



When Complexity Matters

How Kumba Iron Ore uses dynamic simulation to make sense of the complex interdependencies on the Sishen-Saldanha Ore Export Corridor.

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The Presenters



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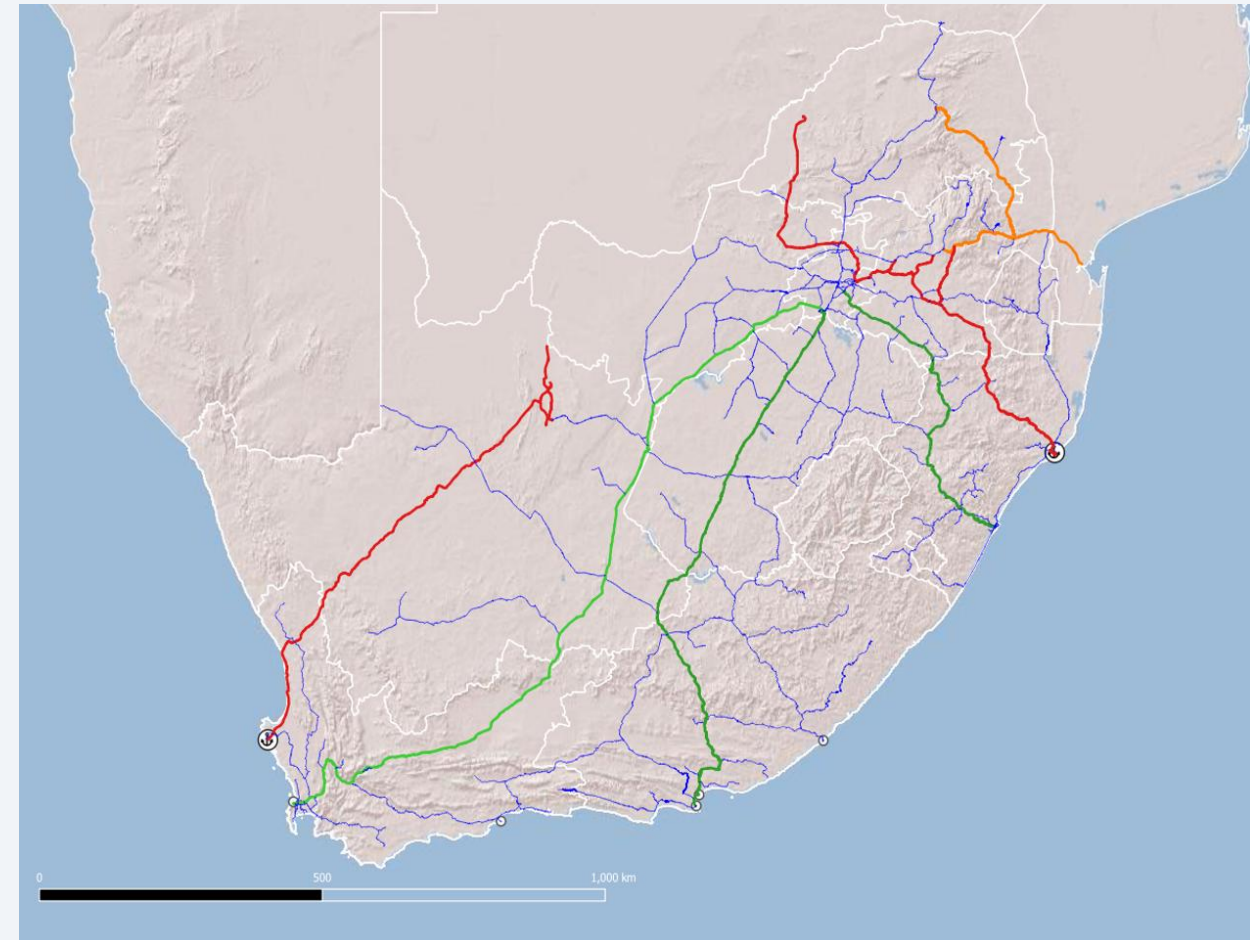
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The System

"The essential properties of a system taken as a whole derive from the interactions of its parts, not their actions taken separately." - **Russell L. Ackoff**

- The Sishen–Saldanha corridor is one of the great pieces of heavy-haul railway infrastructure anywhere in the world — 860 kilometres of purpose-built, 30 tal, 50kV AC heavy-haul line connecting some of the largest iron ore mining operation to a deep-water port with purpose-built bulk infrastructure.
- The corridor (system) was designed around the export of iron ore from the Northern Cape through the Port of Saldanha, with the last expansion project designed around a target capacity of 60Mtpa.
- The system consists of:
 - Bulk rail loading infrastructure at the mines to enable the required train turn around time, while maintaining the strict loading profile for running such long and heavy trains on a cape gauge railway.
 - The 860km heavy-haul single track rail line with ~5km long passing loops at travel time intervals to support the train schedule.
 - Bulk rail offloading infrastructure to support the required port side train turn around times.
 - Bulk product storage enabling multiple customers and product of different commercial grades.
 - Bulk reclaim and vessel loading infrastructure to meet the capacity demand.



