Planning Results Validation - SAP IBP for inventory

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What Problems Are We Solving?

Business Volatility

Today, companies face increased supply chain risk due to economic uncertainty, escalating customer expectations, demand volatility, and supply variability.

Outcomes of Business Volatility:

- High or uncontrolled inventory levels.
- Inadequate customer service levels or inventory availability.
- Multiple planning and inventory target setting processes.
Customer Challenge
Eliminate excess inventory and improve service

- Deploy inventory across the supply chain.
- Meeting service level objectives at the lowest cost.

But, achieving challenges is not easy!
What Makes This Difficult to Do ...

Suppliers

Customers

Business Volatility and Variability

Supply Chain Complexity
### What Makes This Difficult to Do ... (cont.)

**Supply Chain**
- How much inventory do I need at my Manufacturing location?
- How much inventory do I need at my Distribution Center?

**Demand**
- Service level targets
- Forecast
- Forecast error
- Consistently over/under forecasting (bias)
- Intermittent demand
- Outlier sales or forecasts
- Multiple service levels and inventory thresholds
- Seasonality/promotions
- Internal and external demand

**Supply**
- Lead times
- Lead-time uncertainty
- Internal service levels
- Schedule attainment variability
- Production/distribution batch sizes
- Supply reliability
- Capacity restrictions
- Frozen production/planning periods
- Multiple supply sources
What Is Required for Inventory Planning?

<table>
<thead>
<tr>
<th>The real world is …</th>
<th>It is not …</th>
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<tbody>
<tr>
<td>Stochastic (variable, unpredictable)</td>
<td>Deterministic (if ( \ddagger ) then)</td>
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<tr>
<td>Multistage</td>
<td>Isolated Single Stage</td>
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<td>Time Varying</td>
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<td>Comprehensive Data Model</td>
<td>Multiple, Limited Data Models</td>
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<td>Enterprise Scale</td>
<td>Desktop Scale</td>
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<td>Dynamic &amp; Integrated (Online)</td>
<td>Static &amp; Offline Analysis</td>
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### Top Signs That Your Inventory Planning Process Needs an Upgrade

- Lower than expected customer service levels
- Too much working capital tied up in inventory
- Large write-offs for slow and obsolete inventory
- Customer service not a formal corporate planning objective but an outcome of the planning process
- Inability to respond to changes in demand or supply
- Infrequent planning cycles
- Absent scenario planning or what-if analysis capabilities
- Planning focused on reactive tasks
SAP Digital Supply Chain Management Strategy

Real-Time Business Processes

Plan
Respond
Deliver
Operate

Design
Produce

End-to-End Supply Chain Business Processes

Agility & Speed
Real-time Collaboration
Flexibility & Scalability

Real-time Data

Machines / Sensors / Devices
Plan and Respond with
SAP’s Integrated Business Planning Solution

Supply Chain Control Tower
Exception Handling and Business Network Collaboration

Sales & Operations
Strategic and Tactical Decision Processes

Demand
Statistical Forecasting, Consensus Planning & Demand Sensing

Inventory
Multi-Stage Inventory Optimization & DDMRP

Response & Supply
Allocations & Deployment Planning, Order Rescheduling
Unconstrained & Constrained Supply Planning

SAP HANA

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Flexibility, Scalability and Harmonization

All modules run on the same data model with no need for data transformations

Enables frequent and integrated planning cycles on all levels and across all areas
Unified User Experience

Browser-based WebUI
- Real-time insight & monitoring
- Exception handling / alerts
- S&OP Process & Task Management
- Model Configuration
- Job Scheduling

IBP Add-In for Microsoft Excel
- Real-time insight & monitoring to analyze the data
- Advanced planning and data management
- Real-time what-if scenario simulations
- Master Data Management

SAP JAM
- Embedded social collaboration platform
- Exchange ideas
- Keep all stakeholders informed about the latest activities
- S&OP Task Management

Planners and Business Users
Administrators
Consultants
SAP Integrated Business Planning for inventory

