SAP Enterprise Inventory Optimization (EIO) by SmartOps

Multistage Inventory Optimization, Supply Chain “Intuition Building”
April, 2013
Introductions

SmartOps

Leon Dixon, Director, Education Services

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Instead of this…
Supply chain complexity has exploded and is now the price of admission in today’s global market
EIO establish a global inventory policy and provides visibility into the drivers of inventory
Even for one site...
...things rarely go exactly as expected on the demand side

**Demand Factors**

- Simultaneous internal and external demand
- Forecast error
- Seasonal, time-varying demand
- Multiple service levels and inventory thresholds
- Intermittent demand
- Over- and under-forecasting
- Outliers
- Multiple forecast lags
- Consideration of recent forecast process changes
…nor do things go exactly as expected on the supply side

Supply Factors

- Batch size requirements
- Lead time uncertainty
- Schedule attainment
- Reliability
- Supply quantity limitations
- Storage Quantity Limitations
- Time-varying Bills of Material
- Frozen forecast windows
- Multiple supply sources
- Seasonal supply sources
Now take all those uncertainties…
...and multiply!

Inventory decisions at every point in the enterprise-wide supply chain are linked.

Traditional systems ignore this complexity.
...and multiply! ... So what?

Inventory decisions at every point in the enterprise-wide supply chain are linked.

Traditional systems ignore this complexity. ERP and APS systems (APO) handle difficult “Deterministic” math:
If XX Demand, then YY supply, run through the BOM, costed appropriately, production planned, items shipped, sold, invoiced, financials run, and HR handled…

(Chances are, you already know what ERP systems do!)

SmartOps handles “previously impossible” Stochastic Multi Stage Optimization:
- Quantifies and Analyzes Risk, Variability, and Uncertainty (stochastic)
- Considers Customer Service Levels and Profit Objectives (enterprise scale)
- Optimize Service Levels and Inventory Targets across the supply chain (multi stage)

All at the item-location-time period level of granularity, linked to ERP/APS systems, while providing Management level, roll-up Analytics for root-cause improvements
EIO Delivers Ongoing Benefits Through A Sustainable Process

Enterprise Inventory Optimization

- Synchronized with ERP/APS/BI
- Scalable J2EE, Oracle architecture
- Integrated into planning processes

Time-phased inventory targets across all items and locations

Analytics provide visibility into drivers of supply chain variability

What-if simulation capabilities for continuous improvement
EIO Calculates Optimal, Time-Phased Inventory Targets for All Items and Locations...
... Automatically Feeding Inventory Targets to ERP or SNP
Traditional methods oversimplify inventory planning, wasting resources and placing your business at risk

Oversimplified Supply Chain Planning

- Single-Stage Logic
- Ignore Variability
- Improperly Characterize Uncertainty
- Insufficient Granularity
- Infrequent Updates
- Constant Inventory Targets
- Simplified Data Models

If supply chain complexity and uncertainty are not addressed, your business will over-buffer inventories and miss sales
EIO delivers tangible, near-term, and sustainable value

**Improve Customer Service Levels**
- 5-10% increase in order fill rates and on time delivery
- 30-50% reduction in out of stocks and order lead time variability

**Reduced Inventory & Working Capital**
- 15-30% reduction in inventory and working capital
- 20-40% reduction in inventory carrying and obsolescence costs

**Improve Planner Productivity**
- 20-30% reduction in time used in expediting
- 10-20% reduction time spent on manual inventory planning processes

**Reduced Production & Distribution Costs**
- 10-20% reduction in PPE and depreciation due to excess storage facilities
Session Goals

Learning experience

- Understand SmartOps approach to EIO and Analytics
- Quantify benefit of simultaneous multistage inventory optimization
- Build intuition on impact of some key drivers on inventory targets
- Discuss SmartOps best practice recommendations on measuring and managing uncertainty
Agenda

Introduction

Heads-On Training

- Fundamentals and Uncertainty
- Multistage Concepts
- Demand Uncertainty
- Supply Uncertainty
- Key Inventory Factors

Review
Seven Muda, or “Seven Deadly Sins in Lean”

1. Defects / Quality
2. Transportation
3. Motion
4. Waiting
5. Overproduction
6. Over Processing
7. Inventory
Seven Muda, or “Seven Deadly Sins in Lean”

