

#TC18

How Walgreens transformed Supply Chain Management with Kyvos, Tableau, and Big Data

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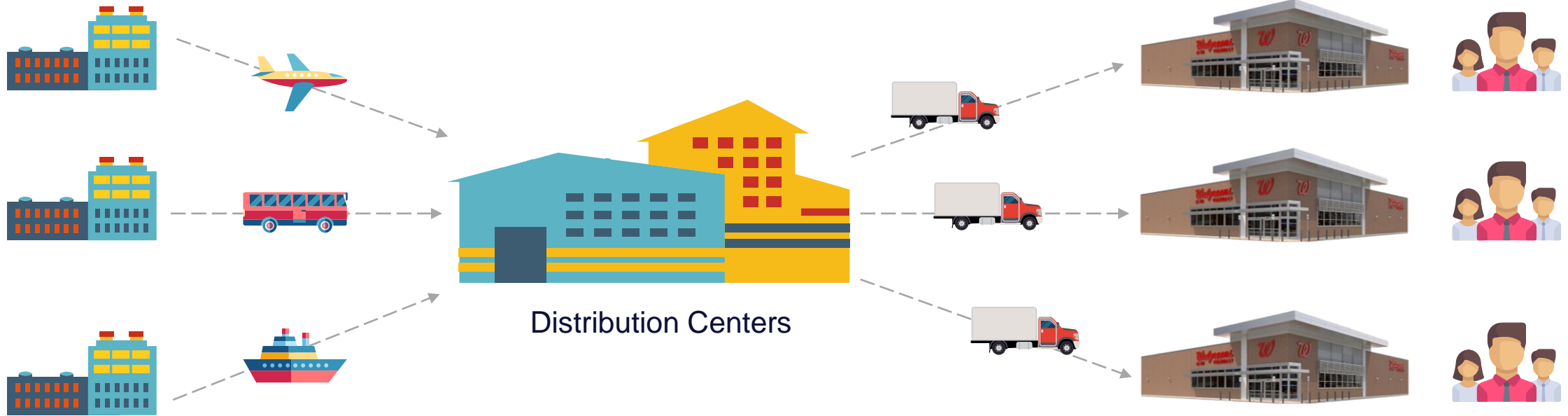
We champion the health and well-being of every community in America.

Walgreens



**40,000
Products**

Walgreens



20,000 Suppliers
40,000 Products

9,000 Stores
100 M Customers

Reporting Ecosystem



Tools

Tableau
Excel
SAS



Databases

DB2
Hive
Hadoop
Netezza
Oracle



Users

Analysts
Data Scientists
Leadership
Planners
Suppliers



Frequency

Daily
Weekly
Monthly
Quarterly

Overview | Reporting Landscape

Thousands of custom reports being created to support the business.

Forecasting

Supplier
Management

Out of Stock (Outs)



Inventory Purpose

Sales & Operations
Planning

Business Questions

| Scorecard | Questions |
|-----------|---|
| Forecast | <ul style="list-style-type: none"> • Items performance (forecast vs. actual sales) across stores & categories? What are the trends? • Accuracy of item level forecasting? <ul style="list-style-type: none"> – How do my forecasting results compare to other planners? • Item forecasts are most important to review today? |
| Suppliers | <ul style="list-style-type: none"> • Suppliers meeting their KPI goals? The overall trend? <ul style="list-style-type: none"> – Suppliers scoring best or worst by KPI? • For specific items and individual suppliers: <ul style="list-style-type: none"> – Purchase orders filled on-time? In full? If not, where are the biggest misses (research through drill down to PO detail). – Where is shrink or waste an issue? |

Business Questions

| Scorecard | Questions |
|-----------------------------|--|
| Out of Stock (Outs) | <ul style="list-style-type: none"> • Items currently out of stock? which categories or stores? <ul style="list-style-type: none"> – For how long? – Root causes? |
| Inventory Purpose | <ul style="list-style-type: none"> • Inventory plan impacting stores? DCs? What are the trends? • Inventory for each item by category? <ul style="list-style-type: none"> – Projected demand by store type? By promoted vs. basic items? – Biggest changes to inventory vs. prior week? • Reduce days of supply without impacting sales? |
| Sales & Operations Planning | <ul style="list-style-type: none"> • Performance against sales goals? • Promotions on the calendar for items? <ul style="list-style-type: none"> – Performance of similar items on prior promotions? – Inventory level for an item we want to promote? • Reliability of suppliers for this item? |

Data Size and Characteristics

| Use Case | Fact Rows | Dimensions | Measures | Data Grain | Time Window of Data |
|-------------------------------|--------------------|------------|----------|------------|---------------------|
| Forecast Scorecard | 62 Billion | 59 | 61 | Weekly | 104 weeks |
| Suppliers Scorecard | 42 Billion | 69 | 36 | Weekly | 104 weeks |
| Out of Stock (Outs) Scorecard | 6 Billion | 57 | 45 | Daily | 104 weeks |
| Inventory Purpose | 124 Billion | 48 | 41 | Weekly | 53 weeks |
| Sales & Operations Planning | 50 Billion | 56 | 36 | Daily | 104 weeks |

Challenges with Existing Systems

- High processing time—**manual compilation and aggregation** taking hours
- Building scorecards **time consuming** hence done monthly
- Slow response times—**minutes & hours to return queries**
- Resources **waiting for days** to get insights
- Contradicting reports because of **data silos** and **lack of common integration logic**
- Existing systems **not scalable** up to trillions of rows
- Not possible to **drill down** to granular details
- Tableau couldn't optimally perform due to **volume of data and query limitations**
- Connecting live via Hive did not work

What we wanted to achieve?

To create a performant solution where multiple prior attempts had not succeeded. Data volumes and query complexity exceeded Tableau's recommended best practices.

It seemed like an impossible task...

