SMART INDIA HACKATHON 2025

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- **Problem Statement ID -** SIH25081
- **Problem Statement Title -** AI-Driven Train Induction Planning & Scheduling for Kochi Metro Rail Limited (KMRL)
- **Theme -** Smart Automation
- **PS Category -** Software
- **Team ID -**
- **Team Name -** Niyati

Niyati

TransitMind

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Proposed Solution (Idea / Prototype):

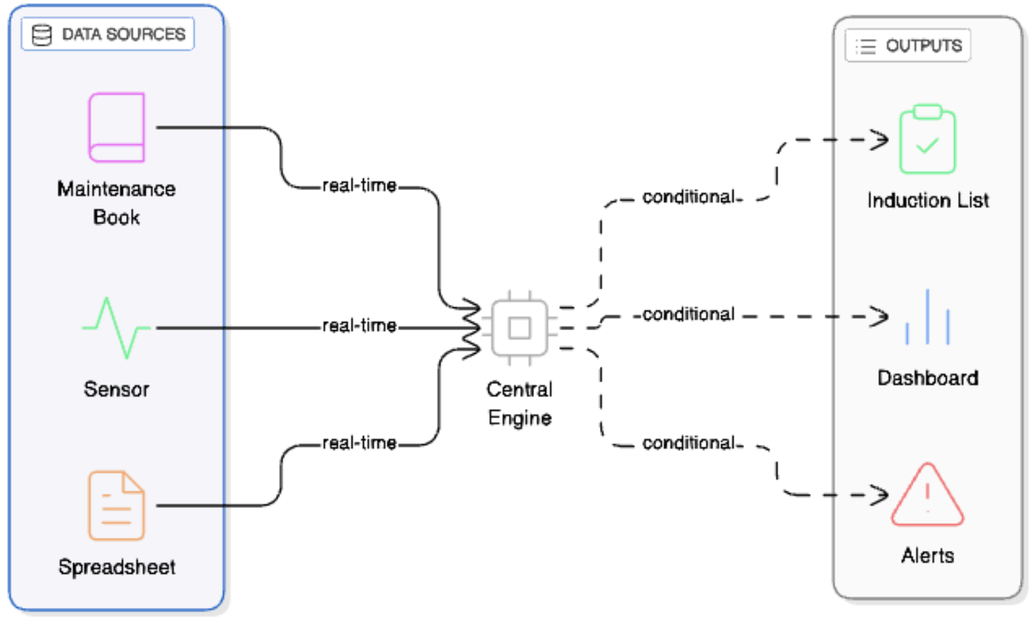
- Integrated decision-support platform for Kochi Metro's nightly train induction planning.
- Combines data integration + constraint-based optimisation + AI-driven forecasting.
- Generates an explainable ranked induction list (which train in service, standby, IBL).

Detailed Explanation of Proposed Solution:

- Ingests data from Maximo, IoT sensors, branding schedules, cleaning slots & depot geometry.
- Applies rule-based constraints (fitness, job-cards, safety) + multi-objective optimisation (punctuality, mileage balance, branding, shunting).
- Provides "what-if" simulation for supervisors to test scenarios.

Innovation & Uniqueness:

- First end-to-end integrated platform for Indian metro induction planning.
- Combines mathematical optimisation + ML predictive maintenance + explainable AI.
- Converts manual, heuristic planning into reproducible, auditable, data-driven process.