The Context

The Problem

- Decades of underfunded sustaining capital and deferred maintenance have pushed throughput well below design capacity, triggering a formal government process on structural rail reform leading to an RFI on a Public-Private Partnership model for the corridor being issued.
- This is further complicated by the reality that the corridor is no longer an iron ore focused corridor accommodating ad hoc general freight activities but has morphed into a dual-commodity corridor with manganese itself being part of a dual-corridor system, all without a purposeful redesign of the corridor and its operating model.



The Gap

No shared, objective way for multiple mine operators, two competing commodities, and government to test capacity and investment trade-offs before committing capital or negotiating reform terms.



A single rail spine now carries two commodities and several independent operators competing for the same capacity — this corridor is our real-world instance of that problem.

The Client



History

Kumba Iron Ore, an Anglo American subsidiary, has exported iron ore via Saldanha for decades; manganese from the same region was added later, sharing the same constrained corridor.



Challenges

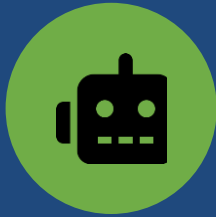
Growing manganese volumes increasingly compete with iron ore for capacity on shared infrastructure, which is constrained — with decisions now needed across multiple independent operators and government simultaneously.



Why turn to simulation

Only a full end-to-end “Logical Twin,” from mine load-out to vessel hold, can objectively test trade-offs that no single party can evaluate alone.

Why AnyLogic



Multi-method flexibility

- Combines discrete-event rail/yard logic with multi-operator, agent-based behaviour in one model — not possible on the legacy platform used for 15+ years of prior work on this corridor.



Agnostic Architecture

- One reusable model of the corridor, not a one-off tied to a single mine or commodity.
- The same design serves iron ore and manganese operators alike, and can adapt as ownership structures evolve.



Experiment Framework

- Systematically run and compare many infrastructure and volume-allocation scenarios, rather than hand-building each one.

The result: one model every stakeholder can run and trust — not a black box tied to one operator's assumptions.

One Model, Every Stakeholder

Previously

Every operator and the regulator brought a different number to the table for the same corridor.



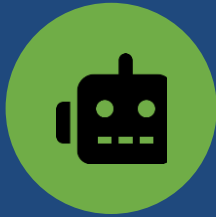
Now

One shared, testable model produces the numbers everyone works from.



Every prior capacity debate on this corridor was fought with each party's own, incompatible estimate — this is the first commodity-, operator-, and user-agnostic model competing parties can run and trust the same way.

Intangible Benefit



De-risked Negotiation

- Competing operators and government can test proposals against a common, neutral fact base instead of arguing from separate assumptions – ensures faster alignment



Long-Term Optionality

- Decade-long, capital-intensive questions can be explored now, cheaply, before money moves – it assists funders with investment certainty



Technical Credibility

- Positions the corridor's stakeholders as bringing rigorous analysis to a national rail-reform conversation, not just competing interests – independent verification of best solution in place

Together, these are what let engineers, executives, and policy-makers act on the same evidence.



The Simulation Model

Model Demonstration



Iron Ore Export Corridor Simulation Model



Input file:

Year:

Logging:



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Why This Was Hard

Scope of Model

One model spans mine load-out, rail network, yard operations, port tipping, and vessel loading — for multiple mines, two commodities, multiple owners, at once.

Detail required

Wagon- and train-level detail (axle load, rake composition, tippler cycles) was needed — aggregate tonnage flows alone wouldn't capture the real constraints.

Limited data

Commercially sensitive mine-level volumes meant designing the model to stay meaningful even where individual operators couldn't share data directly.

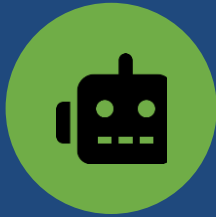
Evolving business landscape

An active government RFI on rail reform meant the model had to stay useful across several possible future ownership structures — not just the status quo.

Story telling

Translating simulation output into something that convinces engineers, executives, and policy-makers — three very different audiences — was as hard as building the model.

The Road Ahead



Model Scope

- Expanding the scope of the model to include the rail dynamics on the Hotazel line
- Building in various expansion infrastructure solutions for trade-off analysis



Study Scope

- Stress testing the system performance under parameter variation (what if we significantly improve the reliability of the tipplers)
- Various volume allocation scenarios



Integration & Access

- Provide controlled multi-user access to the model for driving the model with the most accurate data, while protecting multi-party data access issues



Thank You

Questions?

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