

Demand**Works**

Linking Forecasting with Operations and Finance

About the Speaker

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Consultant, Demand Works Company

- Solutions for forecasting, demand planning, inventory planning & optimization, finite capacity planning, and S&OP
- Used by over 450 corporations including many well-known brands
- Global: Solution currently supports 6 languages
 - English, Spanish, French, German, Italian, and Japanese

32 years experience with Heineken UK (previously Scottish & Newcastle) in supply chain and IT project management

7 years as Demand Manager and then Head of Planning at C&C Group (Magners cider, Tennents Lager, Heverlee etc)

DemandWorks



Sound familiar?

“We make to order so we don't need to forecast.”

“We did an analysis of our inventories a couple of years ago and decided to set our minimum inventories at about 30 day's of coverage.”

“It takes about a week to prepare for our S&OP meetings, and we almost always have to spend another week re-planning as our assumptions change.”

“We don't use the sales forecast. It's always wrong, and it's only updated once or twice per year anyway.”

“I've been here 4 years and sales still can't give me a volume budget by sku”

We Believe...

“Business forecasting is of little value unless it positively changes the way the business operates”

So, not only does forecasting need to be done well, but it also must be linked to manufacturing, procurement, logistics, marketing, finance, and strategic decision-making.

Linking Forecasting with Operations and Finance

- Mechanics
 - Linking for safety stock planning and inventory optimization
 - Linking strategic with tactical plans
 - Linking sales with operations
 - Linking with finance
 - Linking requirements and capacity
- Organizational Considerations
 - Building trust
 - Integrated business planning process
- The Role of Systems in S&OP

Safety Stock

- Safety stock is a function of the variability of demand during lead time
- Classical formulas don't require a forecast

$$SS = z * SD$$

Where:

SS = safety stock

z = the one-tailed z score

SD = the standard deviation

Or, if your calculating variances in a different time granularity than lead time

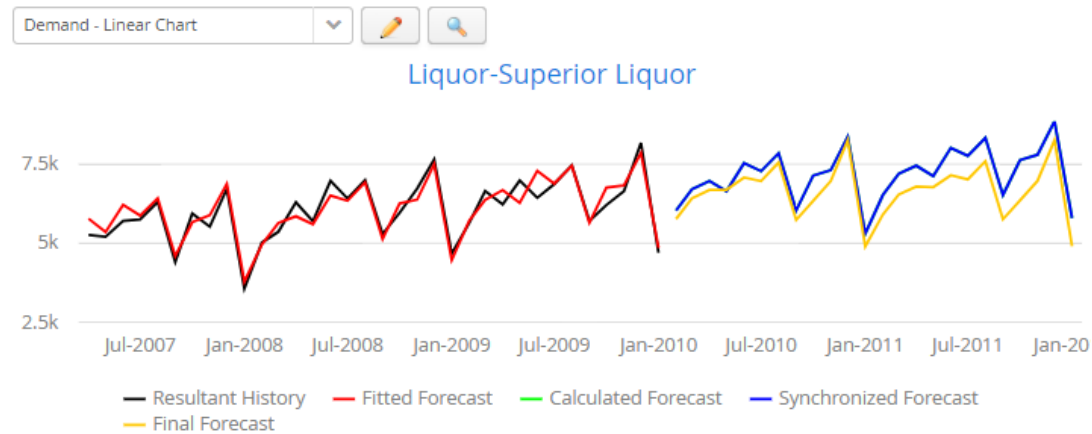
$$SS = z * SD * \text{SQRT}(LT/DFP)$$

Where:

LT = lead time (expressed in days)

