KPMG

VISTAR Vision

Visionary Integrated and Sustainable enTerprise Architecture for Railways

Centre for Railway Information Systems

IREA0004 V1-08072022

Contents

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1 VISION

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About VISTAR

Indian Railways envisages aligning its IT strategy with the overall Business Strategy. A project for development and implementation of the Enterprise Architecture (EA) for Indian Railways has been initiated by the Railway Board which is named as **VISTAR – Visionary Integrated and Sustainable enTerprise Architecture for Railways**. VISTAR blueprint would help IR to standardize and integrate systems and processes for the whole of the Railway to reach a state of automation in a time-targeted manner.

VISTAR is a framework that promotes the evolution of digital Indian Railways ecosystems. It consists of a set of principles and reference architecture that inform, guide, and enable the development of integrated digital systems, with a focus on the value outcome. The following define the characteristics of VISTAR:

- VISTAR is applicable and focusing on ecosystems than limiting to systems.
- VISTAR offers a group of reference architecture across domains, Business, Information, Application and Technology.
- VISTAR is based on agile methodology with evolving pattern
- VISTAR is focusing on unifying but not the forced uniformity.

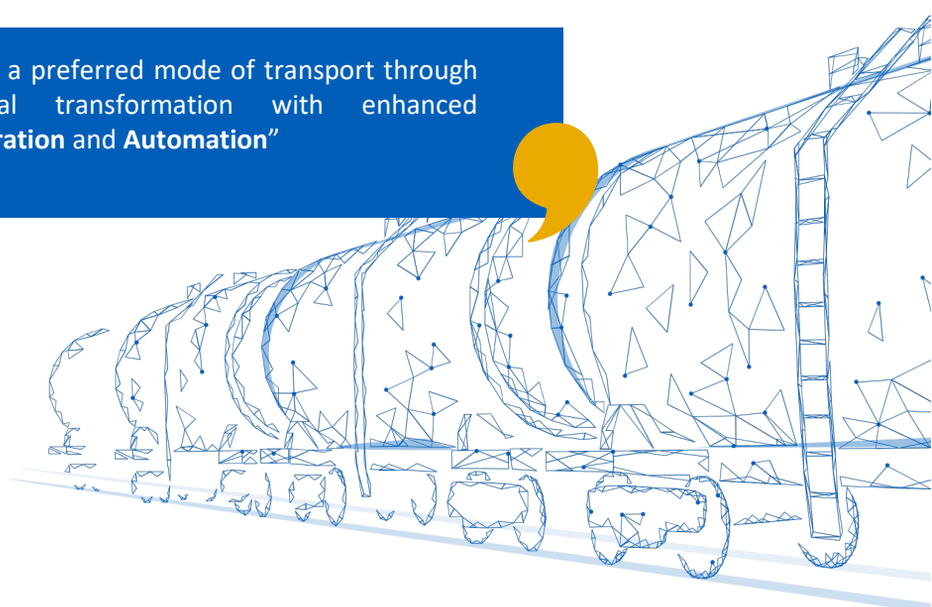
The core value proposition of VISTAR to enable more rational planning of IT investments, cost savings due to reusable and interoperable systems, and better architectures designed faster. To the citizens, it means a more holistic and seamless experience across organizations. And to the industry, it holds out immense promise of innovation.

Centre for Railway Information Systems (CRIS) is nominated as the nodal organization to develop the VISTAR Blueprint and its implementation.

Vision VISTAR

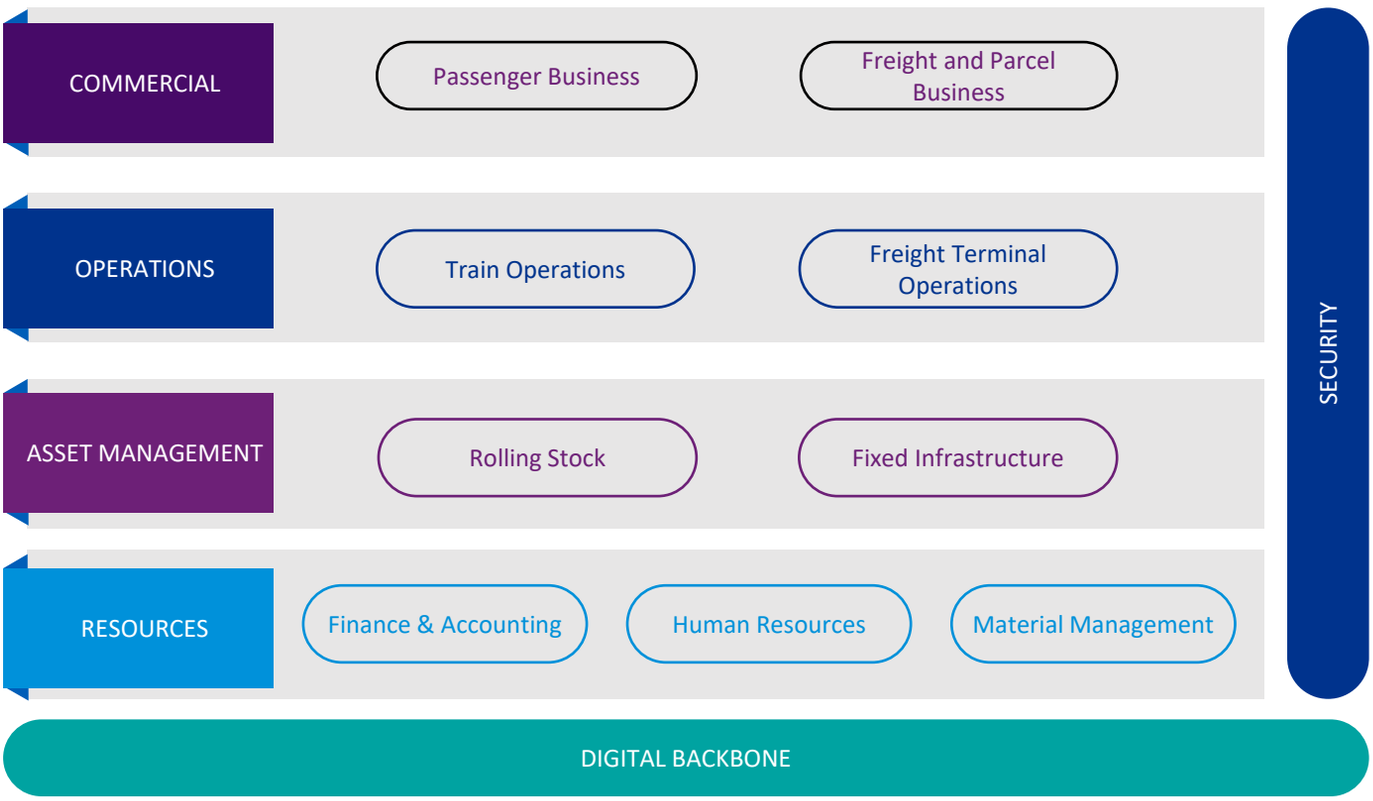
The vision of VISTAR is as under:

> "Make Indian Railways a preferred mode of transport through the use of digital transformation with enhanced **Standardization**, **Integration** and **Automation**"



Business Capabilities

Considering the size and scale of Indian Railways' services, business capabilities are categorized into business areas and various other verticals which support these business areas for the overall functioning of Indian Railways. Indian Railways comprises of the following Business Capabilities:



Business Drivers

Business Drivers act as its catalyst to perform actions that help achieve its objectives and consequently its goals. The business drivers identified for VISTAR are as below:

S. No.	Driver
D1	Growth and Sustainability (Increase modal share/ increase revenue/ Network Expansion/ sustainability)
D2	Enhanced User Experience and service delivery with quality (Punctuality, Reliability, Availability, easy access to services, Ease of doing business)
D3	Operational Efficiency (Optimal utilization of available resources)
D4	Safety (Enhanced safety measures)
D5	Collaboration with partners, sharing of information with partners to make the ecosystem more efficient and agile (Improved institutionalization)

1.1 Passenger Business

This Business area is responsible for management of passenger life cycle including managing passenger services, undertaking marketing initiatives, managing end to end operations with enhanced travel experience.

The IR has been catering to the needs of the suburban and non-suburban areas of the country by providing safe and quick journeys at a low cost for decades.

