

Trammo Trading Desk

Decision Support System — Process Flows & Architecture

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1 System Overview

The Trading Desk is a real-time decision support platform for commodity traders. It continuously ingests live market, weather, river, and operational data from 10+ external sources, applies active contract constraints, and runs a linear-programming solver to recommend optimal trading routes and volumes — all augmented by AI-powered analysis.



Key value proposition: Traders no longer manually check dozens of data points. The system continuously monitors conditions, applies contract obligations, runs optimization, and surfaces clear go/no-go recommendations — reducing decision latency from hours to seconds.

2 External Data Sources

The system integrates with 10+ external APIs organized into four categories: environmental conditions, operational status, commercial pricing, and supplementary logistics data.

Environmental (River, Weather, Locks)

USGS Water Services

waterservices.usgs.gov · Free, no auth

Real-time river stage and flow at 4 Mississippi gauges (Baton Rouge, Vicksburg, Memphis, Cairo). Critical for determining navigability and barge draft limits.

river_stage

Polled every 15 minutes

NOAA Weather API

api.weather.gov · Free, User-Agent auth

Current observations and 7-day forecasts from 4 stations along trading routes (Baton Rouge, Memphis, St. Louis, Vicksburg). Drives safety and scheduling.

temp_f wind_mph vis_mi precip_in

Polled every 30 minutes

USACE Lock Status

ndc.ops.usace.army.mil · Scraped + API

Lock queue delays at 4 critical locks (Lock 25, Lock 27/Chain of Rocks, Old River, Lock 52). Directly impacts transit time and freight economics.

lock_hrs

Polled every 30 minutes

Operational (Terminals, Fleet, Capital)

Insight TMS (Trammo)

Internal terminal management system

Real-time terminal inventory levels and outage status at Meredosia and Niota storage facilities. Determines available supply for each route.

inv_mer inv_nio mer_outage nio_outage

Polled every 5 minutes

Fleet Management TMS

Transportation management system

Count of available barges with “selected” status. Constrains maximum tons that can move simultaneously.

barge_count

Polled every 5 minutes

SAP S/4HANA Finance

OData API · Bearer token auth

Available working capital for the trading business unit. Constrains total capital that can be deployed across all routes.

working_cap

Polled every 5 minutes

Commercial (Prices, Freight, Energy)

Argus / ICIS Market Prices

argusmedia.com, icis.com · API key auth

Ammonia purchase prices at NOLA barge and derived delivered prices to St. Louis and Memphis. The primary revenue/cost drivers for the solver.

nola_buy sell_stl sell_mem

Polled every 30 minutes

Broker / TMS Freight Rates

Barge freight rate feeds · API key auth

Current freight rates for all 4 trading routes (Meredosia/Niota to St. Louis/Memphis). Volatile — weather and river conditions drive rates.

fr_mer_stl fr_mer_mem fr_nio_stl fr_nio_mem

Polled every 60 minutes

EIA Natural Gas (Henry Hub)

api.eia.gov · API key auth

Henry Hub spot price — the benchmark input cost for ammonia production. Correlated with purchase price trends.

nat_gas

Polled every 60 minutes

Supplementary (Vessels, Tides)

AIS Vessel Tracking

aisstream.io (WebSocket) · MarineTraffic fallback

Real-time positions of vessels carrying Trammo cargo via AIS transponders. Enriched with vessel-proximate weather. Displayed in fleet view.

Fleet positions ETA estimates

Real-time WebSocket + 10 min poll fallback

NOAA Tides & Currents

tidesandcurrents.noaa.gov · Free, no auth

Water levels, tidal predictions, and current velocity at 6 stations along the lower Mississippi and Gulf. Context for vessel navigation.