Trillions of records from 50+ tables and sources

Historical analysis at the lowest granularity with 30+ filters

Centralize and standardize data logic

High performance

Scalable architecture

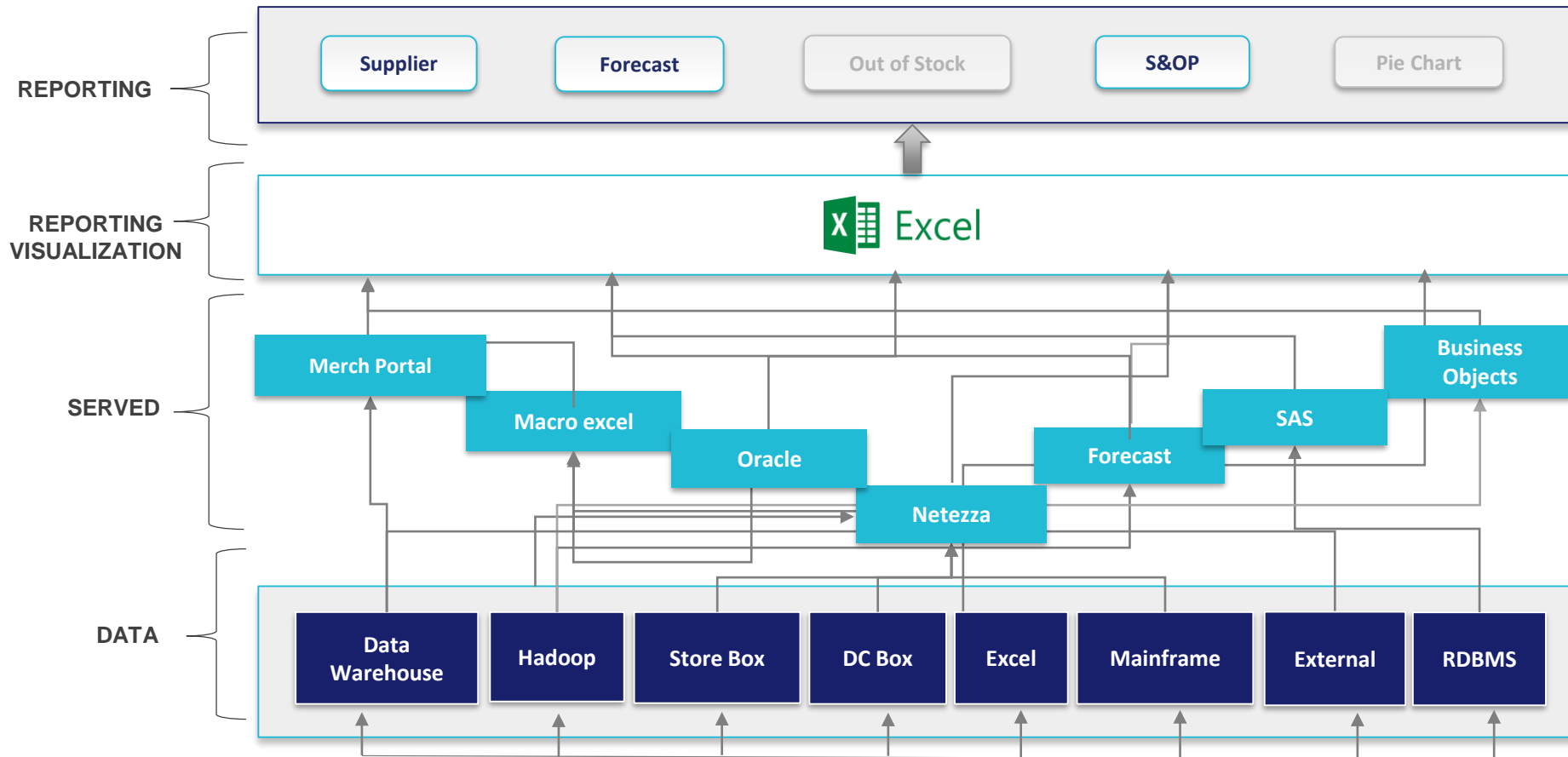
Self-service access – with controls

Security for internal and external users

Why we chose Kyvos?

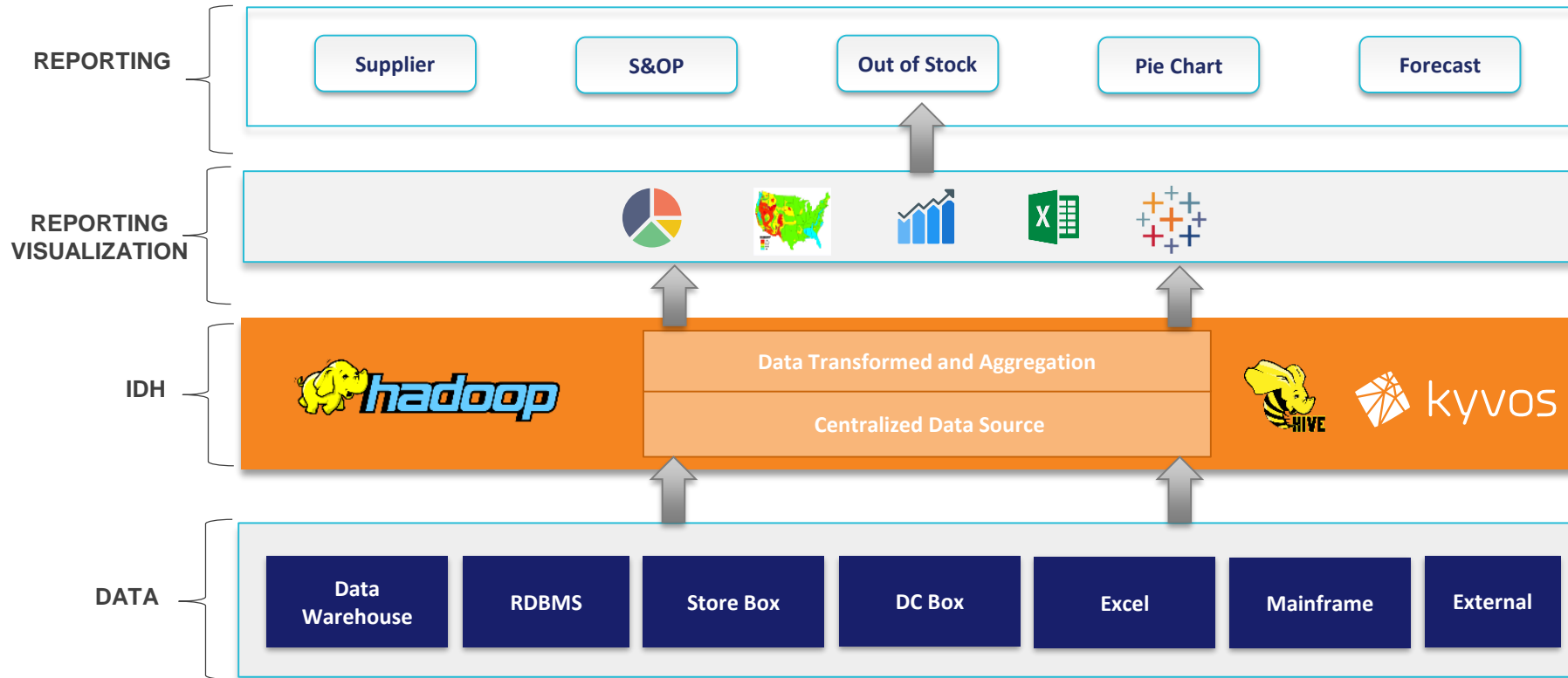
- Surpassed our SLAs—**sub-second responses** for most queries
- High concurrency—supports our **5,000 users and vendors**
- Scalability—availability of lowest grain for **2 years of data** across business units
- Flexibility—**immediate data access** as it becomes available
- Seamless connectivity with Tableau—**SQL connectivity** to maximize Tableau performance
- Responsiveness—excellent support and professional services

