



Optimal Scheduling and Blending of Raw Materials for a Copper Processing Plant



ORMAE

USA | UAE | INDIA



ORMAE

Dr. Amit Garg is the founder and CEO of ORMAE, a company registered in the USA, UAE, and India. Renowned as a Guinness World Record holder in mathematics and the recipient of a silver medal in the 2012 Mental Calculation World Championship held in London. His dedication is channeled into providing consultancy services, offering training, and spearheading innovative product development in the domain of Operations Research and Data Science.



Dr. Amit Garg

FOUNDER & CHIEF SCIENTIST

Before establishing ORMAE in 2016, Dr. Amit spent over 14 years in the United States, where he pursued his PhD in Operations Research from Case Western University and honed his expertise by solving intricate business challenges for four major enterprises, including Amazon, Penske, Genesys, and Progressive Insurance. His educational journey in India encompasses a B.Tech and Master's from the esteemed IIT Delhi.



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Data Science

Machine Learning

Advanced Analytics

We help businesses by providing innovative solutions using mathematical modeling techniques, machine learning, and AI which would help to increase business revenue, optimize costs & improve service levels

Brief Introduction

Adani Group is a diversified organization in India comprising 7 publicly traded companies. It has created a world class transport and utility infrastructure portfolio that has a pan-India presence. Adani Group is headquartered in Ahmedabad, in the state of Gujarat, India.

Over the years, Adani Group has positioned itself to be the market leader in its transport logistics and energy utility portfolio businesses focusing on large scale infrastructure development in India with O & M practices benchmarked to global standards.

With four IG rated businesses, it is the only Infrastructure Investment Grade issuer in India.



Introduction



Problem Statement

KCL(Kutch Copper Ltd - a subsidiary of Adani Enterprises Ltd)'s copper complex requires to streamline its production, procurement, blending and inventory management of copper concentrates. The purpose is to determine optimal procurement and blend plan for the smelter that has an impact on inventory management and financial planning.



Impact

Optimal procurement and blend plan helps in gaining operational efficiency by decreasing the downtime, inventory carrying cost and improving the profit margin for the smelter.



Solution

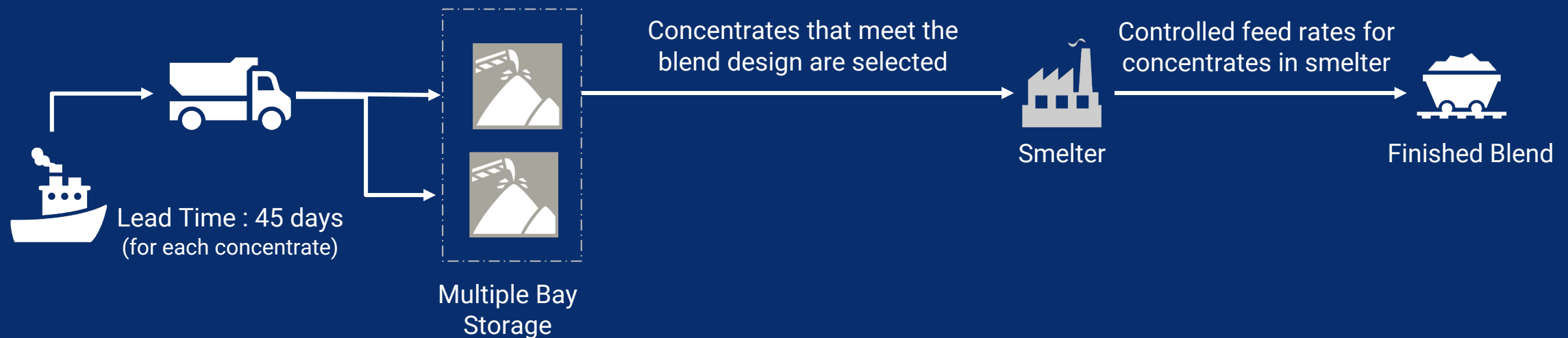
Leveraging the capabilities of Gurobi's MILP solvers, we have created a decision-support tool to assist us in achieving this goal

Business Problem

- To determine an optimal plan for the smelter that maximizes earnings for each blend while adhering to elemental composition requirements.
- The plan must account for logistical, procurement, production, and warehouse constraints, as well as the management of raw material inventory across continuous time intervals within a finite time horizon



