Overview of SAP IBP Supply Planning Algorithms and Criteria for Constraint Based Planning

Ram Halady, Karsten Schierholt, Pramod Mane, Sagar Deshmukh, SAP
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Agenda (60 min)

Criteria for choosing constraint based planning (10 min)
- Ram Halady

Overview of Supply Planning Algorithms available (20 min)
- Karsten Schierholt, Pramod Mane

Combined use of algorithms (10 min)
- Ram Halady

Use cases (10 min)
- Sagar Deshmukh

Q&A (10 min)
Criteria for choosing constraint based planning (Ram)
Criteria for constraint-based planning operator

Finite Heuristic prioritizes individual demand elements, one by one

- Pull-based Production
- Demand Priority and Pegging
- Demand Fairshare
- Assembly

Key Industries
- High-Tech, Telecomm, Consumer Electronics, Fashion, Machinery & Equipment Mfg, and Components, etc.

Optimizer plans entire network for right product mix, taking into consideration constraints and key objectives

- Pull and Push Production
- Demand Priority by Costs
- Asset Utilization
- Fairshare of Demand, SSkt and Max Inv
- Production Wheel
- Shelf-Life

Key Industries
- Chemical, Consumer Products, Mill Products, Oil & Gas, Food & Beverage, Distribution, Pharma, Life Sciences, etc.
Overview of Supply Planning Algorithms available (Karsten and Pramod)
**SAP Integrated Business Planning for Response & Supply**

**Overview of Key Planning Process and Capabilities**

**Unconstrained Planning (Demand Propagation)**
- Infinite time-series heuristic with finite supply propagation

**Prioritized demand fulfillment**
- Develop feasible supply plans and determine allocations and demand fulfillment

**Production and Distribution Optimization**
- Cost-based optimization to create global feasible supply plans

**Deployment**
- Create short-term distribution plans based on given supplies

**Built-in Integration**

**Alerting / Root Cause Analysis**

**Fair Share Distribution**

**Freeze Horizons**

**Manual Adjustments**

**Simulation**
Concept: Comparison of Planning Algorithms

**Priority Heuristics**
- Create a feasible plan by fulfilling the highest-priority demand first:
  - Constraint-based heuristic planning approach considering material and capacity constraints
  - Rules based matching of demand and supply based on priority
  - First feasible result is taken.

**Unconstrained Heuristic**
- Propagate demand through your network:
  - Run infinite heuristic (e.g. no capacity constraints, planning start date in past,...)
  - Plan end-to-end supply network with suppliers, factories and distributors
  - Multi level demand propagation from finished good to raw material level

**Infinite Heuristic Planning**
- Run infinite heuristic (e.g. no capacity constraints, planning start date in past,...)
- Plan end-to-end supply network with suppliers, factories and distributors
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**Finite Heuristic Planning**
- Constraint-based heuristic planning approach considering material and capacity constraints
- Rules based matching of demand and supply based on priority
- First feasible result is taken.

**Optimization**
- Create the BEST feasible plan:
  - Considers entire network at all levels simultaneously (production, distribution, procurement) to minimize total cost
  - Inventory balancing across the network
  - Looks for the optimal result.

**Complexity**
- (Comprehending results, Training aspects, Modelling solution)
Supply Planning Algorithms support Specific Capabilities in Time-Series and Order-Based Planning

**Time-Series Planning**
- Use if you need flexibility in supply chain modelling
- Support planning at aggregate level for tactical decisions
- Loose and periodic integration to source data

**Order-Based Planning**
- Use for operational planning with tight integration to execution system
- Result analysis using gating factors, supply usage and other tools
- Planned: real-time integration with backend

**Direction:** single combined data model for time series and order-based planning
Unconstrained Time-Series-Based Heuristic

The unconstrained supply planning heuristic creates an infinite supply plan without shortages in which all demands are fulfilled regardless of available supply.

The supply is computed based on the assumption that resource capacities are infinite, no component and no supplier constraints. Resources might be overloaded showing utilization of more than 100%.

An arbitrarily deep network of supply chain relevant locations (including customer) and production steps can be modeled.

Lead-times are considered as constraint and any manual adjustments by planner are considered.

The planning algorithm does not propagate constraints upstream. Rather it creates a shortage for the location product where a constraint occurs, which becomes visible to show unconstrained plan.

The generated plan is not feasible providing visibility into where there could be capacity and component issues in future buckets based upon demand.

Unconstrained Shelf life heuristic type available that considers the shelf life of products from demand and supply perspective.
The Priority Heuristic will plan individual demand elements, one by one prioritized by flexible demand prioritization rules.

The planning algorithm plans multi-level. Constraints like production capacity, supplier constraint, material availability and lead time are considered.

The planning algorithm selects highest priority source of supply first. In case of shortage or lateness secondary sources are used.

When used in order-based planning, the planning run writes order results and pegging. It identifies gating factors for faster resolution.
Order Based Planning: How does the Priority Heuristic support Infinite planning?

