Business Aligned IT Strategy | System Operator

Data Architecture Reference Model

Route Services

V1.0

System Operator Planning a better network for you

Executive Summary

System Operator exists to plan changes to the GB railway 'system' to balance the needs of passengers and freight customers and support economic growth. Its vision is to become the recognised expert; trusted by decision makers to plan the GB railway, and its primary output is the national timetable.

It is not realistic to expect industry timetable planners to produce robust and resilient timetables in the timescales set out in the network code using the same manual techniques applied today e.g. manual data entry, visually reviewing train graphs, cross referencing against paper-based reference documents, manual validation of junctions using sectional appendix/unstructured TPR datasets/unstructured WON etc., manual stock and crew diagrams.

It has been observed that the level of data maturity is low. There is not a common industry data platform, taxonomy or full industry data standard in place. Governed sharing of and access to data is too inconsistent to enable systemisation, and automation of activities associated with timetable production. Furthermore, there is no mandatory exchange format of the data between NR and TOC/FOCs to ensure it is aligned.

There are many cultural, process and application issues that account for the current situation but at the root of all of these is the use and quality of the data that underpins all our activities. This data architecture reference model sets out our understanding of the current and future data needs, culminating in the **Problem Statements** and **Target State** sections which provide a series of options to consider and a forward view of change across CP6. The problem statements are extensive, but have been summarised under the following themes:

The Culture of Data: A transformational change in how data is managed and governed requires a culture shift within the industry. Addressing quality issues on the core datasets that the industry use requires a clear vision, committed leadership and the right level of resourcing to succeed.

Doing Things Differently: Throughout the timetable development process, there are opportunities to change to better support the sharing and exchange of information at a people and system level. Without changing the way we do things; improved data quality will only deliver some of the potential benefits.

Embracing Data Ownership: Data ownership is currently very immature. Linked closely with the change in culture, a shift is needed to make people take data governance seriously. If our data is key to developing the timetable, then we must put as much effort into managing it through its full lifecycle as we do the timetable itself.

Better Data, Better Timetable: Data quality issues exist throughout our data landscape. Much of this is managed through skilled teams manually correcting or interpreting poor data sets to make sense of them. Addressing the underlying quality issues is fundamental to improving the quality of the timetable.

Unifying Data Platform: Investing in data governance and improving data quality will have a great impact, however the full benefit will only become apparent when it is

accessible by all parties across the industry. A key output of any data improvement programme will be to put in place an industry data sharing platform that meets the need of all parties to access trusted, assured and version-controlled data sets.

Document Purpose

This document focusses on the data that underpins the core timetable planning processes that are used when developing a new working timetable, managing timetable variations, and the transitional activities required to operate the daily timetable.

This document provides a line of sight from our current data architecture through to a series of proposals for data improvement activities that, if implemented will directly improve the quality of the published timetable. These proposals will then be used as a framework to develop the mandate of the Data Improvement CP6 Programme.

This document starts with the principal timetable planning **Process** Elaboration and identifies the data that underpins them. These data sets are then documented in a **Data Entity** As-Is Capture to understand their content, structure and key characteristics. Through interviews with internal and external planning teams, personal statements and by looking at available external reports an assessment of the **Data** Quality Assessments of the data is made. Finally, this is all brought together in a set of **Problem Statements** which describe each identified issue, its impact and potential options. The document concludes with a **Target State** view that describes an outline for change across the CP6 timeframe.

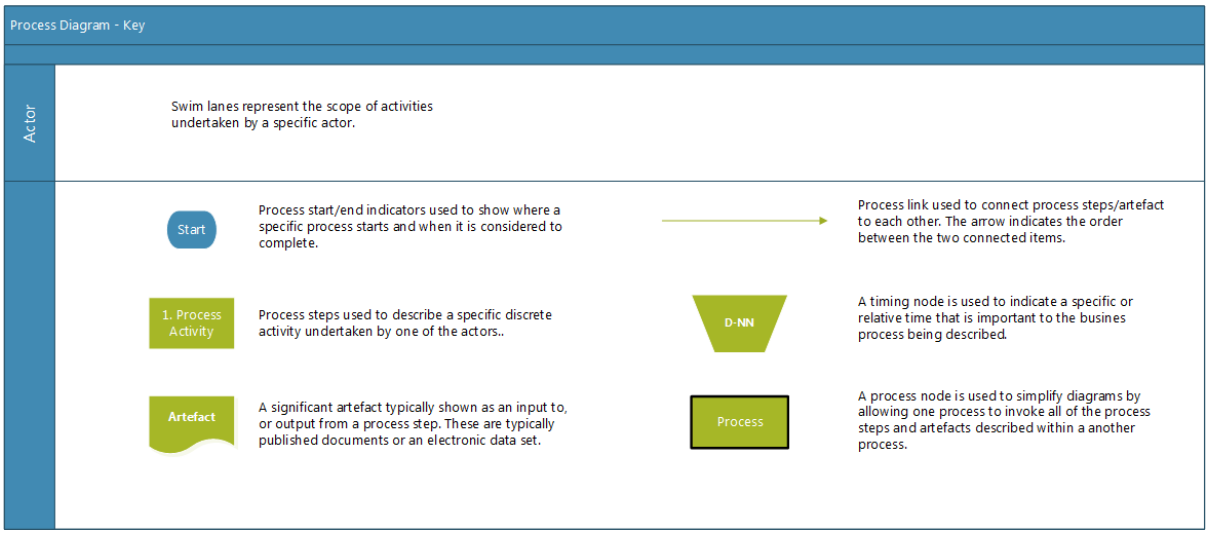
The audience for this document is primarily the timetable planning community and as such the document uses many terms that are specific to the processes used by this community. Whilst the document expands the commonly used acronyms and attempts to describe the environment and processes in terms that will generally be understood, it does not attempt to provide a glossary of all terms used.

Current Data Architecture

To examine the current data architecture the core processes that are involved in the timetable development process have been examined and their data needs assessed. To ensure alignment with other architectural views across Network Rail the data will be examined at both the logical and physical levels and will make use of corporate level models where available.
The following timetable planning process area have been examined:

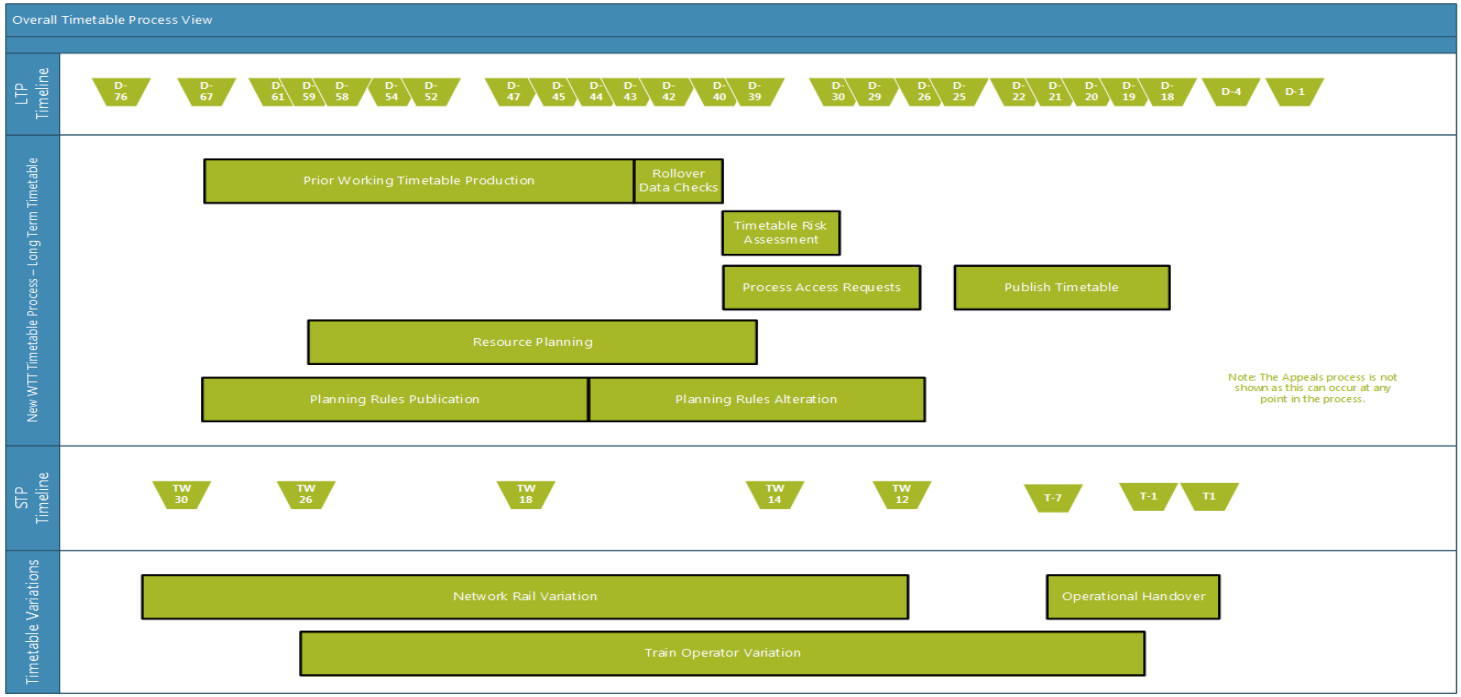
- Working Timetable Process - Long Term Planning
  Covers the processes involved with the initial creation of the new working timetable and the processing of operator bids up till the publication of the principal or subsidiary working timetable (WTT)
- Timetable Variations - Short Term Planning and Rolling Spot Bids
  Covers the processes involved when dealing with the rolling short term planning changes which amend the working timetable plan and culminates with the daily publication of the CIF timetable files.
- Planning Rules Management
  Covers the management and ongoing maintenance of the timetable planning rules that are used to underpin the development of the timetable.
- Timetable Geography Management
  Covers the management and maintenance of the base geography model that resides within the timetable planning tools.

The subsequent sections provide a high-level view of these planning areas in terms of their key business processes. Where more detailed process descriptions exist, they will be identified and referenced. Each process is then looked at in terms of the data that underpins it, which forms the basis for the subsequent data analysis. For readers unfamiliar with process diagrams, the following key describes the shapes that are used within the process diagrams.



The following diagram provides an overview of the process areas that have been assessed and uses three distinct notations for its timelines as follows:

- D-N : Used to describe a fixed week offset from the publication date of the principal or subsidiary timetable. As such these are fixed calendar dates and set out in the planning calendar published at D-73 (i.e. 73 weeks before the publication date of the New WTT).
- TWN : Used to specify a weekly offset from any given day. As such this notation is used to describe the repeating activities that take place in the run up to the daily timetable being published. When using this notation, it is assumed that the week start on a Monday.
- T-N : Used in the final phases of the daily timetable publication to describe the days offset prior to the publication date which is considered T-0. Note that positive numbers can also be used to indicate days after publication.



New Working Timetable Process – Long Term Planning

Overview

This process area covers the steps involved with the creation of a new principal or subsidiary timetable. This process area starts with the receipt of the Route Network Change documents and completes with the publication of the New Working Timetable (WTT).

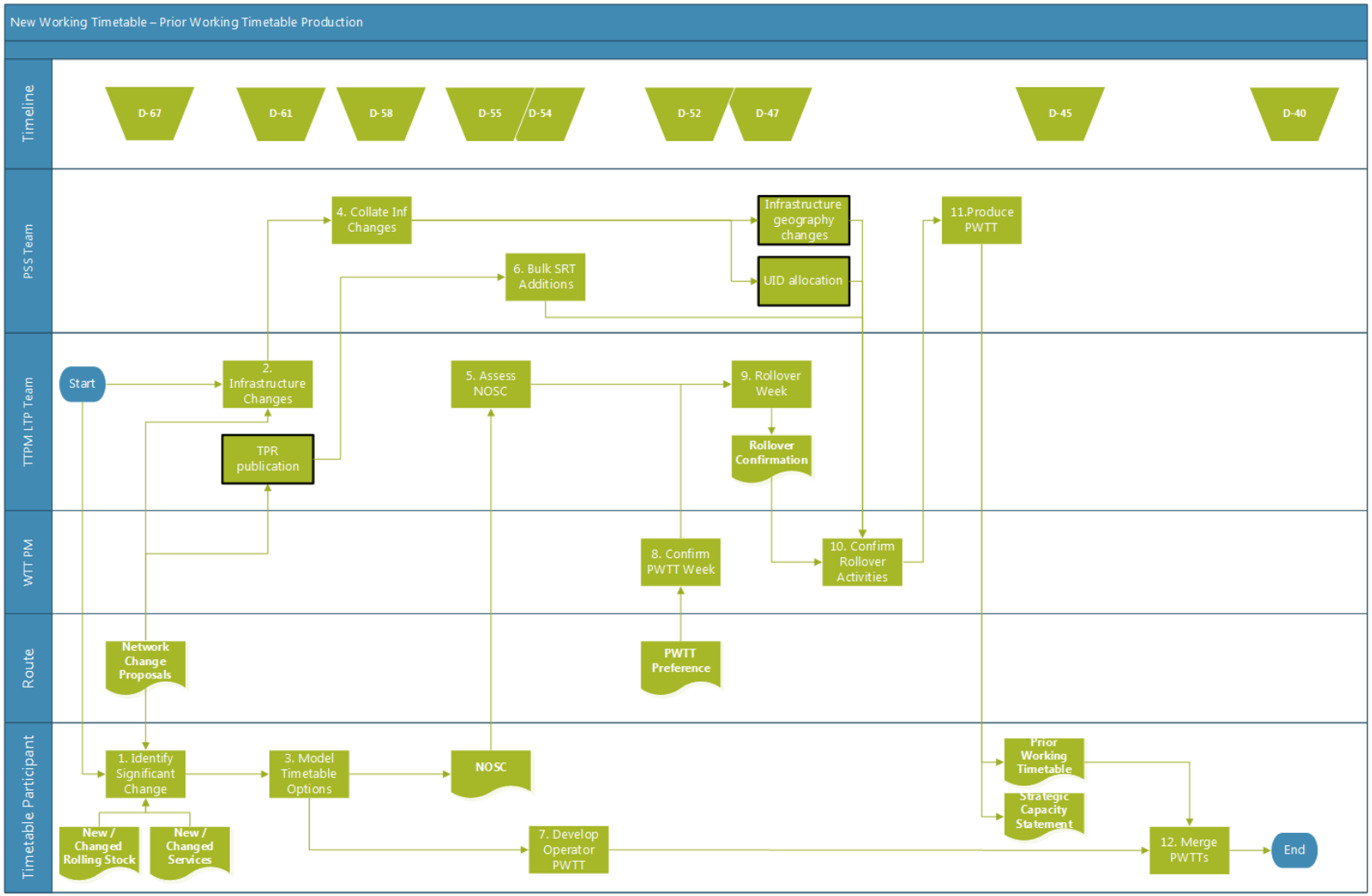
Process Elaboration

The following processes are simplified versions of the formal WTT planning process as described within the "WTT Process" (Ref NR5) and are aligned to the Long Term Planning process as produced within the WSM – Industry Planning Alignment project (Ref NR13) . The following processes have been assessed:

- New Working Timetable – Prior Working Timetable Production
  This process starts with the setting out of the timetable calendar of events at **D-67** and examines the activities and data needed to generate the Prior Working Timetable (PWTT) and Strategic capacity statement (SCS) at **D-45** based on a rollover of the previous year's primary or subsidiary timetable, plus consideration of any significant infrastructure or service changes.
- New Working Timetable – Risk Assessment
  This process starts at **D-40** and covers the activities required to identify significant risks associated with new/amended timetable requirements.
- New Working Timetable – Resource Planning
  Covering the period between **D-59** and **D-39** this process deals with the resource planning needs of the capacity planning department to accurately assess and plan for the timetable planning activities.
- New Working Timetable - Process Access Requests (Priority Date Notification Statements)
  Following the publication of the Prior Working Timetable, timetable stakeholders can submit Access Requests for new, changed or unrequired paths. Access requests (PDNSs) received prior to the Priority Date **D-40** are given priority in the development of the New Working Timetable.
- New Working Timetable – Appeals Process
  Covers the process by which objections to the proposed working timetable are raised and resolved.
- New Working Timetable – Publish Timetable
  Covers the activities followed to formally publish the newly developed working timetable.

Note that the processes include activities undertaken by the Timetable Participants as it is critical to this exercise to understand the whole planning systems data needs. In order to accommodate the different approaches used by train operator planning teams these activities present a generic view and may not hold true for all train operators.

New Working Timetable – Prior Working Timetable Production

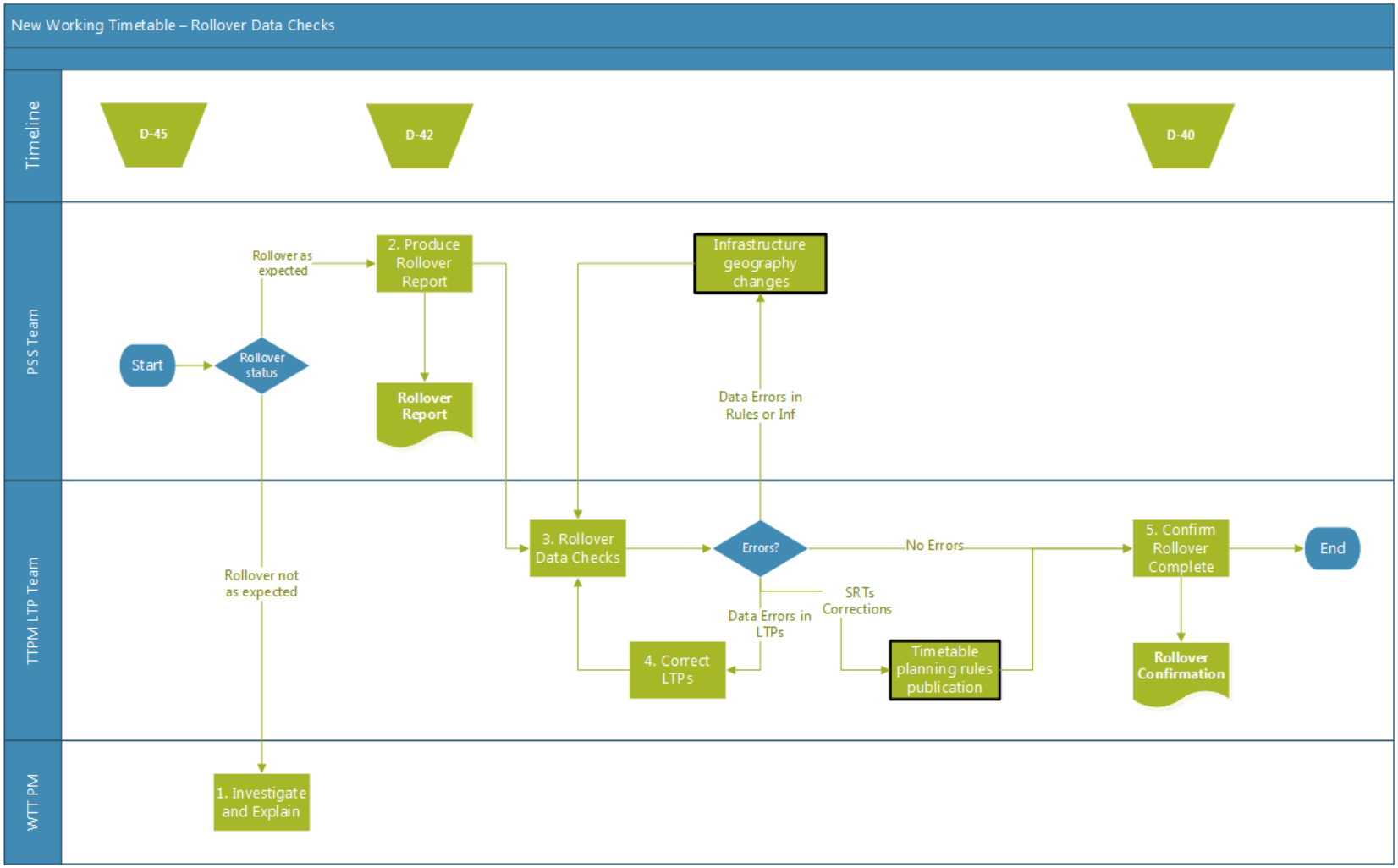


The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)											Notes
Process #	Process step	Network Change	Stock Capability	Crew Capability	Access Rights	Timing Link	Timing Load	Timetable Bid	Candidate Path	Timetable Planning Rules	Network Geography	Timetable	
0	Start	-	-	-	-	-	-	-	-	-	-	-	
1	Identify Significant change	R	R	R	R	-	CU	-	C	RCU	RU	-	Indicative rule, timing loads and candidate paths changes are identified at this stage.
2	Infrastructure Changes	R	-	-	-	-	-	-	-	-	-	-	The collective set of Network Change Notices received up till this point.
3	Model Timetable Options	-	-	-	-	R	R	-	R	R	R	CU	Modelling timetable extracts are developed at this stage.
4	Collate Inf Changes	C	-	-	-	-	-	-	-	-	R	-	
5	Assess NOSC	-	-	-	-	-	-	R	-	-	-	-	For this analysis the NOSC is considered as an indicative Timetable Bid.
6	Bulk SRT Additions	R	-	-	-	CU	-	CU	-	-	-	-	
7	Develop Operator PWTT	-	-	-	-	R	R	-	R	R	R	CU	Operator may develop their own PWTT to allow early development of PDNS submissions.

		Data Entity (Create/Read/Update/Delete)											Notes
Process #	Process step	Network Change	Stock Capability	Crew Capability	Access Rights	Timing Link	Timing Load	Timetable Bid	Candidate Path	Timetable Planning Rules	Network Geography	Timetable	
8	Confirm PWTT Week	-	-	-	-	-	-	-	-	-	-	-	Typically, the PWTT week is the last week of the preceding WTT, however the route or timetable participant can request that another week is selected.
9	Rollover Week	-	-	-	-	-	C	-	C	R	R	-	Includes an intensive manual activity to re-date paths which can only be done in blocks of matching 'days run' patterns. Typically done over the weekend using multiple TPS workstations.
10	Confirm Rollover Activities	-	-	-	-	-	R	-	R	R	R	-	A governance activity to ensure that new TPRs, Geography and Rolled Over paths are all in place.
11	Process PWTT	-	-	-	-	-	R	-	R	R	R	C	Creation of the PWTT and SCS
12	Merge PWTTs	-	-	-	-	-	-	-	-	-	-	U	Operator needs to compare the NR PWTT with any local working version and identify changes to any pre-prepared PDNS submission packs.

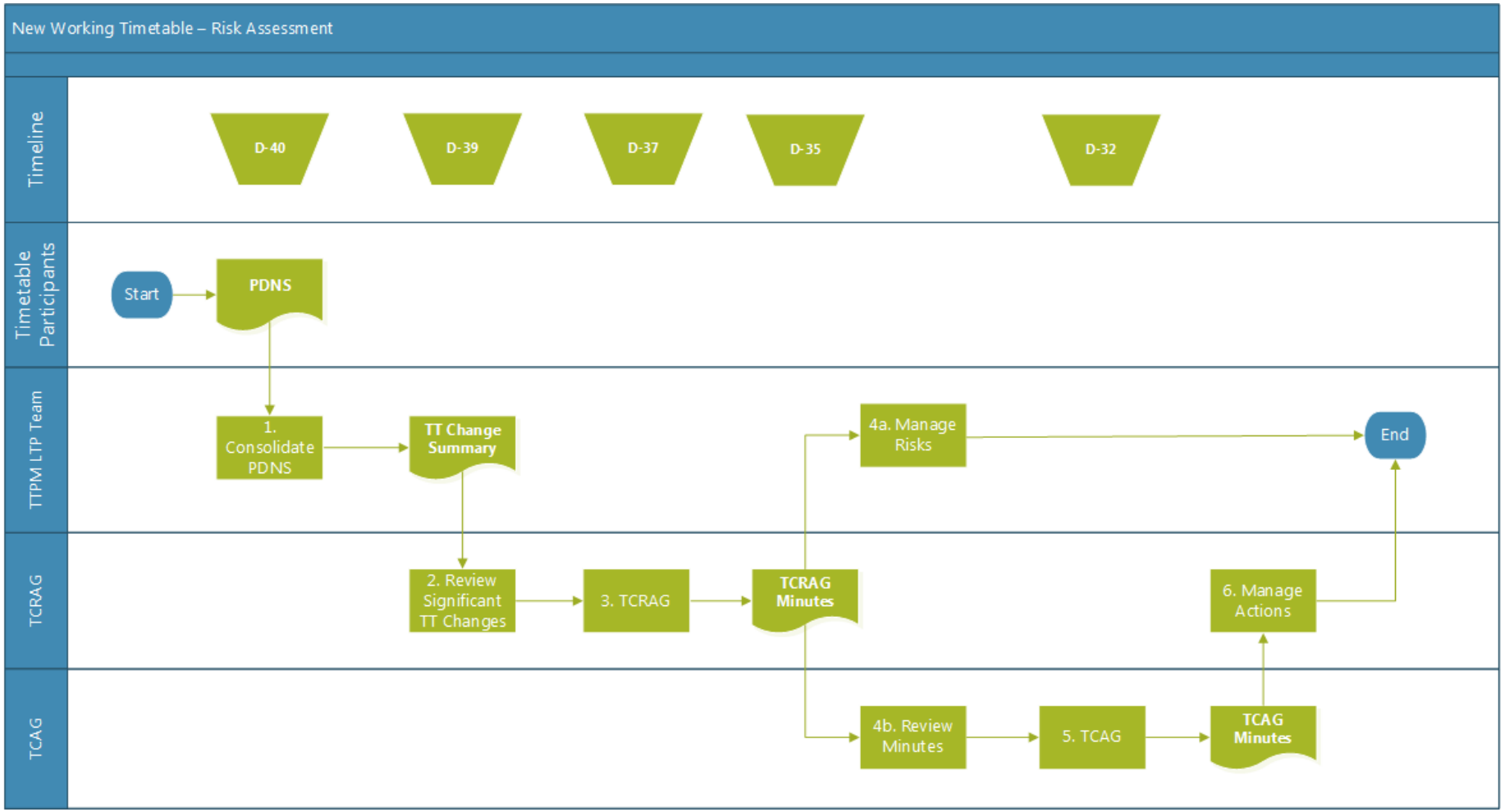
New Working Timetable – Rollover Data Checks



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)			Notes
		Timetable	Timetable Planning Rules	Network Geography	
Process #	Process step				
0	Start	-	-	-	
1	Investigate and Explain	R	-	-	
2	Produce Rollover Report	R	-	-	Documents any known issues with the PWTT that could not be readily addressed.
3	Rollover Data Checks	R	R	R	Minimal checks undertaken against the new PWTT to remove TPS 'red flag' errors. Reality is that some Timetable Participants will simply ignore the PWTT and re-bid a full timetable at D-40. No requirement on Timetable Participants to use the PWTT as a baseline plan. Network Rail would though like operators to take the PWTT and use this as the basis for their bids at D-40.
4	Correct LTPs	U	-	-	
5	Confirm Rollover Complete	-	-	-	

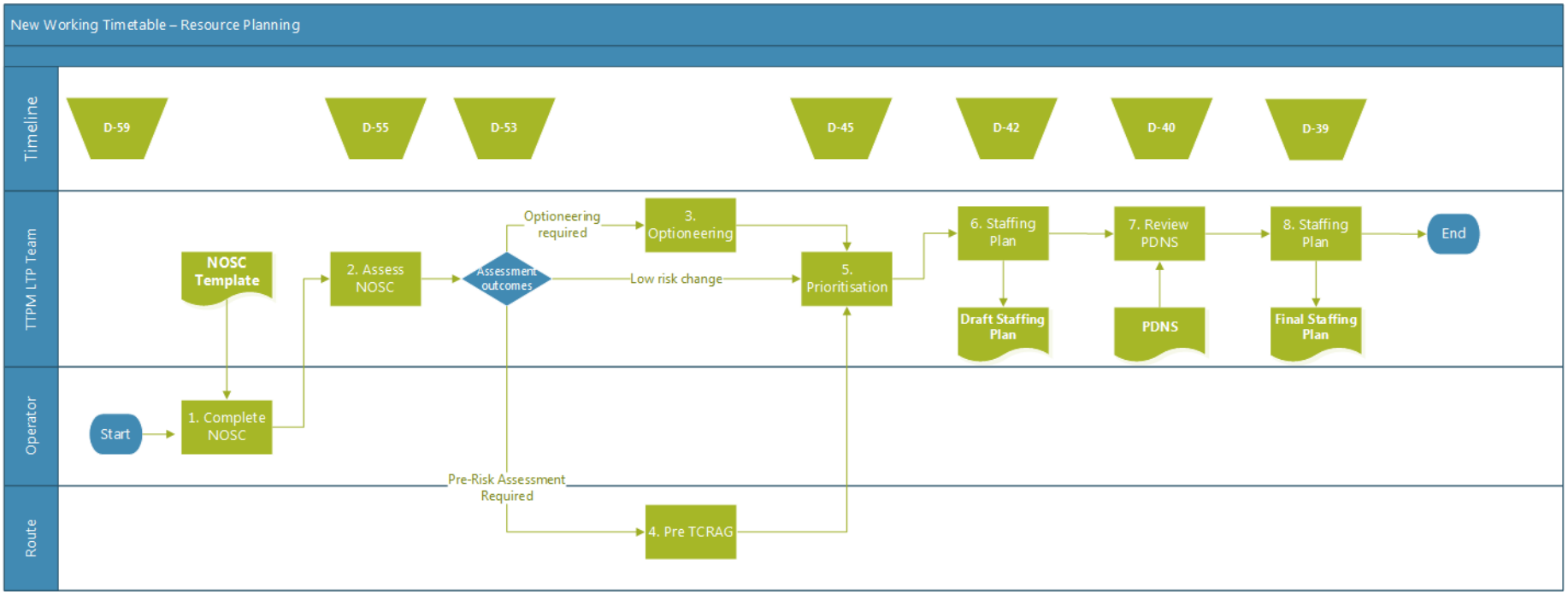
New Working Timetable – Risk Assessment



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)		Notes
		PDNS	Timetable Risk	
Process #	Process step			
0	Start	-	-	
1	Consolidate PDNS	R	-	
2	Review Significant TT Changes	R	-	
3	TCRAG	-	C	The remaining steps within this process involve the capturing and tracking of significant risks. This data is managed within meeting minutes and spreadsheets and has no formal definition.
4a	Manage Risks	-	CUD	
4b	Review Minutes	-	R	
5	TCAG	-	CRUD	
6	Manage Actions	-	CRUD	

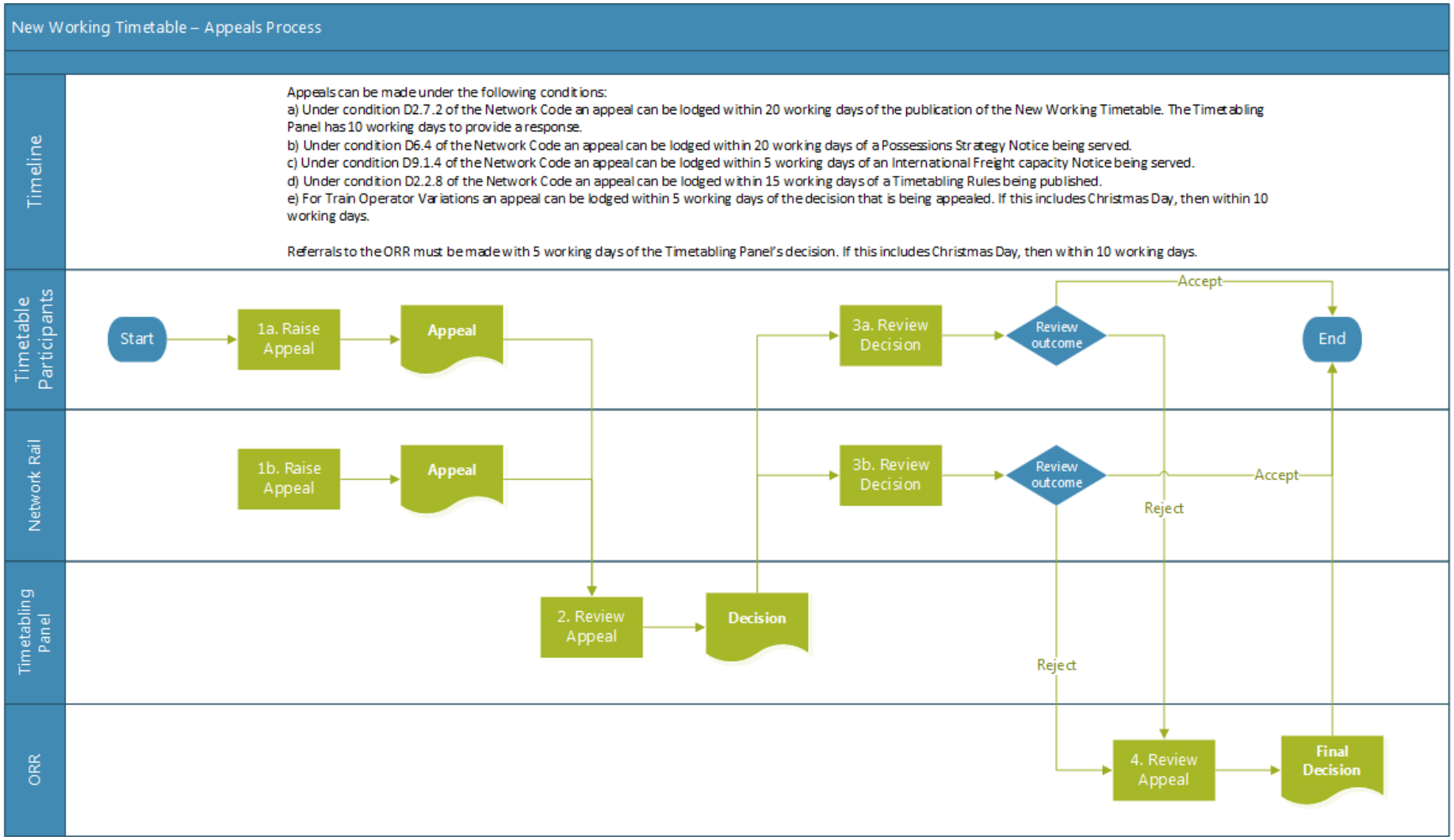
New Working Timetable – Resource Planning



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)			Notes
		NOSC	PDNS	Staffing Plan	
Process #	Process step				
0	Start	-	-	-	
1	Complete NOSC	C	-	-	
2	Assess NOSC	R	-	-	
3	Optioneering	R	-	-	For significant anticipated timetabling change a degree of optioneering/modelling may be required to better understand the new timetabled services and scale of change that will need to be managed.
4	Pre TCRAG	-	-	-	These process steps all contribute to the development of the forward staffing plan. The plan as such is maintained through a combination of document and spreadsheet based records and has no formal definition.
5	Prioritisation	-	-	-	
6	Staffing Plan	-	-	C	
7	Review PDNS	-	R	U	
8	Staffing Plan	-	-	U	

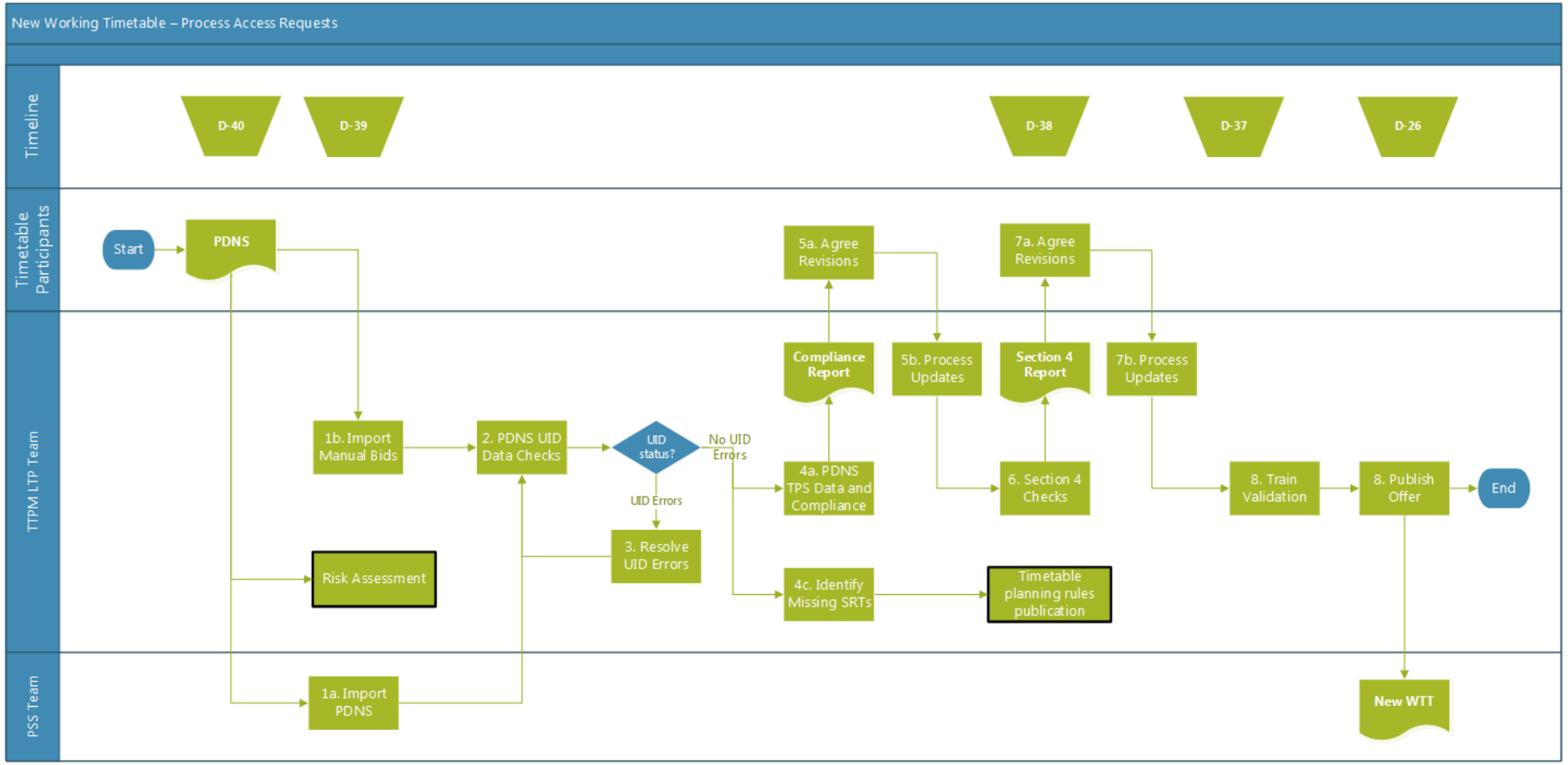
New Working Timetable – Appeals



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)		Notes
		Appeal	Decision	
Process #	Process step			
0	Start	-	-	
1a	Raise Appeal	C	-	The Appeals and Decision entity are free format document based which need to provide the evidence for the appeal and decision process. Given the nature of these entities they will not be modelled in the subsequent sections of this document.
1b	Raise Appeal	C	-	
2	Review Appeal	R	C	
3a	Review Decision	-	R	
3b	Review Decision	-	R	
4	Review Appeal	-	C	