DPF = days per forecast period

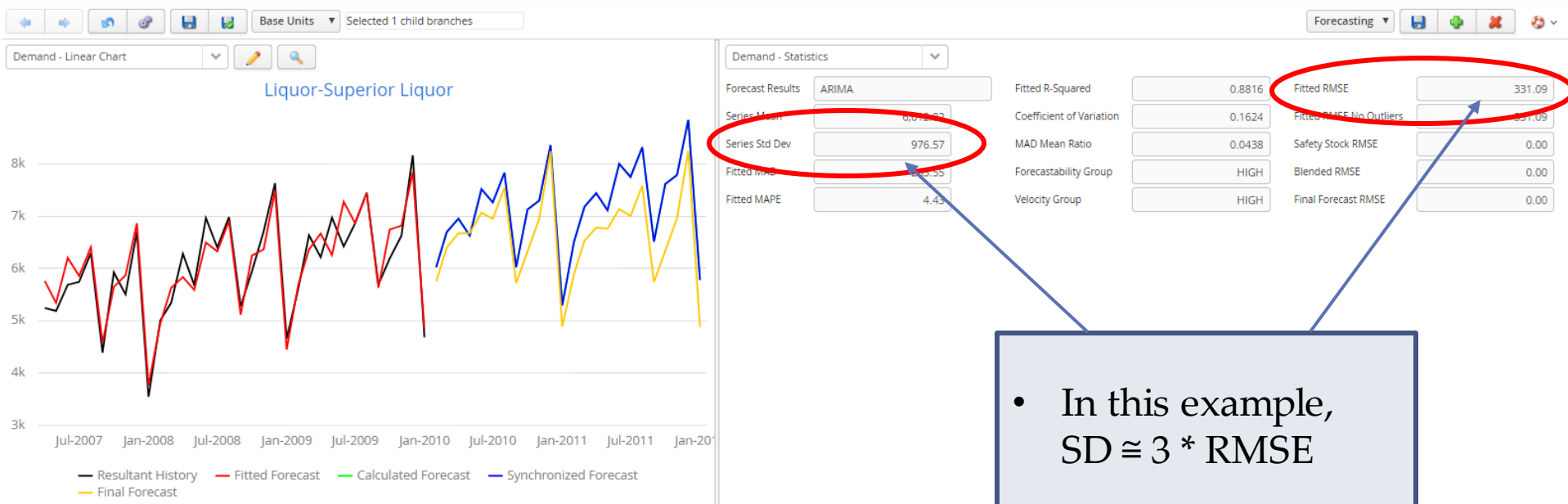
Trends and Seasonality



- SD fails to consider the portion of variability that can be explained by the model
- Therefore, most expert systems use **RMSE** (**R**oot **M**ean **S**quared **E**rror) instead of SD.

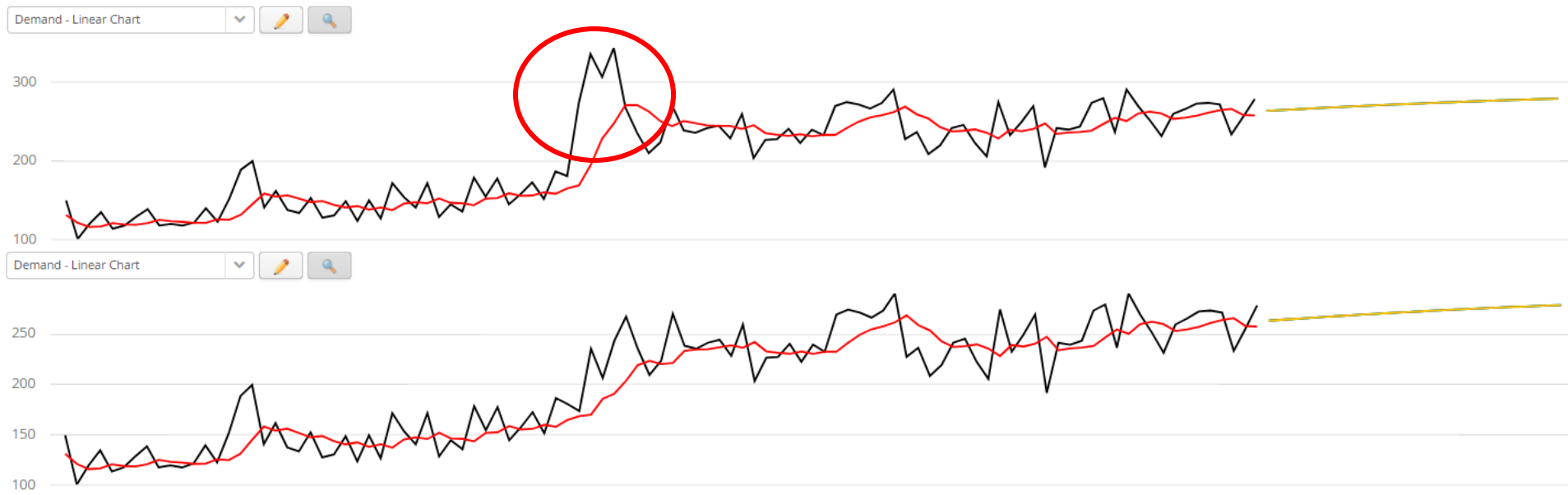
$$\text{RMSE} = \sqrt{\frac{1}{n} \sum_{j=1}^n (y_j - \hat{y}_j)^2}$$