Walgreens Use Case—Old State



- Various methods of Scorecard and Dashboard Generation
- High Processing Time
- Inconsistent Data sets
- Data sourced from across the network
- Manual Report Generation

Walgreens Use Case—New State

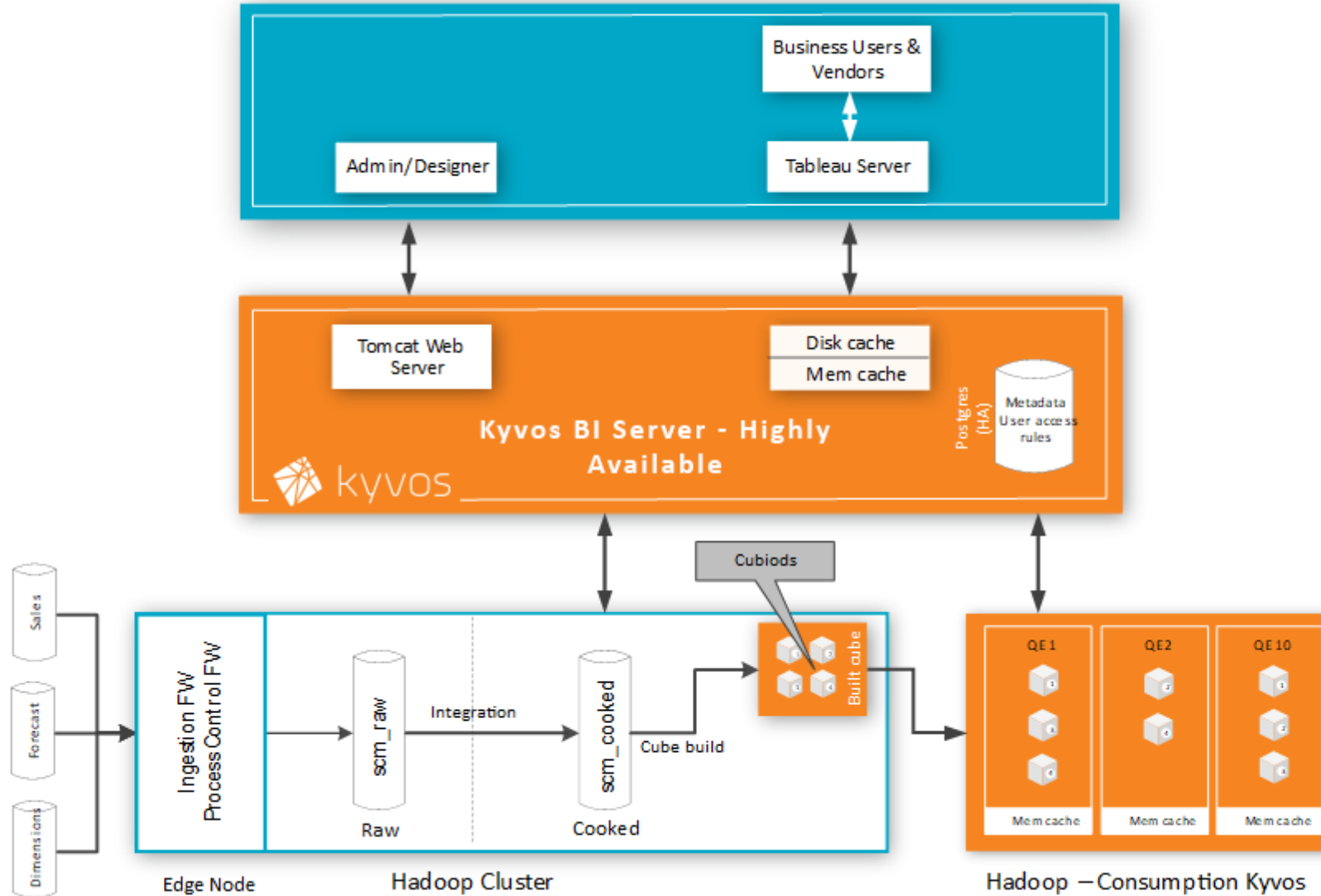


- Centralized scorecard and dashboard generation
- Reduced processing time for timely reports
- Data unification across the network
- Consistent data sets
- Highly-responsive dashboards

Tableau Performance with Kyvos

| Use Case | Fact Rows | Dimensions | Measures | Time Window of Data | Cube Size | Query Performance |
|-------------------------------|--------------------|------------|----------|---------------------|-----------|--------------------|
| Forecast Scorecard | 62 Billion | 59 | 61 | 104 Weeks | 74 TB | 10 seconds |
| Suppliers Scorecard | 42 Billion | 69 | 36 | 104 Weeks | 70 TB | 6.8 seconds |
| Out of Stock (Outs) Scorecard | 6 Billion | 57 | 45 | 104 Weeks | 19 TB | 8.2 seconds |
| Inventory Purpose | 124 Billion | 48 | 41 | 53 Weeks | 29 TB | 9 seconds |
| Sales & Operations Planning | 50 Billion | 56 | 36 | 104 Weeks | 74 TB | 7 seconds |

Walgreens Big Data Architecture



Supplier Performance Use Case

Objective: Enable our vendors to analyze their performance at each item and store level including lead times, shipment, and forecasts.