New Working Timetable – Process Access Requests

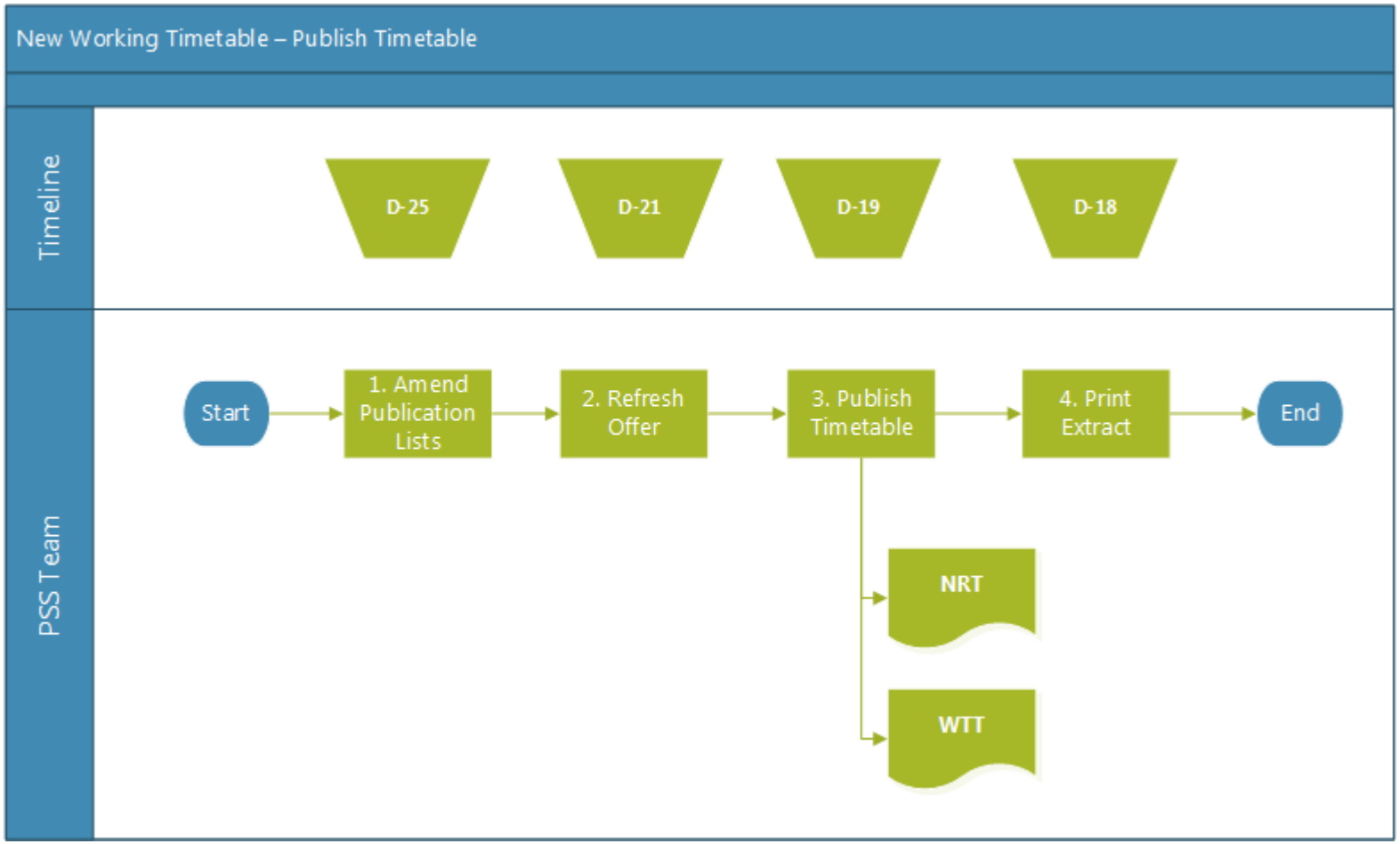


The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)									Notes
Process #	Process step	PDNS	UID Allocation	Timetable Planning Rules	Candidate Path	Working Path	TPR Change Request	Scheduled Access	Access Rights	Timetable (WTT)	
0	Start	-	-	-	-	-	-	-	-	-	
1a	Import PDNS	R	-	-	C	-	-	-	-	-	PDNS PEX files do not go through the DSEA process. Loaded into TPS for initial view of 'red cross' validation errors.
1b	Import Manual PDNS	R	-	-	C	-	-	-	-	-	
2	PDNS UID Data Checks	-	R	-	R	-	-	-	-	-	For electronic imports these checks occur within the TPS product in parallel to other 'red cross' TPS Data checks.
3	Resolve UID Errors	U	U	-	R	-	-	-	-	-	
4a	PDNS TPS Data and Compliance	R	-	-	-	-	-	-	-	-	This is a compliance check against the timetable process rather than a check of the timetable itself.
4b	Identify Missing SRTs	-	-	R	R	-	C	-	-	-	Feeds into Timetable Planning Rule Publication process
5a	Agree Revisions	U	-	-	U	-	-	-	-	-	
5b	Process Updates	R	-	-	U	-	-	-	-	-	
6	Section 4 Checks	-	-	-	R	R	-	R	-		Note that this is done against the EAS rather than from TPS data.
7a	Agree	U	-	-	U	-	-	U	-		

	Revisions										
7b	Process Updates	R	-	-	U	-	-	-	-	-	
8	Train Validation	-	-	R	R	R	-	-	R	-	Manual checks undertaken by planners using TPS and TPR. Some route planning teams also use ATTUne.
9	Publish Offer	-	-	-	-	-	-	-	-	C	

New Working Timetable – Publish Timetable


New Working Timetable – Publish Timetable
Timeline
D-25
D-21
D-19
D-18
PSS Team
Start
1. Amend Publication Lists
2. Refresh Offer
3. Publish Timetable
4. Print Extract
End
NRT
WTT

The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)				Notes
Process #	Process step	Timetable Distribution List	Working Path	Path Offer	Timetable	
0	Start	-	-	-	-	
1	Amend Publication Lists	CRUD	-	-	-	
2	Refresh Offer	-	R	CU	-	
3	Publish Timetable	R	R	-	C	Covers the formal publication of the NRT and WTT timetables.

Timetable Variation – Short Term Planning

Overview

This process area covers all changes to the working timetable after it has been published from the Long Term Timetable process. Timetable variations can be instigated by Network Rail because of infrastructure maintenance restrictions being required, or from an operator if they need to make operational changes to their services.

Process Elaboration

The following processes are simplified versions of the Timetable Variation processes as described within the "Network Rail Variation Requests TW12" (Ref NR6) and "STP Planning" (Ref NR7).
The following processes have been assessed:

- Working Timetable – Operator Variation

  Operator variations (or spot bids as they are commonly called) for the principal or subsidiary timetable can be received at any time following its publication. Typical reasons for operators to raise timetable variations are:
  - Changes to cater for major sporting events,
  - Delivery of driver training,
  - Late planned stock moves,
  - Late planned stock/crew changes

  Driven by the pressures on operators to utilise their resources as efficiently as possible, operators regularly finalise their plan stock and crew plans within the TW-4/TW-3 window prior to the train service operating. As such it is not uncommon for operators to submit between 1000 and 2000 timetable variations a week. It was also noted that most operators plan their changes locally on the Monday/Tuesday and submit their changes to Network Rail from Wednesday onwards which creates a significant workload in the latter part of the week.

  The timetable amendment teams have strict timeframes within which they must respond to the timetable participant (Operator) with a decision to accept or reject the variation request.

- Working Timetable – Network Rail Variation

  Following the publication of the working timetable, changes may be required to accommodate maintenance access requests to the network. This process takes the access requests, determines the impact to the timetable and engages the timetable participants to determine a revised train service. This can result in between 5,000 to 10,000 path changes for a high-volume Timetable Participant.

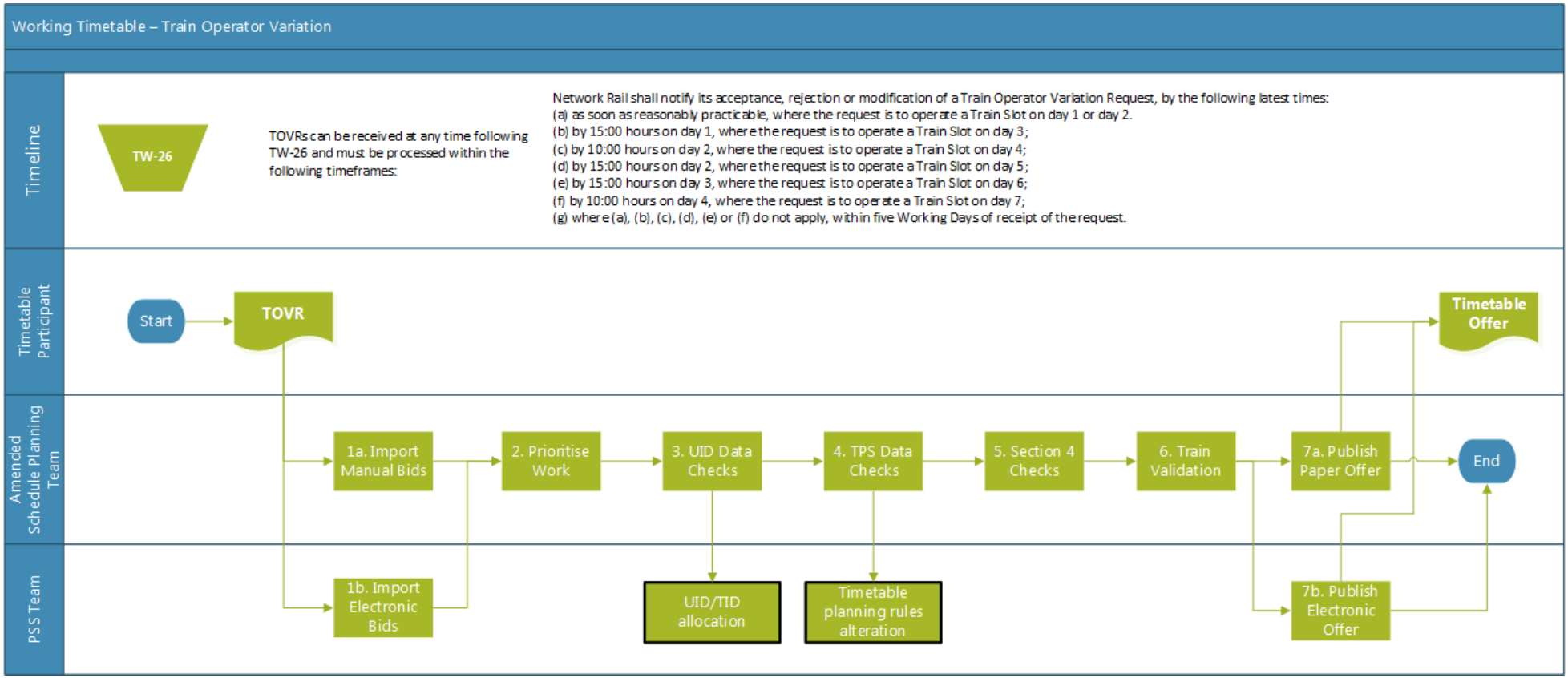
- Working Timetable – Weekly Operational Handover Checks

  To ensure that the timetable can be operated reliably on the network the amended schedule planning teams undertake some additional route specific activities which have been examined.
  - Automated Route Setting (ARS). For those ARS systems that Network Rail planners have access to compatibility checks are undertaken to ensure that

they have an up to date and accurate view of the timetable and related timetabling reference data.

- Platform occupation checks to ensure that the timetable matches the planned platform occupancy for high value stations.

Working Timetable – Operator Variation

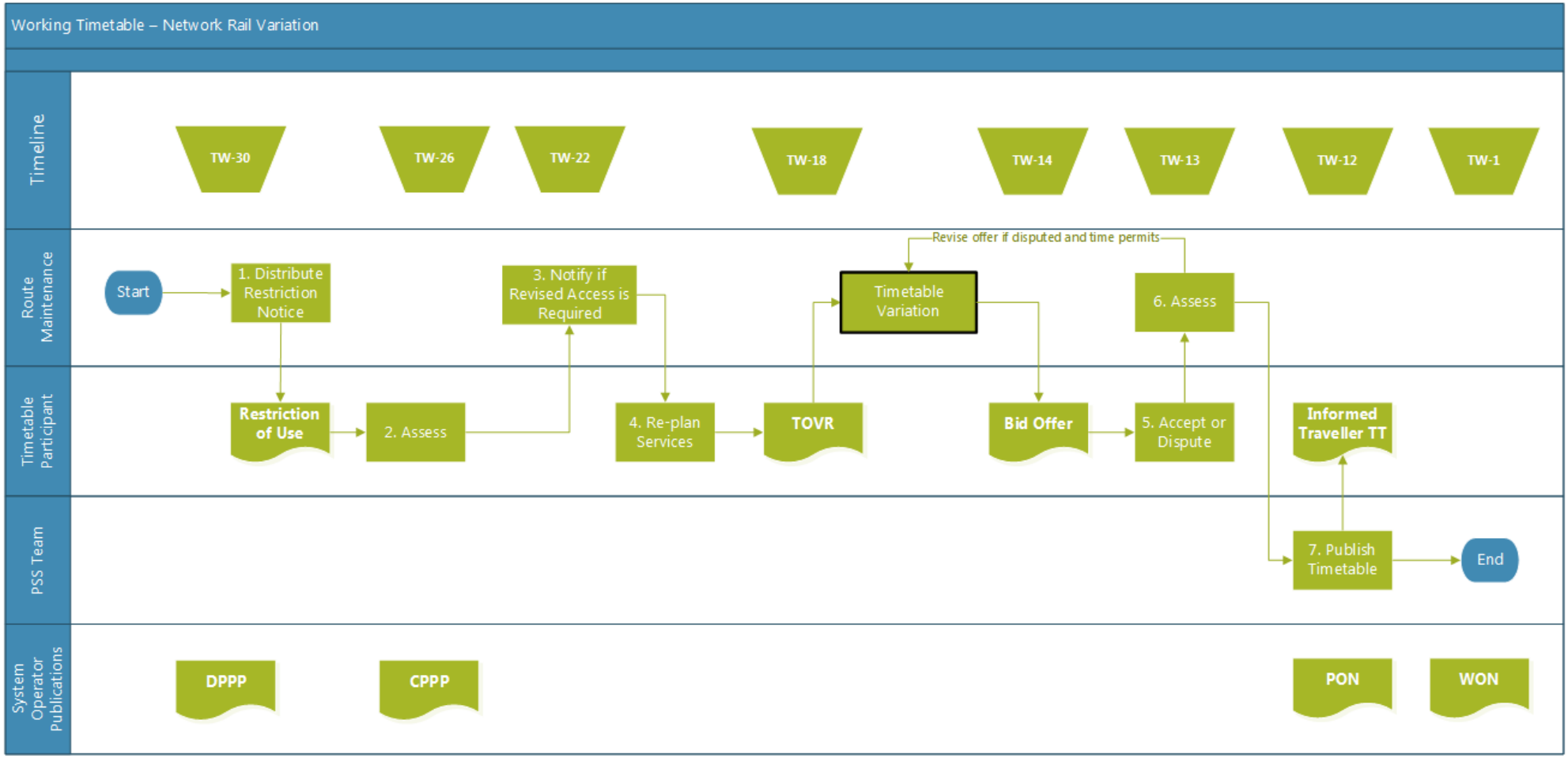


The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)							Notes
Process #	Process step	Bid Path	Candidate Path	UID Allocation	Timetable Planning Rules	Working Path	Scheduled Access	Timetable Offer	
0	Start	-	-	-	-	-	-	-	Train Operator Variation Request (Paper or PEX file)
1a	Import Manual Bids	R	CUD	-	-	-	-	-	DB cargo are the largest operator that still sends paper-based bids, although other Freight operators still use them.
1b	Import Electronic Bids	R	CUD	-	-	-	-	-	Operators using electronic bids utilise the PEX file format which is loaded through the DSEA service. Noted that there is no alternative process for bids with no timing impacts.
2	Prioritise Work	-	R	-	-	R	-	-	Varies by route based on known critical stations, junctions or capacity issues.
3	UID Data Checks	-	R	R	-	-	-	-	
4	TPS Data Checks	-	R	-	R	-	-	-	When overloaded, less critical paths will not be validated.
5	Section 4 Checks	-	R	-	-	-	R	-	Verified against the Periodic Operating Notices rather than from TPS.
6	Train Validation	-	R	-	R	CRUD	-		For the purposes of this simplified process the transition from a candidate path to a working path is considered to take place once the last validation activities have been undertaken.

		Data Entity (Create/Read/Update/Delete)							Notes
Process #	Process step	Bid Path	Candidate Path	UID Allocation	Timetable Planning Rules	Working Path	Scheduled Access	Timetable Offer	
7a	Publish Paper Offer	U	-	-	-	R	-	CRUD	The publication of the Path Offer is based on the new working paths following validation activities.
7b	Publish Electronic Offer	R	-	-	-	R	-	CRUD	Operators using Voyager Plan are not able to consume electronic offers so need to manually import them.

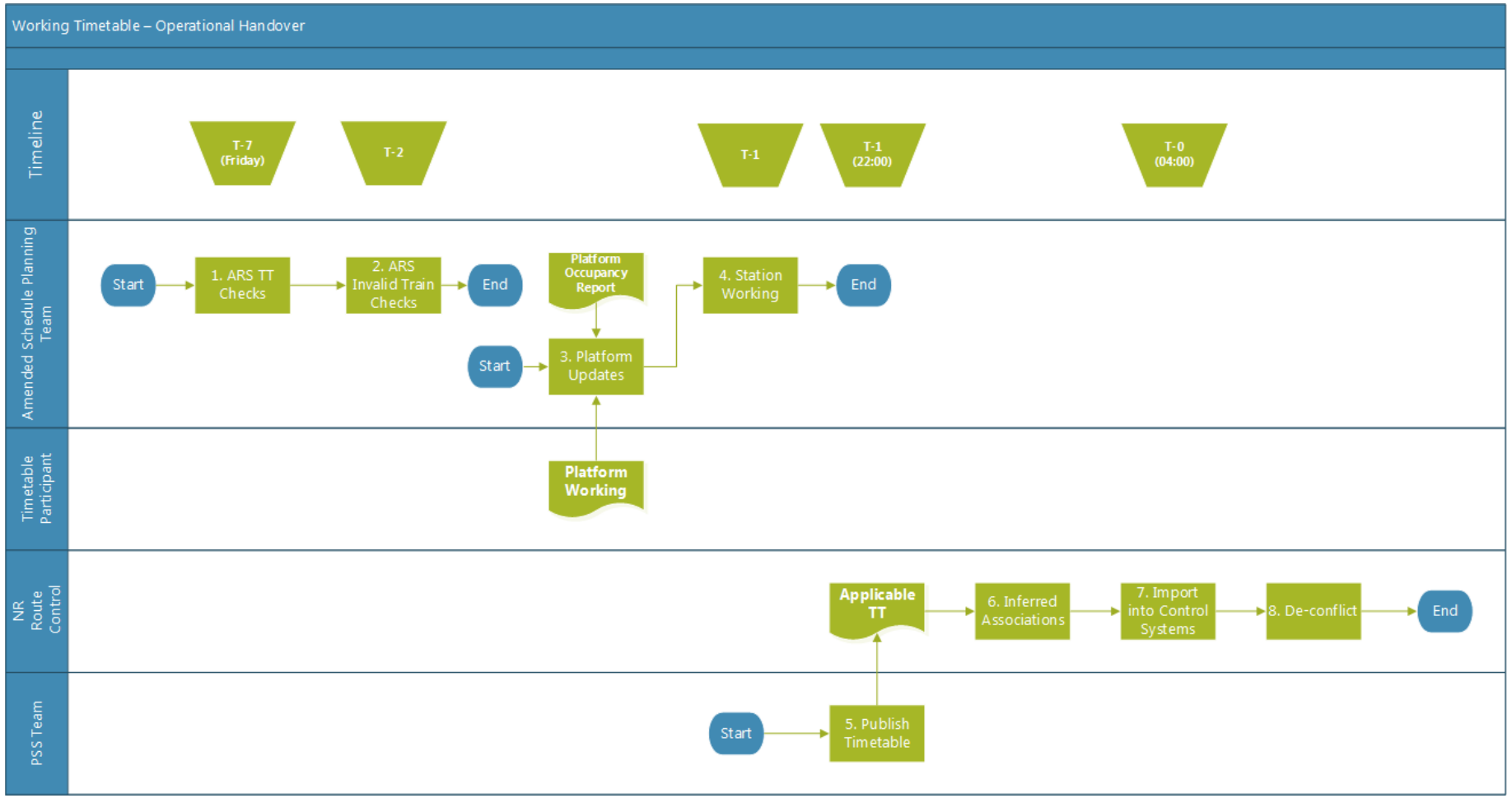
Working Timetable – Network Rail Variation



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)						Notes
Process #	Process step	Scheduled Access	Bid Path	Network Geography	Timetable Planning Rules	Offer Path	Timetable	
0	Start	-	-		-	-	-	
1	Distribute Restriction Notice	C	-		-	-	-	Covered in this document by the Scheduled Access data entity but may not be recorded yet in the possessions planning systems.
2	Assess	R	-	-	-	-	-	
3	Notify if Revised Access is Required	R	-	R	-	-	-	
4	Re-plan Services	R	C	R	R	-	-	Important that operator's planning system's view of the world matches Network Rail's. Most operators use electronic PEX files to send in changes but some smaller ones still using paper bids (e.g. Tyne and Weir Metro, Sheffield Super Tram)
5	Accept or Dispute	-	R	-	-	R	-	
6	Assess	-	R	-	-	R	-	Dependent upon time frame it may not be possible to re-visit the offer back out to the operator.
7	Publish Timetable	-	-	-	-	-	C	He TW-12 timetable is a critical milestone as it forms the basis of the informed traveller process and is the timetable used by the ticketing systems.

Working Timetable – Operational Handover



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)					Notes
Process #	Process step	Timetable (WTT)	Network Geography	Working Path	Station Working	Timetable (Applicable TT)	
0	Start	-	-		-	-	
1	ARS TT Checks	R	R	-	-	-	System Operator can only access some ARS systems (e.g. no access to Hitachi) so these checks are not done everywhere. Note that in times of work overload some of these checks may not get made.
2	ARS Invalid Train Checks	R	-	-	-	-	Where access to an ARS system is available and time permits, System Operator can correct the ARS view to match the timetable.
3	Platform Updates	-	-	U	R	-	Only undertaken at this late stage for a few critical station locations (e.g. Waterloo). ACWN received on a Thursday for Saturday/Sunday operations short term bids.
4	Station Working	R	-	-	C	-	Station Working reports are produced daily for 8 complex stations. Note that the format of each report varies but the contents is largely the same.
5	Publish Timetable	C	-	R	-	-	The daily TT published by 22:00 forms the basis for the performance regime.
6	Inferred Associations	R	-	-	-	C	WACI and POINTA are to such inference systems. System Operator maintain the data for WACI but POINTA has no current business owner and is maintained by the supplier for the route.

		Data Entity (Create/Read/Update/Delete)					Notes
Process #	Process step	Timetable (WTT)	Network Geography	Working Path	Station Working	Timetable (Applicable TT)	
7	Import into Control Systems	-	-	-	-	R	IECC, ARS, TRUST and TOPS are principal current systems. New TMS solutions such as Luminate (Western), Aramis (Romford, Cardiff), Hitachi (Thameslink) and Siemens (Crossrail) are also used.
8	De-conflict					U	Local changes to timings will be determined within the operational systems to allow for best use of the network.

Planning Rules Management

Overview

This process area covers the maintenance of the timetable planning rules that are used during the development of the timetable. Timetable planning rules cover the following distinct data areas:

- Electrification
  - Electrification Limits
  - Electrification Supply Restrictions
- Rolling Stock Restrictions
  - Locomotive Route Availability
  - Passenger Stock Restrictions
  - Freight Wagon Restrictions
  - Freight Train Load Limits
  - Freight Train Length Limits
  - Engineer's Train Restrictions
- Running Times, Margins and Allowances
  - Sectional Running Times
  - Headways
  - Junction Margins
  - Station Planning Rules
  - Platform Lengths
  - Timing Allowances

Process Elaboration

The planning rules management process area covers the activities that are required of Capacity Planning to produce and publish the formal Timetable Planning Rules (TPRs) publication in line with Network Code part D requirements, and are described in detail within the "Timetable Planning Rules Production and Publication Process" document (Ref NR1)

The following specific processes have been considered and will be elaborated below:

- Timetable Planning Rules publication

  Version 1 and Version 2 of the TPRs apply to timetable year commencing at Principal Timetable change (December Timetable) and may contain major changes to the Rules. Version 1 of the TPR's is published as the 'Draft Rules', at **D-59**. Version 2 -incorporate operator feedback of the 'Draft Rules' and is published as the 'Final Rules' at **D-44**.

  Version 3 and Version 4 of the TPRs apply to Subsidiary Timetable change (May Timetable). Version 3 and Version 4 of the TPRs may only contain minor changes and changes that were not foreseeable during the production of Version 1 and Version 2 of TPRs.

- Timetable Planning Rules alterations

  Network rail may adjust the TPR between **D-44** and **D-26** where it considers necessary to optimise the Timetable.

- Publications

  Publications in this context covers the following specific artefacts:

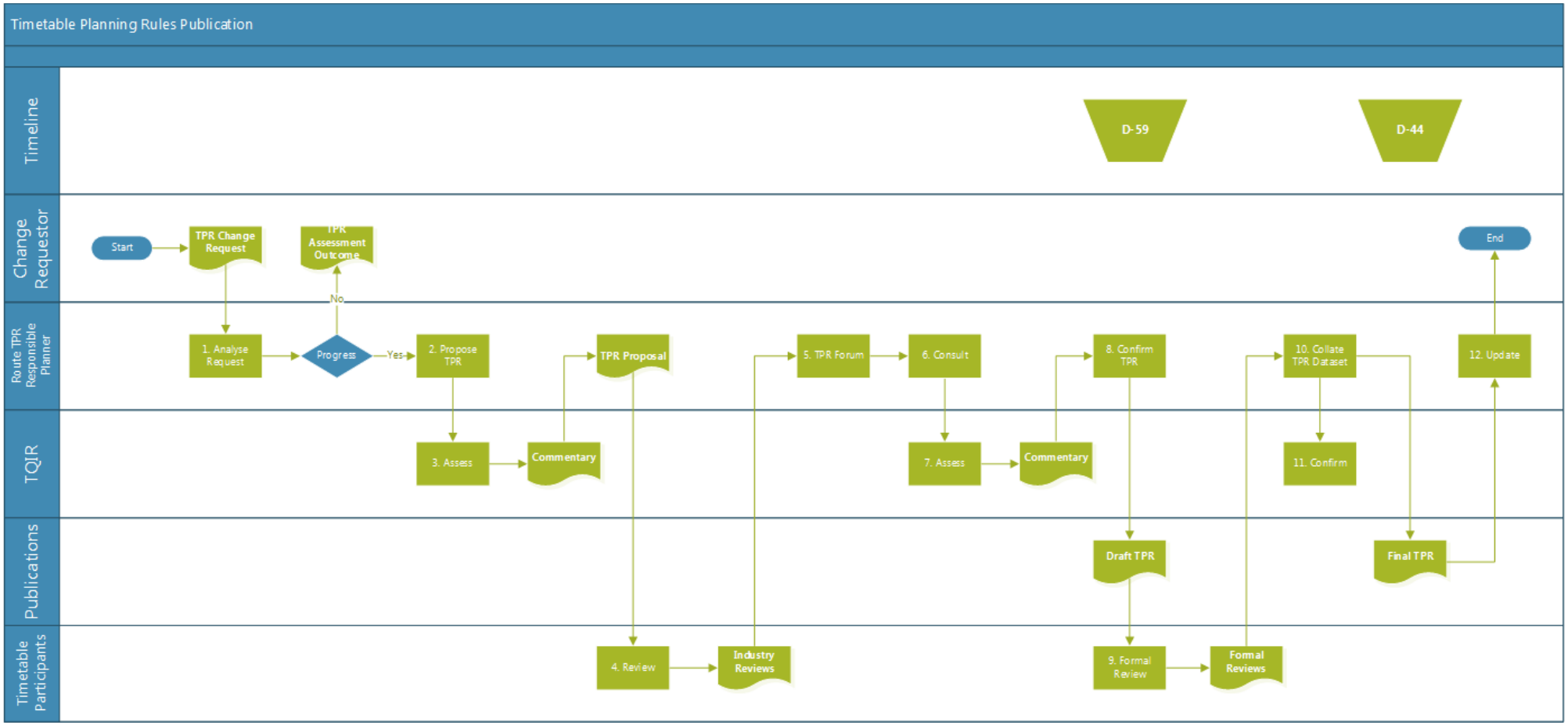
  - The National Sectional Appendix (NESA) which contains a detailed view of the operational network and contains subsets of the timetable planning rules as described within the Timetable Planning Rules publication. NESA is continually updated to reflect the current engineering view of the network and is available on the external Network Rail website as route-based PDFs. Alternatively, people may register for access to the National Electronic sectional Appendix system (NESA), which requires a Network Rail portal sign-on.
  - The Periodic Operating Notice (PON) which provides a periodic snapshot view of any planned access restrictions (for example possessions and speed restrictions) that will impact operational services.
  - The weekly operating notice (WON) provides a weekly snapshot view of any planned access restrictions (for example possessions and speed restrictions) that will impact operational services.

These documents are widely distributed and accessible and provide the Timetable Participants, with their view of our network, its capabilities and planned access restrictions.

- Freight Data Load Book publication

  The freight data load books contain detailed information about freight load and clearance limits and constitute a subset of the Timetable planning rules as described within the Timetable Planning Rules publication.

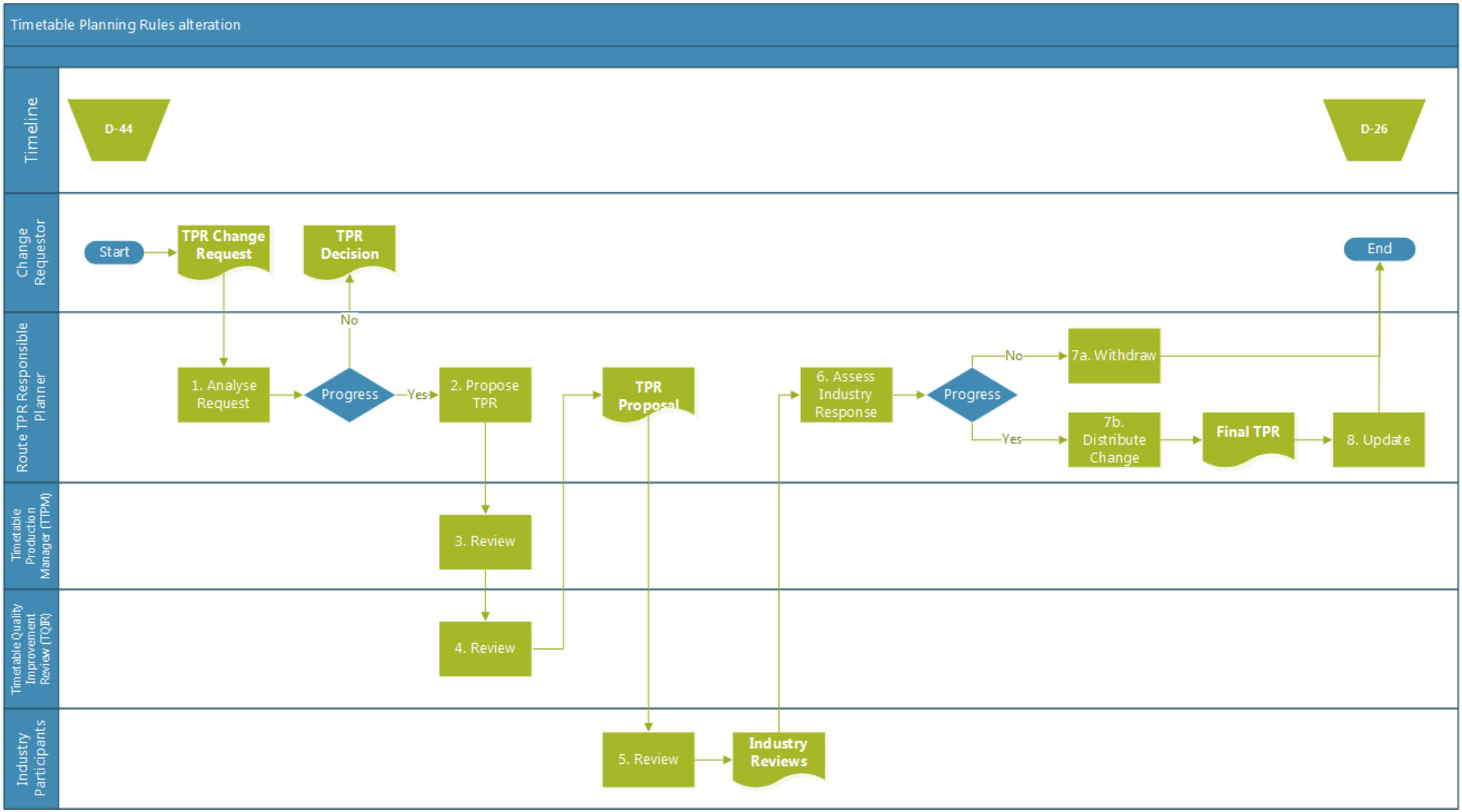
Timetable Planning Rules Publication



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)								Notes
Process #	Process step	TPR Change	TPR Log	SRT	Timing Load	Headway Rule	Junction Margin	Station Planning Rule	Platform Limits	
0	Start	C	-	-	-	-	-	-		
1	Analyse Request	R	C	R	R	R	R	R	R	It is noted that the TPR Log is not consistently used.
2	Propose TPR	U		R	R	R	R	R	R	
3	Assess	R		R	R	R	R	R	R	TPR Publication V1 follows this.
4	Review	R		R	R	R	R	R	R	
5	TPR Forum	R		R	R	R	R	R	R	
6	Consult	R		R	R	R	R	R	R	
7	Assess	R		R	R	R	R	R	R	
8	Confirm TPR	UD								
9	Formal Review	R		R	R	R	R	R	R	
10	Collate TPR Dataset	R		R	R	R	R	R	R	TPR Publication V2
11	Confirm	R								
12	Update	R		CUD	-	CUD	CUD	CUD	CUD	Changes are reflected within official repositories (BPLAN, ADB)

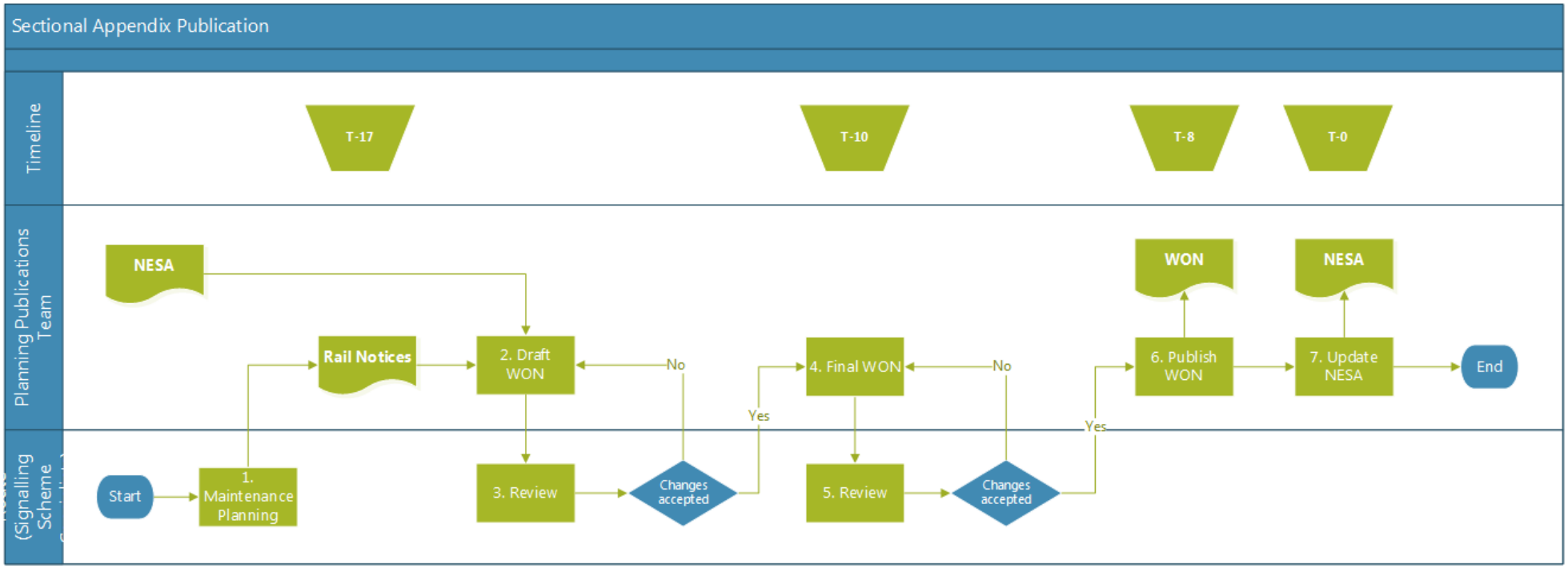
Timetable Planning Rules Alteration



The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)								Notes
Process #	Process step	TPR Change	TPR Log	SRT	Timing Load	Headway Rule	Junction Margin	Station Planning Rule	Platform Limits	
0	Start	C	-	-	-	-	-	-	-	
1	Assess Request	R	C	R	R	R	R	R	R	It is noted that the TPR Log is not consistently used.
2	Propose TPR	U	-	R	R	R	R	R	R	
3	Review	R	-	R	R	R	R	R	R	
4	Review	U	U	R	R	R	R	R	R	
5	Review	U		R	R	R	R	R	R	
6	Assess Industry Response	R	U	R	R	R	R	R	R	
7a	7a Withdraw	R	U	R	R	R	R	R	R	
7b	7b Distribute Change	U	U	R	R	R	R	R	R	Updates recorded in draft form for final agreement.
8	Update	R	-	CUD	-	CUD	CUD	CUD	CUD	Changes are reflected within official repositories (BPLAN, ADB)

Publications

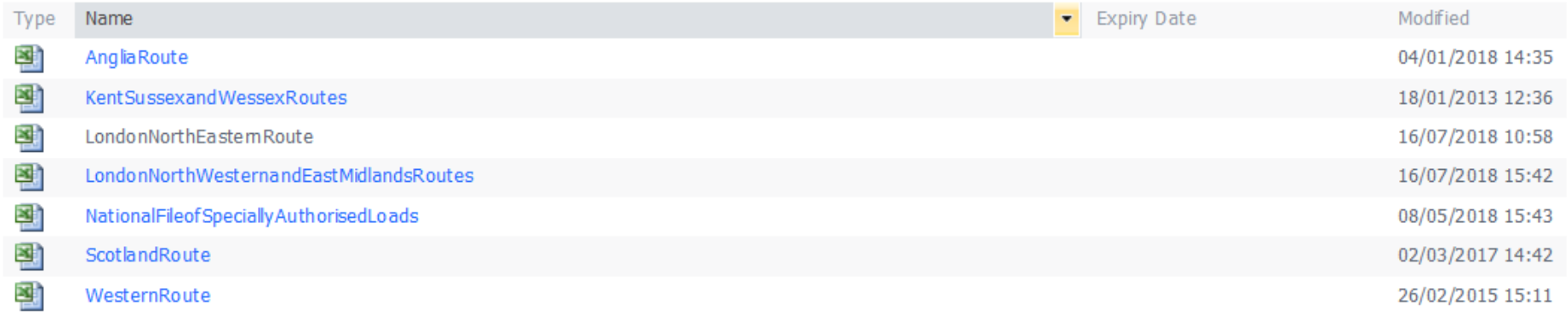


The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)							Notes
Process #	Process step	Network Change	Scheduled Access	Electrification Supply Restrictions	Route Availability	Route Clearance	Line of Route	Platform Limits	
0	Start	-	-	-	-	-	-		Note that there is also a Periodic Operating Notice which is publish every 4 weeks to present the up-coming 4 weeks planned work.
1	Maintenance Planning	C	-	-	-	-	-	-	
2	Draft WON	R	C	C	C	C	C	C	
3	Review	R	R	R	R	R	R	R	
4	Final WON	R	CUD	CUD	CUD	CUD	CUD	CUD	
5	Review	R	R	R	R	R	R	R	
6	Publish WON	-	R	R	R	R	R	R	WON Published
7	Update NESA	R	R	R	R	R	R	R	NESA Published

Freight Data Load Book publication

Whilst the Freight Data Load Books are formal Network Rail artefacts our initial investigation has found that these are maintained by the routes and there is no defined process in place that is followed. These books (spreadsheets) are not publicly available and access to them is provided on a request basis. An initial assessment of these books has found that some routes have maintained them whilst others are several years old. The snapshot image below provides the last modified dates as of 09/01/2019 and as it can be seen the most out of data instance (Kent, Sussex and Wessex) has not updated its books since Jan 2013.