**Multi-stage Inventory Optimization**
Use less inventory to buffer more risk, with multi-stage optimization

**Robust Statistical Models**
Proven algorithms provide significant improvements over textbook calculations

**Embedded Analytics**
Visualize your Supply Chain Network and quickly gain insights into inventory drivers

**Buffer Forecast Error and Demand Risk**
Buffer against forecast error and other demand-side uncertainty, to support your demand-driven supply chain

**Efficiently Master Supply Uncertainty**
Buffer supply uncertainty most efficiently by considering late deliveries as well as other uncertainties in the supply chain

**Manage Exceptions**
Focus planners on problem materials and identify opportunities for improving the root causes of inventory

**What are the benefits?**

- Improve customer service levels
- Maximize the efficiency of inventory and working capital
- Standardize and simplify the inventory target-setting process at each tier within the supply chain to feed operational plans
What does IBP for inventory accomplish for the end to end supply chain?

Achieve the Right Balance Between Service Levels and Inventory Investment

Fix the Mix of Inventory!
Multistage Inventory Optimization

Inventory Optimization simultaneously optimizes inventory across the entire supply chain based on meeting customer service requirements with the lowest amount of inventory dollars.

Single Stage Calculations:
Isolated planning results in over-buffering of inventory across the supply chain.

Multistage Optimization:
Coordinated planning eliminates over-buffering of inventory and ensures services objectives are met.
Inventory replenishment and components

- **Safety Stock**
- **Cycle Stock**
- **Pipeline Stock**

- **Target Inventory Position**
- **Periods Between Reviews**
  - Period 1
  - Period 2
  - Period 3
  - Period 4

- **Lead Time**

- **Average On Hand**

- **On Order**
- **On Hand**
- **Order Received**
- **Review/Order Placed**
Comprehensive data model for Supply Chain

<table>
<thead>
<tr>
<th>Master Data</th>
<th>Manufacturing/Process Data</th>
<th>Uncertainty Data</th>
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<tr>
<td>Item-Locations</td>
<td>BOMs</td>
<td>Forecast error/std deviation</td>
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<tr>
<td>Inventory unit cost</td>
<td>Yield</td>
<td>Total lead time std deviation</td>
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<tr>
<td>Units of measure</td>
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<td>Attainment loss % and std dev</td>
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<td>Holding cost percent</td>
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<td>Source reliability</td>
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<td>Currency</td>
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<td>Pooling factor</td>
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<td>Planning Unit (sub-networks)</td>
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<td>Average demand interval</td>
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<th>Replenishment Planning Data</th>
<th>Transactional Data</th>
<th>Optimization Data</th>
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<tr>
<td>Forecast demand mean</td>
<td>Historical sales</td>
<td>Internal Service Level</td>
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<tr>
<td>Aggregations to attribute categories (product group/family i.e.)</td>
<td>Historical Forecasts</td>
<td>Average expedite</td>
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<tr>
<td>Review frequency (order cycle)</td>
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<td>Safety stock</td>
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<td>Total mean lead time</td>
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<td>Safety stock drivers</td>
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<td>Physical lead time</td>
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<td>Processing lead time</td>
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<td>Vendor lead time</td>
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<td>Target service level</td>
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<td>Minimum batch size</td>
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<td>Incremental batch size</td>
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<td>Sourcing fractions/quotas</td>
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<tr>
<td>Minimum stocking requirement</td>
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<td>Minimum/maximum internal service level</td>
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<th>Scenario Analysis and versions</th>
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<td>Service Levels</td>
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<td>Lead Times</td>
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**Bold** = Basic input  
**Italics** = Additional input  
**Blue** = Time-varying input
Comprehensive outputs across locations and purpose of inventory

Safety Stock Drivers:
- Demand
- Demand uncertainty
- Lead times
- Lead time uncertainty
- Review frequency
- Service level targets
- Service times

Cycle Stock Drivers:
- Demand
- Review Frequency
- Batch Sizes
- Production Rules

Pipeline Stock Drivers:
- Order Processing lead times
- Transit times
- Demand

Pre-Build Stock Drivers:
- Time-varying capacity
- Time-varying demand
- Sourcing ratios
- Changes in safety stock
How does SAP IBP for inventory support scalability?

