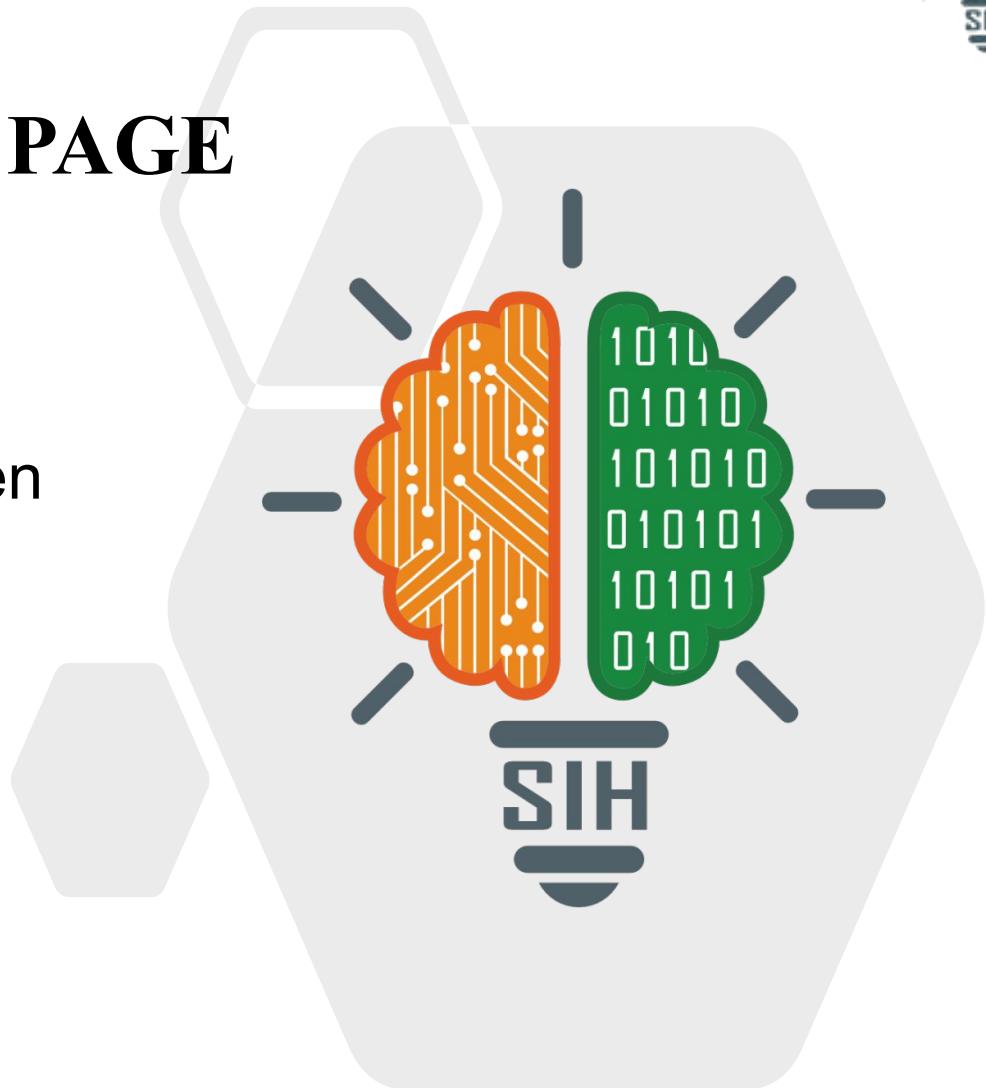


# SMART INDIA HACKATHON 2025



## TITLE PAGE

- **Problem Statement ID** – SIH25081
- **Problem Statement Title** - AI-Driven Train Planning for Kochi Metro
- **Theme** - Smart Automation
- **PS Category** - Software
- **Team ID** - 109\_SIH
- **Team Name (Registered on portal)** - Runtime\_Rebels\_RGUKTN



# AI-Powered Train Induction & Scheduling System for Kochi Metro



## ◆ Proposed Solution

Our solution introduces an **AI-powered decision-support platform** that integrates data from Maximo exports, IoT fitness sensors, maintenance logs, and depot maps through APIs and IoT connectors. After preprocessing, AI/ML models are applied: **Random Forest for risk prediction, LSTM for scheduling, and Reinforcement Learning for mileage and bay optimization**, supported by clustering models for cleaning slot allocation.

