skills needed and using both core traditional technical materials and new sources. Training materials should be aligned with Maintenance Plan instructions and quality system techniques by trainers working closely with accountable professionals in these areas.

**Example:** Southern treats all its engineering training material as Engineering Standards, ensuring they are aligned to Maintenance Plan instructions and subject to the same controls, updating mechanisms and professional oversight.

**Training Delivery:** Best practice is to roster training days for all staff. This is essential to deliver a defined development plan within a specified timescale and hence to sustain continuous progress. Production managers must facilitate robust training programmes to support team leaders with a balanced range of skills to reliably deliver production and quality targets.
Many organisations have found that new entrants benefit from mentoring by an experienced member of staff. Best practice suggests that someone like a trainer is ideal for this role, providing an unbiased guide where peer pressure may not always be constructive.

Example: Northern Rail appoints a personal mentor to each new entrant. The mentor guides the individual’s progress and ultimately decides when the individual is fully capable of performing her/his responsibilities.

Example: London Midland has trained the technical team as trainers, to join up training delivery to staff.

Example: GWR at Exeter Depot use ‘on the job’ coaching of staff by technicians.

7.1.4 Competence Assessment

Competence assessment is the industry’s principal mechanism for assuring work on vehicles. Most schemes use on-the-job observations, focused on inspection tasks as the main source of evidence. However, best practice is to base competence assessment on fundamental risk assessment (see Section 3): this means concentrating on tasks that most influence operational performance and safety, as well as occupational risk. Intrusive tasks are therefore more important than inspection tasks.

When staff turnover is high, some staff will not be registered as competent in all the tasks expected of them. Some depots manage this by regularly publishing current staff competence profiles, so production managers can deploy balanced teams and arrange oversight by fully competent staff where necessary. Published staff competence records also tend to encourage all team members to support the assessment programme.

Complete reliance upon on-the-job competence assessment may lead to an insurmountable workload. Many organisations try to group tasks into those requiring common skills and knowledge, but there is a risk of compromising professional standards. Alternatively, competence can be evidenced by looking at finished work i.e. using equipment condition audits. The results may be used more widely too, e.g. to:

- Validate the accuracy and appropriateness of maintenance instructions and their periodicity.
- Validate training materials and the effectiveness of staff development programmes.

Assess competence, when the condition of equipment can be closely associated with an individual and their activity. (Depending on the task, this can sometimes be assessed sometime after the work is done, making it easier to manage the assessment workload).

7.1.5 Staffing level

The need here is to ensure sufficient capacity – enough to enable and sustain long term reliability growth. ReFocus studies support the finding that depots with more staff per unit deliver higher levels of reliability. Deferred work trends can also be a good indicator of whether you have sufficient frontline maintenance staff (assuming optimal management etc).
7.1.6 **Location**

It is important to deploy the staff you have effectively. Line of route support should be carefully thought through – there is a risk that you give drivers and fitters an excuse to delay a train in traffic (rather than doing cut and run), unless your outbased maintenance staff are only at your terminuses, where there is sufficient downtime to fix issues which might otherwise cause cancellations or delays. Best practice is for fitters to meet and greet all drivers only at terminuses where there is enough time to make repairs without causing service delays (and still don’t dabble with doors!).

7.2 **Depot Capacity**

7.2.1 **Sufficient for outputs required**

Depot capacity is a matter of design. Franchise obligations, fleet mileage, structure of the Maintenance Plan and availability targets must be used to quantify the capacity and capability needed from the depot(s) to maintain the fleet and to support out-of-course activities, including potential fleet modifications. Work out the role the depot will play in the real-time railway and ensure this fits with its scheduled work commitments. As Section 6 explains in detail, agree the process for planning maintenance work and ensuring that trains are diagrammed to return according to an achievable work plan.

Depot capacity doesn’t just depend on the number and type of vehicle berths and equipment. Progression of vehicles through the facility, sequencing of work and vehicle downtimes are equally important, as are team structure and their working methods.

Fleet managers must recognise that inappropriate depot design is likely to: jeopardise the quality of defect investigations; encourage the deferring of work to ease production pressures; and risk not meeting availability targets with serviceable vehicles. In these circumstances, it is difficult to expect front line managers to perform diligently and effectively execute the processes outlined in Section 3, which are critical to improving reliability. Furthermore, it is likely to get harder to identify root causes since more effort is required to resolve the depot’s latest emergency. Overall, inadequate or inappropriate design will push a depot organisation to be increasingly reactive. Trending in this direction should be monitored using appropriate KPIs (e.g. deferred work level, number of moves vehicles do around the site between routine arrivals and departures).

Example: ATW quantified necessary depot capacity in South Wales, and restructured the workforce to introduce well-organised and appropriate team working arrangements. The depot’s operational role was also reviewed and an improved planning process with operations colleagues was defined and introduced.

Example: Northern maps the transit of every train through its facilities to ensure that all work can be fully completed and throughput matches depot capacity.

7.2.2 **Light maintenance**

Put simply, “do not get the trains into your depot(s) when you don’t need to”. Close control of defects is required to ensure the right units are at the depot for long enough to rectify them properly.

Example: SWT have fleet staff in Operations Control who take the final decision on diagram swops i.e. which units really need to go to depot tonight.
There is a risk that a depot may be filled with units just for stabling, making it difficult to access the units that are really wanted for maintenance. This is because depots are often convenient for parking defective or failed stock. Although depots should of course provide this type of support, internal working arrangements must be designed to ensure that it does not disrupt production processes beyond planned limits (see Section 6).

7.2.3 **Heavy maintenance**

Examples of questions to ask include:

- GTR: can we bring all maintenance in-house? (rather than contracting out, to capitalise on economies of scale)
- VTWC Longsight: can we bring critical component overhauls in-house? E.g. HVACs, cardan shaft balancing, most bogie repairs, toilets, pantographs, traction auxiliaries, traction interference testing (to reduce travel time and no. of bits needed, and to enable a common sense of urgency)
- Bounds Green depot: do we need our own wheel lathe? (to minimise vehicle downtime, and optimise wheel life)

**Optimal use** (for Rules of the Depot i.e. coordination with train planning, see 6.1)

- Good, detailed depot maintenance work planning can optimise the use of the depot, its people and facilities.

Example: Central Rivers has grouped exam work into: powered down, powered up and work arising. This enables detailed occupation of individual depot slots to be pre-planned, and for shunts to be done at the same times each day, in accordance with the plan, enhancing the effective capacity of the site.

Example: GWR have improved depot efficiency without loss of traceability by placing Inspection Measuring & Test Equipment at the point of use in tool vending machines. These controls and record the issue and return of equipment whilst having it readily available at the point of use.

Example: GWR’s internalization of Heavy Maintenance has enabled the depot to take greater ownership of vehicles as well as improve staff understanding of systems and improve availability through not having lost time moving trains to a workshop away from the area of the TOC.

Example: At Longsight planning of the workload on nightshift is a very well developed, sophisticated, manual process. The plan allocates which road each set will go on at what time, for how long, what work will be done, and which staff will do it.

Similarly, detailed analysis of servicing and maintenance workflows (everything other than the exam work itself) in the depot can be effective in sizing the capacity.
Example: Neville Hill depot (East Midlands Trains) developed a bespoke computer programme to model the depot, including time to:

- Fuel and water
- Go through carriage washplant
- Empty CETs
- Get into the maintenance shed
- Get out to the departure siding

The arrival and departure times for each train for any proposed timetable change are fed into this programme which confirms whether or not it will work.

Spare capacity should also be considered for contingency, testing scenarios such as out-of-course damage repair requirements on a particular unit through to the unavailability of another depot within the TOC (e.g. through flooding, from recent experience) - and developing plans accordingly.

As with most other things, the capacity delivery of the depot should be measured and trends analysed to understand changes and developments as they occur - and to identify the need/ opportunity for further changes. Suitable measures might be: berth occupancy percentage in maintenance shed, late starts off depot by cause.

7.3 Depot Facilities

Good facilities for vehicles and people aid productivity and boost morale to enhance maintenance quality. A High Performing Depot Specification was developed in 2008 to identify the ideal requirements, which acts as a checklist for existing and new facilities. It has been input to the Network RUS (Route Utilisation Strategy) Depots working group and is shown in Appendix B. It should be noted that Network Rail also produced a document, NR/PSE/SPE/00149, “Design Consideration for Rail Maintenance Depots – Guidance Note”.

8 The Vehicles

8.1 Data collection and analysis; Repeat defects; Trends

Reliability data is needed to understand what is happening, so we know where to concentrate effort – and how effective that effort is. All TOCs feed into the common high level reliability measures set out in Section 2. These are useful for looking at trends across the national fleet (and reviewed in the regular ReFocus meetings).

Within each TOC, more detail is needed for effective fleet management. Fleet Engineers should actively design performance recording systems to:

- Enable and encourage staff to record unambiguously details of operational events, the defective equipment condition which caused the event and the corrective actions they applied; and
- Support subsequent statistical analysis and the identification of an appropriate long term engineering response.

Many operators call this type of record a Failure Mode Analysis (FMA) report. Best practice FMAs include:

- the operational event and impact, using TRUST and other data
- the observed failure characteristics, which can be related to actual equipment defective condition
- unambiguous identification of the failed component within the vehicle structure
- precise specification of the failure mode
- identification of the cause of failure
- the corrective action taken

Subsequent analysis is easier if:

- Standard coding for all vehicle components underpins the recording system
- Free format reports are minimised (because they are hard to analyse)

The above can be facilitated by an appropriate computerised Maintenance Management System.

Maximise/ optimise data volume and integrity (capture all failures and whatever potential failures you can handle): Sources of failure data should be drawn together:

- TRUST incidents (for failures which cause reportable in-service delays)
- Control logs (for failures which affect passenger comfort e.g. air-conditioning)
- Driver feedback (for failures which affect their working environment)
- OTMR, TMS, CCTV - modern and retro-fitted vehicles capture huge volumes of data. Off-train CCTV is also used for some incidents (e.g. to demonstrate that a door incident was caused by a passenger and there are no problems with the door itself, further investigation not required).
- Infrastructure data (particularly on shared systems e.g. AWS, see Section 10)

Example: Class 455 TAPAS retrofitted on Southern (with Eversholt). This system uses enhanced OTMRs to collect equipment performance data and wireless networks to communicate routinely to an analysis database. It is possible to detect incipient fault conditions and identify precisely the components involved (using Southern’s vehicle/ train model). When faults do occur, TAPAS can define the failure mode of the train.
Example: West Coast Traincare use digital pens at depots for arrival audits to get defects (especially on passenger comfort) straight into SAP (their Enterprise Resource Planning system).

Maximise depth of data (understand each failure): Beyond the raw list of failures, we need more data to understand each one fully. Keep asking, “Why?” to get to the underlying root cause, and use an FMA type document to record the result. Periodic analysis and review using proper statistical techniques will then point to the long term solution e.g.:

- Inadequate fault finding guide
- Defective material (supplier feedback, engagement)
- Error in Vehicle Maintenance Instruction
- Insufficient understanding of personnel (training need)

Example: many TOCs use Fleet BUGLE to collate and analyse failure data.

Get to the root cause – don’t accept a “No Fault Found” without thorough investigation.

Example: TPE use TMS, OTMR, CCTV, Door control unit histories etc to help identify what actually happened. There is feedback to traincrew if necessary.

Example: Southeaster hold a Root Cause meeting to dig down to true root causes and highlight lessons learnt in a Reliability Brief. This includes: Top 5 Repeat Embarrassing Defect (RED) units, things for staff to do (e.g. recording any temporary repairs), and things for technical people to do (e.g. develop new repair procedures, mend test equipment).

Optimise data sharing (get the right information to the right people at the right time).

Fast, effective sharing to mitigate impact.

Example: “War rooms” are in use at many depots. The longest established is at East Ham, located where staff sign on, and it’s also used for the daily morning meeting. If problems arise on the fleet, there may be a 2-hourly meeting there to keep all abreast of current progress until the problem is solved. C2C look for a quickly implementable mitigation, minimising the effect on the service and allowing time for a longer term solution to be devised.

Repeat Defect management (dealing with the same apparent root cause).

- Provide the information – so people know it’s a repeat booking

Example: SWT’s Aide Memoire supplements a heritage fleet data management system. Aide Memoire faults are coded by effect (not cause): this identifies repeat faults which would not otherwise show up because the diagnosis was wrong in the first place, and is an effective supplement to root cause analysis work.

Example: Bombardier modern fleets are fitted with Mitrac which incorporates effective repeat defect flagging.

- Provide the management process – so maintenance staff have to be thorough, disciplined and consistent.

Example: Sole users of electronic components often track serial numbers e.g. for static converters, so repeat defects at component level can be resolved (Bounds Green on Class 91 and Mark IV, Slade Green on Class 465). Soho display a 28-day rolling history of each unit and each technical system for all to see.
• Create staff development programmes to teach suitable technicians investigation and analysis techniques. Do not expect key investigative staff and skills to materialise without nurturing and developing people’s potential. (See Section 7.)

Examples: Tyseley’s Level Checks have been widely adopted and Depot Engineer authority is required for a train to return to service after 3 failures of the same apparent root cause. Bombardier Central Rivers depot does not accept more than two No Fault Founds for the same defect: train is not released until something relevant is found. Also, whatever is found is fed back into fault finding guides.

Close the loop (analyse trends to ensure solutions and processes continue effectively and identify promptly any need for further action or new emerging problems).

Example: Dynamic Variance Charts developed by TPE, now being adopted (as “Modus”) in other First TOcs. Modus relies on measuring the actual performance against a standard or predicted level, so new or divergent trends can rapidly be identified. The system works well where there are multiple variables e.g. on midlife fleets where defects may have become embedded and their effects overlap, making it hard to understand the contribution of each.

Top 10 technical issues (target your effort so you’re not overwhelmed by trying to fix too many defect root causes at once).

Example: Pareto analysis is generally applied to identify the 20% of the work you can do to fix 80% of your problems. For technical issues, failure data tends to be grouped by system/ function (e.g. door gear electrical, traction interlock system, door gear mechanical, AWS/TPWS equipment), and then scored by severity (e.g. number of incidents, number of impact minutes). You concentrate on the systems with the highest scores, and review progress.

Example: EMT use Fleet BUGLE to feed a DRACAS (Defect Reporting Analysis and Corrective Action System) database.

The most frequent types of failure are given a DRACAS code, and carefully monitored. Each has a Champion identified, who develops actions for improvement, and progress is monitored at regular four weekly meetings.

For example, DRACAS code X001 is ‘unsolicited brake applications’.

There are 9 recommendations arising from X001, including modifications, changes to VMI, compliance with existing instructions, staff training, and one regarding track levels where units are coupled.

The benefits of each action are predicted, and prioritised. Progress against this plan is monitored by colour coding.

Top 10 non-technical issues (reliability improvement certainly isn’t just about modifying trains).

Examples: At C2C, every TRUST incident is discussed with Operations at a daily conference. A list of actions is produced daily to ensure follow up and close out. Sometimes C2C engineering may write a driver instruction to overcome or mitigate an issue. In addition to the standard fleet metrics, at Groningen in the Netherlands, train faults are measured by driver diagram mile by depot. This highlights those who are unhappy/ not well enough trained/ too rarely drive particular stock and enable remedial action to be taken.

Condition monitoring (how to prevent defects by gathering relevant data and feeding it into effective management processes).
Proactive data sharing and trend-spotting can identify potential failures, which can be managed out by sophisticated electronic call ahead or simple measurement systems and hence prevent actual failures. The infrastructure manager can provide useful information from condition monitoring equipment looking at the trains, and vice versa.

**Example (sophisticated):** Remote Train Monitoring (RTM) is fitted to all AGA Class 90 and DVT vehicles. Any non-conformities against pre-set parameters show up in red, and a history of relevant previous defects can be called up.

A mimic of the cab layout shows the position or display of each switch, handle and gauge in that cab. A ‘live’ electrical schematic can be called up, showing which parts of circuits are presently energised. This is used to assist the process of advising a driver what steps to take to get a failed train on the move as soon as possible. It also provides a very powerful help with fault finding, as the history of what parts of which circuits were energised when, is available for future reference.

**Example (simple):** FCC (now GTR) measure traction motor brush changes to identify rough commutators for grinding, reducing risk of flashover. Brushes changed earlier than normal are flagged up red on XV (their maintenance management system). Diesel operators measure coolant top up at all locations to identify leaks for remedy at next B exam.

**Example:** Southern have proven that OTMR data can be used to obviate the need for routine maintenance of brakes. They have also made a small investment in bodyside door monitors on Class 455s to obviate routine maintenance and improve performance, since the automatic system with SPC filtering is much more accurate than human beings can be.

### 8.2 Deferred work

Good practice is to manage deferred work carefully and to review trends. Specific repair activities are sometimes deferred until the necessary vehicles, parts, personnel or other inputs are available. Vehicles with less deferred work tend to be more reliable. However, it would be too expensive to cater for all eventualities;

Of course, work can only be deferred where it is both safe (any risks acceptably mitigated) and commercially acceptable (running to timetable, toilet provision) to do so. TOCs have decision criteria covering these issues.

Once work has been deferred, best practice is:

- Weekly review of outstanding deferred work (London Midland)
- Through lean review of process, GWR have created headroom in planned maintenance exams for defect clearance.
- Each maintenance team each shift briefed on which items to do
- Target zero deferred work off exam – and each team monitored and benchmarked against this target (East Midland Trains)
- Feedback briefing to frontline staff (e.g. in communications room)
- Deferred work trends should also be monitored, for example:
Deferred work trends are a measure of how adequate the production capacity is, and action should be taken if the trends are not downwards.

Example: Soho have a deferred work database where the root cause of deferring each item of work is recorded. e.g. material shortages so that the reliability or availability of each part can be improved. The database is used to ensure that required materials / equipment are available before the unit is stopped for exam.

8.3 Configuration

It is necessary to know the modification status of the vehicles and the parts fitted to them in order to have a stable benchmark for reliability performance and to make any fleet comparisons meaningful.

It is also crucial to know what materials to order, what maintenance regime to follow etc, especially when fleets are split and combined across different franchises and ROSCOs. Clear records of configuration (vehicles and drawings) smooth the interface with heavy maintenance, ensuring that the correct spares are ordered and that successful modifications are not undone. Use a standardised change management process to control this important area (see section 3.5).

8.4 Maintenance Regime

UK rail vehicle maintenance has a long history of preventive examinations and corrective repairs, generally based on RCM principles, but there is always scope for review and development. Triggers for change include:

- Feedback from failure data – extra/ different maintenance may prevent failure
- Modifications which require less/ different maintenance (part of configuration control)
- Condition monitoring which obviates routine failure-finding activity and identifies superfluous maintenance tasks.
- Exploiting opportunities to make changes – testing out changes in maintenance to check they are as beneficial as expected (e.g. more frequent filter renewals to prevent failures)
- Fundamental assessments of operational and business risks (see 3.2 above)

Example: Southern applied a proactive risk-based approach to its Class 319 Maintenance Plan and identified that air system components had an inadequate overhaul regime and therefore posed a long term risk. The result was a maintenance plan revision to enhance safety and performance standards. Southern’s risk-based assessments also identified intrusive activities which introduced more risk than routine inspections but were inadequately addressed in the Maintenance Plan. This motivated the production of more and better instructions for intrusive activities and led to their inclusion in the competence assessment regime.
Recent developments in communication technology and data storage offer an unprecedented opportunity for radical change in rolling stock maintenance. It is now possible, even on mid-life vehicles, to monitor the operations performance of brake, power door, traction and safety systems. Eversholt’s Class 455 is a good example. By careful design of the data and analysis, maintenance activities have been modified based on data trends. This approach permits maintainers to eliminate many routine maintenance tasks, simultaneously: reducing train downtimes; increasing rolling stock utilisation; and releasing depot and resource capacity.

It is important to match the time for preventive examinations and corrective repairs into the downtimes agreed for service availability requirements. Exams may be balanced into even sized blocks (to fit in more easily to train downtimes and staff rostering); or cumulative building up to more significant activities (where it is easier not to compromise the quality of work to fit too tight a downtime). (See also Section 7.).

Examinations may be driven by time, mileage and/or duty cycles: the best driver often varies by train system, so the overall maintenance regime is often based on a mixture of all these. However, the more accurately you apply optimum periodicities for each individual activity, the more complicated your regime is to manage, and it may not be worth the effort e.g. if excessive visits to depot are required. A compromise of grouping activities together is generally reached. (See 11.4 for examples.).

The management of repairs arising is a challenge which is met in different ways in different circumstances.

Older rolling stock used to have a clear demarcation between ‘light’ ‘Level 4’ maintenance and ‘heavy’ ‘Level 5’ overhaul. Generally, Level 4 could be done in-situ between diagrams or at most when the train is stopped for a few days; whereas Level 5 required shopping the vehicle out-of-traffic. Level 5 work often involved lifting the vehicle to change bogies, engines or do a C4; or work on the body of the vehicle itself, including painting and C6. In the standard arrangements at privatisation, responsibility for Level 4 was given to TOCs and for Level 5 to ROSCOs: some deals still have this split, but most arrangements for new trains do not make a distinction between maintenance and overhaul enabling more efficient use of the rolling stock.

Modern vehicles rarely need Level 5 - compared to some Mark 1 stock requiring annual (although mileage-based) bogie overhaul, because of wear in moving metal parts. Modern vehicles run several years between bogie overhauls (which remain fundamentally mileage-based) because of advances in suspension materials and technology.

Integrating Level 4 and Level 5 saves vehicle downtime, but requires tooling up formerly Level 4 depots e.g. with lifting equipment and painting facilities. Integration makes a holistic approach to maintenance easier (easier to trial changes, fewer parties to negotiate with, risks and benefits seen by same party).

Example: Work is in progress to extend Class 357 C4 from 450 000 miles to 1.5 million miles. The key to this is wheel condition. Wheel flats are very rare with modern WSP and planned reprofiling. The frequency of reprofiling is being increased, so that the depth of cut can be reduced.

Example: At Onnen depot in the Netherlands, reprofiling is very frequent at 40 000 miles: a light cut to maximise wheel life. This is thought likely to be best practice for the UK too.
8.5 Understanding Availability

The level of availability which can be consistently and reliability delivered needs to be established, to prevent either excess vehicles being unnecessarily leased or persistent failure to deliver to timetable.

Availability is affected by factors such as:

- Maintenance workload (including heavy maintenance and running repairs i.e. all vehicle downtime)
- Modification workload (can be significant for the first few years of new trains e.g. safety software upgrades)
- Diagramming (e.g. increasing the number of remote overnight stabling locations)
- Incidents (vehicles requiring significant repair can wait for months; a contingency plan is needed, reflecting the risk of these repairs on a particular route)
- Depot capacity and capability (see Section 7)

Example: GWR have a detailed 15 week plan showing all exams, heavy maintenance etc. This is particularly critical in ensuring that the maintenance workload is both steady and smoothed.

Example: At C2C, a 15 month painting programme required two units to be away for painting at any one time. Agreement was reached within the TOC to reduce the traffic requirement by two diagrams by de-strengthening, avoiding trying to chase an impossible target.

**Measuring availability.** Availability has traditionally been measured at a particular time of day, typically just prior to morning and evening service peaks e.g. ‘0600 stop position’. Availability requirement in the UK is often expressed as a percentage of the total fleet. Some TOCs include ‘hot spares’ in the requirement – these may be shown as less critical. In other words, if you fail to make the hot spare(s) available, you are not short for traffic, but you reduce the resilience of the service delivery. Some TOCs have a “Reliability Train” for “fixing” as part of the availability plan (particularly useful for new fleets with significant volumes of modifications). *(Note that on the continent there exist softer measures e.g. no. of trains supplied for traffic compared with plan, actually drawn from a much larger fleet. As ever, understanding exactly what is being measured is crucial for any meaningful comparison.)*

Example: Alstom (West Coast Traincare) has taken the ‘0600 stop position’ a step further at VTWC, with round the clock scheduled phone conferences (i.e. several availability counts during the 24 hours) which are used to plan depot slots and allocate staff to tasks on Pendolinos.

It is hard to make meaningful comparisons (especially at the high level fleet % measures), but detailed ReFocus visit data has been used to justify increasing fleet size in other TOCs. The extra vehicle leasing costs to make the availability deliverable were justified in terms of reliability performance improvement.

It is of course possible to make available a sub-standard vehicle, but a vehicle truly fit for purpose can only be provided through a successfully completed sequence of specified management processes. Defining these processes and understanding their relationships and dependencies is therefore necessary for sustained success. This work will almost inevitably stimulate change projects (see Section 3). As a minimum, improved understanding will help management reduce the number of times sub-standard vehicles are offered for service.

Critically, the reasons for each unavailable vehicle must be identified, recorded and trended within each fleet/TOC - to identify improvement opportunities and to measure their success or otherwise.
Typical reasons for unavailability are:

- Maintenance planning (peaks and troughs or combinations that exceed organisational capacity) e.g. B exam, C4, C6 Other maintenance/repairs arising e.g. modifications, condition-based work
- Out of course repairs e.g. vandalism damage, collision damage
- Waiting e.g. material, specialist staff, shed space, test run
- Failure investigations e.g. repeat failures

**Example:** Cross Country use Wheelchex to plan tyre turning, and prevent availability problems. A rolling 28 day chart (updated daily) in the planning office at Central Rivers shows any Wheelchex reports greater than 150 Nm. Impact loading can be seen to increase over time, then visual inspection is scheduled, and then tyre turning prioritised. This modifies the baseline 250 000 mile conditioning reprofiling programme. In addition to improving availability, this use of Wheelchex data has enabled better use of the Central Rivers wheel lathe and a reduced requirement to buy-in slots at other lathes.

**Example:** Mileage is carefully managed at C2C by utilisation of shorter or longer mileage diagrams. The tolerance on exams is set at – Zero, + 500 miles. All the exams are planned to be done within the +500 miles range, so all are done slightly late. This ensures the fleet is not over maintained, giving best availability of units, and saving costs.

**Example:** TPE use a 43 day plan for each Cl185 unit. The few units which are almost due exam are allocated to higher or lower mileage diagrams so they are close to the target mileage when they come in, reducing waste from carrying out some exams early.

**Balance availability and reliability.** Once the long term level of availability is set, it is important to balance availability to ensure reliability is not compromised. Best practice is to develop a culture where repairs are done to promote reliability, rather than deferred in order to chase short term availability at any price.

**Example:** some TOCs have agreed contingency plans such as running 3 cars vice 6 on certain trains if necessary e.g. in carrying out thorough Level Checks on repeat failures (see 8.1 Repeat Defect Management example).

A TOC which is persistently short of vehicles, should review what it is doing and assess whether the availability is deliverable, given its understanding of the reasons for unavailability and how they can be addressed.

**Example:** TOCs are reducing maintenance downtime requirements by using Lean Maintenance techniques. ScotRail reduced Class 334 wheelset change from 3 shifts to 2 shifts, making an extra train available for peak service.
9 On-Depot Fault Finding

Good fault finders are drawn to problems. They work with limited or imperfect data to identify symptoms and rectify the faults promptly. They are often compelled to engineer a permanent solution when the all the symptoms have been considered and the root cause has been properly identified.

This section explores good practice for on-depot fault finding. This section does not cover faults in service but Section 11 – Managing the Impact of Fleet Incidents on the Railway does. Some of the main issues with fault finding is the different ages of rolling stock and variance in reporting and recording faults across depots.

This section covers complex No Fault Found (NFF) and systemic faults that often materialise as repeat defects. To help with the diagnosis and rectification of these faults this section contains information on specifications, functional specifications and wiring diagrams. This section also explores root cause analysis and the development of a permanent solution to the fault which may be:

1. Modifications to the train design
2. Additional training and development of staff
3. Addressing supply chain quality issues

Topics covered in this section are as follows:

9.1 Standardising fault finding
9.2 Novel testing and inspection equipment
9.3 Developing the establishment of fault finding within your organisation.

Other sections of the 20PP related to on-depot fault finding are:

- Section 7 – The Depot, which includes details on the human resources aspect of depots.
- Section 8 – The Vehicles, which describes good practice in data collection and analysis, repeat defects and trends.

9.1 Standardising fault finding

One of the most effective ways to defining a process is by a continual improvement loop. Jumping to conclusions when fault finding often leads to an incorrect diagnosis and repeat faults occurring. For example, if a driver reports that they can’t get the train to move then a hastily made assumption that there is a fault with the traction could be wrong; there could be any number of reasons such as a fault with the door interlocking system.

The flow chart below shows the general, 5 high level steps needed when fault finding. The flow chart is based on two principles: DMAIC and OODA. The OODA loop (Observe, Orientate, Decide, Act) is a continuous cycle used when the correct solution to a problem needs to be found fast with several iterations and so is useful for depot maintenance. DMAIC (Define, Measure, Analyse, Improve, Control) is part of the 6 Sigma process and is more useful when time isn’t a constraining factor. By combing both these principles, the flow chart gives guidance on how to arrive at the root cause of the problem in a short period whilst also creating learning points for future processes.
a) At this stage, asking the right initial questions is vital to speeding up the fault-finding process. Whoever is creating the work order must give and receive the correct information.

b) What are the **symptoms**? At this stage the fault finder is looking for specific features and conditions of the fault. Collection and processing of information from sources such as OTDR, CCTV or driver’s reports lead to a more accurate diagnosis of the fault.

c) At this stage fault finders are not trying to diagnose the fault. Broken components are not necessarily the root cause in themselves and may be a symptom of another fault in the system. A system based approach is best adopted whereby inputs, process and outputs are compared to specification of the component; there may be an issue between the train and the component.

d) It is important to carry out visual inspections as well as functional tests by making use of existing VMIs and VMPs.

e) Diagnosis may require working on live systems and so a safe working plan should be created to manage the risks. Safe working practises are covered in the VMI/VMPs in the initial sections covering safety conditions

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**Example:** The quality of information from driver’s reports, especially when the unit has limited telemetry, can greatly assist the collation of information on symptoms. GWR issue drivers with ‘prompt cards’ to use if a HST set fails in service that assists them in getting the unit moving. When the unit gets to the depot, the driver can report that they have completed certain tests to help eliminate some potential faults. The prompt cards are complimented by a guide for maintenance controllers which ensure that the right cards are used and the process followed by the driver can be verified.

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**Step 2: Check the vehicle history and documentation**

a) Using the vehicle history faults can be identified as intermittent, repeat or hard; this will determine how to proceed and whether the fault is active.

b) When dealing with a repeat faults any previous work carried out should be reviewed to avoid repeating procedures. This relies heavily on the reporting process, which is covered in a later step. For intermittent faults, the process followed should be accurately logged so that it can be referenced if the fault occurs again and save time by not repeating fault finding work that has already been completed.

c) Historical data of the fault should be reviewed as well as the vehicle history. This includes change control, modification levels, drawings, etc. It would also be good to review the Failure Mode and Effect Analysis (FMEA) for the vehicle.

d) As a minimum, fault finders need wiring diagrams, all system schematic diagrams, functional specifications and interface specifications for the systems they are working on. Some operators have fault finding procedures within the VMI.

e) Use industry groups, such as fleet comparison user groups, to compare fleet issues. However, information obtained from these sources should be treated with caution and should not replace any existing industry processes (such as raising an NIR).
a) By now the fault finder should have a starting point for further investigation. They should broadly know the scale of investigation for maintenance planning and the resource requirements. The key now is to work in a systematic way and record all relevant information as they proceed towards the root cause.

b) When testing the failed component, the VMI and fault finding guides should be followed; experience can sometimes be a hindrance. The root cause can be overlooked if fault finders are too hasty in diagnosing the fault without considering the symptoms especially where line replaceable units are suspected.

c) There should be a feedback loop in place for situations when drawings don’t match what is in the vehicle. Any modifications or changes must be approved by all relevant parties (such as maintainer, owner, and operator), recorded and added to keep drawings up to date.

d) It’s vital that the fault can be simulated and recreated to confirm the diagnosis. It’s worth noting this may require the development of special test equipment which is discussed later in this section.

e) If the fault cannot be found, consider using the warranty team and the supply chain to get a subject matter expert opinion; whichever party overhauled the system should be consulted at the first instance where possible.

f) By now the fault finder should have identified the nature and cause of a certain fault. Once the failure mode is known a plan can be created to decommission the train, make a repair and then recommission it.

Example: Below is an example of a fault finding procedure used by Angel Trains when the HVAC equipment fails. Following a flowchart such as the one below ensures that all the correct procedure is followed and fault finders don’t jump to conclusions, ensuring the root cause is identified.
This flow tree is intended to cover the most common faults and actions required for them. Any other faults and fault codes found during fault diagnosis require investigation as per instruction given by Faiveley in accordance with training course.
a) The repair needs to be tested thoroughly to ensure it has been rectified but also that other new fault modes have not been introduced as part of the investigation.
b) A functional test should be carried out to confirm that the system is now functioning correctly in accordance with the VMI as this is the certified maintenance plan supporting the safety case.
c) Where a component is continually showing NFF use asset tagging to find rogue offenders. Components can be tracked several ways, including asset tags, bar codes and recording the component serial number. Monitoring equipment such as data loggers or temperature indicator strips can also be used for monitoring specific equipment.
d) Reports should as a minimum replicate each phase of this process and the key findings.
   i. Test data and parameters should be included in electronic format for further analysis. Scanned copies of written reports are acceptable providing they are filed correctly.
   ii. Where fault finding has been limited by testing equipment then a process to allow recommendations on how to improve test equipment should be made.
   iii. The report should focus not only on the technical aspects of the job but also softer elements such as team work and listening to feedback from operations.

Example: Lockheed Martin have developed their own test rig, the LM-STAR. The test rig is adaptable and can easily integrate new testing capabilities as they come to the market. The benefit of the LM-STAR is that all components from the supply chain are tested on the same rig, so if there are any quality issues Lockheed Martin can address them and won’t accept an NFF.

