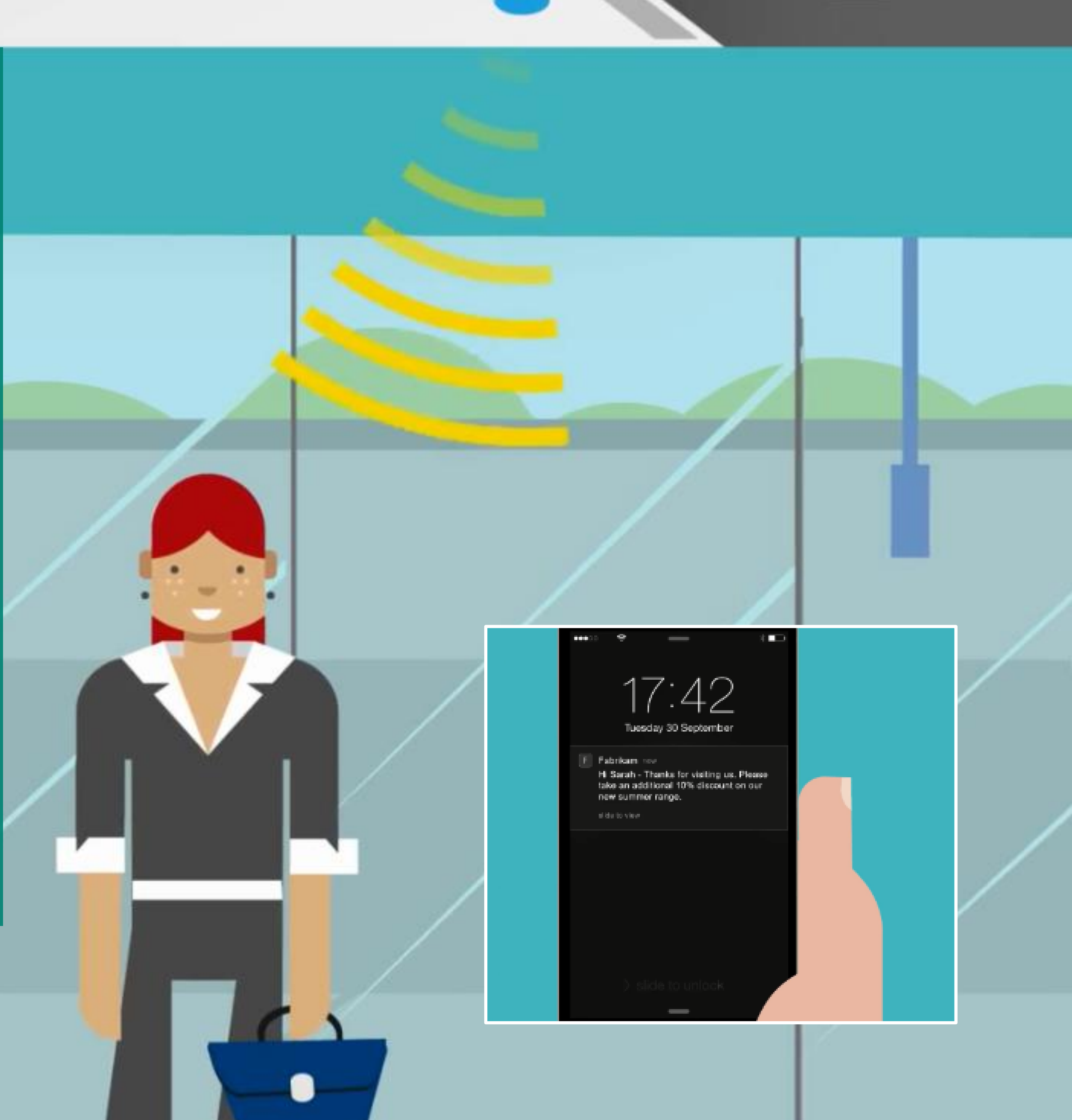
Intelligent Retail with Machine Learning approach

