Engen Bulk Fuels
Supply & Distribution Optimisation

Delen Chetty
Zweli Hlatshwayo
Uberne Tapia

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Agenda

- Business Problems And Solution Objectives
- ENGEN Bulk Fuels Network Complexity
- The Need for Optimization
- RPMS Project Implementation Methodology
- The Final S&D Executable RPMS Model
- Benefits
- Next Steps
Business Problems and Solution Objectives

• Business Problems
  – Inability to manage ENGEN Supply Chain Network and Depot constraints adequately
  – Depot Supply Plan is manually balanced with no optimization
  – Inaccurate Supply & Demand Balance has potential for surplus/deficit stock fluctuations
  – No visibility of economically performing and non-performing depots
  – Operational scheduling system does not comprehend constraints of 2 way ENREF/IV transfers

• Business Solution Objectives
  – To provide a decision support tool for the STO / ESM / Supply Operations Department such that the Team can take effective “operational decisions” within the ENGEN Supply Chain Network to ensure optimal replenishment planning
  – “Operational decisions” include sourcing locations, imports, exports, supply replenishment plans, mode of transport mix planning as well as supply chain network constraint management
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ENGEN Bulk Fuels Network Complexities

• Terminals
  – Supply & Receiving Terminals
  – Supply Terminals
  – Receiving Terminals

• Mode of Transportations (MOTs)
  – Pipeline
    • ENREF – IV
    • DJP : IV - Pipeline Terminals
    • NMPP ( New Multi-Product P/L) – Pipeline Terminals
    • Sasol Northern P/L – Sasolburg/Secunda to Pipeline Terminals incl. Oliver Tambo Intl Airport
  – Railcars
  – Road Tankers
  – 2 vessels

• Terminals Storage Infrastructure
  – ENREF & IV Storage
  – Tara Rail Facility
  – Wentworth Depot
  – Inland Region Depots
  – Costal Region Depots
Network Product Distribution Profile

- Diesel - 500ppm: 40%
- Diesel - 50ppm: 20%
- Illuminating Paraffin: 17%
- Jet: 7%
- Mogas LRP93 - 500ppm: 3%
- Mogas LRP95 - 500ppm: 3%
- Mogas ULP93 - 500ppm: 2%
- Mogas ULP95 - 500ppm: 3%
- Mogas 95: 2%
- Mogas 93: 3%
ENGGEN Supply Chain “Physical” Network

SUPPLY

Product Sources

T1 → T3

DEMAND

T2 → T3

T4 → T5

T6

T7

T

- Depot Terminals
Supply and Demand Balance - High Level Model Structure

**SUPPLY**

- Fixed Crude Rate & Mix
  - Enref Extreme Point
- Supply Contracts
  - PetroSA, Chevron, Sasol

**Imports**

**DEMAND**

- T1 → T3 → T5 → T7
- T2 → T4
- T6

- Exports
- ESM, IBD, AfricOil, Chevron

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IV and Enref Model (Bi-Directional Flow Modelling)

**Mogas**
- Import: 400m³/h = 9600 m³/d
- Export: 200m³/h = 4800 m³/d

**Diesel**
- Import: 400m³/h = 9600 m³/d
- Export: 200m³/h = 4800 m³/d

IV: Import
#E: Export
TPL (DJP + NMPP): Ship
ENGEN Physical Pipeline
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Why Do We Need an Optimization Model?

- To enable ENGEN to generate a best possible “optimal executable” Supply & Distribution plan considering the economics of the entire Bulk Fuels Supply Chain Network from Production to Primary / Secondary Distribution and that is feasible with respect to:
  - Production Facilities representation (e.g. ENREF, Sasol, Chevron & PetroSA) and Demands at Destination Terminals
  - Mode Of Transportation (MOT) constraints
  - Terminal Inventory constraints
  - Port constraints
  - Other network constraints (e.g. receiving terminal constraints)
Refinery and Petrochemical Modeling System - RPMS

- The RPMS Executable S&D Model Captures all the relevant synergies across the entire Supply & Distribution Chain
What Does RPMS Optimize?

Given:

- Economics and Volume data
  - Product demands and prices
  - Raw material availability and costs
  - Freight cost

- Network constraints
  - Pipeline flow restrictions
  - Tank capacities
  - Off Loading & Shipping Capacities
  - Size of batch MOT’s e.g. trucks, rail and ship
  - Voyage duration (e.g. Trip days)

- Sourcing
  - Production Facility
  - Supply Contract Tolerances
  - Imports, Spot Purchases

RPMS will simultaneously manipulate parameters in the model to determine the best optimal executable Depot Supply Plan.
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RPMS Project Implementation Methodology

• Phase I - RPMS Solution Blue Print

• Phase II - RPMS Solution Development

• Phase III – RPMS Solution Deployment
RPMS Project Implementation Methodology

**PHASE 1 – Solution Blueprint**
- Engen / Honeywell 3 Day Workshop
- Engen Brown Paper Model Development / Preliminary RPMS Model Development

**PHASE 2 – Solution Development**
- Preliminary RPMS Model Development (Offsite / Onsite)
- Model Validation (Onsite)
- Raw RPMS Model / Def.
- Manual population of model!

