SAP Integrated Business Planning (IBP) – Meet the Experts
Demand Sensing with SAP IBP

January 09, 2019
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Our Presenters Today

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Plan and Respond with SAP’s Integrated Business Planning (IBP) 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
SAP Integrated Business Planning for Demand

Overview

Demand Management
Develop an accurate mid- and long term forecast on any aggregation level.

Statistical Models
Time-series, regression and machine learning based forecasting methods.

Demand Sensing
Create short-term forecast to drive better fulfillment and inventory reduction.

Exception Management
Focus planners on problems and identify opportunities for improving the forecast and the overall process.

Embedded Analytics
Create Dashboards and ad-hoc analytics for any key figure or KPI.

What-if Analysis
Fast and simple scenario simulation with complete view on overall supply chain impact.
Full Value – A Streamlined Approach to Demand Planning
Cluster and organize your demand planning process

Monitoring & Controlling of the Planning Process

- Process Step 1
- Process Step 2
- ... process Step n

Consensus Demand Planning

- Statistical Forecasting
- Management by Exception
- Manual Input by Planners
- Forecast Accuracy Calculation

Segmentation
- Quarterly/Yearly

Time Series Analysis
- Weekly/Monthly
- Quarterly

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Bridge the Gap between Tactical and Operational Processes
Accurate and granular short term forecast

Focus of classical forecasting:
- Aggregate (e.g. Customer Group)
- Mid to long term
- Weekly or monthly buckets and planning cycles

The Answer:
Demand Sensing is a powerful extension to statistical forecasting
It leverages the power of machine learning and pattern detection to sense daily demand using various signals

How do you translate all this to daily execution for each product, each location, each customer?
How do you come to a detailed daily forecast to guide operational supply planning and daily deployment?
SAP Integrated Business Planning Demand Sensing

Key capabilities and benefits

• Demand Sensing creates short-term forecast:
  • 4-8 weeks forecast in daily granularity
  • Highly automated
  • Using pattern recognition
  • Leveraging multiple demand signals

• Improved short-term forecast and increased automation:
  • Drives right deployment and transportation decisions, which leads to reduced stock-outs and less rush orders
  • Leads to lower safety stock due to higher forecast accuracy (especially if run together with IBP for inventory)
  • Leads to lower cycle stock due to improved over/underforecasting behavior
  • Improves the customer service level and “on-shelf” availability
  • Frees up planner’s capacity due to fully automated process
  • Depending on lead times and reaction time: improved production, packaging and material purchasing
SAP Integrated Business Planning Demand Sensing
A brief view of capability history

2012
- Development started at SmartOps
- Development partner: Global consumer products company
- SmartOps was acquired by SAP

2014
- SAP Integrated Business Planning was born
- First IBP solution focus area was S&OP

2015
- Demand Sensing became part of SAP IBP

2017+
- Accelerated Global reach with growing number of customers
- Several customers running in production environments including large-scale global & multi-regional implementations
- 50+ companies with current active rollout, pilot, and testing projects
IBP Demand Sensing
Current industry presence

Early adopters

- Consumer Packaged Goods
- Electronics & Appliances
- Chemicals & Pharmaceuticals
- Industrial Machinery and Materials
- Automotive Products
- Retail & Fashion
Demand Sensing
Demand Sensing – Next Level of Forecasting
Enhance and disaggregate forecast based on short term demand signals

“Internal” Demand Signals like Deliveries, Sales Orders, Promotions and Open Orders

Demand Sensing
Time Horizon: 4-8 Weeks
Granularity: Days

Consensus Demand Plan

Short Term Forecast

Drive operational supply planning processes:
✓ Deployment
✓ Transportation planning
✓ Production and packaging sequences
✓ Purchasing decisions
✓ Inventory optimization

External Data

Social Media
Competitors
Retailer POS
Weather
Market Share
Events
Weather
Demand Sensing: Example
Replenishment without Demand Sensing

National Company Plant
Annual forecast of 2,650 units

National DC
Weekly forecast of 40 units

East DC
Daily Replenishment Schedule w/ updated forecast

West DC

East Daily Demand Trend

West Daily Demand Trend

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Demand Sensing: Example
Replenishment driven by Demand Sensing

National Company Plant
Annual forecast of 2,650 units

National DC
Weekly forecast of 43 units

East DC
East Daily Demand Trend

West DC
West Daily Demand Trend

Daily Replenishment Schedule w/ updated forecast
Demand Sensing
In a nutshell

**Inputs**
- Consensus Demand (Revisions)
- Historical Sales Orders & Future Open Orders
- Historical Shipments
- Promotions
- Extra Signals *(optional)*
  - PoS,
  - Retailer / Store Inventory,
  - Warehouse Withdrawals,
  - Social Sentiment,
  - Market Research Data,
  - Weather,
  - etc.

