IBM ILOG Optimization and Supply Chain Applications Overview

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Successful companies Use Optimization To Make better decisions

- **€20 mil**
  - Amount a major transportation company reduced operating costs annually through better allocation of rolling stock.

- **$240 mil**
  - Amount a central securities depository saved financial institutions in 18 months by faster clearing of securities transactions.

- **€50 thou**
  - Amount a power system operator reduced daily costs to consumers through better dispatch of generators.

- **$226 mil**
  - Amount a major hotel chain increased annual revenue by offering the right product to the right customer at the right price.
What comes to your mind when you hear these words?

- Optimal
- Optimize
- Optimization
What do people mean when they talk about optimality?

- Maximum Profit
- Satisfied Customers
- Minimum Costs
# When to Use Optimisation?

## To Make the most of …..

<table>
<thead>
<tr>
<th>Resources</th>
<th>Examples of choices to make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>Invest, allocate</td>
</tr>
<tr>
<td>People</td>
<td>Hire, assign, schedule</td>
</tr>
<tr>
<td>Equipment</td>
<td>Acquire, schedule, locate</td>
</tr>
<tr>
<td>Facilities</td>
<td>Locate, size, schedule</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Acquire, route, schedule, deliver</td>
</tr>
<tr>
<td>Material/Product</td>
<td>Acquire, allocate, produce, deliver</td>
</tr>
</tbody>
</table>

**Keywords:** minimize, maximize, how many/how much, decide/choose, plan, when/where, schedule, assign, route, locate, trade-off
Advanced Analytics Landscape
Enable Insight from Diverse View Points

Degree of Complexity

Competitive Advantage

Stochastic Optimization
- How can we hedge uncertain risks?

Optimization
- How can we achieve the best outcome?

Predictive modeling
- What will happen next if…?

Forecasting
- What if these trends continue?

Simulation
- What could happen…?

Alerts
- When are actions needed?

Query/drill down
- What exactly is the problem?

Ad hoc reporting
- How many, how often, where?

Standard Reporting
- What happened?

Based on: Competing on Analytics, Davenport and Harris, 2007
How Does It Work?

A Business Problem

\[ x_L = 1 \text{ if leg } L \text{ is used, 0 otherwise} \]

Maximize \[ \sum c_L x_L^2 - \sum c_{LM} x_L x_M \]
Subject to
capacity constraints

A Mathematical Problem

Business Results

A Solving Engine
What Can Optimization Do?

Optimization helps businesses make complex decisions and trade-offs about limited resources

- Discover previously unknown options or approaches
  - Automatically evaluate millions of choices

- Automate and streamline decisions
  - Compliance with business policies and regulations
  - Free up planners and operations managers so that they can leverage their expertise across a wider set of challenges

- Explore more scenarios and alternatives
  - Understand trade-offs and sensitivities to various changes
  - Gain insights into input data
  - View results in new ways
Optimization Solutions Spans across Industries

From long term planning to real-time scheduling

Manufacturing
- Warehouse/Plant Location
- Warehouse/Plant layout
- Inventory Management
- Production planning
- Detailed scheduling
- Procurement
- Vendor Managed Inventory

Transportation & Logistics
- Depot/warehouse location
- Fleet assignment
- Network design
- Vehicle routing & scheduling
- Vehicle & container loading
- Crew & driver scheduling
- Maintenance scheduling

Financial Services
- Portfolio Optimization and rebalancing
- Trade crossing
- Loan pooling
- Product/price recommendations

Utilities, Energy & Natural Resources
- Supply portfolio planning
- Power generator scheduling
- Distribution planning
- Water reservoir mgmt
- Mine operations
- Timber Harvesting

Telecom
- Network capacity planning
- Routing
- Adaptive network configuration
- Antenna and concentrator location
- Equipment and service configuration
- Field technician dispatching

Retail and Multiple Other
- Workforce scheduling
- Appointment scheduling
- Advertising scheduling
- Marketing campaign Optimization
- Revenue/Yield Management
- Merchandising
- Space Optimization
## What: Well-Documented Optimization Cases

<table>
<thead>
<tr>
<th>Company</th>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPS*</td>
<td>Air Network Design</td>
<td>$40M/yr + 10% fewer planes</td>
</tr>
<tr>
<td>South African Defense*</td>
<td>Force/Equip Planning</td>
<td>$1.1B/yr</td>
</tr>
<tr>
<td>Motorola*</td>
<td>Procurement Mgmt</td>
<td>$100M-150M/yr</td>
</tr>
<tr>
<td>Samsung Electronics*</td>
<td>Semiconductor Mfg</td>
<td>50% reduction in cycle times</td>
</tr>
<tr>
<td>SNCF (French RR)*</td>
<td>Scheduling &amp; Pricing</td>
<td>$16M/yr rev + 2% lower op ex</td>
</tr>
<tr>
<td>Continental Airlines*</td>
<td>Crew Re-scheduling</td>
<td>$40M/yr</td>
</tr>
<tr>
<td>AT&amp;T*</td>
<td>Network Recovery</td>
<td>35% reduction spare capacity</td>
</tr>
<tr>
<td>Grant Mayo van Otterloo*</td>
<td>Portfolio Optimization</td>
<td>$4M/yr</td>
</tr>
<tr>
<td>Pepsi Bottling Group</td>
<td>Production Sourcing</td>
<td>$6M inv reduction + 2% fewer miles</td>
</tr>
<tr>
<td>Fonterra</td>
<td>Dairy Distribution</td>
<td>$15M annual savings</td>
</tr>
<tr>
<td>NA Brewing Company</td>
<td>Mfg Sourcing + Distribution</td>
<td>$150M/yr transportation savings</td>
</tr>
<tr>
<td>US Water Products Mfg</td>
<td>Inventory Optimization</td>
<td>$6.2M working capital reduction</td>
</tr>
<tr>
<td>2 Chilean Forestry firms*</td>
<td>Timber Harvesting</td>
<td>$20M/yr + 30% fewer trucks</td>
</tr>
</tbody>
</table>

Netherlands Railways
Weathers the unpredictability of passenger traffic with advanced modeling tools

**Challenge**

One of the busiest national railway systems in Europe, Netherlands Railways transports over a million passengers each day, and passenger volumes are expected only to increase. Keeping pace with this growth, however, was proving difficult because the organization had to manage thousands of railcars and a 2,800 km rail network. And, with only manual scheduling processes, it could not easily model future requirements.