Further, the Passenger service business area is also responsible for adopting modern measures, undertaking necessary initiatives in areas including Monitoring of train movement, guidelines, and policy level decisions, justification for expanding the railway network, etc. with a view to facilitate services efficiently and cost-effectively ensuring enhanced customer experience.

In order to achieve the VISTAR vision for Passenger Business below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives
Strategy formulation and policy level decisions enablement	• Develop/ Enhance Systems and processes facilitating for/ enabling following: ○ Strategic Planning for Passenger traffic ○ Sustainable and improved Costing model ○ Integrated services, new products and services/Collaborations ○ Effective campaign management/ discount offers/ dynamic pricing ○ Cohesive PPP framework

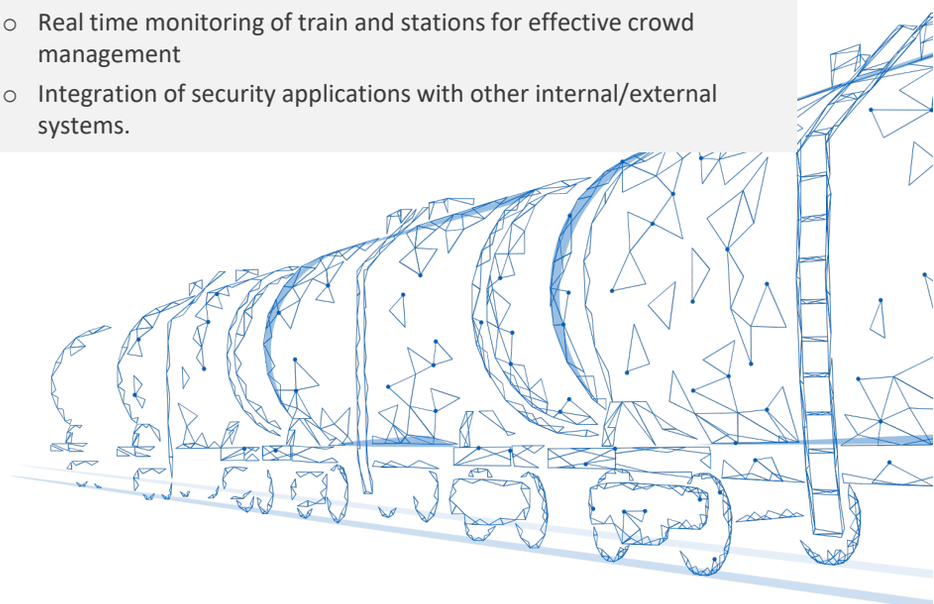
Goals	Objectives

Increase collaboration and diversified services to provide best in class journey experience	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Multi Modal Passenger Travel ticketing system and provide last mile connectivity
	  ○ Collaboration with Travel eco-system
	  ○ Passenger satisfaction index
	• Modernization of existing system to have flexibility and scalability for quicker launch of newer service/product as to remain competitive
	• Enhance booking experience (unified system) comparable with ticketing systems of other modes of transport
	• Enhance Passenger journey experience (End-to-end personalized journey information with a single integrated information system with state of art design and user experience).

Effective utilization of Passenger carrying capacity	• Enabling Project Monitoring systems for the work of :
	  ○ Network of high-speed rail corridors
	  ○ Expansion for last mile railway connectivity
	• Develop systems for capacity planning and monitoring to enable :
	  ○ Effective utilization of Passenger carrying capacity
	  ○ Evaluation of capacity to be released by DFC
	  ○ Forecasting capacity requirements

Ensure safe travel	• Develop/ Enhance systems and processes for facilitating/enabling
	  ○ Achieving zero level of risk for passengers
	  ○ Effective monitoring and management of safety related projects
	  ○ Prompt Disaster management

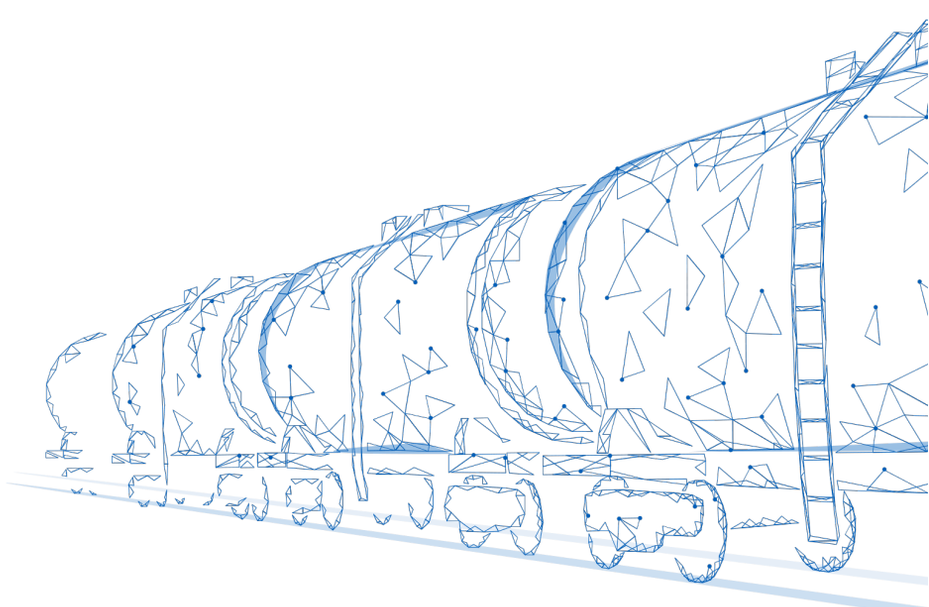
Ensure Security	• Develop/ Enhance systems and processes for facilitating/enabling
	  ○ Security and intelligence measure at stations and trains
	  ○ Real time monitoring of train and stations for effective crowd management
	  ○ Integration of security applications with other internal/external systems.



KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs for Passenger Business are outlined below:

- Occupancy rate of trains
- Modal Share of Passenger Business
- Punctuality of Train (improvement vis a vis last year's performance & target)
- Passenger Traffic volume
- Cost Recovery Ratio
- Percentage of public passenger railway stations with connections to public urban transport
- Index of Customer satisfaction
- Number of Accidents



1.2 Freight and Parcel Business

Freight Business constitutes the most vital segment of Indian Railways' business in terms of revenues. Indian Railways carry about 3.5 million tonnes of freight every day. The major commodities carried by Indian Railways are Coal, Iron Ore, Food grains, Iron & Steel, Cement, Petroleum products, Fertilizer and Containerized Traffic.

The business area is also responsible for adopting modern measures, undertaking necessary initiatives in areas including Infrastructure Development, Guidelines and Policy level decision, Marketing, expanding the railway network, etc. with a view to facilitate services efficiently and cost-effectively and also, to enhance the Indian Railway's freight market share while promoting the Green Environment. Keeping in view the need for an integrated approach for small and bulk commodities, parcel business is being considered along with Freight Business.

In order to achieve the VISTAR vision for Freight Business below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives

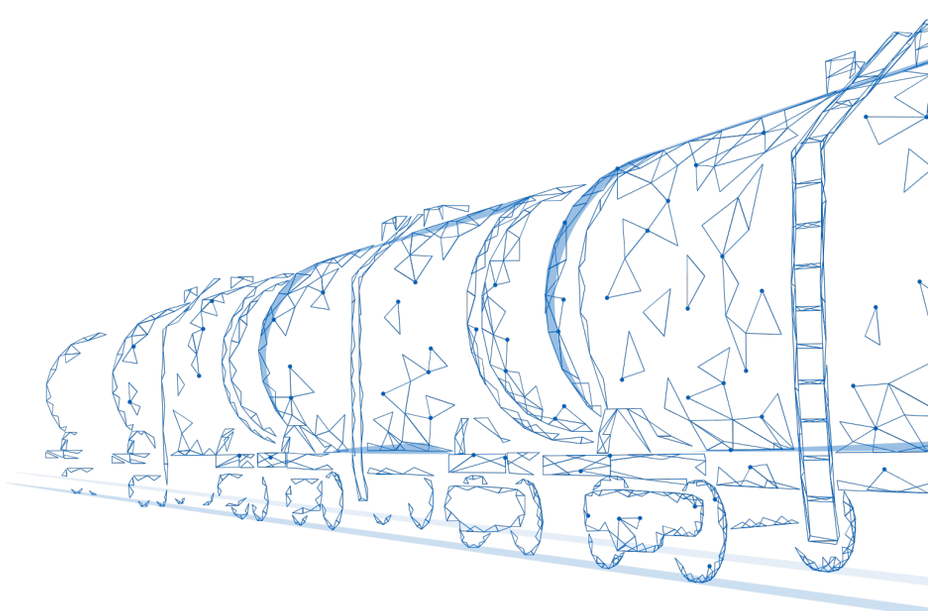
Strategy formulation and policy level decisions enablement	• Develop/ Enhance Systems and processes facilitating for/ enabling following:
	  ○ Demand Forecasting
	  ○ Strategic Planning
	  ○ Redefined logistics cost- competitive pricing model
	  ○ Optimize operational cost
	  ○ Differential pricing/ Dynamic freight and Parcel tariff
	  ○ Route optimization
	  ○ Scheduling of freight and Parcel trains
	  ○ Containerization of Parcels