Type	Name	Expiry Date	Modified
	AngliaRoute		04/01/2018 14:35
	KentSussexandWessexRoutes		18/01/2013 12:36
	LondonNorthEasternRoute		16/07/2018 10:58
	LondonNorthWesternandEastMidlandsRoutes		16/07/2018 15:42
	NationalFileofSpeciallyAuthorisedLoads		08/05/2018 15:43
	ScotlandRoute		02/03/2017 14:42
	WesternRoute		26/02/2015 15:11

The following data underpins or is manipulated within these artefacts.

		Data Entity (Create/Read/Update/Delete)		Notes
		Freight Train Load Limits	Freight Train Length Limits	
Process #	Process step			
0	Update Book	CRUD	CRUD	

Timetable Geography Management

Overview

This process area covers the maintenance of the supporting data needed to utilise the timetable planning tooling used by the System Operator. This process area covers the following specific data areas:

- Train identifiers
- Timetable geography
    - Station identifiers
    - Timing point identifiers
    - Network Links
    - Route Codes,
    - Trains Service Codes,
    - Track Codes,
    - Timing Loads
- Infrastructure geography changes
    - TPS edge/section network model,
    - Nodes,
    - Blocks,
    - Signals,
    - Tracks,
    - Platform,
    - Network Features (Level Crossings, Bridges, Tunnels etc)

These areas will be broken down further under that process elaboration and data sections.

Process Elaboration

This process area covers the activities that are required of Capacity Planning to maintain the geography model that is used within the principal timetable planning tooling, and is described in detail within the “Capacity Planning - Timetable Geography” document (Ref NR2)

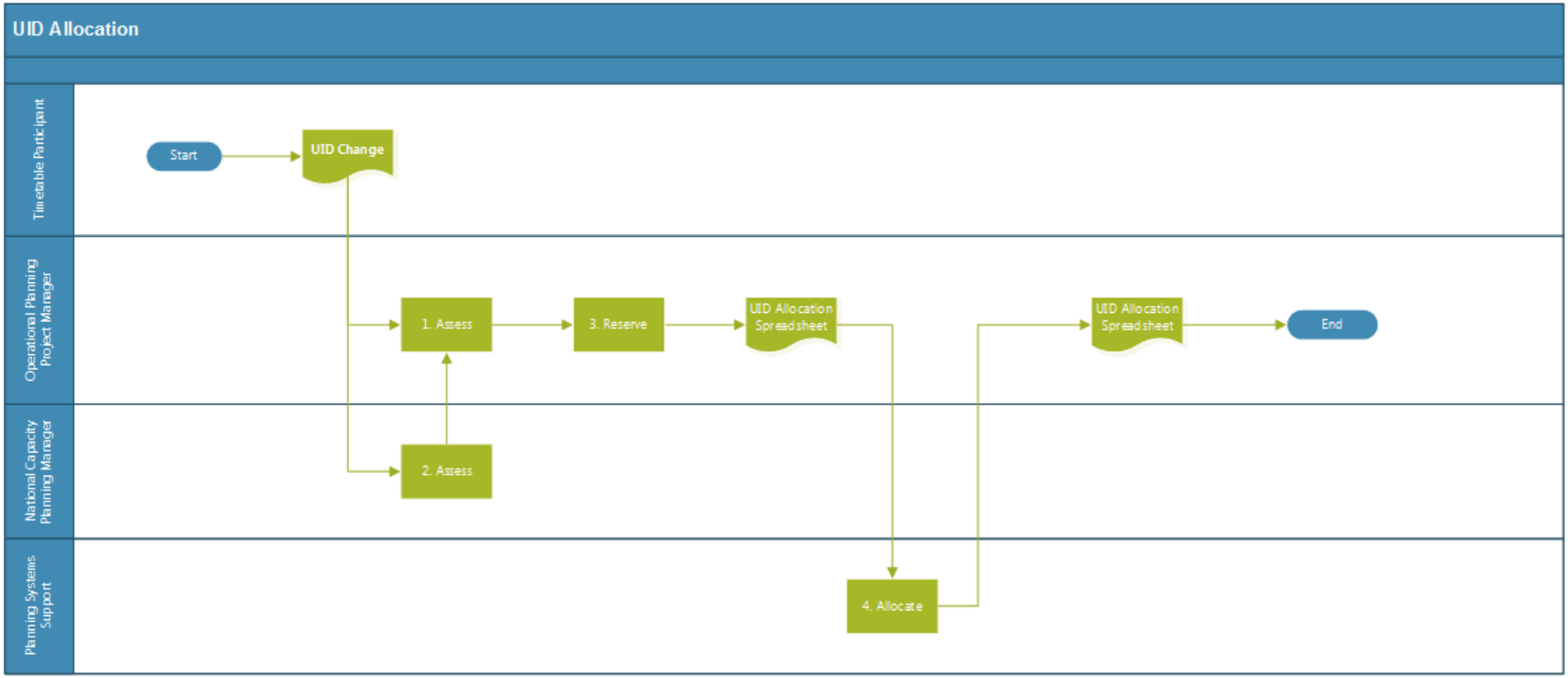
The following specific processes have been considered:

- UID allocation
    - Covers the allocation of the unique train planning identifiers that are used by train planners.
- Timetable geography changes
    - Covers changes to station/timing locations, network links, route, train service and track codes.
- Infrastructure geography changes
    - Covers changes to the core planning network model to keep it aligned to the planned physical infrastructure that the train services need to be planned against.

UID Allocation

Prior to the start of the 'Rules' revision process for each Timetable Change date, Network Rail invites Operators to identify specific TID (head code or train reporting number) or UID changes they have concerns over. In addition, during the timetable development process, Network Rail planners may request blocks of UID train identifiers to support their train planning activities.

It is worth noting that there is work underway to automate this process and allow planners to obtain blocks of UID train identifiers through a self-service approach.



The following data underpins or is manipulated by this process.

Process #	Process step	Data Entity (Create/Read/Update/Delete)	Notes
		UID Allocation	A planning TID is the same as an Operational Train Number in terms of business use and is currently defined as a Headcode. This is not the same as the UID which is a planning id is and equivalent to the TSI definition of a 'path id'.
0	Start	-	
1	Assess	R	
2	Assess	R	
3	Reserve	CUD	
4	Allocate	CUD	

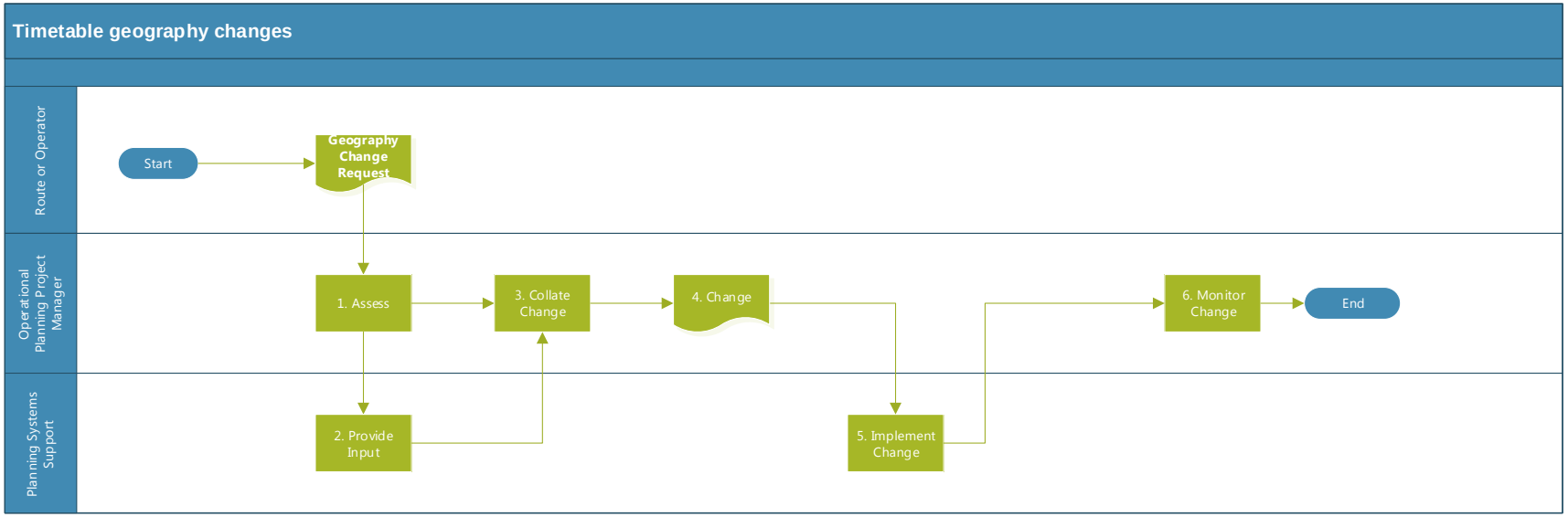
Timetable Geography Changes

New network links, codes and platforms can be added at any time following the conclusion of the established consultation process. Amended network links, codes and platform changes must be dated and only made around a significant timetable change, these changes can be consulted as per the timetable planning rules process but should only be implemented around a timetable dataset.

Changes to network links (new mandatory timing points etc.) must be supported with:

- Changes to SRTs for all timing loads
- End dating and removal of old data
- All possible network and track code links
- Data agreed with operators when all existing WTT and2 STP schedules will be altered
- Update station banks on geography with new mandatory timing points

Train service code changes can be requested at any time by operators or during refranchising.

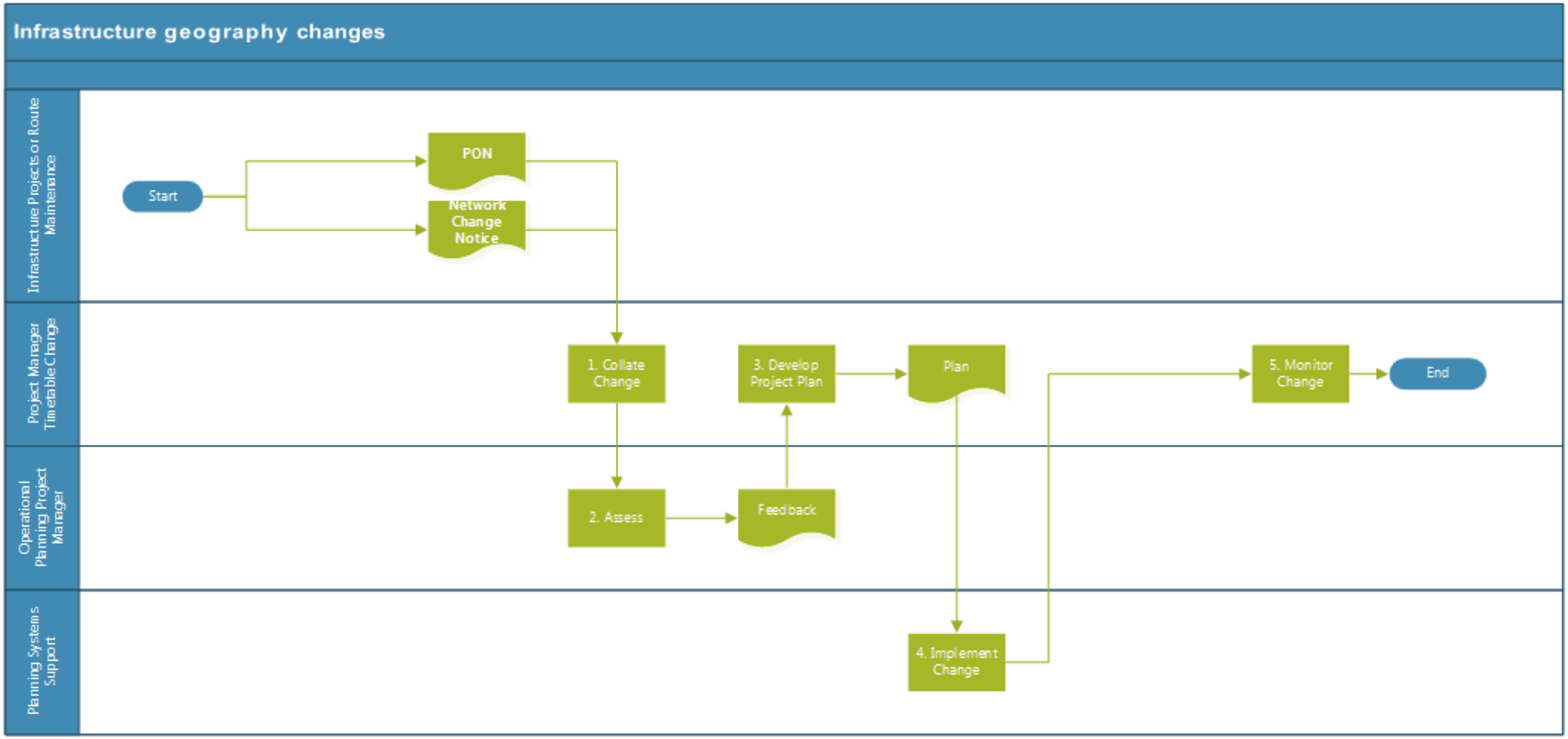


The following data underpins or is manipulated by this process.

		Data Entity (Create/Read/Update/Delete)				Notes
Process #	Process step	Network Link	Platform	Timing Load	Service Code	Timing Loads form part of the Sectional Running Time data entity.
0	Start	-	-	-	-	
1	Assess	R	R	R	R	
2	Provide Input	R	R	R	R	
3	Collate Change	R	R	R	R	
4	Change	R	R	R	R	
5	Implement Change	CRUD	CRUD	CRUD	CRUD	
6	Monitor Change	R	R	R	R	

Infrastructure Geography Changes

Infrastructure changes will either be initiated because of infrastructure project activities or through errors or omissions being identified by the planning teams themselves. Given the significant nature of these changes they will be implemented as part of a significant timetable change.



The following data underpins or is manipulated by this process.

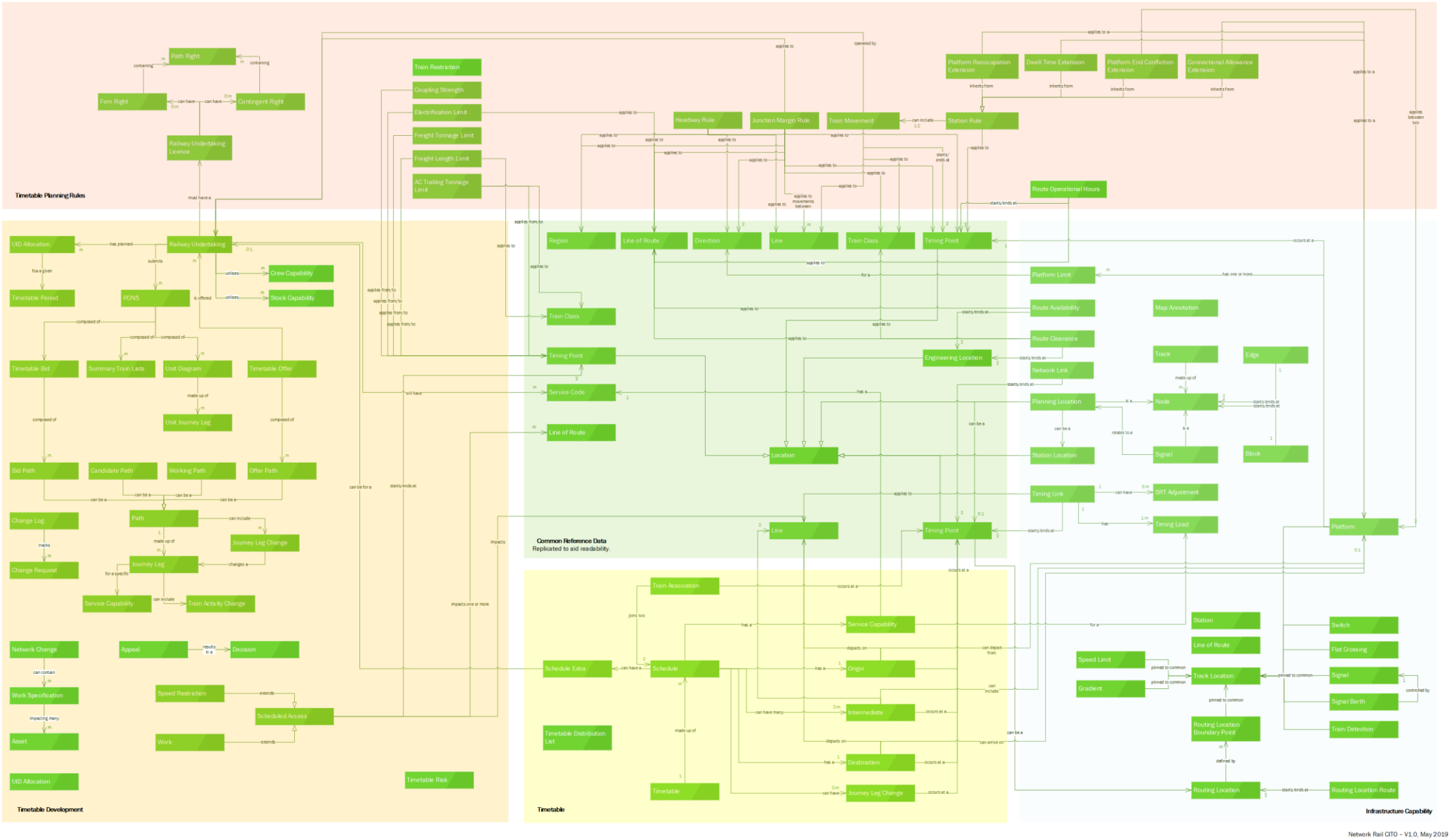
		Data Entity (Create/Read/Update/Delete)				Notes
Process #	Process step	Network Geography	Platform	Timing Load	Service Code	Timing Loads form part of the Sectional Running Time data entity.
0	Start	-	-	-	-	
1	Collate Change	R	R	R	R	
2	Assess	R	R	R	R	
3	Develop Project Plan	R	R	R	R	
4	Implement Change	CRUD	CRUD	CRUD	CRUD	
5	Monitor Change	R	R	R	R	

Data Entity As-Is Capture

To understand how data is used within the timetable planning process, we first need to have a clear position on what the data is and how it inter-relates. Without this view we will not have a shared understanding of our data and there is a danger that the full scope of data change initiatives will be poorly understood, and implications missed.

Logical Data Models

The following diagram shows at a simplified level the data entities that have been assessed and how they inter-relate with each other. This is then followed by more detailed logical data models, ordered alphabetically, for each of the Data Entities that were identified as supporting the core business processes discussed previously.

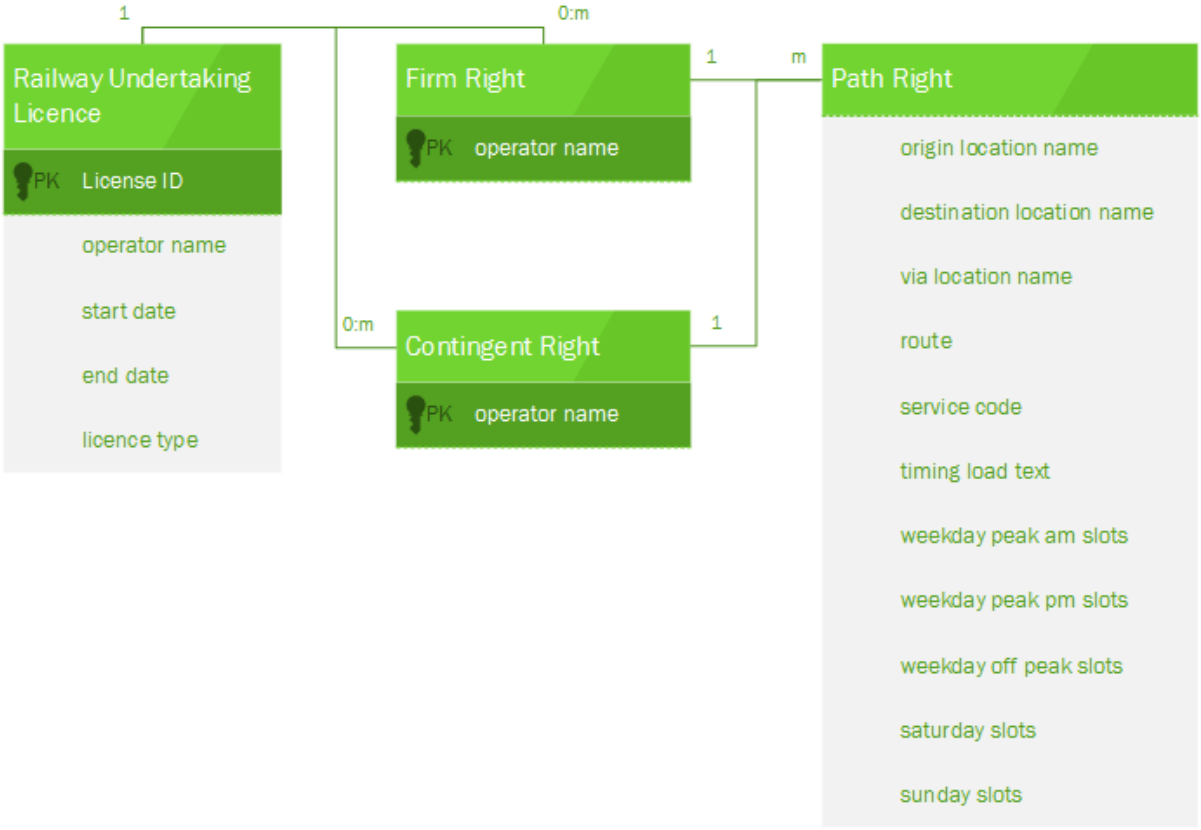


Network Rail CITO – V1.0, May 2019

Access Right

Each franchised operator holds a set of agreed access rights to train paths on the network. Access rights can take the form of 'Firm' or 'Contingent' rights as defined below:

- Firm Rights: Describes the rights attributed to an operator to run specific train slots across the network.
- Contingent Rights: means a right under this Schedule 5 which is not a Firm Right and which is subject to the fulfilment of all competing Exercised Firm Rights and any additional contingency specified in this Schedule 5

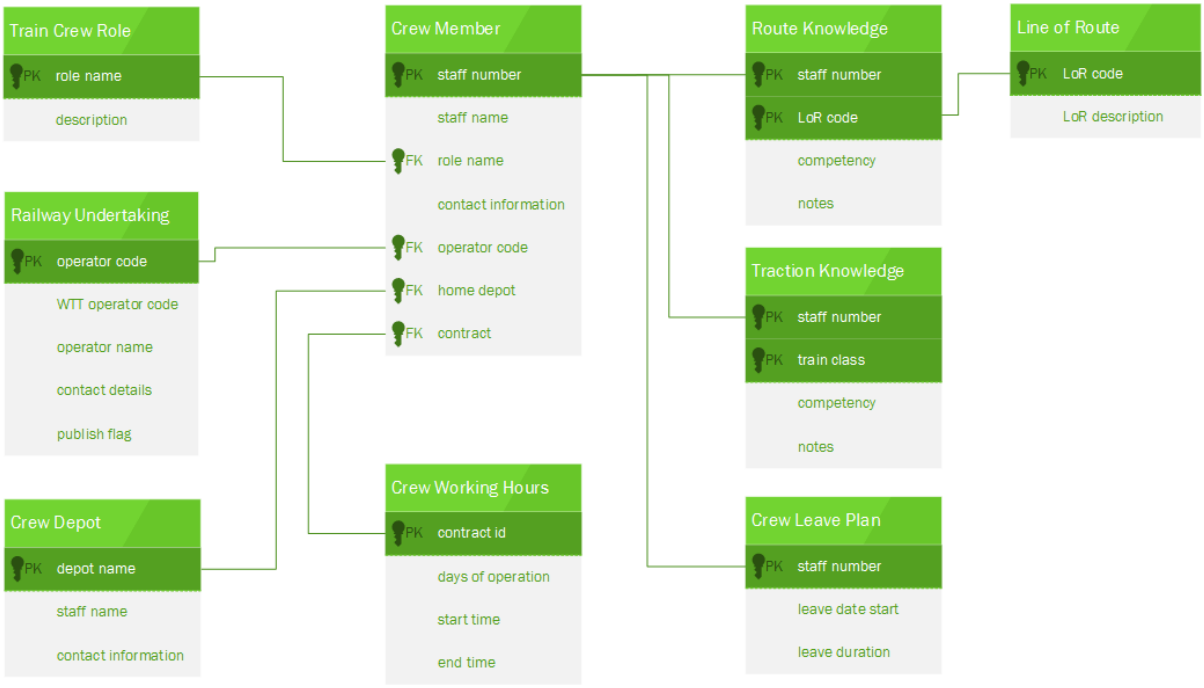


Candidate Path

A candidate path data entity is a path that is being assessed by the Network Rail planning teams for incorporation into a timetable. In terms of structure it is identical to the Working Path data entity and is distinguished as a candidate path via the path status attribute.

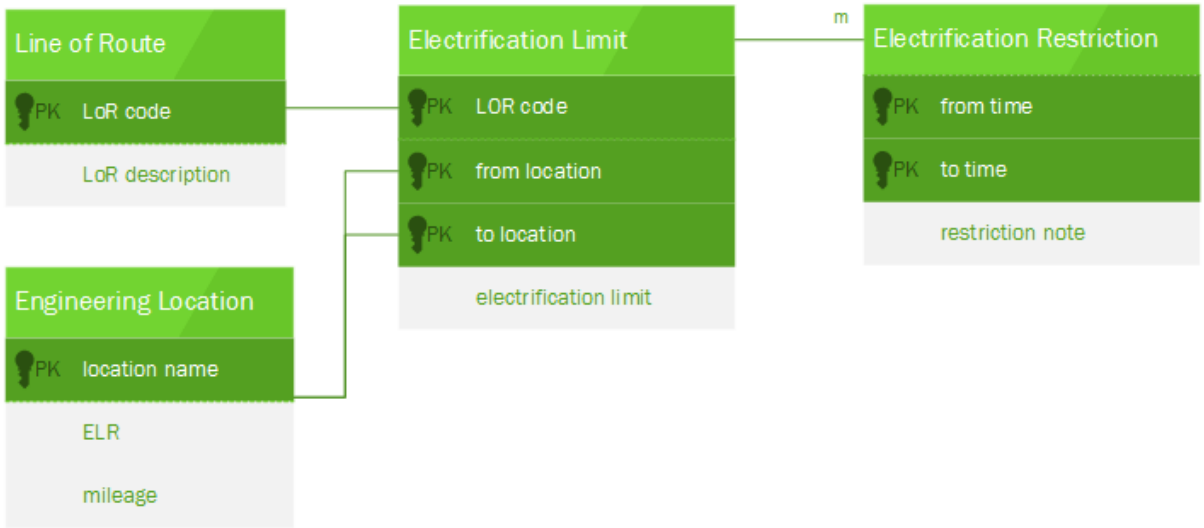
Crew Capability

Crew information, including operational hours, leave and route competency information is required to allow operators to develop timetabled services that work in conjunction with their available staff resources. The logical data model described below builds on the data constructs developed in the DR RDG Conops – Stock and Crew System (Ref NR14).



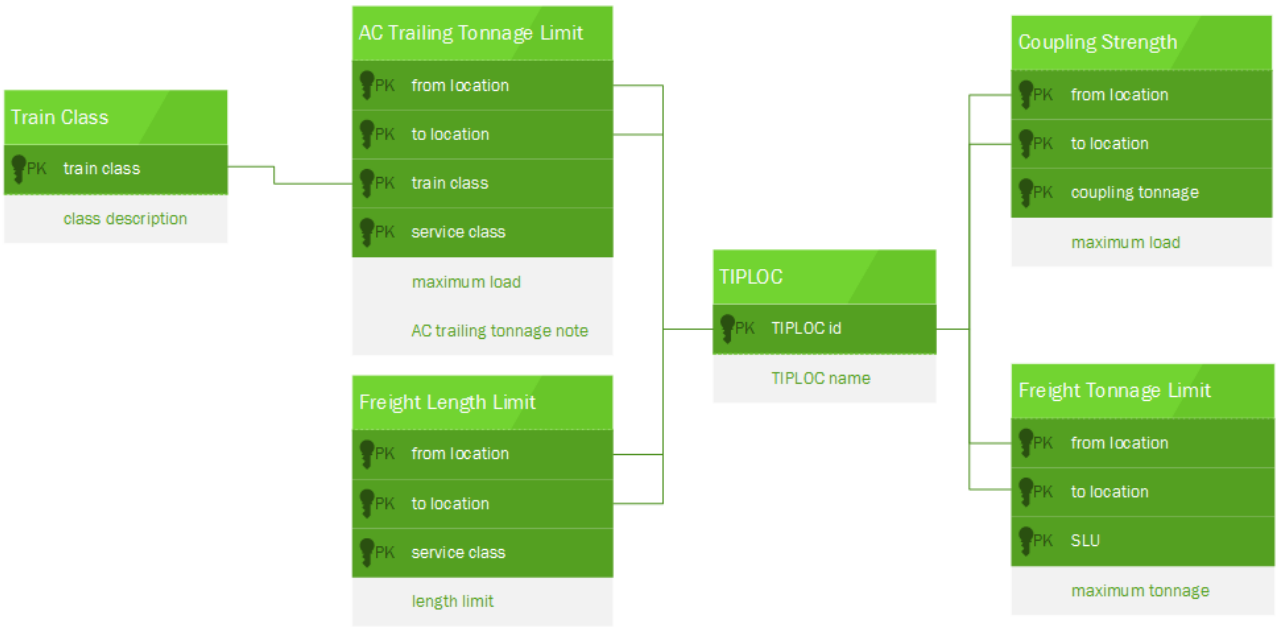
Electrification Limits

Limits of the 25 kV AC and 750V DC electrification systems need to be known to the timetable planners to correctly route electric trains across the network. A failure to apply these rules correctly could result in a train being unable to operate against its timetabled train path.



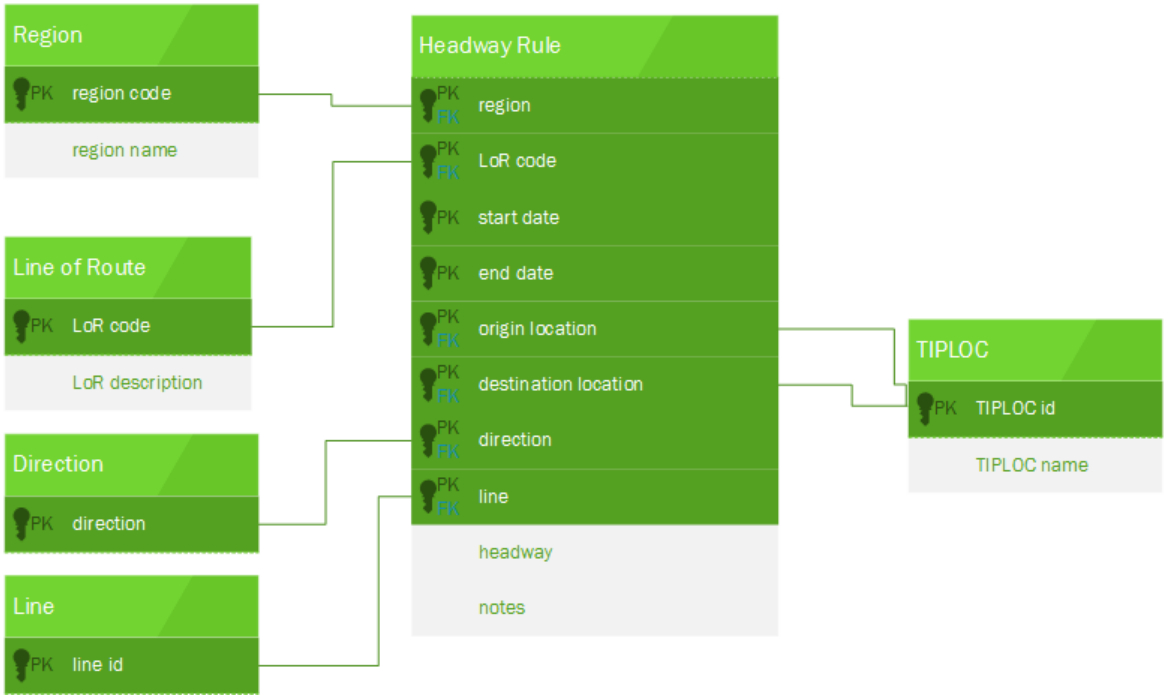
Freight Train Load Limits, Freight Train Length Limits

When planning freight services, it is important understand the load and length limits of the planned service are compatible with the network capability of the path being planned. A failure to do this correctly could result in a freight service blocking lines or being planned in a manner that will not be allowed to operate.