Example: London Midland use the computer based system Equinox to report and record faults. Technicians populate the system with their repair notes and all defects are coded and grouped so they are easier to spot for future reference. The repeat defects are then monitored using screens connected to the network; these screens display data from the last 28 days in places critical to the business. This means that all the data is readily available to technicians. In order to make this effective, technicians should be given guidance on the level of detail needed in the system. The MMS needs to be managed to ensure the information is captured and the work report cannot be closed without sufficient information.
Step 5: Review, rectifications and training

Example: GWR carry out in-house overhaul and repair on certain components (for example, load regulator electronic modules). All work, including defects, is recorded in a database maintained by the ride inspector team. This enables repeat defects to be highlighted and monitored for trends. The Electrical Test Room (ETR) at GWR also has a test rig that allows prolonged testing of any effected modules which can be used to find intermittent faults that may not be obvious under normal testing conditions. The test rig also allows for live testing of high voltage electrical equipment under controlled conditions away from the vehicle allowing the vehicle to stay in service while defective components can be fault found.

Example: Alstom have a test rig set up (shown below) that can simulate a train being in service in order to test the traffic management systems. The use of this simulator means that the root cause can be identified through trial and error without the unit failing in service. The test rig has tested over 500 TMS components and over 350 CCTV components of which only 24% and 35% respectively were assessed as NFF. All of these items were returned to stores for train use and no repair costs were incurred.
a) Fault finders need to own the problem and commit to finding a permanent solution.
b) VMIs and fault finding guides should be regularly updated and reviewed in hindsight of work carried out, especially where the fault could have been identified as part of routine maintenance.
c) The vehicles FMEA may also need updating to include any new failure modes identified as part of fault finding.
d) Return of experience - any lessons learned in the process should be recorded and added to future training regimes.
e) Training and competence needs to be assessed to ensure that lessons have been learnt.
f) Information on any of the above changes needs to be briefed to all relevant personnel, including fleet operations as maintenance may have affected the way guards and drivers interface with the equipment. There may be an issue with the way the defective equipment is being operated that has potential to become a training issue for the whole industry.
g) The use of public advertisement, such as the stickers that are used on Virgin Trains West Coast’s toilets, can help to reduce the likelihood of a fault from the public.
h) Skills availability across teams and shifts needs to be balanced to ensure there are always adequately skilled staff for fault finding work. A skills matrix to manage skill shortages/deficiencies across shifts is one way of managing skill availability.
i) Fault finders should consider if a technical enquiry is appropriate to address the problem and ensure that any modifications to a unit or fleet are recorded for future reference. Fault finders cannot make any modifications without the correct Engineering Change approval.

Example: Alstom use a Root Cause Analysis (RCA) as part of their review process. If a unit fails in service and the fault is a suspected repeat failure, or found to be due to previous incorrect intervention actions, an RCA should be raised against the relevant department or site. This is so the business can understand the root cause and put in place preventative actions so that the events of the repeat failure do not occur again. After the RCA has been completed and the root cause found the report is added to a tracker which is distributed to Head of Operations and the Fleet Engineer.

9.2 Novel testing and inspection equipment
As a minimum to support a systematic based approach to fault finding fault finders need equipment to break into all the trains wiring to test for inputs and outputs and monitor functions. Train wiring schematics/diagrams can help a fault finder locate a feed from the relay panel but actual test looms may require fabrication to ‘break’ into train wiring. Where PLCs and control units are used specialist diagnostic equipment will be required to test processes and fault finders may need specific IT training to support these specialist diagnostic tools.
9.3 Developing the establishment of fault finding within your organisation

9.3.1 Establishment of Fault Finders

When beginning to establish fault finders the following should be considered:

- a) What are the volume, nature and type of faults experienced?
- b) What type of fault finders are required; fleet or systems?
- c) How many fleets or systems will each fault finder be accountable for?
- d) How long is it expected to rectify a fault?
- e) Have training courses/days been planned for and is there adequate cover for these periods?

By considering these points, depots can properly plan how many fault finders they are looking to recruit.
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or development from existing maintenance technicians. Once that has been decided, technicians need to be incentivised to become fault finders. There needs to be enticements such as career progression, increased responsibility and rewards.

Once the potential fault finders are identified (desirable skill sets are detailed later in this section) then a clear training and development programme needs to be set out that progresses their skills and allows them to understand the role properly. Succession planning is a vital element of this so that there is continuous flow of experienced fault finders available for new talented fault finders to work alongside and eventually succeed. The new apprentice levy is an excellent opportunity.

9.3.2 Features of a Fault Finder – Soft Skills

Soft skills are important as often fault finders must work as part of or support a maintenance team and be able to clearly explain faults to their peers to rectify it. Fault finders also need to explain the fault to non-technical staff in a way they will be able to understand. They need to be confident in their competence so they are also able to challenge design elements of the system they are fault finding; evidencing facts using data is a good technique. There may also be a need to converse with the supply chain if there is a NFF component that needs further analysis.

They also need an inquisitive nature. Fault finders should be able to self-reflect on their performance and can identify their own strengths and weaknesses. A fault finder should be disciplined, organised and methodical with the ability to confidently express their ideas on a problem. Fault finders should be able to apply a methodical approach to a problem and take accurate notes through out.

For more information, see Section 7.1 – Human Resources (skills).

Examples: Southern use a core group of people to do fault finding, ‘team technicians’ who support each maintenance team.

9.3.3 Features of a Fault Finder – Technical Skills

Fault finders should aspire to always complete a task to the highest standard using their analytical skills to get to the root cause, and not just go through the motions of a VMI; their ability to see the bigger picture and understand the consequence of a poor or late job should motivate them. Another motivation for fault finders should be their ability and desire to learn skills and progress in their career. Fault finders need experience with complex systems engineering; commissioning experience is a good background. A good basic knowledge of how electricity works and how mechanical systems work combined with a basic knowledge of computing is essential as core skills. Along with knowledge of train systems fault finders should have some operational knowledge so they can judge the standard of an acceptable train in service and understand the reason for their work. Naturally fault finders will eventually start to become more specialised in a certain area due to over exposure to a specific system. When this becomes the case, it is important that they:

a) Can pass their knowledge onto other people using their strong communication skills.

b) Still retain their knowledge of the entire train; due to staffing numbers and the depot they may be required to work on any part of the train. Knowledge is best retained through recording work done and running refresher courses on the different sub systems on board.

c) Consider how the work they are doing can be broken down into chunks (train/subsystem for
With the retirement of a lot of legacy rolling stock and the introduction of new trains there is an increasing need for fault finders to have a solid understanding of IT and software information for trains with advanced telemetry. It is increasingly vital for fault finders to be able to support and maintain their own diagnostic equipment as IT departments do not have the skillset to do so.

9.3.4 Training and Development
Once fault finders have been selected their skills need to be developed. They need to use a systems approach of inputs and outputs to confirm or demonstrate a repeatable fault in one or more parts of the subsystem.

Depots should make use of all available training methods such as simulators like Alstom’s TMS test rig, and Interactive Virtual Training such as Slamps (shown below). Using different mediums of training allows for subject specific training that still allows fault finders to appreciate the whole system. As an extra incentive for training and development, some depots offer technicians the opportunity to get recognised qualifications in engineering and maintenance. These training courses increase the depth of knowledge as well as recognising the level of skill that fault finders have achieved.

Example: GWR have an in-house testing facility for central door locking equipment, electrical converters, HVAC and some catering equipment. As well as providing a controlled test environment for fault finding, these facilities also provide an ideal training facility for new starters and apprentices as well as enhancing fault finding skills for depot staff.

Example: Alstom provide their technicians with a Level 3 training programme for Trains Systems (Traction, AWS, HVAC etc.). The training programme is based around PowerPoint presentations and is supported by a question paper. Technicians have to successfully complete the question paper prior to commencing the competence assessment process.
The above simulation was made for East Midlands Trains. The short video shows the location of the on-board fire extinguishers, the different types of extinguishers on board and when to use them. This video is used by train drivers and on-board staff for training. Using simulations is a powerful tool as components can be disassembled and analysed quicker in a virtual environment than in real life. There are simulations for different operators, Network Rail and other industries available at:

http://www.5lamps.com/

Training doesn’t have to only be delivered on depot. Groups such as:

a) OEMs  
b) Supply Chain  
c) Over haulers  
d) Consultancies  
e) Rail Research UK Association

can be used for subject matter expert training and collaboration on research projects to increase fault finders depth of understanding. There may be issues with companies not wanting to disclose commercially sensitive information so compromise may be necessary.

The use of bespoke testing equipment for verifying a NFF diagnosis (as mentioned earlier in this section) can also benefit training as well as lowering the cost of sending components back to the supplier for fault diagnosing.

Finally, a feedback loop with periodical reviews is needed to assess the quality of training. Fault finders should be encouraged to be honest with their reviews and all feedback should be taken in consideration when reviewing the training material and programme. The information gathered needs to be shared with the appropriate people so that change can happen if needed to ensure that fault finders are receiving the best level of training possible.
The Infrastructure

10.1 The Engineering Interfaces

The Systems involved: There are many engineering interfaces between vehicles and infrastructure that can affect train performance if they don’t work together effectively. The performance impact can be immediate, for example a wrong side AWS failure that causes train delay and cancellations. Alternatively, the interface problem may be subtle, not becoming apparent for a long period of time, after substantial degradation of the vehicle, the infrastructure or both, resulting in greater performance impact and the need for repair investment. For example, Rolling Contact Fatigue (on both Infrastructure and Vehicles).

The main engineering interfaces between rail vehicles and infrastructure are summarised below:

- Wheel and Rail (wear and adhesion)
- Signalling control (AWS, TPWS, ERTMS, ATP)
- Current Collection (Overhead Line Equipment (OLE), 3rd Rail equipment)
- Gauge (static and dynamic)
- Telecommunications (GSM-R)
- Infrastructure based Vehicle Health monitoring systems (Hot Axle Box Detectors, Wheel Impact Load detectors, Pantograph uplift detectors)

Indirect Engineering Interfaces: Whilst most engineering interfaces are obvious, e.g. wheels on rails or pantographs under OLE, train performance can be influenced by the interaction between vehicles and infrastructure that is not so obvious. Identifying these interactions and opportunities to improve train performance can be more difficult but regular liaison and strong working relationships between TOCs and Network Rail provide a better chance for each party to spot them.

Example: AGA train performance suffered from a high number of AWS code 10 failures at a platform on Ilford station (10 incidents in 3 weeks): all resulted in train cancellations. There was no AWS signalling equipment in the area concerned and the signal engineer was convinced that there was no infrastructure interaction involved. However, the relevant NXEA Fleet Performance Engineer, raised the issue with the Anglia Rail Vehicle Interface Engineer who appreciated how both sides of the system worked and undertook a more thorough review of what was happening. This joint investigation identified that the most likely cause was a 60 foot length of new rail that was stored in the 4 foot, where the rail end was partially magnetised and located such that it was ‘visible’ to the AWS receiver when vehicles were stopped in the platform. The RVIE escalated the issue within Network Rail; the rail was removed from the 4 foot and no further AWS code 10 incidents have been reported.

Relationships: To ensure trains and infrastructure interact safely, many engineering standards are focused on design and maintenance of the railway system e.g. the flange height and thickness of a wheel profile or the gauge and alignment of track. There is less focus on the wider aim of good performance and very little guidance or standardisation available when it comes to getting the most out of these interfaces and improving performance.

The variety of engineering factors and duty cycle demands on vehicles and infrastructure in the UK make generic solutions difficult to achieve. Therefore, to get the most out of the assets at these interfaces requires the respective asset stewards to work together, monitoring them and developing performance improvement plans where problems arise.
To enable the cross-company engineering relationship to be more effective, Network Rail has a team of Rail Vehicle Interface Engineers (RVIEs) with a remit to establish engineering root cause that includes improving performance and safety around the engineering interaction of Vehicles and Infrastructure. This team is embedded in the Network Rail organisation and is focussed on engaging with TOCs to identify and facilitate the delivery of performance improvement through better understanding and sharing of knowledge across the engineering interfaces of Vehicles and the Infrastructure.

10.2 RVIE Core Activities:

10.2.1 Rail Vehicle Monitoring

**Purpose:** Rail Vehicle Monitoring is undertaken in order to reduce risks, maintain safety, prevent accidents and improve performance on the rail network. This is done by recording incidents into a dedicated database, which are then subsequently resolved through liaison with the relevant stakeholders.

It is recognised that the database will not be an exhaustive list of all rail vehicle imported risk incidents.

**Benefit:** Improved safety and reliability of the infrastructure; enabling a more efficient asset life and the reputations of stakeholders for delivering a service to passengers kept at high levels.

**General:** Control Centre Incident Logs (CCIL) are used as the primary (but not exclusive) source of information.

Incidents are recorded that carry the potential to import risk onto the infrastructure under the following categories:

- Axle and axle bearing failure incidents
- Brake Failure Incidents
- Collision incidents
- Vehicle Derailment incidents
- Vehicle component Detachment incidents
- Train Division incidents
- Vehicle Door incidents
- Vehicle Environmental incidents
- Vehicle Fire incidents
- Train signal Systems incidents (AWS, TPWS, ATP, ERTMS)
- Defective Wheel / Tyre incidents

Rail Vehicle Interface Engineers liaise with Railway Undertakings to understand root cause and confirm that incidents have been resolved. This is subject to co-operation from the relevant Railway Undertakings. Details of resolution and/or long-term mitigation to prevent re-occurrence are recorded within the database. Incidents are closed out within the database. A route-based period report is prepared showing confirmed imported risks and steps that have been taken to resolve.

In addition, the database is used as a tool for recording vehicle performance issues that do not import risk onto the infrastructure for ad-hoc monitoring requirements and trend identification.

**Example:** GWR chair the ATP User Group and are recognized as having industry expertise in this trainborne system.
10.2.2 Technical Support

**Purpose:** Provide engineering expertise to support internal and external stakeholders to improve performance, safety and efficiency at the interface between rail vehicles and infrastructure.

**Benefit:** Provision of expertise enables time spent by non-vehicle specialists to be reduced. Expedient resolution of commercial claims.

**General:**

- Work with TOC fleet team and Network Rail engineering and maintenance teams to improve performance by resolving joint interface issues
- Take part in formal investigations into serious incidents involving rail vehicles
- Review and validation of TOC claims for damage to vehicles where Network Rail is responsible
- Providing technical support to route commercial teams
- Monitor implementation of HLOS schemes on rail vehicles
- Delay resolution assistance – fleet
- Work with TOC and route enhancement team to validate HLOS / CP4 fleet schemes
- Reporting to Route Director on any infrastructure related issues and in depth analysis of any proposed changes to rail vehicle operations in the route. (NETWORK CHANGE) compatibility forum
- General vehicle technical data enquiries.
- Interface Working Groups
- Sharing best practices and new technologies

Example: Southern and NR are developing a joint investigation process to be facilitated by RVIE where investigations into engineering root cause are envisaged to be concluded within seven days of occurrence. This joint approach will save industry time and enable focus for resolution to be trained eliminating the need for independent investigations.

Example: Sharing data and knowledge from new and existing technologies to improve the reliability of our Network i.e, pan monitoring on LNW Pendolinos, new RETB base stations in Scotland, Third Rail Interface Monitoring Equipment on Southern Electrostar.

10.2.3 Customer Liaison

**Purpose:** To construct and maintain close working relationships between internal and external stakeholders to provide a platform for communication, understanding and method of resolving rail vehicle risk and performance issues.

**Benefit:** Engineering staff in the TOC and NR can discuss and resolve engineering issues enabling reduction in risk, and increase in performance. RVIE is a team of experienced and skilled Engineers that can provide resource for investigations that may not exist elsewhere.

**General:** Liaisons should be scheduled at a regular interval suited to the business requirements of all stakeholders. Further liaison should be held when required and by utilising all communication links available.
Example: Southern fleet technical services alerted RVIE to a wheel damage problem on their fleets; small indentations were seen on various locations around the circumference of one side of the train’s wheelsets. Southern supplied possible locations to check on the infrastructure, RVIE pursued track engineers and the location of the problem was found with matching rail damage, although the exact cause was not identified it is thought to have been a small piece of hard material which was later picked up by a train wheelset and dropped elsewhere as there were corresponding indentations found on the rail head at 2.5m intervals. Southern carried out independent testing and confirmed the wheel damage was O.K. to continue until run out by normal running.

Example: ScotRail reported an aggressive flange wear problem affecting their fleet, RVIE pursued maintenance and maintained daily contact with the delivery units and ScotRail to ensure daily actions and updates were realised until the problem was resolved.

Example: RVIE offers everyone in fleet an “in” into NR, it has often been stated that having a single point of contact that can make things happen is a great asset.

10.2.4 Interface Working Groups

Purpose: To improve the performance of the interface by identifying areas of poor performance and to ensure that Network Rail and the Train Operators are working together.


General:

- To establish root causes
- Identify jointly beneficial solutions
- To provide a focal point for groups to input interface issues as they arise
- To share knowledge and best practice
- To improve the efficiency of the network resulting in a reduction of delay and cost to the industry
- Improve customer satisfaction
- To identify interface capabilities and limitations, challenge those where appropriate.
- Harmonise the balance between vehicle / infrastructure interaction.

Example: First Capital Connect (now GTR) reported that wheel flanges were not as populated with grease as they had been previously and enquired to RVIE in the Anglia route, RVIE alerted track engineers who found a faulty flange lubricator and scheduled an immediate repair preventing a much larger issue of rail and wheel damage from being realised.
10.3 Preventing engineering interaction problems before they start

The Network Rail RVIE team are also able to provide engineering support, bringing the right engineers together e.g. when identifying the impact of train modifications or new fleets on the compatibility between the trains and the infrastructure. Whilst there are formal processes for achieving this collaboration e.g. Assessment of Compatibility as per GM/RT8270, the local RVIE can engage with the local infrastructure engineers during the early stages of the engineering change process to assist in identifying any issues that can be resolved in advance of any committed work being carried out. It is important to recognise that this collaboration is complimentary to, not instead of, the formal process of ensuring compatibility between both asset types.

Example: The Anglia RVIE provided technical support to NXEA, assisting in the assessment of compatibility of their class 360 fleet for route clearance to the new Orient Way sidings.
11 Managing the Impact of Fleet Incidents on the Railway

11.1 Introduction

The majority of good practice identified in this document concerns reliability improvement and reducing the number of technical incidents. The purpose of this section, however, is to give guidance on how fleet incidents can be better managed when they do occur. This section has been developed jointly between fleet and operations - through a series of workshops and meetings - to document how a joint approach to fleet incident management can reduce incident times and improve performance.

Some incidents can cause major disruption to the system due to not only their nature, but also the time and location of the incident. The impact may be lessened by following some simple guidelines that innovative TOCs have developed and by planning for such occurrences. Whilst this section concentrates on fleet type incidents and rolling stock, the principles can be applied to almost all types of railway incidents. This means good planning, having the tools in place and carrying out comprehensive reviews.

It should be noted that the best practice featured in this section is irrelevant to control type and is designed to be compatible with all TOCs. The content is arranged to follow the “Plan, Do, Review” process.

11.2 Definitions

*Primary delay*: A Primary Delay is a delay to a train that results from an incident that directly delays the train concerned, irrespective of whether the train concerned was running to its schedule (schedule includes booked platform or line) at the time the incident occurred, i.e. the delay is not the result of another delay to the same or other train.

*Secondary delay*: Secondary, or as it is sometimes referred to as, Reactionary Delay, is a delay to a train that results from an incident that indirectly delays the train concerned, i.e. the delay is the result of a prior delay to the same or any other train.

11.3 Plan

Good practice in planning for the management of technical incidents consists of developing competent, well trained individuals who can come together to manage it as an incident team. The team is best supported by the following elements of good practice:

11.3.1 Roles and Responsibilities

It is important that all staff clearly know what their place is within the ‘incident management team’. They should know what their roles and responsibilities are in an incident and they should stick to them and have the confidence in others to do their part. They should be fully trained and assessed regularly. It may be helpful to produce a RACI for the incident management team so members know who is Responsible, Accountable, Consulted and Informed for each task they perform.

Incident Management can be quite an intimidating environment for the driver and is also a reactionary situation. This means that some drivers will be unfamiliar with certain incidents which can lead to panic which in turn leads to an increase in the overall incident time. It is critical to have good plans in place which are regularly practiced and point the driver or controller in the correct direction to best deal with the incident.
Potential roles within the team are shown below:

<table>
<thead>
<tr>
<th>Controllers</th>
<th>British Transport Police (BTP) liaison</th>
<th>Signaller</th>
<th>CCTV operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media managers (twitter, etc.)</td>
<td>Passenger Information System Controller</td>
<td>Fleet controller</td>
<td>“Phone a friend”</td>
</tr>
<tr>
<td>Tech Support</td>
<td>Planner</td>
<td>Electrification</td>
<td></td>
</tr>
</tbody>
</table>

Example: A number of train operators employ a “phone a friend” policy, where the driver is expected to contact Control for technical support in an incident within a few minutes. It is important that these “friends” have up to date knowledge of the traction and recent incident alerts. In order to make the “friend” on the end of the telephone as approachable and helpful as possible, Southern have recruited the expertise of a call centre trainer to develop clear protocol for the dialogue between the driver and the Technical expert (the “friend”) on the end of the line. Greater Anglia used conductor staff to train staff on phone manners.

Example: LNW Route has found it beneficial to have a close liaison with BTP and specifically a “Police on Bikes” initiative has been implemented. In areas with high incidences of fatalities this close liaison limits the delay by having BTP on site sooner and also having a BTP Member who is familiar with railway operation reducing the chance of the location becoming a scene of crime with increased line closure time. Forward Facing CCTV has helped significantly in this respect. FFCCTV has also made a significant contribution to identifying the root cause of OHLE failures.

Example: Southern, Virgin Trains East Coast (VTEC) and Northern have noted benefits from having a Network Rail presence within Control. Southern have utilized an integrated approach, with NR staff sitting with TOC staff. VTEC and Northern are co-located with NR, sitting separately however in the same room.

It is important when designing roles and responsibilities that staff are protected during an incident from distractions so they can perform their specific role in an incident without disruption. In an incident, team members should be able to quickly and easily communicate – explained in section 11.3.2.

Example: Southern and Northern benefit from having a strategic seating plan. It demonstrates a clear line of authority with the Service Delivery Managers at the head of the tree (in both cases separated from the main “spine” of the control to prevent frequent interference and micromanagement). The rest of this main spine positions staff next to relevant personnel for handling an incident. The layout and the added benefit of sound ergonomics in the room ensures that in a disruption communication is easier. Northern’s layout is illustrated below.
Important roles that an incident team needs to have:

- **Passenger management.** It is critical to keep passengers informed of disruption and updated on any progress. This will ensure passengers remain calm and instances of uncontrolled evacuation are avoided and the delay prolonged.
  - Excessive passenger loadings on train may influence the way an incident is managed and recovered. On some types of train excessive passenger loadings may inhibit access to cupboards and equipment which is located in public areas.
  - Excessive passenger loadings on platforms may influence the way in which an incident is managed due to the restricted access to the underneath of the train and its equipment.
  - It is important to maintain a consistent approach when managing periods of perturbation, particularly when communicating to customers. Inconsistency can lead to a lack of confidence in the TOC’s ability to manage incidents.
  - Social media should be used to its maximum potential. The use of platforms such as Twitter and Facebook to distribute details of incidents, particularly via photographs, can improve the response from customers, resulting in fewer social media complaints and increased customer acceptance of the present situation.
  - Throughout the duration of an incident and its management, the impact on customers should be considered as a priority.

- **Events planning.** Every TOC should ensure that Control Centre staff making decisions on managing incidents have access to information that provides details of events that may cause passenger loadings to be outside normal levels, for example the Olympics or other such sporting events. This may change the way in which an incident is managed.

Driver availability is also crucial to delivering any plan. This can make a pronounced impact on achieving any plan, particularly at night when fewer drivers are available.

11.3.2 **Clear Lines of Communication**

In an incident, clear lines of communication should be established. A good communications infrastructure should be put into place utilising modern technology such as Emails, phones and other electronic forms. The use of legacy technologies such as fax machines and paperwork should be avoided.

Web conferencing may also be a useful tool where incident management team members are not co-located. Web conferencing allows conference callers to share and jointly interact with information, some essential features to consider when sourcing a web conference package are:

- Recording
- Outlook integration
- Simultaneous user capacity
- Mobile device compatibility
Fleet Management Good Practice Guide: The Twenty Point Plan

- Licence price/availability
- Document/media sharing
- Desktop sharing

Example: There are many packages available online, but a good example of a free one is https://www.anymeeting.com/adw/Free-Web-Conferencing.aspx.

Example: Southern have a visualisation area formed of whiteboards relevant to each department including a route diagram board. These allow members of the team to be aware of all current activities in addition to their own. The board is updated as and when new information is available prior to weekly updates.

Southern also utilise a Fleet Incident Management flowchart, detailing all process from incident conception through to review. This document describes all the necessary actions/tools that are required at each stage of the management process.

Example: Virgin Trains West Coast (VTWC) and Alstom have positioned a visualisation board within the control that illustrates weekly maintenance plans. This board is updated as incidents occur or other alterations are required. Every member of the team is aware of updates on technical or non-technical issues as and when they arise, thus ensuring sufficient information is presented at all times in order to avoid miscommunication. The clarity of the board allows control staff to quickly assess the availability of units in the event of a set swap becoming necessary or other such service alterations.

Example: GTR apply a similar standard to communication between drivers, fleet engineers and train managers in terms of language and terminology used.

Driver/Signaller relationship – many TOCS have trained drivers to standardise communications with signallers. This is checked on the driver simulators and voice recordings to ensure that correct protocols are used and colloquialisms are avoided. In addition to this, voice recordings are reviewed from control to ensure that the standard is being maintained. The standard should only focus on key areas which cause train delays, and in terms of communication between drivers and fleet it would be unnecessary to carry this out on train simulators and analysis of voice recording would not be required.

Example: Southern have a visualisation area formed of whiteboards relevant to each department including a route diagram board. These allow members of the team to be aware of all current activities in addition to their own. The board is updated as and when new information is available prior to weekly updates.

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Example: GTR apply a similar standard to communication between drivers, fleet engineers and train managers in terms of language and terminology used.

11.3.3 Training and Competence

A training and competence regime should be developed for incident management team members. The training should cover not only their roles and responsibilities but also those of others in their teams, all staff members should be familiar with the company’ procedures and the Rule Book. The aim should be to get incident team members up to a level of unconscious competence in their role such that they can maintain a level of situational awareness in an event.

Examples of some online competence assessments are as follows:

http://traindriver.net/

http://www.assure-managementsystems.com/

http://www.rgsonline.co.uk/Railway_Group_Standards/Traffic%20Operation%20and%20Management/
In high pressure scenarios with complicated tasks, it is virtually inevitable that mistakes will happen. Decision support tools and Checklists\(^1\) for incident management can help reduce the likelihood of these mistakes. Extensive work has been performed by the fleet community examining decision support tools and good practice is detailed in Appendix I

Fleet engineers in Control Centres will be covered by the TOC Competency Management System (CMS) and assessed as per the TOC Standards. They should have sufficient opportunities to spend time out on depots and on the route, in order to maintain their competence and refresh their fault finding skills and fleet knowledge. There are a number of ways this can be achieved. An example would be to use spare days, planned refresh days or use of other competent staff to cover the office role. Any new staff into the role would undertake a Training Needs Analysis and be passed Competent prior to undertaking the role. There must be a process in place to ensure CMS is kept up to date.

RDG’s Good Practice Guide (GPG005) on Controller Recruitment - Training and Competence exists to encourage consistent application of established good practice across TOCs in the development of competent personnel in Control Centres. It sets out to achieve the following three objectives:

- Act as a good practice guide that TOCs can base their controller CMS on or compare their existing CMS against.
- Provide good practice suggestions on which recruitment assessments can be based.

Example: Virgin Trains East Coast use exact imitations of control desks and role-play of past incidents involving all members of the incident management team to develop team working and new staff training.

Example: Southern have deployed an extranet to guide technical staff through decision trees during the ‘phone a friend’ process. The tool also helps keep track of time, provides quick links to the “Defective On Train Equipment (DOTE)” and recovery procedures. The system can also be audited. Systems such as this can enable staff with less technical experience to talk on-train staff through required processes during an incident.

The most effective decision trees are designed so that the most likely scenarios are eliminated first. It is vital that the decision trees are updated as soon as incidents happen so that new information is learned.

Example: Southern’s Three Bridges ROC features a simulator to enable the rigorous training of new members of staff in a real-life scenario using the same equipment on the control floor. This ensures that, upon occurrence of an incident, staff are fully capable of and equipped to handle the situation quickly, effectively and professionally.

Example: South West Trains have introduced a Checklist approach focusing on lead measures called the Right Time Railway Assurance Check. The principal is to identify no more than five activities within a person’s job description which are critical to performance and ensure, through team working, that the individual delivers these. The approach has been standard practice in aviation since 1942 and is used by pilots to ensure planning is in place before a flight. Appendix H contains a sample checklist developed by SWT for Fleet Depot Staff.

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\(^1\) [Atul Gawande: The Checklist Manifesto](#)
Example: East Midlands Trains ensure technical support staff return to depot to undertake shop floor work to reinforce competencies on a regular basis. This enables fleet knowledge to be fresh in their minds and improves their ability to deal with faults during a phone a friend scenario.

Line of route fitters should ensure that they are fully equipped with the relevant tools and equipment. It should be remembered that the line of route fitter is primarily employed to get the vehicle moving at the earliest opportunity. Several incidents have been recorded where the line of route fitter has made an incident longer due to trying to fix the train when this approach to incident management was incorrect. The West Coast mainline has engaged in a work stream which allows the MOM to carry the equipment to site. This allows all personnel to work together by ensuring tools are on site quicker and rescue locos can get to site. The work stream is also looking to ensure drivers have flexibility to drive alternative rolling stock for short movements.

Example: In order to minimise incidents, East Midlands Trains employ a Defective On Train Equipment (DOTE) procedure. This allows for the expedient management of incidents as it sets out the rules for isolations and running rolling stock in a degraded mode, allowing the stock to continue without incurring or exacerbating a delay. This approach is employed by several other TOCs where the DOTE may be identified as something else.

11.3.4 Resources

In an incident, a number of resources should be available for staff to use.

Disruption during the middle of the day may allow ‘peak period’ units to be brought into service in lieu of displaced units. If substitute/displaced train crew are not available, this makes this contingency plan unviable. Timely recovery of the train plan is dependent on the availability of replacement train crew/vehicles and well managed manipulation of disrupted resources. The ease with which replacements can be provided is dependent on factors unique to each location in addition to time of day, weather conditions and other such issues.

The ‘Cut and Run’ procedure is then invoked. The objective of the Cut and Run policy is to safely, and as quickly as possible, return the running line to normal working in the event of a train failure. With safety considerations being of the highest priority, this will cause customers the least possible overall inconvenience and disruption. It will also assist in maintaining the highest possible performance level.

In some scenarios, using such a procedure may not be possible. This may be where numerous TOCs operate through a highly congested area. It is therefore advisable for planning to be made for the “worst case scenario”. Where multiple TOCs are likely to be affected, Network Rail should lead the development of the Cut and Run policy, bringing all affected parties together to develop contingency plans to follow upon the occurrence of an incident. Consideration should also be given to the inclusions of FOCs into such discussions as incidents regarding freight services can often cause significant delays or exacerbate those having already occurred.

Example: Northern face causing substantial delays if a unit fails on the approach to Manchester Piccadilly. Due to the layout of the approach to the station, limited opportunities are available for units to be routed around any stranded unit causing a significant accumulation of delays. The variation in rolling stock operated in the region (as much as 5 types) prevents the possibility of rescuing the failed unit with nearby stock.
Northern and First TransPennine Express have, over the past 2½ years, developed an extensive joint contingency plan to mitigate the impact of an incident. As of late July 2015, the document was in the process of introduction with issue aimed for August 2015. This document details, according to certain route sections, how services should run under categories including total blockage, reduced capacity and one line running. On top of this, specific instructions are given on how to handle any special circumstances.

An example is between Manchester Victoria and Milner Royd Junction whereby Biomass freight services to Drax power station are given priority during periods of reduced freight operation due to the nature of their cargo. These cannot be treated like traditional coal trains and must run sooner rather than later.

Thunderbird concept – a fleet of locomotives specifically equipped to rescue a TOC’s main fleet of trains.

Example: Virgin Trains (West Coast), London Midland, Cross Country and Chiltern have been working together to discuss contingency plans for the LNW Route. This has been led by Network Rail, taking a lead from the contingency used on the Anglia route.

The contingency plan not only details actions for partial/full line blockages (including actions for the am and pm peaks), but also roles and responsibilities of persons during an incident, such as Route Control Managers, Shift Signalling Managers and TOCs. Special instructions are also given regarding items including holding of trains at stations, light engine/empty coaching stock moves and engineering possessions. Communication details are also detailed regarding what should be relayed both internally and externally to customers including alternative transport arrangements.

A learning point is that there has, however, been limited consideration by NR of diagram complexity or fleet implementation.

The fleet is not normally used for traffic but is deployed at strategic locations to minimise the time that it takes for the loco to reach the failed unit. It can also cover for infrastructure failures where AC or DC electrification has failed (dropped wires etc.)

Example: VTEC have a set of strategically positioned thunderbird locomotives on their route. Due to the relatively linear nature of their operations, the location of these locomotives is perhaps more evident than for TOCs such as those South of London. They are positioned at Edinburgh, Newcastle, Doncaster and London Kings Cross. At 90 minutes apart, this means that a failed unit will be reached within 45 minutes. These Class 67 thunderbirds are leased from and maintained by DB Schenker, however driven by VTEC staff. Upon the event of the retrieval of a failed unit, a “relay” takes place.

For example, a failed unit at Edinburgh will be taken by the Edinburgh loco to Newcastle where by the driver will take the Newcastle loco back to Edinburgh and the Newcastle driver shall take the loco and unit to Doncaster where a similar process will take place, repeated until the unit reaches Bounds Green depot. The Rolling Stock Controller is the responsible person for the deployment of these thunderbirds. A consistent starting point for incident mitigation is vital for an efficient approach to managing the impact of fleet incidents. This could take a number of forms, however having an initial framework means that all involved know their responsibilities and changes only need be made according to the nature of the incident.

