Supply Chain Value Creation Opportunity in A&D

Average Value of 1 day of Inventory = $40-70 Million

- **Industrials**: 80 Inventory Days On hand
- **Defense Prime**: 35 Inventory Days On hand
- **Diversified A&D**: 117 Inventory Days On hand
- **Commercial Aerospace**: 198 Inventory Days On hand

While government progress payments artificially brings net inventory down in defense, the physical inventory is typically on par or exceeding commercial aerospace.

Key Supply Chain Planning Solution Considerations

Focus Areas

Real time supply chain planning is complex
- Relevant planning data spans across a variety of sources (i.e. finance, sales, inventory) that don’t naturally correlate together
- Generate a stable and feasible master product plan based on demand across multiple streams (OE, MRO, Spares etc.)
- Need to support multi-mode planning from ETO to MTS

Planning efforts go beyond analytics
- Incorporate embedded analytics via alerts/case management/standard dashboard while simplifying user experience
- Ability to do quick what-if scenario planning to determine supply chain risk (for e.g., revenue risk or contract risk)

A need for cloud based solutions
- Historical supply chain planning tools are client based tools
- They lack the benefits and scale of cloud based solutions

Integration is costly
- Streamline execution by tight integration across planning, procurement, manufacturing, warehousing
- Process orchestration from SI&OP to production schedule; Achievable plans based on capacity & material constraints
Integrated Business Planning, powered by HANA
A single data model to swiftly drive collaboration and action in your business

Sales and Operations: Monthly and Weekly Planning
- Balance demand and supply while providing organizational visibility and alignment
- What-if scenarios, using "real time" information
- JAM embedded communication, and analytics

Supply Chain Control Tower: Visibility
- Achieve end-to-end visibility in the extended supply chain
- Integrate Data from various Systems
- Drive visibility and action with configurable Analytics & Alerts and Case Management

Inventory: Master Uncertainty, drive S&OP decisions to the Planners
- Efficiently position inventory to best absorb forecast error, demand variability and supply uncertainty
- Multi-echelon (multi-stage) inventory optimization to solve the science of postponement
- Drive S&OP decisions to inventory target recommendations for Planners

Demand: Demand analytics, demand sensing. Forecast Better
- Demand Sensing (predict and reforecast, pattern recognition)
- Forecasting statistical techniques
- Collaborative Demand Planning

Supply and Response: Master supply planning and response intelligence
- Plan production, procurement, and distribution
- Respond to daily disruptions through what-if analysis to change supply plans and reschedule demand
- Manage allocations where supply is scarce

Demand
- Demand Sensing, Statistical Forecasting & Consensus Planning

Inventory
- Multi-Stage Inventory Optimization

Response & Supply
- Allocations & Deployment Planning, Order Rescheduling

Supply Chain Control Tower
Exception Handling and Business Network Collaboration

Sales & Operations
Strategic and Tactical Decision Processes

SAP HANA

2019 SAP NS2 Business Proprietary and Confidential
SAP supply chain vision
Integrated Business Planning at NS2
Run Securely in the NS2 Cloud

Delivered Integration
Designed to integrate with SAP transactional solutions

Predictive Analytics
Delivered Advanced Planning Algorithms

Optimal Security and Provisioning
U.S. Persons on U.S. Soil

AWS GovCloud (US)
FedRAMP High
Adhere to ITAR

End-to-end visibility
on strategic, tactical, and operational level

Faster planning cycles
Concurrent planning for customers

Dedicated tenant for each customer

AWS GovCloud (US)
Integrated Business Planning Demo
Planning in the A&D Industry

Planning Hierarchy

Inputs
- Strategic Planning
- Financial Planning
- Sales & Operations Planning
- Forecasts
- Sales Orders
- Bills Of Materials
- Routings
- Inventory/WIP

Priority Management
- Production Planning
- Sales & Operations Planning
- Master Production Scheduling
- Material Requirement Planning
- Final Assembly Scheduling
- Production Activity Control