Goals	Objectives
Increase freight and Parcel modal share	• Develop/ Enhance systems and processes for facilitating/enabling **Freight Business** o Multimodal Freight Terminals to be developed as part of Gatishakti scheme o Dedicated Freight Corridors o Private Freight Terminals o Modernized Goods Sheds o PPP model for freight corridors o Expanding and diversifying freight basket • Development of integrated systems enabling Partnership with logistic providers for end-to-end deliveries to cover last-mile connectivity (Door to Door) **Parcel Business** • Establish parcel stores & offices at multimodal freight terminals • Parcel Special Trains for different sectors while ensuring punctuality • Build Partnership with e- commerce players
Enabling ease of doing business	• Enhance capabilities (Systems and processes) for: **Freight Business** o Providing transparent and real time information to customers, partner organizations and third-party agencies. o Enhanced and personalized services o Integrated value chain with other stakeholders/logistics service providers. o Measuring Customer Satisfaction Index **Parcel Business** • Mobile solution enabling ease of booking • Providing transparent and real time information to customers, partner organizations and third-party agencies
Secured delivery of goods	• Develop/ Enhance systems and processes for facilitating/enabling: **Freight Business** o Improved security and intelligence measure at Freight terminals, wagons and Goods shed. o Real time monitoring of freight terminals and Goods Sheds. o Integration of security applications with other internal systems. **Parcel Business** o Augment security and intelligence measure at Parcel offices and stores o Integration of security applications with other internal systems.
Develop future ready product roadmap	• Develop/ Enhance systems and processes for facilitating/enabling: o Inclusion of functionalities and modules considering future requirement in existing systems and applications o Provide unified and faster access to services o Use data to provide personalized experience

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs are outlined below:

- Total annual freight revenues
- Modal Share of Freight Business
- Average speed of Goods Train
- Claim settlements ratio
- Capacity utilization of DFC
- Index of Customer satisfaction



1.3 Train Operations

Railway operation encompasses all the activities connected with running the trains. Trains are arranged to run regularly depending on the requirements. Utilization of staff and infrastructure is also planned such that the entire operation is routine and operates round the clock.

This vertical is responsible for managing overall train operations, crew management, control of train movement and all related operational activities. Operations of Passenger/ freight are controlled and monitored by the Control Rooms in the Divisional offices. The Control Room is the nerve center of the division. The fluidity of train movements over the jurisdiction of the division is dependent on the efficiency of the Control Room operations.

In order to achieve the VISTAR vision for Train Operations below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives
Strategy formulation and policy level decisions enablement	• Develop/ Enhance Systems and processes facilitating for/ enabling following: o Private Train Operations o Strategic Planning to optimize operations o Effective Timetable planning (zero based timetabling, etc.)
Modernization and Advanced Monitoring	• Develop/ Enhance systems and processes for facilitating/ enabling o Modernization of process to reduce manual interventions involved in train Operations at different stages (including train crew, section controllers, crew controllers, etc.) - Utilizing Train Communication Network o Continuous visibility and instant access to information regarding status of trains (Enhanced real time intelligent system) o Unification of on-train devices/ applications

Goals	Objectives

Enhanced and Improved Control	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Integration with New Signaling technologies (ATP, KAVACH etc.)
	  ○ Integrated system having real time data exchange (including Traffic Control, Power Control, Carriage and Wagon Control, Commercial Control, Traction Power control, Engineering control, Signal Control, Security Control, etc.)
	  ○ Advanced yard management systems

Next generation traffic management system	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Integrated traffic management system
	  ○ Dynamic Route Planning : Provide a preferred route for train movement along with the alternate routes and their analysis (including diversion planning, real-time rescheduling of trains, etc.)
	  ○ Identify pattern and predictions to generate more accurate network utilization plan

Efficient crew management	• Develop/ Enhance systems and processes for facilitating/ enabling ○ Effective Crew Management to enhance the utilization

Ensure safe and secure travel	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Monitoring of compliances to the defined safety guidelines
	  ○ On-the-go training of crews on safety parameters
	  ○ Prompt Disaster management

Terminal Operations (Passenger)	• Develop/ Enhance systems and processes for facilitating/ enabling ○ Efficient working of stations

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs are outlined below:

- Availability of trains as per the demand
- Deviation from train schedule
- Availability and assignment of crew
- Average Speed of trains
- Number of accidents and causalities

1.4 Asset Management

Rolling Stock

This Business vertical is responsible for Asset Management of Rolling Stock It includes dealing in manufacturing, procurement, maintenance and overhaul of coaches, wagons, locomotives, trainsets, etc. Operational efficiency is dependent upon the timely availability of rolling stock as per the requirements of operations. This vertical is, therefore, very important in terms of costs reductions as well as efficient train operations.

In addition, it holds responsible for the adoption of emerging technologies, up-gradation of equipment and devices, leveraging IoT and embedded systems, modern manufacturing techniques and undertaking necessary initiatives for effective rolling stock management. The major objectives remain to provide efficient and cost-effective services and enhance the customer experience while promoting Green Environment. The vertical is also responsible for Disaster Management services in Indian Railways, which include quick restoration during train accidents and other allied activities.

In order to achieve the VISTAR vision for Rolling Stock below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives
Strategy formulation and policy level decisions enablement	○ Develop/ Enhance systems and processes for facilitating/ enabling ○ Forecasting and Planning of required rolling stock capacity (inputs received from all sources, historical analysis, strategic directives, etc.) ○ Optimize costs of designing, manufacturing and maintenance of Rolling Stock ○ PPP/JV policies for Rolling Stock (interactive platform to institutionalize Private Partnership) ○ Plant and Machinery Lifecycle Management ○ Adoption of advance manufacturing and maintenance technologies. ○ Promotion of export of Rolling Stock.

Goals	Objectives

Modernizing Rolling Stock	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Centralized design Repository
	  ○ Capability to design, manufacture and maintain for high-speed trains and semi-highspeed trains(system level changes)
	  ○ Upgradation of existing Rolling Stock designs, manufacture and maintenance (Modernization of coaches/ wagons/ locomotives)
	  ○ Encourage eco design for production of Rolling stock

Predictive Maintenance of Rolling Stock	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Adoption of cyber-physical systems for rolling stock monitoring (Accurate condition-based monitoring of rolling stock infrastructure by leveraging IoT and embedded systems)
	  ○ Data Driven decision making across the maintenance lifecycle(identifying patterns and predict patterns to generate more accurate information).

