

AI2RampOptimizer – Technical Datasheet

IFOY Award 2026 | Category: Start-up of the Year
Company: AI2Connect GmbH, Dortmund, Germany

1. Product Overview & System Architecture

AI2RampOptimizer is an AI-based multi-agent system for real-time optimization of dock and ramp processes. The modular architecture consists of five specialized AI agents plus an orchestrator, controlled through a central orchestration layer (LangGraph).

The 5 AI Agents + Orchestrator

Agent	Function
1. Data Agent	Data ingestion from TMS/WMS/ERP via JSON, schema validation, time normalization, and deduplication. Storage in PostgreSQL Silver Tables.
2. Feature Agent	Pattern recognition & feature engineering: Creation of time-series, cost, and queue features, as well as storage in the feature store for train/serve parity.
3. Frame Builder	ML training frames for continuous learning. Creates optimized datasets with temporal validation against label leakage.
4. Training Agent	Multi-model training (XGBoost, LightGBM, Random Forest) and automatic champion selection based on R ² , MAE, and MedAE. Storage in the Model Registry with versioning.
5. Recommendation Agent	Real-time scoring & ranking with <200ms response time. Generates transparent recommendations with confidence scores and alternative scenarios.
☆ Orchestrator	Central control: Automatically decides between training and inference. Feature drift detection with automatic re-training. Audit logs for complete traceability.

Technology Stack

Category	Technologies
Backend	Python 3.13, FastAPI, LangGraph, UV
Machine Learning	XGBoost, LightGBM, Random Forest, Scikit-learn, MLflow Model Registry
Data Management	PostgreSQL, PyArrow, Feature Store
Deployment	Docker, CapRover, GitHub Actions CI/CD

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Category	Technologies
Frontend	React, TailwindCSS, Recharts

2. Performance & Quality Assurance

System performance and quality are continuously monitored based on objective metrics. The system optimizes itself daily through automatic re-training upon feature drift detection.

Metric	Value	Description
Response Time	<200 ms	Average recommendation latency in live operation
Model Update	daily	Self-learning process with automatic champion selection
Train/Serve Parity	100%	Identical data paths for training and inference via Feature Store
Feature Drift Detection	active	Automatic re-training is triggered when the threshold is exceeded
Availability	99.5%	Docker-based redundancy on Hetzner Cloud (Germany)
Data Latency	<10 s	Synchronization between Feature Store and Silver Tables

Data Pipeline & Workflow

The workflow comprises five coordinated agents plus an orchestrator that form a complete pipeline from data ingestion to real-time recommendations:

Step	Technology	Input	Output
1. Ingestion	Python, Pandas	Raw Dataset JSON (TMS/WMS)	PostgreSQL Silver Tables
2. Feature Engineering	NumPy, PyArrow	Silver Tables	Feature Store
3. Training	XGBoost, LightGBM	Feature Store	Model Registry
4. Inference	FastAPI, MLflow	Feature Store	Recommendation Table

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3. Interfaces, Security & Integration

Interfaces & Integration

- **REST API for WMS/TMS/YMS integration**
- JSON data import from 5 source systems (TMS, WMS, ERP, YMS, Telematics)
- Standardized data formats (JSON/CSV)
- Excel import for legacy systems
- **WMS-agnostic:** SAP, Oracle, Infor, and other systems
- PostgreSQL-based Feature Store for consistent data processing

Security & Compliance

- **GDPR compliant** with EU data hosting (Hetzner/Netcup, Germany)
- End-to-end encryption (TLS 1.3)
- Dedicated server infrastructure in Germany
- Audit logs for all system access and model decisions
- **Idempotent data processing** (repeated runs create no duplicates)
- Security audits planned (2026)

AI Technology in Detail

AI2RampOptimizer combines three AI approaches for optimal results:

AI Approach	Application
Predictive Learning	Prediction of arrival times, loading duration, and dock utilization based on historical patterns and real-time data
Reinforcement Learning	Continuous optimization of the allocation strategy through learning from actual results and feedback
Rule-Based Logic	Compliance with regulatory requirements, priority rules, and operational constraints

Technical Features:

- Multi-model ensemble: XGBoost, LightGBM, Random Forest
- LangGraph Branching Tails Architecture for flexible agent orchestration
- Automatic champion model selection based on R^2 , MAE, MedAE
- Train/serve parity through unified Feature Store
- Temporal validation against label leakage
- Model Registry with full versioning

Setup & Deployment

Phase	Duration	Activities
Week 1-2	2 weeks	Potential analysis & data review
Week 3-6	4 weeks	API integration & initial training

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Phase	Duration	Activities
Go-Live	after 6 wks	Production operation with support

4. Measurable Business Results

AI2RampOptimizer delivers proven and quantifiable efficiency gains that directly impact cost structure and sustainability:

KPI	Improvement	Impact
Efficiency Increase	+25-30%	Higher dock utilization & throughput
Truck Waiting Time	-30%	More satisfied drivers, optimized routes
Planning Labor Costs	-25%	Dispatchers focus on strategic tasks
Misallocations	-40%	Fewer re-assignments & stress
CO ₂ Emissions	-15%	Optimized routes & less idling
Disruption Response Time	<5 min	Fast adaptation to disruptions
Planning Reliability	+35%	Reliable forecasts for all stakeholders

ROI Example

Mid-sized logistics company with 8 docks:

- **Monthly savings:** €20,000+
- **ROI achieved after:** 8-12 weeks
- **Annual savings:** €240,000+

Market Validation & References

The system is in active testing with leading logistics companies:

- **SetLog:** Cooperation since August 2025, integration in test phase
- **Prologistics:** Pilot start planned for February 2026
- **Additional prospects:** Active discussions with logistics service providers and TMS providers

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5. Scalability & Future-Readiness

The system is modularly designed and enables gradual expansion to additional logistics processes. The architecture allows horizontal scaling and integration of additional agents via standardized APIs.

Technical Future-Readiness

- **API-first architecture** with clear interfaces between data, model, and decision layers
- **Fully automated workflow** from data ingestion to inference without manual intervention
- **Integrated monitoring** of feature drift, model performance, and process stability
- **Fault tolerance** and restart mechanisms implemented in the orchestrator
- **Complete auditability** through logging and metrics capture

Product Roadmap 2026-2027

Period	Milestones
Q1/2026	First production customers, REST API standardization
Q2/2026	Marketplace & partner ecosystem, white-label option for TMS/WMS providers
Q4/2026	Multi-warehouse management, advanced analytics dashboard
2027	Enterprise sales, DACH scaling, expansion to yard & routing

AI Factory Approach

The modular multi-agent architecture enables rapid scaling to additional logistics processes:

- **Yard Management:** Optimization of yard logistics and trailer disposition
- **Route Optimization:** Intelligent route planning with real-time adaptation
- **Slot Management:** Automatic time window allocation for carriers
- **Cross-Docking:** Optimization of transshipment processes

Competitive Advantages

- **18-24 months technology lead** through multi-agent AI instead of monolithic approaches
- **Reinforcement Learning** for continuous self-optimization
- **Plug-&-Play** with 4-6 weeks setup instead of months-long integration
- **Explainable AI** for trust and acceptance among users

From data ingestion to real-time recommendations: AI2RampOptimizer provides complete automation of dock scheduling – self-learning, transparent, and delivering measurable results.

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