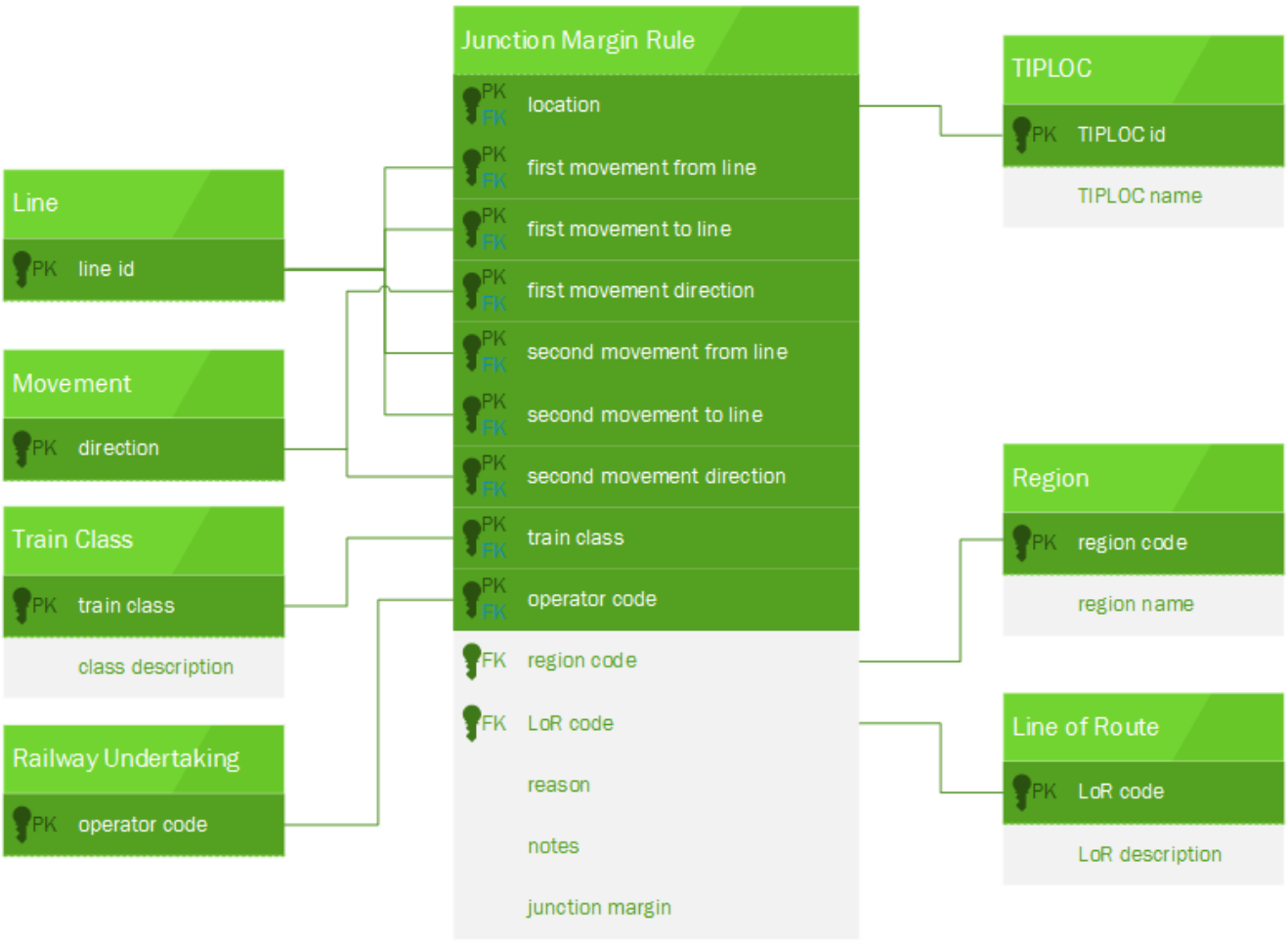
Headway Rule

The planning headway is the minimum planned time interval between two successive train schedules as a specific timing point on the same line in the same direction, such that the second train can meet its sectional running time.



Junction Margin Rule

A junction margin is the minimum permissible time interval between two trains that are performing conflicting moves at a timing point, such that the second train can meet its sectional running time.

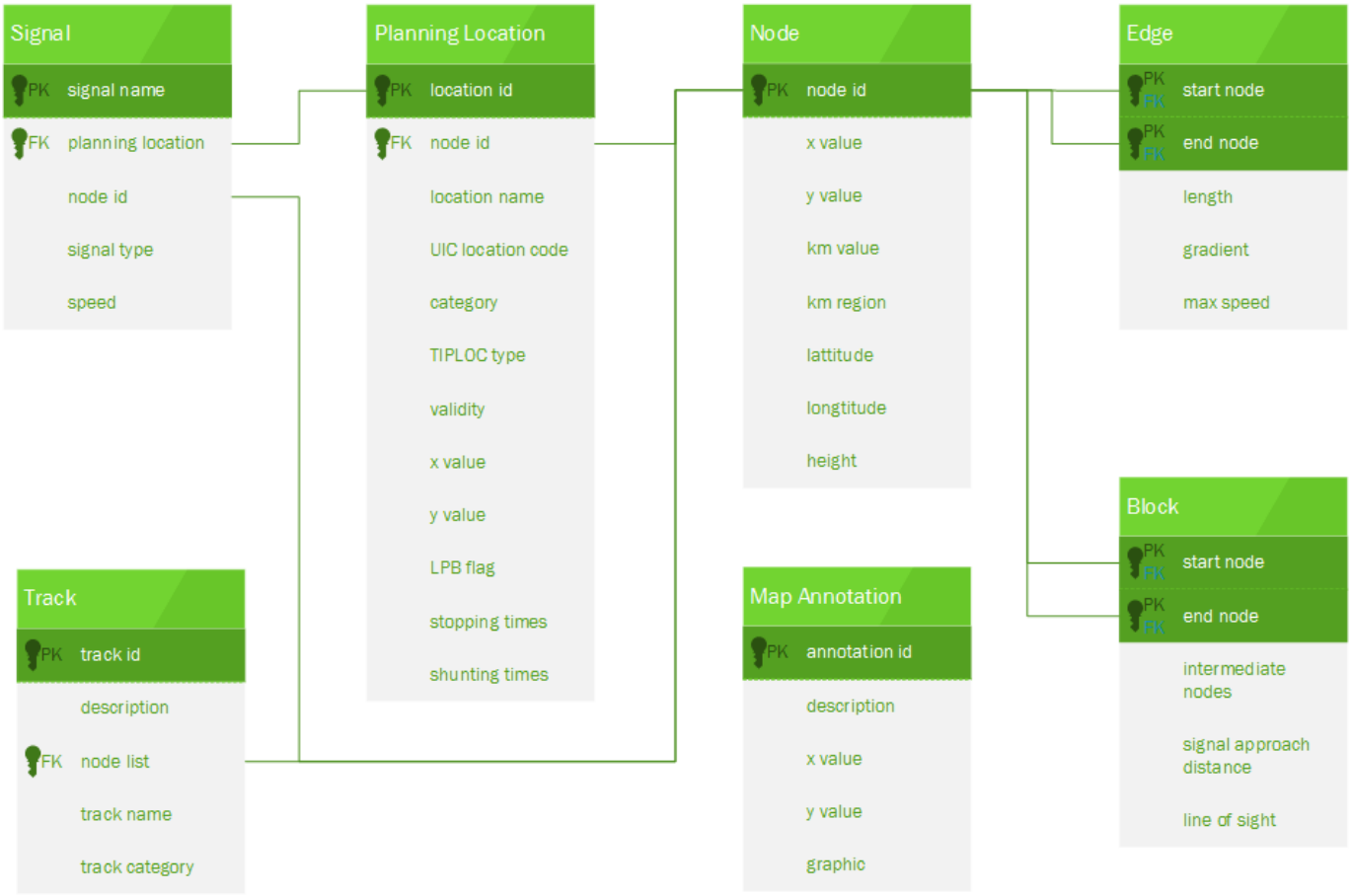


Network Geography

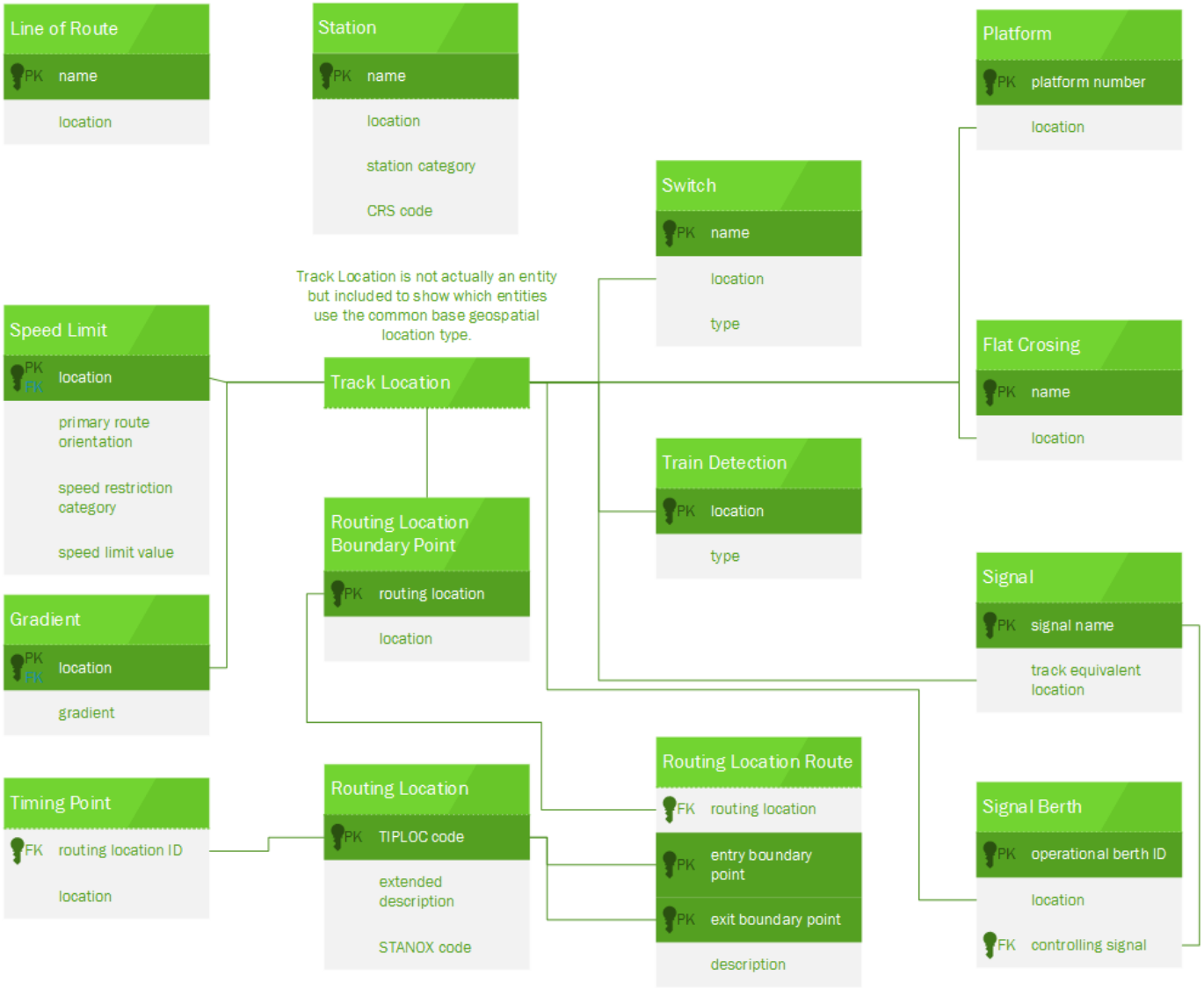
The network geography encompasses those entities that describe the physical geography. Currently this geography is managed independently multiple systems within Network Rail. From a timetable planning perspective the network geography is maintained within the TPS planning product as shown in the first logical data model below. The second logical data model view represent the current model held within the assets focussed infrastructure network model (INM) and whilst not used currently is included as there is an intent to adopt this as a master source.

It is worth noting that many of the features currently presented to the planning users through the TPS product's network geography views are simply annotations that have been pinned to the map screens. Annotations are used to provide features such as platforms and additional planning rules information. Use of annotations to record additional planning data was adopted as a business practice since approximately 2012.

TPS logical network geography model

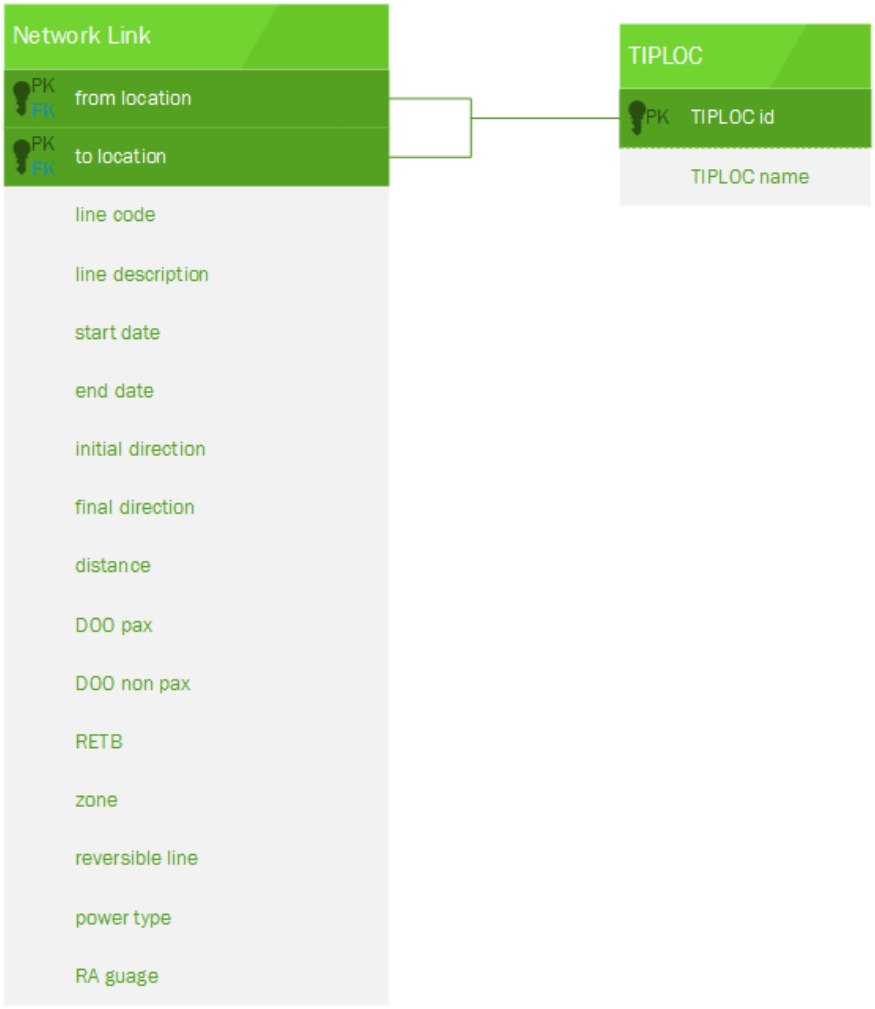


INM logical network geography model



Network Link

Details of a physical link between two locations. A network link between two locations can skip intermediate locations if they aren't mandatory timing points. Note that a Network Link is not defining an operational route between two points, but only that there is a physical set of track assets connecting these two points.

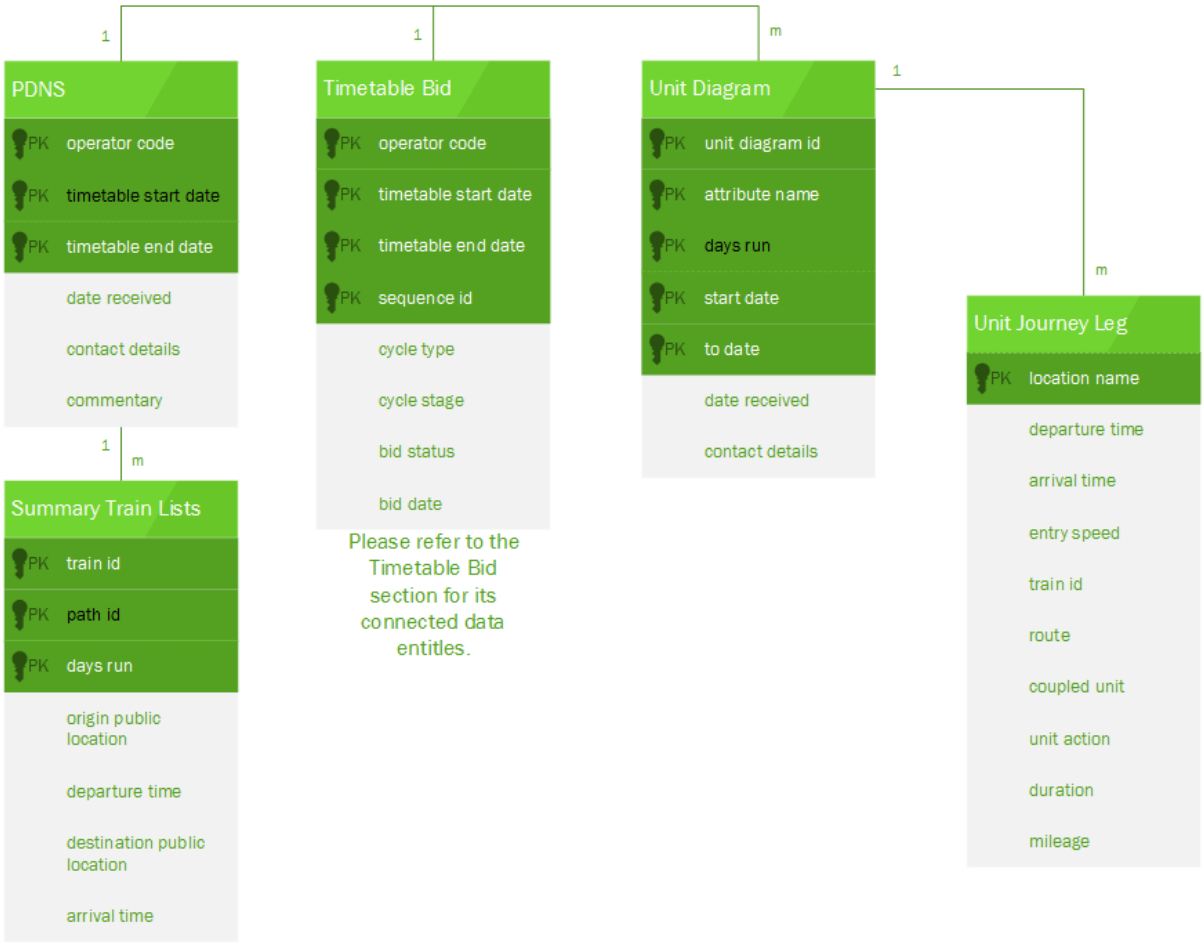


Network Change

Covers the information provided as part of a Network Change notice as defined under the Network Code Part G.

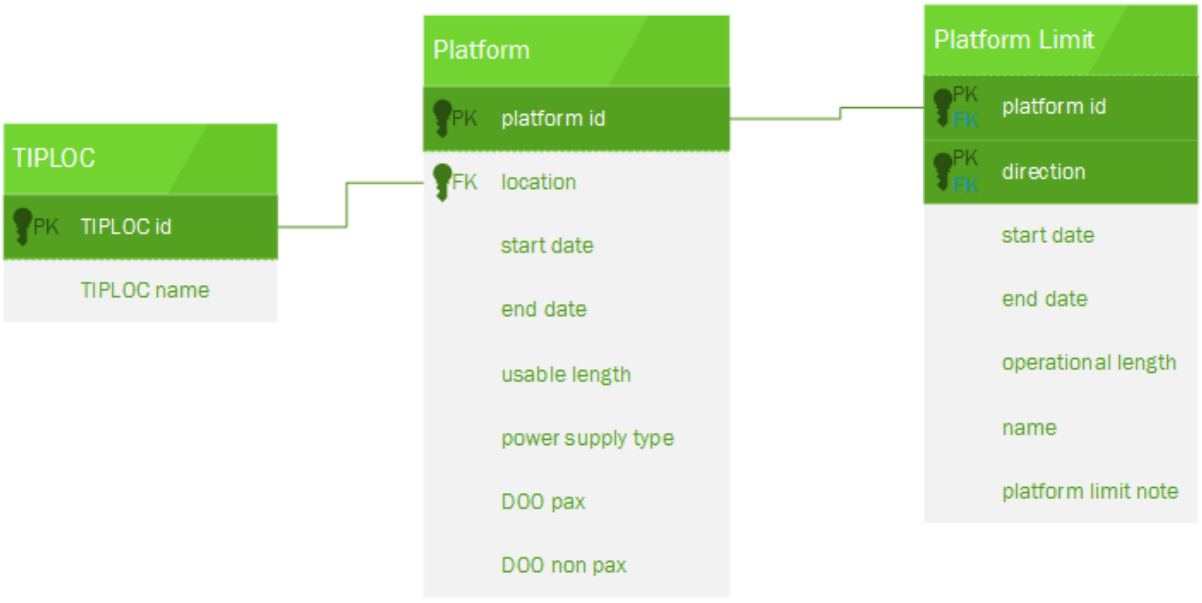
PDNS

The Priority Date Notification Statement is the construct used by a timetable participant to provide their initial response to the Prior Working Timetable provided by Network Rail. The network code defines a set of minimum data elements for an access request in section 2.5.1 however the PDNS incorporates additional mandatory data to support the timetable process and can include additional optional data to support its delivery.



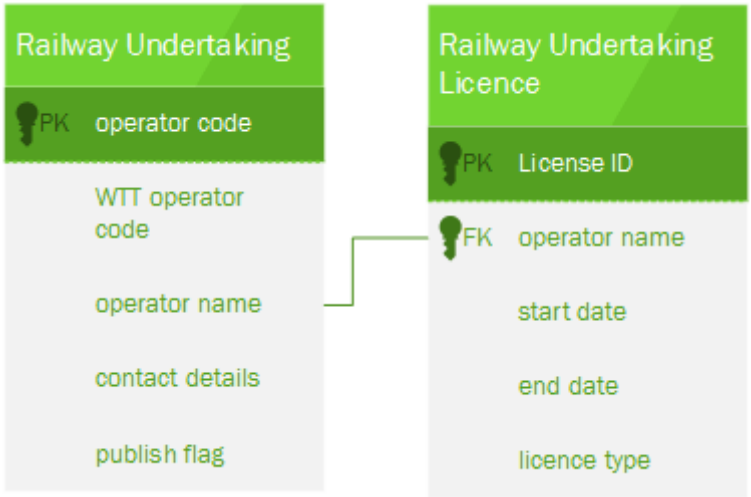
Platform, Platform Limit

When planning train services into stations it is critical to ensure that the train services length is compatible with the available platform space. Failure to ensure this could result in a safety issue should it be possible for the train doors to be opened when not fully in the platform.



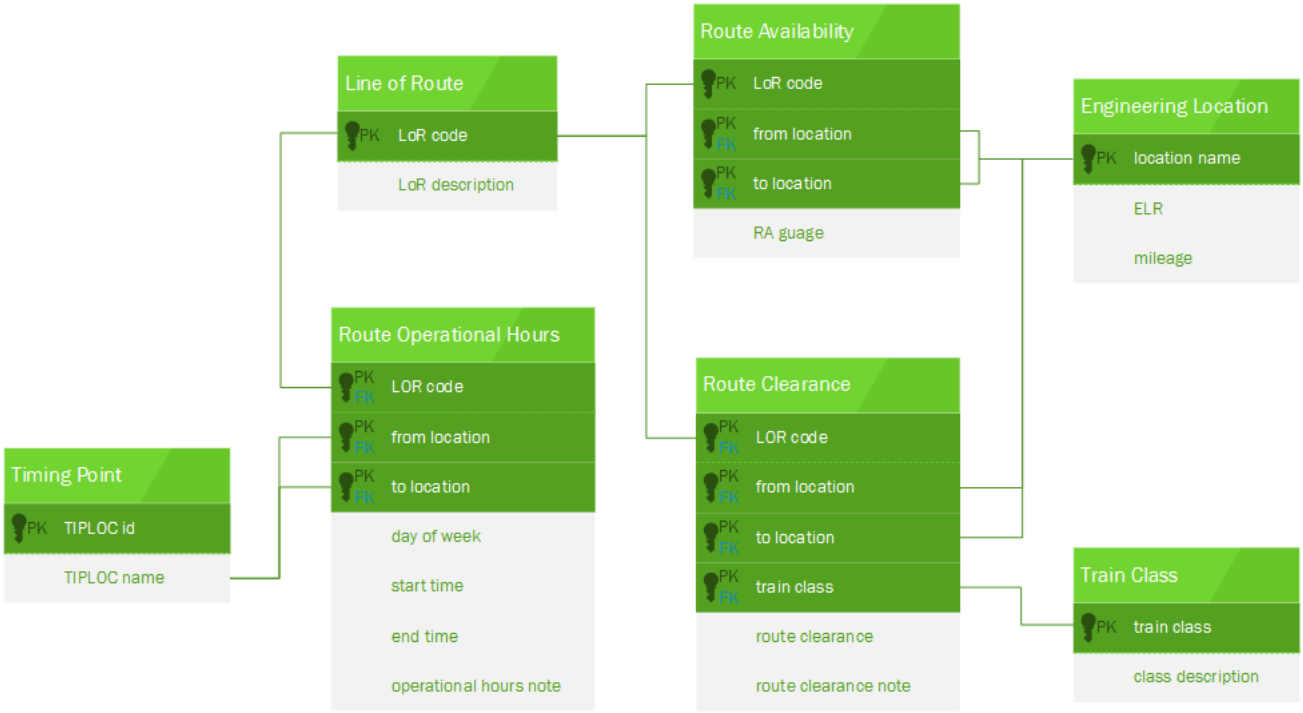
Railway Undertaking

All train or freight operators wanting to operate train services on the GB network are considered Railway Undertakings. This group of entities describes a railway undertaking and their licence conditions.



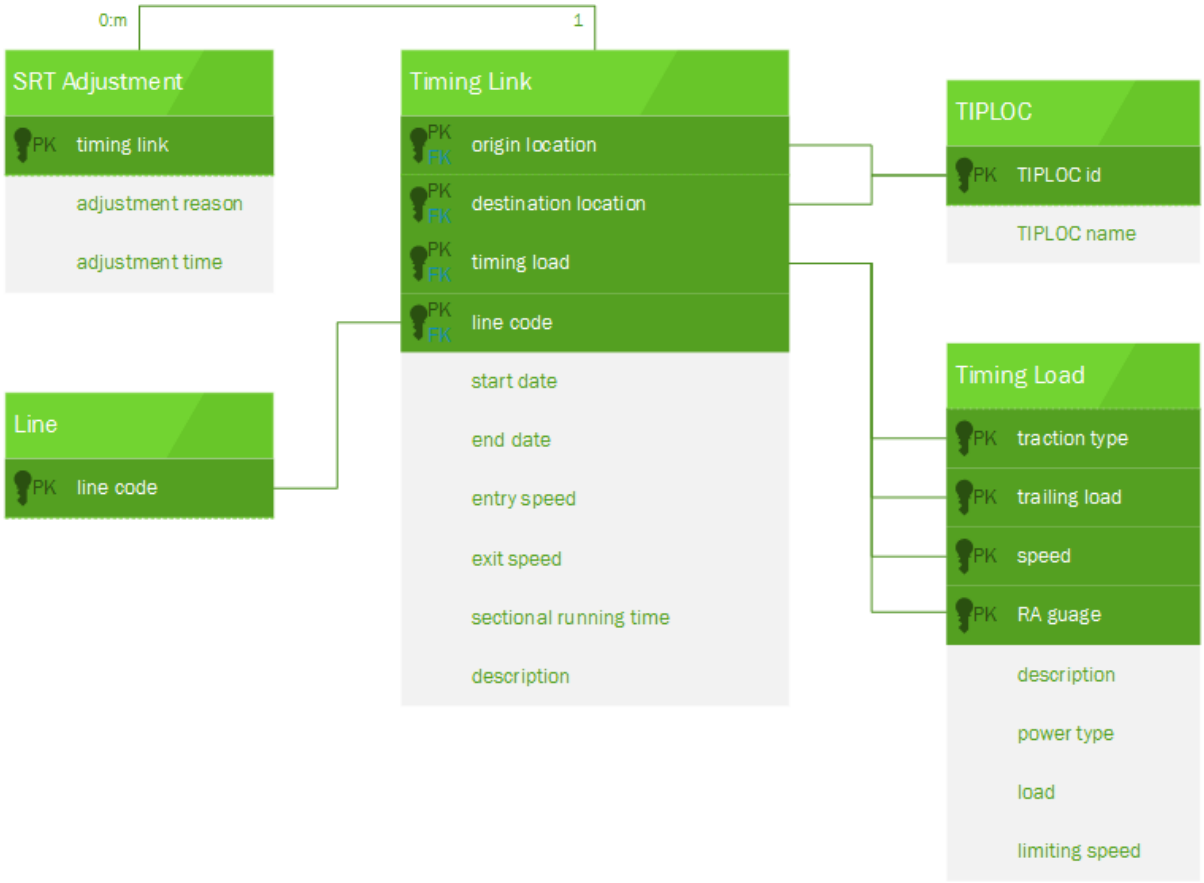
Route Clearance and Availability

Route clearance and availability rules exist to ensure that trains with a specific characteristic are correctly routed across the network. From a timetable planning perspective these route clearances are used to cover electrification supply restrictions, locomotive route availability and passenger stock restrictions. Combined with the route operational hours, these entities describe the overall availability of a route section to support train services.



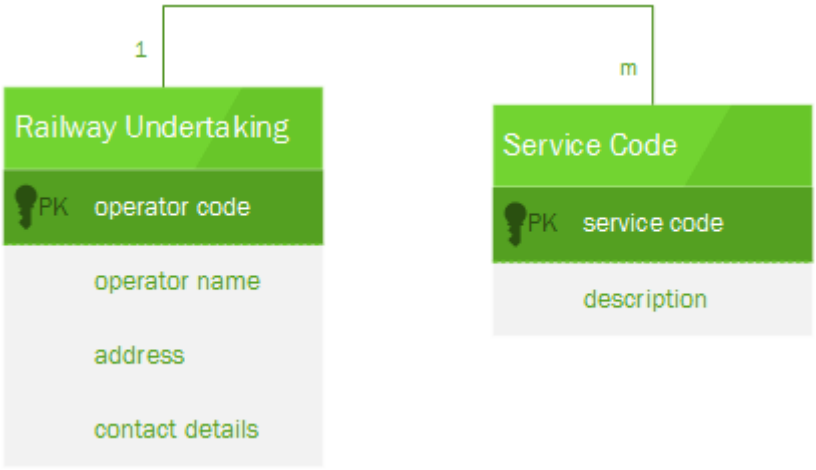
Sectional Running Times (SRTs)

Sectional running times provide a well understood method for operators and infrastructure managers to develop their train paths. A sectional running time is the time taken for various train types (Timing Loads) to traverse a Timing Link, representing the fastest route of that Timing Link. To take account of other factors such as permissive moves, slow speed junctions, crossovers and platform sharing it is also permitted to define sectional running time adjustments.



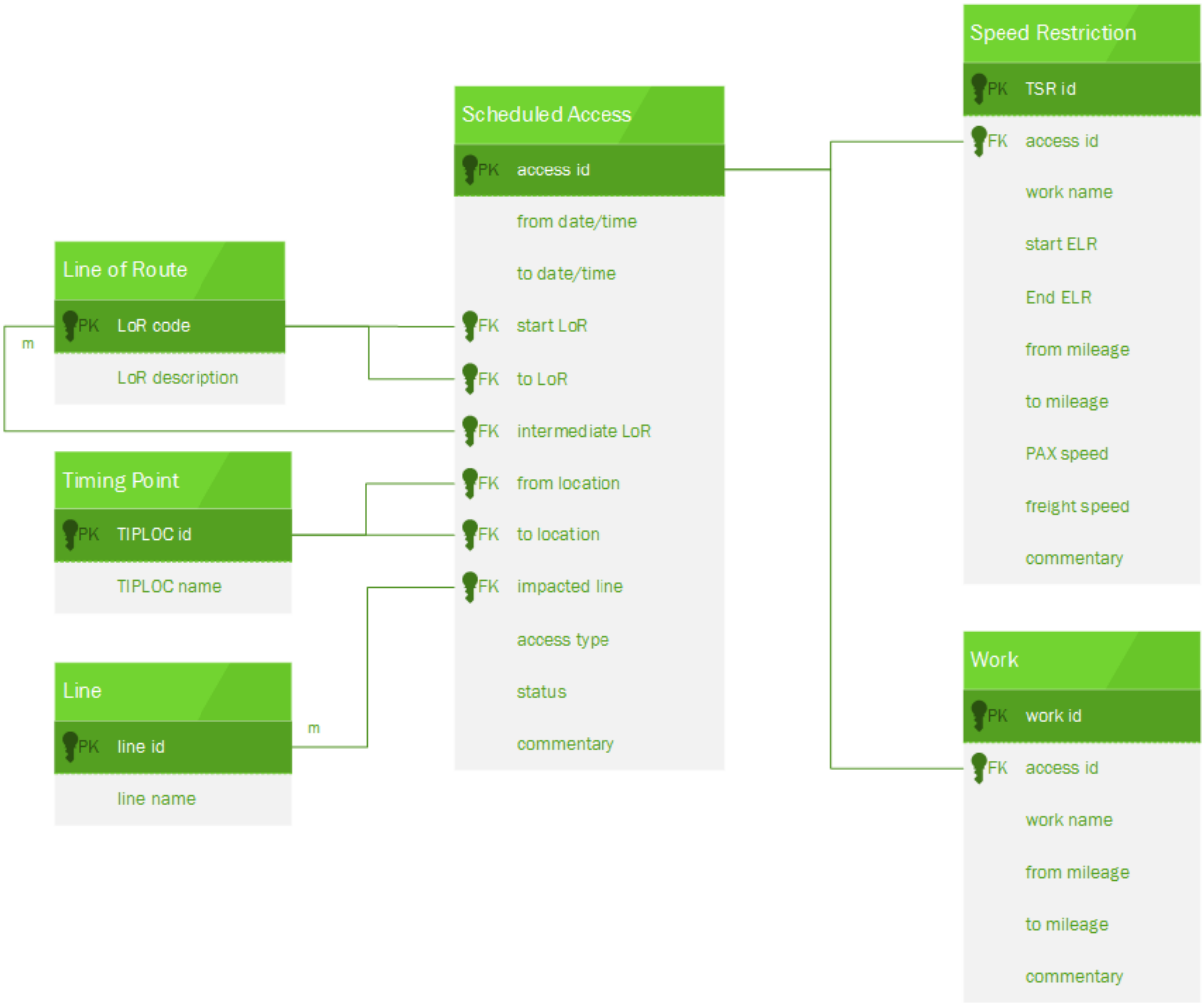
Service Code

A service code is a legacy construct used in some systems to provide a codification for a commonly used route that a train company can operate trains services across.



Scheduled Access

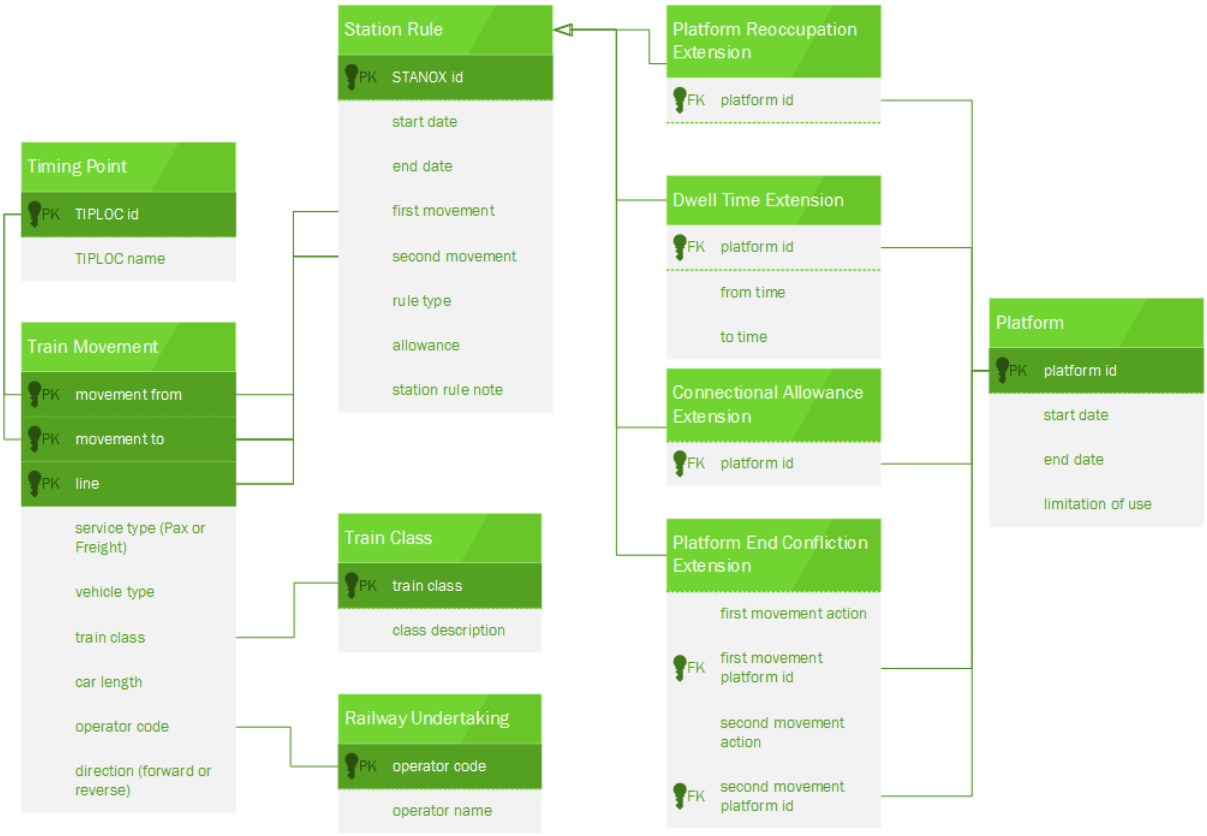
The scheduled access entity defines a period where a specific section of the network is being taken out of operational service to allow for planned maintenance activities to be undertaken. This entity covers both the consultative period of negotiation (Restriction of Use Notice) and the published access restrictions as documented in the EAS, PON and WONs.