Water levels Current speed

Polled every 15 minutes

3 The 20 Solver Variables

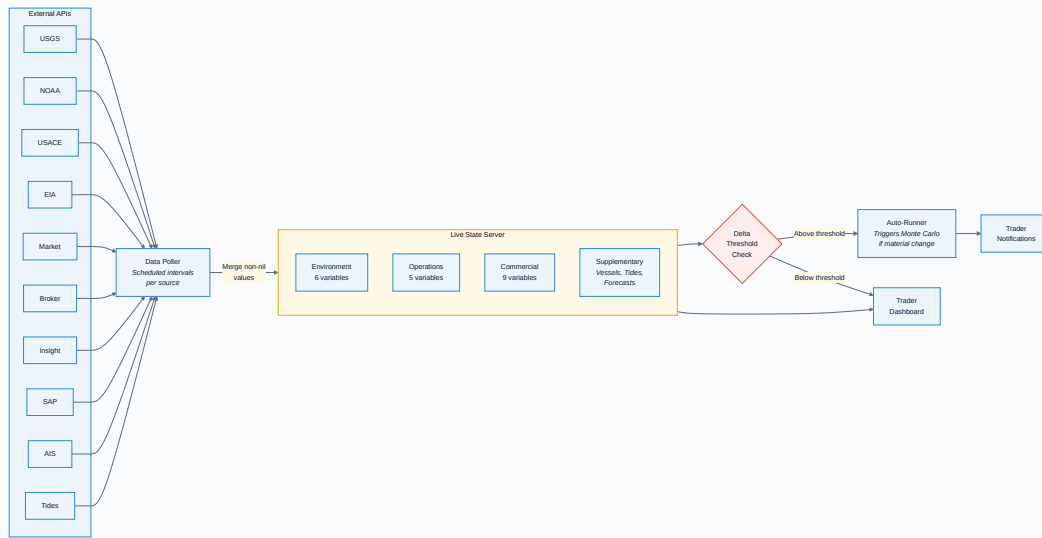
Every optimization run uses exactly 20 variables that fully describe the current trading environment. These are encoded as a compact 160-byte binary and sent to the solver engine.

Variable	Description	Unit	Range	Source
Environment (6 variables)				
river_stage	Water height at Baton Rouge gauge	ft	2 - 55	USGS
lock_hrs	Total delay through lock system	hrs	0 - 96	USACE
temp_f	Air temperature	°F	-20 - 115	NOAA
wind_mph	Wind speed	mph	0 - 55	NOAA
vis_mi	Visibility	mi	0.05 - 15	NOAA
precip_in	3-day precipitation forecast	in	0 - 8	NOAA
Operations (5 variables)				
inv_mer	Meredosia terminal inventory	tons	0 - 15,000	Insight TMS
inv_nio	Niota terminal inventory	tons	0 - 10,000	Insight TMS
mer_outage	Meredosia outage flag	0/1	0 - 1	Insight / Manual
nio_outage	Niota outage flag	0/1	0 - 1	Insight / Manual
barge_count	Available barges	count	1 - 30	Fleet TMS
Commercial (9 variables)				

Variable	Description	Unit	Range	Source
nola_buy	NH3 purchase price at NOLA barge	\$/t	200 – 600	Argus / ICIS
sell_stl	NH3 delivered sell price — St. Louis	\$/t	300 – 600	Market (derived)
sell_mem	NH3 delivered sell price — Memphis	\$/t	280 – 550	Market (derived)
fr_mer_stl	Freight: Meredosia → St. Louis	\$/t	20 – 130	Broker
fr_mer_mem	Freight: Meredosia → Memphis	\$/t	10 – 80	Broker
fr_nio_stl	Freight: Niota → St. Louis	\$/t	20 – 135	Broker
fr_nio_mem	Freight: Niota → Memphis	\$/t	10 – 85	Broker
nat_gas	Henry Hub natural gas spot	\$/MMBtu	1.0 – 8.0	EIA
working_cap	Available working capital	\$	500K – 10M	SAP FI

4 Data Ingestion & Live State

A centralized poller fetches all external APIs on configurable schedules. Data flows into a Live State server that maintains the authoritative current values. Changes above configured thresholds trigger automatic re-optimization.



Graceful degradation: If any API is unavailable, the system keeps the last known value and continues operating. Each source has cascading fallbacks (backup APIs, historical averages, seed defaults). Status is tracked per source with consecutive failure counts.