Capacity Management
- Resource Requirement Planning
- Inventory Management
- Rough Cut Capacity Planning
- Capacity Requirement Planning
- Detail Scheduling
- Capacity Control

Time Horizon
- 24m
- 12m
- 3m
- 0m

Strategic Planning
Tactical Planning
Operational Planning
Product structure and network

- **AD-RW-3000**
  - **Valve Assy**
  - Dynaflow (Vendor)

- **AD-RW-3001**
  - **Cylinder Assy**
  - Precision Mfg (Vendor)

- **Michigan City**
  - Actuator Plant

- **AD-SFG-2000**
  - **Actuator Assy**
  - Test

- **AD-SFG-2001**
  - **Actuator LRU**
  - Workscope-54
  - Repair Planning BOM/ Routing

- **American Airlines**
  - Repair Order

- **Michigan City**
  - Repair Plant

- **AD-RW-3002**
  - **Screw Block**
  - Assay Test

- **AD-RW-3003**
  - **Control Unit**
  - Dassault Sys (Vendor)

- **Stock Transport Order**

- **AD-FG-1000**
  - **Horizontal Stabilizer Actuator**

- **Cedar Rapids**
  - Flight Control Assembly Plant

- **Kaiser Dynamics**
  - (Vendor)

- **Precision Mfg**
  - (Vendor)

- **American Airlines**
  - OEM Sales Order

- **Boeing**
  - American Airlines Spare Sales Order

- **Airbus**
  - American Airlines Spare Sales Order
Demo outline

### IBP Demo

**Sales & Operations Planning (S&OP)**
- Sales History/ Backlog
- OE Forecast
  - VPS Forecast
  - Opportunity Forecast
  - Sales Forecast
  - Consensus Demand
- MRO/ Spares Forecast
  - Statistical Forecast
- Scenario Planning
- Lagged Forecast Accuracy
- Dashboards/ Analytics

**Master Scheduling, Rough Cut Capacity Planning & Response Mgmt**
- Master Scheduling
  - Supplier Constraint
  - Capacity Constraint
  - Gating Factor Analysis
  - System proposed MPS/ Override
- Simulate within lead time demand
  - Baseline/ with changes to order priority
- Simulate within lead time demand
- Simulate expedite request
- Dashboard/ Analytics

**Inventory Optimization**
- Recommended Safety Stock levels based on service levels and forecast error
- Simulation of Safety Stock levels with changed target service levels
- Dashboard/ Analytics

---

OE Demand Planner
Account Manager
MRO/ Spares Planner
Product Development Manager
Finance Manager
Executive Team
Master Scheduler
Purchasing Manager
Mfg Engineer
Production Planner
Customer Service
Inventory Analyst

---

2019 SAP NS2 Business Proprietary and Confidential

SAP NS2 Business Proprietary and Confidential
Integrated Business Planning
Demo Recording
Integrated Business Planning
Demo - Sales & Operations Planning
## Sales History

### Demo Capabilities

- Review Sales History
- Units and Dollars
- Weekly Buckets
- Outlier Correction (where applicable)

### Additional Capabilities

- Different types of history – Order vs Shipment
- Aggregate to Monthly or Telescopic buckets
- Different levels of aggregation – Product Group, Customer Group, etc.
- Time Series Analysis
- ABC/XYZ Segmentation
- Analytics – YOY comparison