The platform delivers a **ranked induction list with explainable reasoning, conflict alerts, and dashboards**, ensuring reliable, scalable, and auditable planning. This results in **higher fleet availability, lower lifecycle cost, and improved passenger experience**, while continuously learning and improving over time.

## ◆ Innovation and Uniqueness

- Algorithmic Automation
- Wear and tear Forecasting
- Branding Hours Forecaster
- Real time What-if Simulation

The screenshot displays the RailOps software interface. At the top, there's a navigation bar with icons for Dashboard, Operations, Maintenance, and Analytics, along with a user profile icon. Below the navigation is a search bar labeled "Search trainsets, locations..." with filters for All, Active, and Inactive. The main area is titled "Trainset Induction List" with a subtitle "Real-time status and conflict alerts for trainset operations". It shows a table with five rows of trainset data:

TRAINSET ID	STATUS	LOCATION	NEXT SERVICE	CONFLICT ALERTS
Trainset 101	Ready	Station A	14:00	None
Trainset 102	Standby	Station B	16:30	Signal Malfunction
Trainset 103	Maintenance	Depot	N/A	Brake System Failure
Trainset 104	Ready	Station C	12:45	None
Trainset 105	Standby	Station D	15:15	Track Obstruction

To the right of the table is a "Key Performance Indicators" section with three cards: "Fleet Availability" at 95%, "Punctuality" at 98%, and "Cost Savings" at \$250,000.

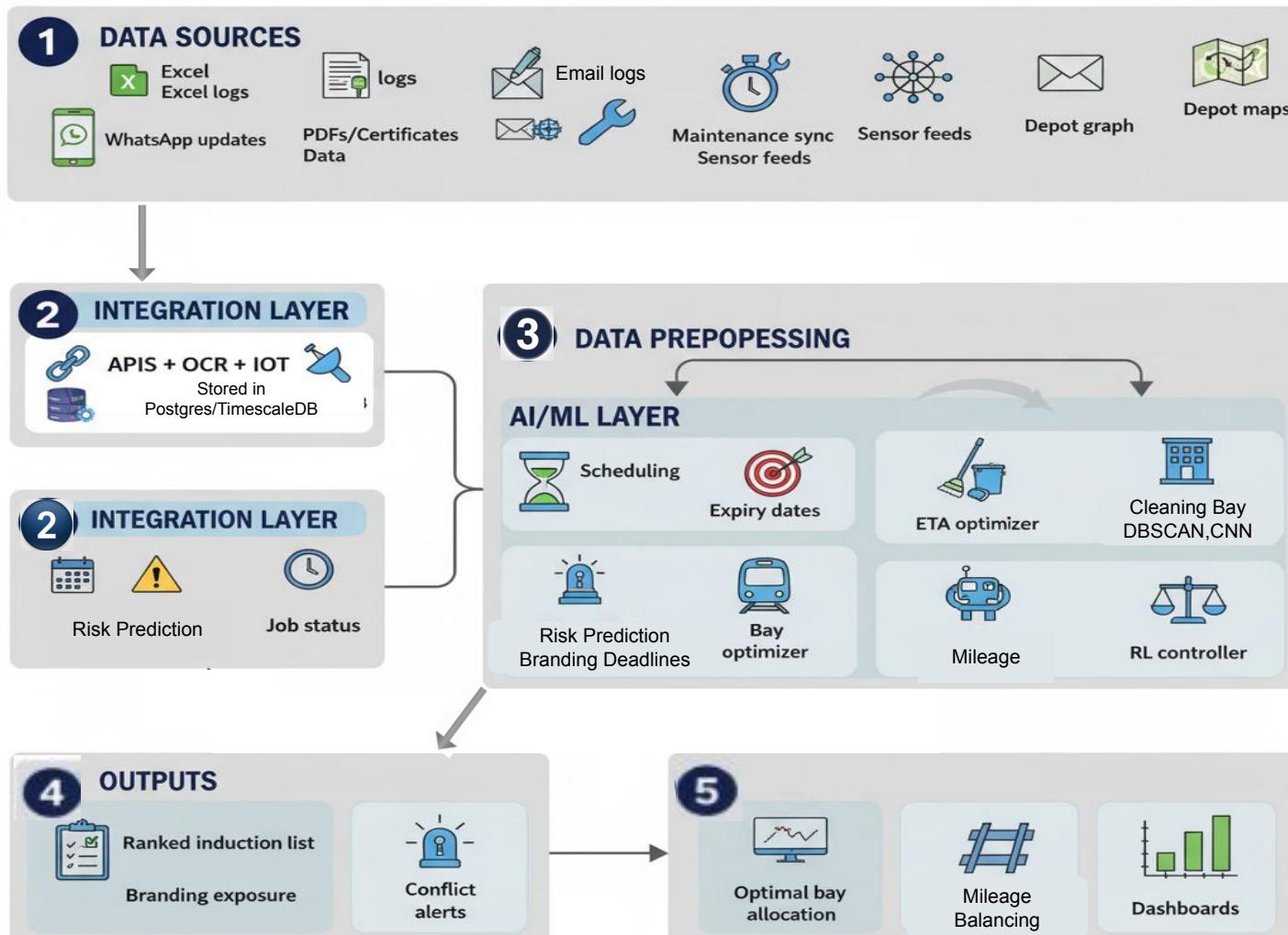
## ◆ How the solution Addresses the Problem :