Dmitriy Solopov

Microsoft



TRANSFORM with **DATA**

Modern retail is data driven

Digital transformation
enables the best of online & offline

Location sales

Try on and try out products
Face-to-face info
In-store behavior

Remote sales

Social connection/user reviews
Product/price comparison
Online history

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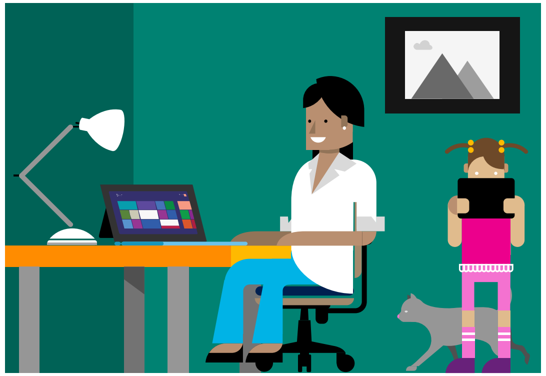
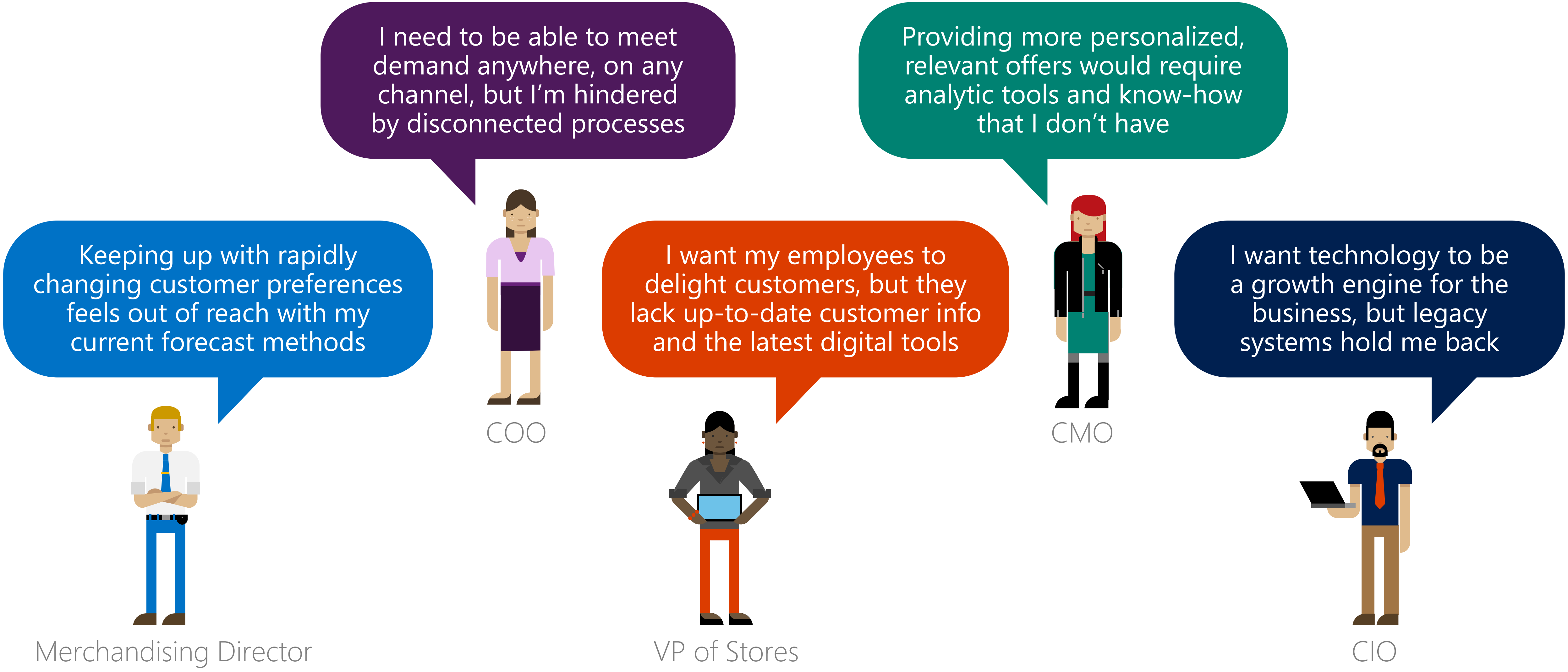
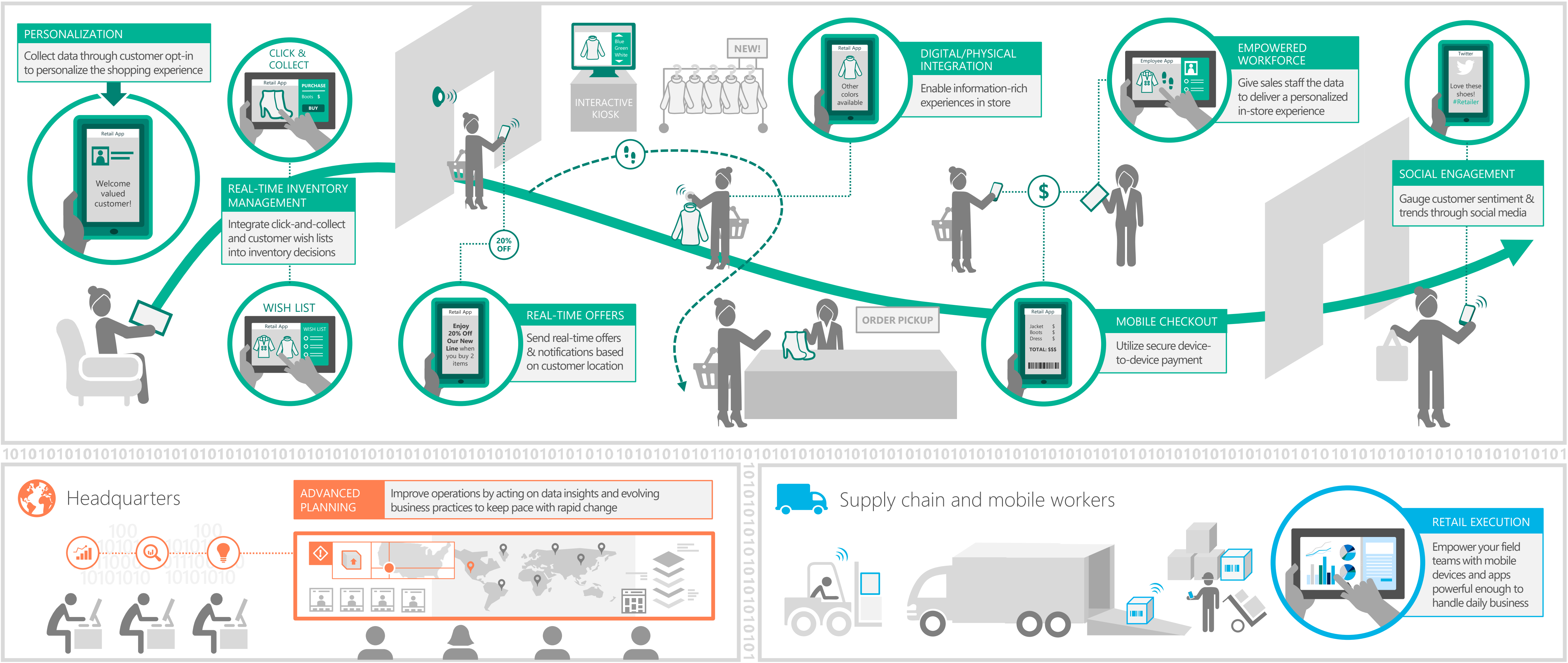