#### Sales History

<table>
<thead>
<tr>
<th>Product BU</th>
<th>Product Group</th>
<th>Product Desc</th>
<th>Customer Description</th>
<th>Key Figure</th>
<th>W10 2017</th>
<th>W11 2017</th>
<th>W12 2017</th>
<th>W13 2017</th>
<th>W14 2017</th>
<th>W15 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Aviation</td>
<td>Actuator</td>
<td>Horizontal Stabilizer Actuator HSA104</td>
<td>Airbus</td>
<td>Actuals Qty</td>
<td>53</td>
<td>144</td>
<td>83</td>
<td>201</td>
<td>93</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Actuals Qty - Outlier Corrected</td>
<td>53</td>
<td>144</td>
<td>83</td>
<td>201</td>
<td>93</td>
<td>35</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Actuals Qty - Outlier Corrected</td>
<td>53</td>
<td>144</td>
<td>83</td>
<td>201</td>
<td>93</td>
<td>35</td>
</tr>
<tr>
<td>Boeing</td>
<td></td>
<td></td>
<td></td>
<td>Actuals Price</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Actuals Revenue</td>
<td>$2,650,000</td>
<td>$7,200,000</td>
<td>$4,150,000</td>
<td>$10,050,000</td>
<td>$4,650,000</td>
<td>$1,750,000</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Actuals Qty</td>
<td>132</td>
<td>131</td>
<td>55</td>
<td>91</td>
<td>80</td>
<td>54</td>
</tr>
</tbody>
</table>
Baseline Forecast

**Collins Aerospace**

**Chart:**
- Series:
  - Baseline Forecast
  - Actuals Qty Prior Yr
  - Statistical Forecast Qty - Moving Avg

**Product Group** | **Product ID** | **Product Desc** | **Customer Description** | **Key Figure** | **W09 2019** | **W10 2019** | **W11 2019** | **W12 2019** | **W13 2019** | **W14 2019**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Actuator | AD-FG-1000 | Horizontal Stabilizer Actuator HSA104 | Airbus | Actuals Qty Prior Yr | 21 | 54 | 44 | 28 | 98 | 32
 |  |  |  | Statistical Forecast Qty - Double exp | 8 | 7 | 7 | 7 | 7 | 7
 |  |  |  | Statistical Forecast Qty - Moving Avg | 59 | 59 | 59 | 59 | 59 | 59
 |  |  |  | Statistical Forecast Qty - Auto | 10 | 10 | 10 | 10 | 10 | 10
 |  |  |  | Statistical Fcst Qty | 58 | 58 | 58 | 58 | 58 | 58
 |  |  |  | DP Planner Fcst Override | 65 | 65 | 65 | 65 | 65 | 65
 |  |  |  | Baseline Forecast | 21 | 54 | 44 | 28 | 98 | 32
 |  |  |  | Baseline Forecast Revenue | $2,900,000 | $3,350,000 | $2,900,000 | $2,900,000 | $2,900,000 | $2,900,000
 |  |  |  | Actuals Qty Prior Yr | 43 | 4 | 47 | 64 | 36 | 6

**Demo Capabilities**
- Actuals Prior Year
- Statistical Forecasting with Single, Double and Auto Exponential models

**Additional Capabilities**
- Advanced Statistical Models – ARIMA, Croston, Machine Learning (Gradient Boosting), Multiple Linear Regression, etc.
- Multiple Models - Pick Best
- Attach Rate Based Forecasting (For products sold with other products or for Configurable products)
- Lifecycle Planning (New Products and Obsolescence)
- Key Figure Fixing
Sales & Consensus Planning

- Vehicle Production Schedule (VPS) based Forecast
- Opportunity Forecast (Units/ Dollars)
- Sales Forecast (Units/ Dollars)
- Consensus Override
- Reason Codes/ Comments
- Consensus Demand Plan (Units/ Dollars)

Demo Capabilities

- Change History
- S&OP Process Templates
- Collaboration (JAM)
- Custom Alerts
- Supply Planning (Bucketed)
- Scenario Planning (for e.g., alternate sources of supply)
- Optimizer
- Vendor collaboration (through Ariba)

Additional Capabilities
Integrated Business Planning
Demo – Master Scheduling & Response Management
### Vendor Collaboration

#### Demo Capabilities
- Long range forecast sharing with vendors
- Supplier commit against forecast

#### Additional Capabilities
- Business Network Collaboration (Ariba Integration)
- Custom Alerts
Rough Cut Capacity Planning