- MCDA (Multi Criteria Decision Analysis) Scoring
- Efficient & Adaptive metro scheduling
- Automated certificate tracking & alerts
- Schedules cleaning & Detailing slots
- Automated compliance tracking using OCR with ML-based expiry alerts

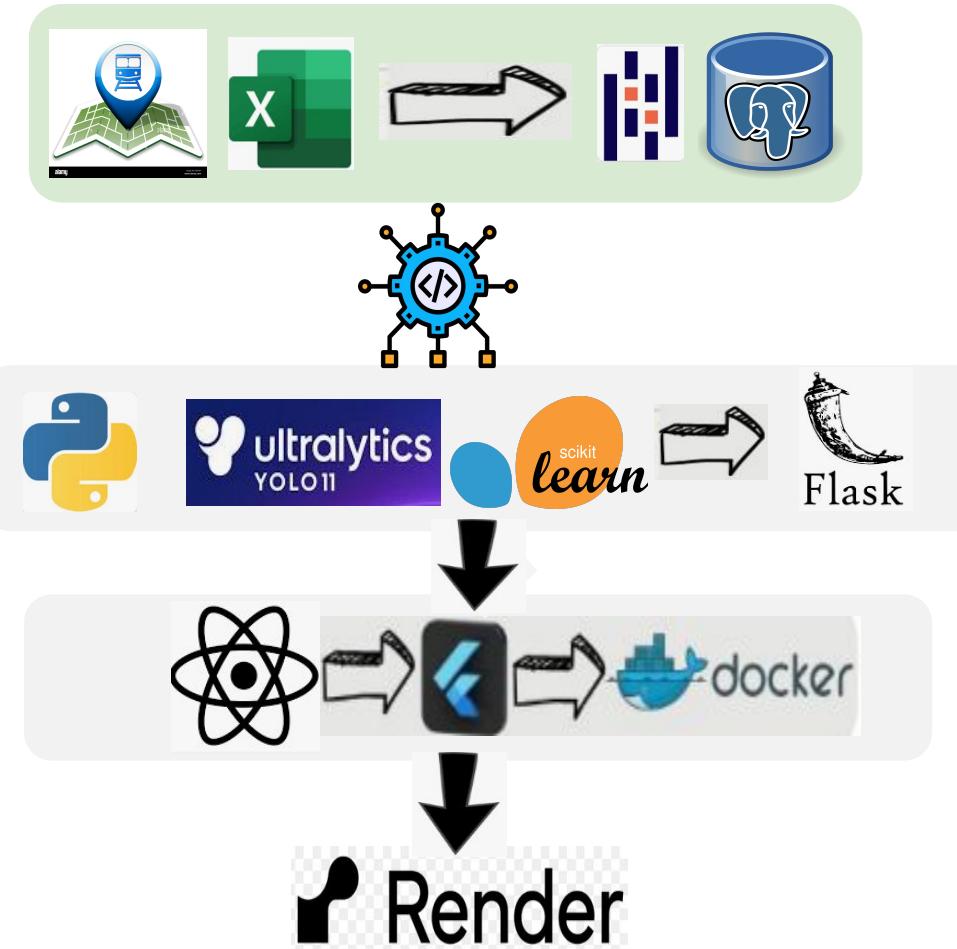
# TECHNICAL APPROACH



## KOCHI METRO – AI-POWERED TRAIN INDUCTION PLANNING



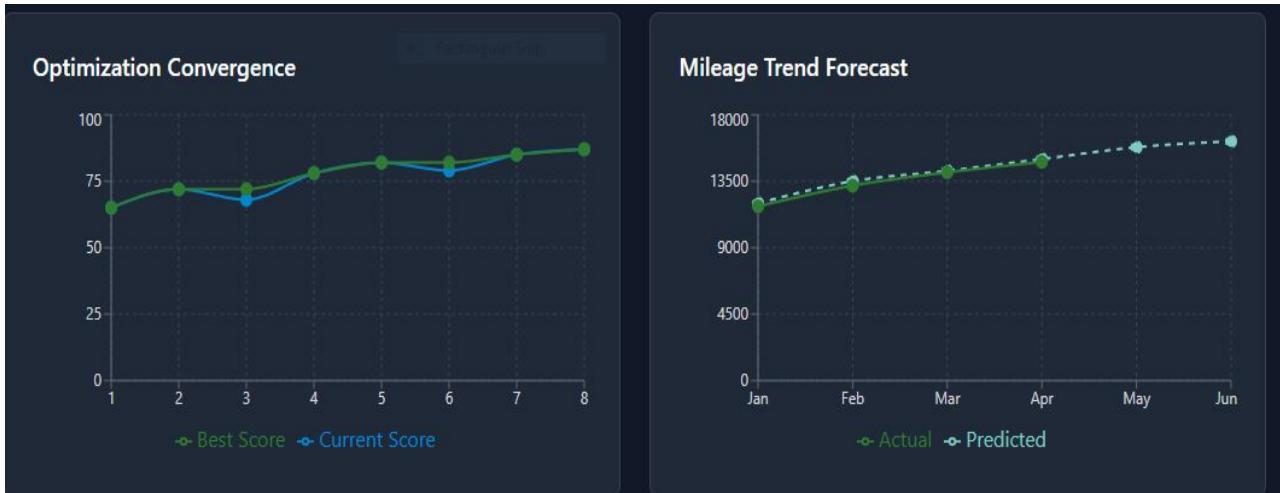
## Tech Stack



# FEASIBILITY AND VIABILITY



- 🎯 **Feasibility (MCDA)** – Strong technical, operational, and financial viability
- 🎯 **Challenges & Risks** – Data gaps, legacy system issues, and capacity constraints.
- 🎯 **Strategies** – ML prediction, API integration, mileage equalization, cybersecurity, and optimization.
- 🎯 **Technical Feasibility** – AI-based scheduling with real-time data (Maximo, IoT) and what-if simulations



Metric	Value	Target	Status
Fleet Utilization	92%	≥85%	Met
Brand Exposure	89%	≥85%	Met
Mileage Balance	0–180 km	≤180 km	Met
Operational Score	724.5	≥700	Met

## Manual Vs AI Powered

Feature	Manual Process	AI-Driven System
Centralised Data Integration	Data stored in silos, not connected	Unified platform integrating all data
Scalability & On-the-go Transfers	Difficult to scale, manual effort needed	Easily scalable with automated transfer
Branding/SLA Breaching	Manual tracking and updates	Automated scheduling and compliance
Simulation and What-if Testing	No real-time simulation possible	Supports real-time scenario testing