Admin-configurable thresholds: The delta that triggers an automatic re-solve is tunable per variable (e.g., river stage > 0.5 ft, NOLA buy price > \$2/ton, barge count > 1). A cooldown prevents rapid-fire solves (default: 5 minutes minimum between runs).

5 The Solve Pipeline

Every optimization — whether triggered by a trader, the auto-runner, or an API call — flows through a standardized 4-phase pipeline. Each phase broadcasts real-time status updates to the trader's dashboard.

1

Contract Check

Verify all active contracts are current.
Re-ingest any that changed since last solve.

2

LLM Pre-Solve Frame

AI reads contracts + trader notes and adjusts variables to reflect obligations.

3

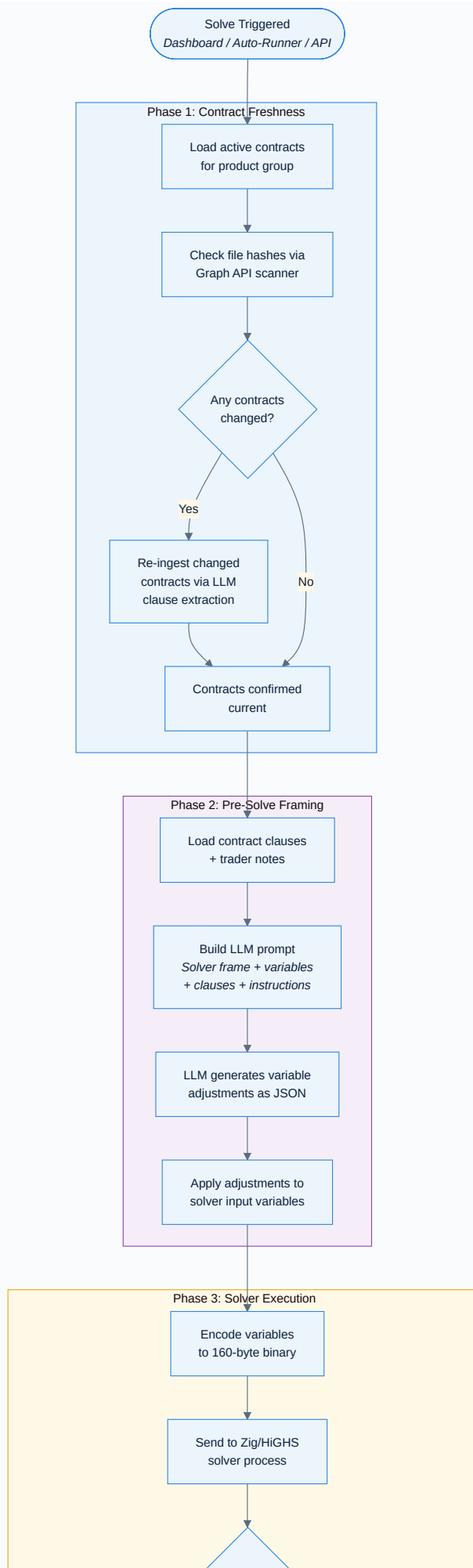
LP Solver Execution

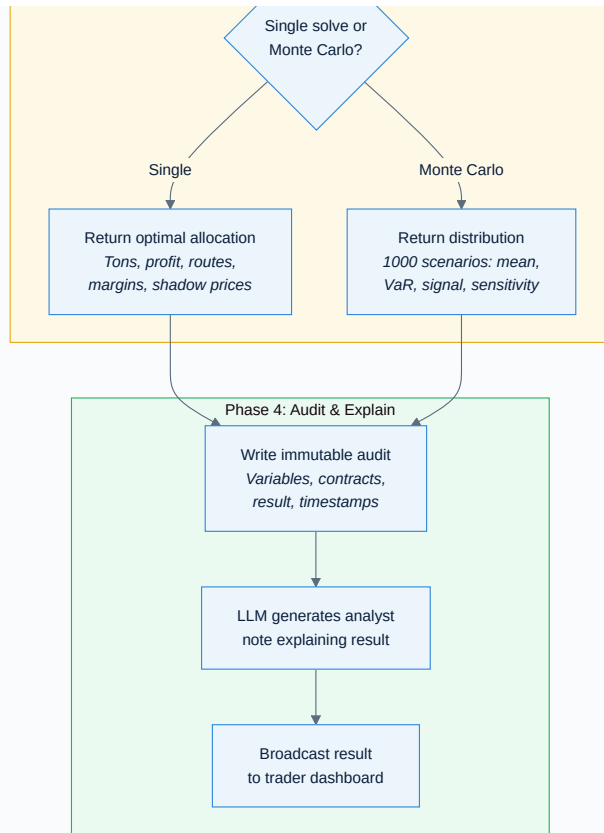
Optimized Zig/HiGHS engine finds the profit-maximizing route & volume allocation.

4

Audit & Explain

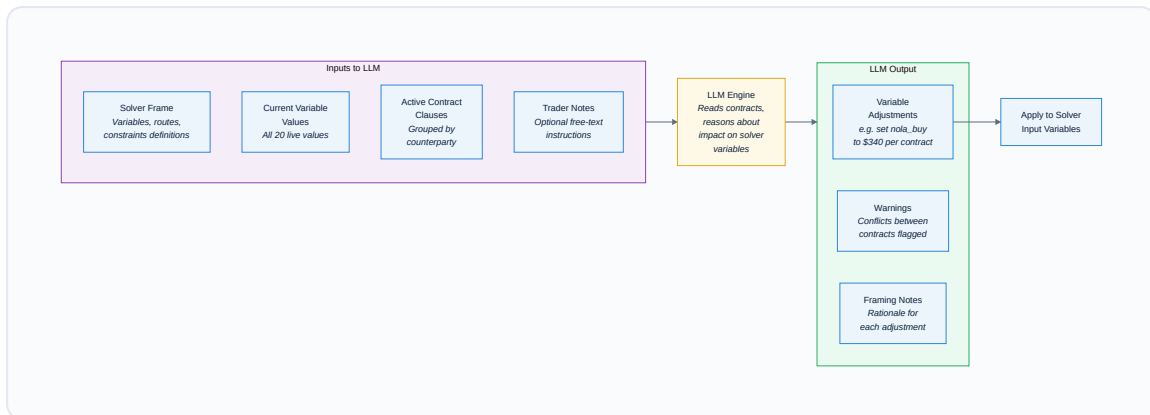
Results recorded to immutable audit trail. AI generates plain-English analysis.





6 Pre-Solve: LLM Contract Framing

Before the solver runs, an AI model reads all active contract clauses and the trader's free-text instructions, then recommends adjustments to solver variables — ensuring the optimization respects real-world obligations like price fixes, take-or-pay volumes, and penalty clauses.



What the LLM considers:

Contract Clause Type	How It Affects the Solver	Example
Price Fixing	Sets buy or sell variable to contract price	Koch contract fixes nola_buy at \$340/t
Take-or-Pay Volume	Sets minimum volume floor on route	Must lift $\geq 2,000$ MT from Meredosia
Penalty Clauses	Reduces effective sell price by weighted penalty exposure	Late delivery penalty of \$5/t reduces sell_stl
Volume Caps	Lowers maximum ceiling on route	Max 5,000 MT to Memphis per month
Formula Pricing	Computes price using other live variables	$\text{sell_stl} = \text{nola_buy} + \90 spread