**PHASE 3 – Solution Deployment**
- Model Calibration & Commissioning (Onsite)
- Engen Model Testing and Usage (Engen Team)
- Engen Team
RPMS Solution Blue Print

- To work with the Customer ‘s resources to define & describe in a common data repository all the activities relevant to the Supply & Distribution Bulk Fuels Network that may have a “real impact” in the RPMS LP model
  - Terminals
  - Mode of Transportations
  - Inventory

- The RPMS Solution Blue Print contains the “Network Knowledge” used to built the RPMS model representative of the Bulk Fuels Network
RPMS Solution Blue Print : Terminal Alrode

General observations / Notes:
- Depot can receive a maximum of 6 x truck loads per day
- The MOGAS products supply from JP to AL (U5 & U3) are coming via SS
- The DL supply from JP to AL is coming via two routes : IV to JP & SS to JP

Supplies APO Locations:
Alrode : Selling point - demand will be placed at the level of Alrode
RPMS Model Development

• How should actual network activities be represented in the LP model?
  – Model structure must be sufficiently robust to generate a “good economic representation” over a practical range of operations
  – Model structure should be robust to accept changing supply and demand data without the necessity for lengthy restructuring or LP manipulation to get quick results

• All "real" network limitations should be modeled explicitly
  – Model it, if it has an impact, such as any operating characteristic limit

• Build the model to meet “business need only” and not to answer every single problem or issue in the network

• Decide upfront whether the model will be utilized for planning or execution decisions and then structure accordingly

• Start simple and add complexity later if needed and understand what you are doing
RPMS Model Calibration & Commissioning

• **Approach : Use Cases**
  – To determine whether the model behavior mimics as closely as possible potentially “extreme” but “real” supply chain disruptions
  – To determine whether the model will default to solutions that are quite similar to human interventions during supply chain disruptions

• **Objective**
  – The LP should perform with “logistic accuracy”
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High Level Model Overview

**INPUTS**
Supply & Demand figures are fixed or have changed due to unforeseen events

- **Demand Data**
  - AfricOil Demand
  - Trading Demand
  - IBD Demand
  - ESM Demand

- **Supply Data**
  - PetroSA
  - Chevron
  - Sasol
  - All Terminals
  - Enref Production

- **Other input data**
  - Product Slate Profile & Pricing
  - Supply Chain Cost
  - Imports / Exports by product
  - Inventory levels
  - Inventory targets

**Operating Constraints:**
- Depots receiving & shipping constraints
- MOT (Pipe, Rail, Road, Ship) availability & capacities incl. Product priorities
- Refinery + Other Oil Company Planned Shutdowns / slowdowns
- Inventory, etc

**OUTPUT**
Operational:
- Supply & Demand Balance by Depot by Product (Depot Supply Plan)

- Bulk fuels requirements

- RPMS Reports
### Island View

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<th>ER-IV Mgs</th>
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**Output – Depot Supply Plan**
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Benefits

• Network Optimization
  – Optimal cost to serve
  – Realistic constraint based plans
  – Reduced stock outs
  – Reduced transshipping
  – Accurate Supply and Demand Balancing
  – Constraint identification and Management

• Develop Faster Executable Depot Supply Plans (DSP)
  – Refinery shutdown/slowdown scenario planning
  – Product phase out/in plans
  – Testing of Refinery Production profiles
  – Network Capacity Planning
  – Mode of Transport disruption scenario planning
  – Capability for extended use of model for Strategic/Tactical/Operational & Execution Planning
Benefits

• Business Collaboration
  – Scenario testing for ENGEM Divisions involved in Bulk Fuels
  – Potential to roll out LP models to wide user base
  – Single platform for agreeing a “single” plan
  – Buy-in from all Business Divisions

• Business Efficiency & Effectiveness
  – Can direct infrastructure planning to real supply chain constraints
  – Focus on optimizing “cost to serve” in bulk fuels network
  – Aligning of key business metrics to S&D LP model output
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• Business as Usual
  – Embed S&D LP Model usage in ENGEN Supply Team
  – Use of Back casting to focus business results improvements
    • Optimal cost to serve
    • Maximization of pipeline and coastal shipping MOT usage

• Further Model Development
  – Dedicated Coastal Shipping LP model or upgrade of current S&D LP model
  – Modeling of new multi-product pipeline in multi-product model
  – Modeling of Depot Shipping Out constraints
  – Modeling of downstream network
Next Steps

- RPMS Infrastructure, Training and Rollout
  - Continued Training efforts
  - Operations research with S&D LP model and RPMS in general
  - RPMS User base development
  - Roll out of 6 new standalone PC’s for RPMS S&D LP model usage in Cape Town office
  - Identification of key areas for S&D LP model usage as well as other dedicated models for continued business efficiency and effectiveness improvement