Mine to Market

AnyLogic Modeling for a Logistics Network

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Project Context

Background, key factors, and client constraints.

Client

- Multi-national mining company.
- Planning a multi-billion dollar mine.

Negotiating

- Confirming strategic options with market players.
- In talks with service providers to establish commercial terms.

Confidentiality

- Client requested anonymity and sanitized KPI values, despite approving today's presentation.

Why AnyLogic

Building on experience, aligning with the future.

Building on years of modeling experience with this client, we adopted AnyLogic to address the logistics focus of this phase and prepare for future needs.

Trusted.

Built on a well-established Arena model.
Shared understanding of the system behavior and its key drivers.

Focused.

Modeled the outbound chain with significant operational detail.
Enabled faster iteration for scenario testing under new market conditions.
Used animation to build trust in outcomes and gain faster buy-in from new stakeholders.

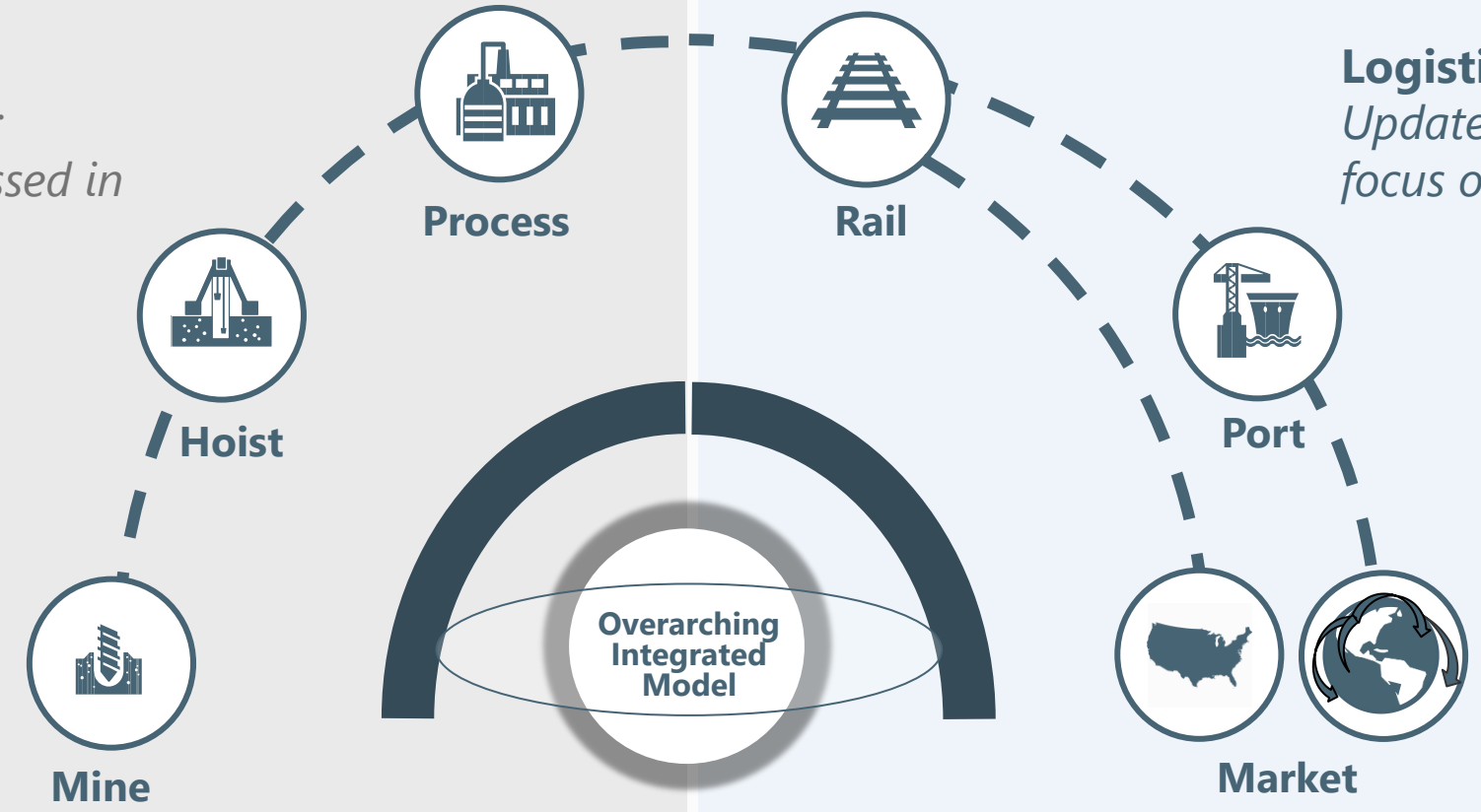
Integrated.