Station Planning Rule

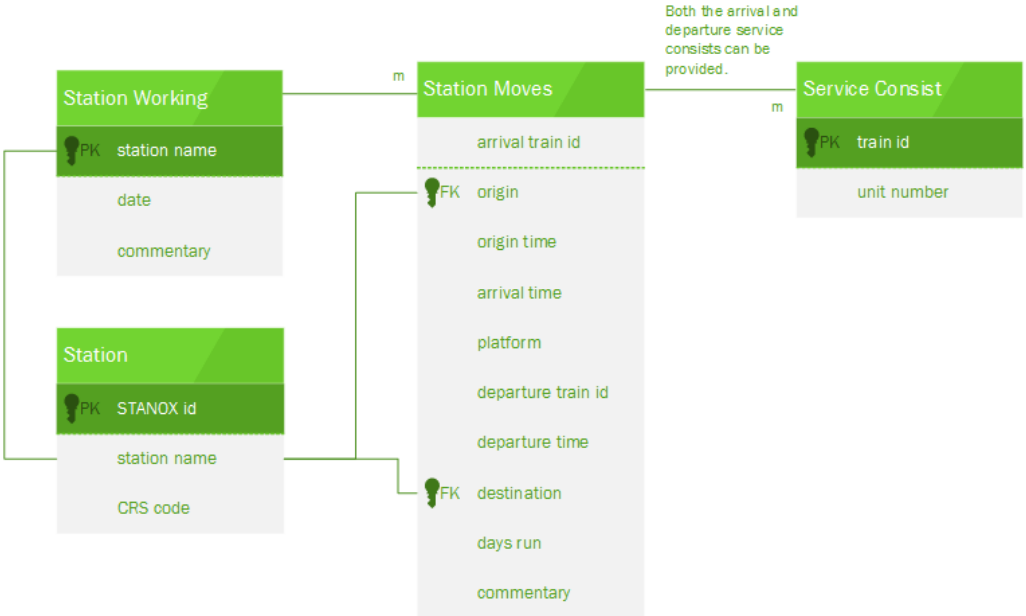
Various planning rules apply at station locations to correctly build in sufficient time for the different operational activities. Station Planning Rule is a superset of the following business rules:

- Platform Re-occupation Times: The time between first train departing and second train arriving at a specific platform in the same direction; this commonly defaults to, but should never exceed the applicable headway. This value need not be calculated on the least restrictive signal aspect, but the second train in the sequence must be able to meet its SRTs.
- Station Dwell Times: The minimum time shown in timetables for trains to be at a stand in a station, from when train wheels stop on arrival to when wheels start on departure.
- Connection Times: For a connecting train service, the time required for the connecting service to remain at the platform.
- Attachment Times: The minimum time required to attach new rolling stock to a service.
- Detachment Times: The minimum time required to detach rolling stock from a service.
- Turnaround Times: The minimum time required for rolling stock to be prepared on completing one service before it forms the next service.
- Run-around Times: The minimum time between arrival and departure at a timing point when a locomotive or locomotives are moved from one end of a train to the other, including detachment, movement, attachment and safety checks.
- Locomotive Change Times: The minimum time required to swap the locomotive engine associated with a train service.
- Reversal Times: The minimum time required for a train service to reverse back out from a station platform.
- Platform End Conflicts: The time gap required between two train services upon leaving their platforms to avoid conflicting with each other.



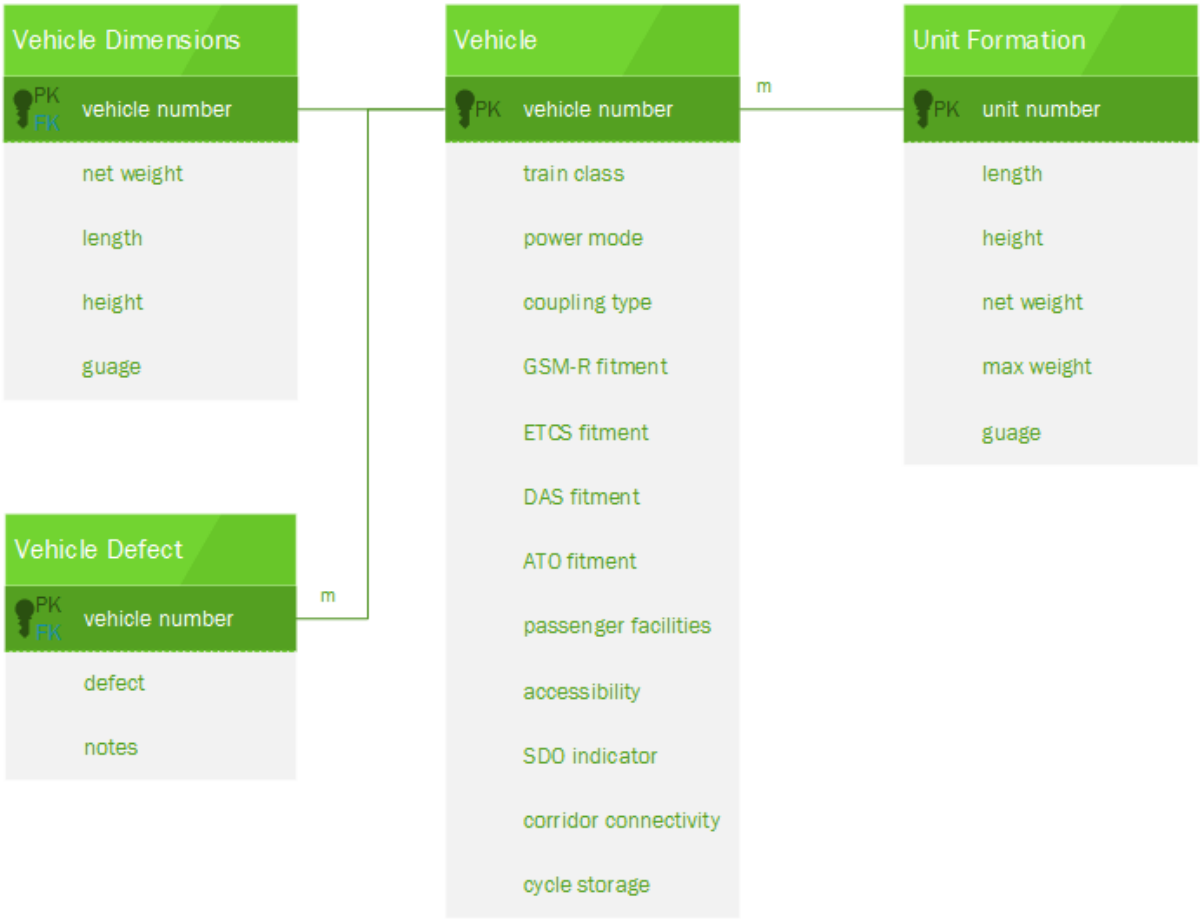
Station Working

The Station Working entity is a collection of data entities that together describe the arrival and departure events for a given station on a given day. This logical entity takes various forms within the operational environment and can be found within both station (Station Working, Platform Working reports) and control operational teams (LATIN reports / Timetable Simplifiers / Train Line-ups).



Stock Capability

The Stock Capability entity describes the physical characteristics and operational capability of railway stock (Engine/Carriage/Wagon) that have an impact on the planning activity. Note that in most circumstances the characteristics of the overall train service are used for planning (i.e. a unit comprising an engine plus 4 carriages), however the characteristics of the individual stock is required to determine this. The logical data model described below builds on the data constructs developed in the DR RDG Conops – Stock and Crew System (Ref NR14).



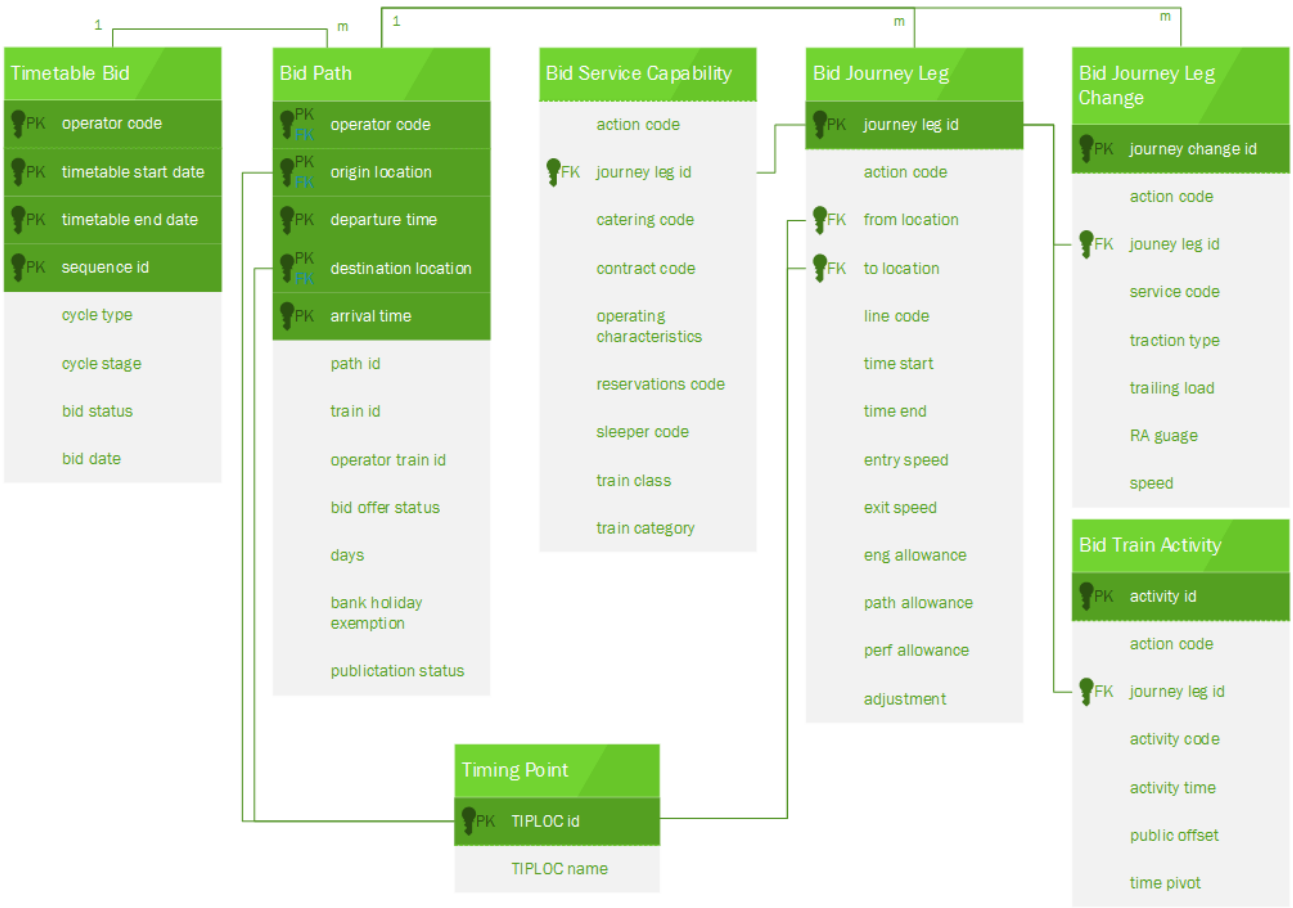
Timetable

This grouping of data entities describes the structure of the formal timetable as distributed today in line with the CIF data specification. Operationally, a Timetable entity is generated at multiple points within the operational timetable process. The following describes timetable publications of the following type:

Applicable Timetable: The applicable timetable is the one used within an operational traffic management system. Its basic structure matches the one described here but it is worth noting that the Applicable Timetable is an extension of the published Working Timetable in that it may have additional intermediate points and inferred train associations added post processing of the published CIF file.
Electronic National Rail Timetable: The eNRT is produced as a twice-yearly one-off publication utilising the data entities described here to create a PDF publication of the Principal or Subsidiary timetable.
Informed Traveller Timetable: The Informed Traveller timetable publication is a special version of the Working Timetable that is published at TW-12. Its purpose is to provide the Timetable Participants and travelling public with a formal timetable to allow advance rail travel bookings to be made.
New Working Timetable: The Working Timetable is the timetable being developed for the next principal or subsidiary timetable period.
Prior Working Timetable: The Prior Working Timetable is the first iteration of a New Working Timetable produced during the timetable rollover activity. It is published no later than D-45.
Working Timetable: The Working Timetable denotes the timetable currently in force and incorporate all timetable variations. It is published each day at 22:00 and is used as the contractual baseline for the performance regime.

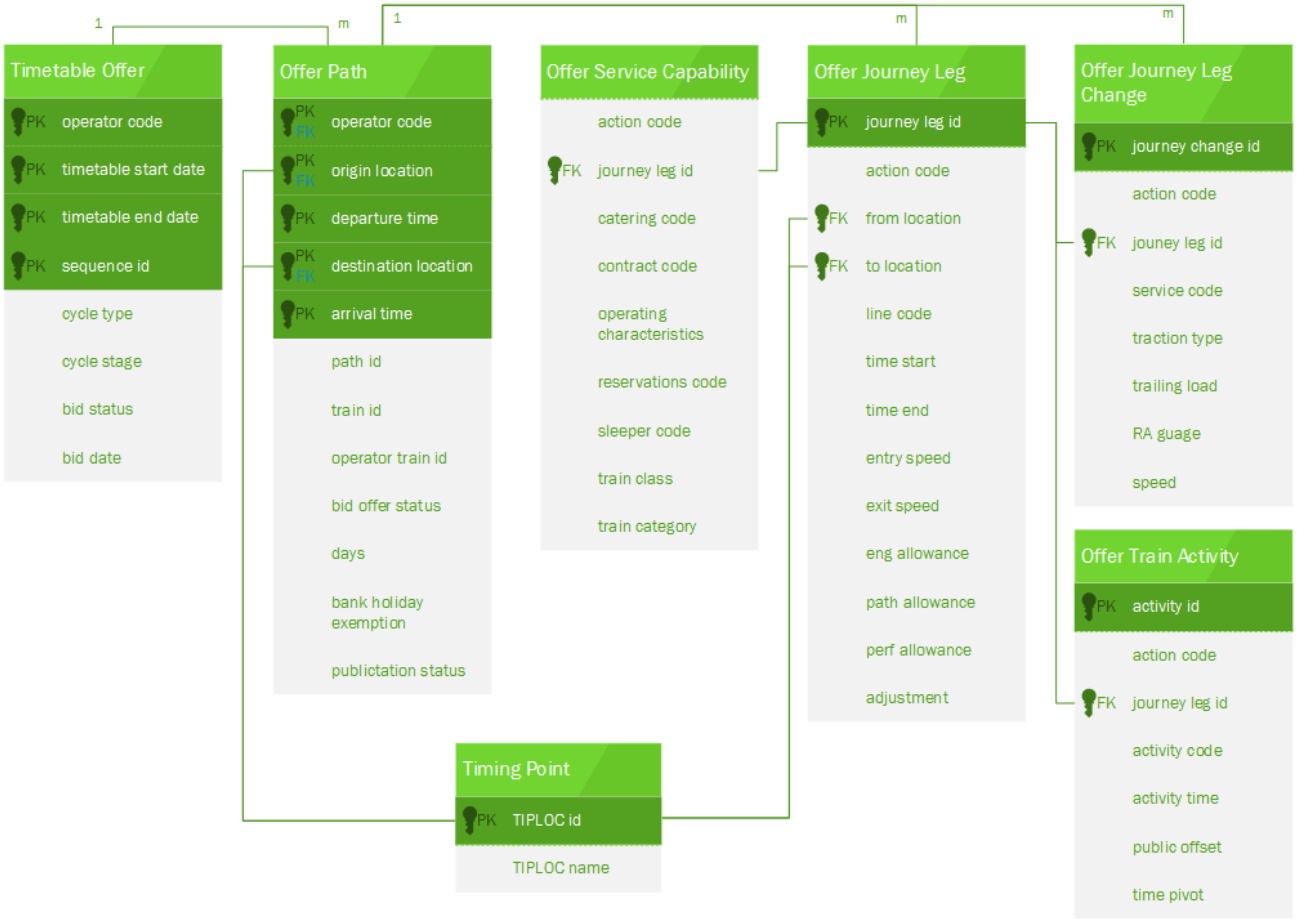
Timetable Bid

The Timetable Bid entity encompasses multiple data entities that together describe a bid for paths on the network to operate train services.



Timetable Offer

The Timetable Offer entity encompasses multiple data entities that together describe an offer of paths on the network provided by Network Rail back to the Timetable Participant.



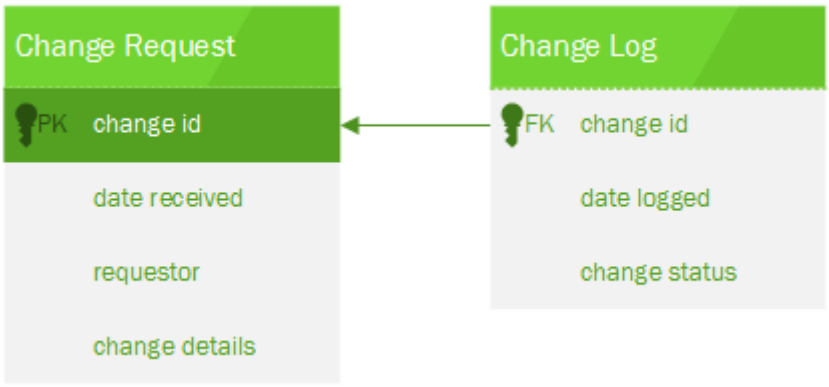
Timetable Planning Rules

A general grouping of entities that together make up the timetable planning rules used to underpin the planning processes. Encompasses the following data entities:

- Electrification Limit
- Freight Train Load Limit,
- Freight Train Length Limit,
- Train Restriction,
- Platform Limit,
- Station Planning Rule,
- Sectional Running Time,
- Headway Rule,
- Junctions Margin Rule,
- Route Availability,
- Route Clearance

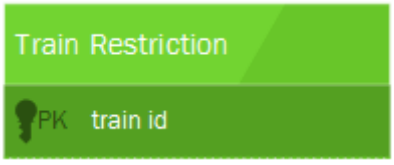
TPR Change and TPR Log

Modelled as generic change request/log data entities as no formal definition exists and the log itself does not contain data attributes that are specific to the TPR process.



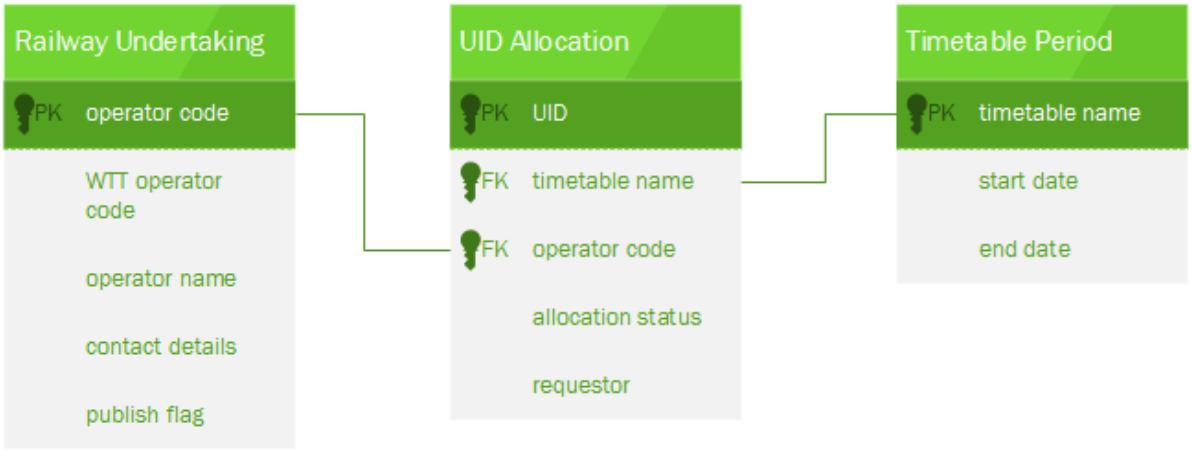
Train Restriction

The timetable planning rules incorporate a note only that certain engineers' trains, as identified by specific headcodes (e.g. 6Z09, 7Z09 and 8Z09) are to be excluded from normal timetable planning rules. As such no specific data entities are required.



UID Allocation

Each timetabled train service requires a unique business identification to be associated with it. The UID Allocation entity is used to allow the different route planning teams to reserve blocks of UIDs so that they avoid duplication errors during the timetable validation process.



Working Path

A working path data entity is a path that has been incorporated into a timetable and now forms part of that timetables baseline. In terms of structure it is identical to the Candidate Path data entity defined previously and is distinguished as a working path via the path status attribute.

Data Entity Catalogue

The Data Entity Catalogue provides a core level of information about each data entity. This includes a view on whether the data entity has a well understood and documented business definition, and an accompanying data specification. This distinction is important since heavily people centric business processes can often work when people share the same business understanding of the data, whereas more automated and repeatable processes require a much tighter definition of the data (the data specification) to function correctly. People are great at dealing with ambiguous data, translating data formats and filling in the gaps, but IT based automated systems need certainty and consistency to operate efficiently. Note that the catalogue presents the static metadata view of the entities and does not consider the data quality aspects. These will be discussed in the next section of this document.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Access Right	Describes an agreed set of access rights held by a Train Operator under its operating franchise.	ORR *	Business definition exists. No data standard.	ORR	ORR	Official	No	Document. Available through ORR website as a pdf document. https://www.gov.uk/government/collections/public-register-of-rail-passenger-franchise-agreements	Access rights are classified as 'firm' or 'contingent'. All operator's firm rights are exercised prior to contingent rights being considered.
Appeal	Describes the data needed to record an appeal against a planning output or decision.	Document Repository	Business definition understood. No data standard.	ORR	NR or Operator	Official	Yes	Document. Available to impacted parties.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Asset	Grouping entity that encompasses any physical asset on the network that may require work done against it.	Ellipse *	Business definition understood. Data Standards mostly exist.	Prof. Head	DRSAM	Official	No	Document. Provided as information within change requests.	Assets are not directly used by System Operator but are referred to in request for scheduled access and network changes. Asset types that are of relevance to the System Operator are: • Track • Switch • Flat Crossing • Signal • Signal Berth • Train Detection • Platform • Station
Block	A block defines an allowable route between two Nodes within the TPS geography model.	TPS	Business definition defined by the TPS product. Data standard defined as part of product.	HaCon	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds. Updated daily.	A Block differs from a Track in that it focusses on the allowed use of the track by a train service. It is therefore more akin to the Route setting tables contained within the control systems (TMS or ARS). Note though that this should not be confused with a signalling block section as used within the signalling systems.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Candidate Path	A candidate path is a train path that is currently under development within the timetable planning tool.	TPS *	Business definition defined by the TPS product. Data standard defined as part of product.	HaCon	System Operator LTP and STP teams.	Official	No	Structured Data. Maintained within the TPS product itself and accessible via the user interface or structured outputs.	
Change Log	Used to track TPR change requests as part of the formal process	Change Log	Business definition understood. No data standard.	None. Locally defined.	PSS-Team	Official	No	Structured Data. Maintained as a spreadsheet.	Note that the only those changes updated within the Assurance Database are recorded so this is not a complete record.
Change Request	The data entity used for recording requests for change to the TPR planning rules.	Document Repository	Business definition understood. No data standard.	None. Locally defined.	System Operator LTP and STP teams.	Official	No	Document. Provided in a variety of formats from emails through to word and XL documents.	
Crew Depot	Defines a base location for a train crew member.	Train Operator system	Business definition exists. No known data specification.	Train Operator	Operator Crew Manager	Official	No	Structured Data. No known interface to Network Rail exists.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Crew Member	Defines a member of the train crew staff.	Train Operator HR or Resource management system.	Business definition exists. No known data specification.	Train Operator	Operator HR Manager	Official	Yes	Structured Data. No known interface to Network Rail exists.	Network Rail has no need to access any personal crew information. Identification via a unique (across all operators) id is required.
Crew Leave Plan	Describes the leave recorded against a specific crew member.	Train Operator HR or Resource management system.	Business definition exists. No known data specification.	Train Operator	Operator Crew Manager	Official	No	Structured Data. No required interface to Network Rail.	
Crew Working Hours	Describes the standard working hours agreed as part of the contract of a crew member.	Train Operator HR or Resource management system.	Business definition exists. No known data specification.	Train Operator	Operator Crew Manager	Official	No	Structured Data. No known interface to Network Rail.	To support shared recovery management of services Network Rail operations is likely only to need to know the remaining hours crew have available to them.
Decision	Describes the data needed to record a decision following an appeal against a planning output or decision.	Document Repository	Business definition understood. No data standard.	ORR	Timetabling panel or ORR	Official	Yes	Document. Available online.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Edge	Used within the TPS geography as the principal data entity that defines all planning geography locations.	TPS	Business definition defined by the TPS product. Data standard defined as part of product.	HaCon	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds. Updated daily.	Works hand in hand with the Node data entity to form the Node/Edge geography model.
Electrification Limit	Provides the electrification details for a defined section of route.	NESA *	Business definition as per NESA. No data standard.	Prof. Head	DRSAM	Official	No	Document. Provided as a standard publication from NR through the sectional appendix.	The current NESA documentation is difficult to interpret and requires a high degree of knowledge of the network to understand.
Engineering Location	Describes a physical engineering location.	NESA *	Business definition and data standard exists.	Prof. Head	DRSAM	Official	No	Document. Provided as a standard publication from NR through the sectional appendix.	NESA locations are presented as description location names. Not all of which will be planning locations, so a translation is required by the user of the information. NESA is supplemented by the PON and WON documents.
Flat Crossing	Track asset defined within Network Rail's infrastructure network model.	Ellipse *	Business definition and data specification exists.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Freight Train Length Limits	Provides the maximum length that a freight train can be across a section of a line of route.	Freight Train Load Book	Business definition as per Freight Train Load Book. No data standard and current ownership unclear.	Prof. Head	Route	Official-Sensitive	No	Spreadsheet. Provided as an internal NR publication through the Freight Train Loads Book.	Some books greater than 5 years old and missing new/modified infrastructure. E.G Reading Flyover not covered
Freight Train Load Limits	Provides the maximum weight that a freight train can be across a section of a line of route. Also includes maximum coupling loads for a given section of a line of route.	Freight Train Load Book	Business definition as per Freight Train Load Book. No data standard and current ownership unclear.	Prof. Head	Route	Official-Sensitive	No	Spreadsheet. Provided as an internal NR publication through the Freight Train Loads Book.	Some books greater than 5 years old and missing new/modified infrastructure. E.G Reading Flyover not covered
Gradient	Specifies the gradient at a specific track related point.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Headway Rule	Provides the minimum planned time interval between two successive train schedules at a specific timing point on the same line in the same direction, such that the second train can meet its sectional running time.	TPR *	Business definition as per TPR. No data standard.	System Operator	System Operator Timetable Production Teams	Official	No	Document. Provided as a standard publication twice yearly (plus amendments) from NR via the Timetable Planning Rules publication.	Data also held in ADB, but some complex rules require simplification to allow capture.
Junction Margin Rule	A junction margin is the minimum permissible time interval between two trains that are performing conflicting moves at a timing point, such that the second train can meet its sectional running time.	TPR *	Business definition as per TPR. No data standard.	System Operator	System Operator Timetable Production Teams	Official	No	Document. Provided as a standard publication twice yearly (plus amendments) from NR via the Timetable Planning Rules publication.	Data also held in ADB but some complex rules require simplification to allow capture.
Line	Describes the operational line between two points. Typically terminal stations.	NESA *	Business definition as per NESA. No data standard.	Prof. Head	DRSAM	Official	No	Document. Provided as a standard publication from NR through the sectional appendix.	Naming indicates direction and speed of line. i.e. UF (Up Fast). Direction is always described in relation to the largest terminal city.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Line of Route	Describes the operational route name used to describe sections of track from an engineering perspective.	NESA *	Business definition as per NESA. No data standard.	Prof. Head	DRSAM	Official	No	Document. Provided as a standard publication from NR through the sectional appendix.	
Map Annotation	Used within the TPS geography to record operational notes on the map layers.	TPS	Business definition defined by the TPS product. Data definition and update processes exist.	HaCon	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds. Updated daily.	Many annotations contain significant amounts of operational planning information held as free text.
Network Change	This entity grouping covers the data that is required to be provided as part of a Network Change.	-	Business definition defined by the Network Code Part G No Data standard.	Prof. Head	Route Scheme Sponsor	Official	Yes	Document. Sent by routes to a standard distribution list.	Network Changes comply to the business definition, but the level of detail included and coverage/granularity of scheme plans can vary.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Network Geography	This entity represents a grouping of data geography data entities that make up the network model that underpins the TPS system.	TPS	Business definition defined by the TPS product. Data definition and update processes exist.	HaCon	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds. Updated daily.	Very difficult to determine the level of accuracy of the model. Much of the detail is presented through annotations which are free text notes pinned to the mapping layer.
		INM	Support for planning features currently being developed.	AIS				Structured Data. To be incorporated into the Infrastructure Network Model. New interfaces required to extract and import into TPS.	Work currently in process to incorporate planning features and put in place the required data governance services.
Network Link	Details of a physical link between two locations. A network link between two locations can skip intermediate locations if they aren't mandatory timing points.	BPLAN *	Business and data definition as per the PIF Spec. (Ref NR3)	Managed under Systems Code	PSS-Team	Official	No	Structured Data. Access provided through PIF files produced weekly.	Network Links are closely related to Blocks which form part of the Network Geography and Timing Links which form part of the Sectional Running Times entity.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Node	Used within the TPS geography as the principal data entity that defines all planning geography locations.	TPS	Business definition defined by the TPS product. Data definition and update processes exist.	HaCon	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds. Updated daily.	Works hand in hand with the Edge data entity to form the Node/Edge geography model.
PDNS	Priority Date Notification Statements are the first formal bids received following the publication of the PWTT.	TOC/FOC	The business definition is defined within the Network Code. No formal data standard exists.	DFT	TOC/FOC	Official	No	Document / Electronic received via email as a combination of word, spreadsheet and electronic data files (PIF)	In some cases, the DFT has given operators permission to develop their timetable through business aligned work packages. However, there is no requirement to align the PDNS submission to the work packages. As such a PDNS can cover multiple work packages, or a work package can be split across PDNS. This creates complexity and makes it difficult to confirm that a work package has been fully addressed.
Planning Location	Used within the TPS geography model to define all the planning related locations.	CORPUS *	Business definition as per CORPUS standard. Data standard as per network code.	Managed under Systems Code	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds.	TIPLOCs are a specific subset of the TPS Planning Locations datasets but other locations are identified such as Engineering Locations which are used to identify the start and end of possessions. These are not contained within CORPUS.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
		TPS	Business definition and Data Standard defined by the TPS product.	HaCon	PSS-Team				
Platform	Provides the set of available platforms	BPLAN *	Business and data definition as per the PIF Spec. (Ref NR3) No data standard.	Managed under Systems Code	PSS-Team	Official	No	Structured Data. Access provided through data files provided monthly.	Platform data is also created in TPS as part of the commentary. Platform data is also contained within RINF sourced from Ellipse/OPAS but maintained separately and not used by the planning teams.
		TPR	Business definition as per TPR. No data standard.	PSS-Team	Timetable Production Team's Route TPR Specialist			Document. Provided as a standard publication from NR twice yearly.	
		NESA	Business definition as per NESA. No data standard.	Head of Assets	DRSAM			Document. Provided as a standard publication from NR through the sectional appendix.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
		Ellipse	Business definition as per NESA. No data standard.					Structured Data. Data extracts are available through the ADS data warehouse.	
		OPAS	Business definition as per NESA. No data standard.					Structured Data. Data extracts are available through bespoke interfaces.	
Platform Limit	Provides length of the station platform that can be operational used by a train service. Note that distinction exists between operational and usable (ramp to ramp) planning lengths. Neither of which consider defensive driving policy / stand-back from signals.	NESA	Business definition as per NESA for the operational platform length. No data standard.	Head of Assets	DRSAM	Official	No	Document. Provided as a standard publication from NR through the sectional appendix.	Some complex additional clauses held in TPR make systemising the data fully difficult. E.g. "Up direction from D292 to D282 Signal". Also note that platform lengths maintained as station commentary with TPS model. Basic lengths and simple clauses held in ADB system. Conflicting business definitions of platform length between operational processes causes data quality issues.
		TPR	Business definition as per TPR. No data standard.	PSS-Team	Timetable Production Team's Route TPR Specialist			Document. Provided as a standard publication from NR twice yearly.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
		BPLAN	Business definition as per PIF Spec. (Ref NR3) No data standard.	Managed under Systems Code	PSS-Team			Structured. Access provided through data files provided monthly.	
Railway Undertaking	Identifies a train or freight operating company.	UIC *	Business definition and data standard exists.	UIC	Train Operator	Official	No	Structured Data Available via the European Common Reference Domain data repository.	The UIC 4 digit format is not commonly used in GB rail although will need to be supported in relation to legal compliance with the EU TSI legislation.
		BPLAN *	Business definition and data standard as per PIF Spec. (Ref NR3)	Managed under Systems Code				Structured. Access provided through data files provided monthly.	
Railway Undertaking Licence	The official licence, as held by the ORR that records what a Railway Undertaking can do on the GB network.	ORR *	Business definition exists. No data standard.	ORR	ORR	Official	No	Document. Available through ORR website as a pdf. https://orr.gov.uk/rail/licensing/licensing-the-railway/current-licences	A European database of Railway Undertakings exists (CRD) and can provide an electronic download. Note though that not all operators may have registered on it and it only holds the UIC codings.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Route Availability	Provides the route availability gauging level for a given section of route.	NESA *	Business definition and data standard exist.	Head of Assets	DRSAM	Official	No	Document. Provided as a regular electronic publication from NR.	Used in conjunction with the Route Clearance and Route Operational Hours entities to determine whether a specific train class can traverse a given route section safely. The current NESA documentation with respect to restrictions is complex and difficult to interpret without pre-existing route knowledge. NESA is supplemented by the PON and WON documents.
Route Clearance	Provides the train class, together with any restrictions that can operate on a route section.	NESA *	Business definition and data standard exist.	Head of Assets	DRSAM	Official	No	Document. Provided as a regular electronic publication from NR.	Used in conjunction with the Route Availability and Route Operational Hours entities to determine whether a specific train class can traverse a given route section safely. NESA is supplemented by the PON and WON documents.
Route Operational Hours	Provides the designated opening hours for a route or signal box plus exceptional notes.	TPR *	Business definition exists. No data standard.	Head of Assets	DRSAM	Official	No	Document. Provided as a standard publication from NR twice yearly.	Used in conjunction with the Route Clearance and Route Availability entities to determine whether a specific train class can traverse a given route section safely.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Route Knowledge	Describes the route level competency held by specific crew members.	Train Operator HR or Resource management system.	Business definition exists. No data standard.	Train Operator	Operator Crew Manager	Official	No	Structured Data. No known interface to Network Rail.	
Routing Location	A construct used within the INM to define a planning location in relation to the physical track model.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.
Routing Location Boundary Point	Used to specify a polygon where a planning timing point encompasses multiple track specific assets. For example, a junction timing point.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.
Scheduled Access	Describes a planned access (possession) or restriction (temporary speed restriction) to the network.	Restriction of Use Notices	Informal business definition No formal data standard	Head of Route Maint.	DRSAM	Official	No	Document Created as required and distributed to operators for consultation.	Managed at a route level and formally recorded in the CPPP publication following consultation.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
		PPS	Business definition exists as per the EAS. No formal Data standard.	Head of Assets	DRSAM			Document Published formally under the Engineering Access Statement, plus periodic (PON) and weekly (WON) operating notices.	Responsibility for publication falls under the System Operator although they are not responsible for any of the data. System Operator also publish the DPPP and CPPP which are the working versions of the EAS.
		TPS	Business definition exists. No formal Data standard.	System Operator	PSS-Team			GUI. Access via the TPS planning tool user interface.	
Service Code	Legacy construct to provide a codification for a commonly used route that a train company operates	CORPUS *	Business and data definition as per the CORPUS standard	Managed under Systems Code	RSIT Business Systems Support Team	Official	No	Structured Data. Access provided through PIF files produced weekly.	When published in document format this data is often segregated by Operator, but this split is not maintained at the data level.
		BPLAN	Business and data definition as per the PIF Spec. (Ref NR3)	Managed under Systems Code	PSS-Team			Structured Data. Access provided through PIF files produced weekly.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Signal	A signal asset defined used to control train movements across the network.	NESA *	Business definition exists. No data standard.	Head of Assets	DRSAM	Official	No	Document. Provided as a standard publication from NR.	NESA is regarded as the master source for signalling information currently in use. TPS holds a subset of signalling data that is entered manually to support certain timetabling rules. RINM also contains signalling information but this is not used by planning teams at present.
		TPS	Business definition defined by the TPS product. Data definition and update processes exist.	System Operator	PSS-Team			Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds.	
		INM	Business definition exists. No formal data standard.	AIS	DRSAM			Structured Data. Standardised interfaces to timetable planning to be developed.	
Signal Berth	Specifies a signal berth as an asset in relation to the track based network model.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Speed Limit	Specification of a speed limit in relation to the track based network model.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.
SRT Adjustment	To cater for factors such as permissive moves, slow speed junctions, crossovers and platform sharing formal SRT adjustments are allowed.	TPR *	Business definition as per TPR. No data standard.	System Operator	Timetable Production Team's Route TPR Specialist	Official	No	Document. Provided as a standard publication from NR twice yearly.	SRT Adjustments are also recorded in ADB. Complex nature of adjustments puts a heavy reliance on timetable planner's knowledge and makes systemisation of legacy SRTs difficult.
Staffing Plan	This is the forward-looking staffing resource plan for the WTT development activities.	-	Business definition understood but no formal data standard.	System Operator	System Operator	Official	No	Document. Managed as a spreadsheet with supporting documentary records.	No identified issues with the staffing plan as such. However the reliance upon knowledge held in peoples heads limits the ability resource flexibly.
Station	Specification of a station asset in relation to the track based network model.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Station Planning Rule	Any timetable planning rule that relates to a station operation.	TPR *	Business definition as per TPR. No data standard.	System Operator	Route TPR Specialist	Official	No	Document. Provided as a standard publication twice yearly (plus amendments) from NR via the Timetable Planning Rules publication.	Some data also held in ADB system, but some complex rules require simplification to allow capture.
Switch	Specification of a switch asset in relation to the track based network model.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.
Timetable	Encompasses any flavour of a timetable being developed and distributed through the System Operator.	TPS *	Business definition defined. Data standard exists as per Network Code and export PIF/CIF standards.	PSS-Team	PSS-Team	Official	No	Structured Data. Provided formally as a CIF file.	Note that NR failed in its commitment to deliver a timely May and Dec 2018 timetables so whilst a process exists to ensure timely delivery, operational aspects can undermine this.
		Operator Planning System (e.g. Voyager Plan)	Business definition understood. Data standard defined.	Third part supplier	Operator Planning teams				

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Timetable Bid	Encompasses a request for access to the network to operate a train service.	TOC/FOC *	Business definition covered within Network Code. No Data Standard exists.	DFT	TOC/FOC	Official	No	Document, Electronic. Generally received as emailed PIF files but can still be sent in as word documents. The latter mainly being used by Freight companies.	The Timetable Bid data entity encompasses the following related data entities: • Bid Path, • Service Capability, • Bid Journey leg, • Journey Leg Change, • Train Activity
Timetable Distribution List	Covers the information need to distribute the timetable to all interested parties.	TPS	Business definition covered within Network Code. Data Standard as per PIF.	PSS-Team	System Operator Planning Teams	Official	No	User Interface. Data is updated through the Metastorm layer of the TPS system.	
Timetable Offer	Encompasses the offer returned to an operator following a request for access	TPS *	Business definition covered within Network Code. Data Standard as per PIF.	PSS-Team	System Operator Planning Teams	Official	No	Structured Data. Provided back to the operators through PIF format.	