1. Defects / Quality
2. Transportation
3. Motion
4. Waiting
5. Overproduction
6. Over Processing
7. Inventory

- Strategic Decisions
- Tactical Choices
- Risk and Uncertainty
Enterprise Inventory Optimization

**Inventory** is the consequence of many different strategic and tactical choices across the organization

**Inventory Optimization** is the science of making these choices more rational, more profitable, and automatic

**Enterprise Inventory Optimization** is the encapsulation of these algorithms into software that integrates into planning systems and handles large-scale, complex supply chains
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Review
Remember this guy
Inventory Components

**Cycle Stock**
Needed to meet current demand until the next order can be placed

**Pipeline Stock**
Needed to meet *future* demand until the next order can be received

**Pre-build Stock**
Needed to anticipate demand peaks greater than capacity

**Minimum Required Stock**
Needed to satisfy strategic marketing or merchandising requirements

**Safety Stock**
Needed to hedge against risk and uncertainty
Inventory Review and Order Process

- The right Target Inventory Position depends on
  - Inventory needed to meet current period demand
  - Inventory needed to meet future demand until next order is received
  - Inventory needed to hedge against uncertainty
Classical Formula For Computing Safety Stock

- Planning for one product/one location/one period with instantaneous lead time, and the *only* uncertainty in the Supply Chain is Demand Uncertainty
- Forecast: 100 +/- 25, Forecast Error Distribution: Normal
- Service Level Target: 95% Non-stockout probability
- Classical Formula: Safety stock = $z\ (95\%) \times \sigma = 1.64 \times 25 = 41$
- Target Inventory Position = 141 units, Safety Stock = 41 units
Forecast Standard Deviation Impacts the Width of the Distribution

Service Level Target: 95% Non-stockout probability

\[ z \ (95\%) = 1.64 \]

Forecast: 100 +/- 25

Forecast: 100 +/- 10
Computing Safety Stock With Gamma Distribution

- Planning for one product/one location/one period with instantaneous lead time, and the only uncertainty in the Supply Chain is Demand Uncertainty
- Forecast: 100 +/- 25, Forecast Error Distribution: Gamma
- Service Level Target: 95% Non-stockout probability
- Safety stock requires numerical integration of the Gamma curve = 45 units
- Target Inventory Position = 145 units, Safety Stock = 45 units

Filled area represents 95% of total
Safety Stock Usage

TIP

SS

How Often ??

How Often ??

S

LT=0

CF

PBR=1

C

NSP 95%

100 +/- 25
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Review
Multi-stage Inventory Optimization

Inventory Optimization is the science of calculating inventory targets
• to meet desired service goals
• at the lowest total inventory cost possible
• across the entire supply chain at the same time

Inventory Optimization is an essential step in Supply Chain Planning
• Targets are calculated at the item-location-period granularity
• Inventory targets fill the gap between planning and execution by providing planning parameters for APS systems
So, Back to this guy...

Single-stage supply chain, with multiple Demand and Supply uncertainties.
It’s a Small Piece of the Larger Problem

Inventory decisions at every point in the enterprise-wide supply chain are linked.
Inventory at each node can and should impact inventory decisions at other nodes
Tandem or Series Supply Chain

- Simplest model
- Node vs Stocking Point
- Single vs Multi-Stage (Echelon)
- Upstream vs Downstream
- “Pull” and demand propagation

- Calculation (single stage)
- Optimization (multi stage)
Multi-Stage Dilemma

Customer-facing (CF) node satisfying external demand
- Service Level is 95% (NSP)
- Forecasts are moderately good

Internal warehouse (WH) staging inventory
- Holding cost is half as expensive as CF

How should we allocate safety stock buffers across the stages?

Customer-facing (CF) node satisfying external demand
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Multi-Stage Dilemma

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Internal warehouse (WH) staging inventory

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How should we allocate safety stock buffers across the stages?

1. As much as possible to WH
2. Shared, more to WH
3. Shared, more to CF
4. As much as possible to CF
5. I have no earthly idea

Demand = 100 +/- 50
Multi-Stage Dilemma

Customer-facing (CF) node satisfying external demand
- Service Level is 95% (NSP)
- Forecasts are moderately good

Internal warehouse (WH) staging inventory
- Holding cost is half as expensive as CF

How should we allocate safety stock buffers across the stages?