Example: Southern use a system whereby each section of the route is pictorially represented on a “slide”, featuring details of the incident management process for each of these areas. These are mounted in a transparent stand on which any writing can be included detailing anything from the nature of the incident to any changes in the management process. This has been found to yield a measurable improvement in the impact of an incident.
11.4 Do

A number of processes need to be implemented upon the occurrence of an incident. Several of these are detailed below. In addition, details on decision support tools can be found in Appendix I.

In order to use these processes most effectively, it is imperative to clearly identify the common goal with regards to managing the incident (e.g. moving the train or fixing the fault) so that an efficient critical path for managing the incident can be established. The Route Control Manager must ensure the plan is communicated effectively to all staff involved in managing the incident.

Where an incident may be managed in one of two ways depending on the outcome of an event (e.g. a technical examination) it is good practice to develop the two plans in parallel in order to minimise the overall length of the incident rather than starting with Plan A and then moving to Plan B at some point in the future.

- Promote practice of early advice of defects/ issues ("Report it first!")
- Clear the line and use “Cut and Run”
- Assume “worst-case scenarios” in plans and take action accordingly.
- Mobilise or prime maintenance staff at earliest opportunity.
- Whilst maintenance staff are working to recover a unit to operation, control staff can be preparing for other eventualities such as rescue (e.g. via use of Thunderbirds).
- Balance long term objectives with short term ones. For example it may be better incurring a slightly longer delay today in order to return units to depot for maintenance, allowing a return to planned service tomorrow.
- Use of train location information
- Use of Remote Condition Monitoring (RCM).
- Emergency services may be required to assist in certain instances; where this is the case it must be remembered that the emergency services will give a priority to the passengers and the scene. This may prolong the incident and, therefore, increase the time for recovery of the network.
- “Huddles” – bringing the relevant personnel together to discuss incidents and the plan of action.

Example: Upon an incident occurring, Southern bring the control personnel together into a 5 minute “huddle”, covering details of the incident and what each person’s responsibilities will be to recover service.

11.4.1 Avoiding Incidents and Robust Maintenance

Ad-hoc maintenance requirements (e.g. unit defects, modifications, component changes) are prioritised according to their urgency. An internal contract ensures that the delivery of Fleet Engineering’s depot requirements align with the service delivery requirements of Operations. The contract for planned delivery will aim to maximise the notice period of any work to be undertaken and be agreed between Engineering and Operations, according to the diagrams available.
Example: A challenge for Northern Rail is their fleet of 8 3-car Class 158s. All are allocated to Neville Hill (Leeds) depot Monday – Friday and there is a requirement for seven units to be in passenger service with one unit in routine maintenance. With the exception of one unit, six end their working day at another location. The arriving unit is delivered on 5T93 2209 Leeds – Neville Hill 2220 (NL197 diagram). It is therefore necessary to plan sufficiently in advance such that any unit requiring maintenance is allocated to the correct diagram such that it returns on 5T93 on the correct date.

Example: VTWC are limited to 6 units out of service to undergo maintenance. It takes careful planning and communication between the fleet engineers and control staff to ensure the whole team is aware of which units are scheduled for maintenance, where they need to be and when.

Deferred maintenance must be carefully managed with regular dialogue both internally within Engineering and externally with Planning and Control staff. The crucial link in this process is the Maintenance Controller who acts as an intermediary between Engineering and their operational colleagues in the control centre.

11.4.2 Dynamic Risk Assessment

Primary Delay

If the fault is catastrophic and brakes require isolating for movement, ensure that any movement fits within the Special Moves Plan (SMP) and ensure the Network Rail representative informs Network Rail Control. For instances where a controlled evacuation is required, all on site personnel must agree a plan and inform Network Rail; it is possible that emergency services will be required to assist. When planning for evacuation, where possible consider moving the unit (under assistance) if necessary to a safe point i.e. siding, station or away from the main line and any rail traffic. As previously detailed, Cut and Run policies allow for the effected unit to be isolated in some incidents to minimise the disruption which the unit may cause to the overall network.

Emergency coupling – it is critical to ensure that the emergency coupler is pre-fitted/extended to failed unit prior to recovery. Some TOCS have emergency couplers strategically located across the network. Assisting a train from the front using a wrong direction move is normally faster than trying to assist in rear with a non-compatible unit. People often jump to use the emergency coupler rather than a wrong direction move.

It should also be remembered that not all emergency services will be familiar with the rules of the railway. It is critical to work with all emergency services to ensure communication between all parties is maintained and clear information is conveyed quickly, clearly and efficiently.

11.4.3 Monitoring of plans and possible changes

Ensure live monitoring of the initial recovery plan is in place, be in touch with the staff on site and make sure you make a primary contact. Confirm that Network Rail understand the safety implications involved in DOTE when dealing with a significant failure. When estimated times for movement are available, use communications systems to relay this information to all concerned and, when robust estimates are achievable, communicate this out to ground staff. A faster recovery will be achieved when a proactive stance is taken from the onset.
11.5 **Review**

After having experienced an incident, it is important to evaluate the management and processes used to reduce the impact and restore service to normal. This section provides good practice in methods of reviewing a technical incident with the aim of improving future response to similar incidents.

- Agree only a few timely actions from an incident review.
  - These should be leading, measurable and carried forward such that it can be proven that these actions have been learned from in future.
- Merge Technical and Operations reviews (focussing on the right area).
- Always use targeted, meaningful and (if possible) tailored feedback.
- Education: Explain why things are done! In particular to train crew (why engineers have given certain advice or control have cancelled a specific service.)
  - Share the mission using a customer focus.

**Example:** Southern examine routes to identify areas of most disruption to understand which customers have been affected and why.

**Example:** Southern perform a “Hot Review” less than 6 hours after an incident has occurred.

**Example:** VTEC perform cross function mock ups of incidents, which involve all levels of staff from crew to senior management. These not only build confidence but allow cross functional teams to develop their relationships in a low stress environment.

**Example:** Within the South Western Railway control, Incident Learning Reviews (ILR) are utilised. This is a process employed by Network Rail used to review significant performance impacting incidents. ILR replaces the SPIR (Significant Performance Incident Review) process and is triggered by incidents of 1000 minute delay or more. It can, however, be used for any size incident where it is agreed there are lessons to learn or actions to capture.

An ILR template is completed as part of the review and aims to capture a maximum of 6 key learning points and 8 key actions. ILRs are submitted to NR centre and stored on a national database which is accessible to all.

The SWR track actions through an Alliance Action Tracker, reporting on open and overdue actions at both Performance Group (head of functions forum) and Performance Board (exec forum). All ILRs are approved by the most appropriate functional director, ensuring value is added in each instance.

**11.5.1 Incident Review**

Perform a final review and provide feedback to local operations managers and all staff involved in order to learn and share best practice. Create a knowledge pot which would compile contingency plans; eventually creating a “one stop advice shop” where ideas and experience can be shared. It is crucial to use all the tools available when reviewing incidents and where necessary implement recommendations made from such third parties as the Rail Accident Investigation Branch (RAIB).
12 The Supply Chain

Not having the right parts when you need them can be a reason for non-availability of vehicles for service (as the analysis described in Section 6.5 may show). It is a false economy to reduce the value of accessible spares holding down to a level which increases the likelihood of a vehicle having to wait for a part.

The best approaches to spares holding involve hard thinking (about how the parts are used by people) and analysis (about what the vehicles need when), in order to produce the right mix of location and accessibility for different items. It also involves trust (if you keep all the parts under lock and key, it will be at best less efficient for staff to access them). Best practice is to create trolleys of materials, tools and instructions for each type of routine activity (e.g. each B Exam). Trolleys include shadow boards for location of items. Parts used can be automatically booked to the vehicles.

12.1 What is the rail industry supply chain?

The rail industry supply chain is complex and includes organisations which may not be primarily regarded as suppliers, for example TOCs and ROSCOs. Essentially the whole railway supply chain consists of a huge network of many smaller supply chains which are linked or integrated to varying degrees. The length and complexity of an individual supply chain is dependent on the product and/or service being provided. Figure 1 below illustrates a typical supply chain for undertaking maintenance on a soggy lease fleet.

![Supply Chain Diagram](image)

Figure 1 – Typical supply chain for undertaking maintenance on a soggy lease fleet

Most organisations within the rail industry are either customers or suppliers, or both, at some level within supply chains, implying that most organisations have a role to play in supply chain management.
12.2 How does the supply chain affect fleet performance?

Supply chain activities can significantly influence national fleet performance, via the reliability, availability and performance of the rail vehicle components, products or services being provided. There are challenges for suppliers in establishing and managing successful supply chains in the privatised railway, and an overriding need for other industry stakeholders reliant on the supply chain to work with suppliers to achieve common goals.

It is essential to understand the interdependencies and interfaces between different supply chains particularly those that involve common sub-systems and equipment that is used across multiple fleet types, and affects multiple TOCs, owners and OEMs and maintenance providers. An example of interdependency is a brake actuator which is common to a number of fleets.

12.3 What are the characteristics of an effective supply chain?

An effective supply chain will:

- Understand, provide for and anticipate the needs of current and future rolling stock operations across the UK
- Have the capacity and skills to deliver targeted asset enhancements that will underpin and improve fleet performance
- Provide effective and efficient through-life material supply
- Have a culture of continuous improvement that seeks and adopts best practice from other railways and industries as appropriate
- Understand the wider implications of its decisions and actions
- To enable this, a supply chain must be cohesive in its nature i.e. a linked chain with aligned interfaces, management processes, priorities and objectives throughout the chain.

12.4 What factors influence supply chain performance?

If the supply chain does not function effectively, there will be an adverse knock-on effect on fleet performance.

A number of generic rail industry factors also affect supply chain performance and the supply chain may not have full control or influence over them. Such factors include:

- Franchise change management
- Configuration management
- Component robustness, testing and component tracking
- Material support contracts and material availability
- Economies of scale
- Adoption of relevant best practice from rail and other industries

A detailed list of issues that need to be considered within these areas is provided in Appendix B. This is intended to be used as a checklist for stakeholders in their management of supply chains, to assess their applicability and determine opportunities and priorities for improvement.
Businesses that demonstrate best practice in supply chain management will undertake regular reviews of their process effectiveness, staff competency and customer/supplier interfacing arrangements to ensure that these are appropriate to the inevitably changing environment in which the supply chain operates.

12.5 What are the cross-industry priorities for improvement?

Whilst stakeholders within an individual supply chain can achieve worthwhile improvements, there are some key cross-industry enabling factors which need to be in place for supply chains to function effectively and consistently.

There are a number of recognised cross-industry issues which require resolution to allow further improvements to be made. An illustration of best practice as detailed below, could be a way forward to improve the operation of the supply chain:

1. The train operator to provide information of the volume of materials (both train borne and non-train borne) that are used by the depot to give an accurate measure of actual consumption to a supplier that will help the forecasting of future demand levels.

2. The correlation of material issued to what level of maintenance work (i.e. Level 1 to 4 or Level 5) and to which fleet, would further enhance the quality of the information provided to a supplier to better forecast future demand. Maintenance schedules and seasonality factors to also be shared with suppliers to provide advance notice of requirements would help the forecasting of future demand patterns. In a planned maintenance schedule, the creation of a “review point” to analyse the actual percentage of on-condition replacement levels used part way through the programme, would enable suppliers to replenish stocks of replacement parts to appropriate levels for future deliveries.

3. Lists of Critical Parts (that could cause a Stopped Vehicle) and Service Critical Parts (to ensure continued customer service) to be shared with suppliers by each TOC to create a Master List of parts that require buffer stocks

4. Parts supplied in Kits that are to be repaired and are time critical for the repair to be achieved, are to be highlighted to the customer so that these are returned in time for the repair to be completed and returned to the customer.

5. The supplier to aggregate data from multiple users of the materials to establish trends and to set appropriate stocking levels for the benefit of all users to increase availability levels and reduce lead-times. First Tier suppliers are responsible for communicating customer’s maintenance and demand schedules to sub-suppliers to ensure that the requirements are aligned across the supply chain.

6. The Supplier to communicate to the customer as early as possible if a part is not to be available due to a delay in the supply chain and the impact on train availability to be minimised by remedial actions taken the supplier.

7. The Supplier to provide feedback at regular intervals to TOCs where current demand levels are not matching historical trends which is causing over or under stocking.
Additional areas targeted for improvement are:

- Management of ‘rogue’ components (repeat offenders)
- Configuration

The work streams being developed are detailed in Appendix C.

12.6 How does the industry manage obsolescence?

This is an important issue which is not exclusive to the rail sector and we aim to seek and disseminate best practice in obsolescence management from other industries.

In the rail sector, there are a number of different reasons why a component may become obsolete:

- Technical obsolescence, where the technology once used has been superseded by a more modern equivalent and the original design can no longer be made. An example would be 1980s microprocessors where only newer versions are available.
- Supplier obsolescence, where the manufacture or repair of a component is no longer possible. This could be due to a supplier going out of business or removing a component from their product range.
- Commercial obsolescence, where it is technically possible to make a spare component, suppliers are available but the cost becomes prohibitively expensive.
- Substance obsolescence, where a material has been designated as obsolete through regulation or best practice for safety, environmental or other reasons.

Regardless of the cause of obsolescence, best practice is to actively manage obsolescence throughout the life of the vehicle.

Principle 1: Agree ownership for obsolescence. Technical and Design Authority as well as commercial responsibility for obsolescence should be clearly defined from the start. This could reside with the ROSCO, TOC, maintainer or first or second tier supplier, depending on the fleet, material type or component.

Example: Porterbrook sets out the ownership for obsolescence in a TOC specific Fleet Management Plan. This document is agreed with the TOC at the start of the lease and forms the basis for ongoing commercial and technical reviews throughout the lease period. Responsibility for obsolescence is contractually documented and will depend on the type of lease in place. Typically, if a soggy lease is adopted, Porterbrook will continue to manage obsolescence for major components on the fleet. If there is a dry lease, this becomes the responsibility of the operator. In all cases, the operator will manage obsolescence on Level 1 to 4 items. Porterbrook has retrospectively put in place a Design Authority agreement with Bombardier related to Electrostar and Turbostar fleets to ensure continued access to the fleet manufacturer’s knowledge base.

Principle 2: No one party has all the answers to obsolescence. Good management requires input from a number of stakeholders: TOC, FOC, OEM, ROSCO, maintainer, first and second tier suppliers.

Example: The Brake Code Conversion unit (CCU) originally installed onto the Class 313, 507 and 508 EMUs became obsolete and no longer supported by the original manufacturer. This was due to obsolete hardware fitted to the original design. Unipart Rail redesigned the CCU to be a direct replacement for the original unit which incorporates modern relay components that are more reliable and require lower power consumption than the original unit and has a lower weight and reduced failure modes.

Throughout the development of the product, Unipart Rail worked closely with First Capital Connect...
(now GTR) to ensure that the final design met the expectations and specification required by the train operator and their maintenance teams.

**Principle 3:** Establish a process for identifying obsolescence risks as part of the day job of good fleet management. This can be done through fleet user groups, supply chain reviews, maintenance or overhaul planning or as a result of an NIR investigation.

Example: Porterbrook’s fleet technical reviews include obsolescence as a standard agenda item. This gives Porterbrook or the TOC a chance to share any concerns and identify obsolete components early on. In one example, the Class 150 alternator was becoming an obsolescence problem and increasingly expensive to maintain. Angel and Porterbrook invested in developing a solution with a new supplier and a trial is currently underway in 2014/15.

**Principle 4:** Create a plan for how to manage the risks and prioritise them. Agree a governance approach.

Example: Unipart Rail has an obsolescence risk register for specific TOCs which is reviewed regularly and has sections for new and priority products. The use of a risk register provides controlled progression of obsolescence issues, the tracking of samples, trial fits and the ability to assign projects to internal development teams to resolve the obsolescence issues.

Unipart Rail uses this register as part of its supply chain and logistics reviews with both 2nd tier suppliers and its customers to progress the timely replacement of the product prior to the obsolete part causing operational issues for the TOCs.

**Principle 5:** Tell everyone. Best practice includes communicating the obsolescence risks between engineering groups, suppliers and materials managers across the supply chain. Methods of doing this across the industry could include the RDG Engineering portal, user groups, PADS, NIR close out or the RISAS website.

Example: The HST User Group meets quarterly and the attendance includes the relevant ROSCOs, TOCs and Unipart Rail. In total, 12 different organisations are represented. As part of the meeting agenda, which covers incidents, technical issues and NIRs, solutions to obsolescence issues are also discussed. The aim is to identify issues early and to develop a common approach. For example, a component overhaul company had identified an obsolescence risk on some equipment they were repairing due to a lack of spares. Solutions including injecting more float material, by either manufacturing some new spares or pooling some spares held by other parties were considered. The issue of the IPR of the equipment was also discussed.
12.7 What role do you have to play?

Optimising the supply chain, to underpin and improve fleet performance, is about the small actions of many people and many organisations across the industry in pursuit of some common goals. No one individual or organisation has all the answers or the whole solution.

The role you have to play is to:

- Reflect on the principles and sentiment contained in this section.
- Evaluate the role of your organisation within supply chain(s)
- Question whether your approach and that of your organisation is supportive and aligned to the principles and sentiment outlined in this section
- Discuss and implement opportunities for improvement within your organisation and with its respective supply chain(s) stakeholders
- Keep abreast of, and participate in as appropriate, ongoing work by ReFocus in facilitating the resolution of industry-wide supply chain priorities for improvement

12.8 Where can I find examples of good practice?

Appendix D provides some current practical examples of best practice in supply chain management. This appendix will be updated on a rolling basis to include the result of current workstreams.
13 New Train Procurement

Since this is a handbook for reliability improvement, we shall concentrate on how to buy a new train fleet to get the best ‘out-of-the-box’ service performance. It is written primarily from the perspective of TOCs because they need to be key players in the procurement of new trains. They have the best knowledge of what they and their passengers need and want, and they will be first in the firing line if the product, and particularly the reliability of the product, falls short. We have therefore set out some lessons learnt, based on recent procurement experience. This is not expected to be completely comprehensive, but intends to raise awareness of issues which can inform future thinking. Equally, this section may be applicable to the installation of new equipment onto trains.

Two powerful lessons learnt are that to maximise reliability, new train procurement demands:

i. the effective deployment of significant train operator resources - this costs money but pays reliability and other long-term dividends; and

ii. adequate timescales, and sufficient contractual rights to enable the TOC to demand that deliverables are right at each stage of the project (so it is not under time or financial pressure from other stakeholders to accept an inferior product).

13.1 Pre-Contract – Product Selection

13.1.1 Planning

It is worth investing serious time and energy in this phase of the project, hence the recommendations in the pre-contract and contract sections of this Section are the lengthiest. There are some things which must be done for legal reasons (such as issuing an OJEU notice) but our focus is on practical steps which we recommend to improve reliability, based on positive and negative experiences of either doing or not doing them.

Critical to efficient implementation of the eventual train service is the early and effective engagement of the TOC’s Operations and Commercial functions. This sets the train in the context in which it will be used, e.g. what the needs of the passengers on the route are, what the roles of on-train staff are, how other trains on that TOC work, etc. It is best if the TOC frees up some of its own staff who know how their railway operates, its constraints and opportunities, rather than hiring consultants to do the job for them (although long-term secondee can be worth having if they become an integrated part of the TOC team).

A one team integrated approach should be adopted early on, bringing operational staff, engineering and commercial aspects of the business on a full-time basis; the team should be cross organisational, preferably with knowledge and experience in fleet introduction. It can also be worthwhile to include representatives from Network Rail, front line staff and driver representatives in cross company workshops with wide engagement.

No matter how tightly the contracts are written, the TOC always has risks that cannot be fully passed back to other parties:

- Safety - the ultimate responsibility to run a safe train falls on the TOC;
- Overall business risk - performance regimes with manufacturers to deal with poor performance are invariably capped, and based on an estimate of possible TOC losses inevitably made years
Recognising these risks, Heads of Terms and a detailed Train Specification (setting out how the manufacturer will deliver a product compliant with the TOC’s functional specification) should be agreed before any preferred supplier is nominated. The more time spent at this stage, the more successful train implementation has been, in terms of: fewer (expensive) variations to contract during the project; higher reliability out of the box; lower risk of an overspent manufacturer being unwilling (or unable) to finish the job properly.

Further, there is a correlation between the time available for the whole project and successful implementation: heroic timescales are less likely to produce good trains. Higher out-of-the-box reliabilities have been achieved with more generous implementation timescales: this gives the TOC the ability to say no (or even to credibly threaten to say no) at critical milestones in the development and delivery of the fleet, providing real leverage to ensure quality requirements are met.

Obviously, however, there is a balance: project timescales cannot simply be allowed to drift. Strong project management, with the ability to “fire a shot across the supplier’s bows”, will assist in achieving this balance.

### 13.1.2 Specification development

First, understand the core requirements. These may be set out in the franchise process, and are supported by many detailed requirements in TSIs.

Where these requirements are set out in the franchise process, often the opinion is formed by the DfT - in line with the Rolling Stock Strategy - and customer focus groups as to what they would like to see in the next franchise, rather than input from the current operator themselves.

The process can be either prescriptive (by Invitation to Tender) or cooperative (by Invitation to Negotiate), the later was the approach taken by Eurostar, highlighted below.

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**Example: Eurostars’ process of tendering for new fleet was unique in that Eurostar issued a ‘tender to negotiate’, looking for a high-speed TSI compliant platform that would suit. Then Eurostar worked with the supplier to build the specification around what was possible. Eurostar are fortunate in that their infrastructure is largely TSI compliant so there was good knowledge in the supply chain of system requirements and products were already on the market that could be easily modified for Eurostar operation.**

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The core requirements should cover:

- Train “technical” issues e.g. route-specific performance parameters such as top speed, kinematic envelope;
- Train “passenger” issues e.g. passenger carrying capacity, ambience, facilities;
- Train “depot” issues e.g. fuel, coolant, sander and toilet interfaces for servicing; and,
- Train “station” issues e.g. water filling, ability to use emergency coupler in platform road.

Next:

- Understand what is available in the market – aim to get proven design and confirm it really is proven and that the client is not being used as a guinea pig for the next stage of product development. For example, TPE based the Class 185 on Class 180 below the solebar and Class 360
above. Is there an opportunity to jump on the back of an existing and running production line? As this can save ramp-up time and costs.

- How innovative should you be? - Southeastern’s Javelin for example was very high performing but not considered as very innovative (it used 1980s/90s traction technology that had been proven before) – there is a line to be drawn between innovation, such that your customers really see this as a new train, and being reliable out of the box.

- Understand best practice - industry codes of practice – don’t be afraid to challenge outdated or non-relevant standards (and allow time in the project plan to achieve necessary derogations).
- Understand your functional needs e.g. how passengers, crew, maintenance staff and other stock will “interface” with the new train – get robust input from operations colleagues within the TOC as well as engineers. For instance, take the train specification detail down to the level of the sequence a driver or guard must go through to open and close doors (including SDO). Does this fit with station dwell times? How does the train’s diagnostic system report faults to the driver? What does it tell them to do? How long will it take them to do it? Is the remote downloading capability sufficient? Everything you decide after you contract could cost you money, and compatibility with other stock in your operation may be critical.
- Specify ‘no single point failures’ and don’t just consider the systems but the train as a whole. I.e. Class 700 units introduced on Thameslink are 8/12 car fixed-formation units, which meant that a single damaged window can take the unit out of service. Is there the ability to isolate or make-safe such failures to allow that unit to complete its journey?
- Be clear on requirements from the data management systems on the train, including data formats and the means of downloading the information.
- Ensure you have the right to participate in the final design reviews. This will be an opportunity to clarify any grey areas left in the specification (see Section 13.3 below).

13.1.3 **Commercial strategy**

Recommendations from experience are:

- Start with at least 5 train suppliers and run with at least 2 – get to at least Train Spec and Heads of Terms Agreements with both, so you could genuinely proceed to contract with either. This is to maintain competitive pressure, and mitigate the risks of going to Preferred Bidder too early (e.g. rash promises can be slipped out of, it is more difficult to return to the non-preferred). Keep two suppliers in, so that you have a credible alternative right up to the point where you go for contract with one of them. Consider the manufacturer’s order book too – success can breed success, but can also stretch the supplier’s resources at critical points in your project.
- Decide whether you want to manage procurement yourself or get someone to do it – and if someone else does it, how much control you wish to retain. Can you afford to buy the trains yourself and then go for re-financing?
- Then, if appropriate, approach 5 financiers and develop 2. Decide between different forms of
Examples: ROSCO and TOC speak with one voice to the supplier, with a clearer focus on reliability and other essential requirements as a result.

In the South West Trains Desiro project, the TOC was contracted to manage ROSCO’s interests in the procurement process on the ROSCO’s behalf. For the Southern Electrostar programme a TOC/ROS CO joint team was formed, where the ROSCO engineer was contractually designated as the TOC engineer’s assistant. Both arrangements require individuals to develop good working relationships, and rely on being able to establish clear and acceptable contracts.

13.1.4 Maintenance Strategy

- Decide what you are buying e.g. Train and Spares only/ Train and Specialist Support/ Design-Build-Maintain/ Train-Service-Provider/ Availability contract
- Maintenance agreements can be thought of as 7-year costs (franchise term) and whole-life costs, to a TOC and a ROSCO they have different emphasis. Over the whole life of the vehicle they are such a small percentage that it pays for itself, spares are critical in later life. After spending a longer time with fleet, the operators team gain a greater knowledge of the vehicles, the same can be said for new builds of an existing platform – Electrostars are a good example of this.
- Agree delivery incentives (more details are offered in later sections)
- Set targets for overhaul cycles and routine maintenance periodicities, as these will be key drivers of both maintenance costs and train availability
- Be aware that a whole life maintenance plan may not be available at this stage. Great care must therefore be taken at later stages to ensure that the subsequent development of the plan does not present additional risks.
- If an aftersales division of the supplier is providing any of the services, what is their relationship with the manufacturing arm, and how committed is the latter to supporting the former? Is there an internal contract in place? How high in the supplier’s management structure do decisions on cross-division support get made?

Example: Be wary of the split of responsibilities between operators and suppliers. Siemens are responsible for all maintenance of the 700s at both Three Bridges and Hornsey, the existing arrangement at Hornsey had GTR drivers who managed wash and moving trains. Three bridges copied this approach and had Siemens maintaining trains but reliant on GTR for movements and the wash side – GTR had to recruit new drivers and management team for Three Bridges. This was a missed opportunity for ease of working at the contracting stages. Both parties are working around problems but very strict contract makes it difficult Handover from maintainers to drivers for example is very prescriptive.

13.1.5 Procurement process

- Develop a risk allocation matrix – who is responsible for what.
- Plan your support services – make sure you have allocated enough good resources throughout the project and that they have the right knowledge and incentives – the person who reviews the bids should be the person who has to live with the product. This includes the operators e.g. ensuring the Driver Manager and Head of Guards sign off the specification.

From considering the primary roles of TOC, manufacturer and financier, roles of other players can be inferred and two key ones are listed below. (The TOC may of course choose to arrange with other players
13.1.6 Role of the Franchising Authority

- If new train procurement is a requirement in a franchise, then enough time should be allowed prior to implementation to enable a robust procurement process to be set up and delivered.
- Timely core specification policy decisions should be made to set the framework and key interfaces (using the criteria set out e.g. extent of compatibility with other stock), to enable the TOC to do the detailed work (and iterate with the franchisor on some of the core requirements, if they appear unduly costly).

Example: What is specified may be found at a later stage to be unfeasible or undeliverable. Connected Driver Advisory System (C-DAS) was specified by the DfT for the Class 700 but had no details of what C-DAS was to include. Siemens fitted a generic solution that ‘should’ marry up with the Hitachi Traffic Management at Three Bridges ROC but currently unknown if it will. Both Greater Anglia and Northern found themselves in a similar situation with “ETCS-Ready”, which DfT has specified within the requirements with no formal definition of what that is.

13.1.7 Role of the Infrastructure Manager (Commonly Network Rail)

- Work with Network Rail and other operators on station design and increasing platform lengths etc. Siemens worked with Network Rail on station designs throughout the Thameslink core to ensure that dwell times could be met, this included signage to optimise flow from doors through barriers and onward in passenger’s journeys.
- Thought should also be given to specifying and buying space or land for depots and stabling etc. Is the land available, possible that it is earmarked for other projects or public sale?
- We also need to work with Network Rail on plans for electrification, how likely are these to remain on schedule and be delivered? This can greatly affect your choice of traction type, with bi-mode offering security in the short term until the electrification is complete.
- Following on from electrification plans; specifications for overhead lines and 3rd rail parameters and interfaces with the train need to be considered, as the actual infrastructure can vary from Network Rail’s drawings.

13.2 The Contract – (Ensure you get what you asked for)

This section is grouped into two parts: one around delivery (what you get) and the other around finance and train performance (how you pay for what you get and protect yourself from not getting it).

Before we jump into it, it’s worth discussing some of the cultural differences you may encounter. There can be a cultural disconnect between commercial and engineering departments in different countries companies, which is often of benefit. However, there can also be a disconnect between project delivery teams and design teams in organisations set up with individual business units which must work together on new train introductions. This is a problem when technical experts are in a different country.

13.2.1 Firstly, some recommendations around acceptance and delivery

- Delivery profile is crucial – TOCs should be comprehensive in requiring delivery gateways. For instance:
  - if some payment milestones are spread through the design and manufacturing phase, chose “hard evidence” gateways (e.g. first article inspections, submission of type test reports); rather than ethereal ones (e.g. the supplier’s internal “design freezes” or assembly line “build stages”, which can be passed with issues outstanding)
  - treat “hard” deliverables (e.g. special tools, initial spares stocks) and “soft” ones (e.g. technical libraries) with equal weight, and specify when (how long in advance of train
• Delivery) they should be provided to unlock train acceptance
- use Qualified Acceptance to incentivise the supplier to close out acceptance issues. This
  should, ideally, be linked to a price retention.

• Detail is critical e.g. if you’re looking at a proven product, explicitly require the defined
  performance levels achieved on other railways – and be clear about when they’re required and
  what happens if they are (or are not) achieved.

• Particularly if the rolling stock being procured is of a substantially new design, time should ideally
  be allowed for evaluation of the first trains built before full fleet delivery takes place. For example,
  TPE gave drivers pre-handover time (say 2 weeks) on the trains to test fault scenarios and “see if
  they can break it”, to enable design tweaks and process changes to be made.

• Getting to the position where the supplier’s aftersales organisation is treated by the
  manufacturing arm as an internal customer in parallel with the TOC as external customer, should
  be the goal when setting up the acceptance process.

13.2.2 Technical documentation and data

• Be specific about technical and user documentation in the contract – flesh out what you mean by
  “all documents required to enable efficient and safe maintenance and operation”. This might be
  by requiring an explanation of why each element of the maintenance plan is there, and an outline
  of the limits on periodicity of individual activities and what risks they were designed to mitigate.
  Such an explanation would boost understanding of how to improve initial reliability and provide
  a robust basis for developing and refining the maintenance plan going forward. A specific
  milestone of maintenance plan delivery on physical media such as a read only memory stick is
  recommended – experience with too easy to change web-based interactive manuals is often
  bitter and can conflict with basic principles of document control.

• Be clear about how you want the information to be delivered – does a bundle of A4 photocopies
  with suppliers’ part numbers on constitute a list of parts? What interfaces are you looking for to
  integrate with your existing maintenance management systems? Similarly require definitive
  delivery of special tools e.g. laptop-based diagnostic software at an appropriate milestone.

• Have the short and long term end users of the documentation agree the format. These users may
  be ROSCOs, TOCs, and the supplier’s own after sales division.

• Require Safety Critical components to be identified for your approval as safety critical, so that the
  requirements of best practice can be met e.g. ATOC/ACOP/ EC01003 Supplier Accreditation (soon
  to be superseded by RIS 2750) and ATOC/ACOP/EC01007 Management of Safety Critical
  Components (which recommends for example that Safety Critical components are also entered
  on PADS).

• Either:
  o formally review and approve or;
  o require sight of maintenance and overhaul instructions particularly of components,
    because TOCs as Railway Undertakings need to know – to ensure they are credible and
    compatible with the maintainer’s facilities.

• Ensure you have access rights to all data within the Train Management System, and all off-train
  software needed to analyse it (contracts have varied, even between TOCs buying the same train,
  and lack of information can hinder reliability growth).

13.2.3 Supply Chain Management

Change control is particularly critical. Be guided by your assessment of fundamental risks and use a
standard engineering change process. There have been instances in long build contracts where inferior
components have been substituted without reference to the TOC. Of course, some changes are necessary
and/ or desirable as better products are developed or existing parts become obsolete: there should be a
contractual clause to the effect that TOC agreement would not be unreasonably withheld. The TOC should
also contractualise the right of audit of supply without warning, but be sure in the contract (and within
company processes and safety case) that this is not used to weaken the supplier’s product responsibilities.

13.2.4 **Obsolescence Management**

This is a growing concern where we have undertaken some benchmarking with other industries who also have long-lived complex products e.g. Westland helicopters. See Section 12.6 above, which recommends that obsolescence risks are identified for every train and a conscious decision is taken about how to manage each one. This may include additional specific contractual requirements or responsibilities extending beyond the warranty phase, possibly into long term management deals.

An important question to ask at the early stages of design is have the bid team left flexibility in their design and requirements? This is more of a concern for future franchises or the rolling stock owners as they may be restricted in later cascades or route changes if there is no future proofing. I.e. are you procuring a diesel fleet when electrification is a possibility in 10 years’ time – perhaps a bi-mode traction type will provide greater felicity in future use, even if the electrification never arrives.

A Design Authority or similar support arrangement should be in place for each fleet, to provide a point of reference for design information and knowledge, and a base from which electronic systems and the vehicle in general can be developed throughout its life i.e. proactive obsolescence management. It will certainly include some careful thought about electronics and software – such as considering requiring life time buys for some electronics and clear software escrow rights in general.