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Timing Link	Provides the fastest running time between two given locations for a given model train.	BPLAN *	Business definition as per TPR. No data standard.	Managed under Systems Code	PSS-Team	Official	No	Structured Data. Access provided through data files provided monthly.	A Timing Link is also referred to as a Sectional Running Time. Note that the SRT Adjustments are not held within BPLAN.
Timing Load	Provides a high level definition of a given model train.	BPLAN *	PIF Spec. (Ref NR3)	Managed under Systems Code	PSS-Team	Official	No	Structured Data. Access provided through data files provided twice yearly.	
Timing Location	Describes the set of locations that train services can be planned to operate between.	CORPUS *	Business and data standard defined.	Managed under Systems Code	PSS-Team	Official	No	Electronic. Published via the CORPUS file.	This is the principal location entity used within timetable planning community. CORPUS file feeds many downstream industry systems.
Timetable Risk	Used to capture an identified significant risk, identified through the TCRAG or TCAG that may impact the development or quality of the NWTT.	-	Business meaning understood but no formal data standard.	TCRAG	TCRAG	Official	Yes	Document. Maintained within minutes and spreadsheet.	No recorded issues with this data.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Track	Represents a physical line asset that connects two locations.	TPS	Business definition defined by the TPS product. Data definition and update processes exist.	HaCon	PSS-Team	Official	No	Structured Data. Provided as part of the TPS Network Geography model to other TOC planning teams and via the Open Data feeds. Updated daily.	Note that Track is closely related to a Line. The distinction is that a Line records the operational behaviour whereas the Track is the underlying physical asset.
Traction Knowledge	Defines the competency level of a train crew member to safely operate a specific type of traction.	Operator systems	Business definition defined. No common data specification.	Train Operator	Train Operator	Official	No	Structured Data. No shared data services known to exist at present.	Limited knowledge of this data exists within Network Rail.
Train Crew Role	Defines a role used by train crew (for example Driver, Guard, Revenue Inspector, Catering, Cleaner, etc)	Operator systems (e.g. CrewPlan)	Business definition defined. No common data specification.	Train Operator	Train Operator	Official	No	Structured Data. No shared data services known to exist at present.	Limited knowledge of this data exists within Network Rail.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Train Detection	Specification of a train detection (wheelchex, mass detector, TD system) asset in relation to the track based network model.	INM *	Business definition and data specification currently being designed.	AIS	DRSAM	Official	No	Structured Data. Will be made available through a standardised data interface.	Currently under design for use by timetable planning.
Train Restriction	Identifies specific Engineering trains for which the timetable planning rules do not apply.	TPR *	Business definition and data standard exist.	System Operator	DRSAM	Official	No	Document. Provided as a standard publication from NR twice yearly.	NESA is supplemented by the PON and WON documents.
UID Allocation	Provides a register of reserved UIDs to avoid planning teams duplicating ids.	UID Allocation	Structure of XLS is defined and business definition understood.	PSS-Team	Planning Teams	Official	No	Structured Data. Held as a series of spreadsheets by the PSS-Team.	
Unit Formation	Many train services run as an engine plus one or more fixed carriages or wagons. This entity describes such a fixed formation.	Operator's train formation systems (e.g GENIUS, GEMINI or TOPS)	Business definition exists. No agreed data standard.	Non known	Operator Fleet Managers	Official (see note)	No	Structured Data. Many bespoke data exchange mechanisms exist but no agreed industry standard.	Note that for trains carrying high consequence cargoes, the formation information may be considered Official-Sensitive. Also note that the TAF/TAP TSI standards provide a basis for a standardised definition for this information.

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Vehicle	This entity defines a single railway rolling stock vehicle. Be it an engine, coach or wagon.	R2	Business and data standard defined.	RSSB	Operator Fleet Managers and ROSCOs	Official	No	Structured Data. R2 open interfaces exist to access this data.	At present NR has no direct interface to the R2 system, although TOPS does have a legacy interface to it. NR also maintains its own system NVR (National Vehicle Registry).
Vehicle Defect	This entity records any operational defect associated with a vehicle that may impact its operational use.	R2	Business and data standard defined.	RSSB	Operator Fleet Managers and ROSCOs	Official	No	Structured Data. R2 open interfaces exist to access this data.	At present NR has no direct interface to the R2 system, although TOPS does have a legacy interface to it. NR also maintains its own system NVR (National Vehicle Registry).
Vehicle Dimension	This entity describes the physical dimensions of a vehicle.	R2	Business and data standard defined.	RSSB	Operator Fleet Managers and ROSCOs	Official	No	Structured Data. R2 open interfaces exist to access this data.	At present NR has no direct interface to the R2 system, although TOPS does have a legacy interface to it. NR also maintains its own system NVR (National Vehicle Registry).
Working Path	A working path is a train path that is held within a timetable planning product and marked as complete.	TPS	Business definition understood. Data standard defined.	HaCon	System Operator LTP and STP teams	Official	No	Structured Data. Maintained within the TPS product itself and accessible via the user interface or structured outputs.	
		Operator Planning System (e.g. Voyager Plan)	Business definition understood. Data standard defined.	Third part supplier	Operator Planning teams				

Entity	Description	Source Repository (* denotes rail industry master)	Data Standard	Data Spec. Owner	Inf. Owner	Security	PII	Access	Notes
Work Specification	Used to describe a proposed change to the network infrastructure.	-	Business definition understood. No data standard.	Prof. Head	DRSAM	Official	No	Document. Provided as information within change requests.	Work Specifications are used to determine likely changes to timetable geography and planning rules.

Table 1 – Entity Level Data Analysis

Data Quality Assessments

In an ideal world a data quality assessment would be undertaken by comparing the physical data being assessed against its formal data definition and specification. As such it can be done at a quantitative level and an absolute statement of quality provided.

At present though, the lack of formal data specifications for much of the data being analysed renders this approach mute and so a qualitative assessment will be undertaken based on:

- Process Focussed Interviews with key planning teams from Network Rail and Operators as listed in Appendix A
- Target State statements from key stakeholder groups
- Analysis of the recommendations from the Hitachi CP6 Data Improvement Programme Industry Engagement Report (Ref NR8)
- Alignment with Network Rail's Knowledge Information Data Strategy (Ref NR9)
- Alignment with external Transport Focus opinions

For each of the activities shown above the key data entities have been identified and their data quality discussed and measured in terms of:

Assessment Category	**Level**	**Meaning**
Completeness	Green	Indicates that the data set is regarded as complete.
	Amber	Indicates that the data set is known to contain omissions and therefore cannot be trusted upon to be used to support operational processes without significant manual verification and external checking.
	Red	Indicates that the data set is known to contain omissions and therefore cannot be trusted upon to be used to support operational processes without significant manual verification and external checking.
Accuracy	Green	Indicates that the data set is regarded as providing an accurate set of data in accordance with an accepted level of data precision.
	Amber	Indicates that whilst generally accurate the data set is known to have some data fields which are known or suspected as not being accurate. The data can still be used to support operational processes, but a level of care needs to be taken and some manual adjustments may be required.
	Red	Indicates that the data set is known to have accuracy issues. Significant care needs to be taken when using the data and it may not be suitable for some operational processes.

Timeliness	Green	Indicates that the data is being maintained in accordance with a data lifecycle that is documented and appropriate to its business use.
	Amber	Indicates that the data's lifecycle is not clearly articulated, or that there are known issues where the lifecycle is not being followed. The data can still be used to support operational processes, but a level of care needs to be taken and some manual adjustments may be required.
	Red	Indicates that no data lifecycle is defined or that the data set is known to be out of date and misaligned to the business processes that use it. Significant care needs to be taken if using the data.

Process Focussed Interviews

New Working Timetable

Note that both a route and operator long term planning interview were conducted with the data quality assessment below being the summary from both these interviews.

Route focussed operational planning teams aim is to build a robust timetable based upon the path requests submitted by the operators. They start with the generation of a rolled over timetable based on the timetable currently in use (the PWTT) and then seek to incorporate new and amended services, identifying and resolving defects which culminates in the publication of the New Working Timetable (WTT). The timetable planning rules and underlying planning geography provide the framework that underpins their work.

From an operator's perspective the long-term planning activities goal is to deliver the commitments that have been made under their franchise commitments and provide a reliable, high quality train service to their passengers or freight customers.

The following table describes the data quality assessment that were identified during the initial interviews and subsequent follow up activities.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Access Right	The ORR statements are a complete set.	No reported issues with accuracy. However, the access rights are held in document form only and not a systemised format. As such they are difficult to incorporate into electronic systems.	No reported issues with timeliness.	Given the format that these are stored within, they are not routinely incorporated into the planning development or verification process.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Candidate Path (PWTT development)	When created as part of the PWTT the set of paths is considered complete in that the set form the baseline.	The current process to rollover the last week of the previous timetable, unless operators request another week. This approach raises issues for the December WTT where the last week of the previous TT may still include weather related variations and known non-compliance issues. These issues result in some operators not using the PWTT and simply submitting a whole new timetable as a PDNS. Re-cast of dates for rolled over paths is a manual and repetitive task and prone to errors in date ranges.	No real issues with timeliness. The manual activity to re-cast all the dates of the rolled over week is officially performed within a two-week window. However, some route teams opt to undertake this over a single weekend as it is a heavily manual and repetitive process that is best undertaken using several TPS workstations running concurrently outside of normal business hours.	The rollover processes whilst relatively simple may not be producing the best starting point to work from as it may include seasonal factors, does not incorporate the STP changes for the base week, and does not consider how well the timetable is currently operating.
Candidate Path (WTT development)	When created as part of the WTT the set of paths is considered complete in that the set form the baseline.	Where TPRs and geography have not been maintained since PWTT into the timetable participant's planning system, the bid paths in the PDNS may not be achievable when loaded as candidate path. Any misalignment between the operator's and NR's planning systems base view of rules or geography causes accuracy issues.	NR planning teams must rely on a significant amount of manual verification of candidate paths against the TPRs, geography and access rights. Use of additional tooling such as ATTune is helping but it is still a largely manual activity. This puts a secondary pressure on the ability to meet fixed deadlines.	The pressure on Network Rail, and operator's planning teams to develop plans using mostly manual checks against strict deadlines stops planners considering the operational robustness of the timetable and in some cases means standard checks get dropped.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Candidate Path (WTT development)	When created as part of the WTT the set of paths is considered complete in that the set form the baseline.	Planners plan based on the reference data held within their planning tooling, together with their knowledge and access to other reference material. Where large scale timetabling changes are required the limited level of support provided by the planning systems does not give them enough support to develop error free timetables.	NR planning teams must rely on a significant amount of manual verification of candidate paths against the TPRs, geography and access rights. Use of additional tooling such as ATTune is helping but it is still a largely manual activity. This puts a secondary pressure on the ability to meet fixed deadlines.	The pressure on Network Rail, and operator's planning teams to develop plans using mostly manual checks against strict deadlines stops planners considering the operational robustness of the timetable and in some cases means standard checks get dropped.
Crew Capability	Assumed to be complete although little information was available to confirm this.	Some evidence to suggest that access to the data is difficult and therefore it is unclear whether route/traction knowledge is available to the required level of accuracy to make informed decisions.	No information available to determine this but assumed that records are updated following training.	To fully embed and share crew capability information across systems the access and accuracy of this data will need to be improved.
Network Change	All received Network Changes form part of the input to the process and therefore must be considered complete.	Quality of the Network Change notices can vary in terms of the level of detail provided and quality of the scheme plans.	Late notices can occur, but this is not considered a significant issue	
Network Geography	Considered complete by both NR and Operator planning teams.	Known to be issues with accuracy of the data and where considered significant change requests are raised. Compatibility with NR's view of the Geography and the Timetable Participants can be an issue, particularly with future infrastructure changes.	No real concerns raised. Network Change notifications are made widely available as per the Network Code rules.	Consistency of the detailed Network geography becomes more of an issue as the planning tools become more sophisticated. At present NR and Timetable Participant systems must be updated separately, albeit based on the same documents.
NOSC	Considered complete.	No reported issues on accuracy.	Presented in accordance with the Network Code timeframes.	

Data Entity	Completeness	Accuracy	Timeliness	Impact
PDNS	Compliance of the PDNS packs against the content laid out in the Network Code is high. It is noted though that in cases where the DFT has agreed that a Timetable Participant can develop their timetable in discrete work packages (e.g. related to new schemes) there is no compulsion for them to submit their PDNS bids in alignment. As such it makes it difficult for Network Rail planners to determine whether all the timetable changes for a specific work package are covered.	Whilst predominantly compliant with the Network Code in terms of the high-level information provided, there is still variability in terms of the detailed data content which results in them being manually loaded into the Network Rail planning system.	Received in accordance with the network code timetable. Late receipts are accepted but processed at a lower priority.	For train operators that assess the PWTT and submit amendment only PDNS packs it becomes critical that their view of the TT, Geography and TPRs remain in step during processing. This puts an overhead on the operator. Conversely, operators that submit a full TT at D-40 don't have this data issue but place a larger burden on NR route planning teams.
PDNS (Associations)	Train associations are not adequately supported within the PDNS packs. However, it is important that they get incorporated into the timetable.	Whilst prone to change as the day of operation gets closer, the timetable participant's view of associations, especially train splits/joins is sufficiently well understood.	Received in accordance with the network code timetable. Late receipts are accepted but processed at a lower priority.	To get the train associations into the timetable, some operators make available their own staff to support Network Rail teams.
Sectional Running Times	BPLAN is recognised as the single source of truth. It does not though contain a complete list of SRTs and new ones are requested weekly to keep up to date with operational needs.	Known that there are issues with the truth of the SRTs but the industry convention is to accept current issues with accuracy.	Process for updating SRT's or creating new ones for modified/new stock is too long. The result is that localised SRT variations are used on the expectation that agreement will be reached.	Whilst the current level of accuracy is managed within the industry, this will not support the move to more granular timing of trains. It is also noted that limited housekeeping of BPLAN is undertaken so many SRTs exist within it that are no longer required.
Scheduled Access (TPS view)	The EAS is considered the master view and checks are undertaken against that rather than the access notations in TPS itself which is not consider complete enough to use.	The EAS is considered the accurate view. The notations (purple hatching) in TPS is not considered sufficiently accurate.	The view in TPS should be updated in line with the published EAS documentation but this does not seem to be the case consistently.	Manual checking against the EAS documentation does not reduce the quality of the WTT but is more time consuming and therefore adds pressure onto the whole process.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Stock Capability	Considered complete in as far as the regulatory certification needs of stock is stored. However, it is not clear whether all data required for operational planning of stock is captured.	Some questions raised over whether the accuracy of data held is enough to support operational planning needs.	Timeliness of update into the central systems may be an issue for on the day operational use but considered OK for planning needs.	To fully embed and share stock capability information across systems the access and accuracy of this data will need to be improved.
Timetable (PWTT)	From a Timetable Participant's perspective, it is not possible to determine whether the PWTT contains all the timetable variations that have been applied to the current timetable. The PWTT will also be missing any spot bids that occur for the base week as these will not have been completed yet.	Given the way in which the rollover process is performed the PWTT will always have a level of inaccuracy associated with it that needs to be addressed through the subsequent PDNS processing.	From the Timetable participant's perspective, the publication of the PWTT at D-45 does not give the Timetable Participant enough time to load the PWTT into their planning tool, verify it against their franchise requirements and determine the amendments needed to submit at D-40	To address this timing issue, some Timetable Participants create their own version of the PWTT around D-55 to D-50 to allow them to get a head start on determining their PDNS bids. This means that effort is being duplicated and a reconciliation is required between their PWTT and the official NR published one. Additional effort is expended by the Timetable Participants to determine which timetable variations have been applied to the PWTT and which have not. If not determined, there is a potential to miss paths out of the subsequent PDNS bids.
Timetable (WTT)	Considered complete from a NR perspective.	Between D-40 and D-26 a significant amount of work is undertaken by planners from both NR and the operators to identify and address changes. However, it is accepted that the resultant timetable is sub-optimal when operated.	WTT is produced as per the agreed timeline set out in the Network Code.	The reasons for the sub optimal timetable are varied and complex. Unachievable timing rules certainly play a role, but operational practices are also a factor.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Timetable Bid (PEX)	Consider complete.	PEX format used does not contain all the data that is required which is especially a concern for Freight path planning. RT3973 and Train Length information is not provided.	No issues reported.	Planning teams need to identify this missing data by follow on conversations with the operator or via the NR Freight team and then manually enter it into TPS. This is inefficient and puts a responsibility on NR for data that the operator should be providing.
Timetable Comparison Reports	Considered complete at time of creation at D-26.	Reports shown to be missing many timetable change records.	Sent out in line with process.	An example from one operator showed that the Timetable Comparison (Flex) report contained 700 changes from PWTT to WTT, however comparison of the PEX files showed 1100 changes.
Timetable Distribution List	Regarded as a complete distribution list from a System Operator perspective. However, re-distribution is performed from Network Rail outside of System Operator's governance.	Considered accurate.	Considered Timely.	No negative impact has been noted. The distribution lists are reviewed periodically to remove old addressees.
Timetable Offer (PEX)	Considered complete in respect that all offers relate back to a received bid.	Accuracy of offer is limited by the quality of underlying data and available time to process offers.	Offers are responded to within strict time limits.	
Timetable Planning Rules	Known to be incomplete and always playing catch-up. Noted that 1400 missing SRTs occur each week during planning.	Known to have inaccuracies and open to interpretation by planners. Complex nature of some rules makes application difficult both within Network Rail teams and between NR and other industry planning teams.	Updated as per the process but full industry support can delay changes on known poor planning rules.	Inaccurate timing rules will result in timetables that cannot be operated as planned.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Unit Diagrams	Diagrams are complete in that they are the best estimate known during the WTT development timeframes. Significant levels of change occur as we get into the short-term planning cycle.	During WTT development unit diagrams are received from operators but they are considered low quality as unit diagrams (and therefore train association data) changes significantly during the short-term planning cycle. As such association information is not added into the timetable for all operators.	No issues with when these are supplied.	The industry practice of only allocating stock and crew close to the day of operation means that train association information is not considered robust enough for all TOCs and therefore not always recorded in the WTT development.
Working Path	The working paths form the complete set of paths being worked on.	The are some known limitations on how the NR planning system interprets incoming data that is of concern. All planned paths require platform and line details with the TPS system, however paths for buses does not include this as it is not relevant. Also, the activity code of '*' is not interpreted incorrectly and causes any subsequent activity codes to be ignored.	No issues reported on timeliness.	To resolve the issue whereby bus schedules require a platform, incorrect platform and line details are deliberately added. This does not cause a data problem with TPS but is time consuming. With respect to the '*' activity issue, the Timetable Participant has to re-instate these within their own planning system to avoid it becoming an operational issue.

Timetable Variation.

Both capacity planning route and operator short term planning interviews were conducted with the data quality assessment below being the summary from these interviews.

Short term planning teams operate in a significantly different way to the long-term planning teams. As opposed to a fixed set of deadlines the short-term planning process works largely on a repeating weekly cycle. In line with normal business practice timetable variations are typically considered by the operator planning teams early in the week taking into consideration current stock needs and likely weekend variations. Timetable variations requests from operators peak Tuesday/Wednesday so the NR variation planner's busiest period is the latter part of the working week to ensure that changes are processed for the weekend period where most variations are required. The whole process then repeats for the next week.

The following table describes the data quality assessment that were identified during the initial interviews and subsequent follow up activities.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Bid Path	The bids received form a complete set from an operator.	Accuracy as reported through the DSEA service is good, although the quality of Freight passing through the DSEA service has reduced in recent periods. Note though that the DSEA only performs limited syntactical checking needed to ensure an error free load into TPS.	The current process drives peaks of timetable variation activity into a very compressed timeframe. This can lead to reduced validation checks to meet the regulatory timeframes.	Given the very short turnaround times, high volumes of timetable variation request become an issue, especially if additional data is required. The result is that some requests may be processed without full validation.
Bid Path	The bids received form a complete set from an operator.	PEX format used does not contain all the data that is required which is especially a concern for Freight path planning. RT3973 and Train Length information is not provided.	The current process drives peaks of timetable variation activity into a very compressed timeframe. This can lead to reduced validation checks to meet the regulatory timeframes.	Given the very short turnaround times, high volumes of timetable variation request become an issue, especially if additional data is required. The result is that some requests may be processed without full validation.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Bid Path	The bids received form a complete set from an operator.	Not all the required data is present within late timetable variations. Platform information is not always included which puts additional effort on the NR planning team to determine a sensible offer.	The current process drives peaks of timetable variation activity into a very compressed timeframe. This can lead to reduced validation checks to meet the regulatory timeframes.	If no platform is provided, TPS will select one as a default. There is little intelligence behind this and therefore requires planner intervention to correct.
Bid Path	The bids received form a complete set from an operator.	Some planning systems (e.g. Voyager Plan) keep their LTP and STP timetables separate. As such it, if these are not kept in step the received bids will not include updates (e.g. Headcodes, lines Codes or platforms) made during the LTP amendment process.	The current process drives peaks of timetable variation activity into a very compressed timeframe. This can lead to reduced validation checks to meet the regulatory timeframes.	This results in the NR STP planners correctly processing an incorrect bid and offering a path back to the operator that is not what they expect.
Candidate Path (Timetable Variation)	When created in response to a timetable variation the set of candidate paths is considered complete.	Planners plan based on the reference data held within their planning tooling, together with their knowledge and access to other reference material. When planning significant levels of variation under tight timelines the limited level of support provided by the planning systems does not give them enough support to develop error free timetables.	NR planning teams must rely on a significant amount of manual verification of candidate paths against the TPRs, geography and access rights. This puts a secondary pressure on the ability to meet fixed deadlines.	The pressure on Network Rail, and operator's planning teams to develop plans using mostly manual checks against strict deadlines stops planners considering the operational robustness of the timetable and in some cases means standard checks get dropped.
Network Geography	Considered complete by both NR and Operator planning teams.	Known to be issues with accuracy of the data and where considered significant, change requests are raised. Compatibility with NR's view of the Geography and the Timetable Participant's is an issue, especially when repeat bids are received with a re-occurring error.	No real concerns raised. Network Change notifications are made widely available as per the Network Code rules.	Repeated violation of rules causes adds to the overall burden of work.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Offer Path	For Network Rail Variations the current practice is to only return to a Timetable Participant the offers to their specific bids. As such they have no visibility of the amended timetable offer for other operators. In multi operator areas having a route level view of the developing timetable would be beneficial.	Returned paths may have '*' activities truncated which requires manual effort to correct.	No reported issue.	Not having sight of the full timetable with all operator's services hampers the Timetable Participant's ability to build an optimal timetable.
Scheduled Access (TPS view)	The WON and PON are considered the master view and checks are undertaken against them rather than the access notations in TPS itself which is not consider complete enough to use.	The WON and PON ares considered the accurate view. The notations (purple hatching) in TPS is not considered sufficiently accurate.	The view in TPS should be updated in line with published access restrictions but this does not seem to be the case consistently.	Manual checking against the WON/PON does not reduce the quality of the offered path but is more time consuming and therefore adds pressure onto the whole process.
Timetable (Informed Traveller)	The timetable, when published is considered complete.	It is known that at TW-12 there are still going to be quality issues with platforming due to stock/crew plans not yet being finalised by operators.	If significant late re-planning is required of the timetable, then the delivery of this timetable is impacted. The inter-connectedness of train paths, and reduced flex in timetables makes this a significant risk.	Failure to deliver the Informed Traveller Timetable is a breach of the network code and will typically result in reprimands and fines.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Timetable (Working)	When published daily, the timetable has some known limitations within it that impact its ability to support downstream operational systems. Missing train association data is the most important of these.	It is recognised that the published daily timetable will contain services that cannot be operated as planned. A minor point was noted around platform recording and the use, or lack of sub-platform use in the timetables (e.g. 1A, 1B). This impacts downstream operational systems ability to properly manage and associated train services. It is also recognised that the current timetable structure limits its ability to support more granular operations.	Not reported as an issue.	Quality issues with the timetable directly result in operational issues and subsequent delays to services.
Timetable Planning Rules	The published set of rules is considered complete.	Operators don't all keep the rules updated within their own planning teams. As such bids are submitted which violate rules multiple times.	Not reported as an issue.	Repeated violation of rules causes delays and adds to the overall burden of work.

Planning Rules Management

Each route focussed timetable planning team includes a specialist timetable planning rules specialist who assesses internal and external requests to change rules and if approved actions their change within the timetable planning systems.

The following table describes the data quality assessment that were identified during the initial interview and subsequent follow up activities.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Change Log	Log not used consistently by all planning teams. No single log appears to be maintained.	Where used it is assumed to be an accurate record.	Where used it is assumed to be updated in line with the TPR process.	Lack of consistent tracking means that it is not possible to assess overall and localised levels of change and therefore identify process improvement opportunities.
Change Request	Captured changes represent the complete set.	Variable nature of the format of changes makes processing more difficult and can introduce errors.	Changes can be received at any time which makes processing of them difficult during busy periods.	Variable nature of change requests from emails to formal documents increases teams' workloads and can lead to misunderstandings.
Electrification Limits	Assumed to be complete at the time of publication.	Assumed to be accurate at the time of publication.	Section Appendix maintains view of current limits however management of future view is unclear.	None from a management perspective.
Freight Train Length Limits	Freight Train Load Books exist for each route. Therefore, there is a complete set of books available.	Lack of clear data ownership of accountability places doubt over the accuracy of the data.	Known to be out of date in some instances.	Limited impact as the data is not used by planning teams. Local LTP/STP crib sheets are used instead. Lack of authorised data may result in unsafe train paths being planned.
Freight Train Load Limits	Freight Train Load Books exist for each route. Therefore, there is a complete set of books available.	Lack of clear data ownership of accountability places doubt over the accuracy of the data.	Known to be out of date in some instances.	Limited impact as the data is not used by planning teams. Local LTP/STP crib sheets are used instead. Lack of authorised data may result in unsafe train paths being planned.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Headway Rule	Complete at the time of publication.	Known to not always adhere to the formal definition as reducing the headway in some circumstances allows for greater capacity without loss of safety.	Updated in line with the planning cycle.	None from a management perspective. Complex nature of some rules though can make their implementation difficult. See Note 4.
Junction Margin Rule	Complete at the time of publication.	Considered accurate but complex nature of some junctions results in rules that may be difficult to implement	Updated in line with the planning cycle.	None from a management perspective. Complex nature of some rules may make implementation difficult. See Note 5.
Platform Limit	National coverage exists of platform lengths.	Lengths recorded in TPR document and those held in NESA do not match and have been shown to be inaccurate when compared to the physical platform's dimensions as required from a planning perspective. (See Leeds station assessment (NR4)). Lack of clarity over planning's requirements against existing usable and operational lengths.	Existing process does not ensure that updates are performed in a timely manner. No record of when last measurement was taken so cannot assess its accuracy.	Lack of common understanding of platform length meaning is creating inaccurate data that could lead to train paths planned that cannot be operated. See Note 2 for explanation of platform length issue.
Route Availability	Complete at the time of publication.	Accurate at the time of publication.	Sectional Appendix maintains view of current route availability however management of future view is unclear.	None from a management perspective.
Route Clearance	Complete at the time of publication.	Accurate at the time of publication but textual definitions allow for complex rules to be created that may be difficult to interpret. See Note 3.	Sectional Appendix maintains view of current route clearance however management of future view is unclear.	None from a reference management perspective although may limit ability to systemise data in future.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Sectional Running Times	Complete at the time of publication, however given the time lag in getting SRTs changed, Timetable Participants need to create their own local SRTs when building future timetables for new stock.	The formal definition assumes a fastest time between two points, but trains do not operate in this way, so adjustments are required. The result combined with the limited number of available timing loads creates an inbuilt level of inaccuracy. See Note 6 which shows how SRT can be calculated.	Process to update is time consuming and the evidence lead barrier to change is high.	Low quality SRTs directly impacts the quality of the operational timetable and can lead to train paths that simply cannot be achieved.
Station Planning Rules	Complete at the time of publication.	Considered accurate but complex in nature which may make them difficult to interpret by non-experienced planning teams and IT systems.	Updated in line with the planning cycle.	None from a management perspective.
Timing Locations	Considered complete at time of publication via CORPUS file.	Considered accurate although believed to contained redundant codes. In part this is a result of use of operator specific location codes.	The locations data is updated in line with timetable planning requirements.,	No significant impact on planning. However, the existence of Engineering, Planning and Timing locations creates risk.
Train Restriction	Assumed to be complete at the time of publication.	Whilst textual the instructions are reasonably simple.	TPR maintains view of current train restrictions however management of future view is unclear.	

Note 2 – Platform Length specification ambiguity

Note 3 – Complex Route Clearance Example from NESA.

LN101	ECM1	Holloway South / North Jns – Wood Green North Jn	1	44	5	07	E R1 R2 R3 R4 R5	E R1 R2 R3 R4 R5	Y	E R2	E R2	E R1 R2	N	E R2 R6 R7	EH	N	Y	R1 Prohibited between Holloway South/North Jns and Finsbury Park R2 Prohibited between Hornsey and Wood Green North Jn R3 Prohibited Down Slow and Down Fast lines through Finsbury Park R4 10mph Finsbury Park platform 6 and Disused Up Slow platform R5 10mph Harringay platform 2 R6 Prohibited Hollwoay South / North Jn - Finsbury Park South Jn R7 Prohibited ECM1/13 Finsbury Park underbridge 02m 43ch

Note 4 – Complex Headway Rule from TPR.

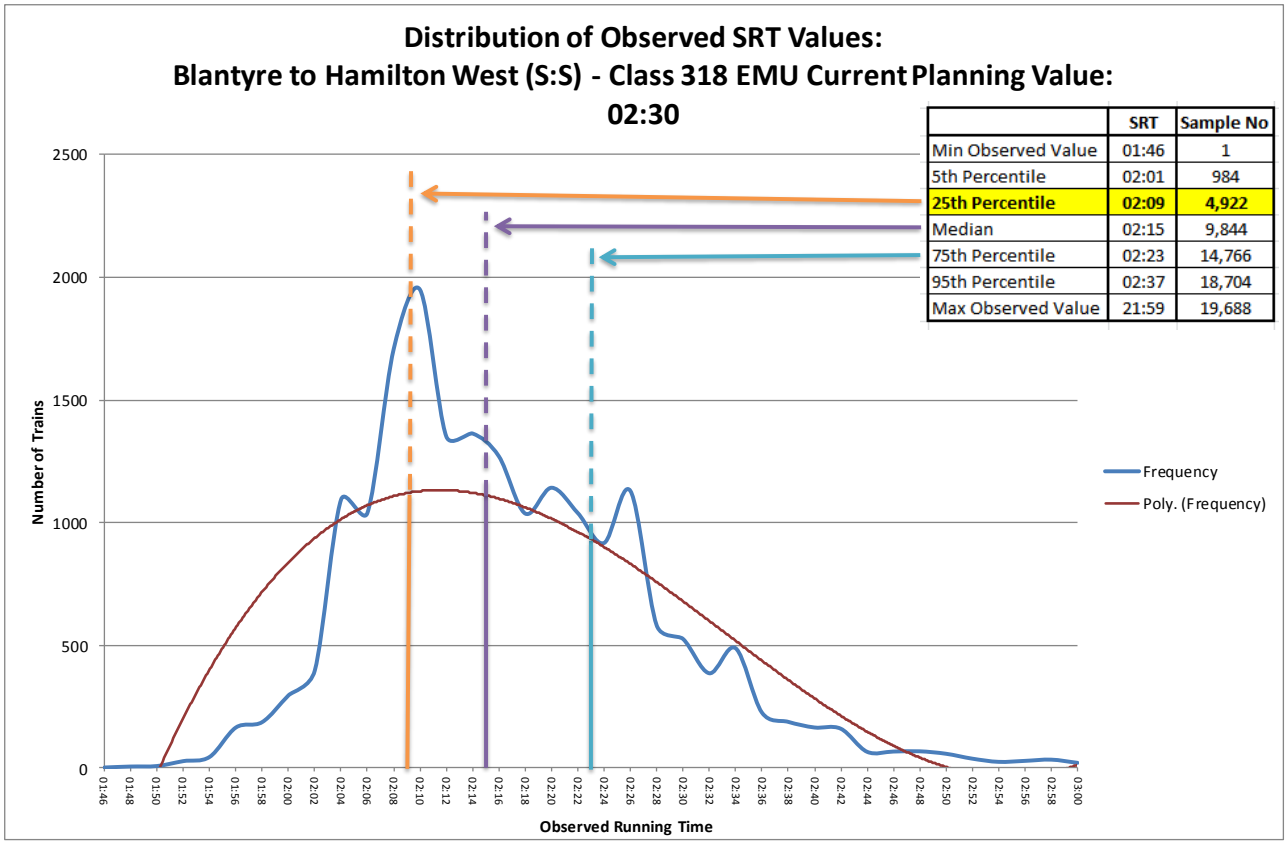
LN101 LONDON KING'S CROSS TO SHAFTHOLME JUNCTION			
TIMING POINT	**DOWN**	**UP**	**NOTES**
Standard Headway	4	4	
Exceptions:			
King's Cross to Alexandra Palace	3	3	
Alexandra Palace to Woolmer Green Junction	3	3* - Fast 3- Slow	*May be reduced to 2½ where a train from the USL at Woolmer Green is following a non-stop train on the UFL that is timed at 100mph or above
Woolmer Green Junction to	3	3	

Note 5 – Complex Junction Margin from TPR.

Junction Margins		
First Movement	**Second Movement**	**Margin**
Up train passes Belle Isle	Pass from SL2	1½
Up trains cross to/from SL	Next train passes Finsbury Park	2^
Down train cross to SL/FL	Next train passes Belle Isle	1½
Down train cross to GL	Next train passes Belle Isle	2
Down FL train pass Finsbury Park	Cross from DSL to DFL	1½*
^ - May be 1½ if 2nd train is also crossing to/from SL		
* - May be 1 if 2nd train is calling at Finsbury Park		

Note 6 – SRT calculation (using ODA data).

When using ODA to look at SRTs the trains are ordered from fastest to slowest and the 25th Percentile observation is taken. As can be seen in the example below the 25th Percentile (LQ) tends to fall on or very near to the peak of the distribution curve. This does not though represent the fastest time possible between two points as per the definition of an SRT.


Distribution of Observed SRT Values:
Blantyre to Hamilton West (S:S) - Class 318 EMU Current Planning Value:
02:30
SRT
Sample No
Min Observed Value 01:46 1
5th Percentile 02:01 984
25th Percentile 02:09 4,922
Median 02:15 9,844
75th Percentile 02:23 14,766
95th Percentile 02:37 18,704
Max Observed Value 21:59 19,688
Number of Trains
Observed Running Time
Frequency
Poly. (Frequency)

Timetable Geography Management

The Planning Support Services team (PSS Team) is responsible for maintaining the underpinning reference data that supports the timetable planning process which includes the base geography and static reference data needed by the key timetable planning systems.

The following table describes the data quality assessment that were identified during the initial interview and subsequent follow up activities.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Block	Full national coverage exists but instances of 'around the world' planning still occur where Blocks are missing between Node pairs, forcing TPS to route the train incorrectly.	Unable to assess the level of accuracy against any external source and the model is known to have errors.	The model is updated in line with the planning process for new geography changes.	Forms part of the Network Geography construct. Issues with data quality result in sub optimal train paths being planned which may not be identified prior to timetable publication.
Edge	Full national coverage of the planning geography exists.	Known to be inaccurate but it is not possible to quantify. Issues are addressed as identified by planning teams.	The model is updated in line with the planning process for new geography changes. However older parts of the geography remain out of date.	Forms part of the Network Geography construct. Issues with data quality result in sub optimal train paths being planned which may not be identified prior to timetable publication.
Map Annotation	Completeness is not a valid concept for notes.	Given the extensive number of annotations used and their free text nature it is expected that incorrect data exists.	The model is updated in line with the planning process for new geography changes. However older parts of the geography remain out of date.	Forms part of the Network Geography construct. Various key details are recorded as map annotations. These include platform lengths, operating hours, possession information. See Note 1.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Network Geography	Full national coverage of the planning geography exists, however specific data entities are known to be incomplete.	Known to be inaccurate but it is not possible to quantify. Issues are addressed as identified by planning teams.	The model is updated in line with the planning process for new geography changes. However older parts of the geography remain out of date.	Poor geography results in timetabled paths that cannot be achieved during normal operations. An example of a recent change for Cardiff station is shown in Note 2, which shows the level of additional detail that can needs to be incorporated.
Network Link	Considered to be a complete data set. Verification largely through feedback from external users of the PIF geography.	Considered accurate with the following data exceptions: power type and distance attributes are not consistently present.	Updated in a timely manner to support planning activities.	None.
Node	Full national coverage of the planning geography exists.	Known to be inaccurate but it is not possible to quantify. Issues are addressed as identified by planning teams.	The model is updated in line with the planning process for new geography changes. However older parts of the geography remain out of date.	Forms part of the Network Geography construct. Missing Nodes result in incorrect timetable paths being proposed. Whilst usually identified during the planning process less obvious poor pathing will be published.
Planning Location	Considered to be the complete dataset required to support timetable planning.	Data mismatches with other UK and EU repositories (See Note 1). No way to verify consistency against other location sources.	Process for updating is well established and in line with planning process.	No current impact on planning with inconsistencies as TIPLOC codes are the primary key but will become an issue as TSI messaging is adopted.
Platform	National coverage assumed.	BPLAN data does not cover power type or length attributes.	Updated in a timely manner to support planning activities.	None.
Service Code	Considered complete.	Considered to be accurate.	Updated in line with business needs and timetabling processes.	None.