RMSE vs. SD



- In this example,
 $SD \approx 3 * RMSE$
- This would cause
SS to be overstated
by 300%

Events & Outliers



- Correcting for the above 4 weeks of promotional demand reduced RMSE from 30.59 to 23.85 (**22%**)
 - Results in a 22% reduction in computed safety stock
 - It also improves the forecast

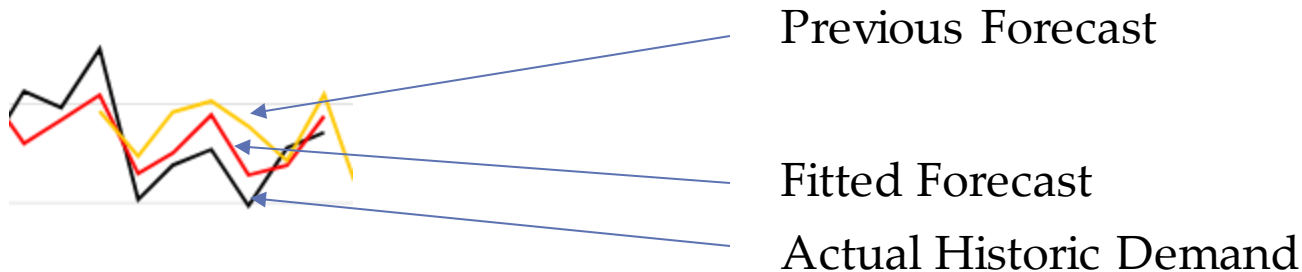
Correcting for Outliers

- It's never a good idea to automatically throw out outliers.
- Correct when...
 - You knew what caused the increase or decrease;
 - And, you knew it ahead of time,
- Don't correct when...
 - It's just normal variation;
 - You don't know the cause;
 - Or, you didn't have prior knowledge.
- Have a regular process to review and amend outliers where appropriate

“If you over-correct, then you'll under-stock”

The “Fit Problem”

- RMSE is a measure of fitted forecasts versus actuals
- It is not necessarily a measure of forecast accuracy



- Why they're different?
 - Statistical models usually “fit” history better than they “predict” the future
 - User intervention can improve or degrade the forecast

Supply Variability

- It is mathematically possible to consider the variability of supply as well.
 - Calculate both the supply and demand variances;
 - Then add them;
 - Then take the square root.
- Variable lead-time
 - Options
 - Increase the lead time inputs to your calculations
 - This is one reason why it's handy to separate the lead time that's used for safety stock optimization from the time fence that's used for planning
 - Manage “strategic inventories,” which are time-phased adjustments to minimum inventories
 - Holidays, shut-downs, seasonal shortages

Multi-Echelon

Independent Demand	0	0	0	0	0	0	0	0	0
Dependent Demand	22,945	20,248	18,921	21,508	15,386	10,462	9,197	9,922	16,686
Total Demand	22,945	20,248	18,921	21,508	15,386	10,462	9,197	9,922	16,686

- You also need to generate a forecast based on historic raw material requirements in order to solve for service-based safety stocks for raw materials
- Two Methods
 - Use the historic raw material usage
 - Use Demand Plan for finished goods, flushed through the BOM

Aligning Strategy with Tactics

Strategic

- Mid-range to long-range
- Monthly or quarterly
- Aggregate
 - Product
 - Geography
 - Channel
- Monetary units