Different stages should optimally share the risk
- Propagate demand from downstream to upstream
- Model the impact of internal service level (ISL) decision of the upstream stage at the downstream stage

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- Service Level is 95% (NSP)
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Internal warehouse (WH) staging inventory
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How should we allocate safety stock buffers across the stages?

Different stages should optimally share the risk
- Propagate demand from downstream to upstream
- Model the impact of internal service level (ISL) decision of the upstream stage at the downstream stage
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 problems make it more difficult 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.
Multi-stage Example

Two Single Stages

- WH
  - LT=2
  - PBR=1, ISL=99.9%
  - SS=267 units, Cost=$267

- CF
  - LT=1
  - PBR=1, SL=95%
  - Demand = 100 +/- 50
  - SS=116 units, Cost=$232

Total Cost = $499
Achieved Service Level = 95%

Two Single Stages

- WH
  - LT=2
  - PBR=1, ISL=90%
  - SS=111 units, Cost=$111

- CF
  - LT=1
  - PBR=1, SL=95%
  - Demand = 100 +/- 50
  - SS=116 units, Cost=$232

Total Cost = $343
Achieved Service Level = 93%

Cooperative Multi Stage

- WH
  - LT=2
  - PBR=1, ISL=90%
  - SS=111 units, Cost=$111

- CF
  - LT=1
  - PBR=1, SL=95%
  - Demand = 100 +/- 50
  - SS=124 units, Cost=$248

Total Cost = $499
Achieved Service Level = 95%

Decrease of 156 units of safety stocks

Increase of 8 units of safety stocks due to internal service level

Internal Service Level Causes Shortages of 4 +/- 16 units
Multi-stage Example

Two Single Stages

- LT=2
- PBR=1
- CF
  - SS= 267 units
  - ISL=99.9%
  - Cost=$267

- LT=1
- S
  - SS=116 units
  - Cost=$232

- Demand = 100 +/- 50

Cooperative Multi Stage

- LT=1
- PBR=1
- CF
  - Decrease of 156 units
  - SS=124 units
  - Cost=$248

- Variability from Internal Service Level Causes Shortages of 4 +/- 16 units

- LT=1
- S
  - SS= 111 units
  - ISL=90 %
  - Cost=$111

- Achieved Service Level = 95%

Ultra Lean WH Node

- LT=1
- PBR=1
- CF
  - Increase of 54 units
  - SS=178 units
  - Cost=$356

- Variability from Internal Service Level Causes Shortages of 34 +/- 50 units

- SS= 0 units
  - ISL = 50%
  - Cost=$0

- Achieved Service Level = 95%

Total Cost = $359
Decrease of $3
Achieved Service Level = 95%

Total Cost = $499
Decrease of $140
Achieved Service Level = 95%
Two-Stage Example: Internal Service Level Impact on Safety Stock Costs

Optimal ISL = 0.72
Example: Optimal

**Optimal ISL=72%**

- SS= 50 units
  - Cost=$50
- Decrease of 217 units

**ISL=99.9%**

- SS= 267 units
  - Cost=$267
- Decrease of 217 units

**Achieved Service Level = 95%**

**Total Cost = $499**

**Variability from Internal Service Level Causes Shortages of 15 +/- 33 units**

**Optimal ISL=72%**

- SS=144 units
  - Cost=$288
- Increase of 28 units

**Achieved Service Level = 95%**

**Total Cost = $338**

**Variability from Internal Service Level Causes Shortages of 15 +/- 33 units**
Multi-Stage Logic for Complex Supply Chains

Simple search works well for simple supply chains

For complex supply chains, complete enumeration of all possible combinations is simply not practical

Simultaneously searching for all optimal internal service levels requires refined optimization mechanisms

SmartOps tools embed and employ fast and sophisticated optimization techniques
Multi stage in the EIO by SmartOps Solution

Muesli (cereal) supply chain:

Input ISL vs. ISL being *calculated and optimized*: EIO by SmartOps

Single Stage Calculations:
Isolated planning results in over-buffering of inventory across the supply chain
Determining postponement strategy is challenging (To stock at upstream or downstream warehouse)

Multistage Optimization:
Coordinated planning eliminates over-buffering of inventory and ensures services objectives are met
Muesli Supply Chain: Key Inputs