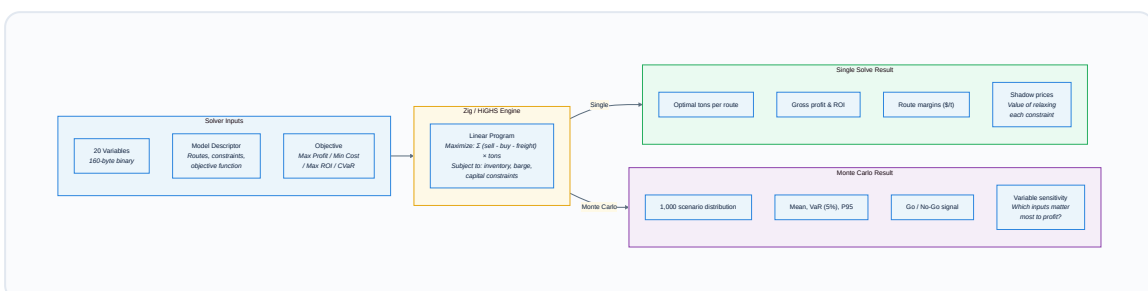
Safety constraint: The LLM can only *tighten* variables (raise floors, lower ceilings) — it cannot relax constraints. This ensures contract

obligations are always respected. Penalty adjustments are capped at 10% of the current price.

Fallback path: If the LLM is unavailable, a mechanical Constraint Bridge applies contract clauses directly using rule-based logic (operators: \geq , \leq , $=$, between). Trading is never blocked by AI availability.

7 The Solver Engine

A high-performance linear-programming solver built in Zig using the HiGHS optimization library. It runs as an isolated external process for safety and supports two modes: single optimization and Monte Carlo scenario analysis.



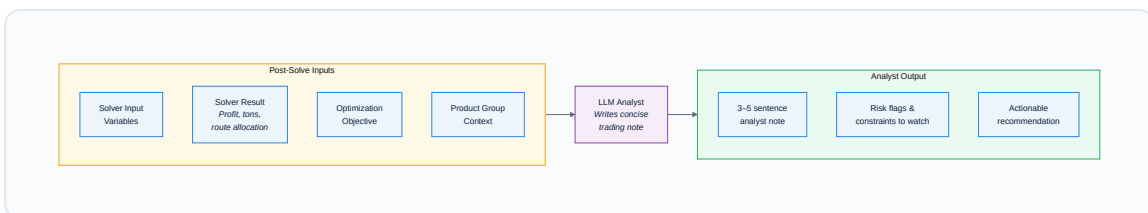
Single Solve vs. Monte Carlo

Single Solve answers: *“Given current conditions, what’s the best allocation?”* Returns the exact optimal tons per route, profit, margins, and shadow prices (the dollar value of easing each constraint by one unit).

Monte Carlo answers: *“How robust is this trade across uncertainty?”* Runs 1,000 scenarios with randomized inputs, returning a profit distribution, Value-at-Risk, and a clear signal: **Strong Go / Go / Cautious / Weak / No-Go**.

8 Post-Solve: LLM Analyst Explanation

After the solver returns a result, an AI model writes a concise analyst note explaining the recommendation in plain English — why this allocation makes sense, which routes dominate, and what risks to watch.



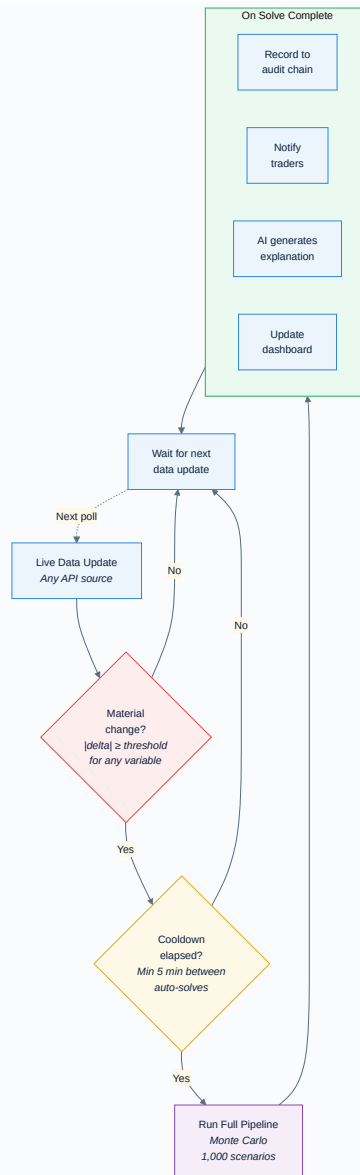
Example output: *"The solver favors the Meredosia-to-St. Louis route at 2,100 MT, capturing a \$40/t margin driven by elevated STL delivered prices. Memphis allocation is limited by barge availability (shadow price: \$12.50/barge). With lock delays at 10.5 hours, transit costs remain manageable but warrant monitoring — a 2-hour increase would shift 300 MT from STL to Memphis."*