**Process Summary (Simplified)**

**Pre-processing**
- New Product Introduction Mapping
- Promotion Elimination

**Machine Learning / Pattern Recognition**
- Weekly Pattern Recognition
- Daily Pattern Recognition
- Weekly Matching & Balancing
- Daily Matching & Balancing

**Post-processing**

**Outputs**
- Weekly Sensed Demand
- Daily Sensed Demand

- Product location customer level
- Intermediate results are also published to help users understand what factors in their supply chain is impacting sensed demand

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Targeted Demand Sensing Model Setting and Review
Focus on what matters most

- Largest part of business volume belongs to the first 3-4 categories. If we ensure DS improves accuracy for these demand categories, overall accuracy will be heavily improved.
Cleaning Sales
Promotion elimination process

Pre-processing Step:

- **Sales History** (including uplift / promotions)
  - **Promotion Sales Lift Elimination** to eliminate uplift from historic sales
  - **Sales History** (without uplift)
  - **Consensus Forecast** (without uplift)

** Algorithms (in Calculation Order)**

1. **Promotion Sales Lift Elimination**
   - Outlier Multiplier 2
   - Sales History
   - Planned Sales Lifts
   - Consensus Forecast
   - Consensus Demand without Promotions

Save Result In: Select a key figure
Demand Sensing Forecast Model System Demo

- **Demand Sensing Full** → preprocessing + pattern recognition + post processing
- **Demand Sensing Update** → preprocessing + **Last pattern recognition** + post processing
Demand Sensing Forecasting Model System Demo
Planners Can Review Sensed Demand in Excel

Example: Under-forecasting

- Often many products in the portfolio are under-forecasted for several periods in a row (due to equal split or fixed quota?)
- Demand sensing understands such patterns in historical data, and adjusted the future forecasts accordingly
Planners Can Review Sensed Demand in Excel
Example: Periodic undersell / oversell patterns

- For many other products, customers have cyclical ordering patterns resulting in repeating over-under forecasts
- Demand sensing understands such patterns, and adjusts the future forecasts accordingly
Uplift Balancing
Promotion elimination process

Post-processing Step:

- Demand Sensing Pattern Recognition Run
- Promotions are added to sensed demand
- Sensed Demand matched against open orders
- Uplift balancing (future periods)
  Reduce added uplifts to Sensed Demand when associated with matched open orders
Understand Sensed Demand Results

Key Weekly Output Key Figures (KFs)

• **Review inputs**: Consensus Demand, Requested Qty. and Uplift (and PoS / Extra Signals if available) are the key inputs to my weekly demand sensing

• **Sales History w/o Promotion** shows sales cleaned from the uplift impact

• Via **Calculated Bias** review the detected over/underforecasting pattern, and via **Future Ordered Quantity Adjustment Factor** review how much lift/reduction factor is provided due to open orders

• If you would like to understand how much order was open at the running time of DS, and how Demand Sensing value is changed because of pattern recognition (optimization), capping, matching and balancing, review the next 5 KFs.

• **Sensed Demand Qty** is the final calculated weekly value.

• You can also review the log file for further information on relevant parameters after every DS run

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The algorithm disaggregates weekly sensed demand to daily, based on an optimal combination of three potential daily profiles:

- **Order Profile, Shipment Profile, and Consensus Forecast Profile**
  (you can also decide to disaggregate based on only one or two of these profiles → you need to request this from the Support team)

- Then the algorithm looks at available orders per day and carries out a correction step (match and balancing on day level)

- Furthermore, if uplifts are planned on the daily level, uplifts will be balanced and added to daily sensed demand.

- Weekly Sensed Demand is disaggregated based on the calculated profiles. (Shipment Profile Weight, Ordered Qty Profile Weight, Consensus Demand Profile Weight)

- For each profile, a disaggregation profile for each day of the week (0..6) is calculated in a KF
Demand Sensing Full Run and Update Run Demo
Demand Sensing System Demo-Full run and Update run

**Initial State**

- Sensed Demand is not yet calculated for Wk40-Wk45 2017
Demand Sensing System Demo-Full run and Update run

**After the full run**

- We run DS Full model usually once a week to predict demand based on the most recent demand patterns.

- After the Full DS run, Sensed Demand is calculated for Wk40-Wk45 2017 based on the preprocessing, pattern-recognition (bias and future order qty. adj factor) and post processing steps.
Demand Sensing System Demo-Full run and Update run

After the update run

- We run DS Update model everyday to adjust sensed demand based on the most recent input updates.

- Even within the week, some demand signals might get updated, e.g. Consensus demand is updated for wk40, wk41 and wk42.

- SD update run uses the last pattern recognition results and re-calculate sensed demand via pre- and post-processing steps.

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### Demand Sensing System Demo - Full run and Update run

**After the update run**

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<td>Calculated Bias</td>
<td></td>
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</tbody>
</table>

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Automate The Demand Planning Process

SAP IBP Alerts

- Best practice is to set threshold-based alerts to enable exception management
  - e.g., is Demand Sensing reducing or increasing forecast too much?