To provide row level security for each vendor's data.

Supplier scorecard fully automated, available weekly with KPIs on supplier performance

- Walgreens Supplier Management team able to **compare suppliers side by side**
- **Multiple reports** consolidated **into a single scorecard**
- Supports **complex filtering and queries** to identify trends and take action

Supplier direct access to their KPIs and performance trends with row level security

- KPIs for **week to date** and **year to date**
- **Current year Performance vs last year**
- KPI to PO Drill down to **line item detail**
- Best/Worst performing items

Supplier Performance Use Case

Scorecard updated weekly with drill down to PO Line and Shipment details by vendor

The dashboard displays a 'Supplier Scorecard - Analyst View' with a table of performance metrics and a 'Supplier Scorecard - Supplier PO Line' view showing 'DC Vendor Level Details' and 'PO Line Item' data.

Supplier Scorecard - Analyst View Table:

| vend_nbr | SSIS Current Period | SSIS Previous Period | SSIS Percent Change | DC SL Current Period | DC SL Previous Period | DC SL Percent Change | OTFR Current Period | OTFR Previous Period | OTFR Percent Change |
|----------|---------------------|----------------------|---------------------|----------------------|-----------------------|----------------------|---------------------|----------------------|---------------------|
| | 98.42% | 98.56% | -0.14% | 99.28% | 99.55% | -0.28% | | | |
| | 96.61% | 97.23% | -0.62% | 75.87% | 80.84% | -4.97% | | | |
| | 98.94% | 99.13% | -0.18% | 87.70% | 96.28% | -8.58% | | | |
| | 98.56% | 98.55% | 0.01% | 94.82% | 96.96% | -2.14% | | | |
| | 98.09% | 98.01% | 0.09% | 87.42% | 90.98% | -3.56% | | | |
| | 99.08% | 99.04% | 0.04% | 89.22% | 95.68% | -6.46% | | | |
| | 96.25% | 96.72% | -0.47% | 63.16% | 68.49% | -5.33% | | | |
| | 97.53% | 97.05% | 0.48% | 97.23% | 95.52% | 1.72% | | | |

Supplier Scorecard - Supplier PO Line - DC Vendor Level Details Table:

| vend_nbr | vend_name | po_nbr | OTFR | Fill Rate | Rev Ordered Units |
|----------|-----------|----------|---------|-----------|-------------------|
| 16 | | 6722459 | 100.00% | 100.00% | 24 |
| | | 6726638 | 100.00% | 100.00% | 24 |
| | | 10714713 | 100.00% | 100.00% | 24 |
| | | 11718542 | 100.00% | 100.00% | 24 |
| | | 17714713 | 100.00% | 100.00% | 24 |
| 25 | | 24715116 | | | |
| | | 24716083 | 72.93% | 72.93% | 10,464 |
| | | 24719743 | | | |
| | | 24723066 | 82.92% | 82.92% | 11,571 |
| 46 | | 1712882 | | | |
| | | 1716757 | 0.00% | 100.00% | 1,656 |
| | | 1720656 | | | |
| | | 3712882 | 100.00% | 100.00% | 1,584 |
| | | 3716757 | | | |
| | | 3720656 | 100.00% | 100.00% | 2,088 |
| | | 4712882 | | | |
| | | 4716757 | 0.00% | 100.00% | 1,008 |
| | | 4720656 | | | |
| | | 6712882 | 100.00% | 100.00% | 1,368 |
| | | 6716757 | | | |
| | | 6720656 | 100.00% | 100.00% | 1,800 |
| | | 8712882 | | | |

Supplier Scorecard - Supplier PO Line - PO Line Item Table:

| dc_loc_name | po_nbr | po_line_n.. | wic_nbr | ops_dept_nbr_name | Rev Ordere.. | effective_orde.. | tot_rcvd_units | vendor_on_ti.. |
|----------------|----------|-------------|---------|-------------------|--------------|------------------|----------------|----------------|
| CONNECTICUT DC | 17714713 | 1 | | | 24.00 | 24.00 | 24.00 | 24.00 |
| PERRYSBURG DC | 11718542 | 1 | | | 24.00 | 24.00 | 24.00 | 24.00 |
| WAXAHACHIE DC | 10714713 | 1 | | | 24.00 | 24.00 | 24.00 | 24.00 |
| WOODLAND DC | 6722459 | 1 | | | 24.00 | 24.00 | 24.00 | 24.00 |
| | 6726638 | 1 | | | 24.00 | 24.00 | 24.00 | 24.00 |

Supplier Performance Use Case

Side by Side
Supplier
Comparisons

The dashboard is titled "Supplier Scorecard - Supplier Comparison" and features a navigation bar with tabs: Executive Dashboard, Analyst View, Store View, DC View, DC Supplier PO Line Details, GMM View, Scatter Plot Comparison, and Supplier Comparison. A left sidebar contains filters for "Select Views", "Select Ad Week" (6/18/2018), "Select Time Frame", and three supplier selection dropdowns: Supplier 1 (31120 - GHIRARDELLI COMPANY), Supplier 2 (48100 - MARS INC), and Supplier 3 (45185 - LINDT & SPRUNGLI). Below these are "Merchandising Hierarchy" filters for GMM, DMM, and CM, and "Vendor Filters" for Parent Vendor and Brand.