Tactical

- Short-range to mid-range
- Weekly (or daily)
- Detailed
 - Items
 - Locations
 - Customers
 - Orders
- Quantities



Operational/Execution

Aligning Sales with Operations

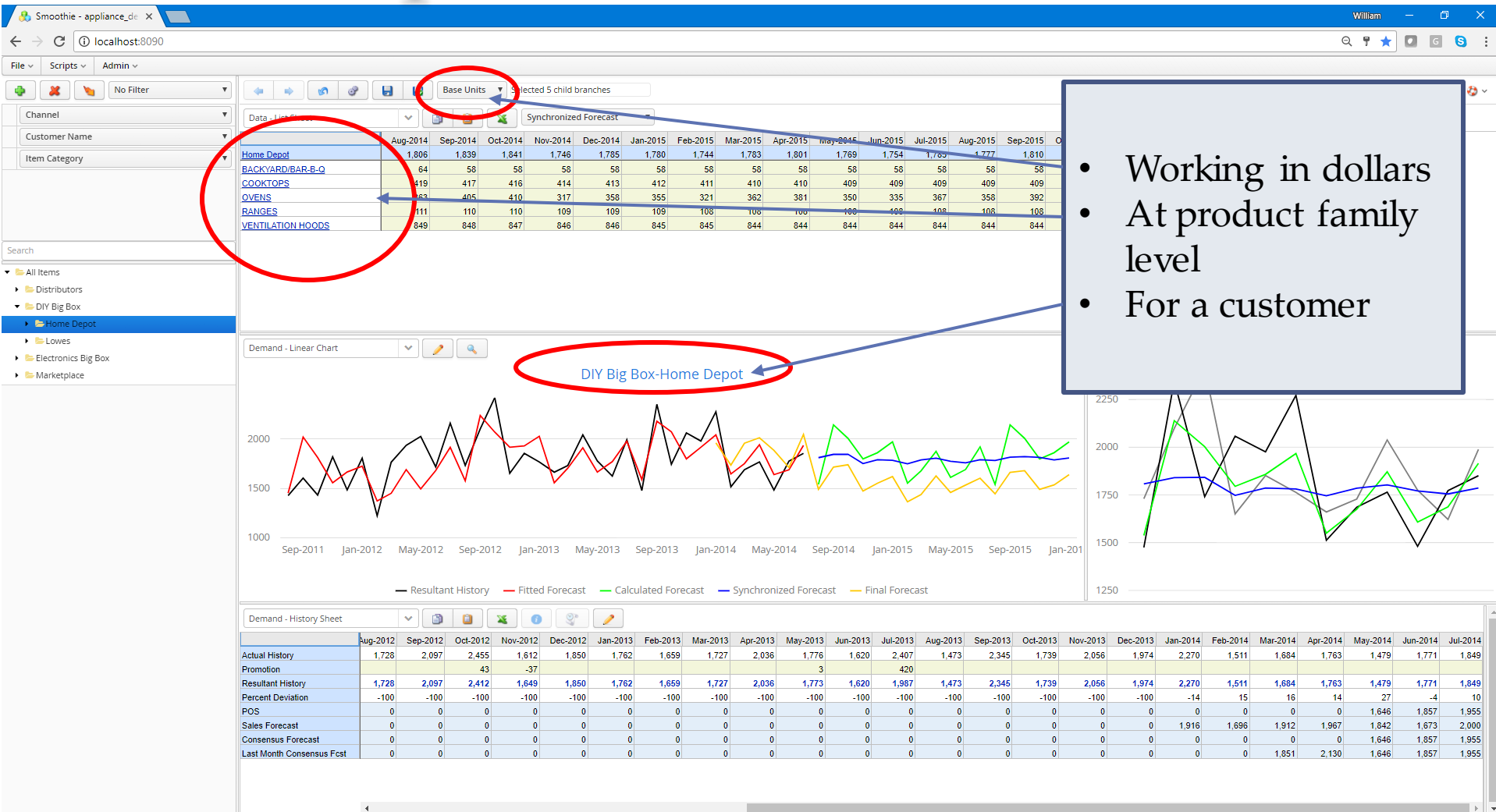
Sales

- Regions
- Customers
- Product Families
- Revenue
- Months

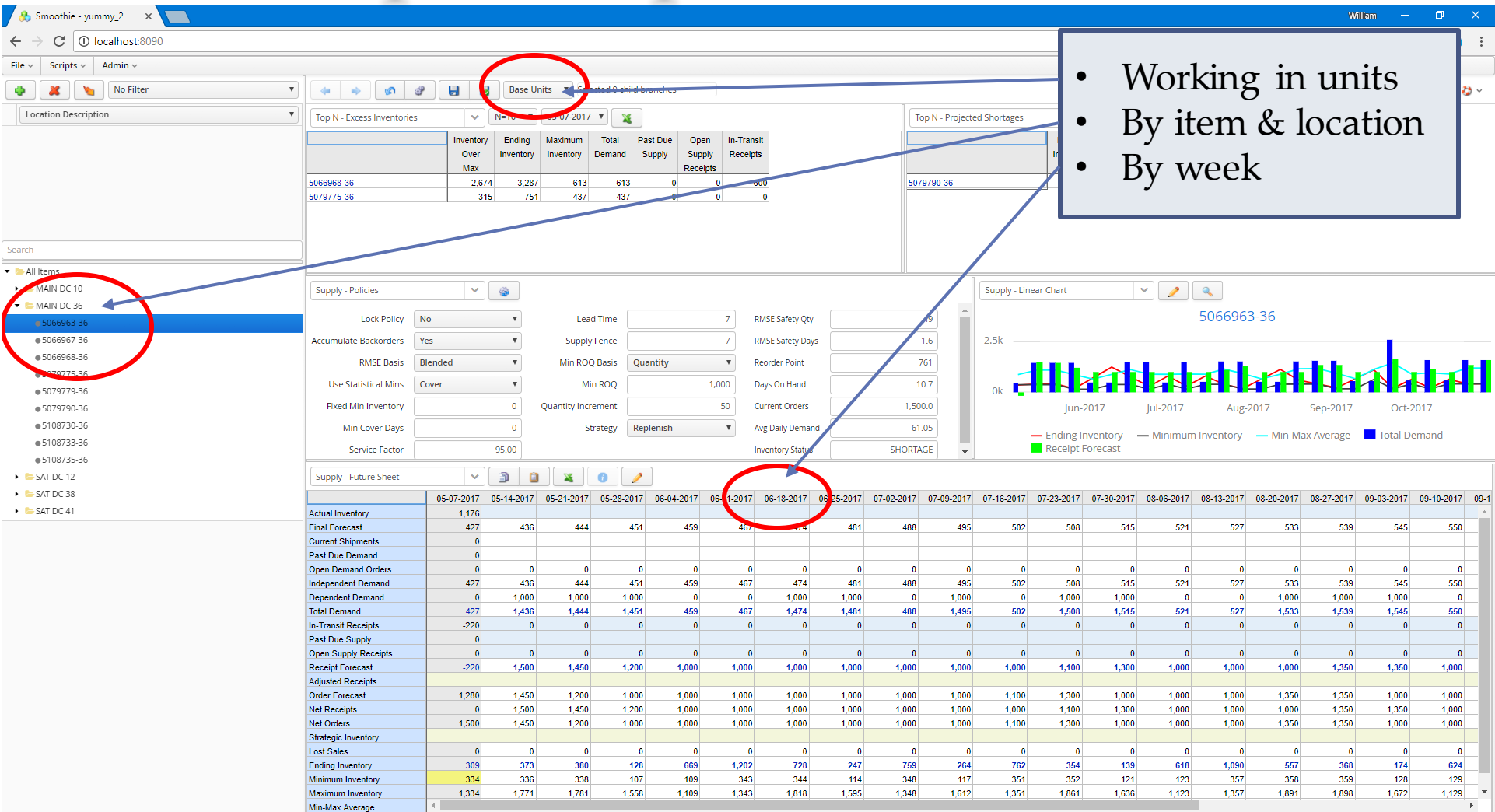
Operations

- Plants
- Warehouses
- Items
- Units, Cost
- Weeks

Example Sales Worksheet

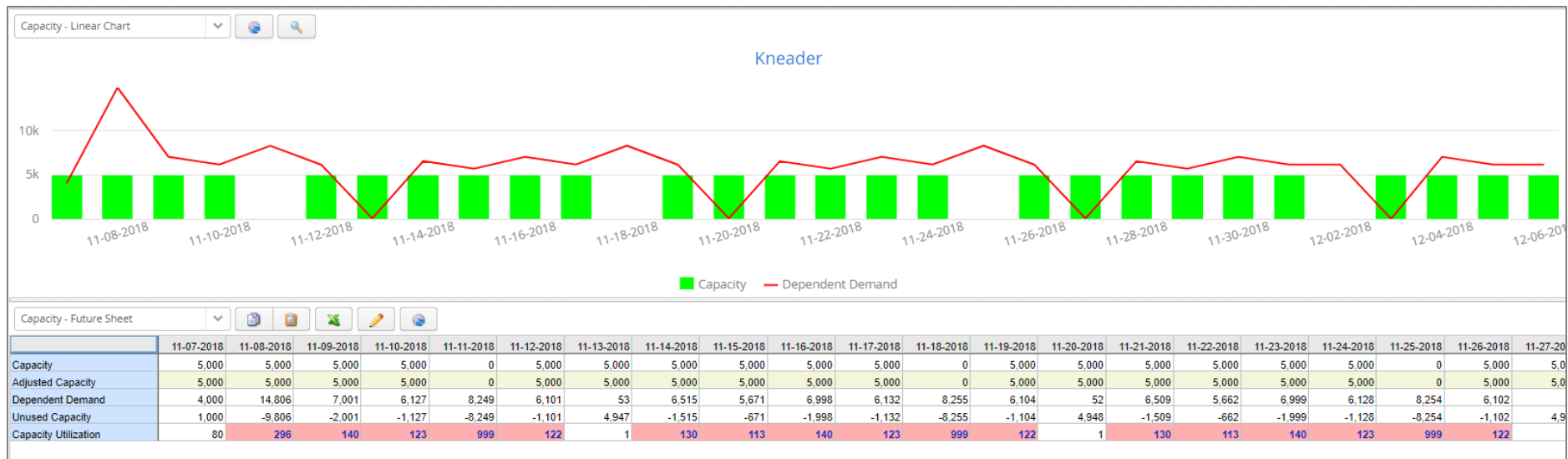


Example Operations View



Linking Production Forecasts with Capacity

- Finite Capacity Optimizations