1. Customer service level targets
   - 96% non-stockout probability
   - 95% non-stockout probability

2. Replenishment lead times
   - 1 week

3. Periods Between Review (PBR)
   - 1 week

4. Forecasts and forecast error
   - 4000 +/- 2000 each week for each cereal
   - 8000 +/- 4000 each week for each cereal

Finished Goods

RAW MATERIALS WAREHOUSE

RAW MATERIALS

PLANT

CEREALS:
- ORIGINAL STRAWBERRIES
- BLUEBERRIES
- RAISINS
- NUTS
- MIXED FRUITS

GROcery CHANNEL

GIANT EAGLE
WHolen FOODS
TRADEr JOES

MASS CHANNEL

WALMART
SAMS CLUB
COSTCO

Finished Goods

1 week

1 week
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Review
The Necessity of Comparing Forecasts to Actuals

Forecast error is the difference between forecast and actual sales
Random variable since both forecasts and actuals vary with time

Finding best fit for historical sales ignores existing time-varying forecasts
Substitutes forecast error by demand variability
Disconnects planning from execution

Demand Variability CV = 1.05
Forecast Error CV = 0.32
Accurately quantify demand uncertainty, forecast accuracy and bias with Demand Intelligence

**Demand Characterization**

- **Frequent Demand**
- **Intermittent Demand**
- **Seasonal Demand**

**Data Handling**

- **Missing Data**
- **Outlier Detection**
- **Forecast Bias**

**Automatic Lag Detection**

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**Data Recency Adjustments**

Legend:
- = Actual sales
= Demand forecast
Demand Analytics Dashboard
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Review
Supply Variability Factors

From a standard order, we deal with

- Lead Time Uncertainty
- Reliability
- Yield
- Schedule Attainment Problems
- Batch Size
Should Lead Time Impact Target Safety Stock?

- Order placed in current period 1 arrives at start of period 3
- The next shipment doesn’t arrive until the start of period 4
- Period 3 is “Most-at-Risk” of stocking out
- Exposure period = PBR + LT
- Most-at-Risk periods = PBR +LT – 1 (+ corresponding review period)
Supply Variability Summary

- Lead Time Variability in multiple “buckets”
  - Physical Lead Time
  - Processing lead Time
  - Other Lead Time
- Reliability
- Yield
- Schedule Attainment
- Batch Size
Incorporating Variability and Uncertainty (Summary)

- **Forecast error variability**
  - Should capture error and bias around forecasts
  - Should reflect demand classification (frequent seller, intermittent, etc) other characteristics

- **Service variability**
  - Should capture less-than-perfect service from internal replenishment points

- **Lead time variability**
  - Should capture variations in lead times due to natural, external forces
  - Should not include the effects of expediting and advance order placements
  - Should not include effects of upstream material unavailability

- **Supply quantity variability**
  - Should capture variations in received quantities due to natural, external forces
  - Can also account for chronic over- or under-production
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Review
Closer Look Into Select Key Factors

**Demand Variability Factors**
- Differentiated Demand Streams
- Carrying Costs
- Storage Capacity Constraints
- Correlated Demand
- New Item Processor
- Time Varying Bill of Materials

**Supply Variability Factors**
- Batch Size
- Supply Capacity Constraints
- Service Time
- Re-order Point Planning

[Diagram with icons for Batch Size, Supply Capacity Constraints, Safety Stock, and Supply Timing & Quantity Error]
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Review
EIO “The Business Case”
SAP EIO is about achieving the right balance between inventory and service levels

Service Levels vs. Inventory Investment

Company Current Performance:
Inv. = $18.5M
CSL = 96%
EIO delivers tangible, near-term, and sustainable value

**Improve Customer Service Levels**
- 5-10% increase in order fill rates and on time delivery
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**Reduced Inventory & Working Capital**
- 15-30% reduction in inventory and working capital
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**Improve Planner Productivity**
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- 10-20% reduction time spent on manual inventory planning processes

**Reduced Production & Distribution Costs**
- 10-20% reduction in PPE and depreciation due to excess storage facilities
With SAP EIO, Pfizer increased customer service, while reducing inventory levels

Industry: Consumer healthcare
Products/Services: Analgesics, nutritionals, respiratory, gastrointestinal and topical
Revenue: $2.7 billion division of Pfizer
Solutions: SAP ERP, SAP APO and SAP EIO