- Available vs Consumed Capacity
- Dashboard/Analytics

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>Cedar Rapids</td>
<td>AD-PL-101</td>
<td>HSA_Asse</td>
<td>Capacity Available (Final)</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
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<td>140</td>
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<td>100</td>
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<td>Capacity Available (Adjusted)</td>
<td>140</td>
<td>140</td>
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<td></td>
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<td>Capacity Consumption Confirmed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Capacity Consumption</td>
<td>35</td>
<td>31</td>
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<td>96</td>
<td>77</td>
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<td></td>
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<td>Capacity Consumption (%)</td>
<td>25%</td>
<td>22%</td>
<td>57%</td>
<td>31%</td>
<td>41%</td>
<td>69%</td>
<td>55%</td>
<td>55%</td>
<td>77%</td>
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<td></td>
<td>Capacity Consumption Planned</td>
<td>35</td>
<td>31</td>
<td>80</td>
<td>43</td>
<td>58</td>
<td>96</td>
<td>77</td>
<td>77</td>
<td>77</td>
</tr>
</tbody>
</table>

Demo Capabilities
- Available vs Consumed Capacity
- Dashboard/Analytics

Additional Capabilities
- Custom Alerts
Master Scheduling

- Supplier Constraints/ Capacity Constraints
- Constrained Forecast (Proposed Master Schedule)
- Gating Factors/ Order Network
- Adjusted Master Schedule
- Dashboards/ Analytics

Demo Capabilities

Additional Capabilities

- Demand Prioritization/ Forecast Segmentation
- Fair Share

- Demand Prioritization/ Forecast Segmentation
- Fair Share
Order Confirmation

- Order Confirmation
- Dashboards/ Analytics

Demo Capabilities

- Order Confirmation
- Dashboards/ Analytics

Additional Capabilities

- Demand Prioritization/ Forecast Segmentation
- Fair Share
- Confirmation update on Sales Order
New Order Simulation

Order Number: T3617819
Item Number: 10

Competing Sales Orders

<table>
<thead>
<tr>
<th>Analyzed Demand</th>
<th>Priority</th>
<th>Segmen...</th>
<th>Order Number</th>
<th>Item N...</th>
<th>Customer Number</th>
<th>Customer Name</th>
<th>Requested Date</th>
<th>Rule Name</th>
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<td>Yes</td>
<td>1-1</td>
<td>Demand...</td>
<td>T3617819</td>
<td>10</td>
<td>AD-CUS-100</td>
<td>Boeing</td>
<td>03/04/2019</td>
<td>DEMAND_PRIORITY_RULE2</td>
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<td>1-1</td>
<td>Demand...</td>
<td>6200</td>
<td>1</td>
<td>AD-CUS-100</td>
<td>Boeing</td>
<td>03/07/2019</td>
<td></td>
<td></td>
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<tr>
<td>1-3</td>
<td>Demand...</td>
<td>6202</td>
<td>1</td>
<td>AD-CUS-101</td>
<td>Airbus</td>
<td>03/12/2019</td>
<td></td>
<td></td>
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</tbody>
</table>

Schedule Line Details for Order Number T3617819, Item Number 10

<table>
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<tr>
<th>Confirmed or Requested Date</th>
<th>Requested Quantity</th>
<th>Confirmed Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/03/2019</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>03/11/2019</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>03/18/2019</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>03/25/2019</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>04/01/2019</td>
<td>13</td>
<td></td>
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</tbody>
</table>
Expedite Request/Reprioritization

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<thead>
<tr>
<th>Item Name</th>
<th>Req. Type Descr.</th>
<th>Order Number</th>
<th>Item Number</th>
<th>Customer Number</th>
<th>Customer Name</th>
<th>Requested Date</th>
<th>Requested Qu.</th>
<th>Confirmed Qu.</th>
<th>Material</th>
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</thead>
<tbody>
<tr>
<td>Sales Order</td>
<td>6202</td>
<td>1</td>
<td>AD-CUS-101</td>
<td>Airbus</td>
<td>03/12/2019</td>
<td>10 EA</td>
<td>10 EA</td>
<td>AD-FG-1</td>
<td></td>
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<tr>
<td>Sales Order</td>
<td>6201</td>
<td>1</td>
<td>AD-CUS-100</td>
<td>Boeing</td>
<td>04/07/2019</td>
<td>150 EA</td>
<td>150 EA</td>
<td>AD-FG-1</td>
<td></td>
</tr>
<tr>
<td>Sales Order</td>
<td>6203</td>
<td>1</td>
<td>AD-CUS-101</td>
<td>Airbus</td>
<td>04/01/2019</td>
<td>120 EA</td>
<td>120 EA</td>
<td>AD-FG-1</td>
<td></td>
</tr>
</tbody>
</table>