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TECHNICAL APPROACH

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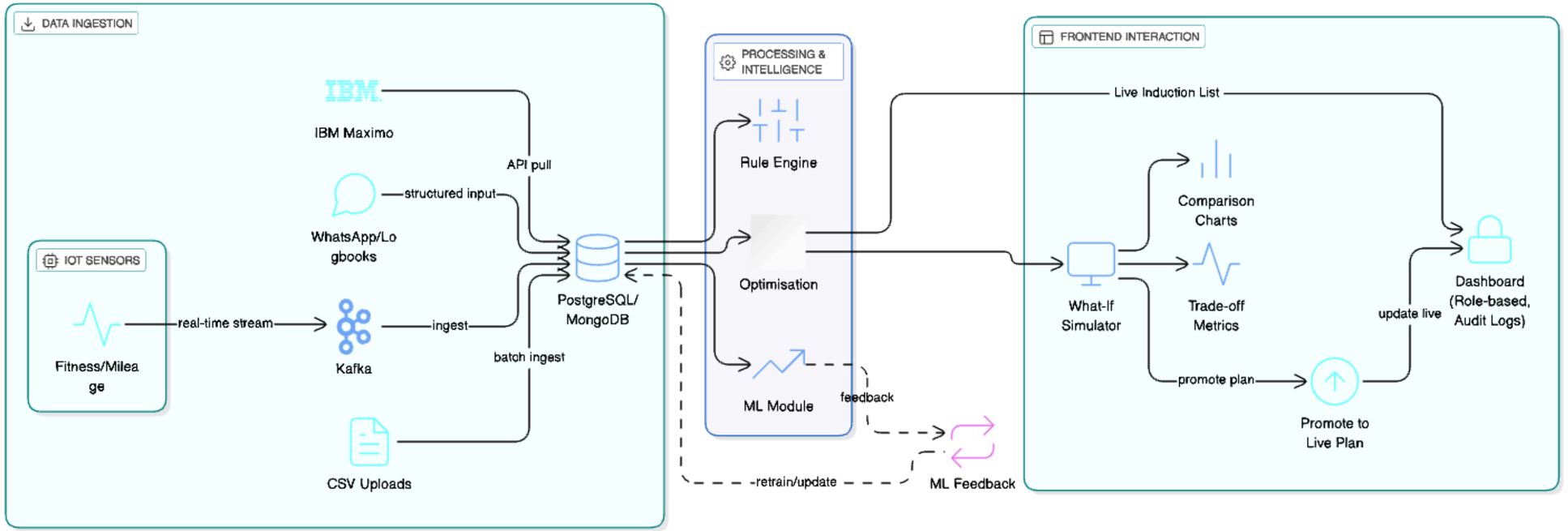
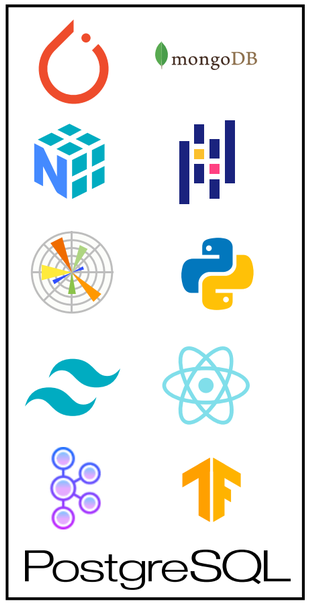
Methodology / Process:

1. Data Ingestion: Collect & normalise heterogeneous inputs (job-cards, fitness, mileage, branding, cleaning).
2. Rule Engine: Apply hard constraints (expired fitness → exclude, open job-card → IBL).
3. Optimisation: Multi-objective solver balances service readiness, mileage, branding, shunting.
4. Decision-Support UI: Dashboard with ranked list, explainability, conflict alerts, what-if simulator.
5. Learning Loop: ML models predict failures & refine optimisation weights over time.





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FEASIBILITY AND VIABILITY

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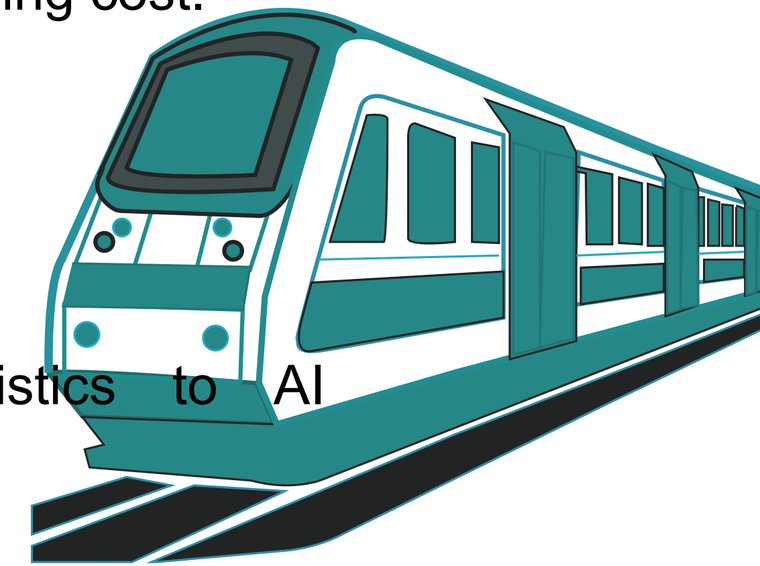
Feasibility Analysis:

- Uses open-source solvers (OR-Tools, Pyomo) → no heavy licensing cost.
- Runs on commodity servers (can scale with fleet growth).
- Modular architecture → future-ready for multi-depot expansion.