New trains’ electronics have shorter product life cycles, therefore an increased obsolescence risk. Electronics are not always expected to last the life of the train. This needs managing, on the basis that the train needs to continue functioning. Obsolescence is also compounded by new trains being built from a ‘kit of parts’. Component drawings and design knowledge may be held at sub-supplier level and not in the public domain, making it harder to resolve future issues. Don’t hesitate to challenge existing designs of systems where appropriate and insist on a new approach or way of thinking.

13.3 **Secondly, some financial recommendations**, (linked to train performance and delivery)

13.3.1 **Performance**

- Insert a heavy dose of realism into the numbers discussed. By all means, set an aggressive figure, but base pre-contract supplier assessment on what they have achieved on fleets with similar technology and what they are going to do differently to get the figure that the TOC’s business case really needs. If the negative impact on the service is marginal, then contracting for a higher reliability figure in a time that has never been achieved is likely to end in disappointment and be sub-optimal in cost (i.e. we will be paying much more money for marginal benefit – compared with spending it on infrastructure for example, and assuming that the supplier does channel the money into improved designs and does not simply build in a higher performance penalty contingency). The best way of getting to this level is to be rigorous, but allow time. Realistic requirements for a fleet might be 18 million miles running (which could equate to 9-18 months elapsed time, depending on fleet size and duty cycles).

- Use standard industry measures (3 Minute Delays [MTINs], delay minutes) as the indicators in your performance regime. Do not allow the suppliers to quote their own measures such as ‘technical capability’ which favour their statistics at the expense of your passengers! Also, be wary of using older performance measure, i.e. DfT specified reliability for the Class 700 using MPC (miles per Casualty).

- Ensure the supplier takes responsibility for problems caused by poor design of ergonomics and
the man/machine interface (e.g. misleading messages on the train’s data management system).

- Include targets and incentives for reliability of passenger amenities (toilets, air conditioning etc.).

Example: Depending on what you are contracting the manufacturer for, synergies can be made between certain requirements and targets.

With the Class 700, the DfT had specified for both optimised maintainability and reliability, and reducing energy consumption – in fact the lighter the train was, the more they were paid. However, Siemens had to make sure that any savings in weight were not detrimental to maintainability or reliability (lighter yet solid). This is a benefit of the train builder and the Maintainer being the same entity, rather than making the train lighter at the cost of reliability.

- Ensure that warranties and financial incentives are clear. Set realistic and enforceable delivery targets e.g. to achieve half the eventual reliability performance on Day 1 - otherwise you won’t buy the first train; unless MTIN of x achieved by day y – you will stop buying, or pay a cheaper price (i.e. link performance to price). Don’t rely on the service organisation to get back to the manufacturer on a “with maintenance” deal. Service organisations will always cap out their warranties on performance – retain a performance warranty with the manufacturer in addition.

- Set out in Warranty the following terms: what you get; what the supplier does; what you do. There should also be a strong endemic defect clause such that if you reasonably believe you’re getting a defective product, you can choose to stop buying until the issue is resolved – without having to reach a threshold of failures first.

- Set up a retention bond - available to put right a major system failure should it happen even after you’ve bought the trains (beyond warranty and for the things you don’t yet know about). Of course, this risk is reduced the more you can buy a proven product.

- Seek timed and priced options for flexibility e.g. to cope with future growth (inserting extra vehicles in a rake) or possible changes in future usage.

13.3.2 Payment profile

The ROSCO has a significant role in the payment profile and this profile can have a significant impact on long term reliability. Bear in mind the risk of conflict between TOC and ROSCO requirements – the ROSCO wants to get a train which someone is paying rent on and which will be leasable throughout its life; the TOC wants to get a reliable train which works and meets its franchise requirements. This points out the need to develop a good relationship with your ROSCO, backed up by aligning interests contractually as far as possible:

- Ensure there are robust incentives on the manufacturer to close out all the technical issues – bonds and retentions are much more powerful in this respect than warranty agreements.

- Consider how Qualified Acceptance could work to incentivise the supplier and financier. If the financier withholds a proportion of payment until qualifications are removed from an Acceptance Certificate, then lease payments should be reduced commensurate with this.

- Require unrestricted access to manufacturing as part of a robust acceptance process, to satisfy yourself that each acceptance gateway has been achieved and the project (and payment) can proceed. It’s also good to link payments to the formal Approvals milestones i.e. work closely with your Notified Body (NoBo) to define and link these. It is less desirable to link to the manufacturer’s own design process because this does not have a direct relationship with your milestones.

- Require pricing transparency on any variation order from the supplier to check it is fair and that they have not made an error (examples of simple errors found include over-stating the number of units required to be modified; double-counting for overheads – both in the artisan rate, and added separately; including the original base design costs in addition to the costs of the actual variation). In some cases, such errors have doubled the quoted cost of the variation.

ROSCO choice may be affected by attitude taken to variations after contract, for example their treatment
13.4 The Design – How the product works

This section starts from the functional specification drawn up by the TOC at the Invitation to Tender stage. At this point the suppliers bid team should hand over to the production team or even integrate with them to maintain knowledge of bid commitments.

13.4.1 Functional Specification

This should identify issues that are important to your operation which might not otherwise be recognised, such as:

- Splitting and joining and moving away needs to be achieved reliably (quantify) and within x minutes,
- Times for door opening and closing sequences; time to shut down, change ends and open the desk; Drivers’ prep time (affects trade union agreements as well as train timing) – what is your performance specification for these timings, no worse than today or an improvement above that?
- Coping with short platforms (Selective Door Opening requirements) and Driver Only Operation,
- Any safety/ compatibility management requirements that might be passed to the TOC by the supplier. For example, requiring electrical interference monitors or other safety systems to be checked daily. This can require attendance of technical personnel at locations such as stabling sidings where they would not normally be present. This adds cost and stretches resources,
- Maintenance constraints and opportunities which the train should be designed around (e.g. that no components of the train should require planned maintenance intervention between the maintenance intervals you need for diagrams),
- For electric trains, ensure the train can be re-started easily after a 3rd rail or Overhead Contact Line supply outage,
- Ease of access to equipment required for in-service diagnostics and fault mitigation (e.g. not putting re-settable or diagnostic devices in cupboards a long way from the driver or adjacent to high voltages),
- Mechanical and electrical compatibility with existing fleets that the TOC will continue to operate,

This is crucial to successful operation in the real railway and to effective mitigation of any defects in service – the TOC must remember that it knows how trains actually operate and translate this information into design requirements. Never assume that the supplier has operational knowledge of their own products.

There needs to be involvement from ASLEF and driver representatives on cab design early in the process. Use ASLEF’s good practice guide and RDG’s Guidance Note for further assistance.

13.4.2 Design review

- Check the comprehensive technical specification you have requested from the manufacturer against your functional requirements; go and ride on existing products that are being touted as proven experience (and talk to the people who are using, operating and maintaining them). Get familiar with the design – require a document that describes how the door control system works, then meet the suppliers’ engineers and check your understanding.
- Take care not to acquire design responsibility – write everything down scrupulously to document what exactly you have agreed to (e.g. that you said option A appeared better than option B – this
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is NOT tantamount to absolving the supplier of their responsibility with respect to option A, and does not alter the reliability requirements in the contract).

- Design freeze and standards freeze – be clear about when exactly this should be, and what exactly this is, so that there is a shared understanding of change flexibility before (and rigidity afterwards).
- Standards conformance – be clear whether any non-conformity or derogation from mandatory standards is required, who is responsible for getting it and determining what is acceptable as an alternative.
- Change control – when you agree a change at whatever level, clarify in writing – and keep all correspondence. Do not absolve the supplier from their obligation to provide a compliant and fit for purpose product.
- Concentrate on interfaces – with the infrastructure, the train crew, the passenger, the maintainer, other trains. Focus on software functionality.
- Focus effort on the biggest risks to reliability, feeding in to the design of the Train Management System and its interfaces to driver and maintainer. Look at the top 10 on your existing fleets and other fleets like the trains you’re buying, and require the maximum data from the train for these areas. For example, doors: emphasise your requirements for door functional information capture, identifying incipient failures, diagnosing root causes of faults, especially intermittent ones.
- Build in redundancy for particularly critical systems where it will bring you reliability benefits that are worth having (e.g. compressors)
- Design risk can be covered off at the performance level, but if you are buying a train and doing your own maintenance then design changes during the build may have significant downstream costs for the maintainer (e.g. a fleet with a mixture of different types of repairable component under the same part number, may require different maintenance specs - cost and effort which could have been avoided if there was a clear requirement not to make any design change (even at a low level which doesn’t impinge on the functional spec) without client approval. One TOC found that employing 2-3 people to monitor this proved worthwhile in terms of downstream costs avoided.

13.4.3 Type tests

The type tests of specific critical systems should be witnessed or at least reviewed, to gain assurance of their validity in terms of the functional specification for this particular TOC application. Insist on agreeing the specification of the type test, especially for systems where operational context is a factor e.g. doors.

13.5 Manufacturing – Making sure it works

13.5.1 Theory – desktop information

The TOC should follow through from type approval to gain comfort that the production roll-out is robust, seeking specific information to review as part of assurance that work is progressing (and tied into payment and progress gateways). The TOC should have access to all drawings and build data, and be able to review assembly processes. The TOC should have access to all stages of manufacture (at critical system OEMs as well as the main supplier, where relevant) and to view the consistency of production and manufacturing standards. Contracts should allow access to sub-suppliers, where necessary.

Take advantage of First Article Inspections, which are a formal method of providing a reported measurement for a given manufacturing process, to create more direct lines of communication, especially when doing in-house maintenance rather than through a supplier contract.

Equally, the TOC should take an interest in the supplier specifying engineering standards, and having a robust staff training and competency management system. Other relevant supplier systems include their
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goods inwards inspection and their configuration database.

13.5.2 Practical - on-site presence

Provided that responsibility for production is not confused, it is generally worth having a customer presence in the supplier’s factory.

Example: Southern found that having 2 TOC engineers in Bombardier’s factory and 1 at their commissioning depot was worthwhile - in terms of the identifying and resolving issues which could have started to cause problems in 10 years’ time.

TOC engineers on site in supplier (and, where appropriate, sub-supplier) factories have often facilitated communications on the latest issues. This minimises the number of vehicles which continue to be built with a defect once it has been identified in service, hence saving rectification work and benefiting all parties.

Example: There is a risk that train builders are tempted to overlook manufacturing problems arising during construction as they believe the TOC will not see or be aware of the problems – such problems might only come to the surface some years later during overhaul or when exchange components do not fit. Reported cases include anti-corrosion treatments, paint quality, and dimensional build tolerances.

Mistakes will be costlier later unless they are addressed early. Although mistakes cannot be planned for, risk analysis should be conducted to identify potential failures and delays to the plan.

Example: SWT (who were also explicitly acting for Angel) found that assembly line audits were useful for residual value issues associated with passenger environment and paint quality.

Working with the supplier’s service organisation can also help raise build quality which has a whole life benefit. Many TOCs undertake factory gate commissioning, requiring TOC acceptance to be achieved before vehicles leave the factory. This is in addition to commissioning on site in the nominated UK maintenance depot.

Resident Engineering rights need to be built in from the start, including requiring an office in the manufacturer’s assembly factory.

13.6 The Acceptance Process – (Does the whole train work)

This document does not cover the safety-focused approvals process (with Notified Bodies etc.); we just deal with customer acceptance, focused on reliability performance.

The kind of gateways which TOCs should set are:

- **Preliminary acceptance** at factory gate (i.e. before each vehicle leaves the factory, after say 1000 miles of fault free test track running). The mileage can only be gained after leaving the factory but before the TOC accepts the train.

- **Commissioning**, both static and dynamic tests to gain enough confidence for trains to be run on Network Rail controlled infrastructure on test runs, accumulating mileage and proving experience. This phase enables the ambience to be assessed (e.g. noise, ride and comfort, in addition to finish and décor).

The examination work associated with commissioning should be regarded as the “Zero Miles” exam in the Maintenance Plan. It is vital to subsequent safety and performance that it:

- Contains every task required to permit the vehicles to run to the next scheduled examination and hence to the longest scheduled maintenance interval in accordance with
the safety certificate.

- Is performed only by people who possess demonstrable competence in applying maintenance plan tasks. That is the supplier or sub-supplier responsible for this should be competent and sufficiently skilled to carry out the work to the required level.

- **Provisional acceptance**, after which trains are fit to run in passenger service, under the TOC’s Safety Certificate (this is usually a static test, after say 15k miles trial running on Network Rail controlled infrastructure, supported by an engineer on the first day in passenger service). This ‘shakedown’ testing should look to mimic their future operations and diagrams on home routes i.e. copying frequency of stopping, door opening, turn-around times etc. At this stage the trains are technically procured (i.e. ownership transfers from the manufacturer to the financier) – but the job isn’t finished...

- **Final acceptance**, 2 or 3 years on, when each unit has had all the latest mods retrofitted and software versions upgraded; plus, say 20k miles of fault-free running and 3k miles of no system faults; plus, all the correspondence between TOC and Supplier has been closed out.

Ensure passenger amenities are given suitable importance, both in the supplier’s test programmes and in your own acceptance checks.

To facilitate acceptance, the TOC should have unfettered access to finished units, this should be clarified in the form of site facilities and what arrangements are made for TOC personnel on site.

Doing Engineering Change (EC) before type approval has risk of differing away from scope – the operator has less control but also less work for processing additional ECs. There needs to be a protocol to come from final design review regarding type approval and commissioning to ensure that the product has not drifted from what was initially promised.

Note on test tracks – they are invaluable for getting past first base in developing the technical safety case for a new train, and for validating later changes to the design. Pre-delivery endurance running on test tracks is useful as a sophisticated build quality check, but a true indication of reliability only emerges from experience on real infrastructure, which tends to draw out many more issues. It would, however, facilitate acceptance if Network Rail would more readily agree to testing proceeding on a particular track between particular times rather than having to set up a signal protection zone.

UK test tracks are in high demand and thus often unavailable due to other activity or installation, upgrade of equipment between testing. It is possible to do some testing abroad but it is difficult to replicate UK trackside to a sufficient standard (mainly due to inconsistencies between our own implementations across routes.

Methods of testing and introductions vary between existing schemes with current trains and new and unused schemes – i.e. Thameslink vs Crossrail. Testing also varies depending on whether they are a First in platform or class of train or a developed production line with a proven platform (i.e. Bombardiers Electrostars vs Aventras).

At the provisional acceptance stage, trains will start to be delivered to the operator. Too often the operator is left to deal with the units once they leave the factory, where will they be stored, depot changes needed, and handling the influx of extra trains on top of the existing fleet, these are often out of scope to the supplier, so it is worth giving this some thought beforehand. There are two types of introduction:

- **Phased fleet introduction** - One strategy is to gradually replace old trains with new, perhaps even while improving old rolling stock, such as Eurostars’ example introducing the new e320 while
overhauling the e300s to match. This is particularly common with partial fleet renewals.

- Alternatively, a more aggressive approach can be taken. Full fleet introduction is often taken under franchise commitments to replace the TOCs entire fleet with new trains and must meet a set date under the commitment, such as Greater Anglia’s complete fleet renewal by 2019.

You should try to combine operations testing with performance building time to start “out-of-the-box” with higher reliability. Use time efficiently, trains are used between 18 and 20 hours a day, training can’t happen all the time; forward planning will be needed to allow service to continue whilst training happens. As well as this we should allow for testing runs and promotional activities.

13.7 Service Introduction – (How well does it work)

Some initial points of note:

- Be sensible with unit introductions: use low mileage return to depot diagrams. Siemens were forced into GTR’s existing diagrams and timetable, rather than optimising a diagram for testing etc. They were running 800 – 2000 miles and 2-3 days before returning to depot. Instead aim for less than a day in service before returning to depot, such as post morning peak etc.

- Have strong contingency plans, Defective On-Train Equipment (DOTE) policy should stay with TOC as supplier cannot influence their ‘cut and run’ policy.

13.7.1 Interface with Operations

It should be noted that the challenge here is to integrate the new train into the Railway Undertaking’s Safety Certificate. There is a significant amount of work which has often been underestimated e.g. training additional drivers (both because TOCs need more drivers available so they can free some up to be trained on the new trains – and for driving the test runs on the new trains). This might imply a 5 or 10% increase in drivers required for a period approaching full service introduction.

Of course, many other resources are affected, not just drivers. For example, the new train introduction may extend over years, so that the fleet organisation might need to change teams to support day-to-day production management and facilitate the necessary changes in the production environment. Vehicle mileages should be managed across the fleets to prevent workload waves which put availability at risk. Overhauls should be anticipated e.g. preparing specs, deploying spares floats, developing capacity and competence at overhaulers.

It would be wise for the Franchising Authority to ask some searching questions where franchisees propose new trains to ensure that they have sufficiently robust plans for increased resources to optimise service introduction.

There can be a disconnect between a projects delivery team and the next projects commissioning team – lessons don’t carry across and there’s no feedback into the build line. Thus, it can be worthwhile to establish contact with other operators who are currently introducing the same platform of train; what has their experience been like, are there any lessons that can be implemented in this order to improve reliability later. Fleet user groups and cross industry stakeholder groups are also seen as good resource within the programme, however there are less of them for new build trains.

Operators should be realistic about the rate of change and ensure that they are communicating with the rest of the company. This could take the form of continuous readiness updates and briefings to carry staff with you through the business change. How are the rest of staff affected?; does their rostering have to
change whilst training takes place, what level of knowledge of the new fleet – and its differences with the current trains - do they need to continue to do their job.

Within engineering, consider how to brief common faults to staff and any procedural changes that arise from them, are their existing ways of working or lines of communication to use? Can staff who will use the supplier’s documents understand them – review Vehicle Maintenance Instructions (VMI) with technicians etc. Likewise, we can use driver trainers and standards managers to review procedure manuals.

13.7.2 Interface with Manufacturer

This is particularly critical if the TOC is taking over the maintenance of the trains, as responsibility shifts.

Example: You should take care not to jeopardise warranties e.g. by altering usage of door release anti-tamper catches, effectively requiring components to deliver more than their designed capacity.

Similarly, if the TOC has a service provision or maintenance contract with the supplier, the TOC is in a good position to strengthen the arm of the service provider/maintainer in resolving build issues and ensuring timely modifications programmes are delivered by the supplier.

Also, consider the period that the suppliers support will be available, if they are doing maintenance for at least the first few years, they will have an interest to get maintenance documentation correct early on.

Depending on the precise contractual arrangements, issues such as spares provision and management should be followed through – and above all, there should be regular contract meetings around all the emergent issues and the delivery of resolutions to them.

Example: A TOC should aim to ensure all emerging issues are openly discussed and resolutions identified between the parties before expiry of the relevant warranty period.

Operators should beware; gone are the days of a commissioning team of 3-4 people who know all the ins and outs of the train, instead we have teams or even departments of 30+ people who specialise in each sub-system and their boundary of scope. This means that very few people in the manufacturers company have an appreciation for the ‘big-picture’ and that when there is a technical problem manifesting across several systems, the diagnosis and corrective action could take much longer. Often, if the local support within the operator cannot find the fault, that component may be sent back to the manufacturers home-country where their specialists are based.

Example: Avoid training that is delivered from a sub-systems OEM point-of-view as this doesn’t give maintainers the ‘big-picture’ of how systems can work together and influence behavior.

Siemens took this approach with the Class 700 and then introduced a ‘wiki’ resource for maintenance staff to act as a repository of knowledge, including; common faults encountered, previous fixes, and how systems work etc. Staff are incentivised to contribute by adding money to staff entertainment fund.

Ask for groups of specialists knowledgeable in the trains and systems during introduction that are on-call 24/7.

13.7.3 Interface with Network Rail

Key to minimising the pain of service introduction is to ensure that Network Rail appoints a Project Manager to pull together their inputs. TOCs should meet with them once a week to work round any emerging problems e.g. booking test slots. TOCs should ensure that they establish compatibility on all the
route sections and tracks that they might wish to run a train on, either as a timetabled or exceptional move, and that Statements of Compatibility are published for all those possible moves. This should be closed out by updating the Sectional Appendix.

13.8 Reliability Growth – Delivery to the passenger

Many of the issues highlighted in this section are cited as best practice for existing fleets in other parts of the 20-point plan. However, it may be worth drawing attention to the particularly critical nature of some of the issues at this stage of a train’s life.

13.8.1 Design for maintenance early on

As with the above discussion on how innovative should you be, it is worth considering your level of dependency on software. Different systems can require updates at differing intervals based on that suppliers’ development, different laptops or maintenance tools to interface with, and different skill sets for fault finding and general maintenance. Eurostars’ e320 on the other hand, still has a lot of train wires hard wired rather than using a data bus to the Train Management System (TMS) - equally, hard wired solutions can limit your scope for future expansion.

Software can present unique issues, there is often no understanding of how it fails, how to fix it, or the impact that might have. Operators need to trust that the developer or competent person within manufacturer can help you understand and mitigate negative effects.

With mechanical systems, we can audit and follow procedures of mechanical fixes however software and discreet electrical components don’t allow for this. With software and discreet electronics, we need to know:

- What’s the test procedure?
- What’s found and led to that failure mode?
- Once a fix is developed and bench tested, it needs a robust test regime before it goes out into traffic;
- This should be auditable between ROSCO, TOC, Train OEM and System/component OEM.

Note that suppliers can get caught up demonstrating that their specific kit works to “pass-blame” to other interfaces and sub-systems, proving a false positive. This builds on the common problem of fixing the fault and not the root cause.

The operator or manufacturer need a robust test regime after implementation of fix to monitor success. Software updates (previous and current version) should be held in ESCRO until updates are made and proven successful to protect from suppliers leaving the market.

Cash flow must go back into improvements. Compensation payments can focus suppliers; another solution is to stop accepting new builds until they sort it – so long as this does not impact franchise commitment dates and targets. Once payments stop suppliers lose interest and move on to next project.

Performance regime will specify the need for support team to be there, and this shouldn’t be hard-coded
13.8.2 Measure everything – and follow it through

TOCs should not underestimate the resource needed to monitor what’s happening sufficiently effectively to be able to identify and resolve root causes of unreliability. Effort is also required to develop efficient mitigations (e.g. switches the driver can reset, work-rounds) to reduce the impact of faults while root cause solutions are being developed and implemented. Work closely with traincrew, as they will be the first to see problems, but build their confidence by giving them feedback on how problems are being tackled and overcome.

There should be engineering support for the maintenance and operations controllers e.g. a technician from the train manufacturer to sit next to them in control. This technician could then download and interpret the information that ought to be available from modern rolling stock, such as remote downloads on critical system behaviour in detail for the past 5 minutes from the Train Management System.

A maintenance team should be committed to monitor pre-faults (not just faults) to make the most of the information downloads which should be available (from OTMR, TMS, condition monitoring on specific systems). Even if the TOC continues to be responsible for maintenance, the maintenance organisation will need to be rejigged to suit the new trains – and to make full use of the likely step change in volume and quality of real facts available for analysis and downloadable remotely.

Manufacturers may need to be reminded that the TOC is accountable for operational safety on Network Rail controlled infrastructure: once trains have been delivered, the supplier must consult the TOC prior to any modification, operational mitigation or change to maintenance activities, irrespective of the contractual position in financial terms.

Exploit the data from the train data systems and ensure it is made fully and freely available. It is your data, about your trains, after all! Avoid being charged by the supplier for collecting or processing information, and use the opportunity to overcome any difficulties with downloading, transmitting or formatting the data.

Example: Ensure that you have access to RCM data even if the manufacturer oversees maintenance. On some of their older trains, Greater Anglia have integrated their RCM with operations & engineering which allows them to monitor the systems and look at events from both disciplines points of view. This is very useful & enables joint investigations etc. With the new trains that they are getting, they won’t necessarily get access to the RCM data, so doing this sort of activity may become impossible or not so easy / joined up (i.e. if the different departments use different systems to monitor what is going on).

Again, make sure that passenger amenities such as toilets, information systems, catering equipment and air-conditioning are given sufficient attention at this stage of the project. Recent experience suggests these are often the hardest items on the train to get right. It is particularly important to involve operational staff, and ensure defect reporting systems are working smoothly in this area.

13.8.3 Manage the interfaces

Joint forums should be set up to discuss and analyse experience and to own the development and deployment of improvements. Relationship building and attention to detail are critical. The manufacturer should be incentivised to design out problems (perhaps facilitated by some of the monies established up-
Other technical issues to watch for (and feedback to future functional specifications) include: operational peculiarities that may not have been accounted for in the original functional specification, such as the impact on particular systems of commuter trains being stabled over more than 24 hours, say on Bank Holidays, e.g. with compressors shut down over this period - the pressure leaks off, electric coupling heads open up, generating a range of fault codes which lead a driver to declare a failure when they comes to take the train on the Tuesday morning.

13.8.4 Consolidation

As the service beds in, opportunities to hone the maintenance regime in the light of experience should be identified and exploited to drive costs down – particularly through using predictive tools and making the most of remotely downloaded data. If there is still room for improvement in performance, the TOC and the supplier should build a Reliability Growth Plan with specific actions to take the project forward and get to where everyone wants to be!
14 No Fault Found Warranty Claims

This chapter focuses on rolling stock component warranty claims where the supplier cannot find a fault with the returned component.

There is a perception in the industry that these events occur too often, taking up limited time / resource across a number of different companies, without ever reaching a satisfactory conclusion as to why the train fault occurred in the first place. It is difficult to quantify the service impact of these events due to the way data is currently collected and stored. Whatever the actual impact it is good practice to try to reduce the number of No Fault Found (NFF) events to as low as reasonably possible.

In order to understand why this issue occurs it is necessary to understand the process which underpins warranty claims, the stakeholders involved and the environment in which this process is implemented. Once these things are fully understood, it is possible to identify the individual issues which cause NFF diagnoses to be made. From this understanding, it is possible to develop good practice guidance which if implemented will help to reduce the number of warranty claim NFF diagnoses.

14.1 The Process

Table 1 is a simplified representation of the warranty return process for components where the supplier finds no fault. N.B. this process is not completely standardised across the rail industry.

Occasions where the TOC disputes the outcome of the warranty claim and repairs outside of warranty are separate processes which are not detailed in this chapter.

Table 1: The High Level Warranty Claim Process

<table>
<thead>
<tr>
<th>Step</th>
<th>TOC Operations</th>
<th>TOC Fleet or Train Maintainer</th>
<th>Logistics Company</th>
<th>Supplier or Overhauler</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Train Defect Occurs</td>
<td>Defect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Faulty Component Alleged</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Receive New Component</td>
<td>Organise Component Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Fitted to Affected Train</td>
<td></td>
<td>Component Tested OR Component Stripped &amp; Inspected</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>Organise</td>
<td></td>
</tr>
</tbody>
</table>
It is important to consider the impact of stakeholder interfaces as there are multiple stakeholders involved in the warranty process which increases the opportunities for silo working.

Commercial agreements between companies and fleets differ, making the detailed application of the process more complex, but commercial agreements should ideally identify the information which needs to be shared up and down the supply chain.

It is important to consider the wider context of managing component failures and how they can affect other parties not involved in managing the specific failure. For example, use of common component pools mean that the TOC which eventually receives the returned component may not be the same TOC who sent it for testing and will not have a full understanding of the component’s reliability history.

14.2 The Issues and Good Practice

By understanding the specific issues which cause warranty claim NFF diagnoses to occur, it is possible to identify good practices which will reduce these events. These are described below in more detail.

14.2.1 Behaviours and working practices.

- Warranty management is not applied in a consistent way across the industry and may sometimes get overlooked. It is good practice for companies to place sufficient emphasis on warranty management and ensure it is a critical part of managing fleet reliability (e.g. ensuring warranty related issues are routinely discussed at reliability meetings).

- Whilst warranty terms in contracts are all different, it is important to review these prior to the start of a new franchise to ensure that terms and conditions are optimised and that old ones aren’t simply copied across to a new contract.

- Mistrust between the TOC and Supplier can encourage parties to engage in a strictly contractual relationship. This may lead to more NFF diagnoses as companies do not openly share all failure information for fear of being held responsible for the failure. It is critical for TOCs and suppliers to develop positive collaborative working relationships in order to improve the quality of failure investigations. This can be achieved by having regular joint meetings which are focussed on a common goal of identifying and resolving technical issues.

- Pressures to deliver a reliable service may lead to components being replaced as a preventative measure. These may then returned to the supplier for further investigation without having validated whether the component was faulty. If possible, it is good practice to quarantine suspected components to see if the fault re-occurs, prior to returning it to the supplier.

- TOCs should avoid having a ‘change it’ culture (n.b. this may not be a culture throughout the whole fleet team but could be shift or depot specific). Efforts should be made to ensure that
technical flow charts used for fault finding do not exacerbate this issue. Warranty managers should work to identify those teams who are quick to change and return components by analysing the volume of claims they process and the number of components being returned for an individual failure.

**Example:** VTEC hold monthly joint technical and commercial meetings with their major suppliers in order to discuss the top issues which are affecting the fleet. This provides a regular forum to discuss issues and work together towards resolution.

**Example:** Virgin Atlantic has a system whereby if a failure occurs which could be caused by a number of different components, they first change the component most likely to have been at fault and place it in quarantine for a set length of time. If the failure does not reoccur in that time, the component is returned to the manufacturer for diagnosis. If the failure does reoccur then the component is assumed to have not caused the failure and the next most likely component is removed and placed in quarantine.

### 14.2.2 Time taken to resolve issues.

- There is a perception that it takes too long to investigate alleged component failures. It is difficult to quantify the validity of this perception due to the diversity of warranty SLAs in existence. It may be that TOCs and suppliers having a slightly different interpretation of an SLA (e.g. whether the clock start ticking on the SLA from the moment the TOC sends off the faulty component or when the logistics company or supplier receives it). It is also important to understand that not all components are treated equally by logistics companies. Those with immediate demand or safety stock levels set will be returned for repair immediately, otherwise the broken component may be stored in a warehouse awaiting future repair. It is therefore good practice for TOCs and Suppliers to agree a common definition of the terminologies used and to measure compliance against a standard set of agreed KPIs.
- The length of time to agree a failure diagnosis where there is a limited shared float available can result in availability / reliability issues at other TOCs who are not involved in the original failure. Pressure to conclude investigations on these assets may result in basic failure investigations taking place and more NFF diagnoses being offered in order to return the component to the common pool. RoSCos should know overhaul spares floats and Logistics companies should know maintenance spares float. Limited floats become a greater issue at times of overhaul and need to be proactively managed. See Section 16 Overhaul Management.
- Logistics companies can identify limited floats through knowledge of critical spares and obsolescence forecasting. Logistics companies should forecast maintenance activities to identify peaks and troughs so that limited floats can be managed proactively.
- When fleets are cascaded among different TOCs it is good practice to consider the impact this may have of component floats.
- It is good practice to identify required component floats upfront when introducing new fleets.

### 14.2.3 Trend identification and information sharing.

- There isn’t a common view of component failures across all involved companies. Each company will maintain their own asset management systems which only show part of the story. Therefore no one has an overview of the complete picture from NFF component diagnoses to impact on the train service. Poor flow of information from end supplier back to the TOC can result in a component being returned to a common pool without the new TOC being aware of its history or
the TOC who returned the component finding out the failure diagnosis. By using shared systems, it can help to create a more joined up asset history with a clearer view from root cause to passenger impact.

- TOCs routinely analyse their failure data to identify their worst performing units, worst performing systems and repeat failures. However, issues may be identified sooner if these types of analyses are routinely shared with other TOCs who operate similar fleets. Therefore, TOCs with common fleets should take part in regular fleet user groups in order to identify common faults and to work together to reduce their occurrence.

- It is difficult for TOCs to identify repeat NFF for some components as not all components have serial numbers and generally no one TOC has a complete view of the component’s reliability history. Component failures and equipment issues are generally identified by TOCs as they cause problems with reliability and availability, however Logistics Companies and Suppliers could also work proactively to identify issues which may affect train service delivery and should be proactive about sharing this information.

- Failures caused by a faulty batch may not be correctly diagnosed straight away (or initially assumed to be random failures caused by bad luck) as the onus is on the TOC to identify reliability issues. Suppliers are in the best position to identify batch issues and component NFF diagnoses. These issues should be relayed to Logistics Companies who can work with affected TOCs to manage the impact of these issues.

14.2.4 Information flow through supply chain.

- Poor flow of fault information from TOC to end Supplier can hinder the failure investigation from making a positive diagnosis. Failure information is either not provided with useful detail or can be lost in process of returning the faulty component to the Supplier. This results in the Supplier being unaware of any symptoms, diagnostics undertaken by the TOC or other useful information regarding the failure which may help them reaching a positive failure diagnosis. Sometimes TOCs may not be able to provide useful or complete failure mode information to the Supplier (e.g. part of a component may have been broken and fallen off the train or the component may be an electrical box which has stopped working). This may impact on the quality of the investigation undertaken by the Supplier as the testing undertaken may not consider the correct issue and therefore result in a NFF diagnosis. In order to do a thorough investigation, a systems approach should be taken with all involved parties understand what information is required and what information is available. TOCs and Suppliers should work together to identify components where better information about the failure symptoms could be supplied by the TOC and agree a minimum standard for returns information on the fault. Logistics Companies should be aware of this to ensure that all relevant information is passed on to the Supplier. Warranty claims reporting templates / documentation should be updated to reflect any agreed changes to ensure that good practice becomes embedded. TOCs should aim to have a dedicated warranty manager to ensure that claims are well managed (i.e. returned with the agreed information) and that outcome reports are followed up.

- Poor change control practices can result in components’ serial numbers being replaced or renewed by the Supplier without the TOC being aware that this has occurred. This impacts trend analysis as repeat failures are harder to identify. In order to ensure component history is easily traceable, a robust change control process should be applied to managing serial numbers and a consistent use of tracking common pool components should be made through the use of component tracker. To reduce the occasions when a serial number needs to be changed,
components should be uniquely identified and fitted with robust serial numbers which are unlikely to fall off or become damaged through the component’s life.