For Monte Carlo results, the LLM also explains:

- What the profit distribution shape means for trade confidence
- The VaR/upside spread and whether the trader should proceed
- Which variables have the highest sensitivity (biggest impact on profit)

9 **Auto-Runner: Continuous Monitoring**

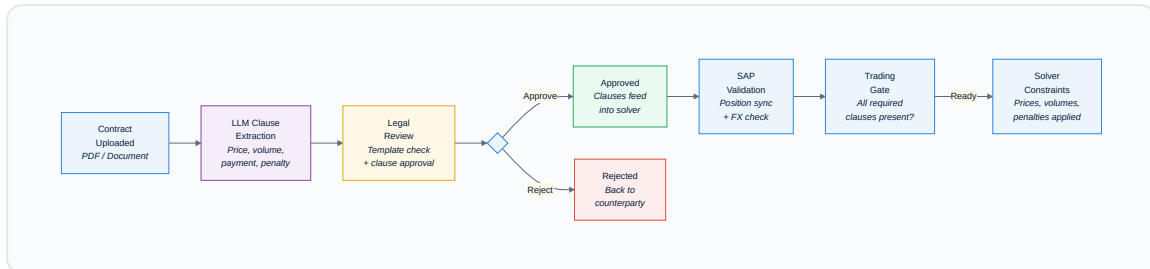
The system doesn't wait for traders to act. When live data changes materially, the auto-runner automatically triggers a Monte Carlo analysis, notifies traders, and records the result on an immutable audit chain.



Always-on intelligence: Traders receive proactive alerts when conditions shift enough to change the optimal trade. The system identifies *which* variables triggered the re-solve and *how* the recommendation changed — so traders know exactly what happened and why.