**Planning Units (Subnetworks)**
- Inventory planning operators support the use of planning units (subnetworks).
- Users can separate/filter the whole network either by region and/or product family into planning units, so they could run them separately.

**Planning Horizons**
- Users can define planning horizon parameters for inventory optimization planning operators.
- This feature supports cases where users desire to use: (1) planning horizons different than the standard Planning Area planning horizons and, (2) apply different planning horizons at the planning unit level.
Consider a Design for Best-In-Class Inventory Planning Process

- **Inventory planning ownership** - Centralized *over* Decentralized inventory planning team

- **Frequency of the inventory planning cycle** – Agile *over* Infrequent

- **Inventory targets review process** – Standardized work and online templates *over* Ad-hoc offline spreadsheets
  - Validate data inputs
  - Review inventory plan
  - Assess drivers of inventory
  - Update inventory plan
  - Perform what-if analysis requests

- **Inventory planning collaboration** – Centralized CoE team supporting end users *over* Black box tools
  - Report planning decisions to end users and engage regional teams with planning questions
  - Respond to what-if analysis requests from end users

- **Inventory performance review** – Formal ownership of inventory health metrics *over* reactionary metrics
  - Review historical inventory performance key performance indicators
  - Review projected inventory KPIs
Inventory Optimization
Mature Solution moving towards Strategic Inventory Management

Components of a Strategic IO Mgmt

- Service Level Optimization
- Optimization based on budget constraints
- Product Lifecycle Management

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Safety Stock Validation Steps

Aggregated Safety Stocks
- Check Safety Stocks and Safety Stock Changes grouped by Business Units/Geographies/Product Lines etc.

Safety Stocks at Item-Location Level
- Identify exceptions using Alerts and changes from last run
- Check safety-stocks at item-location level for the exceptions identified

Safety Stock Components
- Demand Variability Safety Stock
- Supply Variability Safety Stock
- Service Variability Safety Stock
- Zero Lot Size Additional Safety Stock

Identification of Inputs Impacting Safety Stocks
- Target Service Level
- Forecast
- Forecast Error CV
- Lead Time
- Lead Time Errors
- Lot Sizes
- Holding Cost
Aggregated Safety Stocks

Recommended Safety Stock Volume projection by DC (end of current quarter)

- **EU DC Rotterdam**: 6.92K
- **APJ DC Hong Kong**: 9.09K
- **AME DC Seattle**: 22.78K

Location ID
Safety Stocks by Product

Recommended SS by Product: Level 1 Chart Name

Recommended Safety Stock

IBP-200 - IBP-200: 1.43K
IBP-210 - IBP-210: 3.38K
IBP-220 - IBP-220: 1.10K
IBP-300 - IBP-300: 1.18K
IBP-310 - IBP-310: 798.97
IBP-320 - IBP-320: 1.20K
IBP-330 - IBP-330: (not visible)

Location ID / Product ID

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Demand Variability Safety Stock Drivers

- Forecast
- Forecast Error CV
- Lead Time
- Periods Between Review
- Target Service Level
- Lot Size
Supply Variability Safety Stock Drivers

- Lead Time
- Lead Time Error
Forecast and Target Customer Service Level (CSL)

Text Book Formula*: Safety Stock = z \times \sigma \times \sqrt{(LT + PBR)}

- LT is the Lead Time, PBR is the Periods Between Reviews
- LT + PBR is referred to as the ‘Exposure Period’
- z is the multiplication factor corresponding to service level target
- \sigma is forecast error
- \sigma = Forecast Demand * Forecast Error CV

If Future Forecast increases, Safety Stock increases
If Customer Service Level target increases, Safety Stock increases

*This simple formula is only valid for single-stage, normal forecast error and non-stockout probability service level metric. IBP does not rely on simple relationships or rules-of-thumbs but on a complex supply chain model and mathematical optimization to find the lowest-cost inventory targets that meet customer service levels.
Forecast Error CV