Success hinges on insights and optimization

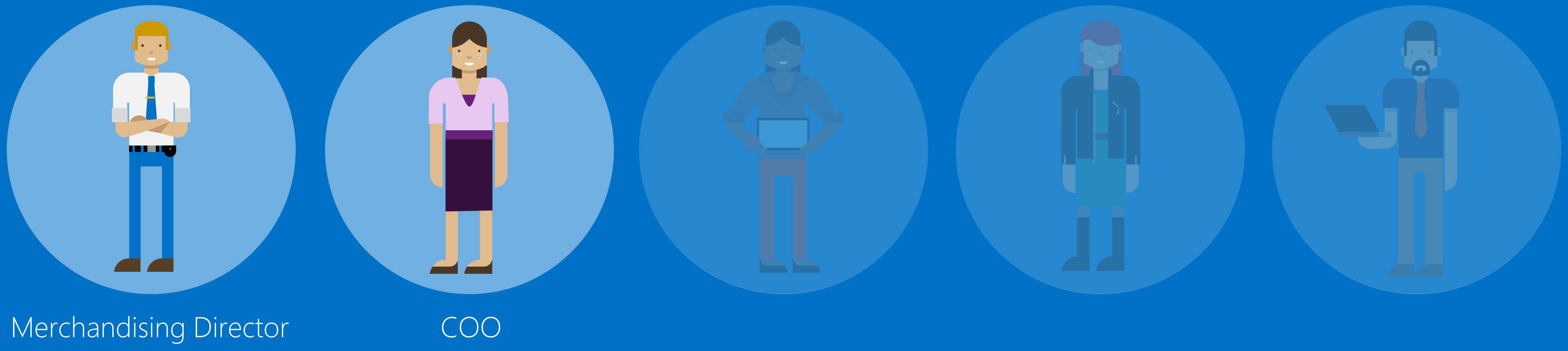
Technology provides solutions to existing and emerging problems