Enhanced Fleet Management System	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Effective utilization of Rolling Stock(integrated systems across operations)
	  ○ Reduced turn-around time of Rolling Stocks (by rationalizing maintenance practices)

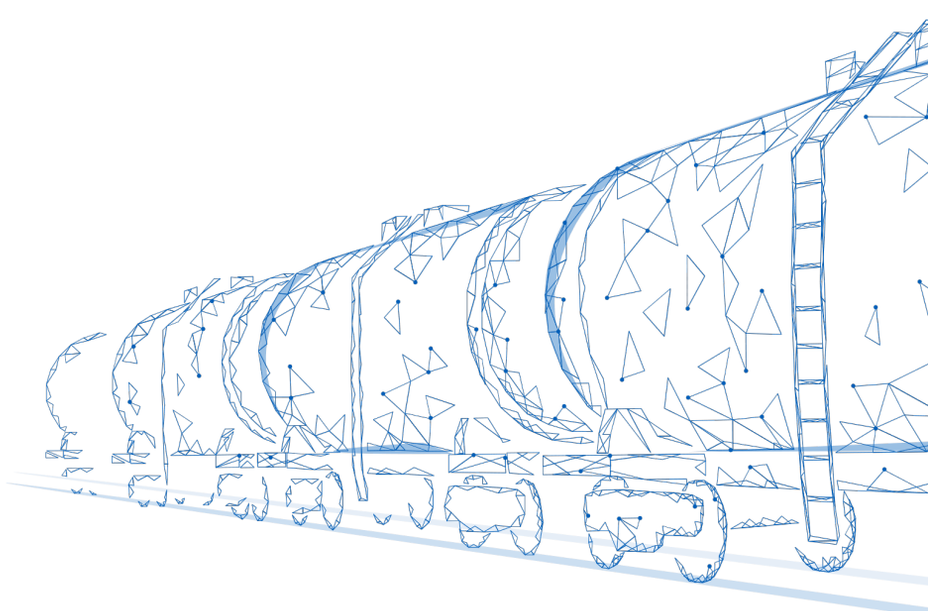
Enhanced Digital capabilities	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Augment related systems and applications to cater to the future requirements (Including requirements for locomotives and wagons as defined in NRP)
	  ○ Centralized system for informed decision making
	  ○ Integrated disaster management system to avert the incidents and quick response measures

Production Units' upgradation	• Develop/ Enhance systems and processes for facilitating/ enabling:
	  ○ Intelligent System for designing, engineering, manufacturing, supply chain, distribution and services
	  ○ Reduced waste generation through recycling and reuse
	  ○ Industry 4.0 implementation

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs are outlined below:

- Wagon/ Coaches holding turnaround time
- Number of sick/ failure counts for Wagon/ Coaches
- Number of Periodic Overhauls
- Reduction in Loco Failures
- Number of coach/ wagon/ locomotive Detachment



1.5 Asset Management
Fixed Infrastructure

This Business area is responsible for Asset Management of Fixed Infrastructure, asset utilization and maintenance of the asset. The service levels for passenger and freight depends considerably on asset reliability and availability.

Fixed Infrastructure includes land, bridges, tunnels, flyover, Subways, tracks, Electric Equipment & Fittings, points and crossings, station buildings, Overhead equipment, Remote Control centers, Signalling and Telecom assets.

The vertical is also responsible for adopting emerging technologies, up-gradation of equipment and devices, leveraging IoT and embedded systems, and undertaking necessary initiatives for effective fixed infrastructure management to enhance the customer experience.

In order to achieve the VISTAR vision for Fixed Infrastructure below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives
Strategy and Policy formulation	• Develop/ Enhance systems and processes for facilitating/ enabling o Planning for Network expansion, upgradation and maintenance plans o Optimum utilization of Network o Multimodal private terminals(GCT) o Integration of contract systems across IR o Use of Geo spatial mapping of important asset(For Effective Disaster management, etc.)
Improve safety and security	• Develop/ Enhance systems and processes for facilitating/ enabling o Installation and maintenance of safety systems for level crossing gates o Integrated monitoring of stations, Tracks and Rolling stocks o Use of advanced signaling systems (ETCS Level 2 and above) and enabling emergency communication o Advanced Rail fracture detection system(Ultrasonic, etc.) o Integrated Safety management system

Goals	Objectives

Next generation signaling system	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Upgradation of signaling system-
	  ▪ Automatic Train Protection (ATP) System
	  ▪ KAVACH signaling system (As National Automatic Train Protection System)
	  ▪ Mobile network (MTRC system based on LTE technology) and unified MPLS IP based data network across Rail network
	  ▪ Implementation of 4G based LTE system (IOT enabled) across tracks (Enabling receiving data from fixed infra as well as rolling stock)
	  ○ Centralized Traffic Control System

Effective Maintenance and Monitoring of Assets	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Integrated Traffic Block Planning(maintenance)(CTC**)
	  ○ Mechanization of asset maintenance
	  ○ Remote condition monitoring- Asset performance management through onboard and wayside sensors
	  ○ Modernized, mechanized and automated systems for Inspection (integrated with other systems)

Effective project management and monitoring	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Develop a comprehensive system for effective project management
	  ○ Establish a multi-layer dashboard for project monitoring

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs are outlined below:

- Building new lines
- Number of tracks renovated
- Degree of electrification of total network
- Delay of trains due to maintenance activities
- Delay of trains due to Infrastructure failures

1.6 Resource Management

Finance and Accounting

The Finance Branch is an important limb of the Administration, and its functions broadly include:

- Compilation of budgets and setting up of a satisfactory system of Budgetary Control
- Making rational plans and decisions
- Controlling the operations of the Railway Administration as a whole
- Controlling the operations within the various responsibility areas of the Administration.

The Accounts functions facilitate a general review of the finances of the Railway as a Commercial Enterprise as well as per the requirements of Government Accounts. It also deals with account of the contingency fund, Financial Results on the working of Indian Railways. Therefore, the objectives of securing the requirements of Commercial Accounting and practices of Government Accounting are being maintained by the link between these two.

In order to achieve the VISTAR vision for Finance and Accounting below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives

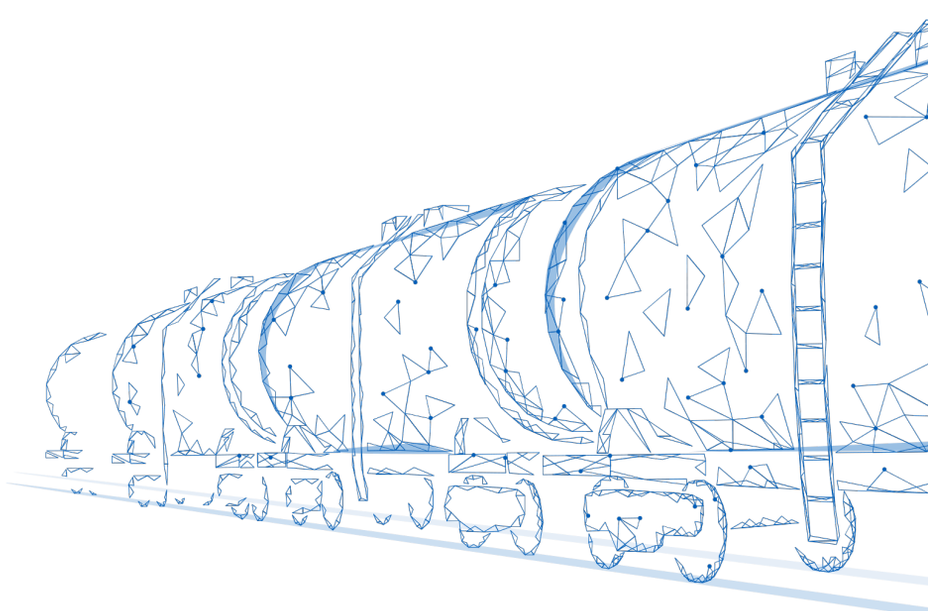
Strategy and Policy formulation	• Develop/ Enhance systems and processes for facilitating/ enabling
	  ○ Strategic Budgeting and Projecting to meet the financial needs of all verticals (Single view dashboard to monitor the financial health of all verticals)
	  ○ Effective allocation and monitoring of IR's income expenditures and assets
	  ○ Efficient planning for throw forward liabilities
	  ○ Independent Regulatory Mechanism for commercial aspects

Advanced systems for Finance and Accounts	• Develop/ Enhance systems and processes for facilitating/ enabling:
	  ○ Centralized integrated system for Financial and Accounts (Finance and Revenue Management, Project Finances, Book-keeping, Claim Settlement)
	  ○ Effective monitoring of adherence to compliances across IR

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs are outlined below:

- Operating Ratio (Percentage of gross working expenses to gross earnings)
- Return on Capital
  - % of revenue surplus to capital-at-charge
  - % of net receipts to capital-at-charge
- CAPEX – capital expenditures in relation to network size (Per Track Km) in terms of cost
- CAPEX – capital expenditures in relation to traffic volume (Per Train Km) in terms of cost
- Total revenue in relation to the traffic volume of Freight
- Total revenue in relation to the traffic volume of Passenger



1.7 Resource Management

Human Resources

Human Resource Management for railway is focused on delivering the output valued by customers, partners, and other stakeholders, sustainably.

The vertical is also responsible for adopting emerging technologies and undertaking necessary initiatives for effective Human Resource management.

The core aim of Human Resource Management is to attain organization's effectiveness. Human Resource Management includes Human Resource Planning, Recruitment and Selection, Training and Development, Reward Management and Industry Relations.

