

# ARAUCO: Supply Chain Planning Optimization

## Case Study

Learn how a decision support system – powered by the Gurobi Optimizer – enabled one of the largest wood production companies in the world to optimize its supply chain planning and operations.

## The Challenge: Supply Chain Management in the Wood Industry

To rise above the challenges and complexity of the wood industry and reach their business goals, wood producers must be able to accurately forecast demand, manage raw material supply as well as production and distribution operations, and make integrated, optimal plans and decisions.

ARAUCO – a multinational wood pulp, engineered wood, and forestry company with a presence in five continents and a network of over 4,300 customers – was struggling to balance supply and demand while keeping operating costs down and customer satisfaction levels high.

ARAUCO was looking for a decision support tool that would enable the company to optimize the production and logistics planning and decision making at its division in Chile.

To provide such a system, ARAUCO engaged Aleph5, a business consulting firm that specializes in dynamic analytics and mathematical modeling & optimization.

Aleph5 set up a decision support system – with the Gurobi Optimizer as its mathematical optimization engine – that enables the wood company to:

- Easily and effectively model the key features of its business processes (including its unique business rules and multiple-objectives and decision variables).
- Optimize the planning of its production and distribution processes and the utilization of the resources and facilities across its operational network.

## Key Considerations

In the wood industry (as in any manufacturing industry), supply chain planning is a complicated and challenging endeavor that involves a huge number of variables and constraints.

To cope with supply and demand volatility and attain end-to-end supply chain visibility and control, ARAUCO must be able to generate optimal plans that take many different factors into account including:

- Demand levels across various markets.
- The production capabilities of different facilities.
- The costs of manufacturing specific products on different production lines.
- Each SKU's uniquely complex production process.
- The volume and variety of products that must be produced on a weekly basis.
- Logistical considerations (including routes and modes of transport) between plants and shipping docks.
- Price policies for each market.
- The capabilities of third-party suppliers.
- The availability and variability of raw materials.

Monitoring and managing the last factor on the list – raw material supply – presents a major challenge for wood producers such as ARAUCO. Wood is a highly variable raw material – as logs constantly vary in terms of their dimensions and quality. This uncertainty on the supply side has an impact on the type and sequence of processing methods and the type of products that can be produced. The decision support system built by Aleph5 for ARAUCO had to be able to take into account demand forecasts as well as the availability of raw materials.

On a daily basis, the system needed to be capable of collecting and processing all relevant data on prices, volume, quality, capacities, costs, and other variables and using that information to make optimal production and distribution plans and decisions.

Additionally, ARAUCO's planners needed to have the capability to create, explore, and evaluate multiple, multi-criteria scenarios.

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### The Solution: Model Formulation and Mathematical Optimization

The key step in solving any mathematical optimization problem is the formulation of the model – as it is imperative to ensure that the business problem is defined in the right way. Otherwise, the model might not be able to deliver an optimal solution to that business problem.

Furthermore, in order to ensure widespread adoption of the new decision support system within the organization, it is essential that the solutions generated by the system are feasible and do not radically change organizational processes and practices.

To achieve these goals, Aleph5 built and deployed a powerful and flexible decision support system for ARAUCO, which dynamically adjusts the required models based on changing conditions across the wood producer's supply chain.

For several weeks, the Aleph5 modeling team worked closely with ARAUCO's planners and other personnel to formulate a robust group of linear models that utilize all available historical and real-time data.

These models also take into account a number of key performance indicators (KPIs) including:

- Cost, revenue, and profit
- Percentage of demand fulfillment
- Resource utilization

A typical model in this application has several hundred thousand variables and many thousands of constraints, and ARAUCO's planning process requires solving several of these models.

The solution was developed using Ernest 4.0 (a modeling language developed by Aleph5) and is fully integrated with the Gurobi Optimizer.

### The Results

The implementation of Aleph5's decision support

system, powered by the Gurobi Optimizer, has enabled ARAUCO to:

- Integrate and optimize its supply chain planning and decision making within its facilities and across its end-to-end network.
- Improve the company's performance against its KPIs (such as minimizing costs and maximizing demand fulfillment, resource utilization, and revenue growth).
- Attain real-time visibility and control over its supply chain.
- Gain a better understanding of the impact of market price fluctuations on production costs.
- Explore what-if scenarios in order to detect hidden risks and discover new opportunities.

### Why Gurobi?

The combination of Ernest 4.0 and the Gurobi Optimizer provides a robust and powerful tool capable of solving complex optimization problems (which require balancing the tradeoffs between multiple objectives). To solve ARAUCO's planning problem, Aleph5 used several of the mathematical optimization algorithms that Gurobi provides.

The flexibility and robustness of Ernest 4.0 as a modeling language enabled Aleph5 to effectively create and explore various models that capture the key elements of ARAUCO's complex business problems. Aleph5 then used the Gurobi Optimizer to simultaneously solve dozens of models during the exploration process – in an way that capitalized on all available computing capabilities.

With the Gurobi Optimizer, Aleph5 was able to swiftly and successfully build models that captured and addressed ARAUCO's highly complex supply chain planning problems and enabled the wood producer to rapidly generate optimal solutions.