1. CONFIDENTIALITY

A fundamental requirement of the procurement process is that tender information is kept confidential at all times. No team members or stakeholders are allowed to communicate these technical specifications to anyone outside of the process.

2. GLOSSARY OF TERMS

Term	Description
Ad-hoc Trains	Once-off trains that are not pre-defined in the resourced base train plan, nor have a supporting slot in the MTS or have pre-defined service specifications. These trains are required to address special conditions that could not be identified and/or defined during the base train planning process.
Approach Paper	A Document that describes the approach / philosophy that is followed by the bidder when developing a specific solution function.
Auxiliary Equipment	Equipment used to fasten or secure a load to a wagon, including tarpaulins, chains, wedges, canopies, etc.
Availability	A resource is deemed to be available when it possesses the quality of being able to be used or obtained.
Backlog Orders	All confirmed orders that deviated from plan in the preceding production plan period and have to be catered for in the next production plan period.
Balanced Train Plan	A train plan that ensures equal number of trains in opposite directions.
Block Swapping	Block swapping refers to the transfer of a block from one train to another train at designated train set-out yards without the need for the block being swapped to be reclassified (shunted/marshalled/etc.) at these set-out yards.
Blocking rules	Blocking rules are the parameters that guide the compilation of the blocking plan. Defined as follows, but are not limited to: • Which commodities can travel together in a block, • Train Compilation Rules, • Day/night train running constraints, • Wagon Types / Commodity Compatibility Rules, • Routing rules and constraints, and • Rail Safety Rules.
Book-off crewing strategy	Crew working strategy where crew from their respective home depot's sign off at another depot after completing their trip. Such crew will sign on at the foreign depot again after resting, to return to their Home Depot on another shift. Such strategy is usually reserved for crew which cannot complete all their trips within a normal shift due to distance and time constraints.

Term	Description
Business Model	A statement of the way in which a company intends to be operated, what its main goals are, how much money it will take to achieve the goals, what activities will be performed and what investments will be made to achieve the goals.
Capacity of a resource	The total available quantities and performance capabilities of a specific resource type over a specified period.
Capacity Planning Process	The process of determining future required capacity for a given demand scenario, including the identification of capacity constraints and scenario testing of potential solutions (both greenfield and brownfields) to address current constraints and bottlenecks.
Commercial Solution	Transnet Freight Rail's commercial management system including all commercial and customer-facing processes from a customer lead to an invoice.
Commodity Master Data	Defines the specifications and characteristics (unit of measure, density, hazardous classification etc.) of the goods which can be transported.
Confirmed Orders	Demand do-ability assessed, specific slots and resources allocated, Production Plan published.
Conflict	Any incompatibility encountered during the optimisation of train scheduling, when one or more constraints are violated.
Constraints of resources	Is anything that restricts the optimal planning and execution of the train plan.
Crew Management Solution	TFR's Crew Management solution that deals with detailed legislation-compliant crew rostering per depot / section (includes train drivers, assistants and shunting crew).
Cross Point Crewing Strategy	Crew working strategy where train crew crosses on the route with a train from an opposite direction and where train crews are transferred to the opposite train, to return to their respective home depots from both sides. Both crew signs on and off duty at their respective home depots.
Customer Engagement and Experience (CEE) Program	A program that is executed to enable the effective management of the commercial solution for TFR.
Customer timetable	A timetable that incorporates scientifically derived tolerances per rail network section/section in the schedule and meant for customer consumption.
Demand	Demand includes everything that can consume slot on a section, including external customer demand, internal demand (e.g traffic moved on behalf of

Term	Description
	other operating divisions), intra demand (e.g. infrastructure material delivery trains, Rail Road Vehicles, Trolleys, etc), and third party slot demand (e.g. PRASA passenger trains) and resource distribution slot requirements, but excluding planned occupations.
Demand Do-ability	The process whereby demand or validated customer orders are matched to available resources based on their capability, position and status in order to produce (a) the Resourced Base Train Plan and/or (b) the Production Plan
Demand Prioritisation Rules	Commercial's methodology used for ranking demand to determine which demand carries a higher priority and which carries the least. These rules are useful when allocating capacity to demand/customer orders during the production plan compilation process.
Demand smoothing	The shifting of demand from periods of overextended production capacity to periods of undersubscribed production capacity.
Deviation	Deviations occur when the difference between actual and planned performance is bigger than the pre-determined thresholds.
Dwell Time	Scheduled waiting time *en route* or at a depot / yard for a specific rolling stock asset.
Earnings Before Interest, Tax, Depreciation and Amortisation (EBITDA)	Total revenue generated from operations, minus total operating costs, before deduction of interest cost, taxes, depreciation and amortisation.
Electrical Demand	The instantaneous amount of power required for moving a train over a given network layout measured in Kilowatts.
Evaluation Criteria	Criteria per capability that are important to TFR. Some evaluation criteria are mandatory.
Execution Monitoring & Deviation Management (EMDM)	The monitoring and control of adherence to the Production Plan, assessment and management of the impact of all deviations.
Gross Ton Kilometres (GTK)	Gross Ton kilometres is an indicator that is used to measure rolling stock productivity. It is one of the parameters used to compare the overall efficiency of different scenarios. GTK is computed by multiplying total train mass (excluding locomotive mass) by total distance travelled.
Headway	The average interval between trains.

Term	Description
Hypercare	It is the period of time immediately following a system Go Live where an elevated level of support is available to ensure the seamless adoption of a new system.
Incident	An undesirable occurrence that may or may not result in operational disruption.
Infrastructure Maintenance standard	Maintenance standards defined on the asset management system.
Infrastructure Manager	The Infrastructure Manager owns and maintains the infrastructure, defines the slots on the infrastructure and manages the selling and contractual agreements with the Train Operators and maintains and publish the integrated MTS and Production Plans.
Infrastructure Occupation Management Solution	The solution used by TFR to plan, manage and execute infrastructure occupations.
Integrated Incident Management Solution (IIMS)	The Transnet Freight Rail System that is used to report rail incidents/occurrences.
Key Performance Indicator (KPI)	Key Performance Indicator, used to measure the effectiveness and efficiency of operational performance. A quantifiable measure used to evaluate the success of a system or process in meeting objectives for performance
Less- than- unit-traffic	A grouping of traffic that uses less than the capacity of a full train, possibly resulting in multiple consignments on one train.
Local Schedule	Schedule that covers all train movements within rail complexes (geographical grouping of yards and sidings).
Local Train	Train that moves from yard to siding / port or from siding / port to yard to place and/or collect wagons.
Location Master Data	Defines the design, specifications characteristics and capabilities of a specific location.
Logistics Services	Additional logistic services required to provide a complete service to the Customers e.g. warehousing, storage, transhipments, loading and off-loading services, crew transportation and cleaning services.

Term	Description
Logistics Support Equipment Capacity	All equipment required for the operation of trains, namely auxiliary equipment (e.g. tarpaulins), train equipment (e.g. telemeters), wagon facilities (e.g. cleaning facilities) and locomotive facilities (e.g. fuelling facilities).
Locomotive Allocation Rules	Rules that take into account train technical operating instruction that stipulate the number of locomotives, by type and class, required to haul a train of gross mass tons over a specified route. These rules include constraints for allocating locomotives to operational areas and to flows, e.g. Export Iron Ore ring-fenced locomotive fleet, Train Crew Qualification considerations.
Macroscopic Infrastructure Modelling	Macroscopic infrastructure modelling is in contrast to microscopic modelling contains a more abstract view of the infrastructure where, for example, details on section speed and gradient are not modelled, but rather a node-link-node model of the infrastructure is modelled.
Mainline Train	Train that moves from hub to hub on the mainline.
Mandatory Evaluation Criteria	Evaluation Criteria that are the absolute minimum requirement to proceed to the next stage of the evaluation ("must have" criteria).
Mandatory Trains	A list of trains e.g. PRASA, long distance and commuter that are allocated to specific slots.
Master Train Schedule (MTS)	An optimal train timetable (menu of possible slots) based on Rail network configuration, train configuration, method of train control & authorisation and Value Chain Partners' capacities and constraints.
Maximum train slot capacity percentage rules	The operational slot capacity of a section or sub-section as a percentage of the theoretical slot capacity. The percentage will depend on the defined operational slot capacity percentage rules, overall line layout, efficiency, risk profile and maintenance requirements.
Meet-and-Pass Plan	The plan provided to the Centralised Traffic Control (CTC) offices to manage crossing and passing of trains during execution based on status, prioritisation of trains, and applicable train working rules. Other interested parties could view the plan for planning and execution purposes.
Incident Notification	All incidents logged in the Incident Management Solution that can potentially impact any part of the Production Plan (Mainline, Yard and Local schedules).
Microscopic Infrastructure Modelling	The modelling or building of the railway infrastructure complete with the minutest detail where track information such as gradients, radii curvature, section speed, signalling system detail and track distance or kilometre points are all taken into account.

Term	Description
Moving Block Signalling	Moving block signalling is a signalling block system where the blocks are defined in real time by computer software as safe zones around each train.
Navis	TFR's Container Terminal and Port Operations Management System.
Neighbouring Railways	These are over border railways in countries that directly share borders with South Africa.
Network Capacity	Percentage availability of the rail network for the operation of trains after consideration of speed restrictions, scheduled maintenance and reliability factors.
O-D Pair	Combination of the Origin Location and Destination Location.
On-Time Placements	The measurement of Wagons placed at required locations within a pre-defined time window (e.g. Day, 6 hours, 1 hour) as planned.
On-Time Train Performance Measure	The measurement of train execution times compared to the published PP based on predefined time windows (e.g. 30 minutes, 15 minutes).
Operational sites	Any area in which TFR operates or interfaces with that can constrain capacity within supply chain operations and includes but are not limited to Customer sidings, Over-border Railways, Third Party areas, Terminals, Yards and Ports.
Operational Slot Capacity	The operationa slot capacity, which includes recovery slots, is determined by multiplying the theoretical slot capacity with a utilisation factor to cater for rail network maintenance, contingencies, etc. (typically 65%).
Operations Control Centre (OCC)	TFR's functional department responsible for controlling all train plans and movements, monitoring of adherence to the Production Plan and deviation management.
Optimal	A scenario that obtains a predefined percentage of targeted KPIs. Such KPIs' can change from time to time based on learning and continuous improvement initiatives.
Optimal Traffic Mix	Most viable traffic mix based on profitability, social responsibility and sustainability.
Optimise	The process of determining the maximum and/or minimum values of an objective function, subject to specified constraints.
Optimised Blocking Plan	Grouping and correctly sequencing all demands into Origin-Destination groups in such a way that block swapping is optimised, total number of trains needed are minimised, and resource utilisation (slots and wagons) is optimised.

Term	Description
Order Management	The commercial process of capturing, validating and confirming an order, including the order credit check and order excise/customs release.
Over-border Railways	Railways of other African countries.
Overhead Traction Equipment (OHTE)	All electrical overhead equipment associated with traction power.
Passenger Rail Agency of South Africa (PRASA)	Passenger Rail Agency of South Africa is responsible for all suburban and inter-city passenger rail transport planning and execution.
Performance Factor	A variable factor used to influence the train performance between stations, impacting train running time.
Permanent Speed Restriction	Permanent speed restrictions are applied on top of the section speed restriction as a result of restrictive characteristics and the topography of the section for an extended period of time.
Primary Impact	The delay or cancellation of a train that is directly affected by an incident.
Primary Impact Assessment	The assessment of the effect of a deviation on the train(s) and/or resources directly involved in the incident (e.g. locomotives and wagons that derailed, Train Crew, section of track and overhead that was damaged).
Priority/rank of a specific demand	Priority is calculated by determining the overall "value contribution" of that demand, based on a combination of parameters, e.g. profitability, total cost, shareholder requirements, social responsibility, strategic value of customers, long term growth potential, customer satisfaction, traffic predictability, demand variability, asset turn-around times, overall customer revenue, capacity utilisation, etc.
Product Backlog	It is a prioritized list of deliverables (EPICs and value streams) that should be implemented as part of a project or product development.
Production Plan	Is the result of the demand do-ability process where validated orders are matched to available resources based on their position and status, to produce a fully resourced, integrated plan which includes the mainline train schedules, local schedules and yard schedules for a given production period.
Project Charter	A project charter is a formal document that describes the project in its entirety — including what the objectives are, how it will be carried out, and who the stakeholders are. It is a crucial ingredient in planning the project because it is used throughout the project lifecycle.

Term	Description
Project Management Office (PMO)	TFR's ICT's Project Management Office, where all transformation and ICT initiatives are planned, managed and tracked.
Rail directives and standards	Train working rules as well as ad hoc directives in addition to the standard working rules.
Rail Network Infrastructure	The Rail Network Infrastructure consists of Permanent way (perway), Signalling, Electrical, Overhead Track Equipment (OHTE) and Telecommunications. The configuration of the rail network relates to the actual design of the infrastructure e.g. the position and length of crossing loops, gradients of track, etc.
Rail Network Occupation	It is an event where a section of line is under possession by Rail Network Engineers for maintenance purposes for a short period (couple of hours in a day).
Rail Network Shutdown	It is an event where a section of line is under possession by Rail Network Engineers for maintenance purposes for an extended period (couple of days).
Rail Operations Asset Management (ROAM) Programme	A program that is executed to enable the effective management of resources, rail infrastructure and yard management processes within TFR.
Rail Simulation Solution (RSS)	Rail Simulation model that can simulate different possible demand scenarios and train timetabling scenarios over the Rail Network in order to determine which scenarios maximise resource efficiency and profitability.
Rail System Capacity	Is the maximum number of trains, expressed in volume terms, that would be able to operate on a given railway infrastructure, during a specific time interval, given the operational conditions and resource constraints.
Recovery Time	Tolerance level added to every train slot in order to absorb contingencies. These tolerances are incorporated into Service Specifications.
Recovery slots	Back-up production plan slots that will be used to reschedule trains that have deviated from their original slots.
Recovery Slot Allocation Rules	Set of rules used to allocate recovery slots.
Regular material trains	Repetitive trains which are used to move materials for Rail Network maintenance and are included in the validated demand for the next period.

Term	Description
Re-Planning	Re-planning involves reconfiguring the train plan to accommodate all trains that deviated from their original slots or were impacted by deviations.
Re-scheduling	Re-scheduling involves the use of recovery slots and or other available slots to move trains that deviated from their original slots.
Resource Balancing	Refers to the process ensuring the equal cross-flow of resources between two points to enable available resources where required.
Resource Based Train Plan (RBTP)	Resource Based Train Plan – medium term resourced timetable used as basic repeatable short term resourced train schedule – forming the basis for short term production schedules.
Resources	The locomotives, wagons, train crew and logistics support equipment that are required to execute the Production Plan.
Rolling Stock	All locomotives (including mainline, hauler and shunting locomotives), rail wagons (also known as rail car etc.), cabooses and guard's vans.
Rolling Stock Facilities	All facilities that support the preparation of wagons and locomotives to execute a service such as wagon cleaning, locomotive sanitation, fuelling, sanding and telemeter charging.
Rolling Train Plan	A Rolling train plan is continuously updated by freezing the first period of the plan and by adding a further planning period at the end of the plan at regular intervals. As an example, a rolling 14-day Production Plan will typically be revised every day, creating a new 14-day plan. Days 1-2 of this new plan will be frozen (no changes allowed, except when there are major disruptions), days 3-13 will be incrementally updated, and day 14 will be added. The periods for freezing will be parameterised.
Roundtrip Crewing Strategy	Crew working strategy where the train crew departing from their home depot to another depot/yard, returns to their home depot within a normal shift. Crew signs on and off duty at their home depot.
Secondary Impact	Delays to or cancellations of other trains as a result of a primary impact.
Secondary Impact assessment	The assessment of the consequential effect of a deviation on all impacted trains, resources and Value Chain partners. The assessment of the consequential effect of an incident on all impacted trains and resources.
Section	A defined main route from a major hub to a major hub (e.g., from Johannesburg to Durban).
Section Speed	Section Speed can be defined as the maximum speed a train is authorized to traverse any specified portion of the rail network.

Term	Description
Services	Standard and tailored / value-added service offerings (published in the service catalogue).
Service Catalogue	The menu of the supply chain service offerings which can be procured by a customer.
Service Costing	Allocation of a specific cost to each Service Specification activity, based on a pre-defined cost driver per activity.
Service Request	A new, amended / expanded service required by an existing or potential customer for a specified period.
Service Specification	Specification of how a service for customer demand will be executed, including required slot capacity, rolling stock resources, trip plans and agreement of all service-specific enabling operational activities and their design time durations.
Single View Monitoring Tool (SVMT)	TFR's real-time reporting tool publishing the latest positions and status of all resources.
Solution Train	The Solution Train is the organizational construct used to build large and complex Solutions that require the coordination of multiple Agile Release Trains (ARTs), as well as the contributions of Suppliers. It aligns ARTs with a shared business and technology mission using the solution Vision, Backlog, and Roadmap, and an aligned Program Increment (PI).
SOP	Standard Operating Procedures
Spare Capacity	Remaining resourced train slots (slots equipped with locomotives and train crew) or train space not allocated to validated demand / orders for the next planning period
Sprint Backlogs	A sprint backlog is the set of items that a cross-functional team selects from its product backlog to work on during the upcoming sprint.
Staged trains	Trains that depart from origin, deviate from plan and are halted within a section before reaching the final destination.
Sub-Section	A defined sub-part of a section from one yard / station to the next.
Surplus Resources	Resources not allocated to spare capacity or demand.
T1	Customer Order Time Appointment when required empty wagons have to be placed by TFR in the origin's customer siding.
T2	Customer Order Time Appointment when loaded wagons must be collected by TFR from the origin's customer siding.

Term	Description
T3	Customer Order Time Appointment when loaded wagons must be delivered by TFR at the destination's customer siding.
T4	Customer Order Time Appointment when off-loaded empty wagons must be removed by TFR from the destination's customer siding.
Technical Solution Backlog	The Solution Backlog is the holding area for upcoming Capabilities and Enablers, each of which can span multiple ARTs and is intended to advance the Solution and build its architectural runway.
Telemeter	A two-piece train communication device (in front of the locomotive and at the rear of train), used to ensure that an entire train is still intact as a complete consist, and that any loss in brake pressure throughout the train is communicated. Also referred to as "end-of-train device".
Temporary Speed Restrictions	Temporary speed restrictions are applicable for a pre-defined period and usually as a result of maintenance issues until the required maintenance repairs can be finalized to return the relevant network to the required standards.
TFR	Transnet Freight Rail, a division of Transnet SOC Ltd that specialises in the rail transportation of freight.
TFR Operating Philosophy	The Operating Philosophy for TFR is to run a scheduled railway and the principles are consistent across all corridors.
TFR Operating Model	The operating model is both an abstract and visual representation of the combinations of service design and train configuration and how the trains will be executed. The principles are consistent across all corridors
Theoretical Slot Capacity	The theoretical slot configuration (quantity, frequency and headways) that can be achieved for a given track layout and train configuration, independent of maintenance and resource constraints.
Third Party Operators	Any party external to Transnet that operates on or has access to the Transnet network and vice versa e.g. PRASA / Rovos Rail
Threshold	Pre-determined deviation size – if exceeded, action must be taken.
Time Buffer	A tolerance level added to train running times in order to absorb contingencies. These tolerances are incorporated into Service Specifications. A pre-allocated time allocation between two trains on the schedule to absorb train delays without impacting the next planned train.
Timetable	Chart of scheduled trains over a section/ Sub section, indicating train departure and arrival times at each location along the section/ Sub section.

Term	Description
Traffic File	Compilation of all demand in origin-destination flow format for a defined period. This includes demand for which approved service specifications exist, as well as demand for which no service specifications exist.
Traffic Flow	A grouping of traffic based on common attributes, e.g. common commodities, area of common origins, area of common destinations, common wagon groups, etc.
Traffic Mix	Specific combination of traffic based on demand.
Train Authorisation System	Method of train control whereby trains are authorized onto a specified portion of the network to safely occupy such network from defined start to end points. Train Authorisation Systems can change from time to time and has an impact on line capacity. Current Train Authorisation Systems include Centralized Traffic Control (CTC), Track Warrant, etc.
Train Compilation Rules	Define the rules on how trains must be built considering the technical specification of the train consist.
Train Configuration	Different possible train lengths, train consists, train speeds, brake types / systems and train/loco axle masses that are allowed per sub section based on what is possible given the physical rail network layout – its loops, signal positions, curves, gradients, etc.
Train Crew	Train drivers, train driver assistants and locomotive preparation drivers. Train crews are categorised as A (Shunting services),B (mainline Train Operations with a gross tonnage of 4000 tons per train) and C (mainline Train Operations with a gross tonnage exceeding 4000 tons per train, and any other specialised train operation e.g. Passenger Trains)
Train Crew Certification	Regular review and testing of required competencies in order to maintain Train Crew qualifications.
Train Crew Depot Strength	The total quantity, which caters for annual leave, absenteeism due to illness or family responsibility leave, training, etc. of Train Crew, both train drivers and assistants alike, per operational area/depot.
Train Crew Depot Matrix	The qualification requirements of Train Crew, both train drivers and assistants alike, per operational area/depot.
Train Crew Qualification	Minimum training required in order to acquire a specific skill that will enable Train Crew to perform a specific job.
Train Equipment	All equipment, such as telemeters (end of train device), required for the safe operation of trains.

Term	Description
Train Number	A unique number allocated to a movement on the network from an origin to a destination across different train slots for a single or combination of confirmed orders. The movements can take place between sidings, hubs and yards or any combination thereof.
Train Number Integrity	The logic and meaning associated with train numbers as interpreted by business systems and operators to avoid conflict or duplication.
Train Operator	The Train Operator buys slots from the Infrastructure Manager and plan and manage movements of trains over the network.
Train-on-Rail Mechanics	Dynamic interaction between trains and the physical rail infrastructure, including all forces and mechanical interactions.
Train Slot	A slot can be defined as a time schedule over a specified section of the rail network. Such a slot can be plotted on a time – distance diagram / string line diagram. Such slot will include all activities for the schedule inclusive of meet-pass, shunting, crew and locomotive changes etc.
Train slot numbers	A unique number allocated to repetitive slots using the same origin, destination, route and time parameters.
Train Technical Operating Instruction	The instruction for the running of specific train configurations over specific routes.
Train Technical Specification	Is the output specification for the units set out.
Train Utilisation	It is the act of making the maximum use of the train capacity considering the train configuration and service specification.
Triangular Services	Services where wagons are allocated to service multiple customers for loading at the location A, off-loading at location B, loading at location C and off-loaded at location A to complete the cycle as defined in the service specifications.
Unit train traffic	Traffic with one origin and one destination that fully utilises the capacity of a train.
Un-met demand	Demand do-ability assessed where specific slots and resources are not allocated due to insufficient capacity of one or more resource types.
Unresourced Production Plan	An unresourced production plan is created when validated orders are mapped onto the Resourced Base Train Plan. It becomes an unresourced production plan since the demand do-ability process is still to allocate train resources based on availability, position and status.