Matched client's technology stack.
Built team expertise in tool deployed on large-scale, high-value systems.

Holistic Model, Logistics in Focus

Upstream recently the modeling focus, but new logistics data presented new risk.

Upstream.
Modeling ongoing; uncertainty addressed in prior work.



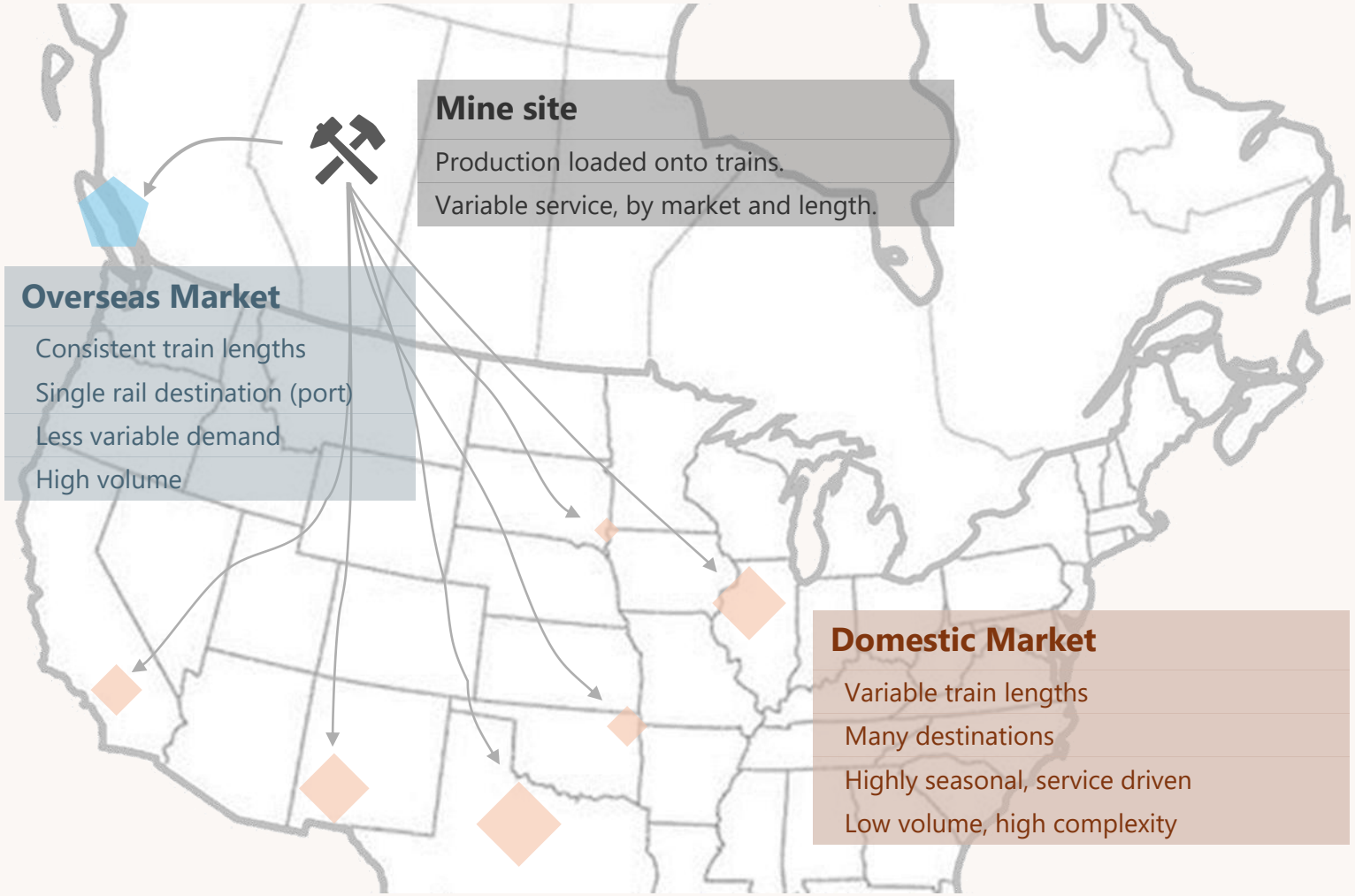
Logistics and Marketing.
Updated data; focus on uncertainty.