The Business vertical is responsible for Human Resource Management, through which Indian Railways optimally manages manpower and their associated performance for the purpose of delivering the IR's business objectives.

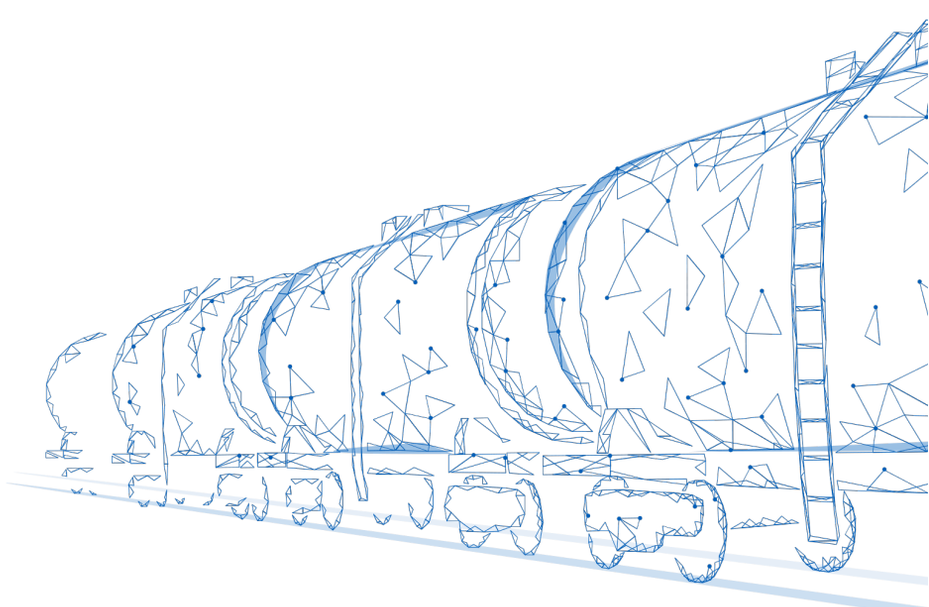
In order to achieve the VISTAR vision for Human Resources below mentioned goals are derived that are mapped with the objectives:

Goals	Objectives
Strategy formulation and policy level decisions enablement	• Develop/ Enhance systems and processes for facilitating/ enabling: ○ Effective planning for Human Resources (Adequate availability of human resources across IR) ○ Compliances formulation across IR(such as based on changes to labor laws)
Effective Human Resource managemnt	• Develop/ Enhance systems and processes for facilitating/ enabling: ○ Centralized integrated system for management of Human Resource ○ Effective monitoring of adherence to compliances across Indian Railways
Advanced Learning and development	• Develop/ Enhance systems and processes for facilitating/ enabling ○ Modernization of training system ○ Blended Learning Platform for learning and development (including content creation) ○ Multi-Skilling/ Cross Training for overall growth of employees

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs for Human Resource function are outlined below:

- Performance – Employee productivity
- Grievance redressal efficiency index
- Learning and development initiatives
- Skill based training
- Rationalization in manpower



1.8 Resource Management

Material Management

Materials Management deals with planning, organizing, communicating, directing and controlling all the activities concerned with the flow of materials into an organization and its further movement to various users. Indian Railways is one of the largest organizations in the country dealing with public procurement.

Key functions of the vertical include Planning, Procurement/ Purchasing, Warehousing/ Store Keeping, Inventory Management/ Control, Surplus/ Obsolete/ Scrap Disposal, Distribution and transportation of materials/ spares/ consumables/ finished products and Value analysis.

In order to achieve the VISTAR vision for Material Management below mentioned goals are derived that are mapped with the objectives:

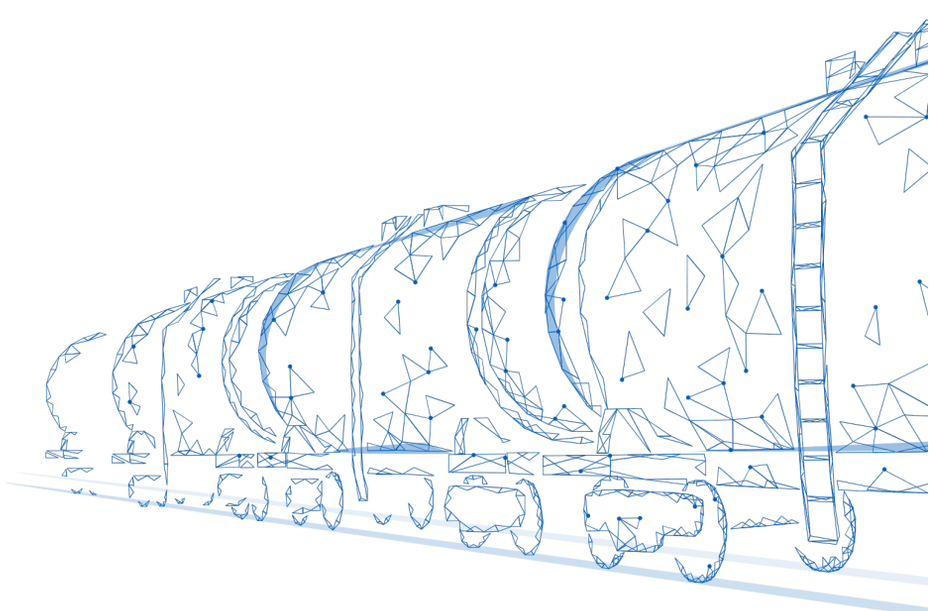
Goals	Objectives
Strategy formulation and policy level decisions enablement	• Develop/ Enhance systems and processes for facilitating/ enabling ○ Comprehensive Demand forecast and generation. ○ Effective implementation of Public Procurement Policy ○ Efficient Scrap/ Unserviceable items disposal policies. ○ Effective financial management through integration with internal systems (budgeting and accounting systems) ○ Innovative contracts
Efficient Inventory management	• Develop/ Enhance systems and processes for facilitating/ enabling ○ Availability of materials at the right time, with consistent quality and maintaining optimum stock level ○ Unique identification of parts/ items across Indian Railways (e.g. PL Number unification) ○ Manage multiple design changes (Integration across organizations including ICF, RDSO, RCF etc. to simplify the process of identification of materials) ○ Automation at warehouses/ stores level: Modernized Warehouse management

Goals	Objectives
Effective Vendor management	• Enhance systems and processes for facilitating/ enabling ○ Integrated and simplified system for vendor management{including Centralized repository for registered vendors(single user ID for one vendor)Vendor Performance Monitoring} ○ Effective contracts management(including Long term contracts, ancillary arrangements, etc.)
Advanced Procurement Management system	• Enable seamless flow of information between end users, Purchasers, Vendors, Approval agencies, Inspection agencies etc. (Augment related systems and applications) • End to end digitization of IR supply chain to improve efficiency

KPIs (Key Performance Indicators)

To measure the extent to which the goals and objectives are achieved, strategic KPIs are outlined below:

- The ratio of demand to supply of material
- Average time in supply of material
- Accuracy of Forecast Demand
- Reduction in Expenditure
- Reduction in turnaround time for finalization of procurement contracts
- Vendor performance and compliance index



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Conceptual Architecture Model

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2.1. Conceptual Architecture Model