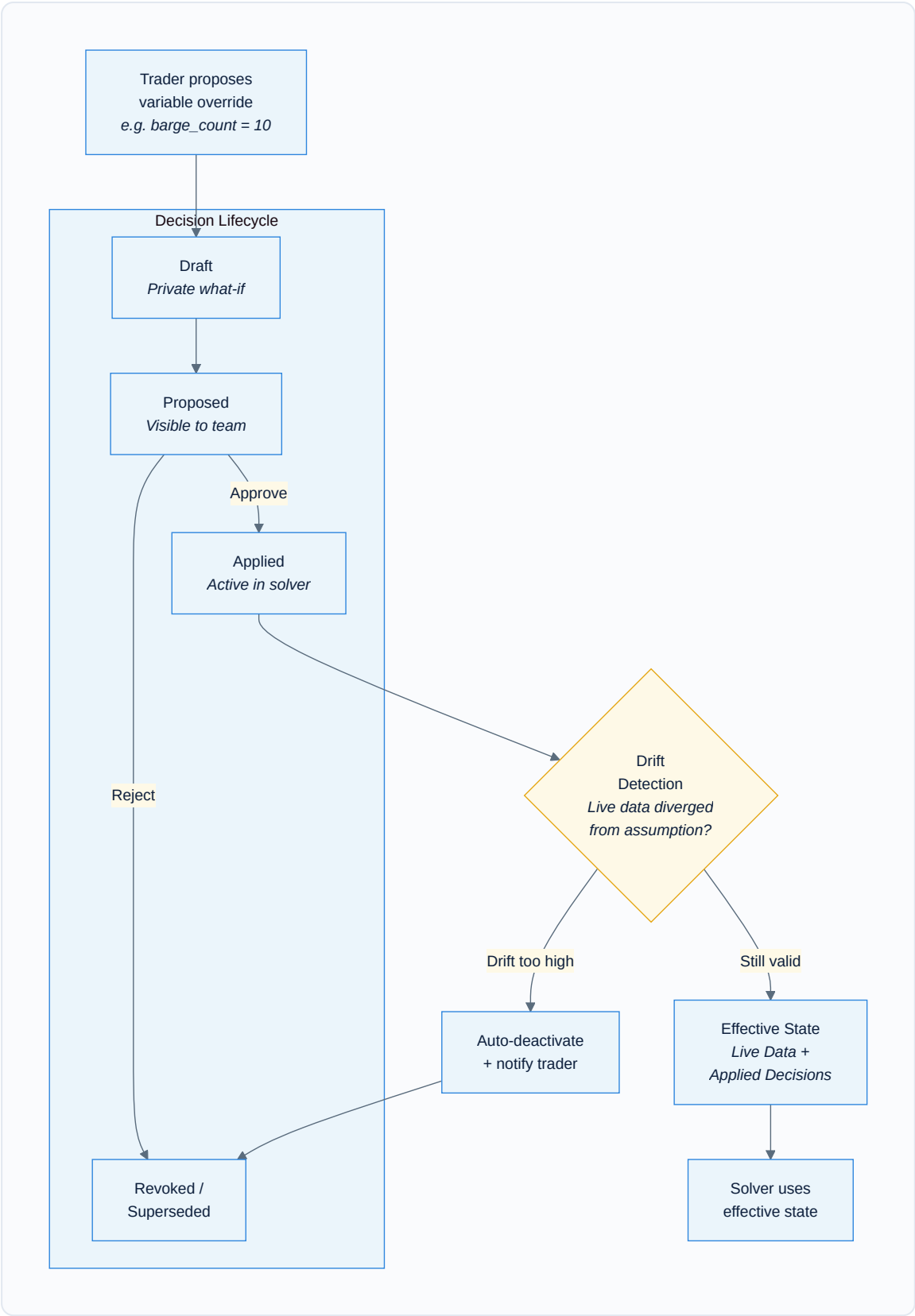
10 Contract Lifecycle

Contracts flow from upload through AI-powered clause extraction, legal review, and SAP validation before they gate trading. The system ensures traders never operate against unchecked obligations.



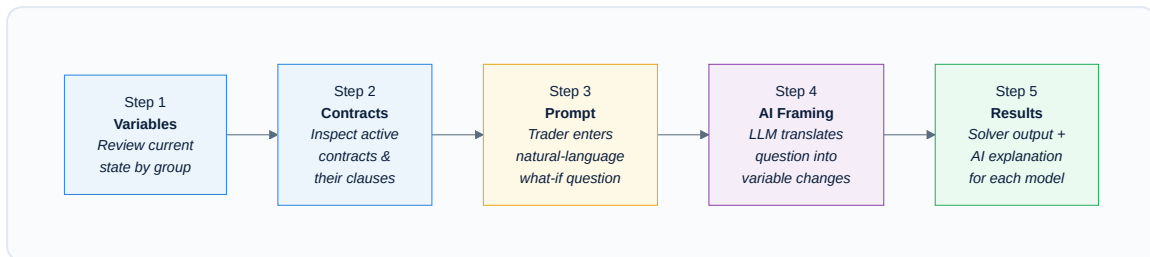
11 **Trader Decision Ledger**

When traders override live data based on their expertise (e.g., “I know barges will drop to 10 next week”), those decisions are tracked in an append-only ledger with drift detection that automatically flags when reality diverges from assumptions.