 - Allocate production requirements over...
 - Alternative resources
 - Subject to varying capacity, cost and productivity
 - Time (produce early)
 - Carrying costs versus higher cost alternatives



The Bill of Resources

To Node	Created	Offset	Factor	Link Cost	Default %	Nov-2014	Dec-2014	Jan-2015	Feb-2015	Mar-2015
Oven Group 1	NO	0	0.0125	0.0110	65	758	705	638	575	557
Oven Group 2	NO	0	0.0084	0.0084	35	274	255	231	208	202

Materials Sales
Forecasts

Inventory Net
Requirements

Capacity Resource
Assignments
& Utilizations

Aligning with Finance

- Financial aggregations
 - Business unit
 - Country
- Monetary conversions
 - Price
 - Cost
 - Contribution/margin
- History must tie out with financial reports
 - Can't simply take unit history and multiply by fixed conversions
- Future plans must be able to reflect planned changes in prices and costs

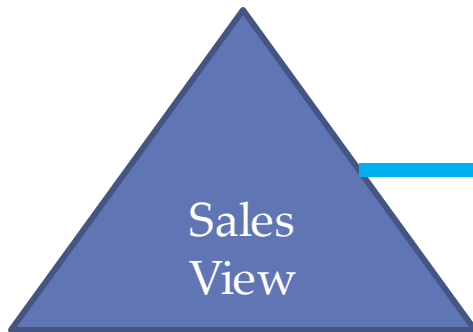
Alignment Summary

- Aggregate and disaggregate (or prorate)
 - Time
 - Product, geographic, and channel dimensions
- Convert
 - UOM/Equiv. Units
 - Units to currencies
 - Price, cost, margin...