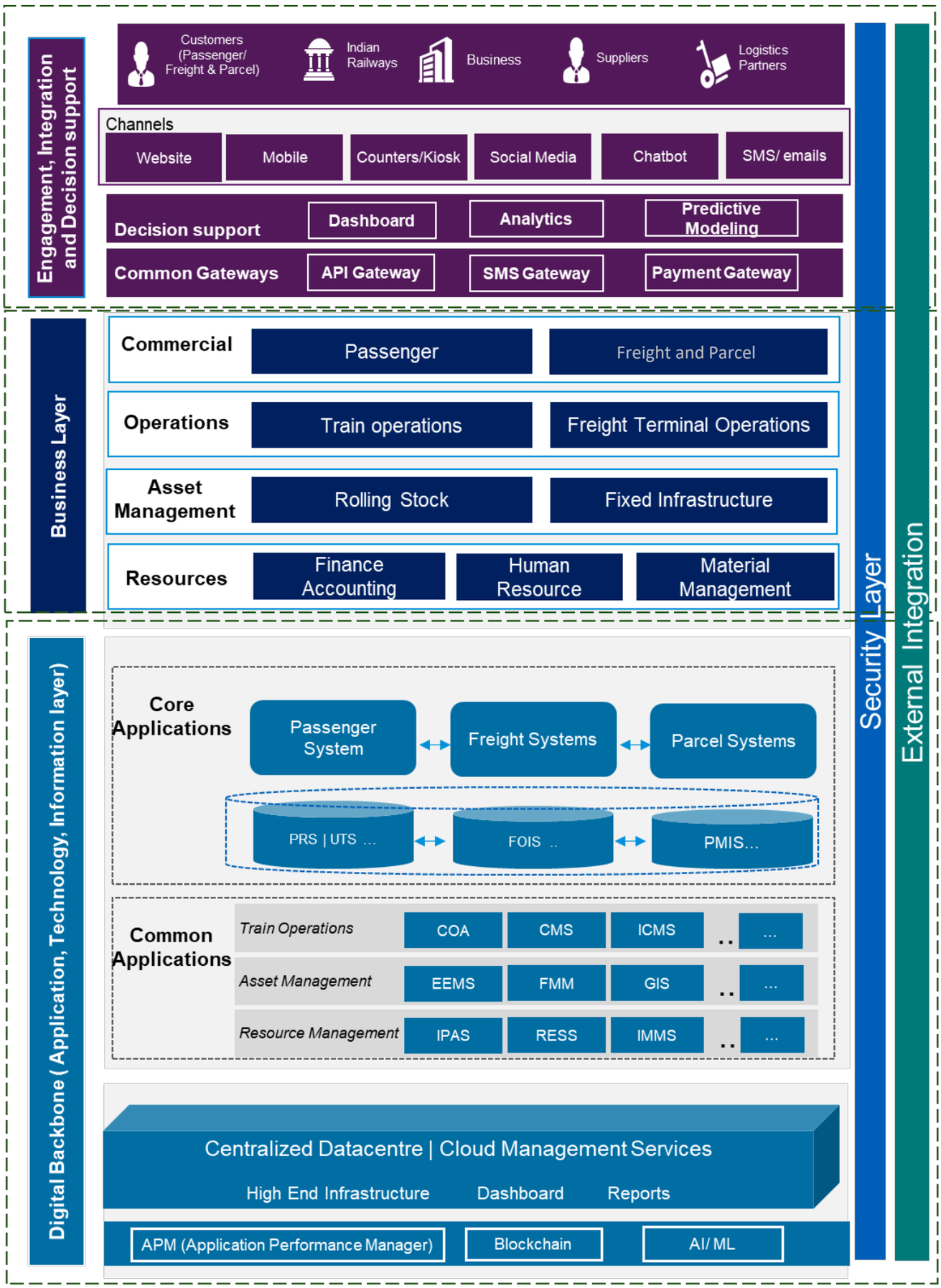
To keep pace with the evolving technologies which brings rapid change in the requirement landscape, digital transformation has become a necessity for IR business which is spread across Railway Board and its directorates, zones, divisions, and stations. To grow and remain informed to ensure IR remain competitive in sector. Industrial revolution like Industry 4.0, is at the heart of this transformation, and is affirming railways in achieving benefits that were unthinkable a few years ago. The impact of enabling technologies in the transport sector is undeniable, and their correct use offers benefits such as improved productivity and asset performance, reduced inefficiencies, lower production and maintenance costs, while enhancing system agility and flexibility. However, moving towards digital transformation is challenging for several reasons, including a lack of standardized implementation protocols, emphasis on the introduction of new technologies without assessing their role within the business, the compartmentalization of digital initiatives from the rest of the business, and the large-scale implementation of digitalization without a realistic view of return on investment.

VISTAR conceptual framework incorporates the factors that are often overlooked during digital transformation and presents a structured methodology. The conceptual framework envisages unified ecosystem for **"whole of Railways"** where systems are working in a collaborative environment, applications are harmonized, and services are available to stakeholders through multiple channels in an efficient and effective way. Envisaged framework visualizes alignment of Information Technology with Business requirement. Top layer of the Conceptual Architecture model is the engagement layer wherein focus is laid on providing unified experience to all stakeholders though multiple interfaces for ease of use. Integration layer envisions common gateways enabling seamless integration and boundaryless information.

The business capabilities of Indian Railways form the Business layer of the architecture. As mentioned in chapter 1, business capabilities are categorized under Commercial, Operations, Asset Management and Resources thematic areas.

As part of the Technology layer, it is envisaged to develop a whole of railways system wherein systems and applications are harmonized and optimized. A unified platform is conceptualized with integrated systems and applications for key business areas of Indian Railways viz. Passenger, Freight and Parcel. Operations, Asset and Resources applications supporting the business applications form a sublayer of the digital backbone and it is envisioned that applications will be standardized, optimized to enable an integrated environment. This will be supported by the adoption of high-end Infrastructure, cloud management services and emerging technology such as AI/ML, Blockchain, API Gateway, micro service architecture, Project Management tools, quality management system, security, etc.

While different business units in Indian Railways have implemented/are implementing various solutions, the central framework can be adopted to move towards a data-driven framework and create a data ecosystem. A typical technology stack to drive this Data-Driven ecosystem is depicted in the following 3 layers:



Heading 1

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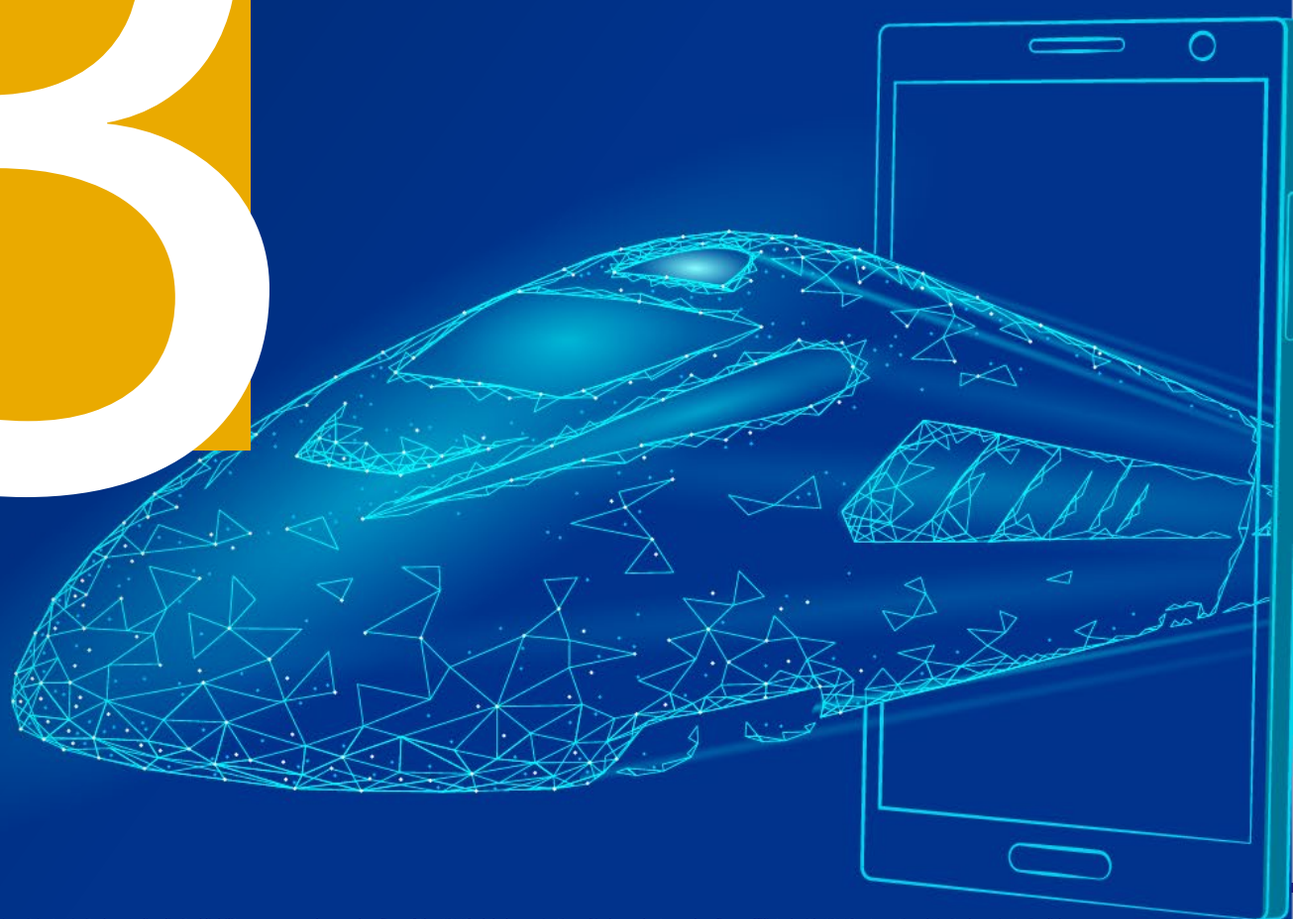
Potential Business Use Cases



