Optimization of the Worldwide Supply Chain at Continental Tires: A Case Study


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Business Background

• Continental tires
  – Worldwide manufacturing and distribution of tires
  – Both Original Equipment Manufacturing (OEM) as well as Replacement tires segments

• Continental tires by the numbers

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly Revenue</td>
<td>10 billion Euros</td>
</tr>
<tr>
<td>Employees worldwide</td>
<td>40000</td>
</tr>
<tr>
<td>Production plants</td>
<td>18</td>
</tr>
<tr>
<td>Product variation</td>
<td>10000</td>
</tr>
<tr>
<td>Production stages per tire</td>
<td>100</td>
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</tbody>
</table>
Production Strategies

• Make-to-stock
  – Safety stock
  – Seasonal sale forecasts

• Multiple production locations for same products
  – Some raw materials: Long lead times and less number of suppliers
  – Full truck-load transportation
  – Custom-made manufacturing tools

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Marketing Strategy

• OEM and replacement tire markets
  – Also serves small dealers and garages
• Diverse product portfolio
  – High-volume, low-margin products
  – Low-volume, high-margin products
• Seasonal sales in some markets
• Need to increase presence in emerging markets
Planning Strategies at Continental Tires

- **Long-term planning (1 to 3 years out)**
  - Decides allocation of products to global production locations
  - Capacity planning for each plant level
  - Transportation of products from manufacturing location to customer regions

- **Mid-term planning (12 to 18 months out)**
  - Defines production requirement for weekly range

- **Short-term scheduling and planning (weekly/daily)**
  - Execution of mid-term planning strategies
Challenges of Complex Planning Process

• Long-term planning
  – Performed worldwide
  – Impacts billions of Euros (€) in terms of revenue and costs

• Objectives

<table>
<thead>
<tr>
<th>Goals</th>
<th>Example Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase sales</td>
<td>Optimal assignment of production to demand</td>
</tr>
<tr>
<td>Reduce costs</td>
<td>Selection of production location</td>
</tr>
<tr>
<td>Balance trade-offs</td>
<td>Supply versus demand</td>
</tr>
</tbody>
</table>
Business Problems

• Lack of distributed and collaborative planning
• Higher customer demand volatility
• Time consuming, labor-intensive planning processes
• Inconsistent data across businesses
  – Forecasting issues
• Various type of toolsets with different capacities across production locations
  – Placement of toolsets among production locations based on production strategies
• Creating business scenarios for simulation is highly complex
Constraints to Consider

• Limited resources
• Worldwide supply networks
• Multiple production locations
• Multiple products
• Production complexity
• Capacity limitation
• Multiple planning models
• Various shifts for employees
• Implemented Future Allocation and Capacity Tracking (FACT) planning solution
  – Creates planning data repository which can be imported to ERP systems and other data warehouses
  – Assigns production numbers to products and resources
  – Provides data for multiple planning horizons
  – Assigns production quantities to worldwide production locations
  – Constraints include plant capacity, availability of machines and variability of product characteristics
Scope of FACT Application

**Decision Horizon**

- **Years**
- **Quarters**
- **Months**
- **Weeks**
- **Days**
- **Hours**

**Supply Chain Design** - Physical asset strategy, outsourcing, distribution flow, customer assignment, service level, logistics strategy, and financial goals.


**Sales and Operations Planning** - Develop optimal deployment and reconciling financial targets with demand, capacity, and materials. Assign production to facility and mid-term sourcing strategies. Coordination among multiple business units and functions, finding globally optimal plan.

**Inventory Optimization** - Optimization of inventory targets and service levels across all levels of the organization.

**Line Balancing** - Determine best allocation of tasks to people and equipment; optimize Takt Time.

**Order Slotting**

Assign orders and forecast to production. Determine best time and assets to utilize in fulfilling demand. Consume Forecast.

**Production Scheduling**

Develop detailed manufacturing, sourcing, and distribution plans, taking into account inventory, orders, resources, shelf life, setups, etc.

**Maintenance Scheduling**

Determine best schedules based on object status, parts availability, people skills and schedules, workflow, and workplace constraints.

Solution Architecture

• FACT application is built on IBM Decision Optimization Center
  – CPLEX Optimization Studio solves the mathematical model
  – Scenario Repository has multiple “what-if” scenario for the planners to consider
  – Client is the graphical user interface (GUI) for the end user
Decision Making

- Two levels of planning:
  - Allocation planning and capacity planning

- Allocation planning at worldwide level
  - Yearly production quantities at all production locations
  - Need to consider plant capacity, critical machine availability, production complexity at each plants
  - Considers Bill-Of-Capacity (BOC) while allocating resources

- Capacity planning at individual plant level
  - Takes input from Allocation planning results
  - Separate optimization model for each production plants
  - Considers products that are manufactured in respective plants
  - Considers Bill-Of-Materials (BOM) for decision making at each plant level
Characteristics of FACT

• Acts as a planning data repository
• Exchange data between systems like ERP, data warehouses and other legacy systems
• Provide graphical as well as tabular view of results
• Supports team collaboration, i.e. multiple location access and multiple user inputs
  – Easier to configure customized data access to users and location
• Computes resource extensions to solve capacity limits
  – Assigning additional work shifts
  – Buying new machines
• Compares cost due to resource extension vs. benefits from increased sales
Benefits of FACT

- Improved master data quality because of consistent data model
- Consistent information flow from central headquarters to each plant because of the use of one standard tool
- Easier to identify and rectify incorrect data imported from legacy systems
- Simulate multiple business scenarios and hence provide better planning granularity
- Identify plant bottlenecks and suggests necessary resource extensions
- Better decision making, higher cost saving and improved customer service