Term	Description
User Story	It is a tool in Agile software development used to capture a description of a software feature from a user's perspective.
Validated orders	Customer Orders agreed with customer, credit check done and customs clearance done, as well as Intra, Inter and Ad-Hoc orders.
Value Chain Partners	Stakeholders with whom TFR interfaces at any of the operational sites within the supply chain to deliver a service e.g., Customers, TPT, Neighbouring Railways Interface Points, PRASA and TE.
Wagon Allocation Rules	A set of rules defining which wagon types can be allocated to specific commodities, operational site loading and off-loading equipment and facilities, and routes.
Wagon Preparation Rules	Definition of requirements for roadworthy inspection and/or wagon cleaning prior to allocation of wagons to customers for loading.
Wagon Master Data	Defines the design, specifications, characteristics capabilities of a specific wagon.
Wagon Efficiency	An indication of how well TFR utilises all its active (in-service) wagons and how fast they are turned around.
Wagon Cycle Time (CT)	Refers to the total time taken by a wagon from the point of being placed for loading, through to its offloading point and back to be placed for loading again. CT is a measure that takes into account only the percentage of the active fleet of wagons that was directly used in the conveyance of cargo, and is computed as follows: ***Wagon CT = (production days X % of active fleet X wagon payload) ÷ (Volumes produced)***
Wagon Ring-fence	Pre-defined origins, destinations and routes to which specific wagons are restricted.
Wagon Turnaround Time (TAT)	Refers to the total time taken by a wagon from the point of being placed for loading, through to its offloading point and back to be placed for loading again. TAT is a measure that considers the entire active fleet of wagons, regardless of whether all of them were used during the conveyance of cargo, and is computed as follows: ***Wagon TAT = (production days X # of wagons in fleet X wagon payload) ÷ (Volumes produced)***
Works Order	A documented instruction provided to operations detailing activities to be performed in order to support the production plan.

Term	Description
Yard Capacity	Is determined by the capabilities at the yards, number and availability of resources at the yards, operating hours of yards, infrastructure layout/configuration of the yard, train processing durations,
Yard Schedules	A plan that covers the processing and consolidation of wagons at the handover points between mainlines and yards, including exchange yards. It details the pre-departure and post-arrival countdown events, activities and their required resourcing to ensure that all trains (mainline and local trains) depart on time.

3. BACKGROUND

3.1 Transnet SOC Limited is a logistics company that has several operating divisions (ODs) namely:

3.1.1 Transnet Freight Rail (TFR)

3.1.2 Transnet National Port Authority (TNPA)

3.1.3 Transnet Port Terminal (TPT)

3.1.4 Transnet Pipelines (TPL)

3.1.5 Transnet Engineering (TE)

3.2 TFR is the largest division of Transnet SOC Limited. It is a world class heavy haul rail company that specialises in the transportation of freight.

3.3 TFR has positioned itself as a profitable and sustainable freight railway business, focussed on driving the competitiveness of the South African economy. Key to being profitable is the ability to plan all operational execution activities and execute a centrally derived integrated train plan in a predictable, safe and reliable manner to ensure quick and efficient recovery from deviations.

3.4 The organisation is therefore compelled to ensure that all its train and resource planning systems are able to determine confirmed and unmet demand to service the demand in a way that satisfies stakeholder requirements.

3.5 Transnet Freight Rail owns the rail network infrastructure (linear assets) and rolling stock (locomotives and wagons) that it operates.

3.6 For the 2019/20 Financial Year TFR ran on average 3 800 (three thousand eight hundred) trains a week. The train lengths vary as does the infrastructure layout with an assortment of loop lengths on a given corridor.

3.7 Transnet is proud of its reputation for technological leadership beyond Africa as well as within Africa, where the company is active in various countries.

3.8 In November 2011 TFR adopted the Scheduled Railway operating philosophy. This philosophy requires rail freight to be planned and executed according to a published, balanced, and resourced base train plan for a given production planning period.

3.9 Based on a benchmarking exercise against class 1 railways (BNSF, CP and Aurizon), the essence of being a "Scheduled Railway" can be summarised as follows:

3.9.1 A scheduled railway is a planned railway, where the rail operator plans the work and work the plan.

3.9.2 Enables the integration of capacity management, demand management and resource planning.

3.9.3 Enables the availability of the published, current version of the integrated, and resourced production plan which instructs all relevant stakeholders what to do, when to do it, who is impacted and what they are impacted by.

3.9.4 Enables the derivation of standardised and appropriate measurements of execution against the integrated production plan. Appropriate performance measures identify areas of continuous improvement and performance optimisation.

3.9.5 The improved quality and stability of the integrated plan results in its reliability, and in the sustainable, adaptable, and resilient adherence to its execution by all stakeholders.

3.9.6 Enables organisational agility by providing information near real time resulting in proactive and timeous planning and quicker recovery from deviations.

3.9.7 The availability of high integrity and quality data supporting end to end business processes allows for predictive analytics empowering informed decision making.

3.9.8 Enable accurate measurement and improvement of key performance indicators resulting in increased operational efficiency, asset utilisation, profitability, customer satisfaction, as well as operational cost reduction.

3.10 Network Configuration

3.10.1 The company maintains an extensive rail network infrastructure across South Africa that connects with other rail networks in the sub-Saharan region. TFR has more than 30 000 (thirty thousand) km of Cape Gauge track (1 067mm), with an approximated route distance of 20 100 (twenty thousand one hundred) km. The branch line network is about 9 000 (nine thousand) km (figure 1).

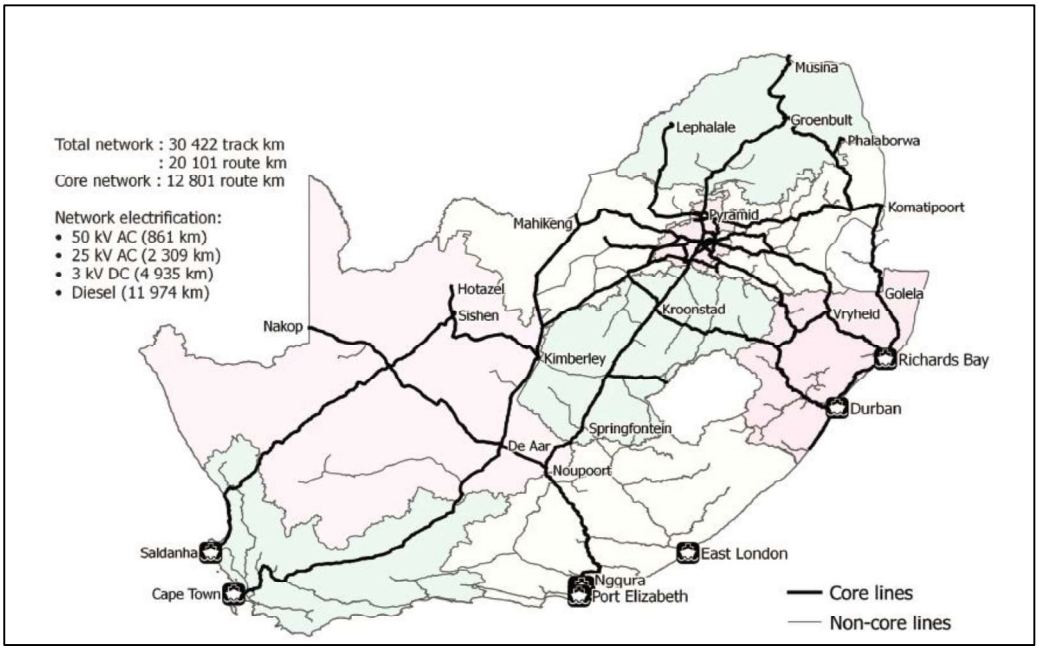

Figure 1 : Infrastructure Overview Map

3.10.2 General freight core lines have a carrying capacity of 20 tons/axle, whilst the heavy haul iron ore and coal lines are at 30 tons/axle and 26 tons/axle respectively. Mass axle loading specifications may change in future (figure 2).

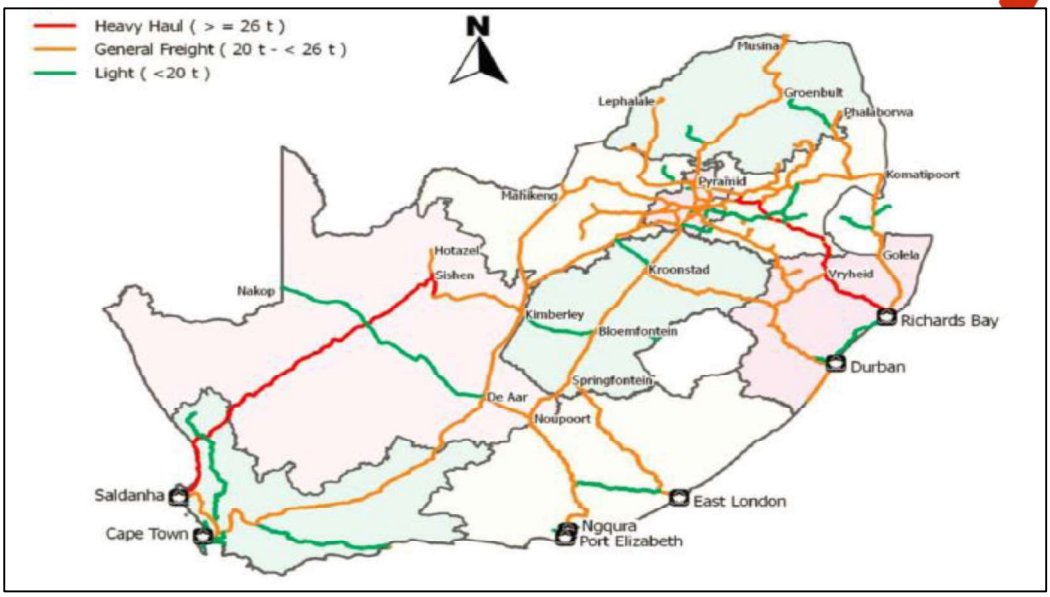

Figure 2 : Axle Load Map

3.10.3 The network electrification covers 3 types, namely 50 kV AC, 25 kV AC and 3 kV DC (figure 3). TFR has a number of electrical changeover yards where traction can be switched from AC to DC and back to enable the change of locomotives based on the network configuration.

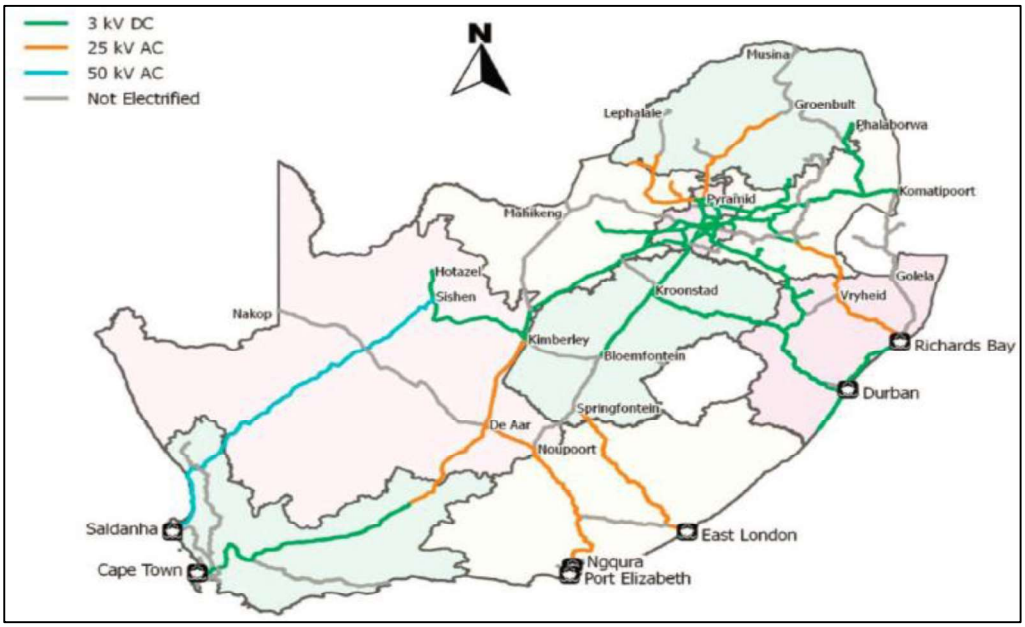

Figure 3 : Electrification Installed Technology Map

3.10.4 Different train authorisation systems are used on different parts of the rail network. Most main corridors are covered by Centralised Traffic Control (CTC), but many secondary lines and branch lines still use older more manual methods of train authorisation (e.g. Radio Train Order, Track Warrant System, Van Schoor and Wooden Train Staff). However, the organisation is on a drive to convert all train control methods to CTC, and hopes to achieve this feat by 2021 (figure 4).

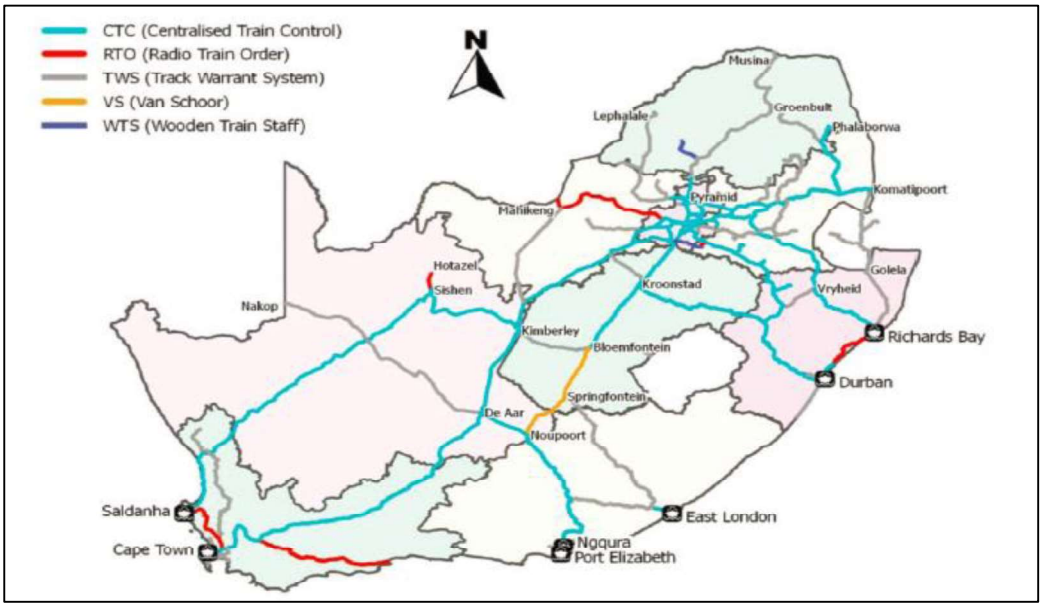

Figure 4 : Train Authorisation Systems Installed Technology Map

3.11 Rolling Stock Configuration

3.11.1 TFR has a growing and changing fleet consisting of alternating current (AC), direct current (DC), Diesel, and Dual Voltage locomotives:

3.11.1.1 The current active rolling stock fleet includes approximately 2 400 (two thousand four hundred) locomotives and 55 000 (fifty-five thousand) active rail wagons.

3.11.1.2 There are 78 (seventy-eight) categories of rail wagons that are in use and 29 (twenty nine) locomotive classes.

3.11.1.3 In addition, some Third Party owned locomotives, wagons and passenger coaches are planned and executed by TFR.

3.12 Train Configuration

3.12.1 TFR operates head end power trains and distributed power trains, ranging in length from 24 (twenty-four) wagons to a maximum of 378 (three hundred and seventy-eight) wagons.

4. CURRENT SITUATION/ PROBLEM STATEMENT

4.1 TFR currently relies on several external consultants to simulate optimal section solutions for capacity expansion on a section-by-section basis. This fragmented approach does not allow for TFR to test the results of the simulated and fragmented scenarios for robustness on a holistic and system-wide approach, which impact negatively on future investment decisions.

4.2 The lack of integration across the planning processes and systems often leads to a fragmented capacity plan being produced, with little or no integration between all efforts.

4.3 Furthermore, the plans produced are not tested to ensure that the models are properly calibrated.

4.4 TFR currently has an array of standalone train and resource planning systems to produce its Integrated Train Plan.

4.5 TFR faces major challenges with disparate, non-integrated systematic and manual legacy processes and systems. These legacy systems do not have a view on real time asset positioning and availability. The lack of integration across the planning processes and systems leads to fragmentation of the train plan.

4.6 As is the case with the fragmented capacity planning processes and systems, the Integrated Train Plan that is produced is not tested for feasibility, neither is the planning done in an integrated manner, with several components of the train plan (e.g. wagon distribution plans, local production plans, locomotive distribution plans, occupation plans, crewing plans) done in isolation to the Integrated Train Plan.

4.7 The different sources of TFR demand (including everything that can consume slot capacity, including external customer demand, internal demand, intra

demand, third party slot demand and resource distribution slot requirements and planned occupations) are currently disparate, causing capacity planning to be sub-optimal.

4.8 Current manual timetabling and capacity planning processes are inefficient, making it difficult to respond to customer demands and leading to lost opportunities to increase revenue.

4.9 The current TFR Master Data required for Capacity Planning resides in multiple overlapping sources and is not consolidated to provide accurate asset configuration and MTS.

4.10 Currently TFR is unable to dynamically link electrical capacity and signalling capacity to the track capacity in the scheduling of trains.

4.11 TFR cannot produce a fleet route plan for Train Crew transportation which results in Train Crew not being available when required thus leading to trains being cancelled.

4.12 The current train planning tool and processes do not consider current resource availability, status, position, and cycle times to compile an integrated optimised, balanced production plan.

4.13 The do-ability of validated demand is determined manually resulting in low customer satisfaction levels due to oversubscription of orders to trains. Spare capacity is not identified accurately due to the manual do-ability process and therefore impacts the resource utilisation efficiency.

4.14 When compiling the mainline and local train schedules, the current manual process does not adequately consider network occupations (including third party network occupations) and temporary speed restrictions, leading to suboptimal plans and high train cancellations.

4.15 Dynamic re-planning is performed manually and does not forecast whether the re-planning intervention will lead to bottlenecks or not, often resulting in delays, cancellations, and customer dissatisfaction.

4.16 Deviation alerts are not consistently transmitted timely due to a lack of integration with TFR's real time train position and asset event reporting systems and adherence to processes, leading to poor recovery as a result of deviations and poor communication to customers and other stakeholders.

4.17 The current toolsets and processes do not adequately assist to determine resource re-scheduling requirements for impacted main line trains, local schedules, and yard schedules when deviations occur.

5. PURPOSE / OBJECTIVE / SCOPE

5.1 Transnet Freight Rail's (TFR) strategic objective is to become one of the global top Railway Companies. TFR will require extensive re-engineering of current fragmented and manual processes and the implementation of benchmarked leading rail industry standards and solutions.

5.2 This initiative aims to procure a turn-key solution for TFR in the areas of: (a) Capacity Planning, (b) Railway Planning and Simulation, (c) Base Train Planning, (d) Production Planning and (e) Execution Monitoring and Deviation Management, and by so doing re-engineer the way TFR currently operates as described in section 6 below.

5.3 TFR wants to implement industry leading practices and processes for all solutions.

5.4 All solutions should use the same shared platform, master data, common interfaces, and common underlying optimisation techniques.

5.5 Enable integration with other enabling TFR business processes and ICT solutions.

5.6 Interface with the related processes of other Transnet ODs and other partners / players in the transportation logistics supply chain.

5.7 **Capacity Planning**

5.7.1 The procured solution must replace all current fragmented Capacity Planning processes and systems.

5.7.2 Capacity Planning Solution shall:

5.7.2.1 Perform strategic operational capacity planning.

5.7.2.2 Use the complete view of future demand requirements, and identify the required rail network, rolling stock and train crew capacity requirements to satisfy the demand.

5.7.2.3 Enable the simulation of different demand scenarios to investigate impacts of changes to the infrastructure, train configurations, resource allocation rules and crew working methodologies to improve operational efficiency to maximise utilisation of resources.

5.7.2.4 Identify the sequence and optimal future rolling stock, rail network and train crew investment requirements as input into the Transnet Investment Plan for improved investment planning.

5.7.2.5 Provide functionality to cover the lifecycle of rail network capacity creation and expansion planning from determination of rail network capacity constraints / bottlenecks until implementation of the optimal expansion / reconfiguration plan.

5.7.2.6 Be able to dynamically link electrical capacity and signalling capacity to the track capacity when scheduling and simulating trains.

5.7.2.7 Provide functionality to cover the lifecycle of rolling stock capacity creation, modification and expansion planning from determination of rolling stock capacity constraints / bottlenecks until implementation of the optimal expansion / reconfiguration plan.

5.7.2.8 Cater for the introduction of new / updated rolling stock or rail network infrastructure optimally in the correct sequence to meet the projected capacity demand from customers at an optimal profitability for TFR.

5.7.2.9 Cater for the determination of the total crew needs for the future train service scenarios. It covers the lifecycle from determination of crew capacity constraints / bottlenecks until implementation of the optimal chosen crew capacity creation and deployment plan.

5.7.2.10 Generate optimal future rolling stock, rail network and train crew investment requirements using the outputs of the capacity expansion planning tools.

5.8 Base Train Planning

5.8.1 The procured solution must replace all current fragmented strategic and tactical train planning processes and systems.

5.8.2 All plans produced by this capability shall be optimal, predictable, feasible, reliable, robust and repeatable as well as improve operational efficiency and increase opportunity for revenue generation with maximised profitability.

5.8.3 Base train planning is an iterative process through which a repeatable train plan is developed with different phases whereby additional constraints are introduced to refine the train plan to determine the maximum capacity which can be performed given the constraints.

5.8.4 The solution shall:

5.8.4.1 Determine maximum slot capacity considering rail network and train configuration scenarios. The solution must differentiate between theoretical and practical slot capacity. Further to this, spare slots must be identified as part of the practical slot capacity.

5.8.4.2 Be able to create a master train schedule (MTS) based on the practical maximum slot capacity and operational site capacities and constraints.

5.8.4.3 Be able to compile an optimal traffic blocking plan that translates forecasted demand into origin-destination wagon blocks and combines wagon blocks into trains (using available slots) in such a way that the total number of trains required are minimised, that shunting at intermediate locations are minimised, that resource utilisation is maximised, and that freight volumes and profitability are maximised.

5.8.4.4 Produce the Resourced Base Train Plan by refining the Master Train Schedule constraining it with TFR and Value Chain Partner resource capacities and constraints. The output of this process will result in validated and costed service specifications.

5.8.4.5 Enable TFR to prioritise and rank all demand based on the total cost and profitability. This ranking and prioritisation requirement will only apply in instances where traffic demand exceeds capacity.

5.9 Production Planning

5.9.1 The procured solution must replace all current fragmented strategic and tactical train planning processes and systems.

5.9.2 All plans produced by this capability shall be optimal, predictable, feasible, reliable, robust, and repeatable as well as improve operational efficiency and increase opportunity for revenue generation with maximised profitability.

5.9.3 Production planning focusses on operational planning for the next production period. Validated orders are allocated to the RBTP to create an un-resourced production plan.

5.9.4 The outputs of the distribution plans are integrated to validate the holistic resourced production plan through simulation and includes mainline train schedules, local schedules, and yard schedules. The meet-pass plan, and the customer time appointment view is extracted.

5.9.5 The solution shall:

5.9.5.1 Confirm validated orders for do-ability by matching it to available capacity.

5.9.5.2 Compile optimal wagon and auxiliary equipment distribution plans by assigning wagons and auxiliary equipment to the un-resourced production plan based on contracted service specifications.

5.9.5.3 Compile optimal locomotive and train equipment distribution plans by assigning locomotives and train equipment to the un-resourced production plan based on contracted service specifications.

5.9.5.4 Compile an optimal train crew allocation plan by assigning train crew to the un-resourced production plan based on skills and qualifications.

5.9.5.5 Produce a resourced Production Plan for the next production period incorporating mainline, local and yard activities.

5.9.5.6 Provide a report indicating confirmed demand, unmet demand, spare capacity and a meet-pass plan after creating the Production Plan.

5.10 Execution Monitoring and Deviation Management (EMDM)

5.10.1 The procured solution must replace all current fragmented monitoring and deviation management processes and systems.