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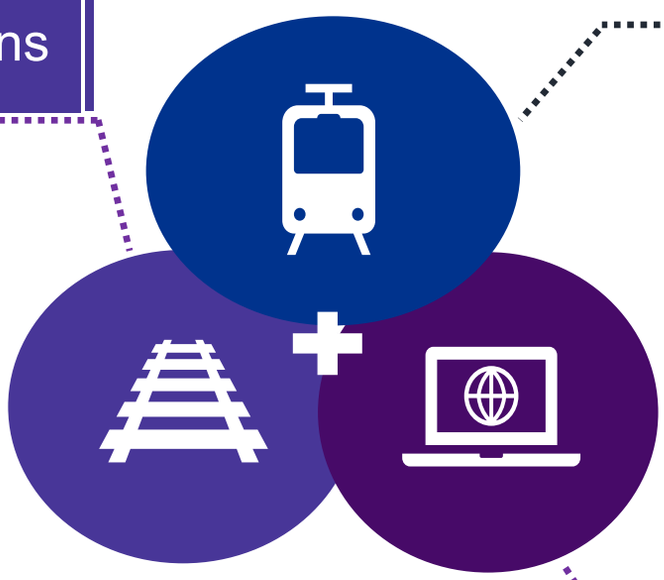
3.1 Potential Business Use Cases

Based on the discussion held with multiple stakeholders, identified potential Business Use Cases for IR are outlined below:

1 Freight Commercial

2 Freight Train Operations



3 Freight Rolling Stock

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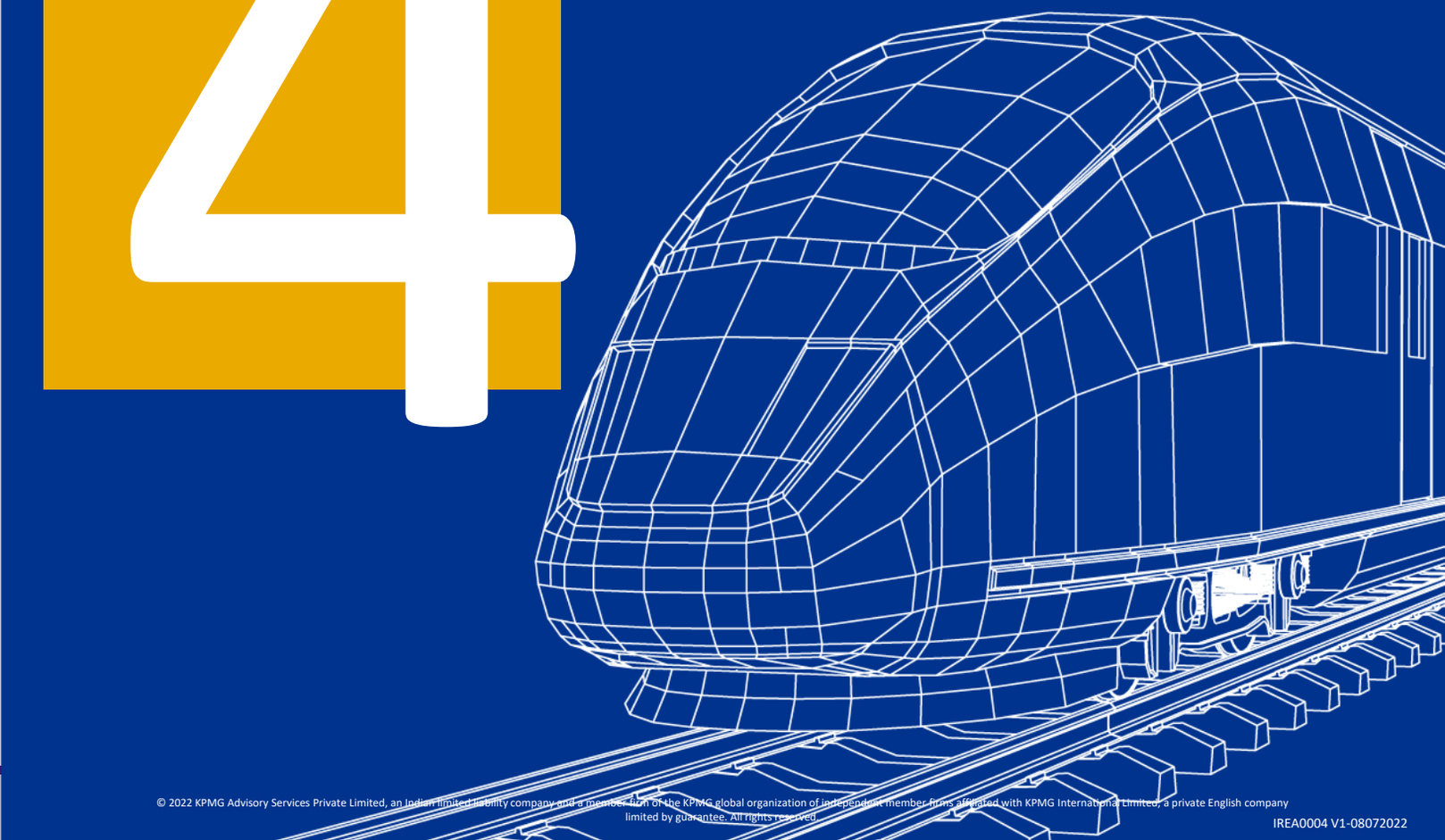
Organization-wide Digital Interventions



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4. Potential areas of Digitization

Based on the discussion held the potential areas for Digitization for IR are outlined below:

Integrated strategic planning system

An integrated strategic planning system to collect information from IR's applications, dashboards, third-party databases, policy papers etc. and provide support for strategic planning in Railway Board.

Integrated analytics system

An integrated analytics system to collect data from across the organization and aggregate it to generate organization-wide statistics in a timely manner. To analyze such data and provide insights and dashboards for different management levels to enable data-driven decision making.

Collaboration with partner organizations

Collaboration with partner organizations to enable system-level interchange of information in a controlled and secure fashion without manual intervention, with authorized customers, logistics and travel partners, suppliers, other government agencies, regulatory bodies, etc.

Cyber Physical Systems (IoT devices)

Introduction of cyber physical systems(IoT devices) to enable automated capture of maintenance parameters from rolling stock and fixed infrastructure, to provide diagnostic systems and a predictive maintenance regime.

Centralized Engineering Design Repository

A centralized engineering design repository to make rolling stock and fixed infrastructure engineering design data available to authorized persons across the organization.

Integrated skill development system

An integrated system for skill development including a pervasive Learning Management and Content Creation system to provide appropriate training materials at each employee's workplace and centrally monitor training and skill development

Resilient IT platform and pervasive data network

A resilient IT platform and a pervasive data network to enable IT systems to be accessed by Railway employees and customers from homes, offices, operational sites, maintenance sites, trackside locations, and in running trains