Case Study



Solution Methodology

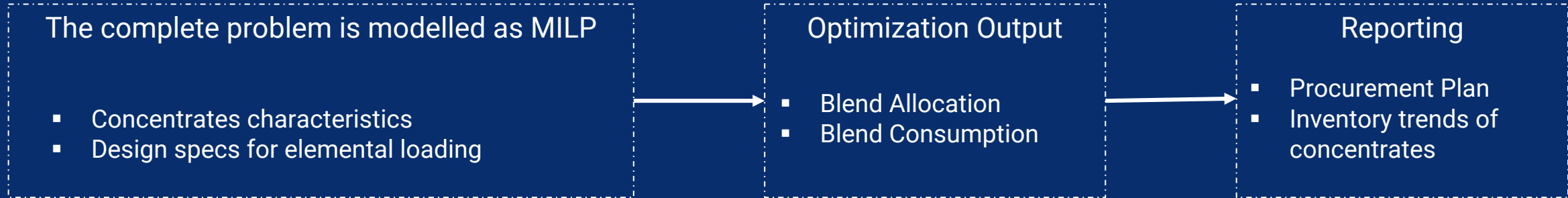


Two different approaches were envisaged:

- 1 Determining both blend plan and the procurement plan using MILP (Mixed-Integer Linear Programming).
- 2 Utilizing MILP to determine blend plan and subsequently generating the procurement plan heuristically.

Different Approaches Considered for Modelling

First approach



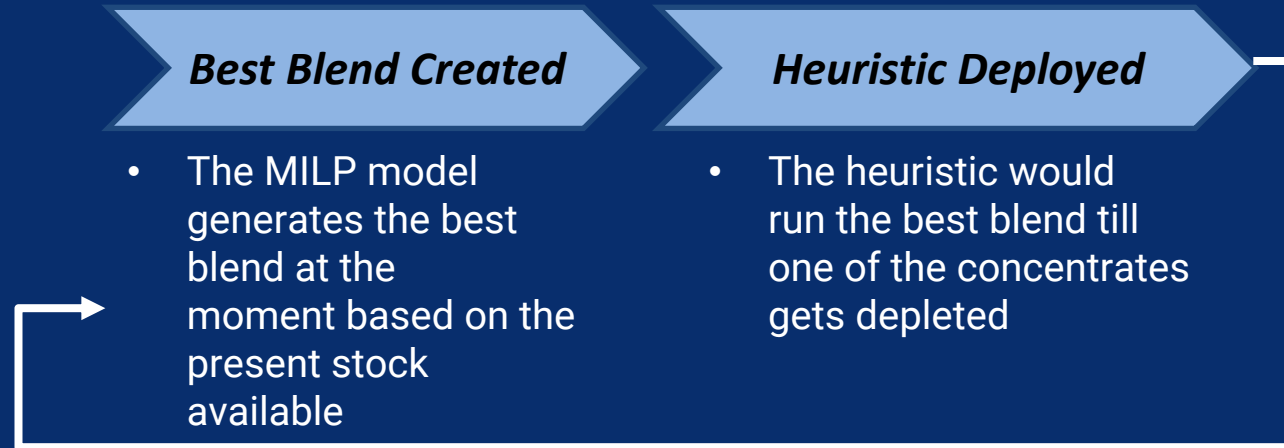
Challenges

- **Complexity due to size of the problem** : To mitigate, a rolling horizon technique was adopted. But the solution time was still around 30mins
- **Other disadvantages:**
 - To generate blends (combination of raw materials to be consumed) at a granular level
 - Wastages of concentrates

Different Approaches Considered for Modelling (Contd...)



Second approach



Updated stock based on consumption and procurements is shared with MILP model to generate the next allocation



Compared to previous approach, the second approach took less time (5 min) for solutioning

The second approach was chosen over 1st approach for solution design

Methodology Deployed in Second Approach

Create Blend Plan (MILP)

- a. Concentrates selection
- b. Assign consumption quantities
- c. Take care of design specs
- d. Optimise for maximum earnings

Blend Allocation (Heuristic)

- a. Allocate the created blend until at least one of the concentrates exhausted
- b. Make procurement decisions for concentrates that have not been made in the last 45 days
- c. Maintain inventory levels

MILP (Mixed Integer Linear Programming) approach is used

Business Operational Constraints

Blend Design Rule

- Adhere elemental composition
- Minimum and max number of concentrates used in a blend

Procurement Rules

- Lead time for every concentrate is at least 45 days
- Every Concentrates can be procured in different parcel sizes