The Priority Heuristic will plan individual demand elements.

It can be configured to run infinite by using the switchable constraints. Each constraint type can be switched on or off. By switching off all constraints, including the planning start date, the algorithm will plan without restrictions, even into the past. The planning algorithm plans multi-level.

The planning run writes order results and pegging. It identifies gating factors for faster resolution.

Using constraint switches, the user can enable a smooth transition from infinite to constrained planning without disruptively changing the underlying algorithm.

Future backlog items will ease the use of the priority heuristics for infinite planning.
The optimizer enables cost-based planning. Independent of the use case, it always minimizes the total cost of the supply plan. During the optimizing process, it searches through all feasible solutions to find the most cost-effective one in terms of total costs.

A solution is feasible for the optimizer when it respects all the planning constraints, for example, the source of supply options and available resource capacities. A feasible solution can contain non-deliveries, that is, not fully satisfied demands, safety stock constraint violations, or violate other constraints.

The most prominent costs are the ones for the source of supply decisions (production, transportation, and procurement) and the non-delivery costs for demands.

The output is a feasible production, distribution, and procurement plan for the selected supply chain network.

When used in order-based planning, the planning run writes order results and pegging.
Comparison of Deployment Algorithms

Deployment Finite Heuristic

- Business Objective:
  Fullfillment of demand based on priorities
- Used for business scenarios where demand exceeds supply (pull deployment)
- Fast and scalable execution
- Easy explanation of results

Deployment Optimization

- Business Objective:
  Network optimization based on costs
- Optimization determines the optimal solution based on predefined costs for supply alternatives and demands
- Network cost model can be flexible defined to support different business scenarios including push and pull deployment
- Complexity of network and constraints impacts on runtime and scalability
Combined use of algorithms (Ram)
Examples of Combined Use of Algorithms (1)
Use of Infinite Heuristic as first step

1a. Large number of networks w/ Promo Kits, Display Sets

Supply Heuristics (Infinite)
- Run first separate Subnetwork assigned to all Kits – generate demand for components belonging to different network – Fix this for Optimizer steps

Supply Optimization
- Priority established for dependent demand from the +1 network – Key assumption is that this is small compared to primary demands in each N network

1b. Understand true network dependent demands for KPI

Supply Heuristics (Infinite)
- Run first Heuristic for entire network, and save dependent demand and other desired KF for reporting and KPI

Supply Optimization
- Compare post-optimizer to unconstraint vs. constraint fulfillment KPI – consider cumulative rather than bucket by bucket to not miss prebuilds

1c. Fairshare Additional Safety Stock

Supply Heuristics (Infinite)
- Calculate additional safety stock to be planned based on Lot Size Policy – fold this into either target inventory or Max Inv – remove subperiods of supply

Supply Optimization
- Fair share does not apply to additional safety stock directly. Making it part of target inventory or Max inventory minimizes stockouts or rebalancing
Examples of Combined Use of Algorithms (2)
Additional examples of Shelf-Life and Customer Demand Management

2. Manage SL and Wastage

**Stock Propagation Heuristics (Shelf Life)**
- Run in separate PA
- Additional configuration to trap expiration and wastage

**Supply Optimization**
- Copy Wastage into Inventory Correction (-ve values)
- Supply planning proactively recognizing expired stock – resell or dispose wastage

**Stock Propagation Heuristic – planned for 2021***
- Match stocks to demands requiring Min SL
- Match Firm Supply to remaining demands w/Min SL

**Supply Optimization**
- Network optimization considering class of service or channels – Fairshare of demand and target inv
- Fairshare to model dependent demand to nodes with varying lead times

3. Manage Customer-facing constraints or Visibility

**Response Management**
- Use Supply Plan from Optimizer as fixed
- Determine allocations and/or confirm orders – publishing may be optional
- Publish allocations to S/4 or APO-GATP for execution

**Supply Optimization**
- Define in same PA – expand planning level
- Run as a pre-step w/ Optimizer or run by itself
Examples of Combined Use of Algorithms (3)

Use Case – Use Optimizers in different versions/PA for different planning needs and cycles

4. Use Optimizers for different planning needs in different versions or Planning Areas

Tactical Planning
- Network optimization for Tactical Planning and What-if Simulations
- Capacity Leveling

Operational Planning
- Operational Production Planning – Granular constraints
- DRP Plan – for projected stocks at destinations
- External Procurement Plan e.g. Raw and Packaging Materials

Deployment Planning
- Use Supply i.e. Use fixed Production Plan from previous Optimization
- Plan Deployment in Daily buckets – Fair Share for Demands and Target Inv
- Manage Lane Volumes and Constraints
Customer Use Cases (Sagar)
Supply Chain Data Model

- Supplyer
- Distribution Center (regional)
- Distribution Center (local)
- Customer
- Manufacturing

Master Data
- Product
- Location
- Customer
- Vendor
- Resource
- Master Recipes
- BOM
- Capacity