5.10.2 The solution shall:

5.10.2.1 Enable the monitoring of individual resources as well as the execution of the production plan at a Train Control Office (TCO) and National Traffic Regulator level.

5.10.2.2 Enable early warning of deviations, identification of primary and secondary impacts of the deviations through deviation impact assessment and enable proactive and dynamic re-planning.

5.10.2.3 Conduct a systematic impact assessment of incidents / deviations by identifying primary and secondary impacts and the influence on the Production plan.

5.10.2.4 Following the assessment, the solution must proactively identify re-planning requirements and activate re-planning at the appropriate level.

5.11 Railway Planning and Simulation

5.11.1 Railway planning and simulation solution is a supporting capability for the other capabilities which receive scenario parameters and produces simulated and optimised results for the scenario.

5.11.2 The solution shall:

5.11.2.1 Provide a railway simulation model which integrates all planning capabilities to test the feasibility, total profitability and performance of a given scenario.

5.11.2.2 Cover the ability to test different scenarios, including the testing of new technology changes to create optimal future capacity solutions and improve operations efficiency and maximise profitability.

5.11.2.3 Enable TFR to do scenario testing and evaluate the operational consequences of rail network failures, rolling stock failures, operational inefficiencies and disruptive incidents, which will facilitate the development of suitable operational KPIs to assess systemic impact on capacity and on future capacity requirements.

5.11.2.4 Enable adequate scenario-testing of multiple re-planning / re-scheduling scenarios and allow users to select the preferred scenario.

5.12 The business processes and related SOP's needs to be aligned to best practises.

5.13 TFR currently operates using a vertically integrated business model. It owns and manages the infrastructure as well control all train operations on the network. Third party operator traffic is consolidated and managed as part of the ITP. TFR is the main operator and third party traffic is catered for on available slots.

5.14 TFR is in the process of moving from a vertically integrated to a vertically separated business model. The future business model will consist of the Infrastructure Manager and TFR Operations as separate entities within the same company.

5.15 The first step of the separation journey is to separate the Infrastructure Manager and TFR Operations at a commercial/accounting level and enable the sale of slots to 3rd party operators. Further details on the business model will unfold as the project progresses.

5.16 The primary scope of requirements in this document is premised on the current business model (vertically integrated). The secondary scope entails the establishment of the approach to accommodate the future business model (vertically separated); which is articulated in Section 7 of this document.

6. DETAILED SOLUTION FUNCTIONAL REQUIREMENTS

6.1 Base Train Planning

i. New service requests from customers for which no matching service specification exists, must undergo the entire MTS, Blocking and Resourced Base Train Plan (RBTP) Process (will be treated exactly the same way as any demand) in order to derive the required service specifications.

ii. The entire MTS process will be automated and will therefore be able to be executed over different time horizons (next 10 years, 7 years, 3 years, year, quarter – or ad hoc as required)

iii. There are 4 clearly identified phases in Base Train Planning.

6.1.1 Phase 1 – Determine Slot Capacity

This process determines the number of slots. The accurate modelling of railway infrastructure is a fundamental input to various railway planning tasks, including timetabling, capacity calculation, railway operational simulation and planning, run-time calculation, etc.

ID #	Functional Requirements	Business Process	Inputs	Output
6.1.1.1	The solution shall allow for both the Microscopic & Macroscopic modelling of the TFR railway network infrastructure.	Determine Slot Capacity	✓ Expanded Rail Network Configuration changes to be implemented During Planning Period ✓ Current /Changed Rail Network Configuration ✓ Historical Statistical Performance Data	✓ Theoretical slot Capacity ✓ Operational Slot Capacity ✓ Base Rail Network Configuration ✓ Allocated Recovery Slots ✓ Train Configuration
6.1.1.2	The solution shall synchronously simulate and calculate the theoretical slot capacity based upon the microscopic modelling of the rail network infrastructure configuration (current and future) and given train configuration scenarios.			
6.1.1.3	The solution shall determine the operational slot capacity of a section or sub-section as a percentage of the theoretical slot capacity. The percentage will depend on the defined operational slot capacity percentage rules, overall line layout, efficiency, risk profile and maintenance requirements.			
6.1.1.4	The solution shall scientifically calculate utilising historic statistical data analysis the Recovery slots which are part of the operational slot capacity and the number of recovery slots per section or sub-section.			

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ID #	Functional Requirements	Business Process	Inputs	Output
6.1.1.5	The solution shall make provision to define train run-time recovery and train block buffer parameters per section or sub-section, and recovery slot allocation rules.		✓ Current and Future Train Authorisation System Details ✓ Train configuration Scenarios per Corridor Section Baseline Rail Network Configuration ✓ Recovery Time Parameters per Corridor/Corridor Section ✓ Recovery Slot Allocation Rules	
6.1.1.6	The solution shall include the regular material trains to move maintenance materials as part of the operational slot capacity.			
6.1.1.7	The solution shall allocate unique numbers to repetitive slots using the same origin, destination, route and time parameters.			
6.1.1.8	The solution shall have the capability to change percentages per section before determining the operational slot capacity.			
6.1.1.9	The solution shall consider detailed perway, traction power supply and signal configurations when determining slot capacity.			
6.1.1.10	The solution shall allow recovery slot allocation percentages to be changed as input parameters per sub-section.			
6.1.1.11	The solution shall calculate and set aside a pre-determined portion of operational slot capacity for recovery slots (not to be used for demand-to-slots) using the predefined percentages and allocation rules.			

6.1.2 Compile Master Train Schedule (MTS)

This process generates an Optimal MTS following the definition of the published operational slot capacity. It takes cognisance of all applicable operational site capacities and constraints across the Value Chain when compiling a conflict-free MTS that optimises bottlenecks to avoid unnecessary train / wagon delays, congestion of yards and mainline, and to minimise the need for en-route staging. Typical operational site capacities and constraints include but are not limited to production schedules, handling tempos, stockpile sizes, working hours, maintenance requirements and schedules.

ID #	Functional Requirements	Business Process	Inputs	Output
6.1.2.1	The solution shall consider all applicable operational site capacities and constraints across the Value Chain Partners and Third-Party Operators when compiling a conflict-free MTS that eliminate bottlenecks to avoid train delays, congestion of yards and mainline, and minimise en route dwell time.	Compile Optimal Master Train Schedule	✓ Yard/Container Terminals Capacities and Constraints ✓ Operational Slot Capacity Schedule ✓ Value Chain Partners/Third Party Operators Capacities,	✓ Optimal Master Train Schedule (Menu of possible slots)
6.1.2.2	The solution shall consider typical operational site capacities and constraints which include but are not limited to siding lengths, production schedules, handling tempos, stockpile sizes, working hours, maintenance schedules.			
6.1.2.3	The solution shall use the static handling capacity and handling tempo at operational sites which are scientifically defined upfront per commodity			

	by the operational site operator and documented in service level agreements.		Constraints and Processing Times ✓ Regulatory Requirement Framework for Third Party Operators	
6.1.2.4	The solution shall identify and produce KPI's during compilation of the MTS e.g. schedule stability, schedule robustness and service quality index measure.			
6.1.2.5	The MTS will be used for demand allocation during the blocking process.			
6.1.2.6	The solution shall allocate unique slot numbers to repetitive slots using the same origin, destination, route and time parameters e.g., if a train is designed to run from point A to point B at 10:00 every day of the week the slot that is uses will maintain the same number for every day of the week.			
6.1.2.7	The solution shall enable the detailed meet-pass logic of how trains will cross by considering and not limited to: i. Hard coding of identified services that should not be changed during the simulation and optimisation of the timetable, e.g., passenger trains that have been hardcoded for a period into the future. ii. Empty trains to be kept on crossing loops while loaded trains pass through (keeps moving), considering the network			

	configuration / profile (e.g., the position of critical signals) and its limitations. iii. Faster trains take precedence over slower trains. iv. The Rail Network Configuration will be the key constraint when trains that are of different length and size (running at same speeds) must cross. In such cases the longer and heavier train will typically get preference over a shorter and lighter train (if the longer train cannot fit into a crossing loop) v. Train Working Rules that are relevant for passing trains must be applied in order to ensure safety at all times (e.g., certain train types, like explosives and petroleum, cannot do cross-point working).			
6.1.2.8	The solution shall acknowledge mandatory trains and exclude them from the optimisation of the timetable			
6.1.2.9	The solution shall have the capability to plot trains from station to station to illustrate graphically traffic density for any given day for each OD pair of all Mainline slot utilization.			
6.1.2.10	The solution shall optimise schedules across the network and network sections.			

6.1.3 Compile Optimal Blocking Plan

Optimal blocking plan is the grouping and correct sequencing of all demands based on blocking rules into Origin-Destination groups in such a way that en-route shunting is minimised, total number of trains needed are minimised, and resource utilisation (slots and wagons) is optimized. After determining the menu of available slots during the Master Train Schedule process, the next phase determines an optimal blocking plan based on blocking rule parameters.

ID #	Functional Requirements	Business Process	Inputs	Output
6.1.3.1	The solution shall consider the following Blocking rule parameters defined, but are not limited to: i. Which commodities can travel together in a block, ii. Train Compilation Rules, iii. Day/night train running constraints, iv. Wagon Types / Commodity Compatibility Rules, v. Routing rules and constraints, and vi. Rail Safety Rules.	Compile Optimised Blocking Plan	✓ Optimal Master Train Schedule ✓ Blocking Rule Parameters ✓ Wagon Types/ Commodity Compatibility Rules/Wagon Dimensions ✓ Train Compilation Rules	✓ Optimised Blocking Plan
6.1.3.2	The solution shall allocate wagon blocks optimally by applying demand prioritisation rules, minimising en-route shunting and decreasing wagon cycle times.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.1.3.3	The solution shall process demand at O-D pair level to determine the optimised blocking plan.		✓ Currently Approved Service Specification ✓ Core Location Data ✓ Third Party, Internal and Intra Demand ✓ Over border Demand ✓ Rail Safety Rules on Hazardous Materials /train Marshalling ✓ Validated Demand and	
6.1.3.4	The solution shall apply rail safety rules to identify traffic combinations and how blocks shall be sequenced.			
6.1.3.5	The solution shall enable a user to create and enhance blocking rule parameters.			
6.1.3.6	The solution shall use the blocking rule parameters and approved service specifications to define optimal blocks.			
6.1.3.7	The solution shall allocate demand to blocks and map such blocks into the network for routing using the MTS.			
6.1.3.8	The solution shall identify and produce KPI's during the compilation of the Blocking Plan.			
6.1.3.9	The solution shall report on the optimal blocking plan.			
6.1.3.10	The solution shall report on block-swapping.			
6.1.3.11	The solution shall report on the density of the different routes for different blocks.			
6.1.3.12	The solution shall report on the quantity of wagons per type required for the given demand.			
6.1.3.13	The Block Optimiser shall allocate wagon blocks optimally by:			

ID #	Functional Requirements	Business Process	Inputs	Output
	i. Applying demand prioritisation rules; ii. Ensuring that demand is planned equitably across customers; and iii. Optimising block swapping.		Demand prioritization Rules ✓ Current and Future TFR wagon Capacity and Availability ✓ Current and Future Third Party and Privately Owned Wagon Carrying Capacity and Availability	
6.1.3.14	The solution shall consider train configurations in determining block sizes.			
6.1.3.15	The solution shall have the capability to upload and re-use existing traffic blocking definitions.			
6.1.3.16	The solution shall have the capability to differentiate between different wagon brake systems (eg vacuum, airbrake, dual brake systems).			
6.1.3.17	The solution shall report on the optimal routing of traffic.			
6.1.3.18	The solution shall identify empty wagon blocks.			
6.1.3.19	The solution shall re-group traffic for block swapping at interim locations			
6.1.3.20	The solution shall maximise train utilisation during the creation of blocks			
6.1.3.21	The solution shall provide a cost report associated with the blocking plan			
6.1.3.22	The solution shall provide different possible blocking scenarios			
6.1.3.23	The solution shall have the capability to impose selected scenarios			

6.1.4 Resourced Base Train Plan (RBTP)

Resourced Base Train Plan is the resourced timetable used as basic repeatable medium-term resourced train schedule forming the basis for short-term production schedules. This process generates the repeatable resourced base train plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.1.4.1	The solution shall have the capability to compile a Resourced Base Train Plan by applying resource capacity, reliability factors and availability; optimal blocking plan, Service Pricing & Costing, Resource allocation rules, Validated demand and prioritisation rules.	Compile Resourced Base Train Plan	✓ Service Costing Parameters ✓ Optimal Blocking Plan ✓ Value Chain Partners and Third-Party Operator Capacity, Availability, Constraints and Other Operational Site Specifications ✓ Master Train Schedule ✓ Approved Service Specifications	✓ Resource Based Train Plan ✓ Confirmed and Unmet demand ✓ Validated and Costed Service Specifications and Deviation Thresholds
6.1.4.2	The solution shall provide the capability to optimally allocate rolling stock (by type and quantity), and train crew (by category and quantity) to the MTS to determine system capacity independent of demand.			
6.1.4.3	The solution shall consider the capacities and processing capability of rolling stock facilities during the allocation of rolling stock to the MTS.			
6.1.4.4	The solution shall enable the user to create different simulation scenarios by altering the parameters for the scenarios.			
6.1.4.5	The solution shall allocate demand to trains using the demand prioritisation rules and profitability calculations during the simulation of the scenarios.			
6.1.4.6	The solution shall produce a traffic mix report for each scenario.			

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ID #	Functional Requirements	Business Process	Inputs	Output
6.1.4.7	The solution shall provide details on confirmed, unmet demand and spare capacity and system performance of each scenario.		✓ Current and Future Train Crew Capacities, Availability and Allocation Rules ✓ Current and Future Rail Network Capacities and Availability ✓ Current and Future Rolling Stock Capacities, Availability, Reliability Factors and Allocation Rules ✓ Trackable logistics Support Equipment Capacities, Availability, Reliability factors and Allocation rules	✓ Overall TFR KPI system performance of every simulated train plan scenario ✓ Spare Capacity ✓ Unmet Demand for Capacity Expansion Planning ✓ Optimal Traffic Mix Report
6.1.4.8	The solution shall enable the user to compare the results of the different scenarios to select the best schedule given the performance indicators, profitability, throughput volumes and asset utilisation.			
6.1.4.9	The solution shall use the selected scenario as a baseline for all further activities in the process.			
6.1.4.10	The solution shall use the RBTP to derive service specifications at an activity level, obtain costs per activity and published for inclusion into the Service Catalogue.			
6.1.4.11	The solution shall provide a report of confirmed and unmet demand including reasons for unmet demand, e.g., rolling stock and train crew constraints.			
6.1.4.12	The solution shall provide a report with the required auxiliary and train equipment to support the plan.			
6.1.4.13	The solution shall define the metrics and planned targets used to track the KPI's.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.1.4.14	The solution shall provide the optimal traffic mix report and spare capacity which will inform the Sales and Marketing Strategy for TFR and assist in decision making during deviation management.		✓ Validated Demand and Prioritisation Rules ✓ Resolutions from Deviations root cause analysis ✓ Costed Resource Based Train Plan Scenarios	
6.1.4.15	The solution shall provide the resource-based train plan and spare capacity which will inform the Rail network maintenance planning and shutdowns.			
6.1.4.16	The solution shall provide the unmet demand report which will be used to plan for required resource capacity expansions.			
6.1.4.17	The solution shall graphically display the RBTP.			
6.1.4.18	The solution shall have the capability to allocate a unique train number.			

6.2 Railway Planning and Simulation

This process covers the simulation of the holistic Railway system through a systemic simulation of the entire train service, incorporating all resources, capacities and constraints as per the predefined scenario detailed parameters and objective functions. It simulates capacity requirements in relation to Customer Orders, Rolling Stock, Train Crew, Rail Network, and Yard operations to meet customer demands in the short, medium, and long term. The simulation capability shall integrate all planning capabilities to test the feasibility, total profitability and performance of a given scenario.

ID #	Functional Requirements	Business Process	Inputs	Output
6.2.1	The solution shall access the base rail network configurations (Microscopic and Macroscopic infrastructure models) as input for optimal simulation runs.	Perform Railway Simulation	✓ Validated Demand ✓ Current and Future Rail Network Configurations, Capacities and Constraints ✓ Yard Capacities and constraints	✓ Baseline Scenario results of each simulation run ✓ Capability Scenario Simulation Results ✓ Demand smoothing Report
6.2.2	The synchronous railway simulation model sought, must be based both on the micro- and macro-scopic modelling, as well as applying the deterministic and stochastic analytical approach.			
6.2.3	The Railway Simulation model must take all resource reliability factors into account, including Value Chain Partners' and Third-Party Operators capacity, operational site capacity, reliability factors, constraints as well as validated demand.			
6.2.4	The solution shall determine the constraining bottlenecks and propose solutions and sequence of resolution.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.2.5	The solution shall determine rail system capacity independent of demand e.g. operational slots, locomotives, wagons, train crew and logistics support equipment capacities.		✓ Base Train Plan ✓ Rolling Stock Capacity Planning and Distribution Input ✓ Train Crew Capacity and Allocation Planning Input ✓ Production Plan Input ✓ Rail Network Capacity and Configuration Input	✓ Overall TFR System Performance and profitability ✓ Optimal MTS and/or RBTP ✓ Identified Bottlenecks, Resolution and Sequence proposals ✓ Model Output Confidence Levels
6.2.6	The solution shall simulate strategically set targets to establish whether they can be met or not and highlight resource and capacity constraints or opportunities.			
6.2.7	The solution shall have the capability to indicate the number of trains that can be accommodated per section and sub section.			
6.2.8	The solution shall have the capability to change input parameters to test multiple scenarios.			
6.2.9	The solution shall have the capability to compare different scenarios and provide a report on the feasibility, optimisation, profitability and performance of each scenario.			
6.2.10	The solution shall have the capability to test the feasibility, total profitability and performance of given demand, resources and timetable scenarios.			
6.2.11	The solution shall accept scenario inputs from any of the processes in the solution or accept parameters directly for the what-if scenario simulation runs.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.2.12	The solution shall have the capability to perform simulation runs to optimise the following processes / capabilities: • Theoretical and Operational slot capacity calculations • Master Train Schedule • Blocking Plan • Resourced Base Train Plan • Train Crew Capacity Planning • Rolling Stock Capacity Planning • Rail Network Capacity Planning • Derivation of Robust & Optimal Production Plan • Locomotive Distribution • Wagon Distribution • Train Crew allocation planning • Monitoring and Deviation Management scenarios • Impact assessment of deviations		✓ Deviation Management Input ✓ Microscopic and Macroscopic Infrastructure Models ✓ Value Chain Partner/Third Party Operator Capacity, Availability, Constraints and Operational Site Specifications ✓ Rail Network Availability,	
6.2.13	The solution shall have the capability to systematically simulate the entire train service			

ID #	Functional Requirements	Business Process	Inputs	Output
6.2.14	The solution shall have the capability to accept objective functions for specific scenarios.		Capacities and constraints, ✓ Current and Future Rolling Stock Availability, Capacities and Constraints ✓ Current and Future Train Crew Availability, Capacities and Constraints ✓ Long Term Rail Network Capacity Expansion Plans ✓ Service Costing Parameters	
6.2.15	The solution shall have the capability to plan for scenario experimentation.			
6.2.16	The solution shall have the capability to capture specific KPIs for a scenario.			
6.2.17	The solution shall have the capability to allow for speed restrictions to be captured / uploaded as an input.			
6.2.18	The solution shall have the capability to specify occupations as an input into the simulation model to determine the impact on the timetable.			
6.2.19	The solution shall have the capability to identify the reasons for the bottleneck.			
6.2.20	The solution shall have the capability to determine the number of trains on a section using the microscopic model and specified train configurations.			
6.2.21	The solution shall have the capability to allocate demand to specific slots based on the service specification during simulation.			
6.2.22	The solution shall have the capability to simulate different scenarios in order to understand requirements for resources comprehensively, catering for all functions including support functions.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.2.23	The solution shall have the capability to To test the need for required recovery slots.		✓ Scenario Details ✓ Resolutions from Deviation Root Cause Analysis	
6.2.24	The solution shall have the capability to determine the optimal locations of rolling stock maintenance facilities.			
6.2.25	The solution shall be compatible with moving block signaling.			
6.2.26	The solution shall have the capability to incorporate capacities and constraints during simulation for the following: • Locomotives • Wagon • Train crew • Electrical traction • Logistics support equipment • Operational site			
6.2.27	The solution shall enable simulation for specific scenarios to determine resource requirements and behaviour of wagons, locomotives and train crew for selected market opportunity; that considers infrastructure constraints and slot availability.			

6.3 Capacity Planning

The scope of capacity planning covers the following:

- Rail Network Infrastructure Capacity Planning
- Rolling Capacity Planning
- Train Crew Capacity Planning

6.3.1 Rail Network Infrastructure Capacity Planning

This process determines the rail network infrastructure expansion requirements for a given demand scenario using current infrastructure configuration, technology roadmap, validated demand; value chain partners capacities and constraints, etc. It produces the confirmed and unmet demand, Rail network infrastructure capacity utilisation, bottlenecks / constraints results, optimal shutdown and occupation schedule, Rail Network Capacity Expansion Requirements and Preferred optimal sequence and timing of Rail network Capacity Expansions.

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.1.1	The solution shall provide OHTE power requirements for a given scenario based on demand, train configuration and rail network infrastructure configuration inputs.	Determine Rail Network Infrastructure Capacity Planning Requirements	✓ Validated Demand (Including new Customers and Train Operating Company) and Prioritization rules ✓ Service Pricing & Costing Parameters	✓ Confirmed and Unmet Demand for the Scenario ✓ Rail Network Capacity Utilisation
6.3.1.2	The simulation must utilise verified strategic requirements, consolidated demand forecasts, existing maintenance strategy, targeted availability and reliability levels, and the			

ID #	Functional Requirements	Business Process	Inputs	Output
	current capacity limits at operational sites as inputs against a given demand and constraint scenario to determine if there are any network constraints / bottlenecks.		✓ Capacity Info of Customers and Privately owned Terminals ✓ Branch line & Overborder Capacities & Expansion Plans ✓ Transnet and TFR Strategy & Corporate Plan ✓ Current and Future Rail Network Maintenance Strategy and Standards ✓ Technology Implementation Plans ✓ Rail Infrastructure Configuration Baseline ✓ A targeted Availability and Reliability level for each section ✓ Rail Infrastructure Condition	✓ Bottleneck/Constraint Results ✓ Model output Confidence levels and KPIs ✓ Optimal shutdown and occupation schedule ✓ Rail Network Capacity Expansion Requirements ✓ Preferred optimal sequence and timing of Rail Network Capacity expansions ✓ Rail Network Infrastructure Capacity
6.3.1.3	The solution shall resolve any constraints / bottlenecks in an incremental approach utilising given parameters for the scenario and the output used as input to develop the business case for the required capital expansion to support the growth in demand or provide the steps to resolve bottlenecks.			
6.3.1.4	The solution shall identify the achievable demand for each scenario.			
6.3.1.5	The solution shall state which rail network capacity was unused or under utilised.			
6.3.1.6	The solution shall define confidence levels for the model.			
6.3.1.7	The solution shall enable version control of accepted scenarios and compilation of single expansion plan for use by TFR.			