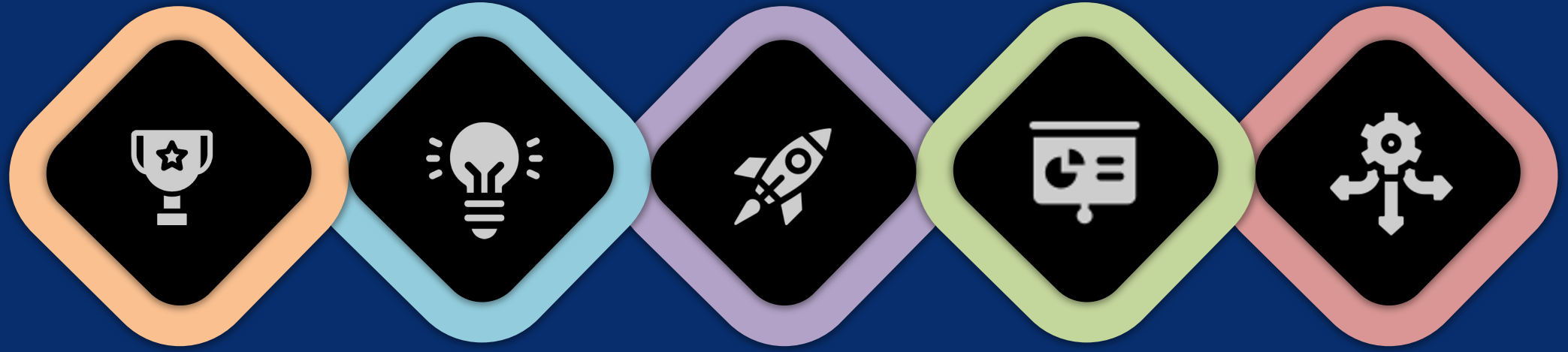
Blending Operational Rules

- Limited blending capacity per day
- Minimum and Maximum Feed rate for each concentrate used in a blend
- No wastage of concentrates

Inventory & Storage Rules

- Limited Bays
- Each bay can store only one concentrate and has a limited capacity

Model Features



Maximize Revenue

- Maximization of earnings due to blend plan and procurement plan

Optimal Solution

- Optimal blend plan with procurement and inventory management

Speed

- Faster model building
- Faster solving time

Detailed Analysis

- KPIs analysis
- Blend Composition Analysis
- Bay storage Analysis
- Consumption Analysis

Multiple Scenarios

- Analyze multiple scenarios
- Flexible to change in arrival of certain concentrates
- Study impact of decisions

Case Study

Business Impact



Prospective savings of approximately 20%



Ability to run decision analysis in less than 5 mins.



Ability to run multiple what-if scenarios for strategic analysis

SUCCESS STORIES

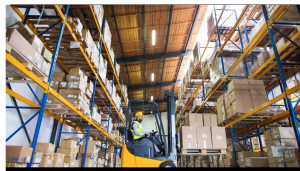


Supply Chain Optimization

MIDDLE EAST

Healthcare & Pharmaceutical Industry

Using operations research and data science, helping to optimize and tracking of all their medical & non-medical inventories



Packing Optimization

AMERICAS

Transportation & Warehousing Industry

Decreased the transportation cost by \$6M USD per year through optimal packing, algorithm of boxes, into pallets, for 10000+ orders per day.



Trade Promotion Optimization

AMERICAS & EUROPE

Retail & CPG Industry

Optimal weeks to promote product promotion group to achieve top and bottom line objectives saving 15M USD.



Anomaly Detection

AMERICAS

Retail Industry

Predict 5,10,15 minutes in the future, in real time Order drop and response time, violation to ensure fewer, order drops for 200+ servers.



Supply Chain Optimization

EUROPE

Pharmaceutical Industry

Using operations research, building multi-echelon SCM network, reduction in Inventory holding & Transportation costs, for a Fortune 500 Client.

BUSINESS



ORMAE

IMPACT



Supply Chain Optimization

MIDDLE EAST

Retail Industry

Decreasing trucking cost by 10% by optimal utilization and routing of vehicles for multiple vehicles in multiple hubs.



Logistic Optimization

AMERICAS

Car Rental Industry

Optimize movement of drivers, and shuttles, to relocate cars, across different dealerships.



Workforce Optimization

AMERICAS

Call Center Industry

Decreased workforce cost by > 5%(\$1M per year) by optimal shift scheduling for call center agent groups along with balancing service level.



Logistics Optimization

ASIA

Food Delivery Industry

Identifying the optimal number of food delivery executives and their optimal routes to deliver food on time at minimal cost saving 4M USD.



Supply Chain & Logistics

ASIA

Shipping Industry

Decreased operations cost by 5% by optimizing vessel routes for multiple ports, multi-commodity and avoiding stock-outs.

Thank You

