

Decision Trace Generation for Governable Autonomous Logistics Systems

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A proposal for independent scientific validation of runtime-generated decision traces for trustworthy autonomous logistics systems.

We are not asking whether AI can optimize logistics more efficiently.

We are asking whether AI-driven logistics decisions can become scientifically traceable.

Background

Artificial intelligence is increasingly being incorporated into autonomous logistics systems, including route planning, warehouse automation, inventory optimization, fleet coordination, and supply chain decision support.

These systems are beginning to support operational decisions in environments where reproducibility, accountability, and governance are becoming increasingly important.

As logistics systems become more autonomous and interconnected, one fundamental question becomes increasingly important:

Can AI-driven logistics decision processes become structurally observable and scientifically verifiable without modifying the underlying AI model?

Current approaches often evaluate autonomous logistics systems through operational efficiency, optimization performance, or predictive accuracy.

SSGE (Structural System Governance Engine) explores a different architectural direction.

Rather than changing the logistics AI model itself, SSGE introduces an independent Governance Runtime that observes execution and generates a structured Decision Trace describing execution flow, evidence references, rule evaluation, and governance events throughout the logistics decision process.

The objective is not to improve logistics optimization, but to improve the observability, traceability, and governability of AI-assisted logistics execution.

Proposed Scientific Validation

We would like to invite your research team to participate in a small feasibility study.

Research Question

Can an independent Governance Runtime generate a structured Decision Trace that meaningfully represents AI-driven logistics decision processes without modifying the underlying AI model?

The validation focuses exclusively on this question.

No performance benchmark, commercial deployment, or product evaluation is involved.

Example Validation Scenario

Scenario

An AI-assisted logistics system performs autonomous route planning and shipment scheduling based on real-time operational data and predefined business constraints.

Governance Runtime

The proposed study investigates whether an independent Governance Runtime can continuously generate structured Decision Trace artifacts throughout the logistics decision process without influencing the underlying AI model.

Validation Focus

The objective is not to evaluate logistics optimization performance, but to investigate whether runtime-generated execution evidence can improve the observability, scientific traceability, and governance readiness of autonomous logistics systems.

Scope (2-week Feasibility Study)

The proposed study would evaluate whether SSGE can:

- generate structured Decision Trace artifacts during AI-assisted logistics decision execution;
- preserve execution order and operational decision relationships;
- produce trace information that is independently reviewable by researchers;

- provide a reproducible basis for governance-oriented analysis of autonomous logistics systems.

Expected Outcome

The expected outcome is not proof that SSGE is superior to existing systems.

Instead, we seek to answer a more fundamental scientific question:

Does Decision Trace Generation represent a viable architectural direction for trustworthy autonomous logistics systems?

If the findings are positive, the results could support further collaborative research, broader validation studies, and future publications. More importantly, the study aims to contribute empirical observations to the broader discussion on trustworthy AI infrastructure and runtime governance.

Collaboration Principles

This proposal is:

non-commercial

non-exclusive

intended purely for scientific exploration.

We welcome critical evaluation and independent feedback.

Why This Validation Matters

If successful, this study would provide initial empirical evidence that runtime-generated execution evidence can improve the scientific traceability of AI-driven logistics decision processes without affecting existing logistics AI systems.

More broadly, the study investigates whether Governance Runtime architectures can strengthen transparency, accountability, and trustworthiness in future autonomous logistics systems while remaining independent of optimization model design.

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