ID #	Functional Requirements	Business Process	Inputs	Output
			✓ Capacity Information of Ports/Port Terminals ✓ Value Chain Partners Capacities, Constraints and Processing Times ✓ Current MTS ✓ TFR Operating Model ✓ Current and Future Capital Infrastructure Expansion Projects ✓ Current and Future Rolling Stock Expansion Projects ✓ Train Configuration Scenarios per Rail Network Section for Baseline Rail Network Configuration	

6.3.2 Rolling Stock Capacity Planning

This process determines the Rolling Stock requirements to meet demand taking into consideration constraints / bottlenecks, allocation rules and efficiency improvement initiatives. This produces the confirmed and unmet demand, spare capacity report, preferred optimal sequence and timing of rolling stock capacity expansions, model output confidence levels and a targeted availability and reliability level for the scenario.

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.1	The solution shall provide a report on confirmed and un-met demand (with reasons), as well as the resultant spare capacity.	Determine Rolling Stock Capacity Planning Requirements	✓ Validated Demand and Prioritisation Rules ✓ Value Chain Partners/ Train Operating Company Capacities, Availability, Constraints and	✓ Achievable Demand for the Scenario ✓ State which Rolling stock were not used or under utilized ✓ Preferred optimal sequence and
6.3.2.2	Rolling Stock Capacity Planning must include recommendation to optimise the maintenance plan.			
6.3.2.3	The solution shall utilize the railway simulation engine to evaluate the total TFR system performance impact of future locomotive and wagon fleet expansion / modification scenarios.			
6.3.2.4	The solution shall utilize various Rolling stock maintenance philosophies/scenarios e.g time-based, condition-based, consist maintenance to determine the most appropriate maintenance location based on required train running times in order to optimise usage and decrease downtime of rolling stock.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.5	The solution shall consider restrictive rail network conditions such as overhead power supply, axle mass loading, speed restrictions and signalling positions for consideration during simulation.		Operational Site Specifications ✓ Current MTS ✓ Rail Network Configurations ✓ Approved Service Specifications ✓ Transnet and TFR Strategy & Corporate Plan ✓ Rolling Stock Management Fleet and Strategy Plans ✓ Current and Future Rolling	timing of Rolling Stock Capacity Expansions ✓ Overall TFR System performance of each Rolling Stock Capacity Expansion Scenario ✓ Optimal Locomotive and Wagon Maintenance Schedule
6.3.2.6	The solution shall enable the creation of scenarios based on the parameters provided with regards to operational boundaries, allocation restrictions, rolling stock compatibility etc.			
6.3.2.7	The solution shall identify bottlenecks/constraints and provide the sequence of the resolution thereof during Rolling Stock Capacity planning.			
6.3.2.8	The solution shall apply rolling stock allocation rules during Rolling Stock Capacity planning.			
6.3.2.9	The solution shall interface with existing Asset Management Systems to upload maintenance schedules and availability for inclusion in the determination of Rolling Stock Capacity Planning requirements.			
6.3.2.10	The solution shall incorporate the availability and capacity of each type of facility (e.g. fuelling facility, sanding facility and wagon cleaning facility, staging facility) during the simulation process.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.11	The solution shall derive Rolling Stock Capacity Planning requirements for inclusion in the Capital Program project list.		Stock allocated capacity, Reliability Factors & Allocation Rules (Including Privately Owned Rolling Stock) ✓ Wagon / locomotive Maintenance Depot Capacities & Locations	✓ Projected Logistics Support Equipment Shortages / Surpluses ✓ Rolling Stock Capacity Requirements
6.3.2.12	The solution shall calculate locomotive and wagon requirements based on % parameterised efficiency if the train schedule is not met and include % parameterised technical allowance allowed for wagon and locomotives to be in maintenance.			
6.3.2.13	The solution shall have the capability to compare the total system performance of every rolling stock expansion / modification / ring fencing scenario using pre-defined system performance KPIs and rank and score simulation scenarios.			
6.3.2.14	The solution shall read from the Asset Management solution the modifications or conversions of existing rolling stock or purchasing of new rolling stock.			
6.3.2.15	The solution shall have the capability to determine the quantity of train equipment required based on a given Master Train Schedule scenario.			
6.3.2.16	The solution shall have the capability to provide a report on spare Rolling Stock capacity.			
6.3.2.17	The solution shall make provision to draw the information from the Master Train Schedule Capability.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.18	The solution shall consider the following to determine required rolling stock capacity: • Required demand • Demand prioritisation rules • Approved service specifications • Maintenance methodology • Allocation rules			
6.3.2.19	The solution shall provide the functionality to incorporate locomotive maintenance plans per asset to meet capacity requirements: • Maintenance plans per asset • Rolling stock facility availability			
6.3.2.20	The solution shall choose the correct types of locomotives and wagons for allocation based on reliability of assets.			
6.3.2.21	The solution shall determine the utilisation targets of the Locomotive and wagon types based on allocation.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.22	The solution shall provide the necessary functionality to incorporate the following in the scenarios: • Future procured locomotives • Planned retired locomotives • Planned retired wagons			
6.3.2.23	The solution shall provide the necessary functionality to calculate required capacity vs existing capacity.			
6.3.2.24	The solution shall optimise the use of maintenance locations based on the origin and destination of flow and to minimise the interruption of flows en route.			
6.3.2.25	The solution shall optimise maintenance capacity based on the origin and destination of flow and to minimise the interruption of flows en route.			
6.3.2.26	The solution shall identify optimal locations for new maintenance depots from simulated scenarios.			
6.3.2.27	The solution shall identify where excess rolling stock capacity is available and cannot be used due to restrictive rail network conditions.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.28	The solution shall use rolling stock facility and capacity as constraints during calculation of rolling stock capacity planning.			
6.3.2.29	The solution shall allow for the capturing of a percentage for technical maintenance allowance per fleet as a parameter for the simulation scenario.			
6.3.2.30	The solution shall allow for the capturing of a percentage efficiency per fleet as a parameter for the simulation scenario.			
6.3.2.31	The solution shall provide a report on the performance indicators for each scenario.			
6.3.2.32	The solution shall have the capability to compare different simulated scenarios.			
6.3.2.33	The solution shall have the capability to select one scenario as a baseline.			
6.3.2.34	The solution shall determine the quantity of train and auxiliary equipment. requirements per depot based on a scenario.			
6.3.2.35	The solution shall determine the facility processing capability and capacity requirements to support the given scenario.			
6.3.2.36	The solution shall propose optimisation of processing capabilities and capacities by identifying the most suitably located facility to support the given scenario.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.2.37	The solution shall identify optimal locations for new rolling stock facilities from simulated scenarios.			

6.3.3 Train Crew Capacity Planning

This process determines the total and optimal crew needs for the future train service scenarios. It covers the lifecycle from determination of crew capacity constraints / bottlenecks until implementation of the optimal chosen crew capacity creation and deployment plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.3.1	The solution shall have the capability to calculate the required Train Crew Capacity for given Master Train Schedule, validated demand and different crew working methodology scenarios e.g. roundtrip, book-off and/or cross point working.	Determine Train Crew Capacity Planning requirements	✓ Validated demand and Prioritisation rules for Customers and Train Operating Companies ✓ Train Crew Depot Locations, Strength, Matrix and Reliability Factors ✓ Train Crewing Working Methodologies /	✓ Projected Completed Train Crew trips ✓ Train Crew Productivity KPIs ✓ Train Crew Manpower Plan ✓ Confirmed and Unmet Demand
6.3.3.2	The solution shall have the capability to calculate the Train Crew Depot Strength which consists of weekly rest, leave, absenteeism, training, stand-by, relief, recovery and train preparation requirements for Local & Yard Schedules and Mainline Train activities.			
6.3.3.3	The solution shall optimise the location of Train Crew depots to improve Train Crew efficiency and utilisation.			
6.3.3.4	The solution shall determine the Train Crew productivity KPIs e..g completed trips, kilometres travelled per period, etc.			
6.3.3.5	The solution shall determine the capacity and optimal location of book off facilities.			
6.3.3.6	The solution shall provide a Train Crew Manpower Plan.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.3.7	The solution shall identify demand that will not be met given the manpower plan report (shortages).		Working Regulations ✓ Current Location and Capacity of book-off facilities where applicable ✓ Locomotive deployment strategy ✓ Service Design Specifications ✓ Master Train Schedule ✓ Train Crew Continuous Professional	
6.3.3.8	Train Crew availability and Continuous Professional Learning rules are obtained from Train Crew Management solution and contain working regulations as agreed with recognised trade unions.			
6.3.3.9	The solution shall consider the following as input: • Train Crew depot quantities and their locations, • Train Crew availability rules • Train Crew allocation rules • Train Crew qualification (categorisation, locomotive and route) • Train Crew reliability factors			
6.3.3.10	The solution shall identify the recruitment requirements for the manpower plan for the scenario.			
6.3.3.11	The solution shall provide the confirmed demand for the scenario with the available Train Crew.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.3.3.12	The solution shall provide the unmet demand for the scenario with the available Train Crew.		Learning Requirements ✓ Recruitment and Training Strategy ✓ Train Crew Master Data	

6.4 Production Planning Requirements

6.4.1 Compile Production Plan

The production plan is compiled to deliver customer services. This process integrates validated orders, backlog orders from previous production planning period(s), resource distribution requirements, mainline, local and yard schedule activities to create an optimal and balanced production plan for the next production planning period, whilst in the process identifying spare capacity for sale to Customers by Commercial.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.1	The solution shall merge validated orders including backlog orders from previous production planning period(s) with the Resourced Base Train Plan to determine the un-resourced production plan.			✓ Publish Optimal and Balanced

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.2	The solution shall use demand prioritisation rules to resolve conflicts in matching orders to available capacity in order to produce the un-resourced production plan.	Compile Production Plan	✓ Validated Orders and Prioritisation Rules ✓ Actual Position & Time(Events) of Trains & Assets ✓ Value Chain Partners/ Train Operating Company Capacities and Constraints ✓ Service Pricing and Costing Parameters	Production Plan ✓ Confirmed Orders Report including alternatives ✓ Spare Capacity Report ✓ Unmet Orders report with reasons ✓ Meet and Pass Plan
6.4.1.3	The solution shall consider all operational site capabilities, capacities and constraints.			
6.4.1.4	The solution shall allocate resources to the un-resourced production plan based on resource availability, position and capability.			
6.4.1.5	The solution shall use the wagon and locomotive distribution processes, as well as crew allocation processes as input to derive the production plan.			
6.4.1.6	The solution shall consolidate and simulate the production plan with allocated orders and resources.			
6.4.1.7	The solution shall identify train imbalances and bottlenecks and propose solutions to resolve these when producing a production plan.			
6.4.1.8	The solution shall propose demand smoothing options to maximise the utilization of resources as well as to balance the train service for the production period.			
6.4.1.9	The solution shall extract KPIs from the Production Plan e.g. resource turnaround, dwell & idle times, total planned volume and profitability.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.10	The solution shall provide a report on the balancing of resources for the production plan scenario.		✓ Deviation Re-planning Requirements (Including Backlog Orders) ✓ Wagon Cycle & Turn Around Time Data ✓ Train Crew, Wagons and Locomotive Availability, Position & Capability ✓ Network Availability and	✓ Wagon Distribution Plan ✓ Locomotive Distribution Plan ✓ Crew Allocation Plan ✓ Generated Works Orders from Production Plan for Production Period
6.4.1.11	The solution shall allow the user to evaluate the performance, balance and optimal design of the simulated plan before it is published for execution.			
6.4.1.12	The solution shall generate yard schedules which include pre-departure and post-arrival countdown activities in preparation of mainline and local train activities.			
6.4.1.13	The solution shall generate local schedules which specify pickup and delivery schedules within rail complexes.			
6.4.1.14	The solution shall publish the locomotive and wagon distribution plans as well as the Train Crew allocation plan.			
6.4.1.15	The solution shall determine Train Crew transportation requirements excluding home to work travel based on the Train Crew allocation to the production plan.			
6.4.1.16	The solution shall provide reports for approved occupations, declined occupations, confirmed orders, demand smoothing alternatives, spare capacity as well as unmet orders with reasons from the solution.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.17	The solution shall have the capability to manually capture the reasons for the unmet orders on the solution as input into the report.		Maintenance Schedule ✓ Resource Based Train Plan ✓ Wagon Maintenance Schedule per Maintenance Facility ✓ Locomotive Maintenance Schedule per Maintenance Facility ✓ Targeted KPI's	✓ Published Yard and Local Plan (Including Pre-departure Countdown activities)
6.4.1.18	The solution shall provide TFR's Train Authorisation systems with meet and pass information as well as the order in which the trains must be authorised in order to provide decision support for Train Control Officers/ Dispatchers.			
6.4.1.19	The solution shall interface with Value Chain Partners' Production Planning systems to enable the displaying of their production plans on shared rail networks.			
6.4.1.20	The solution shall display services operated by TFR.			
6.4.1.21	The solution shall create a graphical view of the Production Plan train diagram.			
6.4.1.22	The solution shall generate unique train numbers and allocate to the Production Plan. The train number integrity management should adhere to the following rules: i. The train number should include the unique slot number allocated to the slot. ii. The train number must be maintained from origin to destination of the train and applied to all train movements on the network.			

ID #	Functional Requirements	Business Process	Inputs	Output
	iii. The same train number must not be allocated to two trains that are planned to be en-route at the same time or if an original train did not arrive at it's destination. iv. Two or more trains with the same number must not be allowed on the network within the plannig period. v. The train number should allow the business systems and operators to identify at least the train configuration, commodity, train length, loaded or empty status, direction of train, the service specification and slot linked to the train. vi. The different train types must be identifiable e.g. original planned freight, original planned passenger, re-scheduled trains linked to the original planned trains, re-planned trains linked to the original trains, dangerous goods trains and ad-hoc trains; vii. The train configuration and consist detail of the unique train must be made available for viewing. viii. Train numbering options are as follows: a. Static repetitive MTS with slot numbers for the repetitive slots			

ID #	Functional Requirements	Business Process	Inputs	Output
	b. Unique train numbers for each train in the production planning period. c. The train number can be a unique 4 digit number or the loco number of the leading loco. d. Reschedule or replanned trains can add two unique identifiers for the train type or it can utilise the second digit to indicate if it is a original, replanned or rescheduled train.			
6.4.1.23	The solution shall create a tabulated view of the Production Plan.			
6.4.1.24	The solution shall re-plan staged trains from the previous production period in the current production period.			
6.4.1.25	The solution shall take Rail Network Occupations into account.			
6.4.1.26	The solution shall interface with a Capacity Planning Solution to obtain blocking rules to ensure adherence to the rules during re-planning.			
6.4.1.27	The solution shall consolidate and integrate resource distribution plans and capacity into the production plan.			
6.4.1.28	The solution shall produce a report indicating possible resource imbalances for the simulated production plan scenario.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.29	The solution shall provide detailed planned activities to the ROAM program for the generation and publishing of works orders.			
6.4.1.30	The solution shall enable other systems/users to view the approved production plan in different dimensions e.g. per depot, corridor and customer time appointments.			
6.4.1.31	The solution shall have the capability to manually decline occupations with reasons.			
6.4.1.32	The solution shall have the capability to select root cause analyses reasons for the unmet orders.			
6.4.1.33	The solution shall have the capability to select a suitable bottleneck resolution option for application in the creation of the production plan..			
6.4.1.34	The solution shall have the capability to select a suitable demand smoothing option for application in the creation of the production plan.			
6.4.1.35	The solution shall have the capability to select a suitable train imbalance correction option for application in the creation of the production plan..			
6.4.1.36	The solution shall have the capability to accept or decline a simulated scenario before publishing the production plan.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.37	The solution shall produce a meet-and-pass plan for the execution of the production plan.			

6.4.2 Compile Wagon Distribution Plan

This process is initiated from the production plan process to compile an optimal wagon distribution plan by assigning wagons to the un-resourced production plan. The capability assesses current and projected wagon availability and positions, and proactively distributes and allocate wagons to where they will be needed to fulfil validated orders as per the wagon allocation rules. This process also produces the wagon shortages and surpluses report in relation to validated orders.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.2.1	The Wagon Distribution Plan must be done per wagon identity (wagon number), quantity and type resolution.	Compile Wagon Distribution Plan	✓ Validated Customer Orders, Prioritisation Rules, Contractual Requirements, Auxiliary Equipment Requirements & Wagon	✓ Optimised Macro Distribution Plan including movements to Wagon Facilities and Maintenance Depots ✓ Optimised Micro Distribution
6.4.2.2	The solution shall integrate the Wagon Distribution Plan into the final resourced production plan for the next production planning period.			
6.4.2.3	The solution shall make provision for the capturing and maintenance of wagon distribution rules.			
6.4.2.4	The solution shall identify available wagons by type and quantity to satisfy validated orders according to the approved and validated service specification.			
6.4.2.5	The solution shall use the wagon maintenance plans and wagon facility capacities, capabilities and requirements (specifying where, when and for which commodities they have to be cleaned) to determine required wagon movements to/from maintenance depots and wagon cleaning facilities			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.2.6	The solution shall plan the distribution of customer owned and over border wagons, assessing current and projected wagon availability and position, allocation requirements, and maintenance schedules for these wagons.		Preparation Requirements ✓ Published production Plan and Unresourced production Plan ✓ Inter, Intra & Adhoc Demand ✓ Real Time Current Position of Wagons ✓ Production Plan Replannng Requirements ✓ Wagon Preparation &	Plan including movements to Wagon Facilities and Maintenance Depots ✓ Optimised Auxiliary Equipment Distribution Plan
6.4.2.7	The solution shall include the assessment of wagon queues (at origin, en route and at destination) when optimising wagon distribution.			
6.4.2.8	The solution shall optimise wagon movements based on demand prioritisation rules.			
6.4.2.9	The solution shall provide wagon shortages and surpluses after performing wagon distribution optimisation and distribute surplus wagons to best holding areas to serve future demand.			
6.4.2.10	The solution shall identify TFR owned wagons in neighbouring countries and wagon distribution activities for those wagons in the neighbouring countries.			
6.4.2.11	The solution shall extract KPIs from the Wagon Distribution Plan e.g. resource turnaround, dwell & idle times, total planned volume and utilisation.			
6.4.2.12	The solution shall identify required auxiliary equipment per wagon based on the auxiliary equipment availability and allocation rules.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.2.13	The solution shall identify trackable and non-trackable auxiliary equipment required to satisfy the validated orders as per the wagon identification for those orders.		Distribution Rules ✓ Wagon Distribution Plan Deviation & Re-planning Requirements ✓ Auxilliary Equipment Requirement per Wagon ✓ Wagon Availability and Allocation Rules ✓ Wagon Cleaning Facility Capacity,	
6.4.2.14	The solution shall provide a report of non-trackable auxiliary equipment requirements per area to satisfy the validated orders.			
6.4.2.15	The solution shall create a distribution plan for the trackable equipment based on the current position, availability of the equipment to the required area for use to satisfy the validated orders.			
6.4.2.16	The solution shall provide auxiliary equipment shortages and surpluses per defined area after performing wagon distribution optimisation.			
6.4.2.17	The solution shall determine optimal empty wagon flows between hubs to satisfy validated orders.			
6.4.2.18	The solution shall define the required macro wagon flows for distribution to satisfy the validated orders considering demand prioritisation rules, wagon preparation rules and maintenance requirements.			
6.4.2.19	The solution shall define the required micro flows within yard complexes as follows:			

ID #	Functional Requirements	Business Process	Inputs	Output
	i. To and from sidings to satisfy all validated orders in time and in full ii. To satisfy all movements to and from wagon facilities. iii. To satisfy all movements to and from maintenance facilities.		Capability and Availability ✓ Wagon Movement Requirement to Maintenance Facility by Wagon Number ✓ Wagon Real Time Conditioning Monitoring Results ✓ Trackable and Non-trackable Auxilliary Equipment Availability	
6.4.2.20	The solution shall consider actual current wagon turnaround times and their location when compiling the wagon distribution plan.			
6.4.2.21	The solution shall have the capability to capture KPI definitions for the wagon distribution.			
6.4.2.22	The solution shall propose surplus trackable auxiliary equipment to address the shortages.			
6.4.2.23	The solution shall have the capability to accept or reject the proposed trackable auxiliary equipment shortage solutions.			
6.4.2.24	The solution shall make provision for service and/or flow-specific ring fences – e.g., Export Iron Ore ring-fence wagons, Jet Fuel, Chrome/Ferrochrome flows.			
6.4.2.25	The solution shall optimise wagon movements based on profitability in the case where customer demand is higher than wagon availability.			

6.4.3 Compile Locomotive Distribution Plan

This process is initiated from the production plan process to compile an optimal locomotive distribution plan by assigning locomotives to the un-resourced production plan. The capability assesses current and projected locomotive availability and positions, and proactively distributes and allocate locomotives to where they will be needed to fulfil to the requirements from the production plan. This process also produces the locomotives shortages and surpluses report in relation to validated orders.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.1	The solution shall compile a locomotive distribution plan as part of the production planning process.	Compile Locomotive Distribution Plan	✓ Validated Customer Orders & Prioritisation Rules ✓ Published production Plan and Unresourced production Plan ✓ Locomotive Distribution Plan Deviation & Re-	✓ Locomotive Distribution Plan including movements to Locomotive Facilities and Maintenance Depots ✓ Locomotive Surpluses/Shortages In Relation to Demand
6.4.3.2	The solution shall identify available locomotives by type and quantity to satisfy trains as per the unresourced production plan.			
6.4.3.3	The solution shall use the locomotive maintenance plans and locomotive facility capacities, capabilities and requirements to determine required locomotive movements to/from maintenance depots and locomotive facilities.			
6.4.3.4	The solution shall identify required locomotive repositioning movements e.g. deadheads (additional locomotives in a train consist, not providing traction power, for repositioning purposes) or light locomotives (locomotives running in a consist without a load for repositioning purposes).			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.5	The solution shall consider the allocation of customer owned and over border locomotives to trains considering the contractual agreements between TFR and the customer or over border railways.		planning Requirements ✓ Locomotive Availability and Allocation Rules ✓ Train Equipment Availability ✓ Locomotive Movement Requirement to Maintenance Facility by Locomotive Number ✓ Locomotive Real Time	✓ Allocated Locomotives to trains by number ✓ Train Equipment Distribution Plan
6.4.3.6	The solution shall compile a locomotive distribution plan to serve as input into the production planning process.			
6.4.3.7	The solution shall incorporate current and projected locomotive and train equipment availability and position, to proactively distribute locomotives to where they are required next as determined by the production plan.			
6.4.3.8	The solution shall apply locomotive allocation rules during the allocation of locomotives, at locomotive ID level / consist, to the un-resourced production plan.			
6.4.3.9	The solution shall proactively highlight locomotive shortages and surpluses when allocating locomotives to trains.			
6.4.3.10	The solution shall include locomotive movements to and from maintenance facilities in the distribution plans.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.11	The solution shall include locomotive movements to and from locomotive facilities in the distribution plans.		Conditioning Monitoring Results ✓ Locomotive Preparation & Distribution Rules ✓ Locomotive Cycle Time Data ✓ Real Time Current Position of Locomotive & Train Equipment	
6.4.3.12	The solution shall distribute locomotives to replanned trains and update locomotive distribution plans, when deviations occur.			
6.4.3.13	The solution shall optimise locomotive distribution to improve given locomotive performance measures.			
6.4.3.14	The solution shall extract KPIs from the Locomotive Distribution Plan e.g. resource turnaround, dwell & idle times, total planned volume and utilisation, Gross ton per Kilometer per Locomotive, Gross ton Kilometer per Locomotive, Net ton Kilometer per Locomotive, Actual Locomotive Cycle Time vs Design, Locomotive Kilometers per period, Locomotive Time Spent Hauling locomotives vs Design.			
6.4.3.15	The solution shall indicate areas of locomotive shortages and surplus to enable reallocation of surplus locomotive to address shortages.			
6.4.3.16	The solution shall identify train equipment to support the locomotive movements.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.17	The solution shall use the current position and status, develop a train equipment distribution plan to support the locomotive distribution plan.			
6.4.3.18	The solution shall indicate areas of train equipment shortages and areas of surplus to enable reallocation of surplus train equipment to address shortages.			
6.4.3.19	The solution shall integrate the locomotive and train equipment distribution plans into the production planning process for the next planning period.			
6.4.3.20	The solution shall optimise efficiency and effectiveness of locomotive movements.			
6.4.3.21	The solution shall consider maximum utilisation of locomotives when compiling the locomotive distribution plan.			
6.4.3.22	The solution shall have the capability to capture KPI definitions for locomotive distribution.			
6.4.3.23	The solution shall provide the capability to accept or reject the proposed shortage solutions.			
6.4.3.24	The solution shall consider location and change status when compiling an optimised Train Equipment distribution plan.			