Data Entity	Completeness	Accuracy	Timeliness	Impact
Signal	TPS holds a subset of Signalling information that has been added to support specific scenarios.	NESA is regarded as the accurate source for current signalling. Signalling data within TPS should mirror NESA but this is a manual activity so unable to confirm quality.	NESA only shows the current situation. TPS geography may show future situation if known.	Forms part of the Network Geography construct. Incorrect signalling information in TPS results in confusion but it is not used extensively and therefore the impact may be small.
Timing Load	To avoid excessive numbers of timing loads, approximations are used and not every possible timing load exists.	Assumed to be correct.	Process exists to update in line with IP work.	Use of general timing loads helps easier timetable development but creates paths that do not match real world operational performance.
Track	Full national coverage of the planning geography exists.	Known to be inaccurate but it is not possible to quantify. Issues are addressed as identified by planning teams.	The model is updated in line with the planning process for new geography changes. However older parts of the geography remain out of date.	Forms part of the Network Geography construct. Poor track data directly results in the development of a timetable that is likely to operate poorly.
UID Allocation	Assumed to provide a complete record of UID allocations being used.	Regarded as an accurate record.	Some minor evidence that the current process adds delays.	Central management by the PSS-Team ensures quality of the data (block allocation and no re-use etc) but adds in additional process steps. Improvements have been identified, but not implemented yet, to allow planners a method to update allocations directly.

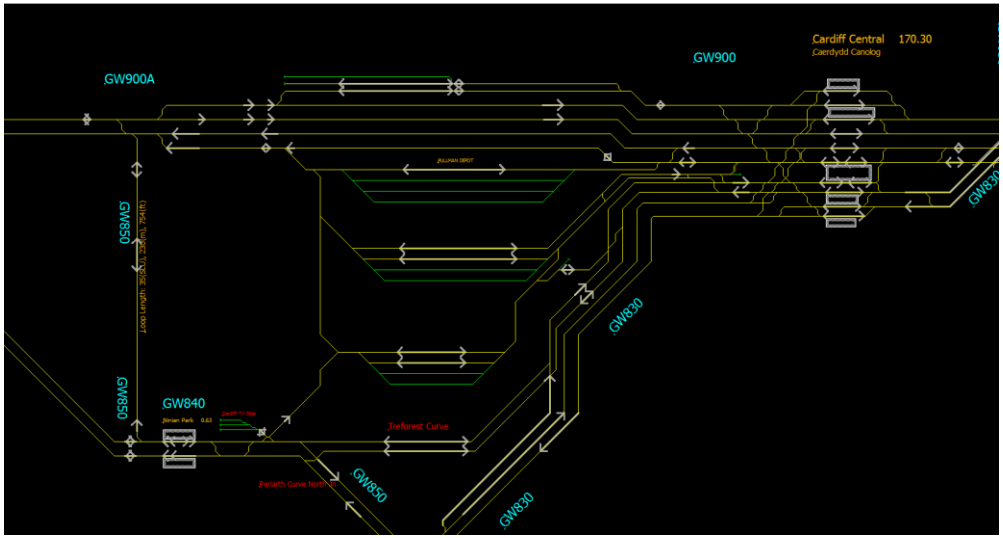
Note 1: Map and Station annotation examples:

Operational Usage Map Annotation.xml

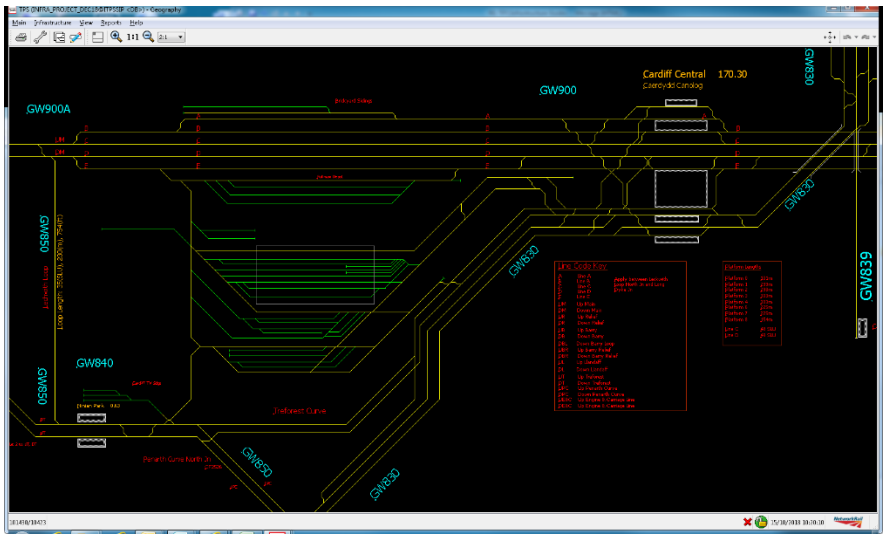
Station example.xml

Note 2: Cardiff track layout updates example

Cardiff before updated geography:



Cardiff after upgrade geography:



Note 3: European coding discrepancy example in Planning Locations

TPS Station Name	TPS UIC Station Code	CORPUS Location Name	CORPUS NLC Code	CORPUS Euro Code	TSI Location Name	TSI Primary Location Code
ALDERSHOT	00124	ALDERSHOT	13710	56230	ALDERSHOT	GB56230
ALDERSHOT SIGNAL WK1371	13907	ALDERSHOT SIGNAL WK1371	562303	-	-	-
LONDON WATERLOO	07414	LONDON WATERLOO	559800	55980	WATERLOO LONDON	GB55980

Personal Statements

The end-to-end timetable planning process has many stakeholder touch points across the industry from input, to the end consumer of timetable information. Improvements in the quality of data used across the process are likely to enable new opportunities for improved ways of working, greater operational performance and more efficient and effective use of existing financial and people resource. Through the realisation of data improvement benefits, this will ultimately enable System Operator to work towards the vision of a safe and achievable timetable and subsequently improvements to the passenger and freight customer experience.

The following section captures a set of stakeholder-centric personal statements. These specific viewpoints have been captured from conversations with various stakeholders with differing perspectives, needs and frustrations. They are intended to help highlight gaps, shaping the set of change recommendations needed to transition from the *current* data state to one that can deliver their personal *target* state.

System Operator | Operational Planner

“As an Operational Planner my role is to build a robust timetable by identifying and resolving defects, accommodating new and amended services, whilst applying the Train Planning Rules and within the constraints of the Network Code. I seek to also meet the commercial aspirations of route and other NR colleagues as well as freight and passenger operators. I am involved in planning the New Working Timetable (NWTT) from D-40 to D-26 (Long Term Planning), working through train operator’s Priority Data Notification Statement (PDNS) bid for train paths which are submitted at D-40. I also process Train Operator Variation Requests (TOVR’s) that are bid continuously throughout the year. These are submitted after D-26 to accommodate amended or additional timetable requirements from the operator’s business needs e.g. stock changes, or additional calling patterns.

One of the biggest issues with data inputs for me are poor quality PDNS bids received from operators. These include instances of Sectional Running Times (SRT’s) differing from the information that we hold (or missing from the bid altogether), and missing route codes and mandatory Timing Point Locations (TIPLOC’s) from schedules. Once these bids have been imported into TPS, they are flagged as ‘red cross errors’ which if left unresolved, affect the actual timing of trains and prevents the publication of schedules. This also has implications on operational performance (e.g. lack of precision required to operate timetable effectively) and safety (if a route code is incorrect and unless a signaller or Automatic Route Setting (ARS) intervenes, a train may be routed on the wrong line).

I find the inadequate data quality of PDNS bids frustrating and time consuming to resolve, particularly during the development period (D-40 to D-26) as planner resource is very limited. Spending time resolving data issues (i.e. ‘red cross errors’ in TPS) uses up a significant amount of my time and prevents me from allocating sufficient time for validation.

Ideally, any data errors that are contained within imported bids should be automatically resolved in TPS which would enable me to focus on the critical validation tasks rather than fixing issues with data. This could potentially allow greater levels of focus on resolving TPR non-compliances, rather than having to worry about the need to remove data errors from services. “

System Operator | Systems & Data

"As Senior Systems & Data Manager within System Operator, my role is primarily of engagement; helping to shape the future of Capacity Planning systems and data, creating links to existing customers and finding ways to continually improve existing and new ways of working. I work closely with internal and external stakeholders to bridge the gap between 'How to create a robust timetable' from a systematic data view to 'How do external systems and processes interact with our internal systems'.

Some of the key issues that I face from a data perspective are as follows:

- Bids (PDNS) received from operators are of regular concern including non-compliance with the Network Code, missing Timing Point Locations (TIPLOCS's), Sectional Running Times (SRT's) and Network Links. This causes conflicts with other data areas such as Service Groups and overlapping dates. My team are then required to fix these data issues. There is a belief that this may be a result of unknowingly poor quality of data within operator's systems; i.e. they may think it's correct but is in fact inaccurate or out of date

- Addressing our current data set whether it's in TPS, Bplan, Metastorm and all the bespoke, and largely tactical tools that I have inherited through Capacity Planning (VBA/Excel/Access tools). Inadequate integration between these systems compounds the challenges of our lack of reporting capability as TPS can't produce the reports we need to produce upon request (e.g. from the DfT or ORR) and requires manipulation of data across systems to get the reports we need.

- I don't feel confident in the quality of data held within TPS. If and when we move from an *edge* to a *sectional* infrastructure model, will the information that was built into TPS 10 years ago work with the next version? Will it be fit for purpose? Do we have a robust enough understanding of what will be needed to address the quality/missing data to push the functionality of Technical Running Times's (TRT's) and Conflict Detection to improve the way we build a timetable, taking into account safety and risk?

- It is often difficult to understand *who* owns or is accountable for the data we are provided with and for the timescales in which it is provided. For example, the limited visibility of future infrastructure changes makes drawing an infrastructure model that is representative of a future timetable challenging. I feel this is inherent of a disjoint between infrastructure projects and System Operator in the absence of a 'whole system view'.

- I don't feel that we understand enough about how the downstream systems consume the data we provide to them. We only focus on what we have but if we had sight or a better understanding, we could provide a different or improved level of service.

- I think that the Network Code can sometimes restrict or hinder the capability to make rational decisions for how the railway runs today. I believe that it's outdated and no longer fit for purpose to plan a modern railway; I don't think it

protects the integrity of Network Rail's decision making and is frequently open to interpretation due to ambiguity which results in the context being manipulated for a specific agenda.

For me, '*better*' would look like the following:

- Automatic transfer of external input data into our systems could enable significant time savings by moving us away from manual data entry which is prone to human error and inefficient use of time. For example, if we were able to obtain Scheme Diagrams in a machine-readable format that could be automatically populated within TPS, this could remove the need to manually recreate infrastructure data within TPS. Other data types that could benefit in these areas include train bid files, associations and stock diagrams. I believe that in order to effectively exploit system automation of processes, we need to have a better understanding of the data that we *have* and the data that we *need.*

- All operators consistently sending compliant bids that can be consumed into our systems without manipulation and data sharing amongst the operators for better planning/alignment, whilst taking into account commercial sensitivity between operators.

- Improved reporting capabilities would enable us to interrogate our data quicker and more effectively, providing fit for purpose management information to drive better decision making without having to manually move data around systems to get the answers we need.

- The Prior Working Timetable should be a robust, zero-defect base to work towards the next version of the timetable which requires only iterative validation. I think there are some key questions needs to be asked – what should/would a *'Zero-Defect'* timetable look like? We have all this data but fail to understand/agree and provide a solid foundation to work from.

- If the Network Code (specifically Part D *the translation of access rights into the construction of the timetable*) placed a greater emphasis on safety, it could help drive the right behaviours, particularly in the management of trade-offs between capacity and performance.

Ultimately, I think that we need to have a better understanding of the data we consume, process and output, to ensure that it's fit for purpose. This would require data governance including clearly defined accountabilities and responsibility across the data management lifecycle.

System Operator | Operational Planning Project Manager

“My role is an Operational Planning Project Manager. My team produces the Working Timetable (WTT) for a route. I am responsible for managing this process, liaising with operations and operators about expected timetable changes, that have been requested, and checking on the formal processes.

One of the biggest data related issues we face is importing operator bids into TPS. This involves checking for data errors and then correcting any that occur – these can range from bids being incorrectly formatted (generally unusual and would require the operator to rebid) through to missing Sectional Running Times (SRTs), locked times, missing network links, and other timetabling errors. These take time to fix (generally the first couple of days from bid received), which reduces the time we have to produce a high-quality timetable. Theoretically, some issues such as missing network links and SRTs shouldn't occur as operators have access to a weekly download of the geography and timing data that we produce. If we had the capability to assess the data of the bids *before* we spend time importing them into the system – we could send the bid back to the operator to rebid, before processing further.

It can be difficult to understand what change operators have bid for – we have tools now that assist us identifying the change (i.e. Tracsis), but these can still be a challenge to understand and assess when trying to gain an overview, and only highlight specific changes (e.g. Minor headcode change but the path remains the same). This can lead us to believe we need to unnecessarily validate an entirely new service. By having the capability to highlight what has changed between trains with matching head codes, dates and origin/destination and identify when the train has changed a headcode, or even is now running in the path of a cancelled previous path, would again help us to minimise rework and focus on analysing change and improving quality.

My team manually checks Section 4 (Engineering Access Statement) possessions for train conflicts which can take up to 1.5 – 2 weeks of a WTT development cycle (as the cycle is only 14 weeks, this is a reasonable chunk of time) and is a manual process that's prone to human error.

We develop timetables in TPS which are then sent to downstream systems when we publish. This includes signalling systems such as Automatic Route Setting (ARS) – however the limitations of ARS aren't reflected in TPS; we can produce a plan for ARS areas compliant against Timetable Planning Rules but is not operationally viable. Reasons for this can range from timing points in TPS not existing in ARS, or moves TPS thinks possible, yet aren't viable in ARS. ARS does not recognise pathing time for example, so schedules may get regulated against the plan. It's also difficult to get ARS updated with new timing points that would assist the train plan; it's a costly and slow process which means we are, on occasion, arguably limiting the capability and quality of the plan. It would be extremely useful if ARS limitations were clearer in TPS (for example, as red cross errors if ARS will not understand it), as this would reduce rework on our part, assist us with planning a timetable that is operationally viable, and reduce the amount of ARS-related delay.

We also face the challenge of clearly presenting timetable changes to operations. The Timetable Change Brief can take around 3 weeks to produce and is a very manual process – significant data entry is required into the Brief, much of which is transposing TPS into

another format. This is an extremely slow process, and the amount of data entry required limits the time available to develop other areas of the Brief, for example focus on rolling stock change or junction regulation changes. An automated Brief that automatically highlights change would help us produce a more relevant document, focussing more on the key issues, in less time. Equally, whilst TPS can feed dozens of downstream systems, it does not seem to be compatible with ALCRM (All Level Crossing Risk Model), the tool used by NR for assessing Level Crossing risk, and so currently the process for supplying the Level Crossing team with data to assess this risk is manual – one team spent 55 hours during the May19 timetable drafting period working on this! Automation of this process could save many days of work, but also allow more timely safety decisions to be made and communicated amongst timetable participants.

Train Operating Company

"As a Train Planning Manager, I am responsible for leading a large team of planners and diagrammers in the development and production of long and short-term timetables, rolling stock and train crew diagrams in line with industry processes and internal agreements.

Production and transfer of data is at the core of the Train Planning Unit and therefore maintaining data integrity is critical to the successful production of a timetable plan, requiring structured processes, systems and training.

As the industry evolves, so does the volume of data needed to be exchanged. Existing systems have been left behind and are constrained by what can be transferred in CIF/PIF/PEX format. New planning and diagramming software products have entered the market, but the constraints of data transfer hinder these from reaching their full potential. The volume of repetitive data exchanged is inefficient with multiple tools having to be used to hunt for changes.

Tactical workarounds never solve long-standing issues and fail to address the root cause. Timing to 30 second accuracy gives quite a margin for error at present which could be reduced. This leads to rounding over a long-distance for point-to-point SRTs. With passenger growth and the modern train door operation, dwell times at stations are now commonly struggling to attain the standard minimum 30 seconds, with 45 seconds now a more-realistic value. To get around this it is common in places to alternate between 30 and 60 second dwells as a workaround.

In my view, having one industry database for timing of train schedules must be the aspiration. This would enable operators and NR to seamlessly load in requests for schedules, and a workload management system for validation and publication into downstream systems. The volume of repetitive data exchanged is inefficient with multiple tools having to be used to hunt for changes. I believe timing to a greater granularity than 30 seconds is must; releasing capacity and helping to identify performance issues

There was significant investment a decade ago into industry planning systems, but I feel this was put into the 'too-hard pile' in the last Control Period. Now is the time to be bold, brave and fit for the future with industry support even if there isn't consensus which hindered projects in the last Control Period.

Freight Operating Company

"As a Train Planning Manager for a Freight Operating Company, I am responsible for Bidding to Network Rail for the Working Timetable, and Bidding of Spot Bids to amend the Working Timetable. Rail Freight is an indispensable part of the UK economy and is an essential component in supporting economic recovery and long-term sustainable growth. Rail Freight is part of a national supply chain for both Business & Consumers. The Working Timetable needs to reflect both the Customer demands and Freight Operating Company Business demands. Freight Operators need to be able to amend the Working Timetable in order to compete with fierce competition from Road Haulage.

In relation to data, one of the biggest challenges we face is the misalignment to Network Rail's data, primarily due to inadequate data exchange. In order to create our Working Timetable Bid, (Priority Date Notification Statement – PDNS), we need to get data from Network Rail's Train Planning System (TPS), into our planning system, VoyagerPlan. Network Rail will create a Prior Working Timetable (PWT) in TPS and then the Train Operator will need to import this to VoyagerPlan. This process is not straightforward and requires third party involvement (Worldline). Network Rail sends a PIF file to Worldline who then input this into a web portal. The electronic download process imports this PIF file & converts it into a Text Document (.txt file) so that VoyagerPlan can interpret this data. NR has the data in TPS that we need in order to make informed, business decisions and responses to Timetable Offers; however, we need to wait for this to be sent to Worldline before we can import it to VoyagerPlan. Timeliness isn't a specific issue in this regard as we receive this in alignment to the timescales prescribed in Part D of the Network Code. The data contained in the PIF file is normally up to date, but some parts of this data can fail to transfer to VoyagerPlan where the data contains errors or discrepancies.
The geography within TPS and VoyagerPlan should match but there have been instances where they don't; TPS has its own geographical reference data (BPLAN) and VoyagerPlan has geography within its architecture imported from Worldlines' web portal. There does not appear to be a way of understanding whether geography and SRT data is correct; I have to make the assumption that it is.

Data-exchange issues also impact the efficiency of the Rolling Spot Bid (Train Operator Variation Request – TOVR) process. I create new or amended trains within VoyagerPlan, send an electronic (PEX) file to NR with a commentary in a Word document. When we receive the response (Offer) back from NR, this is received as a PDF file (F3 train print). As VoyagerPlan is currently unable to import timetable variations (amendments) electronically, we either have to create a new database and import the whole Working Timetable or we can manually key-in new & altered trains back into VoyagerPlan; increasing the risk of human error. On average, I process at least one TOVR a week which could have 5-6 trains (this equates to about 100 trains in a Timetable period). To submit a compliant Bid, I must ensure these paths don't conflict with existing services and are within freight loading time-windows at Ports & Terminals. VoyagerPlan has our operator train data, but we need other operator's data in order to plan an accurate and achievable timetable; if another operator were to change their timings by just two minutes, this could have a substantial impact on our train path availability. I currently rely on 'read only access' to TPS to enable me to see up to date graphs.

In an ideal world, in order to effectively collaborate with NR and get the best possible quality timetable, we really need to be working from the **same** data sets; a 'single source of truth', enabling us to have greater trust in the decisions we make. Having direct 'write' access to TPS where appropriate (for example, to provide updates to specific data that doesn't impact the overall plan) would be beneficial, although I accept (and also expect) that NR would continue to undertake final validation for quality & to maintain the integrity of the Working Timetable. It would also be useful to have some sort of 'play-pen' access to TPS where Operators can create or change schedules that don't actually update the Working Timetable. This would enable Operators to look at various options on up to date graphs before submitting a formal Bid to NR.

Signaller (Automatic Route Setting (ARS) Area)

"As a signaller, I am responsible for delivering a plan in a safe and efficient way that delivers maximum operational performance without compromising safety. On an automated railway, my role is one of monitoring, anticipation and intervention when running a train service, coupled with granting track access to engineering teams to maintain the infrastructure.

To be able to deliver on my responsibility of a safe and punctual train service, I need a plan that works and can be delivered by an automated signalling system. My key pains are that the data side at present does not support an automatically signalled railway.

The manual interventions that I am required to make are far greater than those intended for an automated railway, for example, because of:

- Trains not in the automatic route setting because incorrect line codes have been used.
- Trains hanging off platforms as they have been planned in platforms where they don't fit.
- Wrongly routed trains because incorrect associations have been provided or because planning and signalling input and output are not aligned.
- Trains booked through engineer's possessions.
- Terminating services arriving on one platform with its booked next service departing back of a different platform.

All these scenarios create a constant workload of phone calls and manual interventions, often whilst trying to provide access to the track for maintenance.

This makes me feel stressed, frustrated and not in control. I want to do a good job, but I can't possibly catch everything. I am the last line of defence before an incident happens, possibly a life changing incident; I must get everything right but am correcting so much that is wrong. It's difficult to balance the passion of delivering a safe and reliable railway with restraint not to react when you see so much that is wrong and the potentially life changing consequences.

'Better', for me, would be less manual intervention that occurs as a direct result of poor-quality data. Monitoring and anticipation requires a solid plan; giving control back to the signaller where intervention is necessary, i.e. due to operational incidents or late running

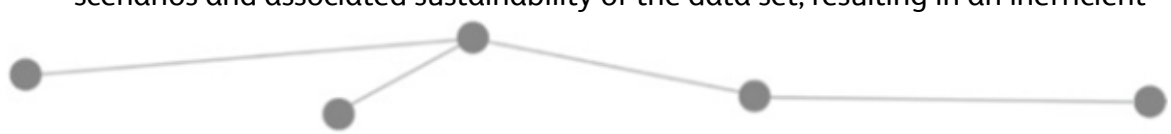
and not the running of a base plan. The base plan should mostly run itself on an automated signalling system. I should have the workload capacity to manage incidents and engineering access; delivering on my responsibility of implementing a plan, not rewriting it or correcting it but delivering it, because it *works*."

Route Services IT – (IT Support Services) | Senior Technical Operations & Service Analyst

"As a Senior Technical Operations and Service Analyst within the Application Support Team (Technical Operations, Route Services IT), my role is to support multiple applications from a technical 2nd line perspective as part of an agreed support model and system/service design. This includes supporting and developing system enhancements and defect fixes through to release and day to day system incident or problem management.

Some of my current frustrations and observations in the context of data itself are listed below with a brief description for each:

- Data Growth and change – the rate of change and data transfer in our systems can be significant resulting in a systems resource requirement and storage increase to accommodate this. There is a financial cost and resource overhead from a system perspective associated with this rate of change and growth.
- Data retention and non-existence of associated retention policies – both non-critical and critical data lack applicable and documented/agreed retention policies resulting in reluctance to commit to removal due to insufficient knowledge of the importance to the business function resulting in the decision to retain being easier in most cases. Data sets which grow also do not have inbuilt supported capabilities to perform maintenance and where these are present the control criteria can lack the ability to define an aligned criterion against our retention requirement.
- Upgrade outages and implementation duration – Upgrades require transformation of objects or new ones entirely created based on existing data, larger volumes of data can and have resulted in extended system outages and greater risk to the implementation
- Legacy constraints – systems, formats and processes are still developed with new systems and/or data solutions to meet the requirements of out of date technology and established methods of working (workarounds). This can constrain the data and solution from being the best it could be. It also results in a more complex estate to support and manage due to new technology being extended, whilst holding on to the old.
- Performance impact of data – increase in data can result in the increase in resource cost to perform system operations, in many applications it can result in the functional performance and loading times being degraded due to multiple factors including server/database capacity, network bandwidth/latency and local client capability. This has been evidenced on multiple occasions, but data volumes can also become the excuse for a poorly understand issue.
- Ill consideration during design – New solutions and functional enhancements within existing systems rarely consider or include data focused management scenarios and associated sustainability of the data set, resulting in an inefficient



solution and or function that has been delivered but is not practical to use due to the data requirements and context. In many cases data management is an afterthought to the initial development, where the benefits case to further develop to add this does not exist.

- System and data architecture – data heavy systems can and have been dramatically impacted by the system architecture impacting the experience the end user receives, additionally the data objects and database structures surrounding the data can have a negative impact depending on its implementation or lack thereof
- Application code – many applications are constrained due to IPR being supplier owned, but there are current cases of poor performing functions and transactions highlighting instances when the application is performing an action inefficiently or un-necessarily and should be changed.
- Absence of data maturity/understanding from users – many incidents and issues are now caused by data issues as data is used more frequently to complete business processes within our applications, a business user should not be expected to know how the system and its interfaces work in detail but neither should a technical resource understand the business process as well as the business end user. As incidents are expected to be resolved by technical support, a greater reliance is being put on the support model and technical resources related to the system to understand a greater and unrealistic breadth of knowledge as use of data in system functions grows.
- Lack of business purpose of the data – data that does not serve a purpose has driven a degrading and unreliable data set and has reduced the understanding of expected definition and system behaviour surrounding it as staff turnover occurs
- Data prioritisation and dedication – reference data management is rarely prioritised leading to reactive situations occurring when data results in incidents or problems, the lack of dedicated roles or teams to do or understand the data further results in low prioritisation amongst other and shared commitments
- Manual error prone processes around the data – most data lacks system controls and validation mechanisms to prevent the introduction of errors when used or entered, this is usually discovered under an incident investigation costing time and impact to the function of the system for what could in many cases be easily avoidable
- Access and training – several cases exist and have occurred where users with insufficient knowledge of the application and associated data have been provided with edit access, the most restrictive and appropriate security policies are not being applied in a lot of cases even the ability to do so is present.
- Lack of Data traceability and auditing – data editing abilities do not have sufficient logging or auditing controls built in, resulting in difficulty in diagnosis or isolation of root causes of incidents raised.

The issues noted above causes frustration primarily as many are avoidable, but equally a strong feeling of vulnerability or failure as I am in a role to provide support to the end user related to the system. Whilst this is specifically technical support, there is a noticeable growth in queries related to the data and business processes as complexity grows and business knowledge is lost. Network Rail behaviours which are encouraged are to do the right thing and put the customer first, but the growth and demand will be un-sustainable in a technical team in the absence of appropriate roles or teams to fill this ever-increasing knowledge gap, nor is it an appropriate expectation in many cases. It also

results in situations where challenges or clarifications must be made on the service offering agreed/provided, which in many cases goes against my core behaviours.

Better data in the future from my perspective would include foresight and sustainability wrapper including people, processes and technology, currently I feel many projects or changes are focused on the initial implementation whereas a stronger consideration on the lifecycle of the data would improve many of the issue areas. I would like to see the inclusion of associated data management, controls and retention required both from a policy and functional perspective to avoid data growth. Better architectural design and single maintained sources of the truth, including the removal of any redundancy and obsolescence to reduce complexity but also to reduce the training and knowledge overhead associated with multiple systems and duplicated data sets.

External Reports

Alongside the activities directly undertaken by the team developing the data architecture reference model we have also examined the following external reports to get as broad a view as possible on data related timetabling issues.

- Hitachi CP6 Data Improvement Programme Industry Engagement Report (Ref NR8)
- Glaister Report: Independent Inquiry into the Timetable Disruption in May 2018 (Ref NR11)
- Transport Focus Williams Rail Review: What do passengers want? – 2019 Report (Ref NR10)

Hitachi CP6 Data Improvement Programme Industry Engagement Report

This report brought together multiple industry stakeholder's views of timetable planning to provide a top down view of the challenges experience by the industry. Its list of the most commonly occurring train planning data issues are listed below and have been incorporated into this document's problem statements:

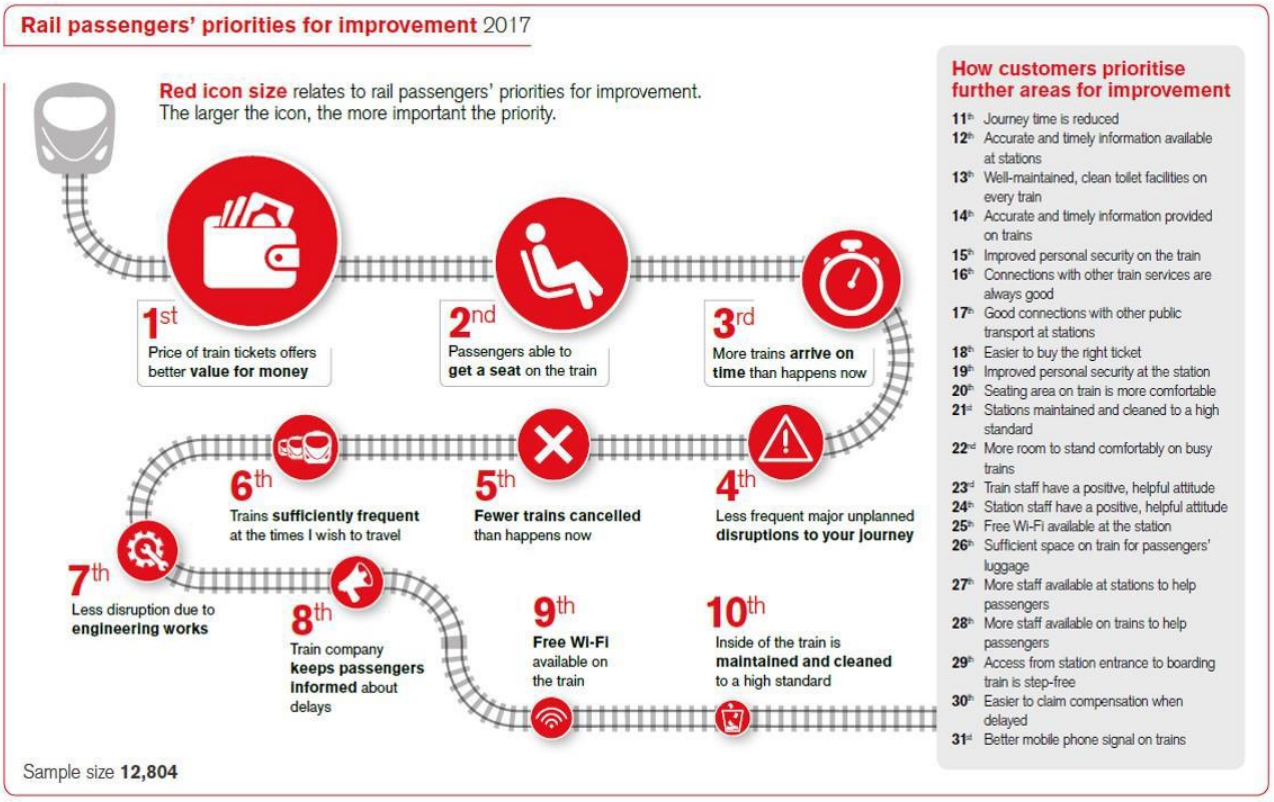
1. Issues in data exchange between NR and TOCs/FOCs as part of the bid/offer cycle related to electronic transfer of timings data
2. Mismatches in geography data and planning rules between NR and TOCs/FOCs
3. Difficulties in tracking individual train services through the planning cycle
4. TPR data not being complete, maintained or effectively shared in electronic format
5. Lack of positional information on assets (specifically, geospatial position as opposed to ELR mileage position)
6. Lack of "model train" traction data and lack of confidence in the data that does exist
7. Related to Issue (6) above, a lack of understanding of human factors and other variables on train performance, and the trends in these over time
8. Downstream systems requiring data of better quality than is provided (e.g. ARS, TMS, ETCS) and a likelihood that this problem will be exacerbated over time
9. VSTP changes not being visible to downstream users
10. Data captured from projects such as TRIP being lost, even where the data itself would be valuable

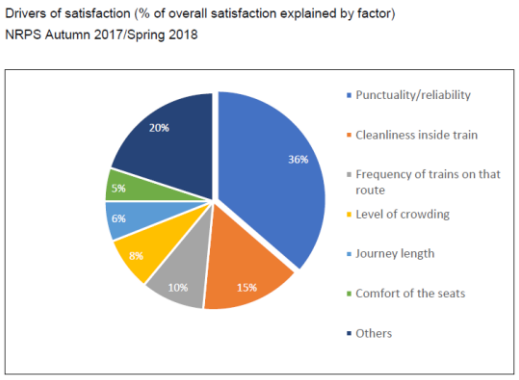
Glaister Report: Independent Inquiry into the Timetable Disruption in May 2018

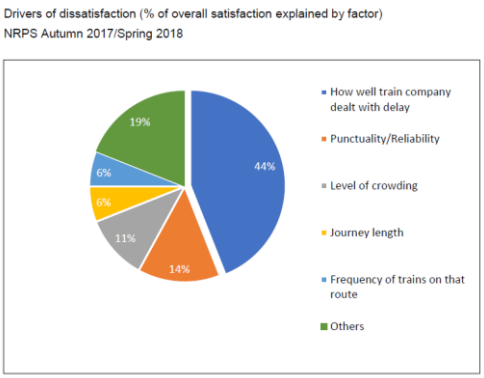
The Glaister report looks at the timetable disruption that occurred with the rollout of the May 2018 timetable and has been assessed and any reference to data quality issues or where data quality could have been an underlying concern have been identified. Appendix B shows this analysis. The resultant concerns have been incorporated into the Problem Statement section of this document.

Transport Focus Williams Rail Review: What do passengers want?

The Williams Rail review looks more generally at what passengers want when they use the railway. Whilst more difficult to align back to the timetabling process and underlying data quality issues, we felt that it was important to include the passenger perspective into this analysis. The following diagrams show the top concerns as identified by passengers.







As one would expect most of the concerns about relate to the operational aspects of running the trains services on the day. Third on their list of concerns is punctuality, and of course having a reliable and achievable timetable will improve that. Reducing the number of cancelled trains will also be affected by how well the timetable and engineering access plans work together. Further down the list of concerns are those related to accurate and timely customer information, especially during disruption. This though falls into the very short-term planning and operational control processes and are outside the scope of this analysis.

Problem Statements

To guide the development the activities for the CP6 Data Improvement Programme a set of problem statements have been collected using the information recorded in this document. Each problem statement describes a reported issue, its source or sources, the impact that it causes and a suggested option or options for addressing it together with an indicative (Low, Medium High) scale of the change required. Problem statements have also been grouped into themes to help simplify further discussions and prioritisation. Note that the Options are just to aid further discussion and should not be taken as a Network Rail formal statement of intent.