Comprehensive IR-wide Project Management System

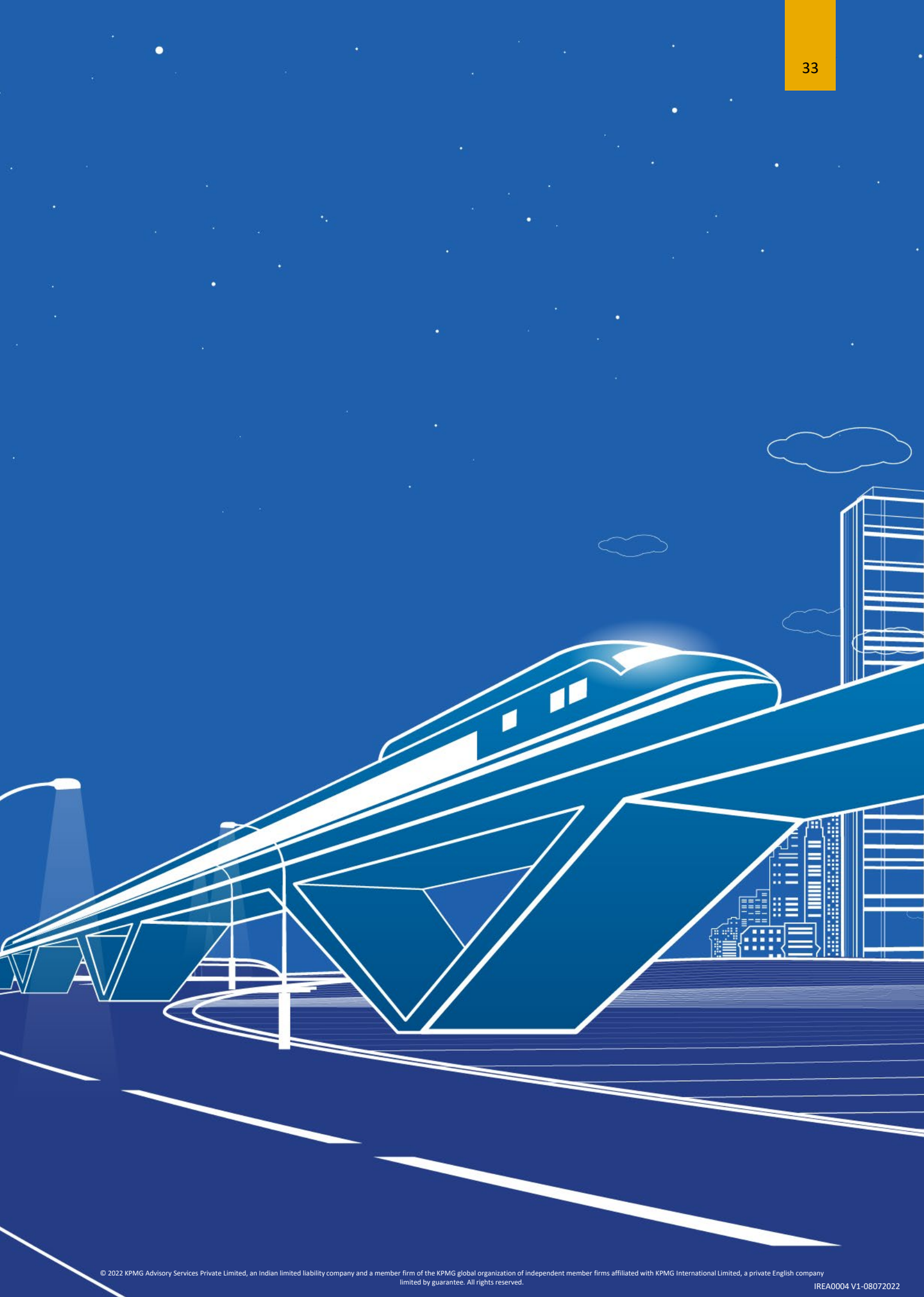
A project management system to provide status of the work completed, timeline adherence and delays in the project including the reports on the financials for the Indian Railways.

IT-enabled automation of Material Handling

An IT-based platform to help with the handling of materials within the Indian Railways. The platform includes sharing of demand, procurement plan, inventory management and the transportation of the materials from inventory.

Integrated disaster management system

An integrated system to help with planning during disasters. This includes integration between various verticals to manage and expedite the relief work to be conducted.



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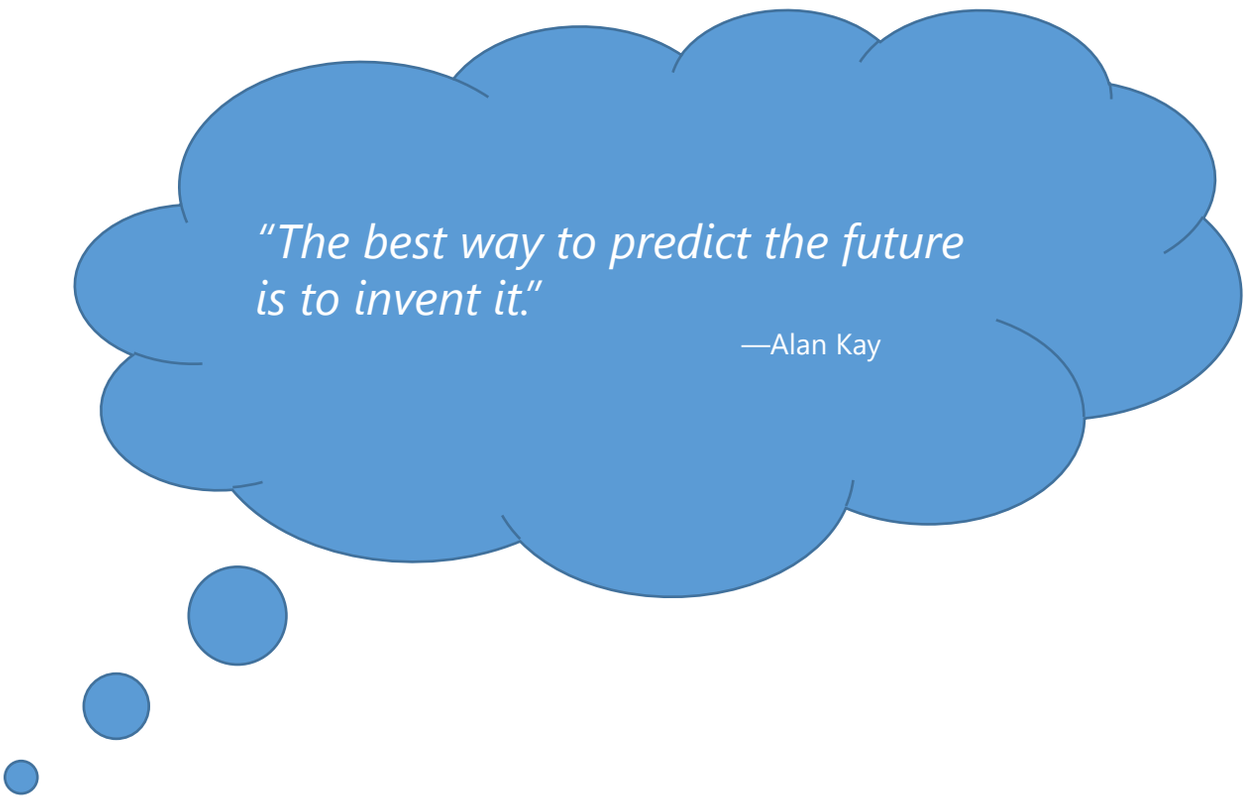
Acronyms

Abbreviation	Expansion
&	And
App	Application
API	Application Programing Interface
AI	Artificial Intelligence
AR	Augmented Reality
ATP	Automatic Train Protection
B2B	Business to Business
COFMOW	Central Organization for Modernization of Workshop
CORE	Central Organization for Railway Electrification
CRIS	Centre for Railway Information Systems
CBM	Conditional Based Maintenance
COA	Control Office Application
CMS	Crew Management System
DFC	Dedicated Freight Corridor
EEMS	Electrical Energy Management System
EA	Enterprise Architecture
FDI	Foreign Direct Investment
FMM	Freight Maintenance Management
FOIS	Freight Operation Information System
GIS	Geographic Information System
GPS	Global Positioning System
GDP	Gross Domestic Product
HSRC	High Speed Rail Corporation
HRMS	Human Resource Management System
IndEA	India Enterprise Architecture
IR	Indian Railways
IREPS	Indian Railways E-Procurement Systems
IT	Information Technology
ICMS	Integrated Coaching Management System
IMMS	Integrated Material Management System
IPAS	Integrated Payroll and Accounting System
IoT	Internet of Things
KPI	Key Performance Index
MFI	Multilateral Financial Institutions
NHSRCL	National High Speed Rail Corporation Limited
OMRS	On-line Monitoring of Rolling stock System
OHE	Overhead Equipment
PMS	Parcel Management System
PRS	Passenger Reservation System
PMIS	Personal Management Information System
PM	Predictive maintenance
RESS	Railway Employee Self Service
RTIS	Real Train Information System
RDSO	Research Designs and Standards Organization
SMS	Short Messaging Service
TAT	Turnaround time
UVAM	Unified Vendor Approval Module
UTS	Unreserved Ticketing System
UDM	User Depot Model
VR	Virtual Reality
VISTAR	Visionary Integrated and Sustainable Enterprise Architecture for Railways



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