Forecast update: New demand patterns, seasonality, and destinations. Major input changes.
Risk shift: Upstream understood, outbound chain in question. Previous strategies needed confirmation or refinement.
High stakes: Small errors can translate to hundreds of millions of impact.

Overview and Key Challenges

Service changes, slower transit, and rising market complexity challenged the outbound chain's ability to meet targets.

Objective: achieve market forecast and maintain timely deliveries



Mine site

Production loaded onto trains.

Variable service, by market and length.

Overseas Market

Consistent train lengths

Single rail destination (port)

Less variable demand

High volume

Domestic Market

Variable train lengths

Many destinations

Highly seasonal, service driven

Low volume, high complexity

Tactical Questions

1 **Mine Site**

Flexible dispatch, several rail delivery options.

- **What service terms delivered the best outcomes?**
- **What terms were negotiable?**

2 **Domestic Market**

Analysis expanded from ~25 to ~100 delivery points.

- **What new risks emerged, and how did this influence strategic choices?**

3 **Overseas Market**

Transit time up to 40% longer.

- **Any impacts to railcar or infrastructure requirements?**

Animation: Overview

Model showcase. Market overview.

Highlights

Orderbook.

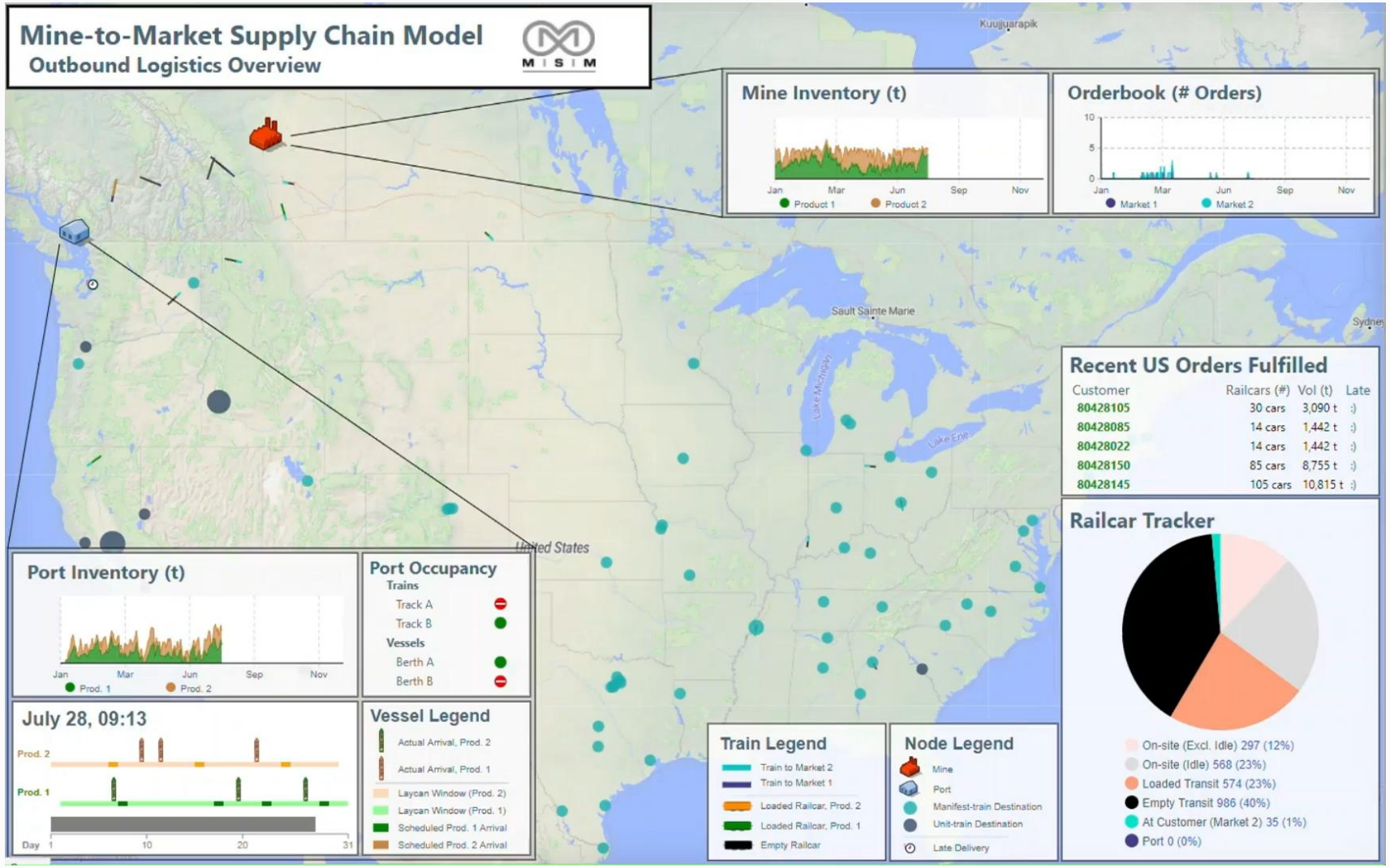
- Monthly orders were managed between both markets and scheduled to match the ratable nature of production.
- Push/pull strategy to manage operating inventory and vessel queueing.