- Sometimes a Supplier may miss the warranty investigation SLA and credit is given to the TOC. If the component is being returned to a common pool, the TOC who returned the component may lack the incentive to chase for an outcome report especially as this can be time consuming. It is difficult to quantify how often this happens because each warranty contract has a different SLA for investigating faulty components. It is assumed that there will be a higher level of NFF diagnoses in these situations. It is important that outcome reports are followed up by the Logistic Company and their results are shared with affected TOCs. In order to better manage outcome reports where SLAs have been missed it would be good practice to introduce standardised component SLAs across the industry.

14.2.5 Testing regimes and specifications.

- It is important for all parties to agree component testing specification upfront (e.g. at the start of a new relationship) to reduce the number of NFF diagnoses and to provide a greater understanding of why faults occur and the way in which components are required to perform. This is especially important for the introduction of new fleets and should also be considered prior to overhaul. See Section 16 Overhaul Management.

- Logistics companies can help to ensure that investigations result in a positive diagnosis by encouraging systems based approach to be taken to fault finding (rather than a component based approach).

- The testing practices of TOCs and Suppliers are not aligned which can lead to there being different views of whether a component is faulty or not because Supplier specifications may not represent how the component is actually used. Testing on depot may rely heavily on subjective events being observed whereas testing at a Supplier’s facility may provide more ideal conditions. It is good practice to align Suppliers’ and TOCs’ testing practices as far as is practical.

- Joint investigations between TOCs and Suppliers can be very productive in providing a common understanding of what causes a component to fail and the steps that need to be taken in order to achieve a positive failure diagnosis, however they can be difficult to organise due to being regarded as symptomatic of a break down in the process / relationship. This may be improved if TOCs and Suppliers work to develop better relationships and find a way to organise joint investigations more easily when they are required. It is also critical to ensure that learning from joint investigations becomes embedded in routine practices. Learning from joint investigations should be shared with other TOCs to prevent the need for a similar joint investigation to be repeated elsewhere, failure to do so may not help when trying to build a positive TOC / Supplier relationships.

- Asset data can be lost through testing. Some testing regimes cause asset history to be wiped prior to the test being taken, thereby losing potentially useful information about the asset’s performance. It is critical to identify components which are at risk of losing failure data either through the testing process (e.g. the testing procedure for door control units wipes their failure data first) or because data is only stored for a limited time (e.g. if the asset is unpowered for a certain amount of time the data can be lost). Methods for data download or backup need to be in place to ensure that potentially useful information is not lost prior to testing.

- Testing methods do not typically recreate vehicle conditions (e.g. Suppliers may only undertake an electrical test, not a mechanical one) which does not provide a complete picture of the failure environment. It is good practice to undertake component tests which more accurately recreate
the operational environment in which the failure occurred (e.g. putting electronic equipment through ‘shake and bake’ tests in which vibration plates simulate train movement and climate chambers which simulate real life weather extremes).
15 ROSCOs

ROSCOs are key suppliers to TOCs and fleet performance depends on the ROSCOs delivering their activity effectively. Generally:

- ROSCOs own the vehicles as assets and need to take a proactive lead on reliability issues with a whole life element;

**Example:** Auto-sanders which operate during braking only were fitted on Class 390s for performance reasons (not a safety need). The VTWC franchise only had 6 years to run, but Angel funded the installation over 12-15 years to reflect the design life of the equipment.

- ROSCOs procure most heavy maintenance which creates much of the capability of a train to be reliable (for the TOC to sustain over the rest of the maintenance cycle);
- ROSCOs manage critical spares pools for most fleets (these pools also create or destroy a TOC’s ability to deliver its fleet reliably).

There are various ways that ROSCOs can facilitate reliability improvement at different stages and from different angles. These typically are:

- during procurement and build of new vehicles (see Section 13)
- during the operation of a particular fleet with a particular TOC (in Fleet Management Plans, see 15.1),
- by joining up thinking and making comparisons between different TOCs and different ROSCOs with the same/ similar vehicle Classes, see 15.2
- by taking a lead in the improvement of components/ systems and issues/ challenges which apply across several or even all fleets, see 15.3
- by working with the supply chain to resolve parts issues (see Section 12)
- by developing and implementing step change modification packages at key stages in the vehicle’s life e.g. C6X near the end of a franchise (not detailed here).

ROSCO support can help prevent reliability deterioration:

- when fleets are transferred between franchisees, but continue doing the same duty (see Fleet Management Plans and aspirations around refranchising in 15.1);
- when fleets are moved between TOCs who have different duty cycle requirements (see 15.4); and
- when stock is transferred between TOCs at other times (see 15.5).

This Section takes the above specific issues and explores what they mean. We set out what is currently done (including some examples of good practice) and also state some aspirations for how things could be improved.

15.1 Each fleet with each TOC and ROSCO: Fleet Management Plans (FMPs)

Fleet Management Plans are one of the most important tools for ROSCOs to facilitate long term reliability improvement, provided that the TOC is engaged appropriately.

Fleet Plans were originally written by the ROSCOs without engaging the TOCs, and so did not reflect the performance of vehicles in service. They should now be jointly signed documents, with each TOC enabled to input to the process. They form the front end of the Technical File for each fleet. The common core information for FMPs was agreed between ROSCOs following FRA8 as follows:
Fleet Management Good Practice Guide: The Twenty Point Plan

- Exec Summary
- Purpose and Scope e.g. relationship plan
- Fleet Technical Data i.e. base Technical File data
- Operations and Maintenance Policy e.g. Overhaul documents history, concessions, VOs, Whole life maintenance and modification plan
- Regulatory compliance e.g. certification and limitations
- Materials supply and Obsolescence e.g. obsolescence plan (see 12.1 above), key spares
- Management of Safety e.g. live NIR matrix
- Fleet Performance e.g. Performance Improvement Plans
- Overview of Projects, Modifications and Enhancements e.g. 18 month unit plan, change control and configuration matrix

One of the explicit purposes of the FMP is to facilitate reliability growth. TOCs need to share emerging performance issues with ROSCOs, so the FMP Performance Improvement Plans can be re-evaluated and appropriate actions identified (Cost-Benefit-Analysis and Plan-Do-Review cycles).

FMPs are live working documents, which must be kept confidential to the TOC to reduce the risk of incumbent blight at re-franchising. They should be updated at least annually and signed off by functional Directors from both the TOC and the ROSCO. The detail should be reviewed regularly (e.g. at the 4-8 weekly technical review) and used as part of the lease review process.

Note: Ownership of the content of FMPs varies e.g. Dry lease FMPs are updated by TOCs with their suppliers, Wet lease FMPs are updated by ROSCOs/ their suppliers.

Example: ScotRail FMPs with Eversholt and Angel. Eversholt: The implementation of the joint ScotRail-Eversholt through-franchise FMPs was considered particularly successful because: 1. The FMP was constructed as a single overarching document that includes all Eversholt rolling stock on lease to ScotRail and clearly set out the high level objectives of the franchise. Separate Appendices address the specific aspects of each individual fleet, facilitating updating and day-to-day management. 2. The agenda for the regular ScotRail-Eversholt contract review meetings were constructed around the FMP template, and an action tracker was used to monitor progress and ensure comprehensive and timely follow-up. Thus makes the implementation of the FMP central to the relationship rather than a one-off activity.

Example: Angel and ScotRail FMPs worked well as the two businesses integrated their high level requirements and day to day interaction around the plan. Ongoing lease and technical reviews were focused around deliverables within the plan. This is due to a direct link between the ScotRail Reliability Action Plan (RAP) and the LPIP such that there is read across and buy-in between the TOC’s and the ROSCO’s long term reliability growth initiatives. The sharing and real-time use of the process, deliver a much greater alignment between the two businesses.

ROSCOs would like FMPs to

1. start sooner (engaging with DfT in refranchising process) and to;
2. develop more details (engaging more with TOC in reliability improvement). TOCs would like FMPs to contain explicit targets for reliability, availability and cost of operation.
Starting sooner during refranchising

The following timeline for a Fleet Management Plan is desirable:

-24 to -12 months (i.e. up to 24 months before refranchising):

ROSCOs would like DfT to engage with them in optioneering, considering key issues to resolve or improve with specific fleets. Then DfT should make requirements visible to ROSCOs as soon as they are published. The “overview of franchise commitment” does not contain enough information - ROSCOs would like to understand the context and concept from DfT (rather than restricting them to preferred bidders) and in good time to get a full picture of what DfT wants to achieve.

This should enable ROSCOs to compete more effectively and provide better offers to TOCs. Perhaps 70% of the ROSCO offer would be common and 30% bespoke to bidder, whereas the current limited information and limited timescale process drives bland ROSCO inputs.

-6 months to 0 months (i.e. during the 6 months before refranchising):

ROSCOs would like any new franchise to be signed 6 months prior to franchise commencement (instead of the shorter timescales often available), so that they can:

Identify and elaborate franchise deliverables, working towards an outline FMP

Identify risks and agree how to manage them, fleshing out the FMP

Prime the supply chain, dealing with any set up and float control issues, exploiting repeat business leverage opportunities, etc

Although franchise requirements can change prior to the actual start date, more opportunity for set up work would increase the likelihood of a successful and reliable franchise start. It should also enable front-end deliverables to be better supported.

ROSCOs also believe the incoming franchisee should have access to existing franchisee staff to facilitate a smooth handover and effective start up.

0 months to 12 months (i.e. during the first year of a new franchise):

Ratify the outline FMP (developed during the 18 months prior to franchise start, see above), i.e. what the plan is and what the agreed milestones are

Hold Technical/ Lease reviews on the detail and the mechanisms to achieve agreed milestones

Have an interim review at 6 months

Have a formal review at 12 months, including measurement data in a feedback loop to modifying the plan

This contrasts with spending the first year of a franchise putting an initial plan together, and would be facilitated by more time and more data sharing in DfT’s re-franchising process.

Steady state (mid-franchise)

Develop and evolve the FMP to improve performance. Pick up more detailed issues – see b. below.
Last 12 months (to franchise end or stock transfer):

Take up the opportunity to avoid stop-start by continuing existing programmes, subject to support from DfT and new franchisee, once announced. A handover plan needs to be agreed, detailing arrangements to clarify configuration of vehicles and provide all support information e.g. NIR resolution status, see 15.5 below.

Sometimes FMPs have been written to maximise the effectiveness and smoothness of a relatively short TOC/ROSCO relationship.

Example: Eversholt agreed short-term (12 month duration) joint FMPs in 2005 with National Express London Lines, for the Silverlink and WAGN franchises on Class 313, 321 and 365 fleets. The well-established process was used successfully, with special care taken to ensure commercial confidentiality of potential improvements, given the ongoing franchise competitions. A joint Fleet Planning Workshop established stakeholder priorities and agreed joint targets and action plans for performance improvement. The limited timescale available for implementation meant that only ‘quick wins’ could realistically be taken forward.

More details during the life of the FMP

ROSCOs would like to have more details in FMPs, so they can better support TOC performance improvement. They would like to:

- Generally, improve interfaces for data transfer and communications (primarily from TOCs to ROSCOs)

Example: AGA has good data flows agreed with both Porterbrook and Eversholt including delay minutes, cancellations, miles-per-5-minute technical delay and trends every period. They also share with the ROSCOs their specific targets such as PPM during Challenge 90, which prioritised some service quality issues over reliability.

Example: EMT holds monthly performance meetings for all their fleets which Angel and Porterbrook engineers attend as full participants: they get all the data (warts and all) and participate in reviewing performance and determining actions.

- Specifically, agree reliability targets with TOCs, based on aligned strategies so stakeholder priorities can be aligned. This would mean agreeing activities to do and resources required for them (people, training, depot improvements).

The heavy maintenance programmes delivered by the ROSCOs are fundamental to creating the capability for the rolling stock to perform reliability over the rest of the maintenance cycle. TOCs therefore often seek to establish Reliability targets for fleets undergoing Heavy Maintenance or other ROSCO-led programmes.

ROSCOs recognise that TOCs will want optimum reliability for their business model/ DfT requirement, not necessarily maximum. For example, TOC priorities might be their bigger fleets, longer term vehicles or perhaps even passenger environment and security (rather than reliability) in the first instance. DfT priorities might preclude TOC investment in depot improvement. The FMP should reflect these stakeholder priorities, but also note opportunities which exist for reliability improvement beyond the current plan – and ROSCOs should consider facilitating the work required.
It is important to note that changes to vehicles may be only a small part of a TOC’s reliability growth plan, for example, Northern plan for only 15% of their improvement from vehicle modifications.

Incorporating the TOC/ Network Rail relationship, the performance improvement model for TOCs is typically:

15.2 Vehicle level comparisons and User Groups

ROSCOs can help join up thinking and make constructive comparisons between different TOCs and different ROSCOs with the same/ similar vehicle Classes (on new/recent builds, this involves engaging the manufacturer in on-going issue resolution).

Specific comparisons can facilitate understanding which drives productive change.

Example: Eversholt holds joint technical reviews with TOCs from different owning groups on Classes 313 and 321. The review includes: discussion (and development of people/ relationships), comparing trends, identifying best practice, pre-empting issues on particular fleets, smoothing any fleet/ vehicle transfers. Variation in Class 313 performance across different TOCs was positively correlated with when successful compressor mods were implemented.

All User groups should be linked to the ReFocus web page, to facilitate the sharing of knowledge and engagement with and between the groups. They should have clear remits and agreed level of attendance from all invited stakeholders. They should all cover reliability improvement and risk mitigation issues as well as sharing safety concerns and advice.

Example: Northern led the setting up of a refreshed mid-life DMU User group in 2008, modelled on the new Electrostar User group. It is now more effective, with a pro-active approach to reliability issues and better engagement from key players.
Example: Eversholt led the setup of a new User Group for Electrostars in 2007, with the following terms of reference:

- To provide a forum for a periodic stakeholder high-level review of Electrostar fleet performance
- To identify emerging issues and trends and ensure that action plans are in place to address identified areas of concern
- To provide strategic direction and guidance on these common issues to the TOC, ROSCO and Bombardier teams responsible for delivering Electrostar fleet performance
- To identify and encourage the implementation of industry best practice and lessons learned from other fleet programmes to the benefit of overall Electrostar performance.

Example: Porterbrook coordinates the Turbostar User group which was re-launched in 2008. Each meeting now focuses on no more than two train systems, sharing best practice in maintenance, operations and reliability initiatives.

15.2 Common bits and issues

ROSCOs are in a unique position to take a lead in the improvement of components/systems and issues/challenges which apply across several or even all fleets.

Some of this will be most effectively done in an on-going User Group style (e.g. Cummins User group, Voith steering group). Other challenges are better addressed with a specific working party. The ROSCO role can be one of pump priming to resolve specific issues.

Example: Oil carry-over on Sprinters and Pacers – Angel and Porterbrook led the development of a design solution to this issue, setting up a project-based TOC/ROSCO group. They then progressed to installation designs for each vehicle Class, and trial fits, cooperating with candidate TOCs. Roll-out is progressing, although some delays have been caused by stock transfers between TOCs and refranchising, and some business cases may not be viable.

It would be much easier to make effective comparisons and spot trends sooner if we were able to collate data more consistently e.g. if we had agreed vehicle models and cause codes. This would facilitate the sharing of ReFocus data at a layer below the vehicle performance, and was recommended in NFRIP’s January 2008 Pacer Benchmarking report as applicable to all fleets.

For more details and examples on Supplier Management, please see Section 12.

15.3 Optimising for Duty Cycle

ROSCOs facilitate the transfer of maintenance plans. If well-documented and understood, these can be particularly useful when fleets are moved to undertake different duty cycle requirements, whether within the same franchise, or TOC to TOC.

ROSCOs are in a good position to observe practical examples of Duty Cycle related maintenance and share best practice.
Example: Class 317 fleet maintained at Hornsey depot. Most of the fleet operated frequent stopping services, whilst a small, dedicated Stansted Airport fleet ran faster, longer distance services with only limited intermediate stops. Door maintenance frequency of the Stansted fleet was reduced relative to miles run, to reflect the reduced number of door operations per unit mile; traction motor maintenance was also adjusted to reflect the higher speed running and the reduced number of high current starts. To help maximise DMU availability and avoid changing wheels between bogie overhauls, C4 mileages were related to wheel life. Where wheel life was driven by tread wear caused by braking, this related to stopping patterns in service. For example, at Newton Heath in the mid-1990s, Class 150 C4 mileage was 325,000, whilst Classes 153 and 156 were 350,000 miles, reflecting the different Duty Cycles.

Three recent examples of Duty Cycle-related maintenance are:

- NX East Coast Class 91 (Eversholt),
- NX East Anglia Class 170 (Porterbrook),
- the Desiro fleets (Angel).

Example: Eversholt commissioned a Strategic Maintenance Review, to identify the theoretical maximum exam periodicity for each element. This involved extensive condition assessments, gathering lots of data and using Failure Modes and Effects Analysis (FMEA). The output is an integrated maintenance regime, involving some time-based elements (e.g. things inside the vehicle such as contactors, relays), and some mileage-based elements (e.g. bogies, running gear, traction motors). This is all contained in one document including all Level 1-4 and Level 5 maintenance. The same document is used by Eversholt, Bounds Green, and Wabtec.

The result is that periodicities are optimised, based on the current duty cycle of the fleet. The TOC’s “little and often” policy means a lot of exams, although, if two larger exams are due around the same time, they are combined to reduce downtime. If, in future, fewer larger exams were preferable for the service, or duty cycles were to change, the data is available to inform relevant maintenance plan adjustments.

VTEC agree that the result is good, but believe it could have been achieved more quickly if the ROSCO had engaged more with the TOC initially.

Angel have since supported Siemens’ unified maintenance manual drive, where core maintenance requirements are identified, reflecting the various sub-fleet mileages and duty cycles. Condition assessments are being conducted, to increase knowledge of wear patterns and deterioration, to determine optimum life for different components. This is seen as a continuous process: SWT and Siemens are aiming to achieve 1 million miles between component overhauls.

Example: A Value Improvement Programme (VIP) was carried out on the Class 170 fleet at Norwich Crown Point, involving Porterbrook, Bombardier and Depot staff. The VIP brings a group of people in a room and, in a structured way, gets them to do the obvious things (which they haven’t been doing!). The behaviour of the senior people from each company can make the difference. VIPs generally solve relationship and process problems; this one contributed to a maintenance regime review too. The review led to some reduction in planned workload, and releasing resource for fault finding. The refreshed Turbostar User group is now sharing duty cycle optimisation for 170/171 fleets, building on the work Bombardier, Porterbrook and AGA have been doing.

Example: The Desiro fleets include the Class 350 at London Midland and TPE, 360 at AGA, 380 at ScotRail, 185 at TPE as well as the SWT 444 and 450. Angel was particularly supportive in facilitating Siemens’ performance on 360 introductions, providing powerful technical support, insisting on mods and escalating issues as appropriate.
15.4 **Fleet Transfer / Cascade**

15.4.1 Smooth transition of rolling stock transfer / cascade and introduction to service

When a transfer of rolling stock takes place from one TOC to another, there are many elements to consider, which, cross many business functions; including engineering, operations and commercial. Good management of these elements will lead to a successful transfer of rolling stock in either receiving or returning vehicles.

Whatever the reasons for transferring stock between TOCs, a handover plan should be agreed by all stakeholders. The following document shows some of the key areas which must be considered in order to manage the initial planning and introduction / transfer stages as well as introduction of units into service.

Required timescales vary depending on the type of cascade. For example introducing a fleet of unfamiliar units to the new TOC will require significant preparation time for training and possibly depot enhancements whilst a short term emergency hire of one unit can be arranged swiftly if it is a known unit to the receiving TOC and subject to a similar maintenance regime to those already carried out on other fleets. Even where the unit type is “known” by the receiving TOC it is important to recognise that there may be detailed differences with the specific unit(s) being transferred.

The purpose of this document is to provide guidance on aspects related to the preparation and planning of any stock transfer. It is not a complete plan. All stock transfers will have their own unique elements that must be considered and managed. Thorough and timely planning and preparation will lead to a smoother transfer. It should also be emphasised that good communication and working together with the delivering / receiving TOC and other key stakeholders is critical to a successful transfer.

15.4.2 **Type of cascade:**
- Small fleet versus whole fleet
- Short term versus long term

15.4.3 Initial planning phase of stock transfer (time prior to receiving / transferring rolling stock).

Outline plan development:
- Identify key milestones and the critical path to achieve the project timescales.
- Identify fleet compatibility and special requirements.
- Consider inclusion of TOCs, ROSCOS and OEMs e.g. Stock transfer support teams (small short term teams which have access to specific fleet experts).

Initial pre-delivery condition survey:
- Establish and agree with the leasing company the condition of the unit(s) being transferred including position in heavy maintenance cycle(s) and any non-standard equipment
- Establish what the impact on current fleets operated is:
  - Adequacy of spares.
  - Ownership of spares (split fleets and or different ROSCOS).
- Involve key stakeholders such as:
  - TOCs (Sending and Receiving).
  - Operations:
    - Simulators.
    - Driver / guard training.
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- Software (interactive / system).
- Sanding system configuration.
- Through gangways (operational safety and revenue protection implications).

- Commercial.
  - Lease type (Wet / Dry).
  - Hand-back condition.
- Seating configuration and passenger reservation requirements.
- Can current booking systems be changed to accommodate new fleets with different seating configuration?
- Train Planning
  - Sectional Running Times
  - Station dwell times (including door control configuration and method of door operation)
- Network Rail (Route / station suitability).
- Passenger Focus (Service expectations).
- ROSCO (Maintenance Plans and spares).
- Department for Transport (Are the trains suitable and timescales for stock transfer achievable?).
- RSSB (Derogations).
- RVAR (Derogations).
- Local Community (Short term increase in noise levels etc).
- Rolling Stock Library (Train configuration).
- Rebranding.
  - Changing the livery of rolling stock can be a very time consuming process and will require considerable planning as a separate project. Consideration should be given to the length of time that the stock will be run, i.e. short term transfers vs. long term transfer. Rebranding of rolling stock can also have implications with regards to PRM TSI regulations (contrasting colours etc).

15.4.4 Preparation of stock transfer and stock introduction:

- Service introduction path for new stock.
- Service level introduction of rolling stock (whole fleet or staggered introduction), even with the best planning and preparation it should be expected to suffer from some initial introduction failures.
- NIR resolution.
- Are there outstanding NIRs.
- Are there outstanding fleet checks to be completed prior to transfer?
- Maintenance support planning.
  - What maintenance support comes with the vehicles (OEM support, warranty support etc).
  - Are special tools required for maintenance of systems / components?
  - Is special test equipment required to maintain systems / components?
- Maintenance documentation.
  - VMI, VMP, COI, VOI etc
  - Unit history files.
  - Exam and overhaul history.
- Materials planning and additional spares.
  - OEM support.
o Second tier supplier support.
o Modification levels of spares.
o Special tools required to fit spares.

• Reliability growth plans. With the introduction of unfamiliar / new rolling stock it should not be expected for the units to work out of the box. With this in mind, reliability growth plans should be developed which will work towards steady growth in reliability.
o Review process (regular and detailed reviews of defects).
o Trend analysis (by system and by component).
o The sharing of reliability data from the existing TOC to the new TOC is desirable and will only aid in developing reliability growth plans.

• Stabling of additional units and overnight berthing arrangements.
• Is sufficient capacity available? Passenger Information Systems.
o Uploading new route information.

• Training programmes for staff to maintain unfamiliar rolling stock (consider where a limited number of initial units are available or where training must take place prior to stock transfer).
o Conflict may become apparent between the requirements of engineering and operations where unit availability is required for engineering / driver training at the same time.
o What training manuals and other training aids are available from the previous operator and can these transfers with / ahead of the stock?

• Rolling stock configuration.
o Selective door opening.
o Mandatory modifications.
o GSM-R
o Modifications for route compatibility.
o Driver Operation Only (DOO) etc.
o Driver cab configuration.
o Defect log books.
o Aide memoirs (fault rectification).
o Other modifications, experiments and trials, specifically non-standard equipment

• Route compatibility.
o Are stopping boards in the correct position.
o Monitors / Mirrors for DOO.
o Signalling distances.
o Stepping heights and distances (raised platforms) may be greater for different stock.
15.4.5 **Rolling stock reconfiguration / reformation**

There may be instances where the rolling stock being received by the TOC whilst suitable is not in the correct configuration to meet the company business need. For example, Northern Rail received 3 car class 150 units. This did not fit with the Northern Rail diagrams and planning requirements. The units were therefore reconfigured to 2 car 150 units. This must be done with the full co-operation of the train owners (ROSCOs). Reconfiguration / reformation also introduces many other aspects which must be considered which have been previously mentioned. However, consideration must also be given to the introduction of systems which have not been enabled for an extended period of time. For instance, class 150’s have a driving cab in the middle of a three car formation, when a reformation takes place to convert to a two car unit the middle vehicle will be used as a driving cab in a 2 car train. This will require all the cab functions and other systems to be enabled which had previously been isolated. There is also a requirement to inform ‘Rolling Stock Library’ of any reformations so unit numbers and mileages can be changed and tracked. Maintenance plans and documentation must also be aligned with the new train configuration.

15.4.6 **Facilities**

In order to maintain the transferred rolling stock, it is critical that the maintenance facilities are suitable. A compatibility check against current stock maintained is an ideal position to start from. Where non-compatibility is identified further detailed assessment will be required with the possibility of maintenance facility changes taking place. This should cover:

- Space envelope.
  - Length of vehicle.
  - Maximum length of train set.
  - Height of vehicle.
  - Weight of vehicle.
- Lifting and jacking equipment.
- CET facilities.
- Wash plant / Roads.
- Primary power source.
  - AC Traction.
  - DC Traction.
  - Diesel.
    - Fuel station and rigging.
    - Extraction (exhaust fumes).

15.4.7 **ROSCO.**

Arrangements to clarify configuration of vehicles should be detailed, including all supporting information for each vehicle, such as:

- NIR resolution status
- stage in maintenance plan e.g. last balanced B exam
- any deferred work
- any outstanding defects or open repairs
- any known problems or special control measures
The ROSCO is responsible for eliciting and transferring the above data from all maintenance providers. (In the past, 3rd party maintainers have not always been asked to supply the information they hold.) In practice, the ROSCO may actively arrange for direct dataflow between depots, but it retains responsibility for the completeness and quality of the data provided to the receiving TOC. Obviously, with Dry leases, the outgoing TOC has a greater obligation to provide details compared with Wet or Soggy leases.

Negative examples exist to underline that an agreed TOC/ ROSCO FMP can be effective in preventing reliability drop-off as stock is transferred to another operator. Negative examples also headline the benefit of having “headroom” i.e. additional stock and/or time. There are also positive examples within TOCs such as First and NX, and also with Porterbrook and ATW. A risk workshop with appropriate people can be an effective tool to manage a smooth stock transfer and minimise potential impact on reliability.

15.4.8 Check lists.

Check lists can be a very useful tool to ensure all elements of the task have been completed. Northern Rail has developed several key check lists from experience gained from many fleet transfers. Appendix F contains examples of the checklists used. The following check lists are only to be used as guides and should be adapted for the individual TOC and type of rolling stock.
16 Overhaul Management

This chapter focuses on the overhaul of rolling stock and / or their components.

The industry has recognised a risk that vehicles re-entering service post-overhaul can suffer from a reduction in reliability.

Analysis shows that reliability for fleets coming out of overhaul can vary widely, with there being no overall correlation between pre- and post- overhaul reliability.

Graph 1: An example of a fleet with improving reliability immediately post-overhaul.

Graph 2: An example of a fleet with declining reliability immediately post-overhaul.

The good practice identified in this chapter aims to address the issues which cause fleets to have a post-

E.g. doors, bogies, gearboxes, engines etc.
overhaul reduction in reliability and to help RoSCos, TOCs, maintainers and Overhaulers ensure that overhauls optimise fleet reliability when re-entering service.

This chapter is structured on a generic high level overhaul process (figure 1), with good practice identified at each stage. Each overhaul will have its own complexities, so the guidance should be followed with consideration taken for the specific fleet overhaul in question.

**Figure 1: The High Level Overhaul Process**

16.1 **Need for Overhaul Identified from Horizon Plan**

The publishing of horizon plans is good practice particularly if they are reviewed periodically and updated to incorporate recent developments. It enables the industry to form a more complete view of overhaul plans and timescales nationally. Conflicts for resources can be identified quickly and efforts can be made to smooth out demand. It also provides the supply chain with information they can use to secure investment for future bids.

**Example:** Porterbrook openly publishes a six year overhaul plan on its website. This gives visibility of work which will become available for tender in the future and gives suppliers the ability to plan future bids.

16.2 **Define Specification**

The purpose of defining the overhaul specification is to provide clarity to all involved parties of what is expected to be achieved from the overhaul process. If done well it reduces the likelihood of:

- unacceptable performance delivery during the overhaul,
- undesirable reliability post overhaul,
- additional / unforeseen costs to the overhaul,
- delays / late delivery; and
- poor quality delivery

all of which can bring reputational damage to the industry and have a negative impact on passengers.

This section will be split into four sub-sections in order to provide clarity around the good practice recommendations:

- Timescales for creating and agreeing the overhaul specification,
- Method for creating and agreeing the overhaul specification,
- Content to be included in the overhaul specification; and
- Clarity over the intended outcome of the overhaul.

16.2.1 **Overhaul Specification Timescales**

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3 E.G. C4 exams are historically more predictable than C6 exams; frequently a minefield presenting numerous potential additional challenges.
The amount of time required to create an overhaul specification will vary from project to project. Factors which will influence the time required include:

- The complexity of the overhaul,
- The number and experience of stakeholders involved,
- The size of the initial scope; and
- Lessons to be learnt from previous overhauls.

It is critical that the overhaul specification is suitably developed prior to contract award in order to avoid late notice contract variations which can result in additional costs and delays being incurred.

### 16.2.2 Overhaul Specification Method

By employing a truly collaborative approach⁴ to developing an overhaul specification, it should create an environment where all parties are properly bought-in to the overhaul process and its outcomes. RoSCos and TOCs should aim to learn from previous overhauls to ensure specifications are created in appropriate timeframes. This includes considering removing tasks which no longer add value⁵.

It is recommended that the overhaul specification should be jointly developed by the Overhaulers, OEMs, RoSCo(s) and TOCs / maintainers. By taking a tri-party approach to creating the overhaul specification it starts the process on a collaborative bought-in footing. A horizon plan can help Overhaulers create a case for investment in this process but framework agreements are also a good solution.

The tri party approach to overhaul specification may also need to be extended to include other parties, particularly where a fleet is common to other TOCs and RoSCos. ACOP1006 provides a framework for multi-party Engineering Change and where possible fleets should be standardised unless there is a valid business case to do something different e.g. duty cycles.

Design for Quality is a good framework to develop the overhaul specification.

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**Example:** Alstom uses a V model to plan their overhaul design and delivery. This Development for Quality (DfQ) process is used to verify project maturity and re-evaluate risks at pre-determined stages of a project. The process is a series of formal, checklist based reviews, emphasising the importance of the project team understanding the significance of identifying and making transparent any potential risks before moving between each stage of the project. The DfQ model is illustrated as follows:

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⁴ BS11000 is a collaboration standard.

⁵ Subject to an appropriate risk assessment.
The overhaul specification should be jointly owned and periodically reviewed by the engineering teams within both RoSCos and TOCs/maintainers during the operation of the fleets to capture lessons learned and good practice. All changes in condition should be noted and captured for the next overhaul. Moreover, good practice which is captured during overhaul should be shared by RoSCos. For example, updates to drawings or Engineering Change (EC) process details should be incorporated into future specifications for overhaul.

16.2.3 Overhaul Specification Content

Expected train condition should be set out in the overhaul specification. If there are any significant differences in asset condition, it can lead to delays for work to begin while it is agreed how these differences will be accommodated. Therefore, condition assessment prior to overhaul is essential in specifying the overhaul regime. It must occur during or prior to tendering and again just prior to the actual overhaul, to get an up-to-date position on asset condition. As a minimum, it may require a survey and audit of at least one or more vehicles.

It is good practice to involve TOC operations staff to ensure that opportunities to make improvements to the train from the users’ perspective are taken into account.

A risk based approach should be taken when planning for corrosion. Technology such as endoscopes are cheap and can be used to inspect hard to reach areas of the body and underframe.

Former British Rail overhaul specifications may assume a level of competence which does not reflect modern maintenance practices and so additional instructions or changes to the overhaul specification may be required.

A good specification should consider how testing will be performed and what test equipment needs to be developed. This should include pre-testing of relevant systems by the overhauler in advance of component removal / overhaul. Testing should be done on the train at a system level and prove functionality. Testing should involve components that were not directly overhauled but which form part of systems with components which were overhauled. Any issues identified in testing should be analysed for the root cause and used to review the overhaul specification with an intention to eradicate or minimise the occurrence of the issue. Consideration should be made as to which components may / will be
disturbed during the testing process and what might need to be removed. Best practice would be to test all disturbed components (pre and post overhaul) to ensure functionality is retained. The specification should require that data captured during overhaul and testing be captured in a manner whereby it can be manipulated and processed. For example, spreadsheets and tables programmes such as word or excel are easier to analyse and manipulate than paperwork, scans of paperwork or PDFs.

The specification should also consider capturing images prior to and during overhaul so condition can be retrospectively reviewed.

16.2.4 Overhaul Specification Outcomes

It is very important that the TOC, RoSCo and Overhauler have a clear and consistent understanding of the desired outcomes of the overhaul.

Specifiers should focus efforts equally on:

▪ improving the reliability of the entire train as appropriate\(^6\);
▪ restoring its condition back to that of a brand new vehicle as appropriate\(^7\) and;
▪ incorporating changes to ensure the vehicle is fit for purpose, easier to operate and maintain.

It is important to understand the performance of the fleet with respect to these points prior to and post overhaul and the specification should take into account how this will be measured.