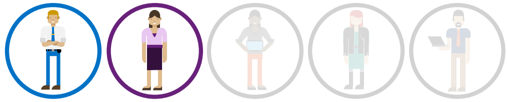
The modern retail environment



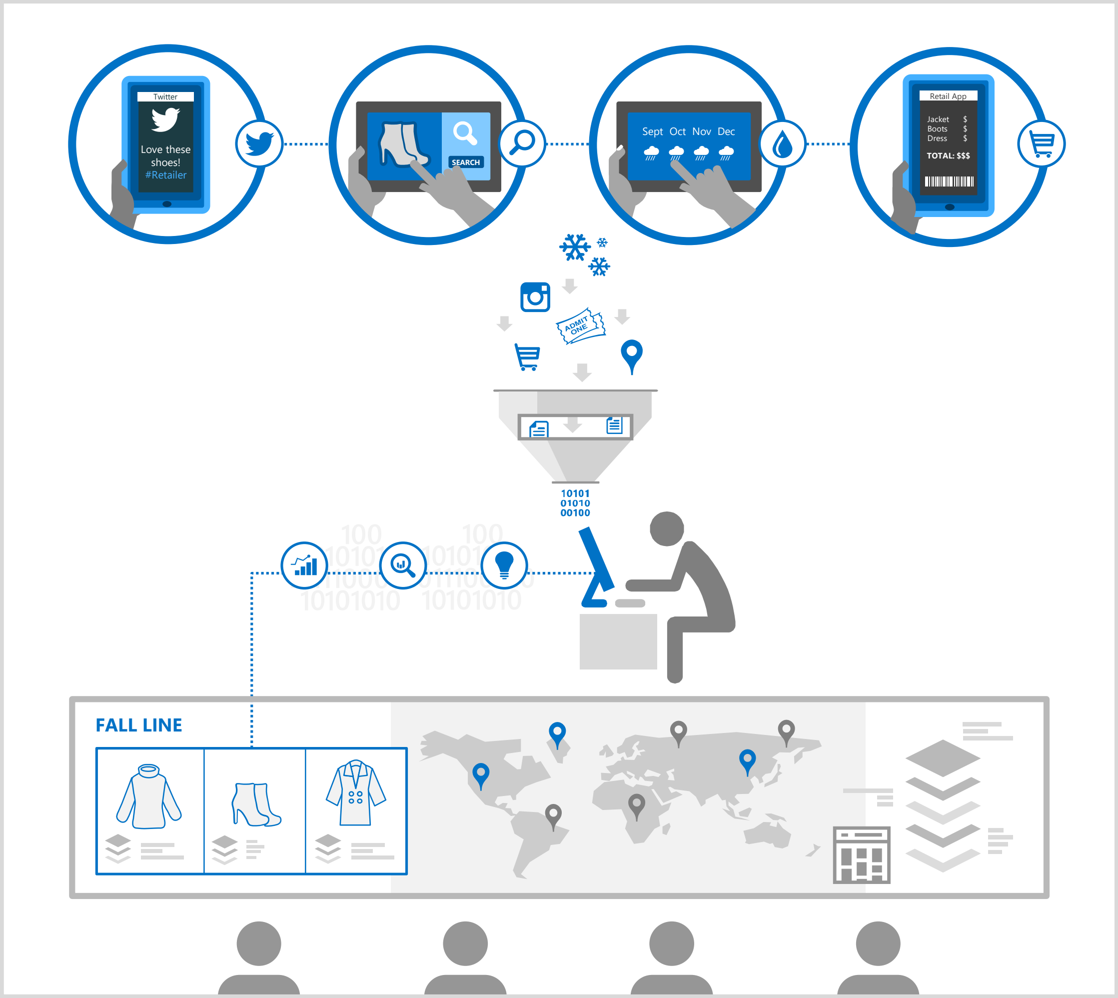
Optimize your forecasting and react faster