Port terminal.

- Vessel laycans and sequencing governed by shared port terms of service.

Multi-market.

- Orders prioritized between markets based on inventory, strategy, and railcar availability.



Animation: Railyard

Model showcase. Site overview.

Highlights

Production & Storage

- Inventory built while accounting for upstream disruptions.

Loadout Loop

- Trains were loaded through a rail loop, with pre- and post-loading processes.
- Queueing for resource availability.

Dispatch modes

- Dispatch rules varied by train length.
- Unit trains retained or requested power; manifest trains required alternate service methods.

Mine Site – train dispatching

Identified acceptable combinations of service, empowering data-driven negotiations.

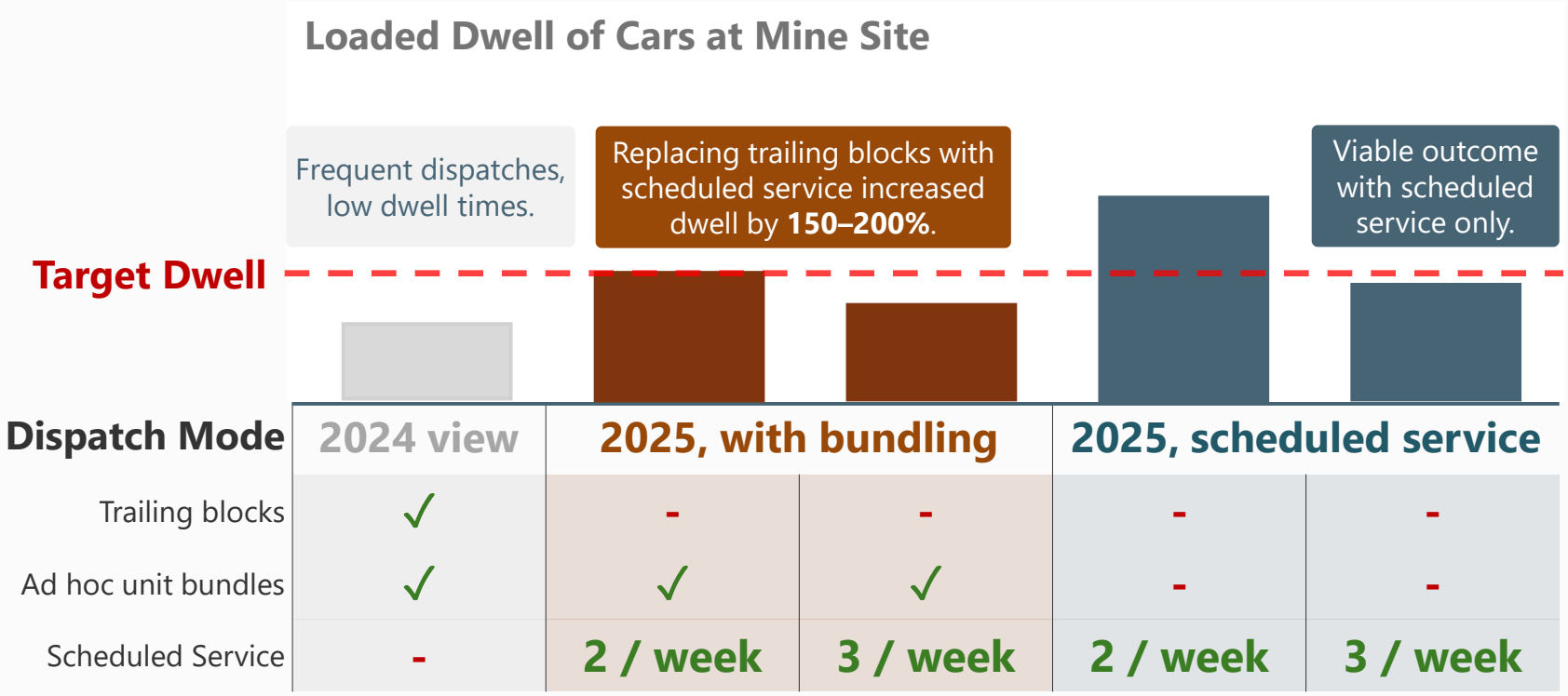
1

What service terms delivered the best outcomes?

Both fixed and flexible service structures proved viable, with multiple dispatch modes helping minimize dwell times..

What terms were negotiable?

Ad hoc bundling could be avoided, provided railways committed to at least three scheduled services per week.



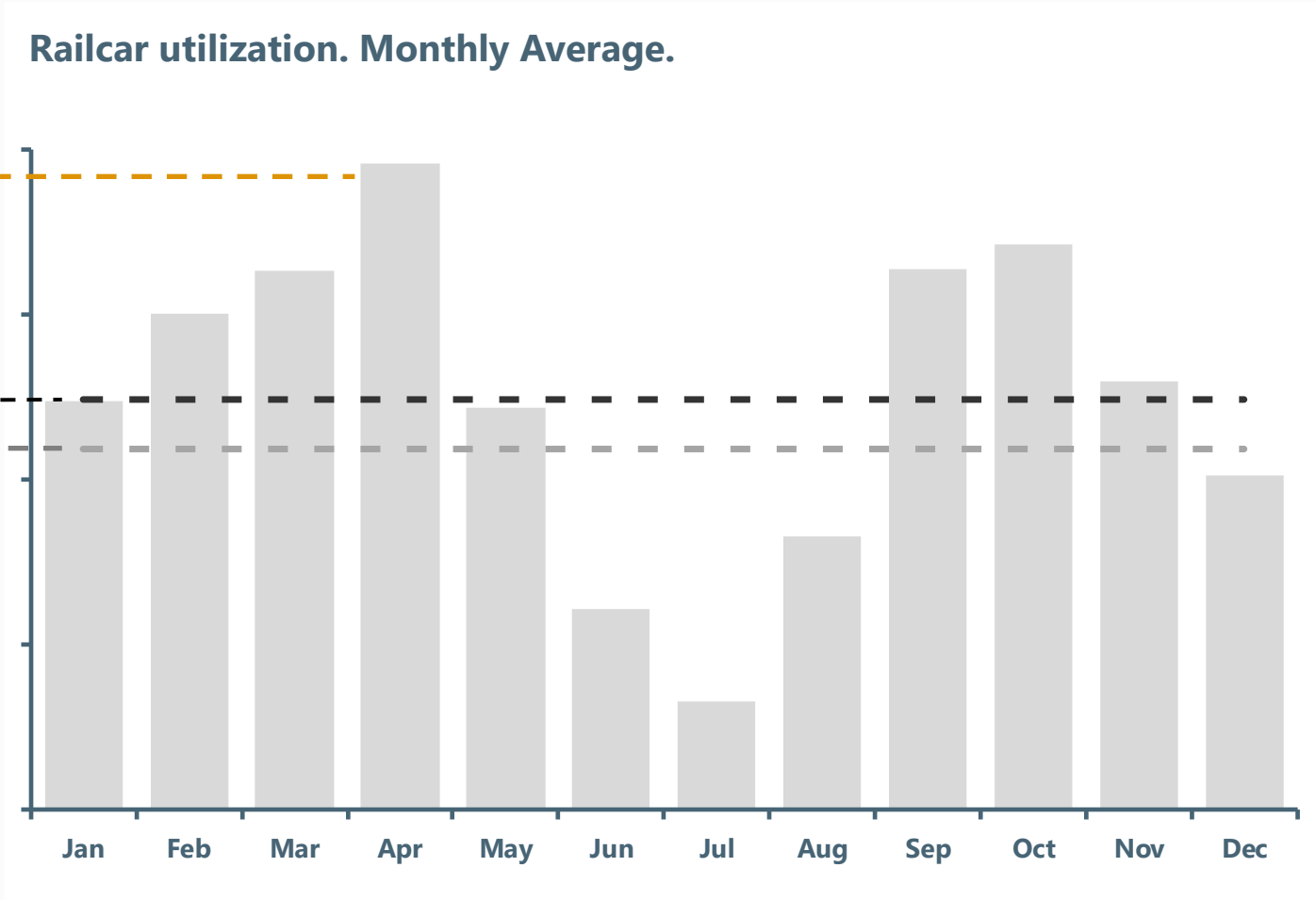
Railcar Requirements – Driven by Variability

