OPTIMIZING LOGISTICS CHAINS WITH SIMULATION MODELLING

Joel Shirriff | 13 June 2018
Ausenco is a global, diversified engineering and construction management company providing services across the energy and resources sectors.
At Ausenco our **Core Values** drive our behavior in how we engage with our internal teams, our clients, and the communities that we work in.
Presentation Overview

• Supply chain logistics are often overlooked by commodities producers as being less important than their central process, but in reality they are vital component often with significant costs.

• Simulation modelling is the only way to effectively predict how a logistics system will perform. They rarely operate at a steady-state, and often experience wild variations in productivity and seasonality factors that static calculations cannot adequately represent.

• This presentation will discuss how discreet event simulation modelling can add significant value to both the capital and operating cost of a project.
What is Simulation Modelling?

• Simulation modelling has become a standard tool to plan new supply chains or industrial processes, and for expanding existing ones.

• Simulation modelling can simultaneously assess the impacts of all operating variables on production in a real time environment that includes random distribution of reliability and external influences.

• The predicted outcomes from simulation modelling are used to validate and support financial decisions in capital investments and operating strategies.

• Models are built using specialty software tools that can be calibrated against historical operating data to better predict the impact of sensitivity cases.
Data is Collected from many Sources

- ERP
- SCADA
- CMMS
- External Interfaces
- PLC / DCS
- Drives
- TOS
- Emergency Devices
The Evolution of Data Storage

As our ability to collect data from our operations has increased, so has our capacity to store this data.

So, what do you do with all this data you collect?
The Importance of Data Analysis
Operating System Analysis

- Benchmarking and cost trend analysis
- Labour utilization analysis and strategies
- Data Analysis
- Analysis of production bottlenecks
- Process optimization and definition of KPI's
- Identify opportunities for system automation
- Third party cost impact reductions
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Key Performance Indicators Examples:

- Annual throughput (tonnes/year)
- Commitment (asset being used)
- Equipment utilisation (working time).
- Berth Occupancy Time.
- Cycle times (repetitive functions)
- Delay time – non loading time
- Breakdown time (unplanned maint)
- Average Ship Turnaround Time or Total Time in Port (TTIP)
Challenges of Data Analysis

- There is lots of data available in most terminal operations, but a major challenge is to sort the good data from the bad and get rid of outliers and errors from manual entries.
- Each area of an operation is often managed by different people with varying responsibilities and expectations.
- Real time statistics and dashboards are great tools for a snapshot view, but do not identify where to make improvements to increase productivity.
- A single operational KPI may be influenced by multiple input factors.
- Overall Equipment Effectiveness (OEE) analysis may identify operational issues but does not highlight where the problem is or offer solutions to fix it.
Typical Analysis of Train Discharge

The operation only had control of 30% of total train time!
Typical Analysis of Ship Loading Time

Total delays average more than twice the loading time!
How to validate proposed solutions?

• Intuition may work in some cases, but an increase in a single KPI may not be linear across the entire system.

• A spreadsheet analysis may offer some general guidance but only through full dynamic simulation modelling can the overall impacts of opportunities be predicted.

• Logistics systems have multiple components: production areas; intermodal transport and port/terminal.

• Analysis of one area in isolation may deliver partial results, but the best value is achieved by looking at the full chain from production to port as a holistic logistics system.
Model the full logistics chain
Isolated Capacity Estimates

Pit-to-Port Exporting Operation

Capacity of the Train Loadout at Mine: 100 Mt/y

Capacity of the Rail System: 100 Mt/y

Capacity of the Marine Terminal: 100 Mt/y

Therefore, the capacity of the combined system must be 100 Mt/y… or is it really?
Integrated Supply Chain Model

- In isolation, each component of the system has 100 Mt/y capacity.
- However, the interactions between the components have dependencies that may cause delays and further knock-on effects to capacity.

The reality of the integrated logistics supply chain system is that overall throughputs will typically be less than the individual components.

Simulation modeling is necessary to quantify the impact that these component dependencies have on the system throughput.
Case Studies
Trans Mountain Expansion Project

Client: Kinder Morgan
Location: Western Canada

• Recommended optimal number of crude oil and refined product storage tanks and assignments
• Integrated a range of failure modes to measure the impact of reliability on storage requirements
• Evaluated effect of 3rd party traffic along Burrard Inlet

Model features:
• 24 commodities
• 59 tanks in 5 terminals
• 3,200 vessels per year total
Dalrymple Bay Coal Terminal (DBCT)

Client: DBCT Management Ltd.
Location: QLD, Australia
• Calibrated against historical operating data
• Optimized stockyard management strategy, including reducing remnants and maximizing dual-reclaim
• Quantified practical terminal throughput capacity
• Operations planning tool

Model features:
• 24 mines & 3 export terminals
• 49 coal grades
• 52 trains on 2,400 km of rail
Mina Justa Sulphide Circuit

Client: Marcobre
Location: Marcona, Peru

- Quantified availability of the proposed design and confirmed its ability to deliver the target throughput
- Determined that intermediate stockpiles within the circuit were not required
- Model expanded in 2018 to include oxide circuit and VAT leaching system.

Model features:
- 5 circuits in series
- 46 major components
- 1,200 failure modes
Las Bambas Concentrate Export

Client: MMG
Location: Arequipa, Peru
- Identified limitations and removed bottlenecks at all operations on the logistics chain including the mine, transfer station & port
- Confirmed truck, container, and railcar fleet sizes
- Included location limits, maintenance restrictions, random breakdowns & weather delays

Model features:
- 420 km truck haul
- 310 km rail haul to port
- 130 loaded and empty trucks per day through facilities
“Value Addition” from Modelling

Energy East Pipeline Supply Chain

Increased NPV by $500M by right-sizing storage

DBCT & Goonyella Supply Chain

Optimized over $100M of Capex investment

Qatargas Global LNG Fleet

Reduced Capex by $150M by optimizing fleet

Calcasieu Ship Channel Traffic

Validated ROI for $40M/y dredging program

Hebron Offshore Platform Logistics

Increased NPV by $250M by aggregating fleet

Hudbay Rosemont Dry Stack Tailings

Increased NPV by $500M by de-bottlenecking
What does this mean to you?

Simulation allows you to prove which decisions maximize your profit (and other KPIs) by dynamically modelling your entire value chain in detail and comparing all your options.”

• Analyze historical performance data – Learn from your past
  ✓ Measure actual productivity and relieve bottlenecks to increase throughput.
  ✓ Measure actual inventory levels and optimize them to reduce waste and increase cash.

• Build a holistic, dynamic model of your business – Know your present
  ✓ Model all of your assets and resources to understand interactions.
  ✓ Calibrate the model to historical performance data to ensure realism and accuracy.

• Compare capital and operating options – Plan your future
  ✓ Test every option and simply pick the best one.
  ✓ Make risk-optimized decisions using the confidence levels we provide.
Closing Message

Simulation modelling informs complex business decisions using predictive analysis of data.

Intuition can be expensive.

Foresight is **priceless**.
Thank you.

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