In addition to reliability outcomes, the financial outcomes also need to be considered. There include:

▪ the cost of overhaul itself,
▪ lifecycle costing; and
▪ future maintenance costs (including consideration for equipment / systems which do not currently have a maintenance plan in place but may require one).

16.3 Select Overhauler

The ITT for overhaul should ensure there are suitable service level agreements in place to incentivise the correct behaviours from all parties. This could include penalties to operators who fail to present a unit for overhaul on time and penalties for Overhaulers to fail to return the units back to the customer on time in a suitable condition.

An overhauler is recommended to respond to the procurer’s questions by use of a compliance matrix.

Good practice shows that a number of different criteria\(^8\) should be used to assess the quality of a bid. These can then be compared to the price to establish which bid presents best value for money. Some options to consider are shown below:

▪ **Alignment of business models.**
  Do the business values of potential Overhaulers match your business values? If not could this cause problems in the future as and when issues need to be resolved?

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\(^6\) Taking into account the level of overhaul required and a scrutiny of the TOC fleet class reliability.

\(^7\) This may not be practical for older vehicles which may require a level of accepted tolerance.

\(^8\) These should be requested in the ITT.
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- **Capability.**
  How capable is the potential overhauler of doing the work? Will specialist skills be required? How is the potential overhauler planning to cover them (in-house or sub-contract)? It is important to be confident that a potential overhauler can reliably undertake the work.

- **Capacity.**
  Can the bidder adequately demonstrate that they can cope with additional work to that which they are already contracted to deliver? While it is important to a supplier to maximise the use of its facility, it is important that this will not impact on deliverability.

- **Deliverability.**
  How much confidence is there in the potential overhauler’s ability to deliver an on time programme? Late delivery can cause operational and therefore reputational damage to TOCs, so it is critical that the overhaul programme is delivered on time. Bidders should submit an overhaul programme for scrutiny which demonstrates how experience will be gained (either through learning from the first unit, having a ‘glass case’ train or utilising pilot runs as relevant) prior to increasing production.

- **Quality and standards.**
  How will potential overhaulers guarantee the overhaul will be delivered to an acceptable quality standard? Will accredited suppliers be used? Is quality process management an embedded part of the operation?

- **Cost of overhaul and impact on whole life cost.**
  How does the cost of the overhaul impact the whole life cost of maintaining the fleet? It may be tempting to choose the overhauler bidding the lowest price, however it may turn out to be a false economy as it may mask additional costs into other areas. Elements such as warranty being offered and impact on maintenance costs need to be factored in.

- **Location of overhauler’s facility relative to fleet’s base depot.**
  Is the potential overhauler close to the fleet’s base depot? It can be difficult and expensive to transport fleet around the country so it is important to consider how it will be done and what impact any fluctuations to the overhaul schedule will have on the ability to move fleet.

It is also good practice to involve a number of stakeholders in the evaluation of the proposal. When an overhauler is rejected they should be clearly informed of the reason why their bid was unsuccessful and what they would have needed to do to have won the bid.

**16.4 Mobilisation**

Good practice is for mobilisation to commence is at least a year in advance of a major overhaul and that the Specification definition is complete. It is critical that this time is kept sacrosanct.

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9 This should be defined in the overhaul specification.

10 i.e. the time between agreeing the contract and receiving the first unit.
Example: Alstom uses 12 months to plan between H exams and builds on previous experience.

This time is required to:

▪ create a robust overhaul plan,
▪ ensure there are enough staff with the correct competencies; and
▪ ensure that the facility, materials, documentation and tooling are ready.

16.4.1 Creating a Robust Overhaul Plan

Overhauls can be very complicated and have a number of constraints which need to be understood. Not all constraints can be easily removed, so the plan needs to make adequate provision for them. This includes (but is not limited to):

▪ learning from previous overhauls,
▪ programme risks,
▪ interdependencies with other projects,
▪ critical path,
▪ critical resources,
▪ impacts of long lead times,
▪ human resourcing,
▪ site layout; and
▪ the need for specialist work to be undertaken off-site.

The creation of a robust delivery plan is key to the successful delivery of an overhaul programme. Critical chain project management is a useful tool to ensure a plan is deliverable.

Where possible, try to co-locate as many overhaul activities as possible to minimise transportation times. Where necessary, Customers should perform a make versus buy analysis to decide where and why to outsource overhaul activities. This equally applies to their third party suppliers.

Transporting trains to an overhaul location by rail barrier wagons / translators provides a logistical problem as there are only seven pairs located on the GB rail network. Good practice is to avoid the use of these wherever possible.

Example: Southeastern utilises the Rail Operations Group to move their Class 375 units for overhaul to Derby. The need for barrier wagons is negated by using a modified Class 37 locomotive with Dellner couplers.

Overhaulers will aim to reach the steady throughput rate\(^{11}\) as early as possible as this will reduce the total time taken to complete the entire overhaul and will minimise the time assets are out of service.

In order to achieve the steady throughput rate as early as possible in the overhaul programme, it is a good idea to do a pilot run\(^{12}\) prior to receiving the first asset from the TOC. It is also a good way of exposing staff to overhaul tasks pre-overhaul which will support their personal development and to allow them to become familiar with the process, tasks and materials.

\(^{11}\) i.e. the time taken to overhaul most assets.

\(^{12}\) A pilot run is a preliminary study conducted to evaluate feasibility, time and adverse events in an attempt to improve upon the process design prior to commencement of a full-scale programme of works.
Where it isn’t be possible to do a proper pilot prior to overhaul it is still worth trying to simulate as much activity as possible to identify any issues. Production bottlenecks should be reduced / eliminated so as to ensure maximum throughput and lean techniques can be used to improve throughput. See Section 16.8 Overhaul Appendix for more detail.

Example: Wabtec, Doncaster, have invested in a new paint shop as this stage of overhaul was acting as a bottleneck to production. Their new Class 321 facility has also been built to allow for vehicles to be lifted over each other so as to remove any bottlenecks surrounding movements within the facility.

Example: Alstom’s Longsight depot is set up around a “pit-stop” strategy, where all materials are located close by where they will be required on the unit. This is due to the depot overhauling specifically Class 390 units. Wabtec, Doncaster, however, is capable of overhauling a wide variety of rail vehicles and therefore a strong planning process needs to be in place to ensure that, if a similar strategy is to be implemented, plenty of time is assigned for developing where materials will be located.

It is recommended that Overhaulers implement a longer term continuous improvement plan to build on the learning from successive overhauls. Planning to learn for future overhaul programmes is about pro-actively planning to learn from current work practices.

16.4.2 Human Resourcing & Competency

When planning for an overhaul, the timing of staff recruitment is important, alongside the identification of the skills and competency they are required to have. It is important to set out clear roles and responsibilities for staff. Having a RACI\(^\text{13}\) can help to achieve this.

It is good practice to ensure skilled project managers are one of the first additions to any overhaul team. When considering the standard of project managers, a datum should be set around specific qualifications (e.g. APMP). Such managers should experience of the application of lean techniques (see Section 16.8 Overhaul Appendix for examples of lean techniques).

For all staff recruitment, good practice is not to rely on CVs and interviews to assess competence of potential staff (although these things are important) but to also use testing procedures involving genuine examples of overhaul work to score potential candidates’ capabilities and identify training and development needs.

KPIs to drive the overhaul business can also be developed based on these competency assessments if they are revisited periodically.

Example: Alstom requires all new contractors joining the overhaul team to undergo a competence assessment to verify that their skills match their CVs. At this time, a record is kept of the skills which each new contractor possesses and uses this to form a framework to match required skills for each task to those available and enables them to report any shortages as a KPI.

BR-built units are usually hand-built and therefore there are tolerance differences between units. Staff

\[^{13}\] A matrix which identifies who is responsible, accountable, consulted and informed for the activities undertaken.
should therefore be granted additional pre-series exposure with these units to become familiar with the variances in vehicle manufacture prior to undertaking overhaul.

Training should also be provided on the use of key pieces of overhaul equipment\textsuperscript{14}.

Where contracting staff are used, it is good practice to consider providing incentives near the end of the contract to retain the essential skills required until the final unit is completed.

\textbf{Example:} Alstom utilises a tool retention bonus whereby ensuring that no tools are lost. In short, the fewer tools lost, the greater bonus obtained. Tool stores are therefore checked twice daily.

Where the overhauler’s workload may fluctuate over time, it is beneficial to try to retain key staff during “down” times, as this will help to ensure consistency and minimising skills loss.

Mobilisation should plan for quality checks throughout the overhaul process from component arrival to final testing and returning the unit. Good practice is to use peer review processes so each team owns responsibility for passing on quality work.

\textbf{16.4.3 Non-Human Resources: The Facility, Components, Tools & Documentation}

The facility should be set up to ensure the overhaul process flow is designed to lean principles (see Section 16.8 Overhaul Appendix) to maximise flow through the facility and to reduce opportunities for process based errors from occurring.

It is important to consider the impact an overhaul could have on small commonly shared component floats as it could negatively affect (other) operators. Therefore, the float of components required for overhaul should be bolstered to ensure that the level is sufficient to cover the overhaul cycle and continue supporting normal operation.

To ensure that good quality components are procured and used for the overhaul, suppliers should all be approved suppliers within the customer’s purchasing system. This applies for RoSCos, TOCs / maintainers\textsuperscript{15} and Overhaulers. Approvals should cover change management.

Components used in overhaul should be of a sufficient quality to fulfil their purpose. This should be included in the overhaul specification and that suppliers are made aware of the consequences of quality issues with their materials. Not only should the customer(s) make the overhaul supplier aware, but the supplier should actively engage with the customer(s) to identify quality issues.

Components should have a warranty appropriate to the overhaul specification and where practicable should be for the duration between overhaul cycles (e.g. C4 to C4).

Where obsolescence materialised during the overhaul it should be managed. Further details on this are located in section 12.6.

Each work station should be equipped with tools appropriate for the activity being undertaken. Tools should conform to relevant standards as necessary. Staff should have the correct training to use the tools provided. For smaller hand tools which are liable to be lost / damaged, shadow boards should be used to reduce loss / damage.

It is good practice to ensure that all documentation available to shop floor staff and supervisors (e.g. work instructions, designs, drawings, check lists etc.) fully support the overhaul specification, are up to date,

\textsuperscript{14} Some equipment requires training & certification in order to be used.

\textsuperscript{15} Maintainers are classified as organisations undertaking the day to day maintenance of rolling stock on behalf of a TOC.
change controlled and easily available to the appropriate people.

16.5 The Overhaul

This stage considers delivery of the plan created during mobilisation to the standard defined in the specification. Each time an Overhauler goes through this process it provides an opportunity to make improvements and to identify improvements for future overhauls using lean techniques.

In order to identify the areas where efficiencies may be made (without negatively impacting on quality) Overhaulers need to ensure they are collecting relevant data.

Example: Knorr-Bremse has a 5 year industrialisation plan to improve the efficiency and quality of overhaul work being undertaken at its Wolverton facility.

In order to provide clarity around the good practice recommendations, this section has been split into four areas:
- Receiving the train.
- Working on the train: a lean process.
- Working on the train: the culture.
- Evaluating the results.

16.5.1 Receiving the Train

Transportation of the vehicles to and from overhaul facilities is a critical element of the overhaul. It is important that the mobilisation locks this element of planning down early and throughout the overhaul it is managed carefully as alterations can result in repercussions for all other plans including missing vehicle movement slots; often the next available slot is not for another week.

When trains or train components arrive for overhaul, they will be tested to check that their condition meets expectations as part of the acceptance process. A status of conformity should be agreed between the Overhauler and the provider. This extends to parts and materials which should be thoroughly inspected to ensure no faulty goods are accepted. A risk based approach is most appropriate as it is impossible to check all materials and components. Goods inwards should be arriving with a certificate of conformity to confirm the goods are to specification.

If the asset condition is not as described prior to the provider releasing to the Overhauler, the asset provider should give consideration to:
- starting discussions with the Overhauler about the asset condition at the earliest opportunity in order to minimise delays; or
- releasing a different asset which meets the specified condition, allowing the provider and overhauler time to agree a plan for the non-conforming asset (without affecting the critical path for overhaul delivery).

16.5.2 Working on the Train: A Lean Process

The overhaul plan will typically allow more time for the first few assets going through the process in order for staff to gain confidence in the process and to identify any issues without creating delays in the overall programme of works. This is a good opportunity to monitor the effectiveness of the process, especially if there wasn’t the opportunity to undertake a pilot run. Lean techniques can be employed to identify and
correct process problems. See the overhaul appendix for more details.

**Example:** London Underground treats the first two units to pass through an overhaul programme as ‘glass case’ examples. The purpose is to trial, fine tune and finalise implementation techniques and processes. It also allows additional time and resource to be allocated to check that assumptions about fleet condition and the overhaul plan are correct and ensures that the plan is achievable for future units.

When confidence in the overhaul tasks is gained, the process can be made more efficient. The Overhauler should analyse all activities which take place (including waiting or down time) and seek to minimise those which do not directly improve the asset as per the overhaul specification.

### 16.5.3 Working on the Trains: The Culture

It is good practice to utilise the knowledge and experience of staff doing the overhaul when trying to identify and implement process improvements.

It is good practice to ensure that staff perform the same task in the same way. If a member of staff identifies an improvement to the way a task is undertaken, there should be a clear process to implement the change. This will ensure that everyone gets the benefit from any improvements and that learning is standardised and embedded.

It is good practice to ensure that there is accountability at all stages in the overhaul process and that defects / quality issues are identified, recorded in a log and rectified as early as possible, however it is important to do this without creating a blame-culture. Using ad-hoc peer checks (or peer mentoring) to inspect work at each stage in the process can be beneficial to both new and experienced staff. A “fresh pair of eyes” helps combat the concept of “work blindness”, whereby flaws may not be evident to the worker, whereas a third party can identify any issues more easily.

**Example:** Wabtec utilises coloured overalls to easily identify the competence levels of staff. Where more senior technicians identify staff who may require assistance/advice, they have a useful visual indicator to understand which skill level they are addressing.

Documentation is vital to record accountability and increase ownership of work. Names signed next to records of work or use of swipe card identity cards will ensure traceability. Sign-offs should be managed so as to not delay the overhaul process or encourage blame to be placed simply because a defect can be traced to an individual. Documentation should be produced in a format which is easily analysed (e.g. .CSV file and not in a free text format).

Ensure Service Affecting Failures (SAFs) are constructively fed back to staff, and include them in the process of eradication from the overhaul process. Consistent bad news can reduce morale, therefore this should be balanced with good news stories.

**Example:** Alstom provides a plasticised booklet to all staff indicating previous SAFs/mistakes. These provide an “incorrect vs correct” point of view so as to provide a positive message to staff and encourage these issues to not happen again in future.

It is also good practice to sign off all consumables (where appropriate).

**Example:** Alstom requires all staff to sign off the use of Loctite upon use including which type and the expiry date. This is to combat the use of out-of-life consumables.

Implementing formal handovers at each stage in the overhaul process is beneficial as it provides the opportunity for defects to be identified before more work is done to the asset (thereby reducing the impact of any re-work). Using a formal handover checklist is ideal, as it will help to ensure clarity and
16.5.4 Evaluating the Results

When each train gets to the end of the overhaul it will be tested in preparation for return to passenger service. It is good practice to involve the TOC in this process. The following points should be considered:

- **Quality**: This is the final opportunity the Overhauler has to identify any quality issues and correct them prior to returning the train to passenger service. Taking a systems approach to this final check is critical. If issues are discovered after the train has been returned into service, it is much more difficult and costly to investigate and fix them.

- **Time**: Is the train being returned on time? If the train is being returned late, it is important to identify the factors which caused the schedule to be missed. The overhauler and TOC need to be realistic about whether these issues can be improved upon for the next train going through overhaul or whether the end to end time for overhauling a train needs to be revised. An honest and evidence based approach needs to be taken when revising the plan for future trains to ensure that it is realistic and achievable.

- **Documentation**: The Overhauler should provide the TOC with the engineering measures and results for the overhauled train, along with details of any deferred work (as per the overhaul specification). While it is convenient for all parties to provide these results in an electronic format, it is worthwhile both parties reviewing them jointly.

16.6 Contract Review

The contract review provides an opportunity for all parties involved in the overhaul to make a joint and structured assessment of the whole overhaul programme.

The review should look at whether intended outcomes were achieved and if not, which factors caused this. It is important that feedback is balanced and fair. If there were a number of problems during the overhaul, it is important that the review is not overly negative as this will not encourage an open assessment. Overhaulers should supply a number of metrics which can be used to evaluate the success of their programme in terms of quality, time and cost. The review should assess what went well so that good practice can be embedded in future overhauls.

The review should also seek to review the tri-party relationship and assess whether it worked as well as intended or whether it could be improved for the future. It is a good idea for all parties to provide feedback on the contractual incentive / penalty conditions and how this was managed. It is important to ascertain what impact, if any, they had the overhaul outcomes. It may be worthwhile asking an independent party to facilitate this discussion in order that it doesn’t seem one-sided or dominated by a particular point of view.

Lastly, the review should seek to review the overhaul specification in order to understand how it might be improved for future overhauls. The results of test results should be fed back into the overhaul specification, providing an enhanced outline of work based on experience from both completed units and initial condition assessments.

16.7 Trains Back in Service

This is the point at which the overhaul programme is effectively over. The post-overhaul review between the RoSCo, TOC / maintainer and Overhauler will have been completed and normal fleet management
processes will have resumed for the whole of the affected fleet.

This is a good opportunity for individual stakeholders to do an internal review of the whole overhaul and identify good practice / learning for the future.

TOCs / maintainers can use the opportunity to review their standard fleet maintenance processes and check that they remain fit for purpose for the overhauled fleet.

It is also good practice for TOC performance teams to check whether the overhauled fleet is delivering the projected performance and reliability improvements which have been agreed as part of the performance improvement process.

The data used during overhaul can also be used to shape future maintenance, future fault finding and engineering change.
17 Outsourced Maintenance

This Section contains best practice in managing outsourced maintenance. However, these principles don’t just cover the obvious case of a TOC that has sub-contracted all of its engineering to another major company. Some of the issues are just as important to a TOC that does most of its work in-house, but has engaged a contractor to carry out a modification programme as an addition to normal maintenance activity.

The principles can be applied to:

- Service Provision contract – the train is totally under the control of the maintenance company until handed over for service at the depot outlet
- Full Maintenance contract – the depot is still operationally controlled by the TOC but all engineering work is done by the supplier
- Joint Venture – management of maintenance is shared commercially and the work force may be drawn from both the TOC and the maintenance supplier
- Extended Warranty – a rolling stock manufacturer has a continuing on-site commitment for rectification of defects
- Technical Support contract – a rolling stock supplier has a long term obligation to provide depot-based technical support
- Special Projects – a team of contract staff are retained for a modification or reliability improvement programme

Any of the above may include supplying spare parts for maintenance and repairs.

Many of the points made in this Section are also relevant to the management of heavy maintenance, which is in effect ‘outsourced’ if it is done through the ROSCO or by another outside contract.

Whatever model is chosen, make the contract arrangements clear and simple, so that accountability for service delivery is unambiguous. This is particularly important in a joint venture where it can be easy to forget who is responsible for what, with resulting loss of focus on reliability and performance.

17.1 Reasons for choosing Outsourcing

Use of outsourcing is a strategic business decision by the train operator, and this is not the place to discuss the economic choices involved. The purpose of this Section is to help anyone who has already decided on some level of outsourcing, to make a success of the arrangement. However, any company following the outsourcing route needs to be clear why they are doing it, and what they expect as a successful outcome. The TOC should check that the contract delivers against at least one of the following three strongest reasons for outsourcing:

- to offset the technical risks associated with a new train fleet and ensure the train builder has a long term stake in the success of its product
- to obtain expertise and resources not available to the train operator without disproportionate effort or expense, or to share commercial or logistical risk with an established partner (this point may be especially relevant to smaller or independent train companies)
- to obtain additional short term or marginal resources and expertise.
17.2 ‘Golden Rules’

The three important principles for a successful outsourced maintenance contract are:

1. **Relationships.** The ‘join’ at working level between maintainer and train operator needs to be as seamless as possible to deliver a consistent and high quality product to traincrew and passengers.

2. **Ownership and engagement.** The TOC (as Railway Undertaking) continues to ‘own’ the delivery of a reliable and safe train e.g. must ensure effective management of safety and competency issues.

3. **Still apply the rest of the 20PP!** The advice in this document is just as relevant to a contractor as to an in-house maintainer. Supplier and client will need to work together to put the 20PP into practice. For example, outsourcers may be managing maintenance plan risks (see Appendix D) which relate to business risks for both companies.

### 17.2.1 RULE 1. Relationships – partnerships (and better) for performance

Major outsourcing contracts are distinctive in that the customer may have difficulty switching supplier in any but the longest term. Failure of the supplier to provide the service could be a potentially fatal business risk to the client. Finding an alternative provider is even harder where a maintenance contract is linked to new train procurement.

This means that many of the usual sanctions (e.g. termination, renegotiation, introducing competition) may not be realistic options for dealing with a contract that it is not going well. A different approach is needed to ensure that the parties continue to work together, whatever difficulties arise along the way. In contracts of this type, a ‘partnering’ approach is not simply a ‘nice to have’ but an essential element for a successful outcome.

It is also important to be alert for financial, industrial relations or other problems in the supplier’s organisation. If there is a partnering approach, such problems are less likely to appear at the last minute, and it may be easier to work out contingency plans. The ‘no surprises’ rule works both ways – an informed supplier may be better able to help a client in a difficult situation.

The relationship can go further than partnership:

<table>
<thead>
<tr>
<th>Example: VTWC sees relationship management models moving through the following stages:</th>
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<tr>
<td>• Combative – hardball negotiations to get what you want at the expense of the other party</td>
</tr>
<tr>
<td>• Co-operative – an ongoing exchange of services on mutually acceptable terms</td>
</tr>
<tr>
<td>• Partnership – seeking to maximise value from productivity and joint developments</td>
</tr>
<tr>
<td>• Collaborative – creation of competitive advantage for both parties</td>
</tr>
</tbody>
</table>

VTWC/Alstom consider the following as a sign they have reached the collaborative stage:

| • Close relationship with shared values and common goals |
| • Work together to develop trust between the parties |
| • Performance regime changed to incentivise even small improvements |
| • Contract amended to reflect how the parties actually work together |

Whatever the relationship, the elements that need to be tackled by both parties can be grouped as follows:

**Organisational**

- Make sure that the client and supplier organisations are complementary, i.e. that they ‘fit’ together in a coherent way and responsibilities are clearly understood.
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- Empower the local contract managers to make all the necessary routine decisions, and to get immediate back-up from other parts of their company when needed. It is very important for the supplier to provide a ‘one stop shop’ to the customer.
- Escalate any genuine commercial disputes promptly to senior level so that front line managers and engineers can concentrate on continuing to work together to provide the train service.
- Make the contract arrangements appear as ‘joined-up’ as possible to the rest of the world. It should not matter to a member of traincrew, a passenger or a third party such as Network Rail, who is doing what to resolve a particular problem. The joint output is what matters.

Cultural

- Encourage the supplier and his workforce to identify with the success of the client train company. This can be done with team building sessions, joint training initiatives, joint ‘branding’ etc. and by making sure maintenance staff get the chance to ride the trains in service and see performance from the passenger point of view.
- Ensure the manager’s suppliers fully understand the business and operational needs of the client.
- Maintain regular liaison at senior management level, even when things are going well.
- Build trust; both partners must ensure their local management teams have the confidence of their counterparts.

Example: one of the keys to the excellent Class 357 fleet performance is seen as the relationship between C2C and Bombardier, which is carefully nurtured. The same information systems are used by both parties, so that all information is shared. Depot procedures are jointly developed, rather than imposed. Many joint social events are arranged.

17.2.2 RULE 2. Ownership and engagement - Integrate the supplier into day to day operations

Team Working – part of the running railway

The real-time nature of a transport operation means that there is no time for contractual discussions or ‘arms-length’ relationships at working level. If the supplier is only a partial player in the overall maintenance activity (as is the case with warranty and technical support contracts) they should be treated simply as a division of the TOC’s maintenance resource. If the outsourcing is more extensive, then the supplier should be working closely with the train operations delivery team to provide the service to the paying passenger.

Example: The Maintenance Controller/ Technical Rider team on TPE is seamless, working on one roster, although some people are paid by the TOC and some by Siemens.

The relationship with traincrew and their managers should be strong so that problems at the driver/train interface are dealt with quickly, openly and effectively. This may involve joint production of fault finding guides, staff briefs and user manuals. The TOC has an equal part to play here; it can’t just expect the supplier to do this spontaneously.

At another level, the outsourced provider should be an integral part of the rail industry as a whole. Where relevant, the supplier should participate in industry reporting systems (such as National Incident Reports) and join wholeheartedly with industry initiatives such as ReFocus and ARTTT (see 12.2).
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Safety and competency

It is essential that safety and competency are pro-actively managed by the TOC as Railway Undertaking. In particular:

- Ensure competency assessments are based on outputs, through audits and process checks, based on operational risks and hazards – not just on training records.
- Ensure competency requirements extend to the supplier’s managers and team leaders, not just to front line staff.
- Insist on strong follow up to technical safety problems so that long term solutions, as well as immediate fixes, are implemented.

If the depot is still managed by the TOC but used by contractor’s staff, then occupational Health and Safety is an important issue.

- Ensure the maintainer’s method statements and risk assessments are relevant to the location involved, and not too generic.
- Work together on routine Health and Safety management activities such as safety tours and accident investigations.

Example: C2C work closely with their maintenance supplier Bombardier on competency and HASAW Issues at East Ham Depot. Initiatives include:

10 Auditing each other’s Health and Safety arrangements
11 Using common procedures for occupational safety matters (e.g. depot protection, accident investigation)
12 Joint training programmes – all staff get the same message
13 Undertaking In Process Checks of supplier’s personnel

17.2.3 RULE 3. Don’t forget the rest of 20PP

Two key areas to highlight here are Performance regimes and Maintenance planning:

Performance Regimes and Performance Management

A robust and relevant performance regime does two things. It encourages the supplier through financial incentives and it provides a yardstick to judge the overall success of the contract. It should never just become a way of punishing the supplier for failure.

In constructing the contract, make sure that the performance regime:

- Reflects the key performance indicators by which the TOC itself is judged (e.g. use the standard industry definitions for delay minutes, see Appendix A)
- Has individual penalties that are sufficient to concentrate the mind of the supplier, and match the business risk to the TOC, but are not punitive (disproportionate penalties may constitute unfair conditions of contract and turn out to not be legally enforceable)
- Does not cap the total performance payment level at too a low a figure

The financial value of a performance regime should be enough to allow the supplier to build a business case for investing in necessary improvements to his product or service.
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The performance regime must also cover the availability of customer services on the train (e.g. toilets, heating and ventilating, information, catering). To get satisfactory results in this area the train company will have to play its part in setting up reliable fault reporting systems and put personnel in place to monitor quality, and operate the systems.

For successful performance management both parties must:

- Adequately resource the reporting, measurement and monitoring systems
- Establish the facts of any incident as quickly as possible
- Settle routine claims promptly, escalate any disputes, and avoid a backlog of unresolved disagreements

But remember: a performance regime on its own is no guarantee of success, and may not always be appropriate to small contracts where there is less money at stake. Avoid being trapped in a situation where the supplier finds it preferable to pay the penalties rather than fix the problems. Financial compensation is very much ‘second prize’ compared to good contract delivery by the supplier, especially if it is your reputation that is suffering. To be fully successful, the performance regime must be backed up with positive contract management and a ‘will to win’ from both sides.

Example: The performance of Northern’s Class 323s significantly improved following a tendering exercise won by Alstom. Factors behind this include: an agreed performance improvement plan in the contract; Northern removing their Site Engineer from Longsight so Alstom have more freedom to manage, and transfer their culture change across to Class 323s; the presence and engagement of Washwood Heath engineering expertise at Longsight.

Maintenance Planning

TOCs should always ensure that the maintenance schedule is the best possible. Even if the supplier carries the financial risk of doing the work efficiently, the client will still see a major business benefit if reliability and availability are maximised through optimal maintenance. To help achieve this, the TOC should ensure that it exercises its rights of approval as Railway Undertaking over the maintenance regime. Remember you may also have obligations to the rolling stock owner to check that the maintenance is done properly.

Points to watch include:

- Check that train maintenance frequencies promised in the original contract offer are being met
- Check that all parts and sub-systems of the train are adequately covered in the maintenance regime (see Appendix D for risk model)
- Insist that the maintenance schedule is fine-tuned to the service requirements of the particular fleet – generic schedules may under- or over-maintain equipment relative to the usage it gets on a particular network
- Always exercise rights to approve changes to the schedule
- Seek C4 to C4 warranties where appropriate
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Be actively involved in maintenance planning and allocation to operational diagrams. Particularly on a complex network, day-to-day operational requirements can upset the carefully crafted programmes of maintenance planners. It is therefore best if all operational decisions are taken by the TOC so that the risks of units running out of fuel or going overdue maintenance are managed by the people accountable for overall service delivery to the passengers.

In the case of contract staff undertaking modifications or reliability improvement programmes, it is important for the TOC to have a very clear view of progress. Such work is sometimes carried out on an ad hoc basis at a number of locations: the TOC should control when and where each modification is being completed on each train.
18 Business Continuity Management

Business Continuity is the strategic and tactical capability of the organisation to plan for and respond to incidents and business disruptions in order to continue business operations at an acceptable pre-defined level.

Business Continuity Management follows a cyclical process of analysis to understand threats and requirements, determination and implementation of contingency strategies, and the validation of planned response through testing and exercising.

Before you start the BC programme, it is advisable to get buy-in from top management and key staff, define and win approval for a project budget, and set detailed timelines for the programme.

18.1.1 Programme Management

In order to implement and maintain an effective business continuity programme, it is imperative that the TOC establishes a Business Continuity Management System (BCMS). Whilst this should be under the coordination of a designated business continuity manager, it is vital that the BC programme is sponsored at the highest level in the organisation, and the following documentation should be signed off by top management. The BCMS should contain the following elements:

18.1.2 Definition of Scope
- Services and locations covered by the business continuity programme
- Organisational objectives and obligations
- Acceptable level of Risk
- Planning assumptions
- Statutory, regulatory and contractual duties
- Interests of key stakeholders
18.1.3 Business Continuity Policy

- Strategic prioritisation of assets and services
- What the organisation will undertake to implement and maintain the BCMS
- Roles and responsibilities
- Statement of endorsement by top management sponsor
- BC programme communication and awareness programme

18.1.4 Policies for Establishing, Maintaining and Reviewing Plans

- Provision of Resources
- Competency of BCM personnel
- Business Impact Analysis
- Risk Assessment
- Incident Response Structure
- BCM Exercising, testing and training
- Maintenance and Review of BCM arrangements
- Internal Audit
- Management Review
- Preventative and Corrective Actions

18.1.5 Understanding the Organisation

In order to implement appropriate contingency strategies, it is necessary to take a structured approach to understanding critical business needs. The two main tools applied in the business continuity programme are the risk analysis and Business Impact Analysis (BIA) processes. The outcome of the risk analysis and BIA is to gain a full understanding of the threats and resource dependencies for the activities that make up the key services of the TOC.

18.1.6 The Risk Analysis Process

In most organisations, a formal risk analysis process is already undertaken, and it is vital that operational risk outcomes from this process are understood in the context of the business continuity programme. The Risk Analysis process should include:

- Gathering of data on threats and previous incidents
- Scoring of threats against likelihood and impact
- Assignment of a plan for individual risks (Treat, Tolerate, Transfer, Terminate)
- Assigning responsibility/deadlines for treatment plans
- Regular Formal review of Risk Analysis by defined committee (as defined in the BCMS)

18.1.7 The Business Impact Analysis

The BIA is the single most important, and generally time consuming, process in the business continuity programme. The purpose of the BIA is to define the criticality of the activities that make up the TOC’s services, and to identify the resources on which this activity depends (NB. The data from this process is most valuable at “activity” rather than “service” level). The data gathering process that should be followed is:
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- Identify services and departments defined in BCMS scope
- Define the impact of activity disruption, and therefore business’ acceptable period of activity disruption
- Define all resource dependencies (location, staff, IT support, technology, etc)
- Define the minimum resources required to re-commence activity over time
- Define the recovery times for each resource on which the activity depends; ensure that the recovery time is less than the tolerable period of disruption.

18.1.8 The Plan

Once the BIA and risk analysis have been completed, strategies for incident response can be developed. Data from the analyses will indicate which activities are most critical to the organisation, and what the likely threats to their continuation are. The response strategy, as detailed in the plan, should be devised in line with this intelligence.

18.1.9 The Incident Response Structure

Each team within the incident response structure should have a plan. Typically, organisations will follow a three tier Gold (strategic), Silver (tactical) and Bronze (departmental) command structure. All teams should be supported by a trained executive support team.

The incident response structure should identify process to:

- Confirm nature and extent of an incident
- Trigger an appropriate BC response
- Have plans, processes and procedures for the activation, operation, coordination and communication of the incident response
- Have resources available to support plans, processes and procedures to manage an incident
- Communicate with stakeholders
The roles of these teams are:

18.1.10 **The Plan Itself**

The plan itself should be a useable document, available to the response teams at the point of need. All responding staff should be familiar with the plan. All teams identified in the incident response structure should have ownership of their own plan. Each plan should:

- Have a defined purpose and scope
- Be accessible to and understood by those who will use them
- Be owned by a named person who is responsible for their review, update and approval
- Be aligned with relevant contingency arrangements external to the organisation
- Identified lines of comms

18.1.11 **Key tasks and reference information**

- Defined roles and responsibilities for people and teams having authority during and following an incident
- Guidelines and criteria regarding which individuals have the authority to invoke each plan and under what circumstances
- Invocation method
- Meeting locations and alternates, up to date contact lists and mobilisation details for any relevant agencies, organisations or resources
- Process for standing down
- Essential contact details for all key stakeholders
- Details to manage the immediate consequences of a business disruption including:
  - Welfare of individuals
18.1.12 Details of organisation’s media response including:

- The incident communications strategy
- Preferred interface with the media
- Guideline or template for drafting a statement
- Appropriate spokespeople
- Method for recording key information about the incident, actions taken and decisions made
- Details of actions and tasks to be performed
- Details of the resources required for BC/recovery at different points in time

18.2 Maintaining and Reviewing Plans

A plan can only be considered to be reliable once it has been exercised. It is also vital that the plan is maintained in line with the policies documented in the BC management system.