6.4.4 Train Crew Allocation Planning

This process is initiated from the production plan process to compile an optimal train Crew allocation plan by assigning train crew to the un-resourced production plan. The capability assesses current and projected train crew availability and position, and proactively distributes and allocate train crew to where they will be needed to fulfil the requirements of the Production plan. Train Crew are essential input resources for creating a feasible Production Plan. The Production Plan cannot be executed without enough Train crew of the right category and qualifications. This process also produces the train crew shortages and surpluses report.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.4.1	The solution shall compile the Train Crew Allocation plan as part of the production planning process.	Compile Train Crew Allocation Plan	✓ Unresourced Production Plan ✓ Production Plan Replanning Requirements ✓ Train Crew Allocation Rules & Train	✓ Optimal Train Crew Allocation for Production Plan ✓ Report on Confirmed and Unmet Demand
6.4.4.2	The solution shall allocate train crew to the unresourced production plan while considering the locomotive types allocated to the train slots as well as the route knowledge incorporated in the production plan from the service specification.			
6.4.4.3	The solution shall consider and make use of the Train Crew availability, position, category and qualification / certification to allocate Train crew to the un-resourced production plan.			
6.4.4.4	The solution shall consider the rules that govern shift patterns, rest periods and permissible overtime hours.			
6.4.4.5	The solution shall accept the locomotive distribution plan as input.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.4.6	The solution shall utilize EMDM re-planning requirements as input when deviations occur, in order to revise all Train Crew allocation plans.		Crew Qualification ✓ Train Crew Availability and Position ✓ Shift Patterns, Rest and Overtime Rules ✓ Driver Categorisation ✓ Status on Train Driver Licenses	✓ Roster Surplus / Shortages of Train Crew with Reasons
6.4.4.7	The solution shall be based upon identified areas of both roster surplus and shortages, allow the user to initiate manual intervention to balance out the roster surplus and shortages e.g. shift swops, neighbouring depot support, and generate trended reports on this action.			
6.4.4.8	The solution shall extract Train Crew Productivity KPI reports (e.g., Driver Kilometers per period, number of trips completed per period within shift and shift length exceedings, etc).			
6.4.4.9	The solution shall Determine Train Crew transportation requirements excluding home to work travel in allocating Train Crew to the production plan.			
6.4.4.10	The solution shall compile the Train Crew Allocation plan which consists of these outputs: • Optimal Train Crew Allocation for Production Plan • Report on Confirmed and Unmet Demand • Roster Surplus / Shortages of Train Crew with Reasons			
6.4.4.11	The solution shall integrate the Train Crew allocation plan into the Production Plan process			

6.4 Execution Monitoring and Deviation Managment (EMDM).

6.4.1 Train Crew Execution Monitoring and Deviation Management

This process ensures the efficient execution of the Train Crew Allocation Plan by monitoring the activities that support the execution of Train Crew Allocation Plan and taking corrective action when deviations occur to maintain the integrity of the Train Crew Allocation Plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.1.1	The Solution shall ensure the efficient execution of the Train Crew Allocation Plan by monitoring the activities that support the execution of the plan and taking corrective action when deviations occur to maintain the integrity of the Train Crew Allocation Plan.	Monitor Train Crew Execution	✓ Production Plan, ✓ Optimal Train Crew Allocation Plan, ✓ Train Crew Availability and Position, ✓ Train Crew Transportation Requirements,	✓ Train Crew Re-planning Requirements ✓ Train Crew Deviation Root Cause Analysis Report ✓ Train Crew Productivity KPI Report
6.4.1.2	The Solution shall monitor the Train Crew Allocation Plan based on deviations occurring during execution of countdown activities as well as current positions of trains and assets.			
6.4.1.3	The Solution shall determine remaining journey time from the actual train trip, evaluate available Train Crew shift time and determine if relief Train Crew will be required to complete the trip.			
6.4.1.4	The Solution shall generate deviation reports with root cause analysis for deviations from the Train Crew Allocation Plan.			
6.4.1.5	The Solution shall issue Train Crew with an instruction to board the train at the designated location if relief Train Crew is required.			

6.4.1.6	The Solution shall Interface with the EMDM Production Planning Traffic Regulator processes to determine and effect replanning requirements for the Train Crew Allocation Plan.		✓ Actual Positions & Time of Trains & Assets at yards and en route, ✓ Yard Countdown Activity Status, ✓ Train Crew Allocation Rules and ✓ Train Deviation Re-Planning Requirements	
6.4.1.7	The Solution shall provide impacts on Train Crew Productivity KPI reports (e.g., Driver Kilometers per period, number of trips completed per period within shift and shift length exceeding's, etc).			
6.4.1.8	The Solution shall identify if Train Crew did not report for duty as per the countdown activities.			
6.4.1.9	The Solution shall determine the impact of the non-availability of the Train Crew.			
6.4.1.10	The Solution shall send the new allocations to the Train Crew Management solution for issuing of amended works orders.			
6.4.1.11	The Solution shall identify impacts on Train Crew for delays of train movements			
6.4.1.12	The Solution shall identify the standby Train Crew that are on duty.			
6.4.1.13	The Solution shall have the capability to manually allocate the standby Train Crew to the train.			
6.4.1.14	The Solution shall have the capability to determine the root cause of the deviation by listing historical occurrences/ executed activities related to the deviated activity.			
6.4.1.15	The Solution shall have the capability to manually capture the root cause for the Train Crew delay.			
6.4.1.16	The Solution shall share the deviation report including reasons and root cause analysis to the TCO and Traffic Regulator monitoring solutions for impact analysis.			

6.4.1.17	The Solution shall recalculate the Train Crew Productivity KPI reports incorporating the deviations.			
6.4.1.18	The Solution shall allow for the comparison of the recalculated KPIs against KPIs calculated during planning.			

6.4.2 **Locomotive Execution Monitoring and Deviation Management**

This process ensures the efficient execution of the Locomotive Distribution Plan by monitoring the activities that support the execution of Locomotive Distribution Plan and taking corrective action when deviations occur to maintain the integrity of the Locomotive Distribution Plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.2.1	The solution shall ensure the efficient execution of the Locomotive Distribution Plan by monitoring the activities that support the execution of Locomotive Distribution Plan and taking corrective action when deviations occur to maintain the integrity of the Locomotive Distribution Plan.	Monitor Locomotive Execution	✓ Production Plan, ✓ Train Equipment Availability ✓ Locomotive Movement	✓ Locomotive Distribution Re-planning Requirements ✓ Locomotive Distribution Deviation Root
6.4.2.2	The solution shall enable the monitoring of the Locomotive Distribution Plan based on deviations occurring during execution of countdown activities as well as current positions of trains and assets.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.2.3	The solution shall in the event of deviations occurring, enable the identification of surplus locomotives in the same depot, before considering swop of other available locomotives.		Requirements to Maintenance Facilities, ✓ Locomotive Availability and Position, ✓ Locomotive Distribution Rules, ✓ Locomotive Maintenance Facilities Capacity and Availability, ✓ Locomotive Distribution Plan	Cause Analysis Report ✓ Locomotive Productivity KPI Report ✓ Confirmed Availability of Locomotives and Train Equipment for Next Distribution Period.
6.4.2.4	The solution shall consider parameters like arrival time of delayed locomotive, preparation activities of the locomotive after arrival etc when swopping locomotives.			
6.4.2.5	The solution shall allow for the manual capturing of swopping rules and parameters.			
6.4.2.6	The solution shall provide deviation reports with root cause analysis for deviations from the Locomotive Distribution Plan.			
6.4.2.7	The solution shall Interface with the EMDM Production Planning Traffic Regulator processes to determine and effect replanning requirements for the Locomotive Distribution Plan.			
6.4.2.8	The solution shall provide impacts on Locomotive Distribution Plan KPI reports e.g. resource turnaround, dwell & idle times, total planned volume and utilisation, Gross ton per Kilometer per Locomotive, Gross ton Kilometer per Locomotive, Net ton Kilometer per Locomotive, Actual Locomotive Cycle Time vs Design, Locomotive Kilometers per period, Locomotive Time Spent Hauling locomotives vs Design.			
6.4.2.9	The solution shall identify if locomotives are not available for execution as per the countdown activities.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.2.10	The solution shall determine the impact of the non-availability of locomotives.		✓ EMDM Production Plan Execution Monitoring (TCO) & Impact Assessment Processes ✓ Actual Positions & Time (Events) of Locomotives and Train Equipment, ✓ Yard Countdown Activity Status.	
6.4.2.11	The solution shall identify surplus locomotives in the same depot for allocation.			
6.4.2.12	The solution shall have the capability to manually allocate the locomotives to trains to manage the deviations.			
6.4.2.13	The solution shall send the new allocations to the Asset Management solution for issuing of amended works orders.			
6.4.2.14	The solution shall have the capability to determine the root cause of the deviation by listing historical occurrences/ executed activities related to the deviated activity.			
6.4.2.15	The solution shall have the capability to manually capture the root cause for locomotive delay.			
6.4.2.16	The solution shall share the deviation report including reasons and root cause analysis to the TCO and Traffic Regulator monitoring solutions for impact analysis.			
6.4.2.17	The solution shall recalculate the locomotive productivity KPI reports incorporating the deviations.			
6.4.2.18	The solution shall allow for the comparison of the recalculated KPIs against KPIs calculated during planning.			

6.4.3 **Wagon Execution Monitoring and Deviation Management**

This process ensures the efficient execution of the Wagon Distribution Plan by monitoring the activities that support the execution of Wagon Distribution Plan and taking corrective action when deviations occur to maintain the integrity of the Wagon Distribution Plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.1	The Solution shall enable the efficient execution of the Wagon Distribution Plan by monitoring the activities that support the execution of the plan and taking corrective action when deviations occur to maintain the integrity of the Wagon Distribution Plan.	Monitor Wagon Execution	✓ Wagon Distribution Plan; ✓ Production Plan; ✓ Trackable Auxiliary Equipment Distribution Plan; ✓ Auxiliary Equipment Availability; ✓ Wagon Movement	✓ Wagon Distribution Re-planning Requirements ✓ Wagon Distribution Deviation Root Cause Analysis Report
6.4.3.2	The Solution shall enable the monitoring of the Empty Wagon Distribution Plan based on deviations occurring during execution of countdown activities as well as current positions of trains and assets.			
6.4.3.3	The Solution shall enable the monitoring of the Trackable Auxiliary Equipment Distribution plan as well as delivery and collection of non-trackable auxiliary equipment for use during loading of wagons.			
6.4.3.4	The Solution shall enable the monitoring of the loaded wagon movements based on deviations occurring during execution of countdown activities as well as current positions of trains and assets.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.5	The Solution shall in the event of deviations occurring, enable the identification of surplus wagons of the same or similar types in the same depot and the nearest holding yard.		Requirements to Maintenance and Cleaning Facilities; ✓ Wagon Availability, Position and Status; ✓ Wagon Distribution Rules; ✓ Wagon Maintenance and Cleaning Facilities, Capacity and Availability;	✓ Wagon Productivity KPI Report ✓ Confirmed Availability of Empty Wagons and Auxilliary Equipment.
6.4.3.6	The Solution shall generate deviation reports with reasons and root cause analysis for deviations from the Wagon Distribution Plan and Trackable Auxiliary Equipment Distribution Plan.			
6.4.3.7	The Solution shall Interface with the EMDM Production Planning Traffic Regulator processes to determine and effect replanning requirements for the Wagon Distribution Plan.			
6.4.3.8	The Solution shall provide predefined Wagon Productivity KPI reports e.g. Wagon Turnaround time, Wagon Cycle Time, Wagon Idle Time, Wagon Dwell Time vs Designed Dwell Time, Empty to Loaded Wagon Ratio, Tons per Wagon, Percentage Empty Wagon Assigned to Production Plan and Tons per Wagon.			
6.4.3.9	The solution shall receive notification about execution of the wagon distribution plan from Asset Management Solution.			
6.4.3.10	The solution shall identify if wagons are not available for execution as per the countdown activities.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.11	The solution shall determine the impact of the non-availability of wagons.		✓ EMDM Production Plan Execution Monitoring(TCO) and Impact Assessment Processes ✓ Actual Positions & Time (Events) of Trains and Assets; and ✓ Yard Countdown Activity Status.	
6.4.3.12	The solution shall have the capability to manually allocate the wagons to orders to manage the deviations.			
6.4.3.13	The solution shall send the new allocations to the Asset Management solution for issuing of amended works orders.			
6.4.3.14	The solution shall have the capability to determine the root cause of the deviation by listing historical occurrences/ executed activities related to the deviated activity.			
6.4.3.15	The solution shall have the capability to manually capture the root cause for the wagon delay.			
6.4.3.16	The solution shall have the capability to manually capture the root cause for the auxiliary equipment delay.			
6.4.3.17	The solution shall share the deviation report including reasons and root cause analysis to the TCO and Traffic Regulator monitoring solutions for impact analysis.			
6.4.3.18	The solution shall recalculate the wagon productivity KPI reports incorporating the deviations.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.3.19	The solution shall allow for the comparison of the recalculated KPIs against KPIs calculated during planning.			

6.4.4 **TCO: Production Plan Execution Monitoring and Deviation Management.**

This process takes on a system approach and is responsible for balancing train traffic flow within different sections and sub-sections of the rail system capacity to ensure traffic flow fluidity whilst maximizing network velocity and minimizing yard blockages and the staging of trains during the execution of the production plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.4.1	The solution shall enable the efficient execution of the production plan by ensuring monitoring of the activities that support the execution of trains through the sections and enable corrective actions to be taken when deviations occur to maintain the integrity of the production plan.	Production Plan Execution Monitoring	✓ Production Plan and Diagram View; ✓ Meet-pass plan; ✓ Actual real-time environmental conditions; ✓ Incidents impacting Train Operations; ✓ Approved Service Specifications,	✓ Deviations detected for mainline, yard and Terminal plans with reasons ✓ Deviation re-planning requirements for locomotive, wagons and train crew
6.4.4.2	The solution shall enable the TCO to monitor that pre-execution countdown activities for D -1 (the day preceding the operation) are carried out to ensure the efficient and successful handover of trains from the yards to the TCO for execution of the day of operation.			
6.4.4.3	The solution shall enable an automated process to track handover of trains and train consist information to the TCO or Yard Operations Manager at the departing yard, intermediate yard, fringe locations and destination yards.			
6.4.4.4	The solution shall enable the request for arrival and workflow the handover process to enable accurate tracking of activities required during handover.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.4.5	The solution shall enable the evaluation of the electrical power supply in the sections and raise early warnings to the TCO when the power supply is reaching the defined thresholds for consideration prior to approval of train departures in the section.		deviation thresholds and buffers; ✓ Actual Positions of trains and asset in corridors and sections; ✓ Train Crew time to complete trip; ✓ Yard Countdown Activity Status; ✓ Local Value chain partner	distribution plans, ✓ Deviation re-planning requirements for Production Plan ✓ To ensure the smooth and safe running of trains and adherence to schedule ✓ TCO decision support for meet and pass
6.4.4.6	The solution shall enable a real-time view of train positions in the sections and the yards for monitoring.			
6.4.4.7	The solution shall enable the activation of the technical teams to perform inspections if the power supply is insufficient or exceeded the thresholds.			
6.4.4.8	The solution shall enable the TCO to evaluate responses from the technical team and identify trains that can be moved through the section with the limited capacity.			
6.4.4.9	The solution shall if an emergency occupation is required, enable the TCO to submit the request with reasons to the Traffic Regulator for evaluation and approval.			
6.4.4.10	The solution shall enable the TCO to perform root cause analysis on any delays and incidents by identifying the related activities and the execution status and scheduled adherence of those activities.			
6.4.4.11	The solution shall enable to TCO to receive automated notifications or manually capture possible disruptions that can impact trains running in the section. The functionality			

ID #	Functional Requirements	Business Process	Inputs	Output
	should allow the TCO to identify the type and exact position of the disruption for evaluation and action.		deviation notifications; ✓ Overborder Value chain partner deviation notifications; ✓ Actual real-time power consumption information, deviation thresholds and buffers; and ✓ Actual real-time track and train conditions	✓ Deviation Root cause analysis report
6.4.4.12	The solution shall enable the TCO to request the relevant departments to investigate the disruptions and receive feedback on the investigation.			
6.4.4.13	The solution shall utilise the predefined buffers and thresholds that were defined in the service specifications to proactively provide early-warning on potential deviations in the sections and subsequently highlight any secondary impact to trains in the Production Plan.			
6.4.4.14	The solution shall enable communication to customers on the progress of their consignments based on the actual status of the trains be it on-time or delayed.			
6.4.4.15	The solution shall identify differences between the actual train movements and the planned movements on the production plan.			
6.4.4.16	The solution shall compare actual movements to planned movements for pre-execution and countdown activities and identify any disruptions.			
6.4.4.17	The solution shall consider the identified thresholds to determine if a disruption should be classified as a deviation.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.4.18	The solution shall identify the delay of execution of countdown activities that could impact the execution of the Train Allocation Plan.			
6.4.4.19	The solution shall recalculate estimated time of arrival using current position, enroute performance and production plan.			
6.4.4.20	The solution shall generate user alerts for deviations.			
6.4.4.21	The solution shall allow the user to capture reasons for the deviation after the investigation is completed.			
6.4.4.22	The solution shall calculate actual locomotive utilisation and efficiency KPIs. e.g. number of hours that locomotives are used in a 24-hour period, % time spent hauling trains, Gross Ton Kilometers/locomotive, Nett Ton Kilometers/locomotive, locomotive kilometers over a given period).			
6.4.4.23	The solution shall calculate actual wagon utilisation and efficiency KPIs. (e.g. dwell time, idle time, turnaround time).			
6.4.4.24	The solution shall calculate actual Train Crew utilisation and efficiency KPIs. (e.g. productive time vs promised shift, driver kilometers, overtime trends).			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.4.25	The solution shall determine successful execution of occupation plans (Scheduled start & finish vs actual start & finish, % execution of plan).			
6.4.4.26	The solution shall determine successful execution of rolling stock maintenance plans (Scheduled start & finish vs actual start & finish, % execution of plan).			
6.4.4.27	The solution shall have the capability to receive automated and manual inputs and incorporate deviations reported by Value Chain Partners.			
6.4.4.28	The solution shall monitor, detect and issue warnings related to Train crew on-shift-time.			
6.4.4.29	The solution shall report actual performance KPIs (e.g. On-Time Performance, Deviation Alerts and Deviation reasons for all parts of the Mainline Integrated Train Plan).			
6.4.4.30	The solution shall determine re-planning requirements for impacted production plan.			
6.4.4.31	The solution shall track the execution of Yard Works Orders.			

6.4.5 **Rail Traffic Regulator: Production Plan Execution Monitoring and Deviation Management.**

This process takes on a system approach and is responsible for balancing train traffic flow with the rail system capacity to ensure traffic flow fluidity whilst maximizing network velocity and minimizing yard blockages and the staging of trains during the execution of the production plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.5.1	The solution shall enable the efficient execution of the production plan by ensuring monitoring of the activities that support the execution of trains on the production plan and enable corrective actions to be taken when deviations occur to maintain the integrity of the production plan.	Production Plan Execution Monitoring Traffic Regulator	✓ Production Plan and Diagram View; ✓ Meet-pass plan; ✓ Actual real-time environmental conditions; ✓ Incidents impacting Train Operations; ✓ Approved Service Specifications, deviation thresholds and buffers; ✓ Actual Positions of trains and asset in corridors and sections; ✓ Train Crew time to complete trip;	✓ Deviations detected for mainline, local yard & Terminal plans, with reasons ✓ Deviations re-planning requirements for Locomotive,
6.4.5.2	The solution shall Enable the Traffic Regulator to monitor that pre-execution monitoring countdown activities for D -1 (the day preceeding the operation) are carried out to ensure efficient and successful execution of the day of operation production plan are still intact to ensure: i. Resources that will enable the execution of trains in the next 24 hours are still in place and flowing to their planned			

	destinations to enable the start-up of the next day's production plan execution. ii. Trains that are being built in the yard in both TFR and Value Chain Partner sidings / yards are in accordance with the published production plan. iii. In-section authorisation of trains is in line with the production plan and achieves maximised network velocity and train traffic-flow fluidity.		✓ Yard Countdown Activity Status; ✓ Local Value chain partner deviation notifications; ✓ Over boarder Value chain partner deviation notifications; ✓ Actual real-time power consumption information, deviation thresholds and buffers; and ✓ Actual real-time track and train conditions. ✓ Early warning: If the resource conditions detected warnings from the condition equipment, report asset, position and reason. ✓ Deviation report: If the resource conditions detected alerts from	Wagon and Train Crew Distribution Plans ✓ Deviations re-planning requirements for Production Plan ✓ Train Traffic Fluidity within the Section/Sub Section ✓ Improved Network Velocity
6.4.5.3	The solution shall utilise the predefined buffers and thresholds that were defined in the service specifications to proactively provide early-warning on potential deviations on the Production Plan and subsequently highlight any secondary impact to trains as per the Production Plan.			
6.4.5.4	The solution shall where delays occur but do not lead to deviations that exceed pre-defined buffers and thresholds, enable Rail Traffic Regulators in deciding which trains are to be held back as well as where they are to be held back, and which trains are to receive right of way so as to maintain traffic flow fluidity through the section at a			

	macro-scopic level, and thereby avoid the blockage of yards and/or key nodes.		the condition equipment, report asset, position and reason. ✓ Early warning: If the resources are not reported completed on time and thresholds time is activated, report activity status and reason. ✓ Deviation report: If the thresholds are exceeded for resource movements and reason. ✓ Early warning: If the train movements are not reported completed on time and thresholds time is activated, report activity status and reason. ✓ Deviation report: If the thresholds are exceeded for train movements and reason.	✓ Deviation Root Cause Analysis Report ✓ Adherence to Production Plan
6.4.5.5	The solution shall enable the Traffic Regulator to monitor progress on resolution of early warning reported activities.			
6.4.5.6	The solution shall consolidate the early warning and deviation report information to provide current and predicted occupancy of network, yards and sidings based on traffic flow.			
6.4.5.7	The solution shall enable the review, evaluation, and approval or rejections of requests for emergency occupations.			
6.4.5.8	The solution shall enable the Traffic Regulator to activate the deviation assessment process.			
6.4.5.9	The solution shall enable the Traffic Regulator to review the primary and secondary results from the deviation assessment process and approve or reject the proposals of trains for re-scheduling and staging.			
6.4.5.10	The solution shall identify and extract the activities in the production plan and meet-pass plan that requires immediate action and publish		✓ Early warning: If the countdown activitivies are not reported	

	the new instructions. The solution must enable the Rail Traffic Regulator to simulate their decisions on which trains to hold back and which to proceed before such decisions are implemented to understand any down-stream conflict(s) that may arise.		completed on time and thresholds time is activated, report activity status and reason. ✓ Deviation report: If the thresholds are exceeded, report activity / train departure and arrival delay and reason. ✓ Early warning: If the occupations are not reported completed on time and thresholds time is activated, report activity status and reason. ✓ Deviation report: If the thresholds are exceeded for occupations and reason. ✓ Early warning: If the weather or rail infrastructure conditions can impact the execution of the	
6.4.5.11	The solution shall enable the Rail Traffic Regulator to decide on which trains can be re-routed where catastrophic rail occurrences such as derailments arise.			
6.4.5.12	The solution shall enable the Rail Traffic Regulator to simulate their decisions on which trains will be re-routed, which will be held back and which to proceed before such decisions are implemented so as to understand any down-stream conflict(s) that may arise.			
6.4.5.13	The solution shall consolidate re-planning requirements and activate the re-planning process based on the impact of the deviation namely at Production Plan, Resource Based Train Plan or Slot and MTS level.			
6.4.5.14	The solution shall interface with Value Chain Partners' Incident Management Systems to enable the displaying of incidents, impact of incidents and re-planning requirements on shared rail networks.			