12 What-If Analysis Workflow

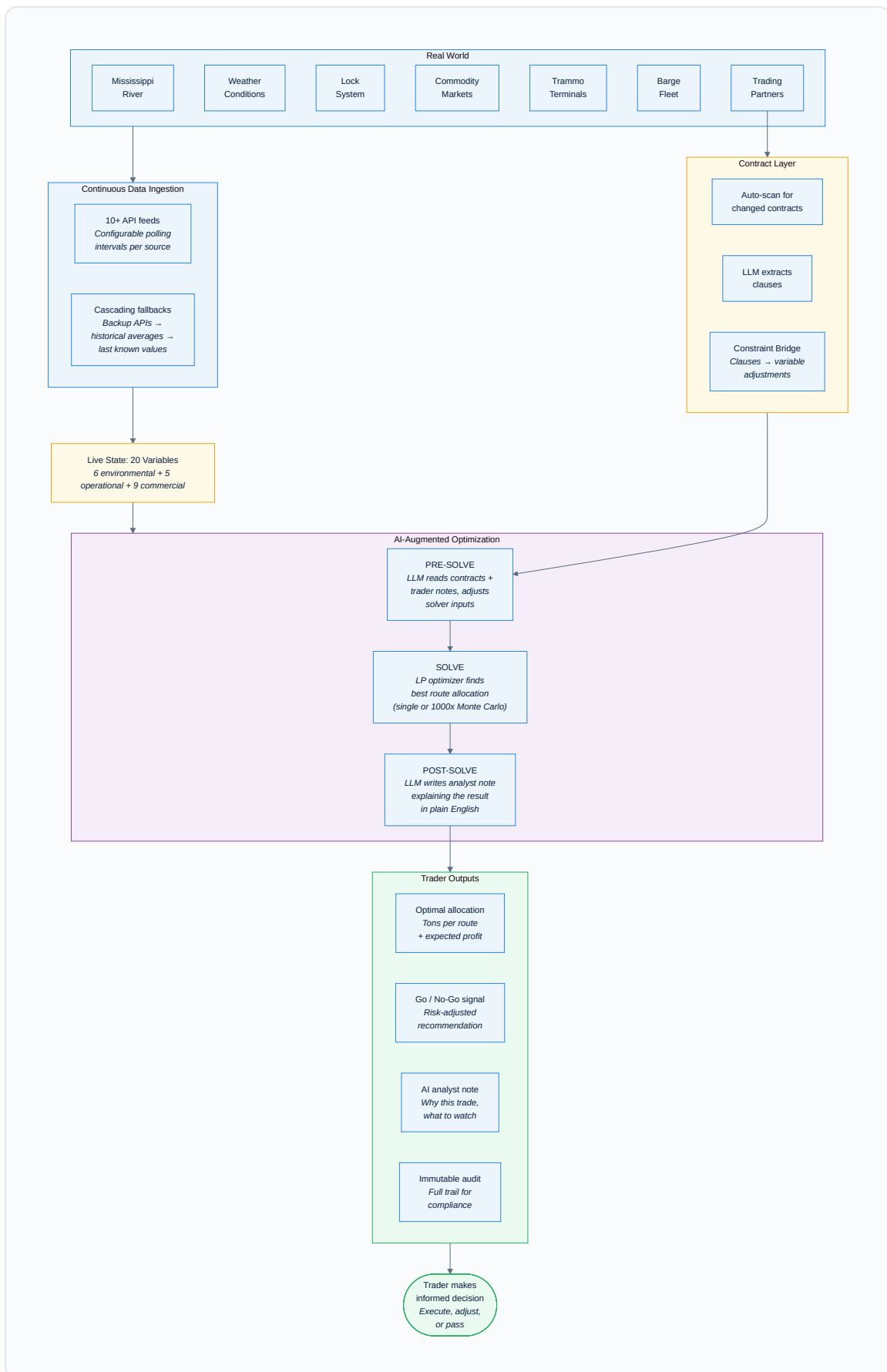
A guided 5-step wizard for exploring hypothetical scenarios. Traders can ask natural-language questions like *“What if lock delays double and we lose 3 barges?”* and get AI-framed solver results with full explanations.



13

End-to-End: From Raw Data to Trading Decision

Bringing it all together — here is the complete flow from external data through AI-augmented optimization to a trader's actionable decision.



The result: A trader sitting at their desk sees a continuously updated, AI-explained optimization that accounts for live river conditions, weather, lock delays, market prices, freight rates,

terminal inventory, fleet availability, working capital, and every active contract obligation — all in real time, with a clear recommendation and full audit trail.