Potential Challenges & Risks:

- Integration with legacy systems (e.g., Maximo, manual logs).
- Data quality & missing information from siloed sources.
- Change management (staff adapting from manual heuristics to AI suggestions).



Strategies to Overcome:

- Phase-wise integration (start with CSV/JSON → later APIs).
- Data validation & fallback mechanisms (manual override panel in UI).
- Explainable AI → builds operator trust by showing “why this train is chosen”.

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IMPACT AND BENEFITS

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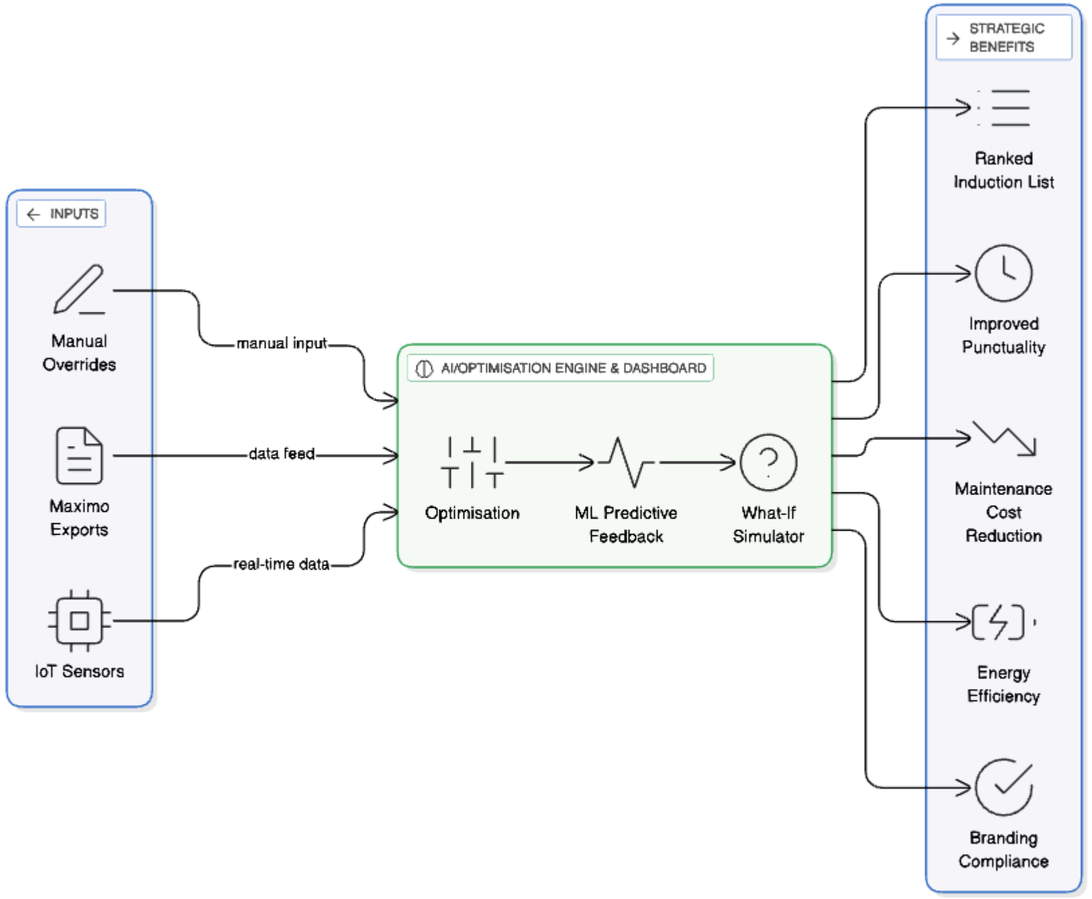
Target Impact (Kochi Metro & other Indian metros):

- Automated, data-driven induction planning.
- Scalable to 40+ trainsets and multiple depots.

Benefits:

- Operational: Higher punctuality (>99.5%), fewer unscheduled withdrawals.
- Economic: Reduced maintenance cost (balanced mileage, less component fatigue), avoided branding penalties.
- Social: Enhanced passenger experience through reliable service availability.
- Environmental: Reduced night-time shunting → lower energy use & emissions.
- Scalability: Template deployable for other metros (Delhi, Bangalore, Hyderabad).



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RESEARCH AND REFERENCES

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- Kochi Metro Rail Ltd. Operational KPIs (public reports) - https://kochimetro.org/annual-reports/
- IBM Maximo documentation (job-card & asset management APIs) - https://www.ibm.com/docs/en/maximo-asset-monitor?topic=reference-rest-apis
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