Operations Research in BASF's Supply Chain Operations

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Information Services & Supply Chain Operations is the business solutions provider for BASF Group

- Competence Center Information Services & Supply Chain Operations is one of the largest BASF divisions.

- We have
  - ~13,000 employees (including functional leadership)
  - ~800 factories
  - ~2,400 warehouses
  - ~400,000 articles

- We support BASF’s “We create chemistry” strategy with our three areas of core business – Information Services, Supply Chain Operations and Business Process Management.
Operations Research at BASF Supply Chain Operations consists of multiple organizational units

Scientific Computing

Conceptual Process Engineering

Supply Chain Strategy

Supply Chain Operational Design

Operations Research @ Supply Chain Operations

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Strategic, tactical and operational perspective of Operations Research

Quantitative decision support …

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<td>• network design (incl. investments, contractual conditions, etc.)</td>
<td>Water Household Optimization in Antwerp</td>
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<td>• value chain optimization (Verbund)</td>
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<td>• supply chain risk assessment</td>
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<td>Mid-term / Tactical</td>
<td>• sales &amp; operations planning</td>
<td>Supply Chain Early Warning System</td>
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<td>• business trend prediction for proactive SCM</td>
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<td>Short-term / Operational</td>
<td>• detailed planning &amp; scheduling</td>
<td>Detailed Planning &amp; Scheduling at a plant</td>
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<td>• online optimization</td>
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The water network of our Antwerp plant as strategic example

Settings:
- Water-consuming or -processing units require water which might be waste-water instead of fresh-water
- Treatment and processing units have limited capacities and are partly connected
- Contamination limits for outlet into the Schelde river have to be observed

Task:
- Minimize fresh-water-consumption

Solution:
- Mathematical model including a free network flow topology, pooling (nonlinear), selecting pipes, treatments, and capacities (discrete)
- Mathematical optimization (MINLP) minimizing overall cost

Strategic
Tactical
Operational
Supply Chain Early Warning system as tactical example of Operations Research (predictive analytics)

Planning perspectives

1 – 5 years
(SC) long term trends
Technological environment, future market trends, etc.

3 – 12 months
SC Early Warning Information
BASF customer industries, economic sectors

1 – 3 months
SC Operations, SC Planning
Material, customer level

Current situation
- Performance monitoring is looking backwards by concept
- Macroeconomic environment is not reflected systematically in SC planning
- Performance monitoring follows BASF’s organizational charts

Current situation
- Future oriented Inventory structures
- Higher Delivery Capability and flexibility
- Reduced supply chain costs

While classical planning is usually focusing on a detailed level, the early warning approach monitors the economic environment.
A statistical model forms the core of the Supply Chain Early Warning system

**Inputs**
- Historical sales
- Business knowledge
- Indicators

**Industry & Market Information**

**BASF Key Customer Industries**
- Consumer Goods
- Construction
- Energy & Resources
- Oil & Gas
- Transportation
- Health & Nutrition
- Agricultural Solutions
- Chemicals

**BASF Value Chain**
- Oil & Gas
- Chemicals
- Performance Products
- Function. Mat & Solutions
- Agricult. Solutions

**Statistical model**

**Outputs**
- Set of relevant indicators
- 3-9 months trend outlook
- Forecast accuracy

**Fully automated process:**
- Estimates trend and seasonal patterns by newly developed exponential smoothing approach with covariates
- Selects the most predictive indicators out of 500 indicators
Typical detailed planning & scheduling problem as operational example of Operations Research

Typical setting:
- Capacity: 50,000 – 80,000 t/a
- 200 products, > 500 articles
- Multi-stage production (15 reactors, 50 tanks plus special equipment, batch and continuous production)

Task:
- Maximum capacity utilization
- Fast rescheduling in case of changes

Solution:
- Synchronization of production stages
- Optimization integrated into SAP APO
Future topics for Operations Research in BASF’s Supply Chain Operations

- Multi-level, multi-product lot-sizing and scheduling with stochastic demand
- Robust supply network design
- Verbund design and collaborative planning between BASF business units
- Sustainable supply chains
- Current Operations Research tools lack flexibility, interfaces for plugging in individual solutions/extensions, etc.
Thank you for your attention