Procedures should be adopted that ensure a structured approach to exercising, corrective and preventative measures, management review and (internal) audit.

**Exercising** the plans, at departmental, tactical and strategic level is the most effective way of ensuring that key staff are familiar with the response strategy, and that the plans meet their aim. All plan holders should be exercised at least annually, according to a progressive exercise schedule. Exercises can be as simple as a desktop walkthrough of plans, through to complex simulations. It is recommended that the complexity of exercises develops with the confidence of the teams. The organisation should:

- Exercise to ensure BCM arrangements meet business requirements
- Develop Exercises consistent with the scope
- Have an Exercise programme approved by top management to ensure Exercises are held at regular intervals / after significant change
- Undertake a range of Exercises to validate the whole BC plan
- Plan Exercises to minimise the risk of the Exercise causing disruption
- Define aims and objectives of every Exercise
- Undertake a post Exercise review to assess achievement of Exercise aims and objectives
- Produce a written report of the Exercise – outcome, feedback and actions required

18.2.1 Corrective and Preventative Measures

The organisation should take action to guard against potential incidents and prevent their occurrence (or re-occurrence). Preventative and corrective actions taken shall be appropriate to the potential problems. The documented procedure should define requirements to:
• Identify potential issues and their causes
• Determine and implement actions needed
• Record results of actions taken
• Identify changed risks and ensure that attention is focussed on significant changed risks
• Ensure that all those who need to know are informed of the issue and actions
• Prioritise actions in alignment with RA and BIA

18.2.2 Management review

Management should review the business continuity management system and programme at planned intervals and when significant changes occur. The review should include opportunities for improvement and the need for change in the BC management system. The results of the reviews should be clearly documented.

18.2.3 Audit

The audit processes for the Business Continuity programme should be consistent with the TOC’s organisational audit procedure. It is however strongly recommended that any auditor undertaking a review of business continuity plans at the TOC has appropriate experience within the field of business continuity.

Any audit programme should be planned, established, implemented and maintained by the organisation taking into account the BIA, RA control and mitigation measures from the results of previous audits.

Audit procedure(s) shall be established, implemented and maintained that address:

• The responsibilities, competencies and requirements for planning and conducting audits, reporting results and retaining associated records
• The determination of audit criteria, scope, frequency and methods

18.2.4 Conclusion

However diligent the risk analysis process, however well managed the health and safety programme is, however well maintain stock is – incidents will always occur.

The ability of an organisation to respond to an incident is significantly improved by following a structured business continuity programme. The reputation of the organisation will be under close scrutiny in the aftermath of an incident – plans that meet the pre-determined continuity challenges of an organisation, carried out by trained teams are the best.
19 Useful Links

Railway Industry information

Find the latest fleet performance data, industry 20pp complete or for sections as required. Industry contacts can also be found at this site.

https://engineeringportal.atoc.org

Improving Rail’s Energy Efficiency

A series of reports produced by RSSB produced covering traction and non traction energy use and traction energy metrics in 2007/2008.


Whole Life Carbon Footprint of the Great Britain Rail Industry

This report was produced by RSSB for the Rail Technical Strategy Advisory Group (now TSLG) in 2010.


The GB Sustainable Rail Programme

The GB rail industry established the Sustainable Rail Programme (SRP) to respond to the opportunities and challenges presented by sustainable development and to contribute to the delivery of key government policy objectives such as reductions in greenhouse gas emissions, sustainable mobility, increased social inclusion and a thriving economy. The SRP is led by cross-industry and Government stakeholders and facilitated by RSSB.

http://sustainablerailprogramme.rssb.co.uk/Libraries/SD_Self-Assessment_Library/User_guidance.sflb.ashx

The Rail Sustainable Development Principles

The Sustainable Development Principles represent core values of the rail industry and are fundamental in delivering a sustainable railway at the centre of the transport system that meets the travel needs of society without compromising future quality of life.

https://www.rssb.co.uk/improving-industry-performance/sustainable-development/rail-sustainable-development-principles

A Guide to RSSB research in Energy

Research in the energy topic covers traction energy sources, electrification safety, electrification systems, fixed interface equipment and vehicle mounted interface equipment.

https://www.rssb.co.uk/Pages/research-catalogue/T928.aspx

A Guide to RSSB Research in Sustainable Development.

This includes reference to research programmes for driver advisory information for energy management and information (T724) and eco-driving: understanding the approaches, benefits and risks (T839).
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https://www.rssb.co.uk/pages/research-catalogue/t839.aspx

Research Brief: Investigation into the use of bio-fuels on Britain’s railways T697 August 2010.

The research has examined the advantages and disadvantages associated with the use of bio-fuels in the rail industry.

https://www.rssb.co.uk/pages/search-results.aspx#k=t697

Managing Rail’s environmental impacts in Control Period 5 and beyond

This document, produced in 2010, sets out a way forward for managing the GB rail industry’s impact, developed through the Sustainable Rail Programme (SRP) and its Carbon Reduction Working Group, and endorsed by the Sustainable Development Steering Group (SDSG) of cross-industry executives. It includes both carbon emissions trajectories and lists possible carbon efficiency interventions in CP5 (2014 – 2019).


Energy Efficiency for Railways (UIC, 2008)

This booklet has been prepared by RDG (Rail Delivery Group) on behalf of UIC (International Union of Railways). Titled "Process, Power, People", it provides practical insights for train operators into tackling energy efficiency through process improvement, technology, training and motivation of staff.

www.uic.org/IMG/pdf/uic_process_power_people.pdf

Transport for London: Sustainable Development

This webpage on the TfL website provides information about TfL’s approach to sustainability, including tackling energy and climate change issues, and sustainable procurement.


UIC and UNIFE websites on Energy and Carbon emissions

The webpage on the UIC (International Union of Railways) and Railenergy websites describes some of the initiatives in which the UIC and UNIFE partners have been involved in pursuit of energy efficiency and carbon emissions reduction.

www.uic.org/spip.php?rubrique1584

www.railway-energy.org

The website public area allows download of energy and environmental documents, and staff of RDG member companies and partner organisations can apply to join the Engineering Extranet which contains more detailed information.

https://www.raildeliverygroup.com/

Environment and energy policy document September 2010

https://www.raildeliverygroup.com/about-us/publications.html
Energy and Emissions Statement 2006/7 (October 2007),
https://www.raildeliverygroup.com/about-us/publications.html

Initial Industry Plans September 2011
https://www.raildeliverygroup.com/about-us/publications.html

General information and educational sources

The Engineering Institutions have Energy, Environment and Sustainability Groups or Sectors that organise conferences and seminars, and provide responses to Government consultation

www.imeche.org/knowledge/industries/energy-environment-and-sustainability/overview

www.theiet.org/sectors/energy/about.cfm

Forum for the Future is a charity committed to sustainable development. This means developing an enriching and enjoyable way of life that does not threaten the global environment or rob future generations of resources.

www.forumforthefuture.org

Government and EU agencies

The Carbon Trust is a private company set up by Government in response to the threat of climate change. Their mission is to accelerate the move to a low carbon economy by developing commercial low carbon technologies and working with business and the public sector to reduce carbon emissions.

www.carbontrust.co.uk

The Energy Saving Trust is a non-profit organisation, funded both by Government and the private sector. Their aim is to cut emissions of CO2 by promoting the sustainable and efficient use of energy.

www.energysavingtrust.org.uk

Envirowise delivers a government-funded programme of free, confidential advice to UK businesses. This assistance is aimed at enabling companies to increase profitability and reduce their environmental impact.


The Low Carbon Buildings Programme provides grants for the installation of microgeneration technologies in a range of buildings to include households,
community organisations, public, private and the non-profit sectors.

www.lowcarbonbuildings.org.uk

The European web portal for energy efficiency in buildings, legislation, guidance.

www.buildup.eu (energy use in buildings, legislation, guidance etc)

BESS programme (Benchmarking and Energy Management Schemes in Small and Medium-Sized Enterprises)

A benchmarking tool and support programme developed as part of the Intelligent Energy Programme sponsored by the European Commission.


Standards

British Standards are available from the British Standards Institution

www.bsigroup.co.uk

PAS 2050 2011 Specification for the assessment of the life cycle of greenhouse gas emissions of goods and services provides a method for assessing the life cycle of GHG emissions of goods and services

Railway Group Standards are available from the Railway Safety Standards Board

www.rgsonline.co.uk

GMRT2132 Issue 1 September 2010 On-board Energy Metering for Billing Purposes sets out the energy metering requirements when electric traction units are fitted with an energy metering system that provides data for billing purposes.

https://www.rssb.co.uk/rgs/standards/GMRT2113%20Iss%201.pdf

UIC/UNIFE Technical Recommendation – Specification and verification of energy consumption for railway rolling stock - TecRec 100_001 March 2010

Appendix A - Evidence Flow Chart

This flow chart can be used to help decision making where Fleet believe an incident should be disputed and there is no initial evidence on first examination of the fault log to indicate the incident was due to a technical casualty. It is worth bearing in mind a few factors as you go through the flow chart. Firstly, can any other responsible manager better deal with the incident than fleet? Secondly, the purpose of delay attribution is primarily to do with collecting data on asset failures and would your dataset be better or worse without the incident?

1. On Train Data Recording can demonstrate the incident was not technical (Remote Condition Monitoring, OTMR FFCCTV, etc)
   - Yes
   - No

2. Have Crew reported the vehicle id and summary of the symptoms in the fault log?
   - Yes
   - No

3. Can a depot test procedure prove that the vehicle is operating as specified?
   - Yes
   - No

4. Do contextual photographs provide evidence that the incident was due to extreme external causes?
   - Yes
   - No

5. Does statistical evidence demonstrate the issue is not vehicle specific or is specific to the vehicles location?
   - Yes
   - No

6. Does statistical evidence demonstrate the issue is crew specific?
   - Yes
   - No

7. Fleet should probably accept the incident if not as a technical incident then as a NFF and use the minutes to either improve reliability or diagnostics to support future disputes
   - Yes

Fleet should be satisfied to dispute the incident
INTRODUCTION

The idea to produce this specification arose from a cross-industry workshop in December 2007. The workshop aim was to challenge fleet people to deliver their next big step change in reliability. Asset improvement was one of the key issues, noting that good maintenance facilities and practices are just as important in providing reliable trains as modifications to the vehicles themselves. This specification for ‘High Performing’ Maintenance Facilities has subsequently been put together by active members of a sub-group.

The list of depot requirements which follows includes all the elements that you would expect to see in a modern, purpose built, train maintenance facility and is in line with what you would find in the rest of Europe. However, we recognise that one size does not exactly fit all, and recommend that the requirements should be customised for each project that involves new or significantly upgraded maintenance or servicing facilities.

It is accepted that in some cases it will not be possible to justify all the features on the list. However, when producing business cases, the true cost of not providing certain features should be taken into account. For example, not having space for storage of consumables at point of use could add several man-years lost productivity over the course of a franchise. Further, ReFocus has case studies of reliability improvements made by point-of-use stores implementation freeing up productive people to resolve root cause, address deferred work, etc.

The scope and design of new or upgraded maintenance facilities should take full account of depot flow (e.g. to minimise the number of movements between the different facilities within the depot), and should also be designed to minimise unproductive time and maximise the touch time on the vehicles.

There also need to be clear plans for overhaul and renewal of maintenance facilities. It is recognised the vehicles themselves have a finite design life, after which they are renewed, with periodic overhaul during their life. The same principles need to be applied to the facilities in which the rolling stock is maintained (although the design life of the buildings and equipment will be different). Responsibilities between the Infrastructure Manager and Lessee for renewal, overhaul and maintenance need to be clearly defined, as they are for rolling stock.

MAINTENANCE DEPOTS

Maintenance Berths

- Separate berths for servicing, light maintenance, heavy maintenance and lifting/major component change.
- No more than [80%] utilisation of any bay (based upon down time for both planned and unplanned activities, average unit mileage and maintenance frequencies).
- Some flexibility provided regarding the use of bays for different activities.
- All berths to have extraction equipment for diesel emissions (DMU depots only).
- Able to isolate OHLE or 3rd rail for each road separately (EMU depots only).
- All berths to have shore supplies, air supply and battery charging points.
- All berths to have pneumatic supply and power points.
- Foot-printed areas to be provided next to each bay for oil storage etc.
Suitable pit lighting to be provided.

Access to pits to provided at each end and at intermediate points.

[Where justified] A bogie drop pit to be provided in at least one maintenance bay. It should be possible to place any bogie within a normal unit formation over the drop pit without fouling other roads or having vehicles stood outside the building.

All clean fluids (oil and coolant) to be piped to point of use.

All waste fluids (oil and coolant) to be piped from point of use.

Side pits and centre pits to be provided in all servicing and light maintenance bays. Centre pits only to be provided in heavy maintenance bays. Pits to be designed to suit the type of rolling stock being maintained.

Fixed roof access equipment in at least one berth. Further berths to have roof access in line with the production use of the berth.

At least one set of jacks suitable for a synchronised lift of a full unit in normal formation to be provided. Where justified, separate jacks should be provided for heavy maintenance and for planned component change.

Each berth should have depot protection designed around one unit of normal length. (Depot protection required across the whole site.)

An overhead crane to be provided in at least one heavy maintenance bay and on any jacking road.

Fork lift truck access should be possible on both sides of each bay.

Paint Facility

As a minimum one berth to be provided with extraction equipment to allow touch up painting.

For larger depots consideration should be given to providing a dedicated paint facility.

Fuelling Facilities

The length of fueling roads to be capable of accommodating maximum length of formation of arrivals on depot.

Fuel road capacity should be based upon each road being turned over no more than [6] times per night.

Fuel dispensing equipment should allow all vehicles on a fuel road to be fuelled simultaneously.

The fueling area should be covered.

All pipes should be suspended off the ground and trays provided to collect spillage.

IT system at fuel point to allow fuel registration or input of defects.

Equipment should be provided to allow fluids to be topped up at the fuel point.

Underframe Cleaning Facility

Automatic underframe cleaning equipment should be provided, which is capable of cleaning the full length of a unit in normal formation.

Lances to be provided to allow localised cleaning of the underframe.

Access to the underframe cleaning facility should be provided direct from the depot arrival roads.

More than one boiler should be provided to give an element of redundancy to the underframe cleaning equipment.

Wheel Lathe
Fleet Management Good Practice Guide: The Twenty Point Plan

- The wheel lathe should be capable of exporting data to industry systems.
- A ground wheel lathe should be provided [on a ratio of 1 lathe to 300 vehicles].
- The wheel lathe road should be long enough to allow any vehicle of a normal unit formation to be placed on the lathe without the need to split the unit.

Wash Plant

- The wash plant should be capable of working at temperatures down to [-3]°C.
- A device is to be provided to warn drivers if they exceed the required speed, except where it would distract drivers, as exit signals are present.
- The wash plant should be capable of cleaning the vehicle roof and side skirts.
- Wash plant brushes should cater for all types of vehicle allocated to the depot.
- The wash plant should be capable of working on soap, acid or water only.
- The wash plant should be fitted with a basic underframe cleaning system and full biohazard kits to deal with fatalities etc [if proven].
- Provision should be made for automatic vehicle identification.

Controlled Emission Toilet Emptying

- Should be capable of simultaneous emptying of all toilets in a typical rake.
- Should be capable of emptying a CET tank from full in no more than [5] minutes.
- Covered accommodation should be provided for the operator.
- A facility to manually discharge CET tanks should be provided.
- The CET emptying facility should be at the fuel point if necessary.

Stores etc.

- Covered storage to be provided for all components, including large items such as engines and gearboxes.
- Space should be provided adjacent to each bay for the storage of tools, low value consumables and other components for efficient exchange at the point of use.
- An area to be provided where major components can be built up.
- Workshop facility to be provided for the in-house overhaul of components.
- Electronics clean room to be provided.
- Jobbing shop, including small welding facility to be provided.
- Adequate workshop and messing facilities for subcontractors.
- Load bank or dynamometer facility.

Office/Staff Accommodation

- Sufficient accommodation to be provided in the form of offices, mess rooms, meeting rooms and classrooms.
- There should be a mixture of open plan and enclosed offices.
- Easy to maintain messing facilities and locker room facilities should be provided.
- Mess room to be shared with traincrew if possible.
- An area should be provided for a communication centre and for start of shift briefing etc.
- A depot IT network should be provided that is fast, efficient and future proof (including the provision for IT at the maintenance berths).
Fleet Management Good Practice Guide: The Twenty Point Plan

- Space for train crew cab simulator – better to have at maintenance depot to ensure fleet and operations relationships are cemented.

Cleaning Facilities

- Cleaning facilities to be covered where possible.
- Access platforms to be provided.
- Shore supply to be provided.
- Hot and cold water to be available adjacent to vehicles.
- 13 amp power points to be provided.
- Storage facilities to be provided.
- Mess room to be provided adjacent to cleaning facilities.
- IT facility to be provided to allow inputting of work done.
- Dry room for seat covers, carpets etc. Dry cleaning facility, where justified.

Stabling Facilities

- Sufficient stabling berths to be provided that, under normal planned circumstances at peak time for departures, will not be more than [90%] utilised.
- Ideally each departure road should not accommodate more than 2 rakes of units.

Access to Depot

- Access between the main line and the depot arrival road should ideally be provided at both ends of the depot.
- Each arrivals road should be long enough to accommodate the longest foreseeable rake of vehicles that will arrive on the depot.
- The depot should have a simplified signaling system that is operated from the production office, but complex depots may require a more substantial control panel.
- Electrified depots should have an independent power supply such that off-depot isolations do not affect depot supply.

Depot Environment

- Adequate lighting and safe walking routes to be provided around the depot.
- Depot to be securely fenced.
- Security facilities to be provided at depot entrance.
- CCTV to be provided covering the depot entrance.
- Sufficient car parking to be provided for the foreseeable depot workforce.
- Road access to be provided for a low loader (in case of moving vehicles by road).
- Lorry turning circles for stores access, and road access for stores at correct end of depot, without need for isolations or line blocks.
- Depot to be very close to a triangle, or within one, to enable reorientation of train sets or vehicles.

Light Maintenance Depots

At a typical Light Maintenance Depot the facilities under the above sections on Fuelling Facilities, Cleaning Facilities and Controlled Emission Toilet Emptying should be provided as a minimum. In addition at least one light maintenance bay should be provided, as described in the above section on Maintenance Berths.
Servicing Locations

At a typical servicing location the facilities under the above sections on Fuelling Facilities, Cleaning Facilities and Controlled Emission Toilet Emptying should be provided as a minimum.
## Appendix C - Supply Chain Sub-group Issues List

<table>
<thead>
<tr>
<th>Category</th>
<th>Issue</th>
</tr>
</thead>
</table>
| Franchise change-management | Consideration of spares management arrangements and spares float issues affected by vehicle cascades (float transfer / ownership / access)  
Order cover for long-lead items during franchise transition periods  
OEM consultation in franchise discussions relevant to fleet or spares issues  
Also consider non-franchise routine transfers / sub-lease arrangements |
| Configuration management  | Confirm a configuration base i.e. robust component/product configuration information, including up-to-date  
Procurement / overhaul / repair specifications (reference back to OEM specs where relevant)  
Drawings  
Configuration (modification) status  
Differentiation of approach between repairable components and consumable items may be necessary. Consumable management may be more straightforward – a quick win?  
Maintain the integrity of the configuration base by having a robust and linked ‘Management of Change’ process between industry stakeholders, i.e.  
Between supplier & TOC/ROSCO customers (change can be initiated either way)  
Between suppliers i.e. 1st, 2nd, 3rd tier (changes can be initiated either way)  
Consider the requirements of ACOP 1006  
Why is the approval of generic changes (e.g. axle reclamation procedures) problematic?  
Design Authority responsibilities defined for components/products/software  
Software management |
| Managing repeat offending or rogue components | Warranty return & diagnostic testing processes which can replicate faults, supporting root-cause diagnosis & preventing NFFs *(generic process/flowchart needed to benchmark existing processes against)*  
Is there a difference of approach for components in or out of warranty, and if so why?  
Managing ‘repeat offender’ product failures (rogue components)  
How are discrete component repairs managed with respect to component overhaul cycles?  
Supplier awareness of product/component operational reliability issues, via TOC/ROSCO feedback.  
Processes for continuous improvement  
Supplier involvement / feedback from fleet user groups  
Suppliers challenging product specifications if weaknesses are identified  
Preventing product-specific NIR issues or other technical problems re-occurring on similarly designed products (i.e. dealing with the full spectrum of an issue, not just a localised issue) |
<table>
<thead>
<tr>
<th>Managing material availability</th>
<th>Awareness by TOC logistics/spares managers of the existence of, and how to execute, spares management contract frameworks &amp; agreed obligations in place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consideration of spares requirements during major projects, mandatory modifications or new build procurement</td>
</tr>
<tr>
<td></td>
<td>Consideration of material requirements for whole life of vehicles</td>
</tr>
<tr>
<td></td>
<td>Managing float condition (clean/dirty); both ongoing and at lease end to maximise availability</td>
</tr>
<tr>
<td></td>
<td>Pooled resources (material floats)</td>
</tr>
<tr>
<td></td>
<td>Appropriate scaling of spares if fleets are leased to &gt;1 TOC</td>
</tr>
<tr>
<td></td>
<td>Ensuring appropriate and accessible storage of material at the point of use, e.g. a depot</td>
</tr>
<tr>
<td>Economies of scale</td>
<td>Standardised and rationalised products where possible to increase volume, and resulting economies of scale</td>
</tr>
<tr>
<td></td>
<td>Could existing pooled spares arrangements be combined in the future to increase spares accessibility?</td>
</tr>
<tr>
<td>Obsolescence</td>
<td>Suppliers proactively advising industry of product obsolescence issues</td>
</tr>
<tr>
<td></td>
<td>Being proactive about whole life required of components (supply risk, research into alternatives, re-base lining components which have reached the end of their natural life e.g. a VCB)</td>
</tr>
<tr>
<td></td>
<td>Potential vehicle Life extension considerations – common cross-ROSCO fleet issues / common solutions / increased certainty of component life requirements</td>
</tr>
<tr>
<td>Adopting relevant best practice from non-UK passenger rail</td>
<td>Benchmark against other rail – UK freight, European rail, Hitachi, Siemens etc (maybe for specific categories or issues, but taking account of differing public/privatised frameworks)</td>
</tr>
<tr>
<td></td>
<td>Benchmark against other transport industries – Airline, Bus, Car (e.g. Nissan logistics)</td>
</tr>
<tr>
<td></td>
<td>Benchmark against non-transport industries – Food, MoD, Logistics, Utilities</td>
</tr>
</tbody>
</table>
## Appendix D – Ongoing Industry Supply Chain Workstreams

### Timely Supply of Material

<table>
<thead>
<tr>
<th>Issue</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Material Supply issues - What and where are the critical material supply issues – pinch points, key components etc?</td>
<td>Poll TOCs to identify their key material supply issues and concerns, including their perceived reasons for the issue or problem. Identify next steps to overcome any identified issues or problems.</td>
</tr>
<tr>
<td>Supply &amp; Demand – material supply for planned requirements perceived to be generally ok, but contingency material supply for unplanned requirements is often problematic, including seasonal factors (Levels 1-5). Suppliers sometimes struggle to meet volatile demand.</td>
<td>Poll TOCs to identify problem areas. Review and agree the contingency strategy requirements with the supply base.</td>
</tr>
<tr>
<td>Material Requirements Planning – What is a best practice model for customers and suppliers to adopt for forecasting, ordering and supplying material?</td>
<td>Define and update the 20PP to include a model that takes account of customer consumption (planned &amp; unplanned) forecasting, leading to proactive order placement &amp; timely supply, taking consideration of lead times. Organisations can then self-check against this model.</td>
</tr>
<tr>
<td>Stock on Shelf – How are minimum stock holding levels defined, e.g. BSI auto-couplers?</td>
<td>Decision criteria need to be understood, to ensure they reflect demand requirements for the industry as well as individual users. Problem areas need to be identified. Could the Network Rail performance fund be used to acquire additional material to address known shortages of common spares floats?</td>
</tr>
<tr>
<td>Dirty / Clean Status of Float Material – Concern that current supply arrangements do not always promote the stocking of clean (usable) and available float material on the shelf at suppliers. Poor component return condition can also inhibit this.</td>
<td>The industry needs to adopt an approach that maximises the usability of available float material (for which there is a demand).</td>
</tr>
<tr>
<td>Making Best Use of Small Material Floats – How can small material floats be used most effectively? e.g. minimising float turnaround timescales or standardising and combining similar floats where possible.</td>
<td>Identify ‘small float’ problem areas, review their utilisation, as a basis for recommending a way forward, both on a specific component basis and in terms of general best practice principles</td>
</tr>
</tbody>
</table>
### Management of ‘rogue’ components (repeat offenders)

<table>
<thead>
<tr>
<th>Issue</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing Consistent Defect Information to Suppliers – How can component failure information be robustly and consistently provided to suppliers, to maximise the chances of successful defect root cause diagnosis? Reporting and warranty return requirements between suppliers are different, and TOC approaches are also different.</td>
<td>Develop a generic template or checklist (drawing on current best practice from new-build and legacy fleets) for inclusion in the 20PP to enable the industry to adopt a more consistent approach for defect reporting across the TOC/ROSCO/Supplier interfaces.</td>
</tr>
<tr>
<td>Defect investigations on components out of warranty – Some suppliers do not investigate defects occurring on products out of warranty. Valuable information and knowledge is at risk of being lost, and the risk of keeping defective components within the supply chain is also increased.</td>
<td>Suppliers to ensure their defect investigation processes are not dismissive of components failing outside their warranty period.</td>
</tr>
<tr>
<td>NFF at suppliers is excessively high – This denudes float during the fault finding process, and increases the risk that defective products might be re-fitted to vehicles. More prevalent on safety systems where precautionary change-out often takes place. Concern that TOCs are not always aware of intelligence held by suppliers of product performance, and that TOCs do not always take full advantage of fault finding with a component in-situ.</td>
<td>Poll Suppliers to identify which components have high NFF rates. Use these components as case studies to work through jointly between TOCs and suppliers to better understand each issue, and to ensure TOC and supplier fault finding processes are aligned and supportive of each other. Suggest beginning with new-build OEMs, and then extend later to legacy fleets. Use the output of this as the basis for an industry best-practice model to be included in the 20PP.</td>
</tr>
<tr>
<td>Serial Number Tracking – Concern that serial number tracking is not being used as effectively as it could be for managing NFFs.</td>
<td>To be considered as part of above NFF case study review.</td>
</tr>
<tr>
<td>Issue</td>
<td>Solution</td>
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<tr>
<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>The industry needs a robust configuration base – Different stakeholders have different pieces of the configuration base and it is important for this to be consolidated somehow. It is important to define what is meant by configuration i.e. drawing, specifications, modification status</td>
<td>ROSCOs need to be responsible for vehicle configuration history and ensure it is updated to reflect changes made during heavy maintenance and enhancement programmes. TOCs must also provide ROSCOs with comprehensive and accurate configuration information for all changes made during their lease. The Supply base needs to have a robust view at component and product level.</td>
</tr>
<tr>
<td>Responsibilities for component and specification information – Components and specifications need a responsible owner, this can be especially unclear in relation to older vehicles.</td>
<td>Each component and specification needs to have a defined ‘responsible owner’, to provide a means for keeping configuration information up to date.</td>
</tr>
<tr>
<td>Linkage between overhaul periodicities and component duty cycles – There is no defined link between the specification of a component’s duty cycle, the extent to which duty-cycle is re-base lined by the COI, and the prescribed use of a component within a vehicle overhaul specification (which also don’t define the vehicle overhaul periodicity). This could lead to the incorrect management of component condition.</td>
<td>Component specification information needs to include details about duty cycle limitations of the component. The overhaul periodicity which is associated with vehicle overhaul instructions (VOIs) needs to be visible to suppliers (not always included in VOI).</td>
</tr>
<tr>
<td>Making component and specification information available to relevant stakeholders within the industry – PADS is used to an extent, but has recently had an upgrade, making it more user friendly and accessible via the internet. Some fleets use alternative systems to PADS, but the principle of enabling stakeholder access to information should be similar. Porterbrook is implementing a document tree initiative in PADS to link primary fleet overhaul documentation to COIs, components and drawings; this concept could be of use to other organizations.</td>
<td>The recent functionality enhancements of PADS need to be made aware to the industry. There may be a value to the industry increasing its use and adoption of PADS, where this is appropriate, to provide a consolidated configuration base. Porterbrook’s document tree initiative to be explained, as a tool for supporting the enhancement of document control. Could non-PADS fleets ghost their information into PADS to create a single reference source? Could the Network Rail performance fund be used to support some of these initiatives?</td>
</tr>
<tr>
<td>Integrity of PADS component information – Need to ensure that PADS contains correct component information, for example mod status, QA rating. Some older components are very sketchy on detail, and in some cases drawings and/or specifications do not even exist.</td>
<td>Deficiencies of component information/detail need to be addressed by the ‘responsible owner’. A review is needed, to understand the scale of this issue. Confirm that QA ratings in PADS agree with ACOP standards. Confirm PADS has the ability to store component mod status Need to ensure that the processing of part number information and associated detail in PADS has engineering input and is not purely an administrative activity.</td>
</tr>
</tbody>
</table>
**Changes to the configuration base need to be well managed –** Management of change to configuration, particularly between multiple stake-holders, needs to be carefully controlled and managed. The current industry approach appears to be varied in its application, and not fully joined up.

**Software/Firmware management –** A consistent industry approach is needed for software/firmware management including mod strike/configuration recording methodology & ESCROW considerations. There is a perception that an education gap exists in some areas of the industry with respect to software/firmware management, and support may be required to close this gap. There is best practice which can be learnt, for example software for Desiro component hardware is not installed until the point of vehicle fitment, and component mod strike status is for hardware only (software is handled separately).

**How can industry-wide approvals be made slicker and more effective? –** The approval of industry-wide procedures or common component enhancements is extremely time-consuming and problematic. It is difficult for suppliers to implement a revised procedure until all stakeholders have signed it off, resulting in stakeholders who have signed-off a procedure becoming frustrated that it hasn’t been implemented during the period of the approval process.

**Responsibilities for updating configuration information –** when a change is made, the update of drawings and documentation can sometimes be problematic

**Sharing best practice –** Product performance and consistency of product configuration would benefit if the industry shared product development information across similar systems on different fleets.

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**Review application of change management at organisations where this is perceived to be undertaken well (e.g. Siemens for Desiro)**

Use this as the basis for prescribing a best practice model against which organisations can self-check. The effectiveness of existing ACOP guidelines needs to be tested.

**Review the application of software management at organisations where this is perceived to be undertaken well (e.g. Siemens for Desiro)**

Use this as the basis for prescribing a best practice model against which organisations can self-check. Seek advice from outside the industry as well if necessary.

Method for raising awareness throughout the industry of software/firmware management principles to be considered.

Poll TOCs to seek their views on whether any problems are perceived to exist with ESCROW management.

**A more effective industry-wide process is needed for approval of common procedures or common product upgrades. The effectiveness of ACOP guidelines needs to be tested. Suggest progressing via existing cross-industry forum e.g. TSRG?**

**The process and responsibilities for updating configuration information following a change needs to be defined and briefed to the industry. There is recognition that no one party necessarily has an overriding responsibility.**

**A partnership approach, respecting commercial boundaries, should be promoted where possible.**
Appendix E – Examples of Best Practice Supply Chain Management

Example: Timely Supply of Material – Spares Holding
The best approaches to spares holding involve hard thinking (about how the parts are used by people) and analysis (about what the vehicles need when), in order to produce the right mix of location and accessibility for different items. It also involves trust (if you keep all the parts under lock and key, it will be at best less efficient for staff to access them). Best practice is to create trolleys of materials, tools and instructions for each type of routine activity (e.g. each B Exam). Trolleys include shadow boards for location of items. Parts used can be automatically booked to the vehicles.

Typical options for different types of parts for work arising / repairs integrate with depot facilities and include:
- Lineside vending machines for low value items with shelf life (e.g. Loctite) – machine dials the supplier when refill required
- Bins in the shed for low value bulky stuff e.g. white overalls
- Lineside supplies of frequently used items e.g. wiper arms
- Designated place(s) in the shed for bulky but expensive parts (and their paperwork) e.g. autocouplers, air-conditioning units

Example: Timely Supply of Material – Float Status
Southeastern monitors floats of critical items e.g. compressors and each wheelset type, broken down into:
- At depot, serviceable
- At supplier, serviceable
- At supplier, under repair
- Not serviceable

FirstGroup Rail are accredited to BS 11000 collaborative business relationships. This has assisted in building collaborative working and improve customer/supplier communication. This standard has also assisted in defining roles and responsibilities and supports collaborative decision-making leading to more valuable business partnerships.

Example: Management of ‘rogue’ components (repeat offenders) – Providing consistent defect information to suppliers & defect investigations on components
Unipart Rail undertook a 6 sigma project on carbon brush pigtails coming out in service and causing delays. Working with the TOC and the supplier, a problem was identified with the sample test methodology. Analysis of the supplier’s data using 6 sigma principles enabled new test limits to be recommended, solving the problem. Northern have monthly meetings with Unipart, plotting failure rates of key components and reviewing actions to improve them. First Group has identified performance data for Unipart to pass down their supply chain to facilitate improvement on key components. London Midland has seen material issues resolved when TOC, Unipart, supplier and relevant ROSCO all get engaged.

Unipart Rail has a very simple high level performance measure which shows what welcome progress has been made. Component reliability, in total defects per million components (DPMC), based on warranty claims made (whether rejected or accepted)
Contd...

