



Constraint-based network optimization

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Optimize

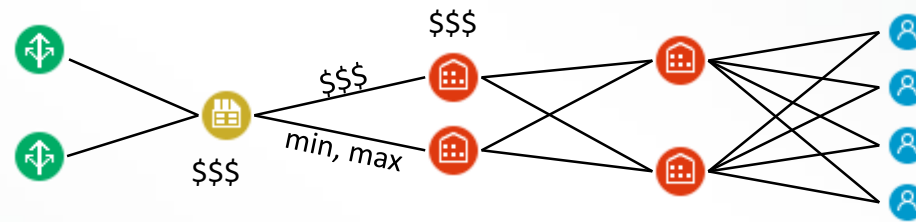
Design

Experiment

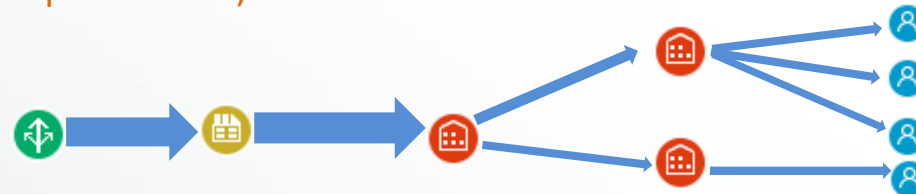
Innovate

Network Optimization

- Optimization models describe the supply chain as a set of all possible flows and facilities and corresponding constraints:

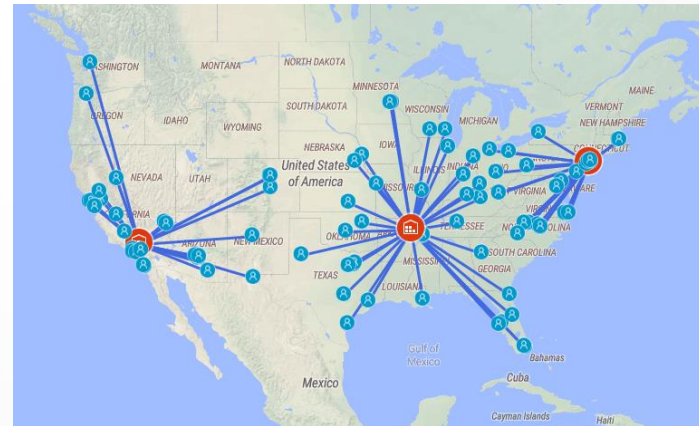


- The optimal solution is the best set of flows and facilities considering:
 - A profit maximizing objective
 - Adherence to all constraints (i.e. production)



Network Optimization

- Goal:
 - Find the “best” configuration of supply chain facilities and optimal flows in each period while considering the network structure and constraints from suppliers to customers
- Network Optimization uses the following information:
 - Demand
 - Locations of suppliers, customers, existing and potential facilities
 - Transportation Flows
 - Inventory Storages
 - Costs (DC fixed/variable & transportation)
 - Constraints
 - Time Periods
- Objective:
 - Maximize Profit



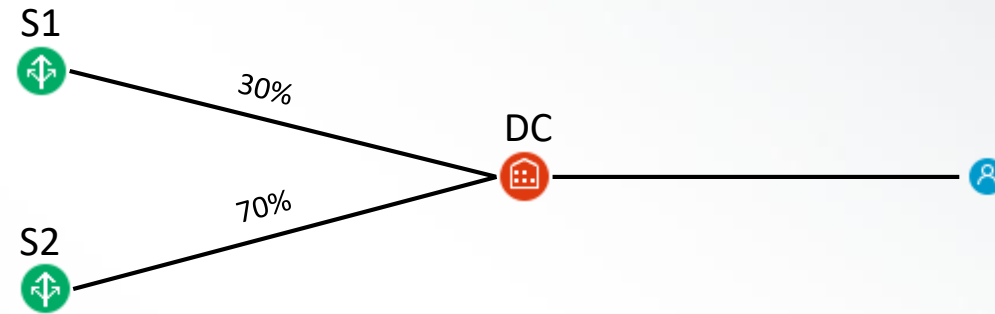
Business-specific requirements examples

- Two-step optimization
- Multi-sourcing
 - The optimal solution should maintain certain ratio between two suppliers
- Storage size defined as a percentage of incoming flow
 - E.g. Storage = 10% of incoming flow
- Storage size defined as a fixed value if a flow exists
 - If facility deals with the product storage size is 100

Two step Optimization

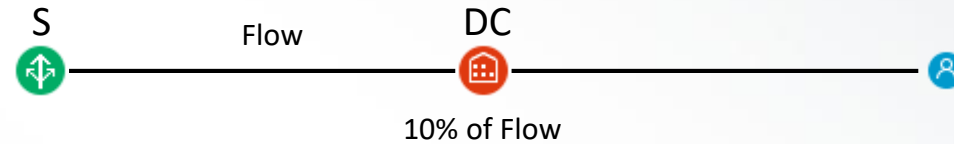
- Perform 1st optimization pass:
 - Objective function: Maximize Total Profit
- Identify Optimal Total Profit
- Define a Custom constraint:
 - Total Profit \geq Reasonable Profit level
- Perform 2nd optimization pass:
 - Custom objective function: Minimize CO2 emission

Multi sourcing



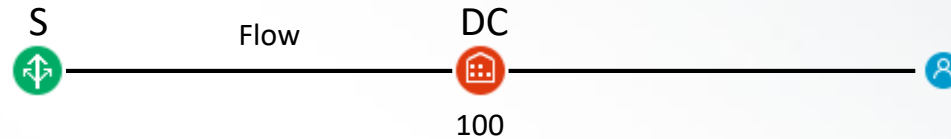
- Flows from different sources should adhere defined proportion
- The solution would be to label both flows and define a Custom constraint:
 - S1 -> DC Label: S1 Flow
 - S2 -> DC Label: S2 Flow
 - Custom constraint: $S1 \text{ Flow} = 0.3 * (S1 \text{ Flow} + S2 \text{ Flow})$

Storage as proportion of the flow



- DC should build stock equal to 10% of incoming flow
- The solution would be to label the Flow and Storage and define a Custom constraint:
 - S -> DC flow Label: In Flow
 - DC storage Label: DC Storage
 - Custom constraint: $DC\ Storage = 0.1 * In\ Flow$

Fixed Storage size if flow exists



- DC should build stock equal to 100
- Defining min Storage = 100 will force optimizer to have the flow
- The solution would be the following:
 - Binary variable: Flow exists = (0 | 1)
 - S -> DC flow Label: Flow
 - DC storage Label: DC Storage
 - Indicator Constraint: IF (Flow exists = 1) THEN (DC Storage = 100)
 - Indicator Constraint: IF (Flow exists = 0) THEN (Flow = 0)
- Linear ranges
 - $1 \leq \text{Flow exists} \leq 1$
 - $100 \leq \text{DC Storage} \leq 100$
 - $0 \leq \text{Flow exists} \leq 0$
 - $0 \leq \text{Flow} \leq 0$

Upcoming events



28 Aug anyLogistix Workshop at IFAC Conference MIM 2019 in **Berlin, Germany**

11 – 13 Sep anyLogistix Training in **Oakbrook Terrace, IL, USA**

15 – 18 Sep Council of Supply Chain Management Professionals in **Anaheim, CA, USA**

18 – 20 Sep ASIM Dedicated Conference in **Chemnitz, Germany**

21 – 23 Oct anyLogistix Training in **Paris, France**

24 – 26 Oct anyLogistix Training in **São Paulo, Brazil**