The main content area is divided into three columns, each representing a supplier's performance metrics. Each column has a header with the supplier name and a list of 20 metrics. The metrics are grouped into four categories: COGS, DC SL, Fill Rate, and Inventory. Each metric is displayed in a blue bar chart format, showing the current period value and the previous period value. The metrics for each supplier are as follows:

- Supplier 1: 31120 - GHIRARDELLI COMPANY**
 - COGS Current Period
 - COGS Previous Period
 - COGS Percent Change
 - DC SL Current Period
 - DC SL Previous Period
 - DC SL Percent Change
 - Fill Rate Current Period
 - Fill Rate Previous Period
 - Fill Rate Percent Change
 - HDOS Current Period
 - HDOS Previous Period
 - HDOS Percent Change
 - FDOS Current Period
 - FDOS Previous Period
 - FDOS Percent Change
 - Inventory \$ Current Period
 - Inventory \$ Previous Period
 - Inventory \$ Percent Change
 - OTFR Current Period
 - OTFR Previous Period
 - OTFR Percent Change
 - SSIS Current Period
 - SSIS Previous Period
 - SSIS Percent Change
 - Sales \$ Current Period
 - Sales \$ Previous Period
 - Sales \$ % Change
- Supplier 2: 48100 - MARS INC**
 - COGS Current Period
 - COGS Previous Period
 - COGS Percent Change
 - DC SL Current Period
 - DC SL Previous Period
 - DC SL Percent Change
 - Fill Rate Current Period
 - Fill Rate Previous Period
 - Fill Rate Percent Change
 - HDOS Current Period
 - HDOS Previous Period
 - HDOS Percent Change
 - FDOS Current Period
 - FDOS Previous Period
 - FDOS Percent Change
 - Inventory \$ Current Period
 - Inventory \$ Previous Period
 - Inventory \$ Percent Change
 - OTFR Current Period
 - OTFR Previous Period
 - OTFR Percent Change
 - SSIS Current Period
 - SSIS Previous Period
 - SSIS Percent Change
 - Sales \$ Current Period
 - Sales \$ Previous Period
 - Sales \$ % Change
- Supplier 3: 45185 - LINDT & SPRUNGLI**
 - COGS Current Period
 - COGS Previous Period
 - COGS Percent Change
 - DC SL Current Period
 - DC SL Previous Period
 - DC SL Percent Change
 - Fill Rate Current Period
 - Fill Rate Previous Period
 - Fill Rate Percent Change
 - HDOS Current Period
 - HDOS Previous Period
 - HDOS Percent Change
 - FDOS Current Period
 - FDOS Previous Period
 - FDOS Percent Change
 - Inventory \$ Current Period
 - Inventory \$ Previous Period
 - Inventory \$ Percent Change
 - OTFR Current Period
 - OTFR Previous Period
 - OTFR Percent Change
 - SSIS Current Period
 - SSIS Previous Period
 - SSIS Percent Change
 - Sales \$ Current Period
 - Sales \$ Previous Period
 - Sales \$ % Change

Out of Stock Items

Out of Stock trends for Puerto Rico stores, filtered on selected OpStudies

Landing Page | Executive Outs | Executive Activity | SC Owner Root Cause | SC Owner Details | Benchmark | Raw Data

Outs Scorecard: Landing Page

Currently viewing data for selected date: 10/13/2018
Max date in dataset: 10/13/2018

Select Filters

Mandatory

Date: 10/13/2018

Optional

Owner
GMM: (All) | Demand Manager: (All) | Demand Planner: (All)

Item
Opstudy: (Multiple values) | SSIS: Include

Store
Market: 9 - Puerto Rico | MDG: (All) | State: (All)

Vendor
Market Vendor: (All) | DC Vendor: (All)