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Network Rail planning teams do not have real world feedback from operations (Network Rail and Timetable Participants) to understand how well the timetable performs.	The Culture of Data	Data Assessment	There is a feeling from Timetable Participants and Network Rail operational staff that Network rail timetable planning teams do not fully understand, or cannot experience, the effect of timetabling on the operational teams in Network Rail and the Operators. As such they cannot change learnt behaviours or identify areas where improvement can be made.	This could be addressed in many ways. • NR Timetabling teams should have access to real time dashboards that show, on a day by day basis the impact on services attributed back to timetabling issues. • Vertically aligned co-located timetabling and operations teams could be setup to break down barriers. • Timetabling staff training could include secondments into operations so that they can experience the 'other side'. This may be especially useful as new traffic management systems expect to include a 'de-conflict' phase prior to the operational day to address 'correct' the timetable.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
The Network Code sets out the operational framework that Network Rail, and Timetable Participant's must adhere to. Whilst essential to maintain the separation between parties, it can though create an adversarial climate of 'them' and 'us' which can get in the way of developing a reliable and achievable timetable.	The Culture of Data	External, Process	Whilst it is not suggested that anyone has set out to create barriers between parties involved in planning, when tight deadlines are the norm, workloads increasing and in an environment of ever public/political scrutiny, it is human nature to focus on your own teams' responsibilities as set out in the Network Code and become entrenched.	This is a difficult area to address but the process as set out in the Network Code needs to be looked at afresh with a shared route/operator set of goals defined. This may result in changes to the role of the System Operator or specific operating models for differing routes or operators.	H
Whilst all parties involved in this analysis recognised the importance of data to the timetable planning process, there was no identifiable driving force that focussed on the data explicitly.	The Culture of Data	Process, Personal Statement	The quality of the data used in planning directly contributes to the quality of the plan produced. As such developing a culture of excellence in the data will translate into better timetabling.	It is recommended that the System Operator follow a similar approach to the engineering disciplines and introduces a Professional Head of Timetable Data role with specific accountability for improving the quality of the data that underpins the timetable planning processes. Adopting the same 'Professional Head of' role will send a message that planning data is as important as other rail physical assets. Track and signalling for example.	M
Whilst Operator and Network Rail timetable planning teams work collaboratively to develop the timetable, there is a lack of an industry strategy and vision for data management.	The Culture of Data	Process, Personal Statement	Data issues are identified and address, or circumvented, as part of the planning process and not as an issue in its own right. As such, step change improvements in the quality of the data cannot be made.	Fundamentally addressing the issue of data requires a cross industry approach to resolve. If a new 'Professional Head of…' role is created, their mandate must include developing whole industry strategies for data improvements.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Lack of data ownership and accountability means that there is no clear statement and measurement of quality.	Embracing Data Ownership	Data Assessment, Personal Statement	Without an accountable owner data improvement is not a day to day activity, and instead is driven by sporadic projects and initiatives which only have limited impact. Currently unable to measure the quality of the data that underpins planning. Unable to measure the change in data quality from an initiative.	Put in place clear data owners how have the accountability to improve given business processes and underlying data sets. Data improvement needs to become part of the normal job. It is important that people are given the time and resources to improve data. When considering this the framework set out in the Knowledge Information Data Strategy (NR9) must be followed.	H
Data exchange points are not well understood, particularly between Network Rail parties.	Embracing Data Ownership	Data Assessment, External Reports, Personal Statement	Without clear data exchange contracts the efficacy of the data handover between parties cannot be measured, and therefore cannot be improved or issues addressed. This issue is particularly seen with respect to the teams that supply data to the System Operator. A specific example raised was with the notification of future infrastructure changes.	Data exchange contracts should be introduced as part of improved data governance. They will spell out when, how and to what quality the data is required, plus include a measure for measurement of the data exchange service.	M
Lack of complete data specifications allows for misinterpretation of data and no management of the data lifecycle.	Embracing Data Ownership	Data Assessment	Information on detailed data structures is difficult to locate. Automation of processes and integration between systems is hampered and becomes costly. Data is not managed through its lifecycle properly.	Starting with the common data entities, put in place a templated data specification document that details the data lifecycle, data usage policy, security level, and detailed attribute specifications.	H
Knowledge about the quality and usage of data is spread across the organisation, mostly in people's heads. Insight from one-off projects is often lost over time.	Embracing Data Ownership	Data Assessment	Effort is wasted in single initiatives/projects as information is not retained and made accessible. Without some management of the data about data, information owners will duplicate activities or develop siloed approaches.	Actively support the introduction of enterprise data management tooling such as the Information Asset Register. Embed responsibility to maintain data related metadata within job descriptions to ensure that it is kept up to date.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Data is retained for longer than required	Embracing Data Ownership	Personal Statement	Increased financial costs and resource overhead to accommodate storage and transfer of large data sets. Degradation to system performance (load time / functional) due to increase in resource cost to perform system operations across large volumes of data. Reluctance to remove data as there is limited understanding of its criticality and importance to the business.	Review existing data retention policies for completeness and gaps. Where existing policies are fit for purpose, educate the business as what these are, where they can be found and how they should be applied in context. Where there are gaps, apply best-practice retention policy, document it and educate (as above). Implement inbuilt, supported capabilities to perform automated maintenance of data sets against an agreed set of retention requirements.	L
Lack of access to all flavours of ARS systems (e.g. Hitachi and POINTA) to ensure compatibility with the timetable can result in ARS systems being unable to operate.	Embracing Data Ownership	Data Assessment, Personal Statement	When operational ARS systems get out of step with the operational timetable, signallers lose trust in them and switch them off for safety reasons. There are many areas of the country which have ARS systems in place that have been switched off.	System Operator must take a clear position on what its role is with respect to control systems such as ARS. It should consider: • Formalise the existing 'Gold – paid for' and 'Silver – best endeavours' offerings as standard services that can be procured by the routes. This may require more options to be made available, especially if placed under a more formal, contractual framework. • Withdraw from managing ARS systems and pass this responsibility firmly back to the routes.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Access to trusted, authorised planning data is still a very paper-based process and not suited to the development of modern systems.	Unifying Data Platform	Data Assessment, Personal Statement, External Reports, Process	When different systems (IT and people based) are working from different versions of the timetable planning data the quality of the overall process, and therefore the quality of the end result – the timetable, will suffer.	A complete review of how consumers want/need to get access to timetable planning data needs to occur. The result is likely to be a new data portal that makes available, version controlled, datasets and offers access to real time planning data services. Ideally this would be the only place where planning data is retained. This assessment also needs to consider the non-system operator sources of data and seek to bring them onto the same platform.	H
The Network Code enforces the split between an RU and IM through rigorous and numerous information exchange points. This creates multiple opportunities for data to get out of step and lose quality.	Unifying Data Platform	Process	The greater the number of handover points and the use of multiple independent IT systems create an environment where data quality issues become more common and their impact more serious.	Whilst the Network Code enforces the contractual separation between parties, a more collegiate approach to planning, including a culture of shared risk and reward should be explored to see if changes to the code and processes would improve the quality of the timetable.	H
Lack of Scheduled Access information within the planning tools can lead to possessions conflicts within the timetable.	Unifying Data Platform	Data Assessment	Currently planners use the paper-based Engineering Access Statement to verify paths against planned (negotiated, not disruptive – i.e. STP restrictions) scheduled access requirements. Current planning tools may have annotated schedule access entries included but these are not fully trusted. The current process is susceptible to errors which lead to trains pathed through known possessions.	Address the known issues with how access planning is managed within Network Rail and ensure that identified CP6 business change programmes make data access and data governance for all consumers of the data a key driver.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Inconsistency between Planning and Train Control systems views of Timetable Planning Rules and Network Geography.	Unifying Data Platform	Data Assessment	When the timetable is developed against a different view of the world to that used by the operation Train Control systems (e.g. TMS, ARS and DAS) there will inevitably be instances where the train services will not operate as planned.	Incorporate strict version control of the key reference data sets. Publish these out in a more controlled manner which clearly states the approved current version being used. Note that this can be driven either from planning to operations or operations back into planning.	H
Train Association data is not adequately formalised within the data exchanges between Timetable Participants and Network Rail.	Unifying Data Platform	Data Assessment	Train Association data falls into two distinct uses. One is the operational train associations which link inbound and outbound services based on their stock/crew resources. The second is the passenger focussed ones which address joins/splits of services. Both are important to get into the timetable, but the passenger focussed ones are particularly important as they impact the provision of accurate customer information.	At present, associations are not consistently included within the timetable. Some operators provide Network Rail resources to manually update TPS with this data due to its importance. For other areas the associations can be determined from stock diagrams, but this can be time consuming and is subject to change. It is recommended that train associations data is fully incorporated into a modified path bid data structure. This will require an industry agreed, standardised data exchange specification to be developed and adopted. The goal is that train associations are supplied by the Timetable Participant at all stages of the planning process and incorporated directly into the Network rail planning system.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Inconsistency between operator and Network Rail views on Timetable Planning Rules and Network Geography.	Unifying Data Platform	Data Assessment	Occurs both during the WTT production and during timetable amendments. Whenever the base timetabling rules or geography get out of step, timetabling discrepancies will arise. This negatively impacts both the Network Rail and operator's planning processes and reduces the overall quality of the finished timetable.	Possible options are: • Adopt a single timetable planning solution which will remove the need for multiple reference data sets. • Incorporate strict version control of the key reference data sets. Publish these out in a more controlled manner which clearly states the approved current version being used. Mandate that incoming bids specify the reference version that they were built against and reject those not using the approved set. • Create a single shared data repository which can be interrogated by all planning systems to access rules and geography data.	H
It is not easy to access future views of rules and geography.	Unifying Data Platform	Data Assessment	The formal TPR and Sectional Appendix present a current view only. The future view is spread across local documents, emails and in people's heads. As such it is very hard for all relevant parties to have a consistent view of this and even harder to incorporate correctly into a federated set of planning systems.	Future TPR and Infrastructure changes should be collected in a consistent manner in a single place that is accessible to all relevant parties. It should also be made system ready by providing standard data services that use standard data formats.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Current practice to support multiple variants of the Station Working reports, plus various types of simplifier adds an overhead that detracts from other activities.	Unifying Data Platform	Data Assessment	Generation of flavours of train lists or simplifiers is currently seen as an overhead for the System Operator.	Two approaches should be considered: • System Operator could embrace this as a fully supported service and offer it as a value-add activity. However, it should be monetised as a pay-for-timetable service and the income used to develop the technology for a self-service timetable generation service. • Alternatively, System Operator can shut this down and concentrate on a couple of standard timetable formats which it will make available. Possibly consider newer transport generic formats. The consumer (including NR Routes) can then re-factor at their own cost to support their business needs).	H
Current Rollover process of using the last week from previous timetable as the basis for the new timetable creates a sub-optimal baseline due to seasonal variations and a failure to take account of timetable variations.	Doing Things Differently	Process (PWTT Production)	Rolled over timetable may not be a good representation of the next timetable period, particularly for the December timetable due to seasonal impact at end of previous timetable. Operators will be less inclined to bid amendments only if the PWTT is not considered a good starting point.	Investigate how close the PWTT was to the final TT at D-26. Look at alternative approaches to produce the PWTT and see if these can provide an output that is closer to the D-26 TT. This should include consideration of the NTF-OG Baseline Timetable Working Group output from 2016.	M
Rollover process involves manually re-dating all paths which is tedious and prone to errors, although not excessively time consuming.	Doing Things Differently	Process (PWTT Production)	If path dates get misaligned during the rollover process, then this adds further effort in addressing by both Network Rail and Operator planning teams. Any loss of quality of the PWTT is compounded if the operator is maintaining their own version.	Automate the rollover process or change the process to negate the need.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Lack of clarity over how the rollover process is undertaken means that Timetable Participants cannot easily determine which timetable variations were included in the rollover.	Doing Things Differently	Data Quality	Timetable Participants need to manually compare the PWTT against the current timetable to identify path variations and include any missing ones in the PDNS. If this is not done correctly paths can get missed from the PDNS bids.	If the current rollover process remains as is then there should be a freeze notice issued as soon as the rollover week is agreed (approximately D-52) to say that the current timetable at that point will be used. This will allow Timetable Participants to have confidence over what is in and what is out of the PWTT in terms of variations.	L
Timetable Participant's response to PWTT is inconsistent. Some submit amendments whilst others submit whole timetables.	Doing Things Differently	Process (PWTT Production)	Current inconsistent process makes it difficult to size up the resource needs within the planning teams.	Review the PWTT process with the operators to identify options for the development of a better baseline timetable.	M
Long-term planning bids and timetable amendment bids are managed in different ways which increases complexity and reduces flexibility of timetabling resources.	Doing Things Differently	Process (Process Access Requests, Timetable Variation)	There is a mix of use of F3 style train amendment requests and electronic (PEX) bids used by Timetable Participants which appear to be largely a legacy issue. This limits the ability to introduce more automated bid checking (e.g. DSEA only used for spot bids) and also embeds a culture of difference between long and short-term planning.	Create a single unified bid/offer process that works for both Network Rail and the Timetable Participants.	H
From a Timetable Participant's perspective there is insufficient time to respond to the PWTT.	Doing Things Differently	Process (PWTT Production)	If the operator is rushed, due to difficulties in flexing their team resources, then the quality of the initial bids at D-40 may be reduced.	Review the PWTT process to see if there is better way to allow planning teams to develop the initial view more collaboratively over a longer timeframe. This should include consideration of the NTF-OG Baseline Timetable Working Group output from 2016.	M
Some operators develop their own PWTT in advance, and independently, of the Network rail publication.	Doing Things Differently	Process (PWTT Production)	Whilst done to smooth out the process, this could lead to the formal PWTT being different from the operator's expectation and could lead to incorrect PDNS being submitted if timetables get out of step.	Review the PWTT process to see if there is better way to allow planning teams to develop the initial view more collaboratively over a longer timeframe. This should include consideration of the NTF-OG Baseline Timetable Working Group output from 2016.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Poor quality PDNS bids puts an overhead on the NR planning team to interpret and resolve.	Doing Things Differently	Data Assessment, Personal Statement	Inconsistent use of the PEX file, in terms of the completion of all data fields, combined with the need to incorporate other data from supplied stock diagrams increased the WTT planners' workloads and requires a level of interpretation and inference that could lead to misunderstanding and a reduced quality response to the operator.	Replacing the PEX file format with a new standard based on the TAF TAP TSI regulatory data exchange structure would provide an opportunity to redefine the data exchange contract between Timetable Participant and Network Rail.	H
All path changes must be bid in the same way. There is no accelerated process for ones that have no timing related changes.	Doing Things Differently	Process (Train Operator Variation)	Whilst the single process provides greater control, it also creates a burden on the NR planning team to process and validate paths with no timing impacts.	This can be addressed in several ways as follows: • The NR planning system could recognise such bid paths and automatically approve them. • Access could be given to the Timetable participant to update these paths directly within the Network Rail planning system. • Such date could be removed from the planning process and held by the Timetable Participant. The responsibility would then fall to them to incorporate it at the point of advertising services to the public.	M
Bidding of plans in work packages causes tracking issues for NR long term planning staff.	Doing Things Differently	Data Assessment	When a Timetable Participant has agreed with the DFT to bid in work packages, the PDNS process cannot carry that logic through and therefore it becomes difficult for Network Rail planners to confirm that the work package is fully covered in the bids.	The current process has no concept of work packages and indeed it is not clear what Network Rail's responsibility is to verify that a Timetable participant has covered the full scope of a work package in their bids. Confirm the Network Rail responsibility and incorporate into a revised bid process.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
The sheer volume of paths processed under the timetable variation process overloads the planning teams. It is also unclear whether senior management and the DFT fully appreciate how many changes are being made at this stage.	Doing Things Differently	Data Assessment, Personal Statement	A Timetable Participant may bid more than 1000 variations per week to deal with scheduled access, stock moves, driver training, special events, etc. This volume of change, condensed into a few days, requires teams to prioritise on critical pinch points in the network at the expense of doing all checks. As a result, some issues will get through.	This whole process needs to be re-assessed to determine whether things can be done differently. Possible options would be to introduce more automated data exchanges, create closer NR and Operator teams, or allow more immediate path validation to allow the Timetable Participant to self-validate and approve paths.	H
Timetable variation offers are specific to a Timetable Participant.	Doing Things Differently	Data Assessment	A Timetable Participant can only see the responses to their timetable variation bids. In areas of shared operator use the Timetable Participant's view of the evolving timetable will not show other operator's revised paths and they get only a partial picture. This can lead to a sub optimal process.	Where a route agrees, there should be a way to provide access to the complete evolving working timetable so that all changes can be seen. How this might be achieved may be complex and may also introduce more complexity dependent upon the behaviours that it could drive so further work is advised on this.	H
Customer passenger and freight information does not feed into the timetable planning process.	Better Data, Better Timetables	Personal Statement	If train planning understood the passenger loading ratios or the value of the freight being transported then different planning approaches could be employed to develop a higher valued timetable.	Identification of the master sources across the industry for this data and industry agreements for its sharing and use would allow the System Operator to assess whether it could be incorporated into the planning process.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
The variability of quality of incoming PDNS bids puts an overhead on the NR planning teams.	Better Data, Better Timetables	Data Assessment, Personal Statement	Whilst the structure of the PDNS pack is followed by the operators the quality of the supplied PEX file varies such that it cannot be loaded into TPS through the automated DSEA service.	Working collaboratively with the industry, a review of the current variability in quality of incoming PDNS bids is required to understand why this occurs and to quantify the impact on the overall planning process. On completion a consensus on a way forward to improve the handling of the initial bids as part of the overall long-term timetabling process is required. Possible options that should be examined are: • Adoption of a shared timetable planning system to allow operators to enter bids directly into the system and therefore remove the current PDNS exchange mechanism. • Redesign the current process to smooth out the current peaks in processing between parties and strengthen up the data quality accountabilities. • Strengthen the existing controls on data quality through the data exchange process to catch data quality issues earlier. • Develop new tools to provide greater visibility to timetable participants of the progression of their bids through the timetable planning process and enable earlier visibility of issues.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Timetable Planning Rules can be complex and difficult to interpret consistently.	Better Data, Better Timetables	Process (Planning Rules Management)	Automation of rules validation is difficult to achieve. Complex rules require more training to understand. New or unfamiliar train services may be planned incorrectly. Complex rules provide more scope for challenge from operators.	Put in place a simpler framework for timetable planning rules that is 'IT Friendly'. Store all TPRs electronically and publish from this to timetable planning systems (NR and Operator). Retain TPR documents for general access but create from electronic TPR master repository. Coupled with the above, there is a need to review the current levels of competence within the planning communities understanding of planning rules and their meaning, providing additional training where needed.	H
Sectional Running Times are well understood but known to be inconsistent. A better way for the industry to manage SRTs, both in terms of their definition and the process for change needs to be agreed.	Better Data, Better Timetables	Data Assessment, Process (Planning Rules Management)	SRTs form the basis for how paths are planned, both in planning and operational systems. As such they have a significant contribution to how well the plan reflect the real world. If they are wrong, then the plan is going to function badly.	The industry approach to SRTs and their amendment needs to become more flexible and open to support rapid changes, based on standardised evidence. Long term the use of TRT's needs to be explored and demonstrated to see what data is needed to support them.	H
It is not possible to verify the timetable against the operator's access rights.	Better Data, Better Timetables	Data Assessment	The lack of any structured, accessible access rights data makes it very difficult to validate the timetable against the operator's access rights.	Create a systemised 'Access Rights' database and information services to facilitate their exploitation within other IT systems.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Where Timetable Participants are building future timetable's that incorporate new stock, they need to create their own version of the SRTs based on an expectation as to what Network Rail will accept.	Better Data, Better Timetables	Data Assessment	Creation of multiple versions of the SRT data repository creates a high risk of mismatches between the Timetable Participant's and Network rail's planning system. This is compounded where a planning system maintains the SRTs, timetable planning rules and geography as a single reference data set as the scope for variation between systems is increased.	Review the process for changing SRTs to speed it up. Potentially add an option within the formal timetable planning rules to include candidate SRTs so that they can be used consistently across planning systems. Specific to the ATTune timetabling product, look to split out the SRTs from the base geography to allow for a more limited set of localised data.	M
The quality of network geography that underpins the current planning tool limits the ability to produce safe and achievable timetables and is likely to be a bigger limitation as operation control systems develop.	Better Data, Better Timetables	Data Assessment, Personal Statement, External Reports	Without a view of the underlying network geography that matches the physical network, the timetable will inevitably include errors, some of which have safety implications.	Network Rail has a detailed asset focussed view of the network and efforts need to be re-doubled to find a way to make that model fit for purpose to support planning's needs. This issue will become more important if we are to move towards more accurate timetables based on the physical characteristics of the track and train. i.e. technical running times.	M
The newer digital railway traffic management and ETCS signalling systems will require a timetable that understands the geography and train behaviours in a more sophisticated way that used today.	Better Data, Better Timetables	Personal Statement, External Report	As the railway moves progressively to an automated system; there will be a greater dependency on a high-quality data-driven plan. There is a likelihood that this issue will be exacerbated over time.	Review the timetable content against the requirements of automated railway systems to identify gaps and to inform the structure of a next generation timetable. Some specific example that have been identified as part of this analysis are: • Trusted geography and model train data will be required to support ETCS traffic management control systems. • Review timetable planning rules to ensure that they align with operational use of new technology such as connected driver advisory systems.	H

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
The base timetable creates opportunities for unsafe scenarios to arise during operations.	Better Data, Better Timetables	Personal Statement, External Report	Implications on operational safety and performance. Signallers are required to manually intervene to correct the plan on the day of operation; safely re-routing trains and amending the plan to be operationally viable. This poses unacceptable risk to the safe operation of the railway; relying on the signaller, as a last line of defence, to manually detect defects in the plan.	Engage with the signalling community further to identify specific issues that are known to cause downstream operational problems such as: • Ensure ARS limitations are made clear in TPS, and reflected in the Timetable Planning Rules, to assist planners with producing a plan that is operationally viable. • Require planners to populate relevant route codes within TPS, rather than manual noting instructions to signallers on station simplifiers • Review Platform Length values to ensure that they are in line with operational use.	M
Timetable variation bid quality is variable with some key data fields incomplete.	Better Data, Better Timetables	Data Assessment	It was reported that some variation bids miss out key data such as platform and sub platform codes, freight RT3973 and Train Length information. This causes increased workload on Network Rail planners in an already compressed process.	It is recommended that the industry look to adopt more automated timetable variation processing. This should be based around the European TSI bid/offer specification. Responsibility for providing complete datasets will be defined and enforced through validation of the bids with real time feedback given to the Timetable Participants.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Operator access rights are recorded outside of the planning process.	Better Data, Better Timetables	Process, Data Assessment	The System Operator must endeavour to accommodate all access proposals (Network Code D4.2.2). Where this cannot be met due to the capability/capacity of the network planners must priorities path allocation based on the Operators access rights. Retrieving the access rights information is currently a time consuming and manual activity and open to misinterpretation that could result in poor decisions being made. Verifying that the timetable treats all operator's fairly and in accordance with their firm and contingent access rights is done manually and based on planners' knowledge rather than built into the timetable planning rules dataset and planning systems. As such checks may not get made correctly or at the right time.	The access rights should be codified and included as a formal part of the timetable planning rules. Such codification must take account of both firm and contingent rights and needs to cater for both specific and quantum definitions. Where possible, these rules should be incorporated into automated timetable compliance checks.	M
Freight Train Load and Length Limits not being maintained.	Better Data, Better Timetables	Data Assessment	The Freight Data Load books are out of date and as such not being used. These are a formal part of the Timetable Planning Rules and relying on local team knowledge creates a risk of error.	It is recommended that a formal data contract is agreed between the routes and System Operator to provide this data, to an agreed level of quality, and in a suitable format that will allow it to be stored within a codified TPR database. From here it can be made accessible to planners and should be incorporated into automated timetable planning checks.	M

Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Platform Limits are not well understood and have different meanings to different teams within Network Rail.	Better Data, Better Timetables	Data Assessment	Dependent upon whether you are maintaining the platform as an asset, managing a station or planning a timetable the meaning of platform length can be different. This ambiguity can lead to incorrect data being recorded and used in an inappropriate manner which can lead to poor operation of the timetable.	The operational planning community needs to provide a clear definition of the data specification for Platform Length for planning use and distinguish it from other uses. In conjunction with the route asset managers a review of platform lengths needs to be undertaken and if required added as a responsibility of the route professional head to update their data specification and enforce the gathering and maintenance of this data.	M
Sectional Running Times calculations do not always match the definition	Better Data, Better Timetables	Data Assessment	The formal definition of an SRT states that it is the fastest time between two points, however this does not reflect the real driving behaviour and instead where data is available a measure of the 25 percentile is used.	Recommend updating the formal definition to reflect the use of observed train running information.	M
Planning data does not incorporate EU TSI regulatory data structures.	Better Data, Better Timetables	Data Assessment	Under GB law Network Rail and Timetable Participants should be able to exchange data using the TSI standards. However specific TSI data structures (e.g. Operator Codes, and Primary Location identifiers) are not commonly supported.	Adoption of TSI data standards and structures must be built into all future data sharing work, in accordance with GB law and NR IT policy.	M
Timing load approximations in use.	Better Data, Better Timetables	Data Assessment	The use of timing loads underpins the current sectional running time process; however, it is quite a crude approximation for the operational performance of a train and in many instances will not match the actual train performance. This can be an issue if the approximation results in a train service not being able to meet its timetabled commitment.	Work to assess and plan a move away from sectional running times to theoretical running times which are based on modelled train and track capabilities will provide a resolution to this issue but will also create significant new data challenges.	H

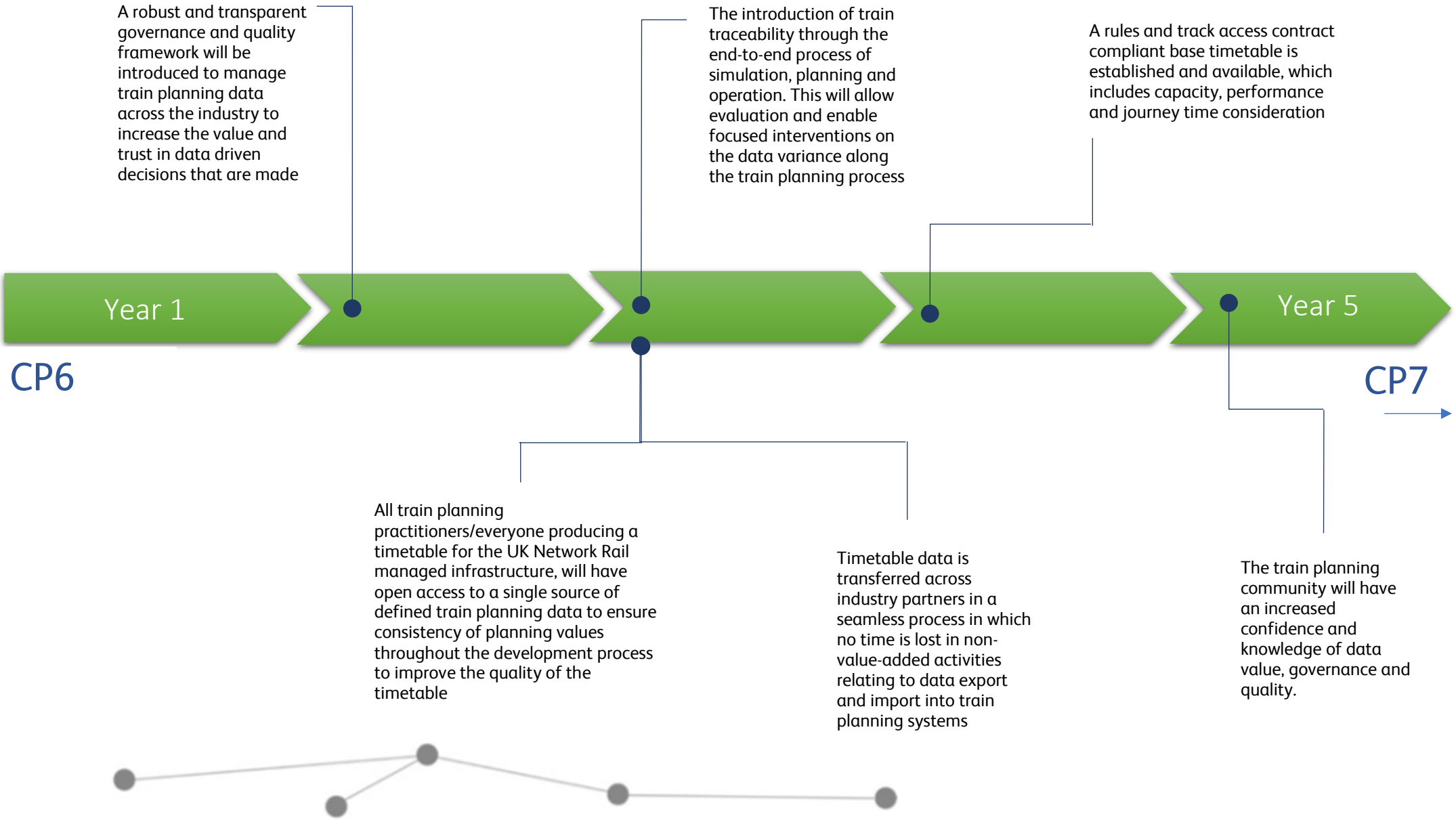
Problem Statement	Theme	Source	Impact Statements	Options	Scale of Change(L/M/H)
Limitations in timetable planning tools requires human workarounds.	N/A – This is a system problem rather than a data improvement related one. Included here for completeness.	Data Assessment	There are several known limitations within planning tools used in the industry that require manual intervention to correct. Some examples are below but others will exist: • TPS requires does not manage BUS paths well and requires them to have a platform/line which makes no sense. • TPS does not interpret '*' activity codes correctly which can require manual corrections. • VoyagerPlan cannot load back in amended offers automatically so they are done manually.	Work closely with the industry to identify and capture known system/product limitations, possibly through an industry technical group. Assess known limitations to identify the cost vs benefit metrics and actively address those where industry value can be demonstrated.	M

Target State

Following the initial internal review of the draft Data Architecture Reference Model, a workshop was held on the 10th April 2019 to agree a Network Rail Capacity Planning consensus view on a 'to-be' state for data within the industry timetable planning process. The workshop featured representation from senior business leaders in Capacity Planning (or appropriate delegation) to gather an agreed *business* view, prior to external review and presentation at OPSG (Operational Practitioner Steering Group).

The output of the workshop was used to form a set of high-level target 'outcomes' across CP6, which will help shape the mandate for the System Operator Data Improvement Programme. These outcomes have been articulated by Capacity Planning and presented in a roadmap view below with indicative milestones upon which they are targeted to be realised by.

Outcome Roadmap



Appendix A – Interview List

Company	Team	Topic Covered
NR	System Operator – PSS-Team	Timetable Geography Management
NR	System Operator – LTP – Western & Wales	New Working Timetable, Timetable Variation
NR	System Operator – LTP and STP – Freight & National	New Working Timetable, Timetable Variation
NR	System Operator – STP- LNE and Wessex	New Working Timetable, Timetable Variation
NR	Safety, Technical & Engineering – Information Governance	Data Governance
NR	System Operator – Publication	Sectional Appendix
NR	System Operator – Observed Data Analytics	Timetable Planning Rules
Train Operating Company (x2(	Train Planning	New Working Timetable, Timetable Variation
Freight Operating Company	Train Planning	New Working Timetable, Timetable Variation
Bellvedi	ATTune Product Development	New Working Timetable, Timetable Variation
NR	System Operator – TPR Specialists	Planning Rules Management
NR	Route Businesses – Freight Access	Freight Data Load Books

Appendix B – Glaister (ORR Report)

Statements from Glaister that call out Data in the context of the May '18 timetable disruption.

24. page 11 – The Interim Report identified inadequate provision of passenger information during the disruption as one of the key failings. Passengers did not have the necessary information to be able to plan their journey with confidence or understand what the real-time status of their journey was….

25. – page 12 – The Interim Report findings have also revealed questions for the broader industry. The provision of good quality information requires successful collaboration and integration between many parties, each of whom must be clear on their role in various complex scenarios. Operators may not always consider the quality and usefulness of the information actually received by passengers, either online, on trains or at stations.

38.- page 14 - The Interim Report identified inefficiencies within the timetabling process, in terms of collaborative working and the use of technology. Although they were not direct causes of the disruption, data handling and integration processes compounded the inability of SO and train operators to recover planning timescales in time for the timetable change.

42. – page 14 – The Inquiry recommends that the System Operator review the progress of a trial with Abellio Scotrail to provide greater access to the planning system. Where benefit exists, the System Operator should roll this trial out more widely (in terms of participants and other opportunities) across the planning activity in the first year of CP6 to provide a wider industry benefit, and report on this in its annual narrative reporting.

2.60 – page 49 – The Inquiry found that collaboration and interaction across the timetable process was somewhat limited by the available timetable planning systems and data. Discussions with Network Rail and operators have highlighted three underlying challenges that must be addressed to improve the current position: a lack of a consistent database all parties use to plan timetables, a lack of integration between systems, and issues with the data handover points.

2.61 – page 49 – There is no unified dataset on which all industry train planning activity is based. Such a dataset would hold, amongst other things, the authoritative position of the track layout of the railway, how long it takes trains to cover sections of track, and the rules about how trains can use the infrastructure.

2.62 – page 49 – The absence of a unified dataset means that mismatches between individual operator and Network Rail datasets can occur, meaning that operators and Network Rail can be planning train services based on different assumptions. These mismatches lead to avoidable rework of timetabling proposals and inefficient use of the scarce capacity of timetable planning resource.

2.63 – page 50 – In addition to the lack of a version-controlled and uniform dataset, the industry has built up a network of non-integrated timetabling systems used to plan trains. Passenger and freight operators generally use one of the Voyager Plan, Train Plan, ATTune or TPS systems to produce their timetables, whilst the SO uses TPS. Transferring data between these systems can require a high level of manual intervention and, in the worst case, manual data entry.

2.64 – page 50 – The timetable development process is not underpinned by specific data standards or regulations relating to the type of data the systems generate. Additionally, Part D of the Network Code5 sets out the minimum information an access proposal is required to include, but not the format in which data should be provided. The lack of an agreed data transfer format between systems has caused three main breakdowns in the process:

- *Operators provide datasets in varying formats which are not transferrable into the SO TPS system. These datasets require manual file transfer or input by the SO.*
- *Data from the Network Rail possessions planning process is not structured in a digital format and requires significant human intervention to format it for both the SO TPS system and train planning systems of the operators.*
- *The outputs of the SO TPS is not always compatible with operator systems. This requires further manual intervention to make them useable by the operator.*

2.65 – page 50 – The challenges of not having a uniform dataset, a lack of integrated systems, and no standard way of transferring data between systems have implications upon the ability of the industry to deliver timetable change. Network Rail estimates that roughly 10% of industry train planners' time is spent undertaking avoidable manual data activities to compensate for a lack of integration and for ensuring uniformity of data. We have not verified whether this figure is accurate for operators, but evidence we have received from operators notes that data quality also causes them integration issues, requiring manual rework. As well as the time taken to input data, manual intervention also carries the risk of inserting new errors into the data transfer process. Across an industry of over 650 planners and a further 150 support staff, Network Rail estimates that this would equate to approximately 100,000 employee hours per year that could be reinvested into improving the quality of the train plan6 through engagement and collaboration with the operators.

2.67 – page 51 – The data improvement programme will work with operators and across Network Rail to improve the quality of train planning data, how it is exchanged between parties and how it is used in the timetabling process.

2.68 – page 51 – The programme aims to create a unified track layout, timings and rules database, on which all train planning across the industry is based. This database will have version control, and temporary standalone sandbox functionality to enable industry parties to test proposals at an early stage before they are used in the formal train planning process.

2.69 – page 51 – Additionally, the programme aims to enable the seamless transfer of electronic timings data between industry parties through the introduction of a common data transfer standard. Whole industry access to a standard set of information will improve the interaction between industry parties and reduce the need for rework as data passes between industry systems.

2.70 – page 51 – One of the main aims of the better access planning programme is to produce possession data in a structured, digital format so it is easily imported into train planning systems. This will help address the current issues with data exchange and the subsequent level of manual intervention that is required.

2.72 – page 51 – In addition to the challenges encountered with the underlying dataset, there are opportunities to use existing but unused system functionality to enhance the planning process. The SO has proposed to review how it might activate some of that functionality once the quality of the baseline dataset is improved sufficiently.

2.73 – page 52 – The SO has begun a programme to use more of the functionality available in the TPS system. Using the full functionality would materially improve the efficiency and effectiveness of the timetabling process through, for example, the reduction in manual data checking. As TPS has approximately 225 system interfaces across the industry7, the SO must work collaboratively with the industry to make this programme a success.

2.74 – page 52 – An example of the unused functionality is that the TPS software has the ability to detect train service conflicts automatically. A trial in 2014 of the line of route between Oxford and Birmingham highlighted that the functionality could be applied and materially improve the accuracy and speed of development of the timetable. In order to use this functionality, the SO will work with operators to improve the quality and detail of the train planning dataset over the course of CP6.

2.78 – page 52 – Better collaboration between the SO and operators has the potential to streamline the timetabling process. Where there is no impact on the commercial or competitive outcomes for other operators, allowing an operator to take responsibility for activities presently undertaken by the SO will reduce the reliance on the need for system integration and deliver benefits through the removal for the need to double-handle data and protect planning time for value-adding activities.

2.79 – page 53 – The SO and Abellio ScotRail have confirmed that they have initiated a trial to streamline planning processes through improved collaborative working and the sharing of TPS access. The pilot is expected to 'go live' in early 2019 following the completion of technology testing and staff training.

2.80 – page 53 – The SO has confirmed that the pilot will share write-access to TPS with Abellio ScotRail, the main train operator on the Route, for a controlled data subset of the station workings at Glasgow Queen Street. In providing access, the SO must be alert to its obligations to maintain fair and equal access for all parties to train planning services, and ensure that Abellio ScotRail does not gain an unfair advantage over

other operators or receive access to confidential information. This access is therefore being given with access limitations, a ruleset and assurance process to ensure Abellio ScotRail acts only within the area that it is responsible for. The SO has confirmed that this access trial is intended to reduce the double handling of planning activity and data, and also allow the operator to quickly make changes to data that would be of a lower priority for the SO, thereby better balancing the accountabilities of the SO and operators, improving the quality of information and streamlining this part of the timetabling process.

1.52 *– page 62 – Timetable changes can be reliant on a cascade of rolling stock from one operator to another. With the introduction of new technologies comes an additional element of risk. The new trains entering service across the network are increasingly reliant on new technologies that integrate track, signalling and train control systems.*

1.53 *– page 69 – When approaching the introduction intro service of a major network change, which relies on the delivery of multiple projects or programmes by different parties, active management of the transition from the project state to the operational state is crucial. It requires integration of technical systems, human processes, planning and testing before operation can successfully begin*

Document Control

Version	Date	Comment
0.1	31/03/2019	1st draft. Still some minor additions required but minimal viable product for discussion.
0.2	03/05/2019	Issued formally for internal/external review.
1.0	23/05/2019	Updated with internal/external review comments.

Table 2 – Document Control

References

Referenced documents are held by the data improvement programme team and can be provided on request if not publicly available.

Ref	Location
NR1	Timetable Planning Rules Production and Publication Process
NR2	Capacity Planning – Timetable Geography
NR3	PIF Specification
NR4	Leeds Station Platform Assessment
NR5	WTT Process
NR6	Network Rail Variations Requests TW12 https://pco.hub.networkrail.co.uk/PCOProcess%20Documentation/Forms/AllItems.aspx
NR7	STP Planning Process https://pco.hub.networkrail.co.uk/PCOProcess%20Documentation/Forms/AllItems.aspx
NR8	Hitachi CP6 Data Improvement Programme Industry Engagement Report
NR9	NR Knowledge Information Data Strategy
NR10	http://d3cez36w5wymxj.cloudfront.net/wp-content/uploads/2019/02/01160753/Williams-Rail-Review-what-do-passengers-want.pdf
NR11	https://orr.gov.uk/__data/assets/pdf_file/0010/39916/inquiry-into-may-2018-timetable-disruption-december-2018-report.pdf
NR12	Associations Review 2017
NR13	WSM Industry Planning Alignment process maps
NR14	DR RDG Conops – Stock and Crew System V1 0 0418

Table 3 – References

Glossary

Acronym	Meaning
ADB	Assurable Database (ATTune)
AIS	Asset Information Services
ARS	Automatic Route Setting
DAS	Driver Advisory System
DPPP	Draft Periodic Possessions Plan
DSEA	Data Staging Evaluation Area
CIF	Common Interface File
CPPP	Confirmed Periodic Possessions Plan
EAS	Engineering Access Statement
INM	Infrastructure Network Model
NESA	National Sectional Appendix
NOSC	Notice of Significant Change
ODA	Observed Data Analytics
OPSG	Operational Practitioner Steering Group
PIF	Public Access Planning Interface Definition

PDNS	Priority Data Notification Statement
PON	Periodic Operating Notice
PSS	Planning Systems Support
PWTT	Prior Working Timetable
SCS	Strategic Capacity Statement
SRT	Sectional Running Time
TAF	Telematics Application Freight
TAP	Telematics Application Passenger
TCAG	Timetable Change Assurance Group
TCRAG	Timetable Change Risk Assurance Group
TMS	Traffic Management System
TOVR	Train Operator Variation Request
TPS	Timetable Planning System
TRT	Technical Running Times
TSI	Technical Specification Interface
WON	Weekly Operating Notice

Table 4 – Glossary