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DPMC Target</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2,500</td>
<td>3,900</td>
<td>3,400</td>
<td>3,100</td>
</tr>
<tr>
<td>Actual</td>
<td>20,000</td>
<td>3,900</td>
<td>3,400</td>
<td>3,700*</td>
<td>4,500^</td>
<td>3,100</td>
<td></td>
</tr>
</tbody>
</table>

* down to 2100 if lighting inverters are excluded (these were 30% of total warranty claims and arose from Unipart

Being forced to re-source away from the OEM because it no longer wanted the business - the new supplier actually worked to the drawing, which was subsequently found to be inadequate).

^ Lighting inverters still a high volume issue – latest versions not actually failing, but protection operating – if the power is removed and reconnected they work again. Another big issue in June and July which affected the year’s figures were fasteners – they hadn’t actually failed, but were of substandard quality in some cases.

Example: ScotRail asked a Unipart facilitator to help Haymarket depot management team implement a communications cell. They worked from deciding what to measure and how to measure in order to help achieve delay reduction commitments. Boards displaying Key Performance Indicators for people and vehicle maintenance processes compared to plans and targets were implemented to share information and improve problem solving focus. Delays were significantly reduced and staff morale rose.

In addition, Unipart Rail has undertaken initiatives such as Policy Deployment with their suppliers ...

Example: Unipart Rail was concerned that the culture inherited from the pre-privatisation era was leading to sub-optimal relationships with its main suppliers. They wanted to replace buyer/ seller relationships based on price with partner relationships based on mutual interest. One day exercises with each of their 4 main suppliers helped them draw up a shared Policy Deployment Matrix, and derive 3 joint projects from it. Feedback was positive, with clearly defined common goals and specific actions for achieving them. The mutual trust developed has led to further joint projects and more collaborative relationships at all levels.

Example: Eversholt’s high level supplier management strategy has been developed with the input of people from within its business, its key suppliers and with several TOCs to ensure that it is more reflective of TOC requirements, including current and generic requirements such as ACOP1003 and RISAS. The objective is to develop the market place to meet Eversholt’s and its customers’ current and future needs.

Five key management tools are deployed, comprising:

* A structured communications strategy
* Implementations of account plans
* Supplier evaluation
* Segmentation
* Market analysis

Contd:

These business-level tools are underpinned by project-specific management regimes that provide Eversholt’s supplier community with visibility of TOC performance requirements and key performance drivers, ensuring alignment of stakeholder objectives. Supplier senior management commitment to fleet reliability improvement is fostered through Steering Groups, with clear terms of reference and which give a perspective to performance trends and any emerging issues. Recent successful examples are the 3-way groups with Bombardier, Eversholt and NXEA (for Class 315 C6X) and GTR (for Class 365).
## Appendix F - Fleet Transfer Checklist

### A/ Depot Acceptance Checklist.

<table>
<thead>
<tr>
<th>DEPOT ACCEPTANCE CHECK LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Parameters</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Depot Name</td>
</tr>
<tr>
<td>Sectional Appendix No</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Maximum Length of Vehicle (m)</td>
</tr>
<tr>
<td>Maximum Height of Vehicle (m)</td>
</tr>
<tr>
<td>Maximum Width of vehicle (m)</td>
</tr>
<tr>
<td>Maximum lift weight (Tonnes)</td>
</tr>
<tr>
<td>RA code</td>
</tr>
<tr>
<td>Primary Power source</td>
</tr>
</tbody>
</table>

Fill out applicable unit and vehicles details in the New Stock Parameters boxes.

Details must be less than or equal to those in the Location Details to comply (“YES”). If details are greater than those in the Location Details, then does not comply (“NO”).

Any non-compliance indicates the vehicle does not fit the proven envelope of the depot concerned and a more detailed assessment is required.

### B/ Acceptance of rolling stock – checklist.
<table>
<thead>
<tr>
<th>Item</th>
<th>Yes/No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Commercial Arrangements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do the Terms and Conditions deviate from TOC X’s standard terms?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the terms and conditions clearly understood and agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the customer contact details known?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a purchase order been raised?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is insurance cover in place?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have commercial arrangements following the condition survey report been made?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the warranty arrangements clearly understood and agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the specification clearly understood and agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does it meet TOC X’s requirements?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Delivery Requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the delivery date known?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have movement arrangements been made?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a fitness to run certificate been provided</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Depot Acceptance check</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the Depot Acceptance check process been carried out?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the vehicle comply?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Yes/No</td>
<td>Comments</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>5. Facility Changes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will delivery require changes to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tooling/equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is Capacity/Resource available?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6. Training/Competency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will formal training be required?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are new competency standards required?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>7. Depot Change</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are Depot changes required?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If ‘yes’ is regulatory approval required?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>8. Safety and Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is safety validation required for the supplied services? ACOP1003, RISAS etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there any environmental issues to consider?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are these units approved for Route and Gauge Clearance to GE/RT8270?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a copy of the existing Certificate of Engineering Acceptance or Certificate of Engineering Assurance been received and reviewed?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C/ Rolling stock entering service – checklist.
<table>
<thead>
<tr>
<th>Item</th>
<th>Yes/No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Maintenance Documents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a copy of the maintenance plan been obtained and reviewed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is it intended to use the suppliers VMI or adopt own VMI / blockcards?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a copy of the existing block cards been obtained?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the unit(s) modification status been obtained and reviewed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicle History and Maintenance Records</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a copy of the following history and maintenance records been received?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Next exam due</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last A and B exams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UAT Mileage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deferred work and outstanding defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outstanding NIR’s and special checks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major component mileage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy maintenance arrangements (C4/C6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical wiring schematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Databases</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the Rolling Stock library been informed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have RAVERS and GENIUS been updated?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have the technical databases been updated?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a safety check been carried out on the vehicle?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Item

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes/No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has a date been advised when the vehicles will enter service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the NRN or other radio account been transferred to the new operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has diagramming, stabling and maintenance arrangements for outstations / sidings been agreed and briefed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a vehicle information brief been produced and distributed to all staff</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D/ Return of Rolling Stock – Checklist.
### RETURN OF ROLLING STOCK - NORTHERN CHECK LIST

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Checked (Y/N)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Have re-delivery arrangements been made?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Has the status of the maintenance regime been advised? (VMI, VOI, bulletins, and temporary procedures)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Has the commercial arrangement been agreed following condition survey report?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Are there any commercial arrangements concerning surplus material?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Have the vehicle records been returned?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Have all databases been updated and defect entries closed out?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Has a list of open defects, checks, modifications, and NIR’s been advised to the appropriate third party?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix G - Vehicle Incident Decision Support Tool Customer Requirement Specification

Introduction

The purpose of this document is to describe the requirements for an Information Technology Decision Support Tool which can be used to establish with a driver, or other crew member, the symptoms of an alleged train fault and combine these with fleet specific technical knowledge to provide advice to the driver taking into account the time and location of the fault. The Tool will most likely be a computer based in a control room, but may take other forms, such as a mobile device for train crew.

This paper has been split into must haves and nice to haves to create a customer requirement specification to assist us in understanding the exact product our members require.

Requirements

Commercial must haves:

1. The supplier shall agree to a third party source code escrow arrangement that ensures the licensee obtains formal access to the system source code when maintenance of the software cannot be otherwise assured. The arrangement shall be defined in contractually agreed upon terms & conditions.

1. Access to the system shall be offered under a minimum of 1 year fixed term contract between both parties along with support services as per local agreement.

2. Shall provide a service level agreement to be commercially negotiated but circa 99%.

3. If the main channel to access the system fails, some form of locally stored decision support should be available for users to access instantly until access to database is restored.

4. Shall enable the super user to populate/modify/change the contents within the database at no extra cost; as and when required.

5. Shall allow both parties to propose change requests and evaluate them on commercial grounds.

6. System shall suffer no more than 5 incidents per year.

7. The supplier shall provide a service level agreement covering:
   a) Performance.
   b) Quotes for different features.
   c) System updates.
   d) Configuration.
   e) Change control.
   f) User assistance.
   g) Training packages.
Fleet Management Good Practice Guide: The Twenty Point Plan

Technical must haves:

1. Shall be able to work or be accessible on a range of off the shelf IT solutions (e.g. tablets, mobile phones, computers etc.).

2. The supplier shall provide a standard template fault tree which the super user can populate with textual or pictorial information and upload into the system for users (e.g. a diesel multiple unit may have fields for power packs, gear boxes, hydrostatics etc.; and an electrical multiple unit may have fields for traction motors, transformers, propulsion electronics, etc. The supplier shall agree with customers the fields comprising the standard template.

3. Shall automatically progress through the fault finding process based on feedback from the user in the form of question and answer prompts.

4. Shall provide user security.

5. Shall commence a timer when the standard template fault tree has been accessed and flat to the user when 5 minutes intervals have elapsed.

6. Shall provide a link to defective on train equipment rules.

7. Shall provide a link to information on assistance policy for recovering vehicles with another in service vehicle.

8. Shall be interactive and easy to use:
   a) Dependant on local bandwidth, when clicked on the page should appear within 5 seconds.
   b) Home screen should be configurable including shortcuts to variable elements in the database.
   c) Ability to build relationships with data set within the system (e.g. hyperlinks, wiki, etc.).
   d) Demonstrate bandwidth minimisation for page loading.

9. Shall take account of time and location of the incident when providing triage advice (e.g. 17:00 at Waterloo Station; get the unit moving as soon as possible/14:00 country end try to reset the faulty equipment).

10. Customer needs to appoint a super user – who will have authority:
   a) To grant access to other users within the organisation.
   b) To change the content of the database.
   c) Amend historical information on events.

11. Shall automatically send an email containing a link to change password every 90 days.

12. Shall timeout:
   a) With super user access – after 30minutes of inactivity.
b) With user access – after 12 hours of inactivity.

13. The system provider shall provide training material to the customer.

14. Shall have a training package which will require users to log in to update their skills.

15. Shall be capable of recording information – including free text notes for export to other systems (e.g. HTML, CSB etc.).

16. Shall be downloadable to Windows and Androids or web based.

17. Shall alert super user when a user is accessing the system.

18. Shall be compliant with all applicable legislations including periodic server updates and requirements for the use of proxy servers, DMZ and geographic redundancy services where applicable.

19. Shall be internet based.

20. Shall alert user when the system is offline and not recording:

   a) Offline data – basic information should be able to be uploaded into the live system.

Nice to haves:

1. Could store information when:

   a) Drivers raise a fault on the system if the solution is provided to crew on a hand held device and then transfer these files to another system.

   b) Where available in the system, provide drivers with feedback on the remedial actions to take to address the issue.

2. Could provide a feature to flag up to the user any ongoing fleet incidents.

3. The system to link into TRUST incidents, along with open interfaces for other systems to link in.

4. The system to link into BUGLE.

5. A health-check that recorded the last export, files received and records of dialogue and information exchanges.

6. Built-in help guides and user guides would be useful.

7. Whilst an internet based system should be a must-have, it would be nice for it to be external (operate when internet is offline) and therefore only needing a single standardised template for submissions.

8. Engagement with drivers as they should have visibility to check whether the issue has been resolved. It was noted that visibility would drive behaviours.
### Appendix H – example of a checklist

#### Details of the Right Time Railway Assurance Check

- Name of manager carrying out the check
- Date and time of assurance check
- Location of assurance check
- Which Depot Manager’s patch is this location on

#### The Right Time Railway Five Activities for this staff member

- I make sure units are prepared and in the right position
- I advise Control of short-forms at the earliest available opportunity
- I confirm the correct formation
- I make sure the train leaves the blocks on time
- I make sure the train presents at the exit signal right time & is brought back onto the depot promptly on return

#### Observation work to be carried out

- Has the staff member signed on in good time?
- Is the staff member and units at the correct location for departure?
- Have the pre-departure checks carried out?
- Has the member of staff been in contact with the driver?
- Has the prep sheet been given to driver?
- Has the service departed right time?
- Have any incoming arrivals been brought back on depot promptly?

#### Questions to ask the staff member

- Have you been briefed on what the Right Time Railway Five Activities are for your job?
- Do you know what the Right Time Railway Five Activities are for your job?
- Why is it important that units are prepared and in the right position?
- Why is it important to advise Control of short-forms at the earliest available opportunity?
- What is important to confirm the correct formation?
- Why is it important to make sure the train leaves the blocks on time?
- Why is it important to make sure the train presents at the exit signal right time?

#### Calculation of the Right Time Railway Assurance Check Score

- Number of ✓ recorded
- Number of X recorded
Total of these two numbers above

Percentage of total which were recorded as ✓

Record here (or overleaf) any suggestions/observations which arise in conversation with the staff member which may be important for Right Time Railway Groups, Performance Team or Area Manager to progress and try to improve.

Return to: Anna Langford, Performance Reporter, 7th Floor, Friars Bridge Court.
No copies need to be kept or signed for.
Appendix I - Decision Support Tools

NB: The following has been extracted from Section 11 hence the numbering system.

11.6.1 Introduction

A Vehicle Incident Decision Support Tool (DST for short) is normally used in a revenue service environment to help train drivers and fleet control/maintenance centre support staff isolate train system faults, expediently, and determine the most effective course of remedial action based upon prevailing network circumstances.

The implementation of a systematic, computer based DST is considered business critical by many TOCs and forms an important part of any modern fleet management programme. Whilst the degree of system functionality may vary significantly between organisations, it is generally acknowledged that the principal objectives of the system should strive to achieve the following:

- The continuous development of Fleet/Operations relationships.
- Encourage train crew feedback on technical issues affecting revenue service.
- Minimise network service delays.
- Promote a culture of transparency and mobility of information.
- Conform to railway authority regulations where required.
- Drive reliability growth.

The benefits of implementing a DST are numerous and feedback from TOCs with live systems suggests that:

- There is a genuine return on investment/the process adds real value.
- Delays per incident are improving.
- The best systems incorporate a Defective on Train Equipment (DOTE), assistance guide, event timer and facility to export data to other TOC systems for post incident review.
- User engagement is increasing.

Example: FCC (now GTR) reported an incident data capture rate of circa 60% and Southern 90%.

11.6.2 System Automation & Staff Interaction
Ideally, the DST system should be internet hosted and Microsoft Windows compatible, relational and accessible from a range of proprietary IT devices including: tablets, smart phones and laptops.

The system should provide a standard template fault tree that can be populated with textual or pictorial information and uploaded into the main system database for fleet use. Some typical examples include the following: a diesel multiple unit may have fields for power packs, gear boxes, hydrostatics, etc.; and an electrical multiple unit may have fields for traction motors, transformers, and propulsion electronics. Some form of interactive DVD or virtual image architecture can also be employed to aid incident management such as the Interactive Virtual Train (IVT) tool described in Section 11.6.9 of the 20pp.

The system should automatically progress through the fault finding process based on feedback from the user in the form of question and answer prompts.

It is recommended that suitable interactive training materials or modules are included as an integral part of the system to ensure user skills are recorded and maintained. This may form part of a separate competence database or internet hosted facility.

Example: C2C Rail Ltd is moving towards a Google based competency system.

11.6.3 Timing Monitoring

When a train fault occurs and the DST system is accessed a timer should commence such that the elapsed time is flagged to the user in predetermined intervals, normally 5 minutes. In this way the time associated with fault diagnosis and corrective action can be monitored and/or recorded and subsequently used to inform reliability metrics (e.g. MTIN and DPI).

11.6.4 Location & Time Specificity

It is important that the system has the ability to account for the time and geographic location of a technical incident when communicating service critical information between driver and control centre so that effective decisions can be made quickly based upon the prevailing circumstances.

Example: it would be critical to move a unit as soon as possible if there was a rush hour incident at Waterloo Station; conversely, during a rural off-peak incident the fleet management team may attempt to remove power and reset the faulty equipment in the first instance.

Ideally, the DST should be compatible with existing Global System for Mobile Communication – Railway (GSM-R) technology.

11.6.5 Interfaces

11.6.5.1 Links to DOTE & Assistance/Vehicle Recovery

Where a DOTE or similar management system exists, the DST should have relational functionality such that the rules for isolations and running rolling stock in a degraded mode are respected. The link should also permit the communication of information governing vehicle recovery, in particular the assistance policy relating to: the recovery of vehicles with another in-service unit or consist; preferred fleet configurations; available maintenance facilities and; platform constraints.
11.6.5.2 Links to Maintenance Management Systems & Other Data
Ideally, the system should be sufficiently flexible to permit communication with/access to information from other maintenance management systems and databases (e.g. TRUST, Bugle, Equinox, Genius, etc.). Some typical methods include: an html internet based tablet/smart phone system, which supports remote access; downloading fault logs for manual input to the maintenance management system; links to the incident history database for trend analysis; an engineering developed online wiki based system linked to trainbourne remote condition monitoring devices.

11.6.5.3 Links to Trainbourne Condition Monitoring
Some of the most advanced systems utilise trainbourne remote condition monitoring technology (RCM), which can be accessed remotely to diagnose faults, recognise tolerances and identify potential faults before they occur.

Example: Southeastern fleets have been fitted with RCM. As soon as a fault is logged, a breakdown of train systems and failure modes is made available, which the driver can then communicate to the control depot. The depot can subsequently access the system, obtain a cab view, isolate the fault, diagnose the problem and recommend a solution.

11.6.5.4 Recording System Usage
It is important that post event data is recorded and made available between systems so that it can be subsequently consolidated to inform performance analyses and reports including common reliability trends and metrics, return on experience, lessons learned, etc.

11.6.6 Change Control & Information Maintenance
Whenever business critical information is distributed for use within an organisation it is necessary to formally control its maintenance by establishing suitable review, approval and issuing mechanisms/authorities. The same is true when implementing a DST system, regardless of whether it is paper or internet based, and will ensure that fleet management/maintenance staff are working to accurate and current information. The challenge for TOCs, however, is to develop a practical application that is commensurate with its needs without losing control of technical content.

Whenever new fleet technology is introduced, or existing fleets undergo a modification programme, consideration of the impact to the DST should be part of the change control process.

11.6.7 System Implementation
11.6.7.1 Strategy & Funding
To ensure a fleet DST system is implemented successfully it is important that the initiative is addressed at a strategic level and justified by a robust business plan. Once a suitable business case has been developed and approved, a top-down management approach is recommended to ensure all the necessary resources are made available (e.g. manpower, planning and training; investment and funding; development, validation and integration requirements; regulatory compliance, etc.).

TOCs may wish to consider funding sources such as Future Railways, etc.
11.6.7.2 In-house Development
One cost effective solution may be to develop a system utilising existing in-house engineering and IT resources. This method can provide greater flexibility of resources and has the added benefit of ensuring that system requirements are customised to meet specific business demands. Whilst a number of proprietary virtual assistant technology tools exist, a good example of a generic application for managing customer conversations across mobile, web, and social media channels is the V-Portal product supported by Creative Virtual (http://www.creativevirtual.com/v-portal.html). A mock up can be found here: http://173.204.116.213/fleetdemostaging/.

11.6.7.3 Existing System Utilisation
A number of TOCs already employ DST systems and these are described in more detail in Section 11.6.7.4 below. It follows, therefore, that if mutually acceptable terms were agreed, the development of existing system architecture could be explored as an alternative to the in-house method outlined in Section 11.6.7.2 above. Such agreements would normally necessitate the drafting of formal contractual documents to safeguard any commercial and Intellectual Property Right (IPR) arrangements (e.g. nondisclosure and licensing requirements, copyright protection, patent and trademark registration, etc.).

11.6.7.4 Overview of Existing TOC Systems

<table>
<thead>
<tr>
<th>Some examples of specific decision support tool applications follow:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Southern has a ‘Managing Train Fault Database’ (MTF) that provides consistency for fault rectification. It includes a defect matrix and spreadsheet of on-call engineers. Drivers are taken through a step by step guide of what to check for in different scenarios. If it is unclear what the failure is then key critical questions are asked in the early stages. All drivers on the Southern network have access to mobile phones.</td>
</tr>
<tr>
<td>• Southeastern has an extensive engineering developed online ‘wiki’ based system that utilises on-train remote condition monitoring. Remote access is via tablet or smart phone. A ‘yardboard’ gives an overview of depot activities and restrictions.</td>
</tr>
<tr>
<td>• C2C has complimented their paperback aide memoire system with an html internet based flowchart application that is available on tablets and smart phones. A teleconference facility between drivers, signallers, controllers and technicians is also planned for the future.</td>
</tr>
<tr>
<td>• First Group has an extensive web based fault tree system that permits external access. Remote access trials are underway using tablets. A dashboard gives visibility of all live incidents raised.</td>
</tr>
<tr>
<td>• London Midland adopts a general training aid that identifies critical systems and components using photographs and schematics.</td>
</tr>
</tbody>
</table>

11.6.7.5 Generic Customer Requirement Specification (CRS)
A generic CRS for a Vehicle Incident Decision Support Tool has been developed by ATOC in collaboration with various industry stakeholders and is included as Appendix G of the 20pp for reference. The CRS addresses both commercial and technical requirements and can be used as a guideline for DST development/procurement.

11.6.8 Incident reduction tools
The list below is some examples of incident management tools which are used by several different TOCS, the list is not exhaustive but shows where certain concepts could be developed to meet individual company requirements. It should be noted that all the concepts shown below can be used on several different media types from paper, smart phones and tablets etc.
Fleet Management Good Practice Guide: The Twenty Point Plan

IVT – Interactive Virtual Train is a tool that has been designed to simulate the workings of various types of rolling stock through an interactive DVD. It contains Computer Generated Images (CGI), video segments and written documents on a range of train based equipment and failure modes. It can be used for a wide range of activities such as training, incident management, fault finding and simulation of defects all in a safe environment with no need to take a resource out of traffic.

DOTE – every TOC should have a ‘Defective On Train Equipment’ standard. This will have been risk assessed to ensure that all failure modes have suitable response and locations to take out of traffic are correctly documented. The standard will include mitigations that are needed for degraded working modes on stock (such as example speed restrictions) to enable it to remain in traffic where this is permissible.

Virgin Trains uses the concept of a B6 document. This is a contingency planning document that details on a fleet basis how a failed train can be used for the remainder of the current journey and then for the remainder of the day. This document is issued to the Fleet Engineer, Control and drivers so that everyone involved in a failure is clear on what actions are required limiting confusion in the event of a failure.

Some TOCs have online tools which show where isolation cocks are located and also the procedure for carrying out the isolation. These tools are used by the fleet engineers within the control centre; this information is then passed onto the driver at the incident. This process enables the driver to be guided and thus reduce the overall incident time. These online tools also contain much more information on incident reduction techniques. Southern Trains have developed an online Management of Train Failures tool with guides for the controller which allows for accurate information to be passed to the driver.

Phone a friend – Northern, Southern and SWT have a Maintenance Controller working 24/7 in each Control office (Manchester/York). All staff that require technical assistance will contact the Maintenance Controller, who will direct them accordingly and in conjunction with the Control team make the most suitable decision to manage the situation.

Fleet cards/in cab notices (layout of train) - this enables the driver to have all the phone numbers which are critical to managing an incident. In cab notices allow for exactly the same numbers of the fleet cards but it also shows a layout of the train depicting axle numbers etc.

Aide memoirs – are concise small guide books which are used to remind the driver of what to do in the event of a train failure e.g. the sequencing of isolations as well as giving critical information such as train layout, critical phone numbers etc. These have proved quite successful for fleets where failures are getting rarer due to improved reliability.

Train position mapping – this is often achieved from the Wi-Fi positioning and some TMS systems. This allows a map to be viewed of where all the fleet are positioned simultaneously and also allows for the positioning of a failed unit relative to access points and hazards such as canals, rivers etc.

RCM - Remote Condition Monitoring – Trains may be fitted with various methods of RCM. This will vary between fleets depending on the TOC, age of fleet and level of investment that has been made. Some examples of RCM would be engine monitoring systems, door monitoring systems, remote OTMR downloads, GPS based systems, electrical monitoring systems etc. As technology develops it is expected that more and more RCM systems will be fitted to trains.
Blocks – on West Coast there is an agreement that where a failed train needs to extend its couplers that a driver requesting a block will be granted the block as a priority, this is to minimise overall delay. This priority also applies to other failures where line blockages are required to inspect the train. In many cases it is better to take the block early rather than to delay.

Southern have a ‘Managing Train Fault Database’ (MTF) that provides consistency for fault rectification.
Appendix J – Creating a Lean Process (for Overhaul)

This appendix highlights some tools\(^{16}\) which can be applied to make the overhaul process more efficient and improve the quality of the outputs.

16.8.1 Create a Process Improvement Culture

Having the right workplace culture is a key enabler to successfully implementing and embedding the process improvement techniques described below. In a workplace with an improvement-focussed culture, staff will:

▪ know what the common goal is and what good looks like,
▪ understand the role they all play in delivering the goal,
▪ feel empowered to identify problems and make improvements\(^{17}\),
▪ be supportive of colleagues and work as a team to achieve the common goal; and
▪ feel pride in a job well done.

It is critical to create a culture where staff feel able to identify problems and are involved in creating the solutions.

16.8.2 Identify & Eliminate Waste

Activities are either Value Adding (VA) or Non-Value Adding (NVA). VA activities are those which:

▪ transform the asset,
▪ the customer cares about (i.e. would pay for); and
▪ are done right first time (therefore correcting a defect created within the process is not value adding).

NVA activities are also called ‘waste’. It is good practice to identify and eliminate / reduce them. They can be identified as follows:

▪ Transportation
  Transportation is movement which occurs between process steps (e.g. if the asset needs to be sent away from the main overhaul facility to another facility for specialist work, or if the asset needs to be moved from one part of the facility to another). In these examples, transportation could be eliminated (or minimised) by bringing the specialist to the main overhaul facility or by optimising the facility layout.

▪ Inventory
  Inventory is having too much stock. Good stores management will ensure that there is the right amount of equipment available for the overhaul and that larger items are ordered in a timely manner so that they are delivered to point of use when required.

▪ Motion
  Not to be confused with transportation, motion is concerned with in-process movement. While the asset is being worked on, if the worker has to go to the stores to collect equipment, this is wasteful. Ideally the worker should move as little as possible and have all tools and equipment

\(^{16}\) This is in not intended to be a comprehensive summary of all lean techniques.

\(^{17}\) This doesn’t mean making unilateral changes without involving anyone else.
required easily to hand.

- **Waiting**
  Waiting occurs as a result of bottlenecks because part of the process takes longer than other parts (i.e. the process flow isn’t balanced). In a process like overhaul which typically has only one asset being worked on at a time, bottlenecks could result in people having nothing to do whilst they are waiting for colleagues to complete their work. Multiskilling staff or combining process steps are ways in which the process flow can be balanced and bottlenecks removed or reduced.

- **Over-processing**
  Over-processing is doing more than required to the asset. In order to prevent over-processing, there should be standards or guidelines for each task so that it is clear what is expected and that it is done consistently by all members of the team.

- **Over-production**
  Over-production may not be a common form of waste in the overhaul process. It is typically where more items are produced than is required. This could be a symptom of process problems which cause variation in quality.

- **Defects**
  Defects are mistakes. There are many reasons why mistakes occur (e.g. having the wrong tools, equipment, plans or training). It is important to identify defects early on in the process and to be able to identify the underlying cause, otherwise they could continue to occur. In process handovers are a good opportunity to identify defects at an early stage. This reduces the impact of the asset getting to the end of the process and needing to correct an error.

Another way to eliminate waste is by using “5S”. It is a particularly good technique to help improve in-process activity:

- **Sort**
  Ensure that the workstation only has the tools, material and work instructions which are required for the activity being undertaken at that workstation as this reduces the risk of defects caused by using the wrong work instruction or tool.

- **Set**
  Arrange items to ensure efficient workflow and to eliminate time taken looking for tools or materials.

- **Shine**
  Ensure the work area is clean. This reduces the risk of contamination and enables defects to be spotted more easily.

- **Standardise**
  Where possible ensure consistency between workstations (e.g. use of shadow boards, use of electronic version controlled work instructions.)

- **Sustain**
  Ensure that improvements are embedded in standard procedure so that they aren’t forgotten about once a “5S drive” has ended.

16.8.3 Root Cause Analysis
There are many reasons why defects occur and it is important to consider all factors before attributing cause. Too often individuals are blamed for causing a defect without considering other factors. This can be damaging as it harms employee relationships and will not necessarily prevent the defect from re-occurring in the future. In order to identify the true causes behind a defect, it is important to involve those involved in order to utilise their expertise and get their buy-in to implementing any changes.

- **Cause & Effect Analysis**
  This is a useful tool to identify all possibly causal factors which could have contributed to a defect occurring. This helps to prevent individuals from jumping to one particular cause without considering other possibilities first.

- **5-Whys?**
  This is a useful technique to apply once the cause and effect analysis has been done. It helps to identify the true root causes, which is important if the solution is to be properly embedded within the process to avoid the problem from re-occurring in the future.

Once the causal factors have been identified, it is important to select the most likely root cause(s). This can be done by data collection or group to vote (as appropriate).

### 16.8.4 Evaluate the Outcome

Yield is a useful measure of the process. There are different ways of calculating yield, so it is important to decide which is the most appropriate for the operation in question during the mobilisation stage.

- **Process Yield**
  Gives the quality at the end of the process and can be used as a proxy for customer satisfaction, however it doesn’t take into account re-work.

- **First Time Yield**
  Gives the quality at any point in the process.

- **Rolled Yield**
  Gives the probability that an item will pass through the process defect free.

- **Normalised Yield**
  Gives the average yield per process step.

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18 Also commonly known as a fishbone diagram or Ishikawa.

19 Use n/3 voting where n is the size of the group. Each member gets the same number of votes and can cast them on the cause and effect diagram using sticky dots. This can be done in silence (to prevent more vocal members from dominating the discussion). The issues with the most votes should be addressed.

20 Assuming that the customer (in this case the TOC) satisfaction only relates to the quality of the overhaul output. Yield does not take into account other factors such as on-time delivery and cost.
<table>
<thead>
<tr>
<th>Key Performance Indicator</th>
<th>Description</th>
<th>Measure</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leading</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset life</td>
<td><em>This monitors the maintenance history and interventions on critical assets through their life. Other data recorded is component creation, usage information (hours/miles operated) and scrappage date. Assets considered are not limited to Wheelsets, bogies, engines, motors, AWS/TPWS, etc.</em></td>
<td>Preventive Planning</td>
<td>Extend maintenance periodicities</td>
</tr>
<tr>
<td>Wheel wear rate</td>
<td>To monitor/compare the rate of wheel wear in different seasons, for a better understanding of seasonal impact to units. Also helps to prioritize planned maintenance.</td>
<td>Preventive Planning</td>
<td>Uptime &amp; Industrial Wheels measurement limit</td>
</tr>
</tbody>
</table>
| Unavailability of mandatory exam kit per period | Availability checklist of all the required tools, parts & components for scheduled maintenance. Parts are usually made available to fitters as Kits placed by the side of the maintenance road. This should record: \[
\text{\% of deficient kits per shift} = \frac{\text{Total number of deficient kits per shift}}{\text{Total number of Kits per shift}} \times 100
\] | Maintenance Scheduling | <10% |
| Open work orders          | Monitors all open work orders for a depot across all the fleets per period as a percentage of total volume of work raised. eg. wheel lathe, HVAC, Doors, etc. | Maintenance Scheduling | <20% |
| Available for services    | Records of all units ready/available for services on daily/weekly base. This should be measured at a particular time of day, prior to morning and evening service peaks, eg. at 05:30. Example TOC operates 300 trains per week and 240 trains are available, \[
\frac{240}{300} \times 100 = 80\% 
\] | Uptime | % of the total fleet |
<p>| Repeat defects            | Measures number of reported incidents linked to a known fault per period. Repeat defects show that the underlying root cause has not been identified. | Maintenance strategy | &lt;5 |
| Delays due to defect      | Reports total primary delay attributed to a sub system per period and displayed as a Pareto so engineers can see which sub system is having the largest impact on service. It helps to show which sub systems need more work/fault finding. | Maintenance strategy | &lt;10 delay incident per device per period |
| Outstanding defects       | Monitors reported issues, defects which have not been attended/instigated e.g. Any isolation done by drivers, logged in the book but not raised as a work order. | Maintenance Scheduling | &lt;5 per unit per week |
| Degraded Mode             | Monitors volume of trains per period entering service with an allowable degraded mode as per TOCs DOTE. | Performance | &lt;5 per unit |
| <strong>Lagging</strong>               |             |         |        |
| Technical issues per period | Records total number of technical defects per unit per period including MTIs and other non-service affecting defects. It shows which unit is performing worse. | Performance | No of defect per unit |</p>
<table>
<thead>
<tr>
<th><strong>Number of days taken to repair</strong></th>
<th>Monitors how many days, it takes to repair/attend to a reported defect.</th>
<th>Execution</th>
<th>&lt;3days</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tweet (fault reported by customers)</strong></td>
<td>Monitors how long it takes to repair/feedback on faults/issues report by passengers on social media. This issue must be reported/mentioned more than a 5 time by at least 5 different passengers</td>
<td>Execution</td>
<td>&lt;5days</td>
</tr>
<tr>
<td><strong>Late on</strong></td>
<td>Monitors the sum of unit lateness per period to the depot for planned maintenance and examination. It shows how much maintenance time is lost due to the unit lateness as a sum of the minutes.</td>
<td>Punctuality</td>
<td>&gt;3mins</td>
</tr>
<tr>
<td><strong>Off-depot lateness measure</strong></td>
<td>Monitors the sum of unit lateness per period off the depot for operation. It shows how much operational time is lost due to the unit lateness as a sum of the minutes.</td>
<td>Punctuality</td>
<td>&gt;3mins</td>
</tr>
<tr>
<td><strong>Maintenance induced failure</strong></td>
<td>Monitors the number of issues raised after maintenance or light or heavy maintenance work. Some unit comes back worse than before (something missed or incorrectly added during the scheduled maintenance)</td>
<td>Performance</td>
<td>Total per period</td>
</tr>
</tbody>
</table>