Navigate to view

Executive Outs

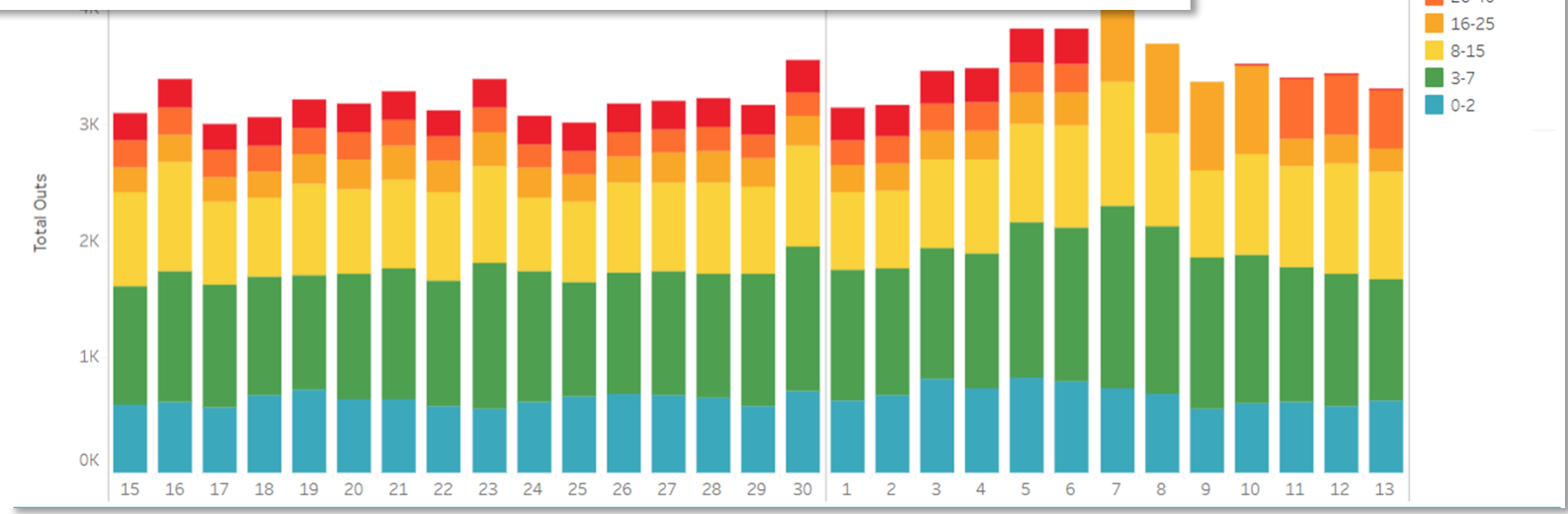
Executive Activity

SC Owner Root Cause

SC Owner Details

Benchmark

Raw Data



Inventory Purpose

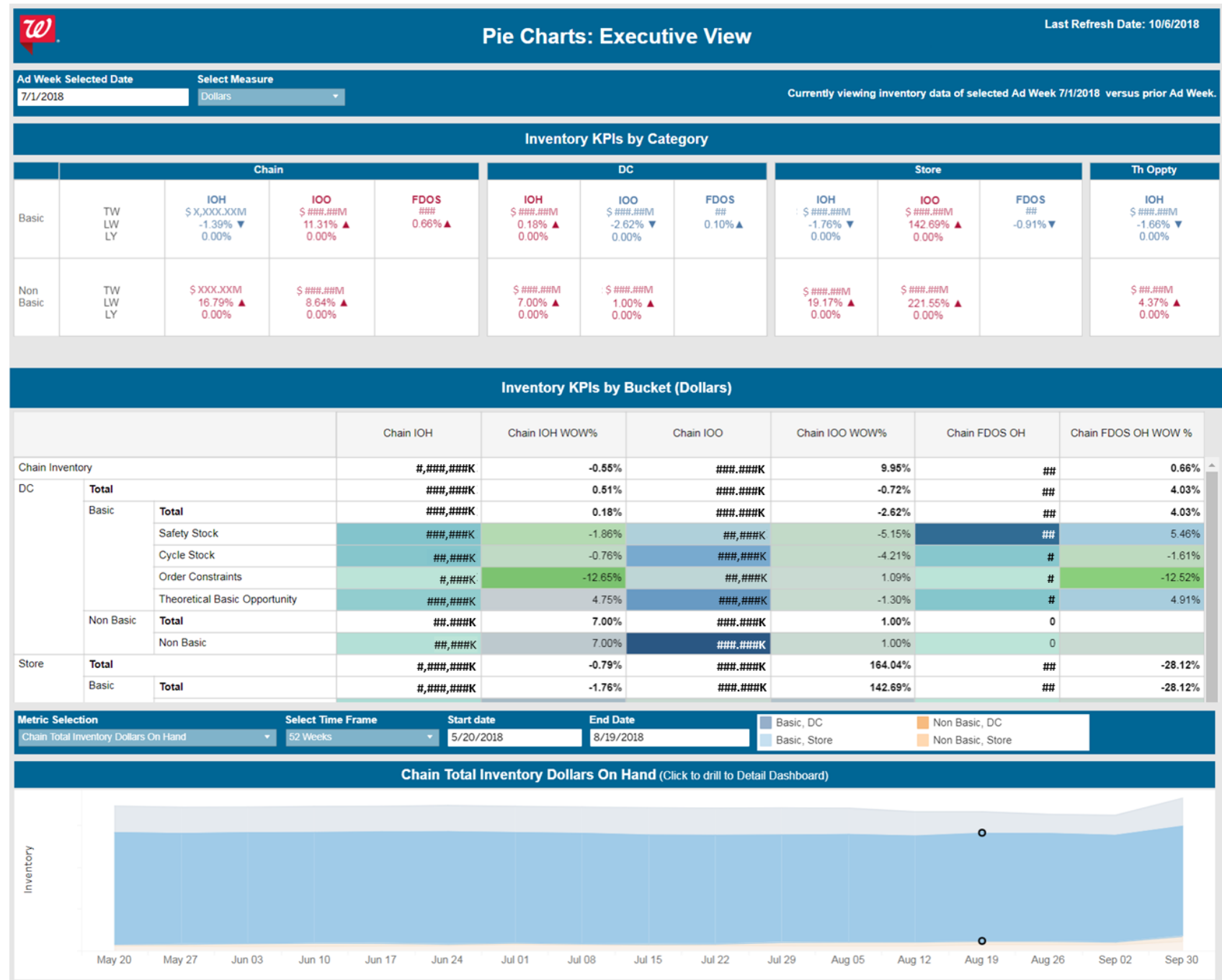
Objective: Identify ways to reduce excess days of supply across 9,000 stores by analyzing all products at the store and distribution center level.

- Critical component of Supply Chain
- Four business units—different planning and forecasting needs for each
- Need to engage vendors and merchants to stock the right SKUs
- Inventory Management flow—tracking inventory to DCs and stores for better customer experience