6.4.5.15	Actual production plan execution performance data should be fed back, for trending purposes, to the Capacity Planning & Simulation solution to inform updates, where applicable and necessary, to the Master Train Schedule, Blocking Plan, Resourced Base Train Plan and Service specifications.		production plan, report asset, position, status and reason. ✓ Deviation: If the weather or rail infrastructure conditions are impacting the execution of the production plan, report asset, position, status and reason. ✓ Deviation report: Declare emergency occupations / TSR.	

6.4.6 **Assess Impact of Deviations**

This process assesses the impact of deviations on the production plan.

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.6.1	The solution shall have the capability to assess the impact of deviations on the production plan	Assess Impact of Deviations.	✓ Published Production Plan	✓ Detailed Impact Analysis of the Primary and Secondary Impacts to the Train Service
6.4.6.2	The solution shall determine the re-planning requirements for the production plan based on the impact assessment results.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.6.3	The solution shall have the capability to assess and predict the primary and secondary impact of all deviations on the Production plan.		✓ Deviations with Reasons ✓ Incidents Impacting Train Operations ✓ Approved Service Specifications, Deviation Thresholds and Buffers ✓ Actual Positions and Time (events) of Assets per	✓ Re-planning Requirements for Locomotive, Wagon and Train Crew Distribution Plans ✓ Re-planning Requirements for Production Plan ✓ Projected Network Congestion Bottlenecks and Resolutions
6.4.6.4	The solution shall assess the impact on Value Chain Partners' operations and time appointments, planned maintenance occupations, planned resource distribution plans and propose re-planning requirements.			
6.4.6.5	The solution shall indicate where the network will be congested as a result of deviations and incidents and propose bottleneck resolutions.			
6.4.6.6	The solution shall utilise the designed and actual power consumption in the assessment of impact.			
6.4.6.7	The solution shall be able to display deviations detected for mainline, yard and local plans, with reasons.			
6.4.6.8	The solution shall determine the impact of deviations on locomotive distribution plan.			
6.4.6.9	The solution shall determine the impact of deviations on wagon distribution plans.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.4.6.10	The Solution shall determine the impact of deviations on Train crew allocation plans.		Corridor / Corridor Section ✓ Actual Positions and Time (events) of Trains per Corridor / Corridor Section	
6.4.6.11	The Solution shall determine the impact of deviations on planned occupations as per the production plan.			

6.5 Reporting Requirements

ID #	Functional Requirements	Business Process	Inputs	Output
6.5.1	The solution shall provide the Total Service Performance KPI/ reports?	Railway Simulation		
6.5.2	The solution shall calculate idle time (unproductive time) for each wagon and locomotive for each scenario (unproductive time report).			
6.5.3	The solution shall calculate planned Gross Ton Kilometer per rolling stock asset per flow (Planned Gross Ton Kilometer report).			
6.5.4	The solution shall calculate planned Turn Around Time/cycle time for wagons and locomotives (Planned Turn Around Time/cycle time report)			
6.5.5	The solution shall calculate dwell times per wagon and locomotive (Dwell times report).			
6.5.6	The solution shall provide reports on train cancellations (Train Cancellations Report)	Compile Production Plan		
6.5.7	The solution shall provide reports on trains re-planned (Trains Re-planned Report).			
6.5.8	The solution shall provide reports on trains re-scheduled (for mainline, local and Yard schedules).			
6.5.9	The solution shall provide reports on overall EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) per re-planning / re-scheduling scenario (EBITDA Report).			
6.5.10	The solution shall provide Planned volume, cost and EBIDTA Key Performance Indicators.			

ID #	Functional Requirements	Business Process	Inputs	Output
6.5.11	The solution shall report on the planned train slot utilisation per network section compared to the Resourced Base Train Plan (Planned train slot utilization).	Compile Resourced Base Train Plan		
6.5.12	The solution shall identify planned throughput time per train (Planned throughput time).	Compile Production Plan		
6.5.13	The solution shall determine deviations of planned throughput time per train between Resource Based Train Plan and Production plan (Deviations of Planned throughput time Report).	Compile Resourced Base Train Plan and Production Plan		
6.5.14	The solution shall identify planned resource turnaround time per resource (Planned resource turnaround time Report).	Compile Production Plan		
6.5.15	The solution shall determine deviations of resource planned turnaround time per resource between Resource Based Train Plan and Production plan.	Compile Resourced Base Train Plan and Production Plan		
6.5.16	The solution shall identify planned idle time per train(Planned idle time per train)	Compile Production Plan		
6.5.17	The solution shall determine deviations of planned idle time per train between Resource Based Train Plan and Production plan (Deviations of planned idle time Report).	Compile Resourced Base Train Plan and Production Plan		
6.5.18	The solution shall identify planned dwell time per train (Planned dwell time per train Report)	Compile Production Plan		

ID #	Functional Requirements	Business Process	Inputs	Output
6.5.19	The solution shall determine deviations of planned dwell time per train between Resource Based Train Plan and Production plan (Deviations of planned dwell time per train).	Compile Resourced Base Train Plan and Production Plan		
6.5.20	The solution shall identify planned volumes per train (Planned volumes per train report).	Compile Production Plan		
6.5.21	The solution shall determine deviations of planned volumes per train between Resource Based Train Plan and Production plan (Deviations of planned volumes per train).	Compile Production Plan		
6.5.22	The solution shall identify planned profitability per train (Planned profitability per train report).	Compile Production Plan		
6.5.23	The solution shall determine deviations of planned profitability per train between Resource Based Train Plan and Production plan (Deviations of planned profitability per train).	Compile Resourced Base Train Plan and Production Plan		
6.5.24	The solution shall calculate planned cent/nett-ton.km per train (Planned cent/nett-ton.km per train).	Compile Production Plan		
6.5.25	The solution shall determine deviations of planned cent/nett-ton.km per train between Resource Based Train Plan and Production plan (Deviations of planned cent/nett-ton.km per train).	Compile Production Plan		
6.5.26	The solution shall calculate actual locomotive utilisation and efficiency Key Performance Indicators. e.g. number of hours that locomotives are used in a 24-hour period, % time	Production Plan Execution		

ID #	Functional Requirements	Business Process	Inputs	Output
	spent hauling trains, Gross Ton Kilometers/locomotive, Nett Ton Kilometers/locomotive, locomotive kilometers over a given period)			
6.5.27	The solution shall calculate actual wagon utilisation and efficiency Key Performance Indicators (e.g. dwell time, idle time, turnaround time).			
6.5.28	The solution shall calculate actual Train Crew utilisation and efficiency Key Performance Indicators (e.g. productive time vs promised shift, driver kilometers, overtime trends).			
6.5.29	The solution shall determine successful execution of occupation plans (Scheduled start & finish vs actual start & finish, % execution of plan).			
6.5.30	The solution shall determine successful execution of rolling stock maintenance plans (Scheduled start & finish vs actual start & finish, % execution of plan).			
6.5.31	The solution shall report actual performance Key Performance Indicators (e.g. On-Time Performance, Devation Alerts and Deviation reasons for all parts of the Mainline Integrated Train Plan) (ITP Adherence Reports).			
6.5.32	The solution shall provide total service performance Key Performance Indicators / reports			

6.6 Master Data Build

6.6.1 A central repository of rail network, equipment, Train crew and rolling stock data will be made available by TFR.

6.6.2 The bidder must list all the required input data and their formats per capability (Appendix D).

6.6.3 This information will be used to identify activities for operational readiness prior to commencement of the contract.

6.6.4 The maintenance function for master data management must enable creation, modification and deletion.

6.6.5 Full audit trail is required for any changes to the master data.

6.6.6 The solution shall at least cater for the maintenance of the following:

6.6.6.1 Logistic support equipment maintenance schedules;

6.6.6.2 Deviation thresholds on Service Specifications and slot activities;

6.6.6.3 Locomotive allocation rules;

6.6.6.4 Train configurations;

6.6.6.5 Maximum train slot capacity percentage rules and recovery slot allocation rules; and

6.6.6.6 Blocking rules.

6.6.7 Master data must be able to be processed for the calibration and resourcing of the Master Train Scheduling Capability for a 10 year traffic file.

6.6.8 The solution shall at least cater for the upload of the following:

6.6.8.1 Operational site capacities and constraints;

6.6.8.2 Resource allocation rules;

6.6.8.3 Rolling stock maintenance standards;

6.6.8.4 Infrastructure maintenance standards;

6.6.8.5 Rail directives and standards;

6.6.8.6 Rolling stock asset maintenance plans;

6.6.8.7 Infrastructure maintenance plans;

6.6.8.8 Train crewing strategies;

6.6.8.9 Train crew availability rules;

6.6.8.10 Asset reliability factors; and

6.6.8.11 Train crew depot locations, strength and matrix.

6.6.9 The solution shall have a link with the engineering document repository to manually maintain train technical specifications.

6.7 Data Management

6.7.1 All master data required for all capabilities must be extracted from the relevant TFR sources.

6.7.2 The master data includes but not limited to geographical locations, locomotives, wagons, Train Crew personal information, Train crew qualifications, auxiliary equipment, telemeters, commodities, customer information and service specifications, and their related attributes.

6.7.3 Data maintenance functions for master data not available on current TFR sources must be included in the proposed solution.

6.7.4 All data collected for building the master data and analysis thereafter is to be carefully stored in a structured manner to allow for traceability and accessibility.

6.7.5 Data management is crucial to ensure configuration management. The data that will be used for analysis shall be extracted from the various source systems and stored into the warehouse which is updated daily to keep it up to date.

6.7.6 The solution shall provide for a standardized data transfer mechanism across capabilities.

6.7.7 The solution shall have a capability to manage versions of the simulations in the capabilities.

6.7.8 The solution shall have the capability to automatically generate naming conventions for simulation scenarios.

6.7.9 The Bidder shall provide a proposal describing how master data will be captured and maintained in the solution.

6.7.10 The solution shall keep audit trail of all master data changes in the system.

6.7.11 The solution shall keep time stamps of all master data and transactional data changes in the system.

6.7.12 The solution shall keep time stamps of all master data and transactional data creation in the system.

6.7.13 The solution shall enable the Datawarehouse and AI platform to perform delta extraction periodically in order to perform root cause analysis and reporting.

7. ARCHITECTURE AND SOLUTION DESIGN

7.1 Architecture standards and requirements

The TFR Architecture standards applicable to the proposed solution:

7.1.1 The proposed solution should be able to run on the latest version of Windows endpoints (Current version Windows 10).

7.1.2 The proposed solution should be able to run on the latest server operating system (Windows, Linux, Unix).

7.1.3 The proposed solution should be browser Agnostic and support the latest browser technologies (Current Browsers are Microsoft Edge, Google Chrome).

7.1.4 The proposed solution should be able to run on the latest Java (JRE) environment (applies to the solutions that have a Java runtime dependency).

7.1.5 The proposed solution should be able to consume and publish Restful Web Services (Preferred) and SOAP Web Services (Current Integration layer used for the consumption and publishing of Services in TFR is Webmethods) and expose API's.

7.1.6 The proposed solution should be able to avail and seamlessly ingest data into any the Datawarehouse and AI platform

7.1.7 The proposed solution should be able to seamlessly integrate into TFR Landscape.

7.1.8 The proposed solution should be accessed through TFR Portal (Preferred).

7.1.9 The proposed solution must authenticate via Microsoft Active Directory (Single sign-on through Microsoft Active Directory)

7.1.10 The proposed solution should be able to run on any mobile device (App Version for End User experience).

7.1.11 The proposed solution should support Modular/Functional deployment of solution in support of Agile/DevOps Methodology.

7.1.12 The proposed solution should be able to be customisable to support the variation of TFR Business features. (up to 20% of the proposed solution is allowed to be customised, 80% of the solution capabilities should meet the business requirements)

7.1.13 The proposed solution should have full Audit trail capabilities.

7.1.14 The proposed solution must be cloud ready (public, hybrid or private), service provider agnostic and be able to seamlessly migrate to cloud platform (cloud architecture diagram is required).

7.1.15 The proposed solution must adhere to the best practice security standards (minimum baseline security standards.

7.1.16 The diagram below provides an overview of the solution architecture for TFR and responses should be aligned to the solution architecture.

7.2 TFR ICT Reference Architecture

7.2.1 The diagram below provides an overview of the solution architecture for TFR and reponses should be aligned to the solution architecture.

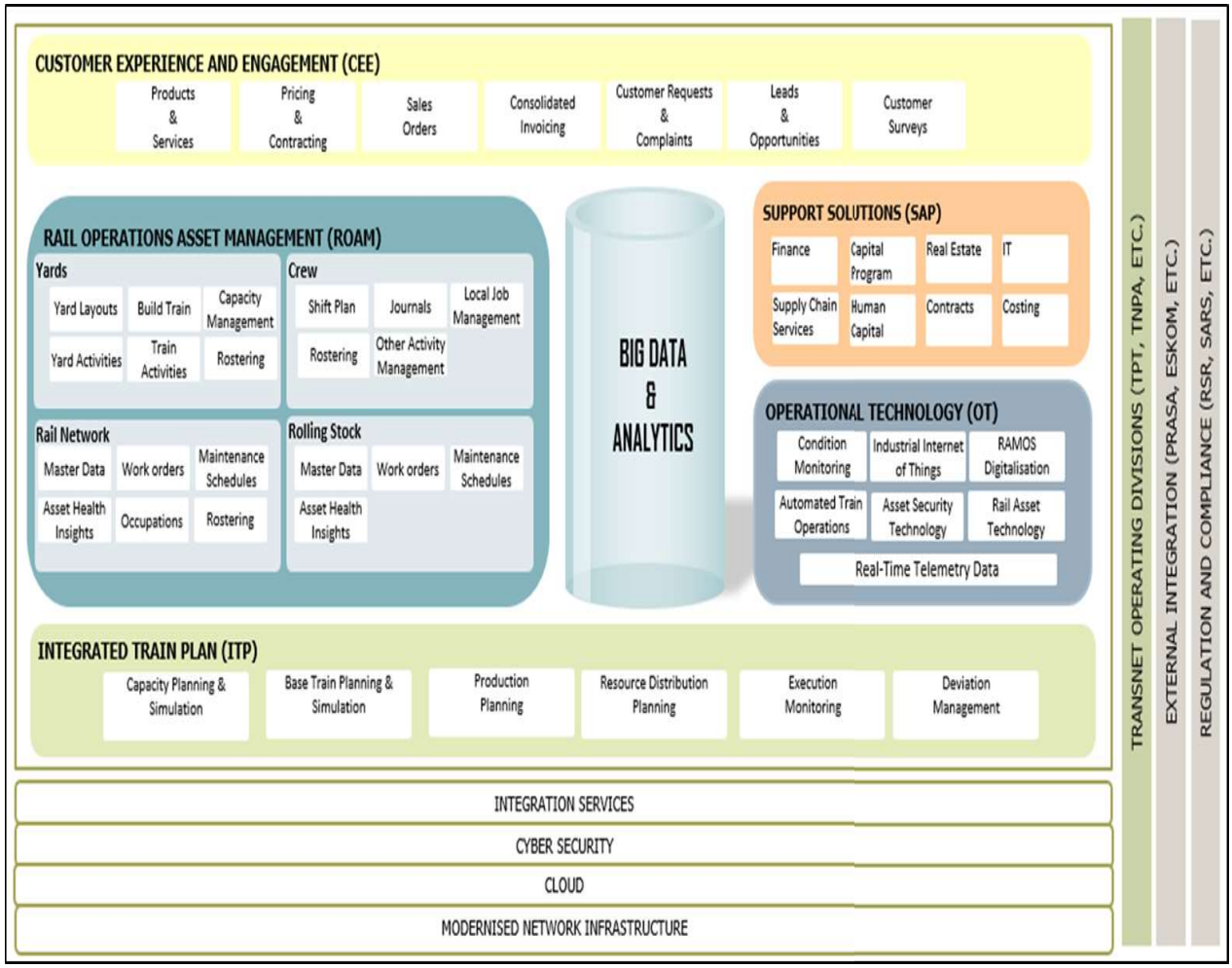

Figure 22: TFR ICT Reference Architecture

7.3 TFR ITP Solution Architecture

7.3.1 The following diagram depicts the Integrated Train Plan solution architecture with respect to TFR's ITP technical landscape.

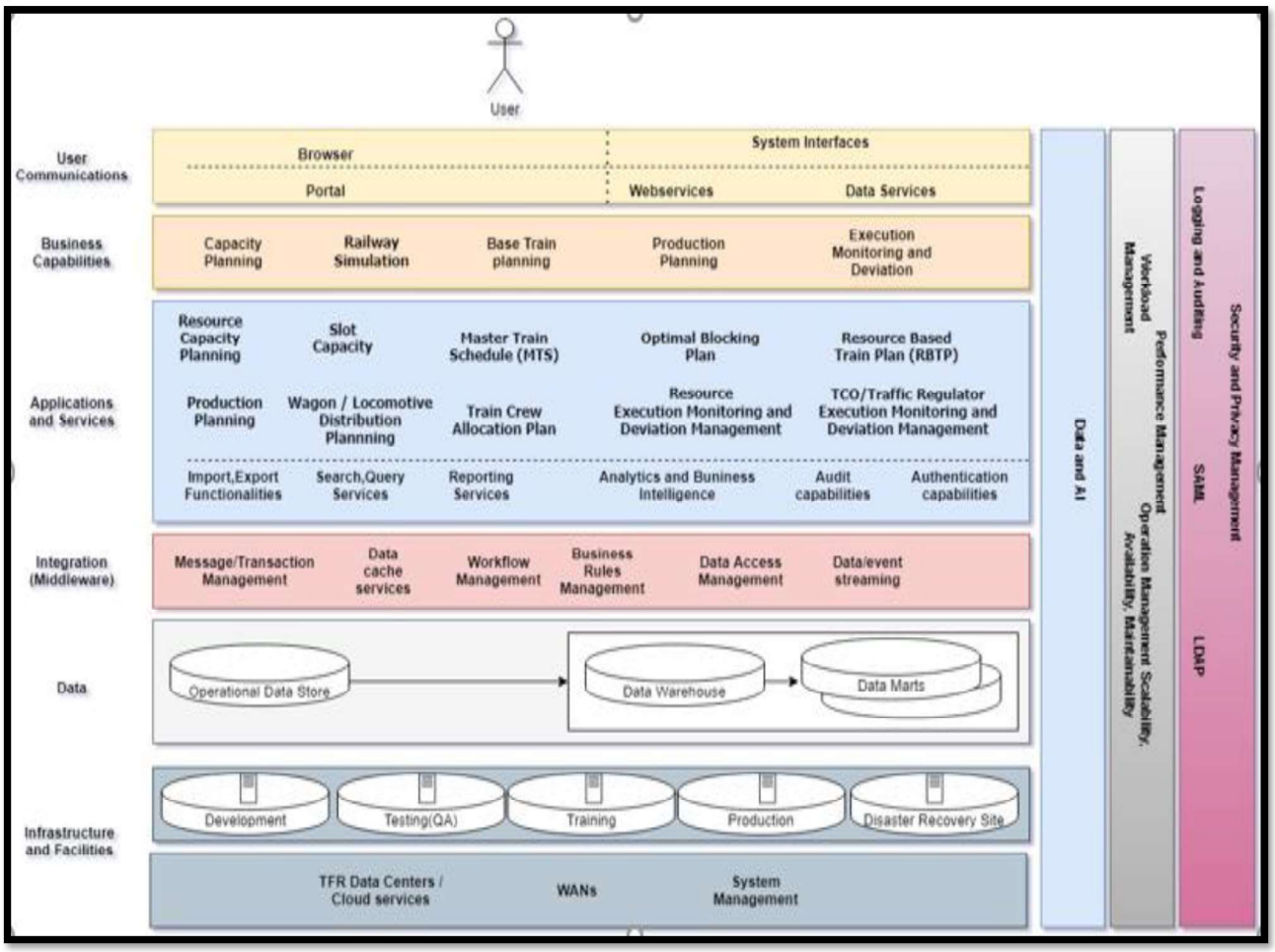

Figure 23: ITP Solution Architecture

7.4 Solution Products and Capabilities

7.4.1 Represented below are the products required to enable the solution. The capabilities for Capacity Planning, Base Train Planning, Production Planning, Railway Planning and Simulation and Execution Monitoring & Deviation Management are depicted below. The capabilities are described by asking key binary questions related to the required solution (see detailed questions per capability listed in Appendix A01). Other capabilities that are required for an effective solution can also be recommended by the bidder.