Forecast Error is determined by the by:

- Comparing historical forecast and sales data.
- Calculating variability at the planning period length granularity
- Incorporating intermittency, seasonality, forecast bias, forecast lag, outliers

Traditional Best-Fit Approaches are based on historical sales only and ignore historical forecasts

Traditional Approach: Demand Variability CV = 1.05
IBP Approach: Forecast Error CV = 0.32

Black Line – Forecasts; Blue Dots – Actual Sales

If Forecast Error CV increases, Safety Stock increases
Service Level Type

Service Level Type can be Fill Rate or Non-stockout Probability

**A - Available in Full (Non-stockout probability)**

Percentage of time that demand in a period is *completely* satisfied

Safety stock calculations numerically integrate relatively simple “Yes / No” function under the probability density function

**F - Fill Rate**

Percentage of demand in a period that is satisfied on average

Safety stock calculations numerically integrate relatively complex “Proportion” function under the probability density function
Periods Between Review - PBR

Periods Between Review (PBR) - For a given item at a given location, PBR is the frequency at which shipments of that item are received from upstream locations. In other words, it is an average order frequency.

For example, a PBR of 3 weeks means that on average, a replenishment order is placed (and received) every 3 weeks. PBR cannot be null / fractional.

If PBR increases, Safety Stock increases*

*If Service Level is Non-Stockout Probability, Safety Stock will increase; if Service Level is Fill Rate and set at low value and if the forecast variability is low there might situations where Safety Stock will decrease
Lead Time

Lead Time in IBP is defined as the lead time from the immediate upstream node. It is not the cumulative lead time. Lead Time may be the production lead time at plant or the transportation lead time between two locations.

If Lead Time increases, Safety Stock increases.
Lead Time Error

Lead Time Error is the statistical measure of uncertainty regarding the magnitude of expected lead time in a given period. It defaults to zero if not populated.

If Lead Time Error increases, Safety Stock increases
Lot Size defines the quantity that has been agreed-upon between the upstream and downstream nodes.

Lot Size can be used either in the context of production of shipment. In production, lot size refers to the production lot size. In shipment, it refers to the agreed upon shipment quantity between two locations.

In IBP we enter a Minimum and an Incremental Lot Size

If Lot Size increases, Safety Stock decreases

Zero Lot Size Additional Safety Stock output tells us the Additional Safety Stock that would have been present if there was no lot size
Holding Costs

Holding Cost = Unit Cost * Holding Cost Percentage

Unit Cost defines the actual value of a unit of inventory at a given stocking point.

Holding Cost Percentage defines the annual cost of holding inventory at a given stocking point as a percent of unit cost. Holding cost (unit cost * holding cost percentage) typically increases as you move towards downstream in the supply chain.

If Holding Cost increases at a given node, incentive to carry safety stock at that node decreases. Relative difference in holding costs across stages decides the positioning of inventory.
Service Variability Safety Stock Drivers

Internal Service Level of Upstream Node

Depends on

Lot Size

Lead Time and Lead Time Error

Holding Costs
Capturing Interactions Between Stages

In multi-stage supply chains, stages are all linked together.

Orders placed by the customer-facing node create demand for product upstream.

Upstream service level have an impact on ability to meet service level downstream.

Multi-stage models allow the internal service level of the upstream stage to be modeled at the downstream stage and ensure that service level targets are met.
Two-Stage Example: Internal Service Level Impact on Safety Stock Costs

Holding cost at CF = $2, WH = $1

- Increase of 8 units of safety stocks due to internal service level
- Internal Service Level Causes Shortages of 4 ± 16 units

- PBR=1
- ISL=90%
- LT=1
- Demand = 100 ± 50

- SS=111 units
- Cost=$111

- PBR=1
- SL=95%
- LT=2

- SS=124 units
- Cost=$248

Optimal ISL = 0.72

Total Cost = $359
Achieved Service Level = 95%
Thank you. Q&A.

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