The model showed the railcar fleet required additional cars.

3 **Model Outcome, Recommended**
Much higher peak monthly utilization driven by seasonal market demand and railway performance variability.

2 **Model Outcome, Average**
Slightly higher than static due to delays from congestion, inventory, and operational factors.

1 **Static Estimate**
Back-of-envelope annual average railcars needed to move the volume.

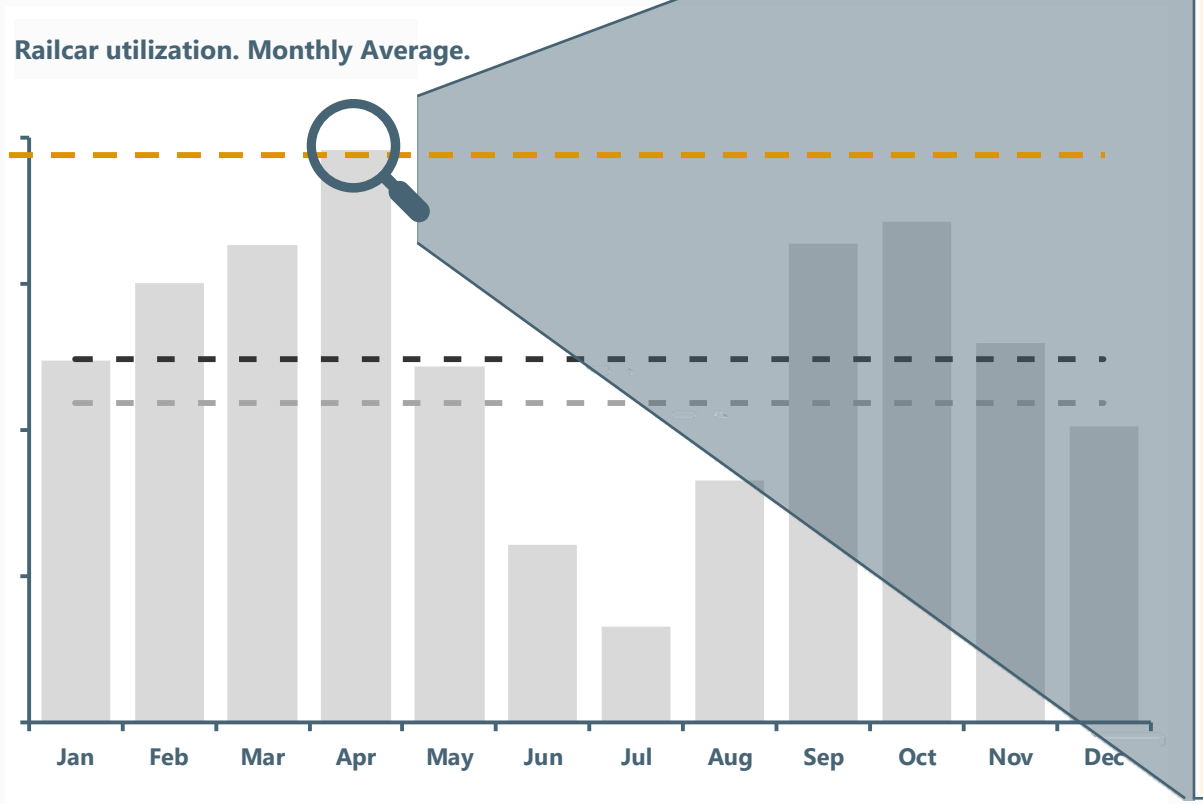


Quantifying Resilience – Capturing the Full Range of Outcomes

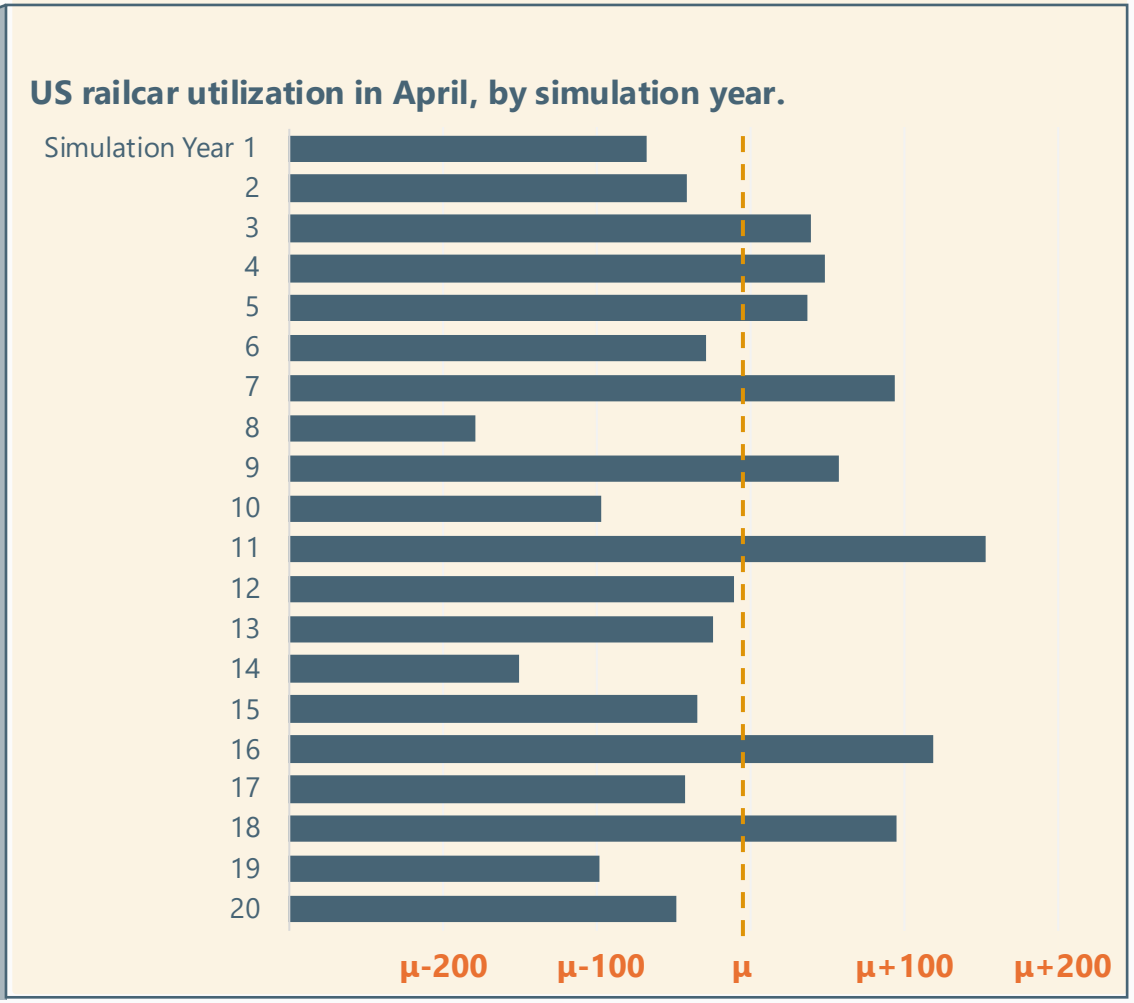
More railcars, more resilience.