Optimized mileage & balance	Experience-based, reactive decisions	Data-driven balancing and predictive maintenance

# IMPACTS AND BENEFITS



## IMPACTS

- Reduced passenger waiting time, better travel experience
- Lower energy use and carbon footprint through optimized train rotation & stabling
- Increased ridership and extended revenue hours
- Transparent, auditable, and AI-driven metro operations



## BENEFITS

- Higher train availability during peak hours, fewer delays
- Reliable fleet performance with predictive scheduling
- Real-time tracking of mileage, depot activities, and usage
- AI-driven insights for efficient scheduling & stabling
- Reduced O&M costs via data-driven mileage balancing and wear optimization

# RESEARCH AND REFERENCES



- ❖ **Kochi Metro Rail Limited (Official Website)** : Official updates, operations, project details, and annual reports :  [click here](#)
- ❖ **Kochi Metro Rail Project – Railway Technology**: Detailed case study of Kochi Metro project, funding, design, and operations :  [click here](#)
- ❖ **Train Scheduling with Deep Q-Network: A Feasibility Test - MDPI**: Optimization models for railway Traffic rescheduling and Tackle the Problem :  [click here](#)
- ❖ **Data driven Predictive Maintenance Scheduling Policies for Railways** : Lopes Gerum, Pedro Cesar; Altay, Ayca; Baykal-Gürsoy, Melike, Transportation Research Part C: Emerging Technologies (2019).  [click here](#)
- ❖ **Kochi Metro Project** : Railway-Technology case study with design, infrastructure, and technical features.  
 [click here](#)