Order Number: 6202
Item Number: 1

Confirmed: 100%
Dashboard/ Analytics

Master Scheduler
Customer Service
Account Manager

AD - Capacity Utilization (%)

AD - Unconstrained vs Constrained Forecast

AD - Orders Confirmation
Integrated Business Planning
Demo – Inventory Optimization
Inventory Optimization

**Demo Capabilities**

- Recommended Safety Stock levels based on service levels and forecast error
- Simulation of Safety Stock levels with changed target service levels
- Dashboard/ Analytics

**Additional Capabilities**

- Supply uncertainty/ Lead Time Variability
- Service Level Optimization
- Lost Demand (Revenue at Risk)
Integrated Business Planning
Value Drivers
IBP Value Drivers

Integrated Business Planning – Value Drivers

**Usability**
- Role based UI - Web and Excel UI, Mobile
- Scenario and Process Modeling Capabilities
- Inherent Advanced Analytics (e.g.: Forecast Accuracy/ Bias metrics, Demand/ Supply stability charts, real-time dashboards)
- JAM Collaboration Platform

**Unified Data Model**
- One System – One Data for all Planning Functions - Demand, Supply, Inventory, Response, Control Tower
- Flexible Planning Levels
- Pre Configured Planning Templates

**Integrated Cloud Environment**
- Standard Integration with execution systems (SAP ECC, S/4 HANA)
- Integration to other cloud solutions (Ariba(Native), BPC, SFDC etc.)
- Cloud Platform Integration service to external systems

**Commitment to SCM Roadmap**
- SAP will continue to deliver industry specific solutions with a Quarterly Upgrade to IBP.
- Customer Feedback is the key for roadmap
- Seamless Transition from APO to IBP

**Key Performance Indicators**
- Reliability
- Responsiveness
- Agility
- Cost
- Efficiency
Integrated Business Planning
Appendix
## Planning Horizons

<table>
<thead>
<tr>
<th>Horizon (Typical)</th>
<th>Long Range Planning (IBP)</th>
<th>Mid Range Planning/Response Management (IBP)</th>
<th>Inventory Optimization (IBP)</th>
<th>Short Range Planning &amp; Detailed Scheduling (S/4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 24 Months, &gt; 6 Months / Monthly Buckets</td>
<td>&lt; 12 Months, &gt; 1 Month / Weekly Buckets</td>
<td>Less than 6 Months, Weekly Buckets</td>
<td>Less than 3 Months, Daily Buckets</td>
<td></td>
</tr>
</tbody>
</table>

### Objective
- ✓ Validation of long range cross-location aggregated capacity (internal and external)
- ✓ Alignment between Sales/Operations/Financial Plans
- ✓ Identification of constraint resources
- ✓ Long lead component requirements
- ✓ Generate Feasible Master Schedule considering capacity and material constraints
- ✓ Rough Cut Capacity Planning
- ✓ Respond to within lead time demand
- ✓ Respond to expedite requests/customer reschedule/reprioritization
- ✓ Determine target Safety Stock levels considering service levels and demand variability
- • Analyze revenue at risk
- • Analyze impact of supply/lead time variability
- • Service level optimization
- • Determination of buffer levels for DDMRP
- • Validation of short range plant level detail capacity.
- • Scheduling/Sequencing

### Tool Set
- ✓ IBP S&OP, IBP Demand
- • Ariba Collaboration
- ✓ IBP Supply & Response
- • Ariba Collaboration
- ✓ IBP Inventory
- • S4 (PP, PPDS, DDMRP)