Business Challenges
- Increased demand for customization, delivery and service
- Supplier quality issues buffered site stockpiles
- Inconsistent planning processes across organization

Objectives
- Deliver outstanding service with less inventory
- Make planning process based on customer demand “pull”
- Analyze trade-off between inventory and cost drivers

Why SAP EIO?
- Proven success at other consumer-products and life-sciences companies
- Compatibility and experience with existing ERP systems
- Easy to use software user interface

Benefits
- Exceeded inventory reduction goals
- Customer service levels lifted from 93.7% to 99.1%
- Increased throughput due to improved planning and scheduling
- Consistent planning process across organization

Source: Pfizer presentation at SAP EIO Outperform Forum, September 2009
“Fix the Mix”

Optimization is not across-the-board inventory changes; it’s about correcting the product mix at the item-location level to meet service objectives.

Change in Inventory Level by Item
(SAP EIO vs. Actual)

More Needed

Less Required

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...and multiply!

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Traditional systems cannot account for this interconnected supply chain
...and multiply! ... So what?

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All at the item-location-time period level of granularity, linked to ERP/APS systems, while providing Management level, roll-up Analytics for root-cause improvements
Simultaneous Multi-Stage Optimization is required to balance inventory investment with supply chain risk

**Stocking Point Data**
- Inventory unit cost
- Holding Cost Percentage
- Period Between Review (PBR)
- Risk Pooling Factor
- Maximum shelf life
- Schedule attainment loss % and CV
- Costs: Processing, Transportation, Order administration, Handling, Other, and Unit purchase, Unit transfer price

**Customer Demand Stream Data**
- Forecast mean ($\mu_t$)
- Forecast standard deviation ($\sigma_t$)
- Target Service Level (SL)
- Service Time

**Stocking Point Time-Varying Data**
- Minimum required stock

**Supply Path Static Data**
- Total lead time mean (LT)
  - Physical lead time
  - Order processing lead time
  - Other lead time
- Total lead time std dev
- Service time
- Frozen Window (FW)
- Yield
- Batch Size
- Minimum Batch Size
- Reliability

**Supply Path Time-Varying Data**
- Maximum process capacity
- Sourcing fraction
- Planned receipts

**Process Point Data**
- Manufacturing/Packaging BOM
- BOM Activity Dates

SmartOps' Solution Suite provides scientific, profitable, scalable, and visible approaches to calculating the optimal time-varying safety stock targets across the entire supply chain at the lowest total inventory cost while meeting your customer service level targets
SmartOps Integrated Engagement Model

Our engagement model ensures we are in constant contact with our clients to realize value from the software & services we provide

Value Assessment (4 – 8 Weeks)
- Model Customer Supply Chain
- Determine potential areas of value

Solution Design (4 – 8 Weeks)
- Determine Inventory Planning Process
- Develop business solution
- Identify data sources
- Develop business rules
- Determine integration strategy

Quick Win (8 – 12 Weeks)
- Identify phased implementation approach.
- Determine products where a quick win can be gotten.
- Build model and start using inventory targets.
- Start generating value.

Solution Rollout (6 – 16 Weeks)
- Add additional products onto system.
- Evaluate results from “Quick Win” stage
- Adjust business process if required to drive value
- Adjust application settings to refine result to drive incremental value

Post “Go-Live” Support (Continuous)
- Account Services team continue to work with client to drive and document value
- Ensure customer is referencable and satisfied with the solutions we provide
- Customer works with “User Group (SUG)” to prioritize any new requirements (if needed)
SmartOps enables an agile & cost competitive supply chain

1. Acknowledge Risk
   - Improve visibility around supply chain uncertainty
   - Accurately quantify demand uncertainty, forecast accuracy and bias with Demand Intelligence
   - Protect against supply variability with Supply Intelligence
   - Mitigate the risks of chronic underproduction with Production Intelligence
   - Dynamically link current and future inventory targets to service level goals with Multistage Inventory Planning & Optimization

2. Reduce Costs
   - Drive higher margins & supply chain efficiency
   - Stop inventory holding cost from eroding your product margins with Service Level Optimization
   - Strike the financially optimal tradeoff between changeover and holding costs through Production Planning with Patterns Optimization
   - Reduce expediting cost and stock-outs by improving short term forecast accuracy with Enterprise Demand Sensing.