**Solution**

Netherlands Railways worked with IBM Software to deploy a dynamic timetable and railcar management solution that can accommodate fluctuations in passenger traffic. The solution, built with IBM ILOG software, can account for more than 56,000 variables and 32,000 constraints to generate optimized train schedules. And the solution’s advanced modeling capabilities enable the organization to better prepare for unexpected changes.

**Results**

- Cuts annual costs by €20 mil with more accurate modeling processes that help better predict traffic patterns and streamline operations
- Improves asset utilization, enabling Netherlands Railways to increase the frequency of routes, without investing in new railcars
- Produces more accurate weekly schedules, improving on-time train performance by more than two percent and increasing customer satisfaction

**Customer Profile**

Netherlands Railways is the principal passenger railway operator in the Netherlands. NS handles 1.1 million passengers every day, with 4,800 scheduled trains.
Securities Settlement at INDEVAL

Strengthening a country's financial system

**Challenge**

INDEVAL's securities settlement system was making it impossible for smaller financial institutions in Mexico to participate in financial markets due to high reserve requirements and excessive borrowing costs.

**Solution**

Indeval built a new securities settlement system, adopting best practices from international settlement banks. Using optimization, the value of pending trades was maximized and securities transactions were settled in near real time.

**Benefits/ROI**

- $240 million USD in 18 months saved in borrowing costs for Mexican financial institutions
- 52% reduction in liquidity requirements for banks required for settlement
- 26% reduction in securities required for settlement

**Customer Profile**

Indeval, Mexico's central securities depository, settles over $250 billion USD in securities transactions per day.
Unit Commitment at Red Electrica de Espana
Managing power grids to balance generation with demand

Challenge
Red Eléctrica de España, in charge of managing the Spanish national power grid need to replace the approximate, heuristic methods it had been using for the last 20 years.

Power consumption must be balanced with generation, as power cannot be stored.

Solution
Optimization solutions from IBM provided operational advantages to REE’s managers and engineers enabling them to simplify all maintenance tasks and changes made to the model, thereby significantly reducing planning time and associated costs.

Benefits/ROI
- Reduced production costs by between €50,000 and €100,000 per day.
- Reduced its carbon emissions by approximately 100,000 tons of CO2 annually.

Customer Profile
Red Eléctrica is the sole transmission agent and operator of the Spanish electricity system. Its mission is to ensure the global functioning of the system guaranteeing at each moment the continuity and security of supply.
Major International Hotel Chain

Improve Profitability Using Revenue Management

**Challenge**

This major hotel chain needed to offer customers the right product from its room inventory, at the right time and for the right price.

Customers have different preferences for room accommodations and are willing to pay different prices for them.

**Solution**

**Mathematical optimization** is used to model and maximize the revenue that could realize based on pricing decisions tied to its available room inventory, while minimizing vacancies.

**Automatically sets prices daily** for each property, and conveys prices to reservation agents and its booking website, improving productivity of key management staff.

**Results**

- Maximized revenue
- Minimized room vacancies
- Improved customer satisfaction
- Now able to rapidly respond to market fluctuations and maintain profitability during recessions
- Increased revenue by $226M annually

**Customer Profile**

One of the largest hotel chains in the world with 4500 hotels and 650,000 rooms.

Over 130 million stays occur at this chain annually.
ILOG Optimization and Supply Chain Apps Offering

- LoB
- IT
- OR

- Scalable Enterprise Deployment
- Unique Customer Requirements
- Industry Assets
- Quick Deployment, Vertical Functionality

- CPLEX Optimization Studio
- Engines & Tools
- ODM Enterprise (ODME)
- Solution Platform

- LogicNet+ (LNP)
- Plant PowerOps (PPO)
- Transportation Analyst (TA)
- Inventory and Product Flow Analyst (IPFA)

- LogicTools Supply Chain Applications

- DB2
- WAS
- Visualization

- Middleware & Components
Importance of supply chain planning

The majority of a supply chain’s lifecycle costs are locked-in at the start.

Such “up-front” decisions include:

- Distribution network
- Inventory locations
- Supplier network
- Inventory levels
- Logistics suppliers

Source: AMR Research, BCI
Supply Chain Based Offerings

- **IBM ILOG LogicNet Plus XE** for network and sourcing optimization: location of facilities, assignment of stores, managing seasonality, and carbon footprinting. Value: 5-15% reduction in supply chain costs, better service to stores and for on-going multi-plant production sourcing and capital investment decisions. Value: enhanced S&OP capability, 2-5% reduction in manufacturing costs.

- **IBM ILOG Inventory and Product Flow Analyst** for enterprise multi-echelon inventory optimization and strategic analysis: integrated inventory planning within your ERP system. Value: 10-30% reduction in inventory costs, better fill rates. And of analysis to determine strategic shifts in your inventory policies and practices. Value: 25-50% reduction in inventory.

- **IBM ILOG Transportation Analyst** for transportation optimization: routing analysis, backhaul, mode selection, and fleet sizing. Value: 10-30% decrease in trans costs.