- Thresholds would depend on segmentation / importance of products, locations, or customers

- This enables planners to focus on the critical demand streams while the system automatically manages the rest
Demand Sensing Alert System Demo
Review DS KPI improvement to find out if you want to put some demand streams on your watch list.
KPI Reporting
SAP IBP Analytics and Dashboard
Demand Sensing Dashboard and Analytics Demo
KPI Reporting

Review products to be excluded
Extended Planning Process
With SAP IBP for demand and SAP APO

SAP Advanced Planning & Optimization (APO)

Demand Planning (DP)
Supply Network Planning (SNP)

Mid-Term Forecast
Short-Term Forecast

Demand Sensing in SAP Integrated Business Planning for demand

Market Research Data
Point-of-Sale (POS) Data

SAP Demand Signal Management

Master Data, Sales Orders
Forecast adjustments
Master Data, Sales Orders
POS Data

SAP Enterprise Resource Planning (ERP)

*POS Data Integration from DSiM towards IBP is available.
Case Study 1: Demand Sensing Weekly Forecast Accuracy Improvement

Global confectionary products company

- 14% reduction in forecast error across 5 weeks
- Reduction of forecast bias across 5 weeks
- Driven by significant over-forecasting bias, 7–8 day average order lead times, and complexity from large number of SKU location combinations
- Typically early adopters of Demand Sensing are those with stable and mature Demand Planning process who are looking for the next step on improvement

<table>
<thead>
<tr>
<th>Lag</th>
<th>Demand planning wMAPE</th>
<th>Demand sensing wMAPE</th>
<th>Absolute difference</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>53.1 %</td>
<td>15.0 %</td>
<td>38%</td>
<td>72%</td>
</tr>
<tr>
<td>1</td>
<td>49.7 %</td>
<td>34.2 %</td>
<td>15%</td>
<td>31%</td>
</tr>
<tr>
<td>2</td>
<td>53.0 %</td>
<td>39.4 %</td>
<td>14%</td>
<td>26%</td>
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<td>3</td>
<td>55.9 %</td>
<td>42.9 %</td>
<td>13%</td>
<td>23%</td>
</tr>
<tr>
<td>4</td>
<td>59.1 %</td>
<td>46.6 %</td>
<td>13%</td>
<td>21%</td>
</tr>
<tr>
<td>5</td>
<td>59.9 %</td>
<td>49.0 %</td>
<td>11%</td>
<td>18%</td>
</tr>
</tbody>
</table>

wMAPE = Weighted mean absolute percentage error
Case Study 2: Demand Sensing Weekly Forecast Accuracy Improvement
European Food/Dairy company

- Large planning team dedicated to daily forecasting. Therefore the forecast error on this level was already very good.
- Goal was to further improve the forecast while freeing up capacity in the planning team for other high priority projects.

<table>
<thead>
<tr>
<th>Lag</th>
<th>Customer wMAPE</th>
<th>Demand Sensing wMAPE</th>
<th>Abs. Diff.</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40%</td>
<td>37%</td>
<td>3%</td>
<td>5%</td>
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<tr>
<td>2</td>
<td>40%</td>
<td>38%</td>
<td>2%</td>
<td>4%</td>
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<tr>
<td>3</td>
<td>43%</td>
<td>40%</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Overall</td>
<td>41%</td>
<td>39%</td>
<td>2%</td>
<td>5%</td>
</tr>
</tbody>
</table>

wMAPE = Weighted mean absolute percentage error

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Case Study 2 (cont): Demand Sensing Daily Forecast Accuracy Improvement
European Food/Dairy company

- Large planning team dedicated to daily forecasting. Therefore the forecast error on this level was already very good
- Demand Sensing improves accuracy of daily forecast
- Customer will now be able to significantly improve planner productivity by automating demand sensing – which will allow planners to focus on strategic scenario analysis and understanding/shaping drivers of demand for hard-to-forecast products

<table>
<thead>
<tr>
<th>Lag</th>
<th>Customer’s DP wMAPE</th>
<th>IBP-D wMAPE</th>
<th>Abs. Diff.</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49%</td>
<td>44%</td>
<td>5%</td>
<td>9%</td>
</tr>
<tr>
<td>2</td>
<td>48%</td>
<td>46%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>3</td>
<td>50%</td>
<td>47%</td>
<td>3%</td>
<td>7%</td>
</tr>
<tr>
<td>Overall</td>
<td>49%</td>
<td>46%</td>
<td>3%</td>
<td>7%</td>
</tr>
</tbody>
</table>

wMAPE = Weighted mean absolute percentage error
SAP Integrated Business Planning Demand Sensing

Select future research direction

- Utilize monthly forecasts as input and automatically disaggregate to weekly and daily levels
- Utilize input forecasts at any aggregate hierarchy level and disaggregate to SKU-location-customer level for every week and day
- Support user-specified outlier periods as input and ignore these periods during machine learning / pattern detection
- Support flexible, user-configurable rules that guide the algorithm when to ignore balancing in a sensing horizon week
- Capability to handle multiple reference products with validity dates (predecessor chains) for complex NPI scenarios
- Explicitly learn from the impact of shortages as a feature in machine learning
- Capability to use granular location.factory calendars

1. This is the current state of planning and may be changed by SAP at any time without notice.
Thank you.

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