### Planning Approach
- • Unconstrained Heuristic
- • What-If Scenarios
- • Time Series Based
- • Constrained Forecast Run (Rule Based)
- • Confirmation Response
- • Simulation Planning
- • Order Based
- • Multi-Echelon Inventory Optimization
- • MRP + Capacity leveling
- • Finite Scheduling
- • DDDMRP

### Process Output
- • Unconstrained Consensus Forecast
- • Capacity Shortages
- • Constrained Forecast
- • Master Production Schedule (MPS)
- • Safety Stock Levels
- • Detailed Schedule
- • Operation Sequencing

### Master Schedule Flexibility
- Open (+/- 20%)
- Trading (+/- 10%)
- Firm (+/- 5%)
- Frozen
A&D Manufacturing Strategies
Complex & Mix- Mode (Project Mfg./ ETO/ MTO/ CTO/ MTS)

S4 (Production Planning, Detailed Scheduling & Execution)

- Project Mfg
- Engineer-To-Order
- Make-To-Order
- Configure-To-Order
- Make-To-Stock

IBP (S&OP, MPS & RCCP)

- Plan in IBP for Capacity
- Plan in IBP for Material & Capacity

WBS Structure
- Network
- WBS Structure
- FG
- Assy
- Comp
- Raw

Customer Order or Project Specific (Account Assigned)
Can be planned as generic

✓ WBS/ Network
✓ GPD
✓ Parameter Effectivity

✓ Order BOMs
✓ Order Routings

✓ Variant Configuration
✓ Super BOM/ Routings
✓ Object Dependencies

✓ Planning BOMs
✓ Planning Routings

THE BEST RUN
A&D Manufacturing Strategies - Example

1. Master Schedule for Base Engine - From Medium Range Planning (MRP)
2. MRP Planned Order
3. Production Order
4. Sales Order for OE Engine
5. MRP Planned Order
6. Forecast Consumption
7. Production Order

- Assemble-To-Order
- Make-To-Forecast

- Base Engine Assembly
- Module 01 Assembly
- Module 02 Assembly
- Non Modular
- Shipping
- Make Parts
- Buy Parts
- Forecast for Spare Parts - IBP or Spare Parts Planning Tool (For e.g., SAP SPM)

Replenishment using Demand Driven Replenishment
Simplifying Product Structures

**Manufacturing BOM/BOP**
Short Range Planning & Production Execution
- Complex – 15+ BOM Levels
- Detailed – 3,000+ Parts
- Designed for – Manufacturing

**SOP BOM/BOP**
Long/ Medium Range Planning
- Simple – 4-6 BOM Levels (Typical)
- High Level – 50-200 Products (Typical)
- Designed for – Long/ Medium Range Planning

1. **Filter**
   - Select critical parts/resources
     - Long Lead Time
     - Impact on critical resources
     - Decoupling points (For e.g., crosses facilities or significant inventory buffers)
     - Vendor constraints

2. **Flatten**
   - Where possible, blow through BOM levels
     - Parts flagged as Phantoms in MBOM or Parts that can be considered as Phantoms for S&OP purposes.
     - Parts repeated in BOM – different location codes or used in different workcenters

3. **Group**
   - Where possible, group products and/or resources
     - Different FFF from Engineering perspective but not different for SOP Planning (variants)
     - Different grouping attributes to support different requirements – for e.g., Product Group for Demand Planning and Product Family for identifying commodities to support long range purchasing
Key trends driving five strategic initiatives for Supply Chain

Driving Forces

- Global network dynamics
- Optimize across value chain
- Need for agility and predictability
- Disruptive technologies

Five strategic initiatives

- Synchronize planning, response and execution (end-to-end, incl. collaboration)
- Integrate and orchestrate supplier network
- Simplify logistics, track & trace, trade compliance
- Harmonize source-to-invoice across spend categories
- Global transparency and risk control across supply chain and finance