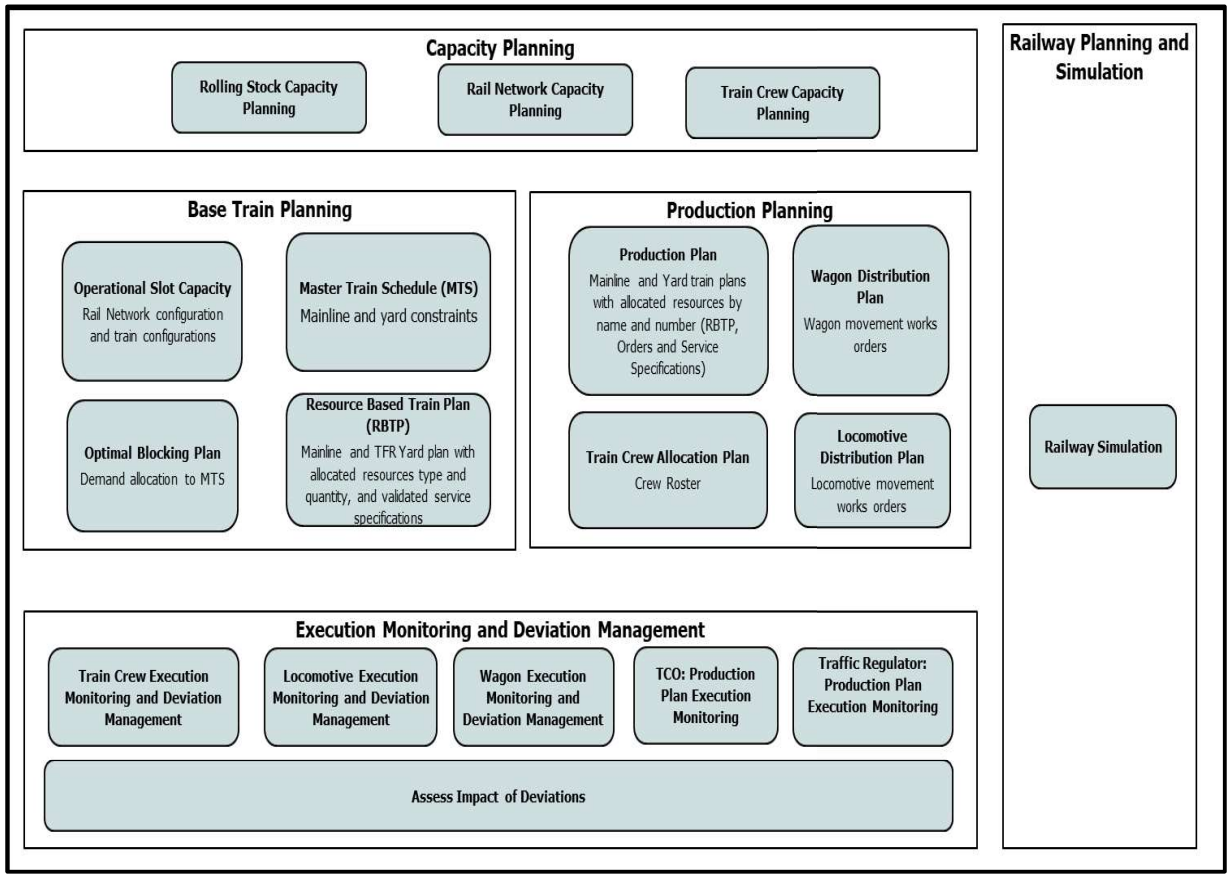

Figure 24: Required Capabilities

7.4.2 The Bidder shall provide a solution architecture document for the current vertically integrated business model, containing at least the following:

7.4.2.1 Architecture diagrams that depicts the proposed solution for each capability and its sub capabilities,

7.4.2.2 The high level solution architecture for the capabilities,

7.4.2.3 Identify the proposed solutions with standard mobile capability,

7.4.2.4 Identify the method for each solution to perform user authentication,

7.4.2.5 Provide security standards for each proposed solution,

7.4.2.6 Specify all components required for the solution using the following criteria, describing the full system landscape:

7.4.2.6.1 Desktop Software (GUI, Plug-ins etc.)

7.4.2.6.2 Databases and version supported

7.4.2.6.3 Solutions application server and version

7.4.2.6.4 Solution software and version

7.4.2.6.5 Server operating Systems and version supported

7.4.2.6.6 Integration software (including database connectors, middleware, web-services etc.)

7.4.2.6.7 Recommended hardware specifications

7.4.2.6.8 Specific hardware platforms required

7.4.2.6.9 How system performance/scalability is achieved

7.4.2.6.10 Support for VMware where relevant

7.4.2.6.11 Information Security Features applied

7.4.2.6.12 Cloud compatibility of solution (Cloud solution, Hybrid, Onsite)

7.4.2.6.13 Client-Side Software Licenses and Hardware required (e.g. Thin or thick client, Web browsers and versions supported, Plug-ins required, Java run times, .Net frameworks, ODBC/JDBC Drivers, other runtimes / components required, emulator or virtual terminals required, Windows terminal server or Citrix compatibility).

7.4.3 The bidder must provide a clear Roadmap for the Solution's digital journey providing proposed periods for patches, new features and upgrades. The implementation of Patches

and Upgrades needs to be included as part of the Maintenance and Support Contract of the solution.

7.4.4 The solution must provide the following operational management capabilities:

7.4.4.1 Monitoring capabilities on the health of the system

7.4.4.2 Performance analytics.

7.4.4.3 System audit trail.

7.4.4.4 Incident reporting from within the application.

7.4.5 Provision should be made for all customised source code of the solution to be kept in ESCROW.

7.4.6 The bidder must include a high-level diagram with the full landscape of the proposed hardware and software including client connections. The detailed solution designs should be developed as part of project execution.

7.4.7 The bidder should indicate to which degree a single unified, integrated system will be used for the solution requirements. TFR would prefer one integrated solution.

7.4.8 Multiple systems with different interfaces cause integration and usability issues; therefore, TFR would prefer one common portal for interacting with the system.

7.4.9 The solution should provide for role-based access. Depending upon the access rights, users should be able to perform different functions specific to their roles.

7.4.10 The bidder should describe the required database architecture together with possible licensing implications and the implementation could be optimised during execution to meet TFR requirements.

7.4.11 The bidder should indicate whether the same modelling and optimisation logic will be used across the different capabilities of the solution.

7.4.12 User Interfaces into the solution should provide up-to-date visualisations designed to present information in a manner that can be grasped and acted upon quickly. User Interfaces should be designed to maximise human productivity and efficiency. User interfaces that have the same look and feel and will be easy to learn and use, will be preferred.

7.5 Solution Integration and Interface Requirements

7.5.1 The diagram below depicts a high-level application and data flow view of TFR's requirements for the integrated solution.

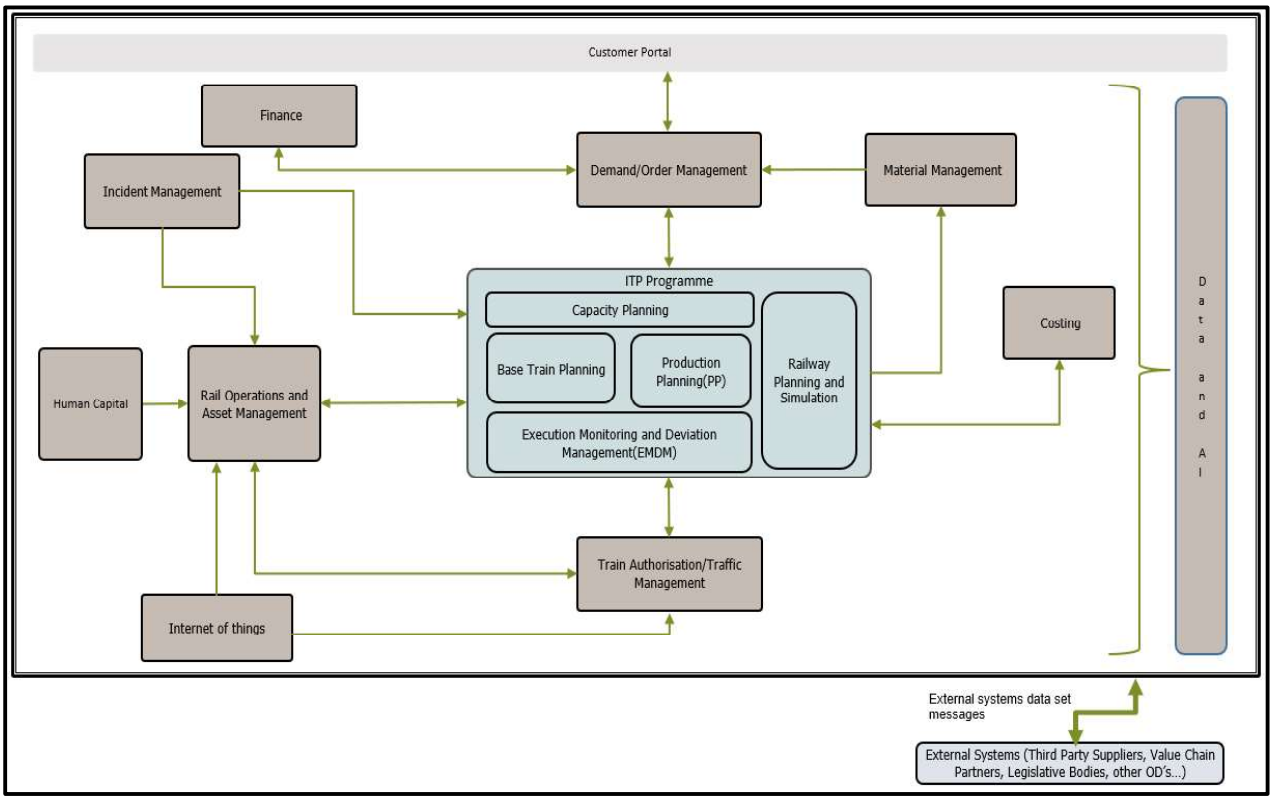

Figure 25: Integrated Application View

7.5.2 The data flows described in figure 25 above does not provide a detailed view of data integration however it can be used as a guideline to identify required interfaces.

7.5.3 In addition, interfaces between procured capabilities Capacity Planning, Base Train Planning, Production Planning, Execution Monitoring & Deviation Management and Railway Planning & Simulation must be catered for by the bidders as part of the proposed turnkey solution.

7.5.4 The entire process should be executed in an iterative manner, allowing up- and down-stream information exchange between Capacity Planning, Base Train Planning, Production Planning, Execution Monitoring & Deviation Management and Railway Planning and Simulation.

7.5.5 The demand and order management includes:

7.5.5.1 The process of capturing, validating and confirming an order, including the order credit check and order excise/customs release.

7.5.5.2 An integrated view of forecasted and captured demand.

7.5.5.3 Demand Prioritisation Rules.

7.5.5.4 Operational deviations reported by Customers.

7.5.5.5 Publishing of the service catalogue.

7.5.5.6 Pricing per service.

7.5.5.7 Publishing of spare capacity to Marketing.

7.5.5.8 Publishing time appointment schedule to Customers.

7.5.6 The material management solution converts service specifications in materials for inclusion into the service catalogue.

7.5.7 The costing module will provide costs at an activity level for costing of the service specification and determination of critical KPIs to determine the feasibility of the proposed schedules.

7.5.8 The meet-pass plan is provided to the Train Authorisation module for execution. In return the Train Authorisation module will provide EMDM with updates on completed work against the meet-pass plan and any deviations that might occur during execution of the production plan.

7.5.9 The Rail Operations Asset Management (ROAM) solution includes at least the following:

7.5.9.1 Rolling Stock Asset Management:

7.5.9.1.1 Owns the master data for rolling stock.

7.5.9.1.2 Provide a view of rolling stock (locomotives and wagons) condition, availability and maintenance plans/schedules.

7.5.9.1.3 Provide the latest positions of rolling stock.

7.5.9.1.4 Manage works orders, handovers and payments for the maintenance of rolling stock.

7.5.9.1.5 Informs the EMDM of deviations from the rolling stock maintence plan execution.

7.5.9.1.6 Manage the rolling stock works orders for the inspection and actions related to reported incidents impacting the execution of the production plan.

7.5.9.2 Rail Network Infrastructure Asset Management:

7.5.9.2.1 Owns the rail network infrastructure configuration master data.

7.5.9.2.2 Provide a view of infrastructure condition, availability, occupation plans/schedules and temporary speed restrictions.

7.5.9.2.3 Manage works orders, handovers and payments for the maintenance of rail network infrastructure.

7.5.9.2.4 Informs the EMDM of deviations from the occupation maintenace plan execution.

7.5.9.2.5 Manage the rail network infrastructure works orders for the inspection and actions related to reported incidents impacting the execution of the production plan.

7.5.9.3 Crew Management:

7.5.9.3.1 Provides availability, allocation rules and qualifications of train crew for allocation purposes.

7.5.9.3.2 Provide at least work and rest rules, national safety regulations, and TFR's agreement with labour unions.

7.5.9.3.3 Derives the crew roster from the production plan.

7.5.9.3.4 Manages the train crew transportation to the designated locations to execute the production plan.

7.5.9.4 Yard Management:

7.5.9.4.1 Owns the yard activity master data.

7.5.9.4.2 Receive the published production plan for execution.

7.5.9.4.3 Create and manage works orders, handovers and payments for the execution of the production plan with regards to local trains, shunting trains and pre-departure and post-arrival activities as per the published production plan.

7.5.9.4.4 Informs the EMDM of deviations from the production plan execution.

7.5.10 The incident management module records incidents throughout the company. Incidents impacting the execution of the production plan will be send to EMDM and ROAM for action and re-planning.

7.5.11 The Datawarehouse and AI platform will perform delta extraction periodically in order to perform root cause analysis and reporting.

7.5.12 The solution shall use the existing master data sources.

7.5.13 Integration to planning and monitoring solutions for Value Chain Partner should be enabled through well designed services.

7.5.14 The Bidder shall provide the integration architecture for a vertically integrated business model, which contains at least the following:

7.5.14.1 Provide integration architecture view and description of proposed solutions,

7.5.14.2 Demonstrate how data will be integrated seamlessly and near real time between proposed solutions,

7.5.14.3 Provide integration architecture views between proposed solutions and TFR solutions, and

7.5.14.4 Describe the method used for integration including integration platform and type of integration services e.g SOAP webservices, REST webservices.

7.6 Future Business Model

7.6.1 TFR currently operates using a vertically integrated business model. It owns and manages the infrastructure as well control all train operations on the network. Third party operator traffic is consolidated and managed as part of the ITP. TFR is the main operator and third party traffic is catered for on available slots.

7.6.2 The future business model is to move to a vertically separated business model where the infrastructure manager and TFR operator are separate entities within the same holding company.

7.6.3 The diagram below depicts the current vertically integrated business model and the future state of the business model with the required ITP capabilities used by each entity.

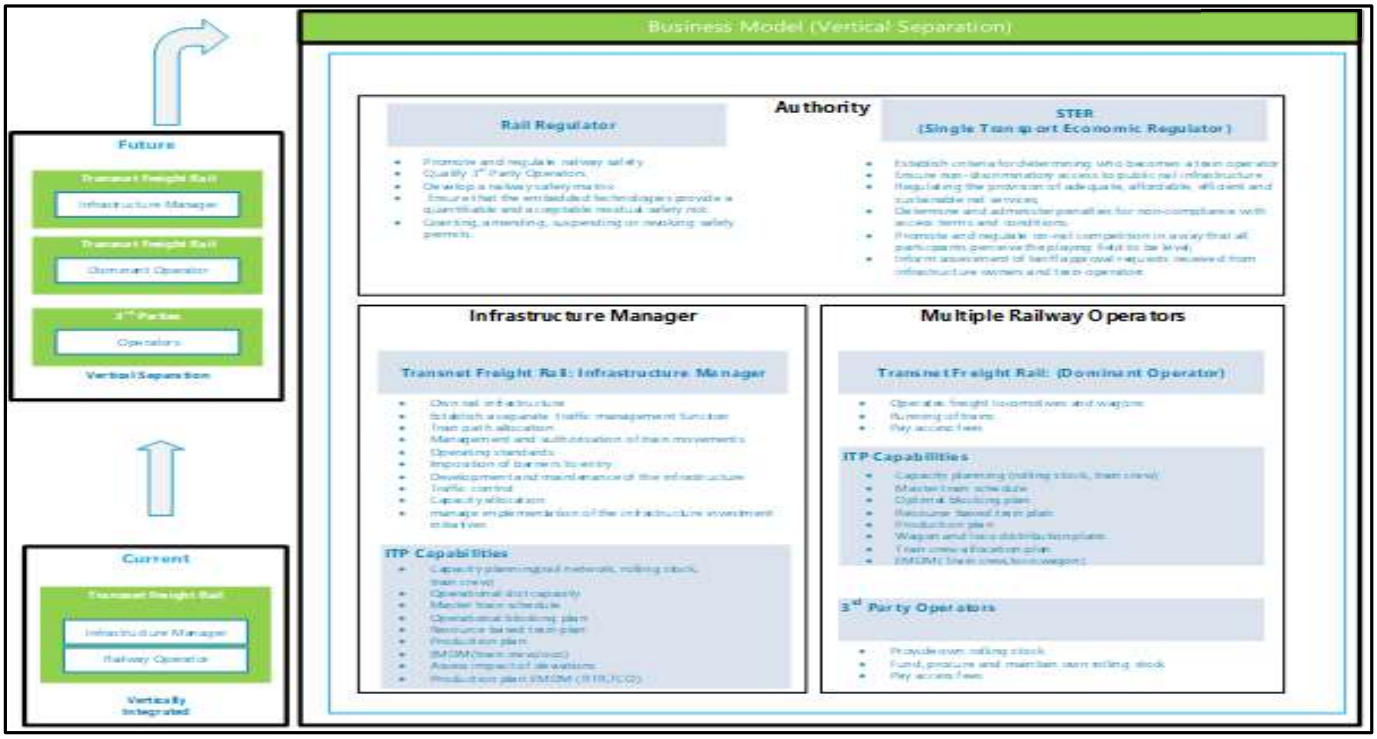

Figure 26: Business Model

7.6.4 The picture below depicts the ITP capabilities that will be performed by the infrastructure manager and the TFR Operator. Third party operators will provide their own solutions for integration with the infrastructure manager.

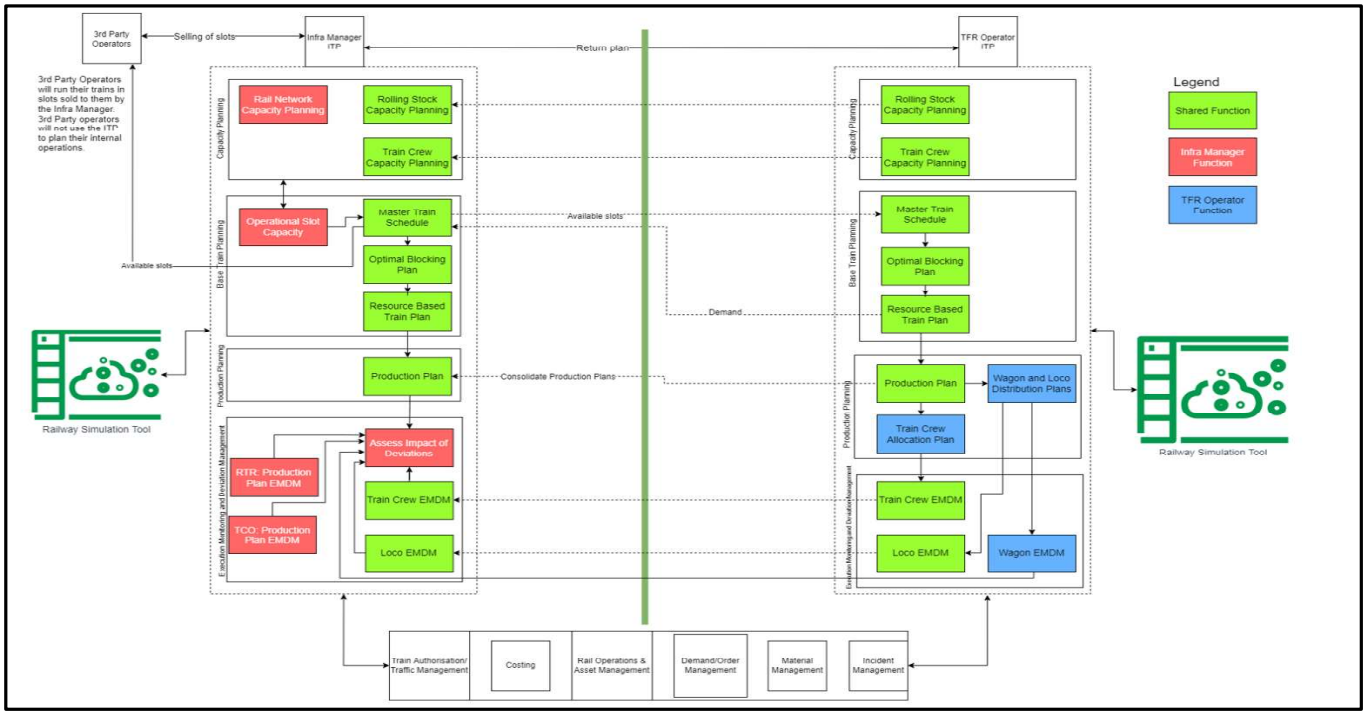

Figure 23: Vertically Separated ITP Solution View

7.6.5 The Bidder shall provide :

7.6.5.1 High level architecture for the vertically separated scenario,

7.6.5.2 Demonstrate how the proposed solutions for the vertically integrated scenario will be used in the vertically separated scenario.

7.6.5.3 Provide an overview of the effort required to change the proposed vertically integrated ITP solution to accommodate the vertically separated business model.

7.7 Non-Functional Requirements

7.7.1 The non functional requirements will be incorporated in the project strategy documents.

Non-functional Category	Non-functional Sub-category	Non-functional ID	Mandatory (YES/NO)	Required (YES/NO)	Expectation (Requirement)
Performance (related to the performance requirements from the new system)	Response Time - How much time it takes to login into the system? How much time it takes to load a screen with single/multiple record(s)? Rating: Low –(60 seconds) Medium--- (3 seconds) High--- (500 milliseconds)	NFR001	YES	YES	MEDIUM
	Processing Time - How much time it takes for Simulations/batch update operations? Rating: Low –(12 HOURS) Medium--- (6 HOURS) High--- (<1 HOUR)	NFR002	YES	YES	MEDIUM
Scalability (is usually related to the ability for a system to continue to function well as it is changed in size or volume in order to meet a user need)	Software Scalability - Can the hardware be scaled to support increase in no of users?	NFR004	YES	YES	Software should be scalable
	Hardware Scalability - Can the hardware be scaled to support increase in no of users?	NFR005	YES	YES	Hardware should be scalable
	Vertical Scalability - Can the site be replicated to multiple locations to cater to increasing user base?	NFR006	YES	YES	Should be able to replace components with something that works better or relocate to another location
Capacity (refers to the system's	Throughput - How many transactions can be processed per hour?	NFR007	YES	YES	5000 per Hour

Non-functional Category	Non-functional Sub-category	Non-functional ID	Mandatory (YES/NO)	Required (YES/NO)	Expectation (Requirement)
ability to maintain storage for the user's data)	Number of Concurrent Users	NFR010	YES	YES	100
Recoverability (refers to the system's ability to recover from a disaster with minimal loss of time or data)	Recovery Process (Restore from a point in time)	NFR017	YES	YES	Required
	Recovery Time - How quickly should a recovery take to perform?	NFR018	YES	YES	4 Hours
Maintainability (refers to the system's ability to be serviced after initial configuration, setup, and startup tasks have been completed.)	Error Handling - How easily can defects be isolated or corrected?	NFR020	YES	YES	Hardware and software errors should be gracefully handled and execution resume when interrupted
	Exception Handling - How should the exceptions be handled?	NFR021	YES	YES	The application should be able to survive the exception and continue to process events and requests
	New Requirements - How easily new requirements can be added to the system?	NFR022	YES	YES	BENCHMARK
Serviceability (refers to the system's ability to support hardware and software upgrades once the system has been deployed)	Can the system support upgrade in current version of hardware and software?	NFR024	YES	YES	System must be compatible with Hardware, Software and Database Upgrades

Non-functional Category	Non-functional Sub-category	Non-functional ID	Mandatory (YES/NO)	Required (YES/NO)	Expectation (Requirement)
Security (refers to legal, regulatory, privacy and security considerations. For example, policies and procedures that system shall follow, compliance with privacy act in different geography, audits, etc.)	Data Privacy Policy Cyber Security Policy	NFR027	YES	YES	Comply with all South African Laws and Data Privacy Laws (i.e POPIA)
Regulatory (refers to the system's ability to meet country-specific (or related) statutes and regulations)	What country specific regulations should be followed? (POPIA, RSR, etc.)	NFR028	YES	YES	South Africa
Data Integrity (refers to the integrity standards for system data)	What referential integrity standards should be maintained in database tables?	NFR034	YES	YES	DATA STANDARD
	Data Retention - What data retention policies should be followed?	NFR035	YES	YES	As Defined in the data retention policy
Usability (refers to the system's ability to provide a User Interface that is simple to use)	What internationalization/localization requirements should be followed?	NFR037	YES	YES	As per international best practise
	What are the inputs from external systems?	NFR038	YES	YES	Details are in the mapped processes
	What are the outputs to external systems?	NFR039	YES	YES	Details are in the mapped processes