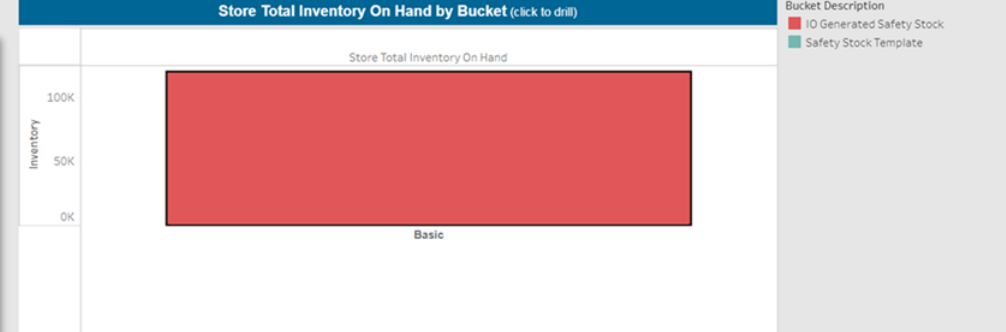
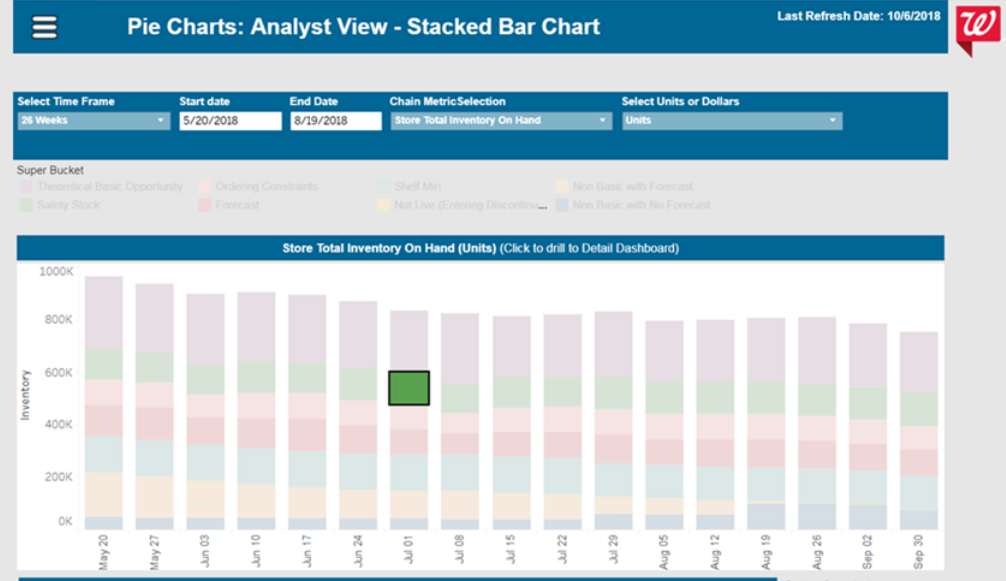
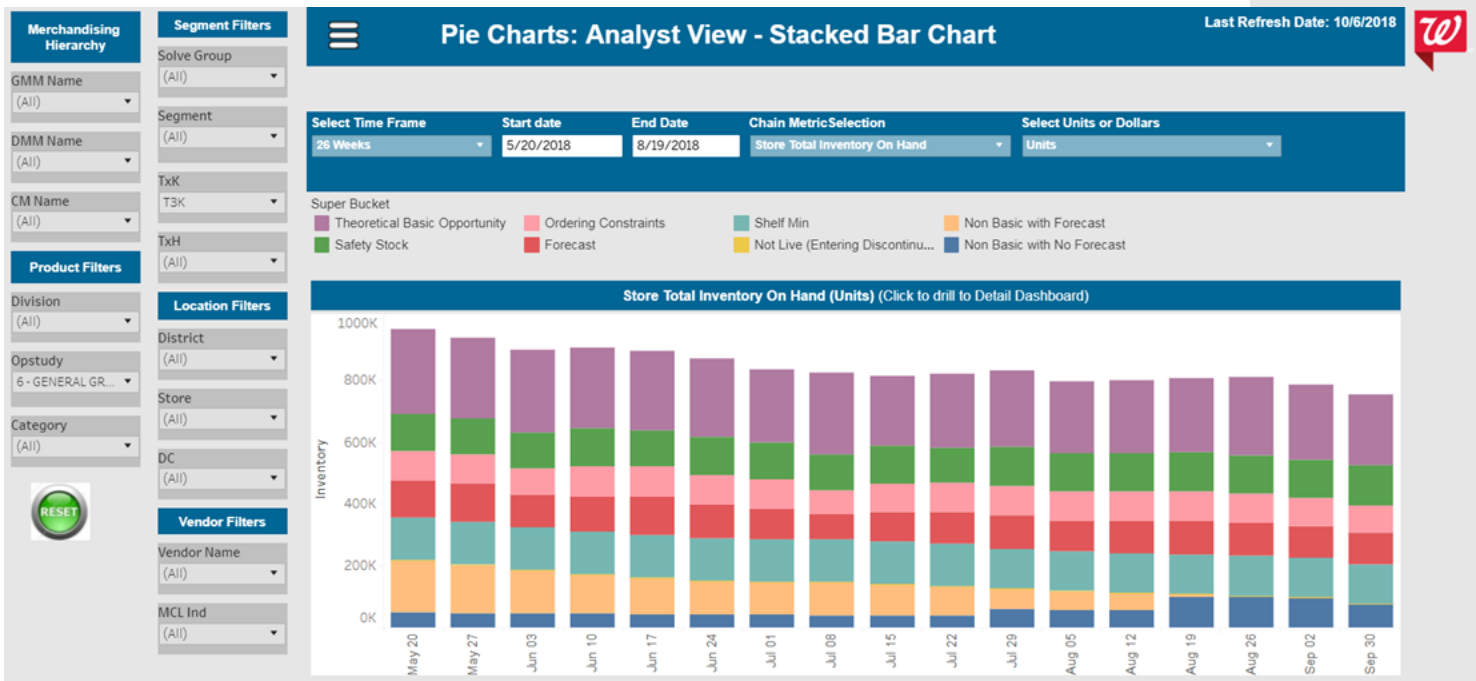
Inventory Purpose

- Current positions for all levels in the supply chain
 - YoY comparisons
 - WoW comparisons
 - Largest changes by category
- Visual guides to identify patterns, drill for details, make adjustments
- Chart builder tool to identify outliers, research issues