Product Family
Product Sub-Family
Item

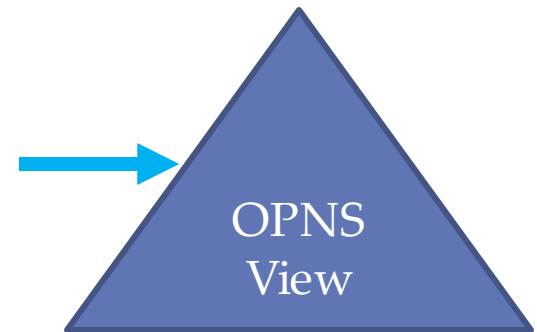
Channel
Customer Group
Customer Sold-to
Customer Ship-to

Region
Country
Warehouse
Resource



Product Family – Channel
- Region

- Spread monthly forecasts over weeks
- Prorate product families to items
- Prorate regions + channels to warehouses
- Convert \$ to units



Item – Warehouse
Requirement – Resource

Organizational Considerations

- Building trust
 - Forecast accountability is vital
 - Performance must be measured and reported...
 - ...Using the appropriate lags and actionable, operational levels of detail

“Aggregate forecast accuracy may not be correlated with accuracy at item-location levels, which is where production & procurement are planned and where inventory is held.”

Top N - Absolute Forecast Deviations N=10 Jul-2014

	Absolute Deviation	Final Forecast	Actual History	Deviation
PGM365-1S/NG-7	55	86	141	-55
REMP3-7	41	135	94	41
IVSR1-7	27	43	16	27
CABP3-7	21	94	73	21
SGM365S-7	19	51	70	-19
ECS230SBK/208V-7	17	17	0	17
IVSR2-7	15	39	24	15
MCS130S-7	15	71	86	-15
IVS2-7	13	74	61	13
SGM365S/LP-7	13	31	18	13

Demand - History Sheet

	Feb-2014	Mar-2014	Apr-2014	May-2014	Jun-2014	Jul-2014
Actual History	1,511	1,684	1,763	1,479	1,771	
Copied History	0	0	0	0	0	
Adjusted History						
Promotion						
Resultant History	1,511	1,684	1,763	1,479	1,771	
Fitted Forecast	1,641	1,745	1,937	1,634	1,683	
Final Forecast	1,730	1,951	2,007	1,880	1,707	
Forecast Deviation	219	267	244	401	-64	
Percent Deviation	15	16	14	27	-4	
WMAPE	44	42	33	50	33	

Organizational Considerations

- Basic S&OP Process

- Monthly demand review
 - Review previous action items
 - New products, launches, promotions, to-do's
 - Review forecast accuracy and discuss key deviations
 - Discuss and document key assumptions in current plan(s)
 - Mix, volume, and timing
- Monthly supply review
 - Analyze feasibility of current demand plan
 - Reconcile differences between detailed and aggregate plans
 - Determine whether adjustments need to be made
 - Mid-term
 - Changing vendor/plant assignments
 - Strategic inventories
 - Extra shifts, overtime
 - Long-term
 - New plants, suppliers, manufacturing methods, machinery
- Executive review
 - Present plan, recommended changes, and strategic/operational assumptions
 - Assess and manage risk
 - Seek approvals, as needed
 - Discuss process issues/opportunities



Does your company have a structured periodic process for aligning your organization and plans?

Systems for S&OP

ERP

- Manage master data
- Transaction processing, data capture and execution
- Repository for majority of structured corporate data

**HIGHLY
STRUCTURED**

Excel

- Ad hoc analysis
- Aggregate reporting and off-line distribution of information
- **Anything else that you don't have a system for...**

UNSTRUCTURED

S&OP Systems

- Align detailed and aggregate plans
- Align financial and operational plans
- Improve performance & precision with advanced analytical methods (forecasting, optimizations, etc.)
- Enable visibility
- Facilitate teamwork

SEMI-STRUCTURED

Systems for S&OP

ERP

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- Replace spreadsheets and custom reports
- Perform functions that spreadsheets and ERP systems are incapable of doing in a usable, precise, or scalable way

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THANK YOU!

Questions?