Non-functional Category	Non-functional Sub-category	Non-functional ID	Mandatory (YES/NO)	Required (YES/NO)	Expectation (Requirement)
Interoperability (refers to the system's ability to inter-operate with related systems)	Browser Supported - What all browsers should be supported?	NFR042	YES	YES	Refer to the Architecture Standards
	Compatibility with shared applications - What other systems does it need to talk to?	NFR044	YES		Refer to the Integration diagram
	Compatibility with third party applications - What other third party systems does it need to support?	NFR045	YES		Refer to the integration Diagram
Concurrency (refers to the minimum, average and maximum number of simultaneous users using the software)	What is the total capacity of multiple computations that can execute simultaneously, and potentially interfacing with each other?	NFR050	YES		100
Criticality (refers to what the criticality is if the Function/capability fails)	Critical - Service required to be restored within 0 to 8 hours, High - Service required to be restored within 8 to 24 hours, Medium - Service required to be restored within 24 to 72 hours, Low - Service required to be restored after 1 week)	NFR052	YES		Simulation Capability should be up and running within 0 to 8 hours of downtime
Availability (refers to a system or	System Uptime - What are the hours of operation of the system?	NFR012	YES	YES	24/7 98% system uptime

Non-functional Category	Non-functional Sub-category	Non-functional ID	Mandatory (YES/NO)	Required (YES/NO)	Expectation (Requirement)
component that is continuously operational for a desirably long length of time)	Locations of Operation - Where should it be available from?	NFR013	YES	YES	Centralised Solution Installation, used Countrywide
Reliability (refers to the system's ability to remain operational under abnormal conditions)	Mean Time to Recovery - How much time is available to get the system back up again.	NFR016	YES	YES	3 Hours
Manageability (refers to management procedures defined for the following environments - development, testing, staging, deployment, life cycle etc. It usually addresses roles and responsibilities, configuration and change control, monitoring and controlling activities, etc.)	What design standards must be adhered?	NFR029	YES	YES	Annexure of Standards
	What coding standards should be followed?	NFR030	YES	YES	Annexure of Standards
	What architectural standards should be followed?	NFR031	YES	YES	Annexure of Standards

8. IMPLEMENTATION APPROACH

8.1 Project Methodology

TFR is in the process of adopting an Agile/DEVOPS project methodology. Elements of the SAFe approach should be applied during the design and implementation of the project as depicted in the diagram below:

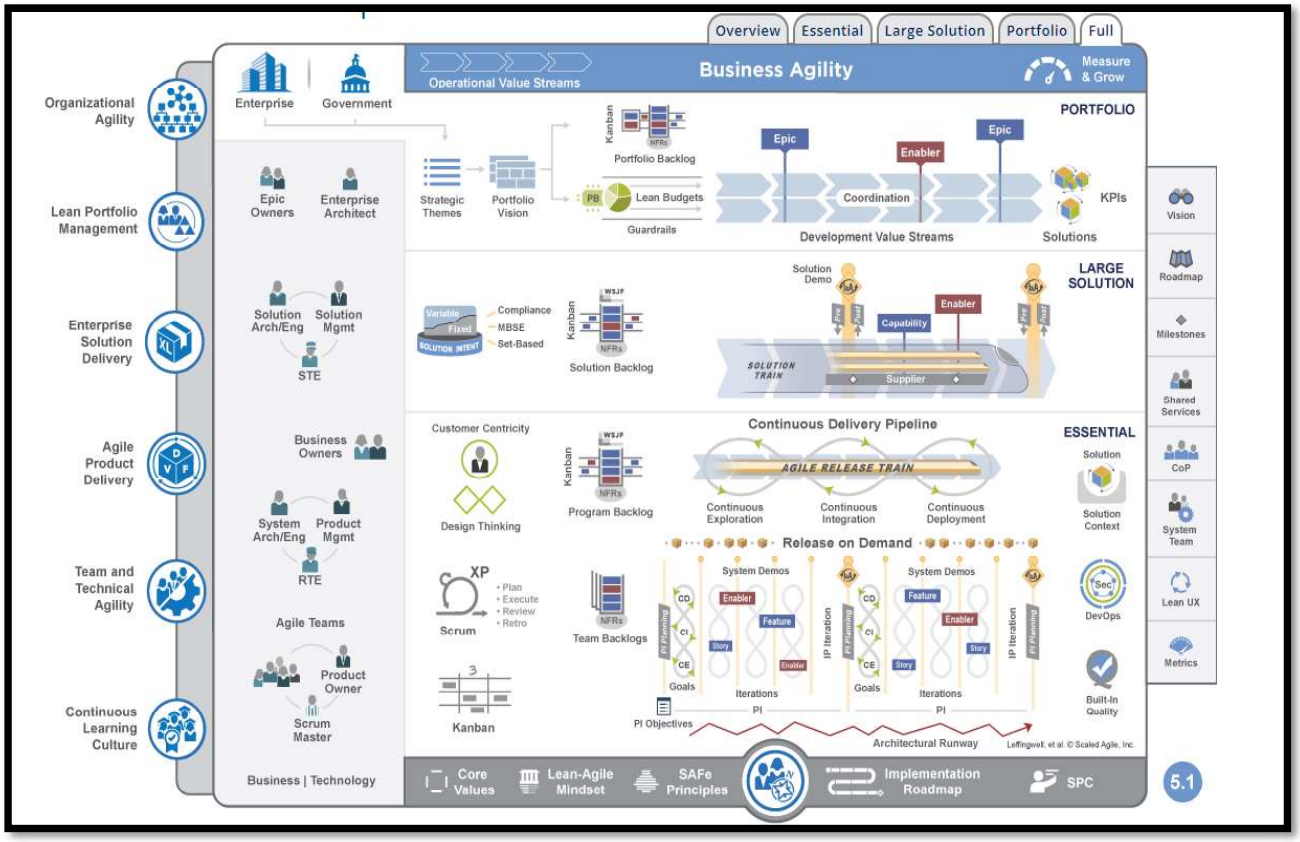

Figure 26: SAFe Configuration

The diagram is available from: https://www.scaledagileframework.com

8.2 Technical Project Deliverable Requirements

8.2.1 The approach is to deliver the solution in an iterative manner throughout the execution of the program thus ensuring incremental value delivery.

8.2.2 All artefacts will be reviewed and approved by relevant stakeholders during project execution.

8.2.3 Provide a detailed project schedule with milestones linked to the pricing schedule – to be used during contract negotiations.

8.2.4 The detail project activities should include at least the following activities per capability:

8.2.4.1 Project Execution Plan

8.2.4.1.1 Product Backlog

8.2.4.1.2 Best practice KPIs per capability

8.2.4.1.3 Solution Train with capabilities and enablers

8.2.4.1.4 Data Management Strategy

8.2.4.1.5 Integration Management Strategy

8.2.4.1.6 Testing Strategy

8.2.4.1.7 Training Strategy

8.2.4.1.8 Change Management Strategy

8.2.4.1.9 Risk Strategy

8.2.4.1.10 Project Charter

8.2.4.2 Analysis

8.2.4.2.1 Business Process development and approval

8.2.4.2.2 Standard Operating Procedures (SOPs) development and approval

8.2.4.2.3 Requirements collection, documentation and approval

8.2.4.2.4 Technical Solution Backlog

8.2.4.2.5 Iteration planning, goals and milestones

8.2.4.2.6 User Stories, features and enablers

8.2.4.3 Design

8.2.4.3.1 Detailed solution designs

8.2.4.3.2 Integration specifications

8.2.4.3.3 User access role definition per solution

8.2.4.3.4 Sprint Backlogs

8.2.4.4 Configuration

8.2.4.4.1 Setup environments

8.2.4.4.2 Configuration and build as per TFR requirements

8.2.4.4.3 Data take-on

8.2.4.4.4 Integration

8.2.4.4.5 Unit Testing

8.2.4.4.6 String Testing

8.2.4.5 Testing

8.2.4.5.1 System Integration Testing

8.2.4.5.2 System Testing

8.2.4.5.3 Non-functional Testing

8.2.4.5.4 Stress Testing

8.2.4.5.5 Regression Testing

8.2.4.5.6 User Acceptance Testing

8.2.4.6 Change Management

8.2.4.6.1 Change Impact Assessment per capability / solution

8.2.4.6.2 Change Management Plan

8.2.4.6.3 Communication Management Plan

8.2.4.6.4 Compilation of change communiques and posters

8.2.4.7 Training

8.2.4.7.1 Training Plan.

8.2.4.7.2 Compilation of training material aligned to the process and specific roles.

8.2.4.7.3 Training material must be compiled in collaboration with Transnet Academy and in line with Transnet Academy standards.

8.2.4.7.4 Training and skills transfer to internal development team and operations.

8.2.4.8 Deployment

8.2.4.8.1 Change Management execution

8.2.4.8.2 Training execution

8.2.4.8.3 Go-live cut-over plan

8.2.4.8.4 Go-live

8.2.4.9 Hypercare

8.2.4.9.1 User support

8.2.4.9.2 Fix issues logged by users

8.2.4.9.3 Identify areas of improvement

8.2.5 Milestones will be agreed upfront including "definitions of done" for each activity.

8.2.6 Milestones are deemed completed on sign-off of the deliverables.

8.2.7 The contents of documentation to be supplied will be agreed between TFR and the successful Bidder.

8.2.8 All documents will be stored in a central server and adhere to the configuration management policy of TFR ICT PMO.

8.2.9 Stakeholder identification and on-boarding:

8.2.9.1 The bidder must identify the required stakeholder roles required for each product at each phase of the project.

8.2.9.2 Project team members' contribution in man hours must be specified.

8.2.9.3 These stakeholders will be limited to Subject Matter Experts in each area and TFR will appoint these stakeholders to form part of the project core team.

8.2.9.4 All identified stakeholders will be on-boarded, and the necessary access provided.

8.2.9.5 A full list of users per capability must be confirmed during project execution for change management and training.

8.2.10 The bidder shall supply the following as part of the tender:

8.2.10.1 A product backlog with a breakdown of the EPICs.

8.2.10.2 Solution Train with capabilities and enablers.

8.2.10.3 Technical Solution Backlog with best practice features and enablers for each EPIC and capability.

8.2.10.4 A deployment strategy which explains the approach for deployment.

8.2.10.5 Programme and Project Management approach and methodology.

8.2.10.6 Flight Plan and detailed project plan with underlying planning approach, assumptions, milestones and deliverables for each product.

8.2.10.7 RACI chart for the milestones and deliverables.

8.2.10.8 Planned specialist bidder resources (quantity per type) for each product at each phase of the project; and

8.2.10.9 Solution / capability interdependencies and prerequisites.

8.3 Previous Reference Sites

8.3.1 In order to display a level of confidence in the Bidders successfully implementing the required solution, the Bidder will be required to provide at least 3 reference sites where the solution was successfully implemented at freight railways. The information must be provided in the following format:

#	Company Name	Contact Person	Contact Number	E-Mail	Date of Implementation	Duration of Implementation	Is the solution still in use? If no, why not?	# Of Users

8.3.2 The information above must be accompanied by references in the form of a letter from the companies where the solution was implemented.

8.3.3 The reference letter will state the nature of the business of the company and the nature and length of service, training and change management expertise (i.e. number of months) provided by the Bidders.

8.3.4 The letter will be on the Bidder's customer's official letterhead signed by the owner of the implemented system as well as the finance manager (or similar) who authorised payment for the services provided.

8.3.5 Provide Key Success Factors (KSF) and lessons learnt from previous (successful or failed) implementations.

8.3.6 Provide KSF for the Transnet ITP Solution.

8.4 Experience and Team Composition

8.4.1 The Bidder will be required to provide details of the team and skillset involved in the implementation of the solution. This will include but not be limited to the experience of the entire project team highlighting each skill and the number of resources assigned per skill.

8.4.2 Resumes should indicate familiarity with allocated Proposed Solution roles, process/capability focus areas and tasks, as well as relevant experience and qualifications, and include an outline of any work done in the Freight Rail Industry over the past five years.

8.4.3 Transnet expects the team members named in the proposal to be actually available for the entire duration of relevant Solution Scrum implementations. Transnet will not consider substitutions during the duration of each Scrum implementation except for reasons of health of key team members or resignations form the organisation.

8.4.4 The Bidder needs to provide experience in agile coaching to assist scrum masters.

8.4.5 Transnet personnel to be paired with the implementing team for effective skills transfer – Bidder Resources to take the lead.

8.4.6 The Bidder needs to provide experience in training of each capability.

8.4.7 The Bidder needs to provide experience in change management implement a programme of this magnitude and complexity.

8.5 Change Management

8.5.1 TFR regards this initiative as a major business transformation programme that will require extensive re-engineering to change from existing business processes to global best practice processes. Re-engineering activities always require extensive employee change management in order to successfully implement the new best practice business capabilities required.

8.5.2 The bidder should provide a Change Manager who has experience in delivering this type of solution at other railway companies to work in collaboration and support the TFR Change Manager from the TFR People Change Team to execute all change management activities for the program; however, TFR People Change Team will be accountable for all change activities.

8.5.3 The Bidder should:

8.5.3.1 Adhere to the Transnet change management methodology as described in Annexure C – Transnet People Change Management Methodology.

8.5.3.2 Provide a comprehensive change management approach for the solution and demonstrate where the approach has previously been used to deploy a similar type of project.

8.5.3.3 Demonstrate experience in the domain of change management for a similar type of project.

8.5.3.4 The change management approach must also include a comprehensive communication approach, methodology and high-level change plan that is aligned to the proposed program plan.

8.6 Training

8.6.1 In order to successfully deliver the solution TFR envisages extensive training to be undertaken by its employees. This RFP includes training requirements and bidders must demonstrate the proposed training plan in order to implement the integrated solution.

8.6.2 Pre-requisite user qualifications and experience is to be defined by the solution provider.

8.6.3 Training material must cater for manual and e-learning material with assessment tools, criteria and results management.

8.6.4 Provide Expert User Training – Expert users will be interacting with the proposed system and require extensive training on using the system. Training for these users must be role based and each end user's role in the overall process must be demonstrated.

8.6.5 Formal training requirements, duration and frequencies must be specified.

8.6.6 Training material will be developed by the Bidder in collaboration with Transnet Academy to ensure that the approved standards are adhered to.

8.6.7 The Bidder will be required to provide training on the following:

- 8.6.7.1 Role based training to end users to use and operate the solution;
- 8.6.7.2 Training on how to interpret the results of each capability and to use these results in decision-making and data analytics;
- 8.6.7.3 Assess candidates to determine competency as per Transnet Academy standards;
- 8.6.7.4 Software support of the solution to the TFR ICT application development team; and
- 8.6.7.5 Capacitation of Transnet Academy facilitators for continuous training.

8.6.8 The Bidder will be required to provide proof of knowledge transfer of the following:

- 8.6.8.1 How to perform detailed railway train simulations by configuring all required resources, constraints and business rules;
- 8.6.8.2 How to compile a Master Train Schedule based on demand over a given set of network and train configurations;
- 8.6.8.3 How to run various calculators to determine future resource requirements (train crew capacity planning, rolling stock capacity planning, rail network capacity planning);
- 8.6.8.4 How to translate a Master Train Schedule into a Resourced Base Train Plan by applying all resource constraints;
- 8.6.8.5 How to extract and cost the Service Specification;
- 8.6.8.6 The ability to interpret the results of each Capacity Planning Capability and to use these results in decision-making and data analytics;

8.6.8.7 How to apply the validated demand to the Resourced Base Train Plan to compile the Production Plan;

8.6.8.8 How to compile the master data and business rules to derive the production plan;

8.6.8.9 How to determine resource distribution plans and train crew allocation plans;

8.6.8.10 How to assess that the production plan is optimal and balanced;

8.6.8.11 How to monitor adherence to plan;

8.6.8.12 How to determine and interpret primary and secondary impacts resulting from deviations;

8.6.8.13 How to compile re-planning requirements;

8.6.8.14 How to re-plan the Production Plan using the re-planning requirements;

8.6.8.15 Environment setup and support to the TFR ICT application support team; and

8.6.8.16 Software support of the solution to the TFR ICT application development team.

8.6.9 The bidders should provide TFR with the following as part of the tender submission:

8.6.9.1 The training methodology and strategy;

8.6.9.2 The training plan;

8.6.9.3 The proposed roles and role job requirements for training purposes for the solution;

8.6.9.4 The minimum skills requirements for each proposed role;

8.6.9.5 Training durations for each role pre-requisite qualifications and experience.

9. AREAS OF DEPLOYMENT / SERVICES

9.1 Services during project execution and deployment will be required at the following physical address:

9.1.1 TFR Corporate Offices
Girton Road
Parktown
Johannesburg
2000

9.1.2 Any other premises deemed necessary by TFR.

9.2 Super User Training and Knowledge Transfer will be performed at one of the following physical addresses:

9.2.1 TFR Corporate Offices
Girton Road
Parktown
Johannesburg
2000

9.2.2 Transnet Academy
Esselenpark Campus
Kempton Park
2000

10. PROCUREMENT TIMELINE

The envisaged solution will be fully deployed in a maximum period of 36 (thirty-six) months, followed by 6 months of hypercare. The successful bidder will be expected to provide with a support period of 10(ten) years after successful deployment.

11. PROPOSAL SUBMISSION

11.1 Bidder proposal submission must follow the TFR Supply Chain Process requirements as set out in section 1 of the RFP.

11.2 The Bidders are required to propose a automated and seamlessly integrated solution to TFR and obtain the necessary partnerships before submission of the tender.

11.3 TFR reserves the right to descope certain portions of the solution to fit the budget where necessary.

11.4 The briefing session will be compulsory. The business processes will be provided to the bidders during the briefing session.

11.5 The bidder must complete the data requirement template (Appendix D) for each set of input data required for the proposed solution. The provision of the data will be finalised during the analysis phase of the project.

12 POST DEPLOYMENT SUPPORT

12.1 The Bidder will be expected to provide 6 months hypercare after the solution is fully deployed as part of the 3.5 years execution period. The scope for hypercare will include the following:

12.1.1 Accept, analyse and resolve all calls escalated from Level 1 support team and perform root cause analysis where appropriate

12.1.2 Assist Level 1 support with resolution of problems including liaising with users replicating defects and assisting with creation or update of data

12.1.3 Support housekeeping of transactional database tables, interfaces and application on a regular basis, review the application and integration logs and identify if there is an error and reconcile the data to ensure that application system of records is valid.

12.1.4 Restart the application or application components, if required.

12.1.5 Work with other ICTM teams to resolve problems related to interfaces for missing data or incorrect message formats

12.1.6 Provide functionality assistance to users

12.1.7 Work with the bidder software support and product developers, as appropriate, to resolve problems and defects

12.1.8 Provide skills transfer to ICTM needed for support activities

12.1.9 Address any bug fixes raised during implementation phase

12.1.10 Address minor changes required that are raised during hypercare

12.1.11 Assist users where training gaps are raised.

12.2 Licensing, maintenance and support

12.2.1 The Bidder shall provide the proposal for licensing, maintenance and support for 10 years after the successful implementation and deployment of the solution.

12.2.2 The proposal shall at least include:

12.2.2.1 Software Maintenance and Support

12.2.2.1.1 Product Support

12.2.2.1.2 Software Defects

12.2.2.2 Software Upgrades

12.2.2.2.1 Software Upgrade

12.2.2.2.2 Security Patches

12.2.2.2.3 Performance Upgrades

12.2.3 The bidder shall complete the section for licensing, maintenance and support in the pricing workbook.

12.2.4 The bidder shall provide for the implementation of the updates, patches and fixes, inclusive of upgrades and enablement of latest features to the product during the product lifecycle.

12.3 Premium SME support

12.3.1 The Bidder must include application support submission for 10 years after the successful implementation and deployment of the solution which includes:

12.3.1.1 Development hours allocated per month for production incidents, operational support and configuration assistance;

12.3.1.2 Training hours for skills transfer of work done by specialist sme's;

12.3.1.3 Specialised tuning of environment to ensure well performing production system;

12.3.1.4 Consulting services on best way to implement configurations as to not impede future upgrades to the system;

12.3.1.5 Access to specialist SME's to guide on how to make best use of product capabilities to meet business need;

12.3.1.6 Product consulting – optimal utilisation, improvement reviews;

12.3.1.7 Warranty forecasts, IMAC coordination, product guidance etc;

12.3.1.8 Major incident support, incident monitoring and escalation management, problem management & determination (cross platform);

12.3.1.9 Monthly reports – environment health checks, incidents; and

12.3.1.10 Performance monitoring.

12.3.2 The Bidder shall cater for new features on TFRs request according to future business requirements.

13 PERFORMANCE REQUIREMENTS

13.1 The Bidder must comply with the requirements stated in this RFP.

13.2 The roles and responsibilities of each party should be clearly outlined in the tender / bid documents to ensure liability is properly assigned and the submitted bid price has regard to this.

13.3 If the Bidder does not perform according to the agreed contract, Transnet reserves the right to appoint an alternative bidder at the successful Bidder's cost.

14 COSTING REQUIREMENTS

14.1 Provide itemised costing including the hourly rates as per the template forming part of the RFP.

14.2 The tables provided for pricing can be extended to provide any additional information that is going to assist in understanding the pricing.

14.3 Pricing is Maximum Fixed Total Price for the project;

14.4 Provide a billing schedule that is linked to delivery of milestones.

14.5 Payments will be made per accepted/done delivery of agreed milestones.

14.6 All deliverables that are completed and approved by the 15th of the month must be invoiced in the same month.

14.7 Invoices must be submitted by the 20th of each month to ensure payment in the following month.

14.8 The bidder must complete Pricing booklet see Annexure D – Pricing workbook.

14.9 The bidder must state annual subscription and premium licence fees which includes the following services:

14.9.1 Software Maintenance and Support

14.9.1.1 Product Support

14.9.1.2 Software Defects

14.9.2 Software Upgrades

14.9.2.1 Software Upgrade

14.9.2.2 Security Patches

14.9.2.3 Performance Upgrades

14.9.3 Solution Support

14.9.3.1 Configuration/Development

14.9.3.2 Solution Optimisation

14.9.3.3 Solution Incident Resolution

14.9.3.4 Audit Requirements

14.9.3.5 Knowledge Sharing

14.9.3.6 Training

14.9.3.7 Disaster Recover

14.9.3.8 Monitoring of environment

14.10 All project related travel costs deemed necessary by TFR, within the borders of South Africa, will be paid for by TFR and need not be costed by the bidders.

15 CONSTRAINTS

15.1 The solution has to integrate with other systems within TFR, other Transnet Operating Divisions and third-party partners where required e.g. other operators on TFR network.

15.2 Deliverables must be approved before it is considered to be completed.

15.3 All work will adhere to TFR standards and policies i.e. architecture, training, change management and project management.

15.4 TFR user availability as well as solution freeze period for production changes must be taken into consideration namely 4 week break in December from the 15th, financial year end closure at the end of March where availability is impacted for March and April of each year.

16 IMPLEMENTATION REQUIREMENTS

16.1 The contract will be negotiated after the award of the tender.

16.2 The successful Bidder and the TFR ICT PMO will engage to compile the full schedule including training, change management and deployment before the contract is finalised.

16.3 The operational readiness requirements must be defined and listed during the contract negotiation. Activities required for completion by TFR before execution shall be stipulated separately.

16.4 The start date of execution will be agreed before the contract is approved.

17 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Adherence to the Environmental Impact Assessment Universe within which Transnet operates.

18 BASELINE RISK ASSESSMENT

Adherence to the Transnet Risk Management Policy.

19 HEALTH AND SAFETY

Adherence to the Health and Safety Universe within which Transnet operates.

20 LEGAL REQUIREMENTS

Adherence to the Regulatory Universe within which Transnet operates.