Inventory Purpose

Drilldown to details against 2 billion records per week



| Inventory Details | | | | | | |
|--|-----------------------|--------------------|--------------------|-----------------|-----------------|--------------------|
| Planlink Desc | Opstudy Department | Chain IOH Selected | Chain IOO Selected | DC IOH Selected | DC IOO Selected | Store IOH Selected |
| 40000507946 - CHICKEN/SEA LIGHT TUNA WATER 50Z | 6 - GENERAL GROCERIES | 3,242 | 15 | 0 | 0 | 3,242 |
| 40000916649 - ARMOUR VIENNA SAUSAGE 4.60Z CAN | 6 - GENERAL GROCERIES | 2,026 | 5 | 0 | 0 | 2,026 |
| 40000404160 - OLD EL PASO TACO SEASONING MX 10Z | 6 - GENERAL GROCERIES | 1,846 | 16 | 0 | 0 | 1,846 |
| 40000397507 - BUMBLE BEE TUNA SALAD/CRKR 3.50Z | 6 - GENERAL GROCERIES | 1,833 | 6 | 0 | 0 | 1,833 |
| 40000920737 - NICE! PRUNES POUCH 90Z | 6 - GENERAL GROCERIES | 1,766 | 4 | 0 | 0 | 1,766 |
| 40000303156 - JIF PEANUT BUTTER CREAMY 160Z | 6 - GENERAL GROCERIES | 1,562 | 2 | 0 | 0 | 1,562 |
| 40000487433 - HEINZ KETCHUP EZ SQUEEZE 320Z | 6 - GENERAL GROCERIES | 1,553 | 13 | 0 | 0 | 1,553 |
| 40000360990 - BUSH S BEST BAKED BEANS ORIG 8.3Z | 6 - GENERAL GROCERIES | 1,530 | 9 | 0 | 0 | 1,530 |
| 40000981999 - NICE! INVERTED HONEY SQUEEZE 240Z | 6 - GENERAL GROCERIES | 1,535 | 0 | 0 | 0 | 1,535 |
| 40000513220 - BUMBLE BEE CHNK LGHT TUNA WTR 50Z | 6 - GENERAL GROCERIES | 1,489 | 2 | 0 | 0 | 1,489 |
| 40000464531 - BUMBLE BEE SLD WHITE TUNA WATR 50Z | 6 - GENERAL GROCERIES | 1,488 | 13 | 0 | 0 | 1,488 |
| 40000979595 - NICE! UNSWTND APPLE SCE RG 40Z 4S | 6 - GENERAL GROCERIES | 1,476 | 7 | 0 | 0 | 1,476 |
| 40000445798 - HIDDEN VALLEY ORIG RANCH 160Z | 6 - GENERAL GROCERIES | 1,272 | 6 | 0 | 0 | 1,272 |
| 40000490717 - GR GIANT WHL KERNEL CORN 15.250Z | 6 - GENERAL GROCERIES | 1,245 | 12 | 0 | 0 | 1,245 |
| 40000833423 - HORMEL MARY KTCN CRND BF HSH 140Z | 6 - GENERAL GROCERIES | 1,242 | 4 | 0 | 0 | 1,242 |
| 40000633639 - SWEET BABY RAYS BBQ SAUCE ORIG18Z | 6 - GENERAL GROCERIES | 1,234 | 15 | 0 | 0 | 1,234 |
| 40000361222 - DOLE PINEAPPLE CHUNKS 200Z | 6 - GENERAL GROCERIES | 1,201 | 5 | 0 | 0 | 1,201 |

Performance: Tableau on Kyvos

Inventory Purpose Example Introduction

- Filtering 30+B Inventory Records
- Across 17 weekly partitions
- For multiple store segments...
- In under 10 Seconds



Merchandising Hierarchy

GMM Name
(All) ▾

DMM Name
(All) ▾

CM Name
(All) ▾

Product Filters

Division
(All) ▾

Opstudy
(All) ▾

Category
(All) ▾



Segment Filters

Solve Group
(All) ▾

Segment
(All) ▾

TxK
(All) ▾

TxH
(All) ▾

Location Filters

District
(All) ▾

Store
(All) ▾

DC
(All) ▾

Vendor Filters

Vendor Name
(All) ▾

MCL Ind
(All) ▾

Pie Charts: Analyst View - Stacked Bar Chart Last Refresh Date: 10/6/2018



Select Time Frame: 26 Weeks ▾ | Start date: 5/20/2018 | End Date: 8/19/2018 | Chain Metric Selection: Store Total Inventory On Hand ▾ | Select Units or Dollars: Units ▾

Super Bucket

- Theoretical Basic Opportunity
- Order Constraints
- Cycle Stock
- Safety Stock
- Non Basic
- Or

Store Total Inventory On Hand (Units) (Click to drill to Detail Dashboard)



Tableau/Kyvos Development Key Points

- **Leverage the Strengths of both parts**
 - Pause/Resume when changing filters
 - Help users make good design tradeoffs (e.g. breadcrumbs, no. of filters)
- **Getting the data design right upfront is key**
 - Hierarchies must be fully qualified in Kyvos
 - Measures should be defined in advance
 - TDS file from Kyvos required to show hierarchy in Tableau
- **Appropriate partition schema is critical**
 - Optimize based on analyst use cases
 - Use Kyvos Partitioning to support fast query response time
- **Minimize Tableau layer calculations**
 - Weighted calculation using LOD function of Tableau
 - Data source joins

Benefits

Technical

- Super fast response times on trillions of rows
- On-demand analysis
- Instant insights
- Single source of truth
- Minimal IT dependency
- Scheduled automated pre-aggregation
- Drill down to lowest level of granularity
- Tableau on steroids

Business

- Reduced time to insight
- Better forecasting visibility
- Granular drill down that was impossible before
- Improved supply planning
- Reducing out of stock items
- Cost savings on excess inventory
- Enhanced supplier collaboration
- Identify sales opportunities sooner
- Ability to share and collaborate across teams

Lessons Learned

- A picture paints a thousand words
- It's very important to provide accurate visualizations
- Criticality of data visualization at this scale
- Deliver essential information and make visualizations user friendly
- Focus on exact business requirements
- Technology stack is important, but correct infrastructure is more important
- Choosing the right technology partners

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Q & A

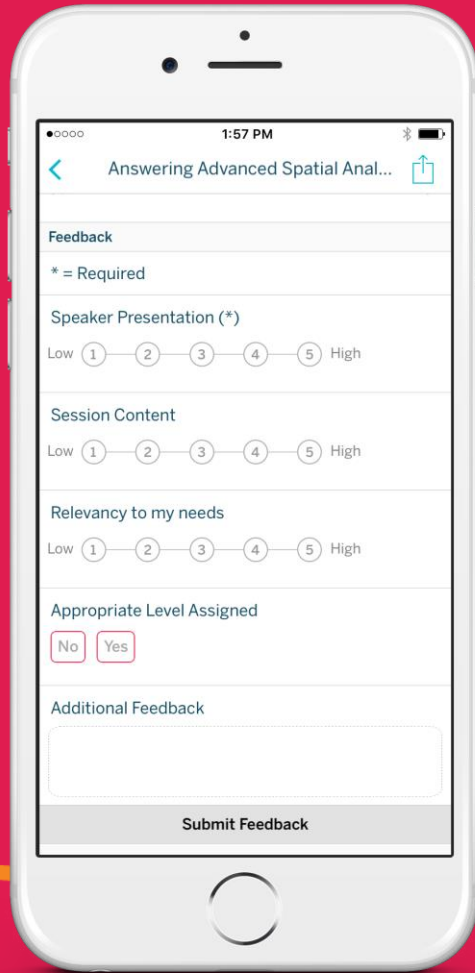


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Thank you!

Meet Kyvos Team at Booth #628



Please complete the
session survey from the
Session Details screen
in your TC18 app

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