3. Grow Market Share
   - Provide best-in-class customer service
   - Rapidly automate synchronization of bi-directional data for scalable, sustainable processes with Integration Connector.
   - Drive visibility, widespread adoption and better decision-making with easy-to-use Scenario Planning and Analytics Dashboard
EIO Related Solutions
SmartOps Flagship: EIO (Enterprise Inventory Optimization)
Right - Size Inventory to Capture More Sales

Quantify Variability at Correct Granularity
- As variability increases so should inventory levels to cover the uncertainty in the supply chain
- Understanding characteristics and forms of uncertainty is necessary to determine inventory.

Holistic View of Supply Chain
- Calculation of inventory at each stage individually leads to “planning silos” and to a supply chain with excessive inventory stocks.
- Multi stage optimization eliminates the “silo-effect” and plans all stages simultaneously.

EIO Fixes the Mix of Inventory
- By adjusting inventory requirements to meet the variability of individual items across the entire supply chain it is possible to reduce inventory while improving service.
- Time-varying targets put inventory in the right amount at the right sport at the right time.
SAP Connector: Integration Assets

SAP EIO Integration Assets

ERP or Source Systems

- Standard SAP Enhancements
- ABAP
- ECC
- APO
- BW
- BusinessObjects Universe & Reports

SAP Connector has four main components:

- An ABAP Add-on for maintenance of EIO-relevant master data in SAP ECC
- A library of commonly used and custom inbound and outbound BAPIs for ECC and APO
- The SAP Java Connector (JCo)
- An XML configuration file to map fields between SAP and the SmartOps Data Gateway

SAP Connector also has capabilities that support SmartOps Cloud applications
Demand Analytics Dashboard

**Forecast Error**
- Average CV: 1.37
- Distribution of Demand Streams by CV:
  - CV: 0.00-0.25: 10
  - CV: 0.25-0.50: 20
  - CV: 0.50-0.75: 40
  - CV: 0.75-1.00: 30
  - CV: 1.00-1.25: 20
  - CV: 1.25-1.50: 10
  - CV: 1.50-1.75: 5
  - CV: 1.75-2.00: 2
  - CV: 2.00-2.25: 1
  - CV: 2.25-2.50: 1
  - CV: 2.50-2.75: 1
  - CV: 2.75-3.00: 1
  - CV: >3: 1

**Bias**
- 54% Demand Streams are biased:
  - Negative: 30
  - None: 40
  - Positive: 20

**Intermittency**
- 9% Demand Streams are intermittent:
  - ADI 1: 10
  - ADI 2: 40
  - ADI 3: 60
  - ADI 4: 20
  - ADI 5: 10
  - ADI 6+: 10
  - N/A: 5
Service Level Optimization - SLO

SmartOps Service Level Optimization (SLO)
Optimizes Service Levels by balancing inventory costs with the opportunity costs of sales

- An additional 5-10% on hand inventory reduction on top of EIO
- Better understanding and decision-making capability around the trade off between service and inventory
Short-term operational forecast can differ from consensus forecasts:
- Populated by Demand Sensing
- New information gained
- Previous patterns recognized
- Populate according to supply chain cadence

New forecast feeds other APS parameters in the cadence you or your Planner can work with
Enterprise Demand Sensing
Predictive analytics that increase near-term sales while reducing stock-outs

Capture historical forecast trends and service performance

- Compare and mathematically blend different forecast sources with demand analytics
- Characterize demand by analyzing historical forecast accuracy, bias and intermittency trends
- Track service performance by customer with order analytics

Improve accuracy and reduce latency of short term demand predictions

- Boost sales by predicting and reducing stock-outs with demand patterns and trends recognition
- Free planners from granular micro-forecasting through enterprise-scale predictive mathematics
- Find revenue upside opportunities by tapping data from downstream demand signal repositories (DSR)

Create effective demand-response strategies

- Lower repositioning costs through improved short term forecasts
- Improve production and deployment agility by translating demand signals to short term supply requirements
- Improve collaboration with downstream partners through embedded analytics, scenario analysis and collaboration tools
Conclusion

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

- **Cycle Stock Drivers:**
  - Review Frequency
  - Demand
  - Batch Sizes

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

- **Pre-Build Stock Drivers:**
  - Time-varying capacity
  - Time-varying demand
  - Sourcing ratios
  - Changes in safety stock
Thank you