2 What new risks emerged?

The latest demand and railway data drove a "range" of additional railcars needed, beyond what previous calculations predicted.



Year-to-year variability increased risk, forcing a choice: higher exposure or higher investment.



Overseas Market

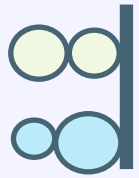
Key considerations.

Orderbook Management

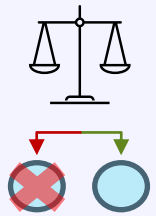
Mill production is ratable, customer demand is not.

- **Placement**

- **Aggregation**



- **Evaluation**



- **Schedule**

Port Terminal

Shared facility with operations governed by terms of service.

- **Shared**

- **Service Terms**

- **Prioritization**

- **Metocean**

Variability

Demand and performance varies month-to-month (“intra-year”) and year-to-year (“inter-year”).

- **Spot vs Cont.**

- **Seasonality**

- **Discrete Event**

- **Railways**

Overseas Market

Latest railway data indicated increased mainline transit times.

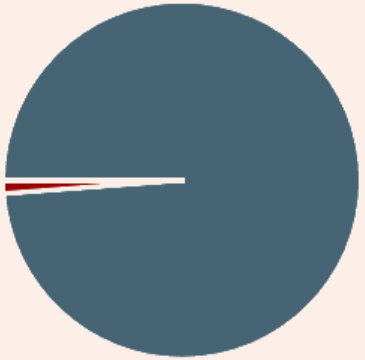
3 **Any impacts to railcar or infrastructure requirements?**

KPIs remained stable, but the contingency allocation of railcars is now needed to sustain normal operations, not just as backup.

Order Management

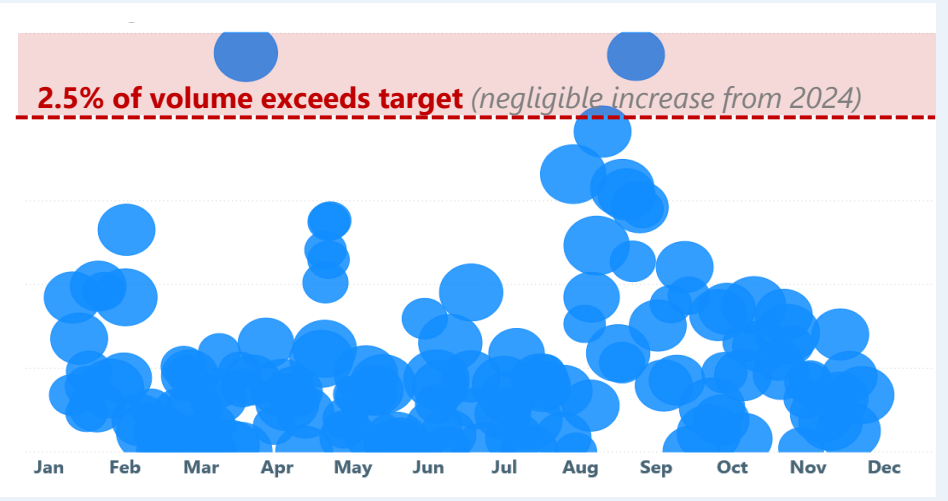
- Goal: service customer vessels as soon as possible; minimize deferrals.
- Deferral frequency tracked as KPI for customer satisfaction.
- 2025 outcome: <3% of orders required deferral.

<3% of orders required deferral
(unchanged from 2024)



Vessel Demurrage

- Goal: minimize anchorage wait time - a cost driver.
- 2025 outcome: marginal increase vs. prior view.
- Chart shows a sample year of arrivals; dot size = cargo volume.



Highlights

Numbers at a glance.

$100M+

Value protected.
Verified outbound logistics safeguarded upstream production, avoiding potential losses worth well over $100M.

2,500

Lines of AnyLogic code.
Comprehensive model code representing the full outbound logistics chain to a high level of detail.

500

Compute Hours Saved.
Accelerated analysis by simulating in **AnyLogic.**

20

Stakeholders Engaged.
Aligned decision-making across Engineering, Operations, Logistics, and Commercial teams.