Transaction Data
- Planned Orders
- Process Orders
- Sales Orders
- Shipments
- Inventory
- PIR

Constraints – Business Rules
- Demand trade-off considerations
- Network-level source determination
- SKU-level constraints
- Capacity Constraints
- Material availability constraints
- Aggregate Planning Hierarchies
- Changeover Minimization

Output

Aggregate Level

Constrained Demand (Bucket Level)

Capacity Utilization

Projected
- Inventory
- Safety Stock
- Stock Out

Cross Network Production plan, Distribution Plan, Procurement Plan

Customer Use Case 1
Initial Design - Supply Planning With Optimizer

### Constraints – Business Rules
- Demand trade-off considerations
- Network-level source determination
- SKU-level constraints
- Capacity Constraints
- Material availability constraints
- Aggregate Planning Hierarchies
- Changeover Minimization

### Master Data
- Raw Materials > 3 weeks
  - All Lines
  - Increased horizon and discretization to 92 W

### Transactional Data

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### Output
- **Aggregate Level**
  - Constrained Demand (Bucket Level)
  - Capacity Utilization
  - Projected
    - Inventory
    - Safety Stock
    - Stock Out

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### Cross Network
- Production plan,
- Distribution Plan,
- Procurement Plan

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### OBP Deployment Heuristic Optimizer
- Single Subnetwork

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### TSOptimizer
- Output
  - Deployment Plan

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Final Design – TS Optimizer, Finite Heuristic and Deployment

**Constraints – Business Rules**
- Demand trade-off considerations
- Network-level source determination
- SKU-level constraints
- Capacity Constraints
- Material availability constraints
- Aggregate Planning Hierarchies
- Changeover Minimization

**Master Data**
- Raw Materials > 3 weeks
  - All Lines
  - Increased horizon and discretization to 92 W

**Transactional Data**

**Output**
- Deployment Plan

**Aggregate Level**
- Constrained Demand (Bucket Level)
- Capacity Utilization
- Projected
  - Inventory
  - Safety Stock
  - Stock Out

**TS Optimizer @ Finished Goods Subnetwork**

**TS Finite Heuristic @ Semi-Finished & Raw Material**

**OBP Deployment Heuristic/ *Optimizer**

**Output**

- Aggregate Planning Hierarchies
- Changeover Minimization
- Production plan, Distribution Plan, Procurement Plan

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Customer Use Case 2

Supply Chain Data Model

- Supplier
- Distribution Center (regional)
- Distribution Center (local)
- Customer
- Manufacturing

Constraints – Business Rules

- Demand prioritization
- Alternate sourcing
- Capacity Constraints
- Material availability constraints
- Push production
- Pegging
- Fair Share

Master Data

- Product
- Location
- Customer
- Vendor
- Resource
- BOM
- Capacity

Transaction Data

- Planned Orders
- Production Orders
- STOs
- POs
- Deliveries
- Inventory
- PIRs

Output

Aggregate Level

- Constrained Demand (Bucket Level)

Capacity Utilization

- Projected
  - Inventory
  - Stock Out

Production Plan,
Distribution Plan,
Procurement Plan

Gating Factors

Customer Use Case 2

- Inventory
- Stock Out
Supply Planning With OBP Heuristic & OBP Deployment Optimizer

Constraints – Business Rules
- Demand prioritization
- Alternate sourcing
- Capacity Constraints
- Material availability constraints
- Push production
- Pegging
- Fair Share

OBP Heuristics

Master Data

Transactional Data

Output
- Constrained Demand
- Production Plan, Distribution Plan, Procurement Plan
- Projected Inventory Gating Factors
- Capacity Utilization

OBP Deployment * Optimizer

Output
- Deployment Plan

*Planned
Q&A
Useful links

SAP IBP Help: [Getting Started with Time-Series-Based Supply Planning](#)

SAP IBP Help: [Recommendations for Making Your Start with TS Planning Easier](#)

SAP IBP Help: [How Order Based Planning Works](#)

Webinar [Wiki]: Upcoming webinars on Synchronized Planning, Deployment, OBP Optimizer

SAP Note [2907554]: Optimization in S&OP

SAP Note [2238074]: Additional information on supply planning (look for the attachments)

SAP IBP Training courses: [Learning journey](#), [IBP 700: TS Optimizer](#)

Webinar on IBP Training courses [PDF](#) | [Recording](#) | [FAQ](#)
Thank you.

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# Current Coverage: Time-Series and Order Based Planning

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1) Supports TS shelf life planning in conjunction with subsequent Optimizer run
2) Infinite planning using priority heuristics with constraints switched off (switchable constraints)
3) Demand and sources of supply priorities derived from cost
4) Excluding response planning
5) Forecast Consumption used as pre-processing step for any of the planning processes
6) Even with engine re-use, the applications enable different capabilities as of today (e.g. aggregated constraints, calendars)