Optimize your forecasting and react faster



Merchandising Director, COO



Increase loyalty and share of wallet through hyper-local assortments and inventory

with scalable cloud solutions that take advantage of data, such as social and weather, to complement existing demand signals

Improve management of merchandise allocation across channels

with data-driven understanding of what will sell, when, where, and to whom

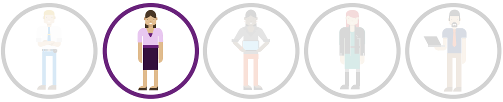
Enable forward-thinking, agile pricing and promotions

with analytics capabilities to predict optimum pricing and quickly make changes as needed

Modernize your supply chain with analytics-driven operations

COO

Modernize your supply chain with analytics-driven operations



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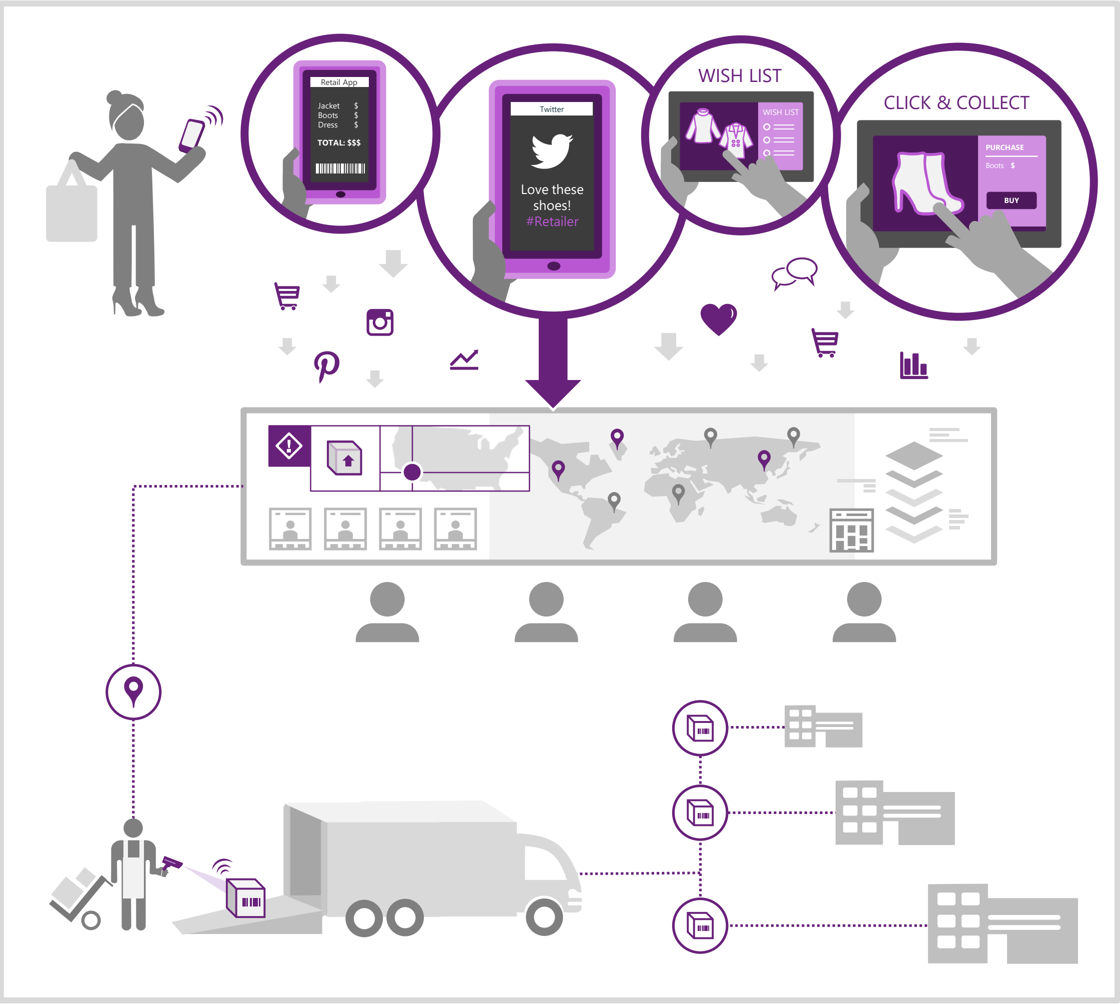


Reduce time to market for new products and services

using actionable insights provided by market trend analysis and customer feedback

Develop a more cost-effective, collaborative supply chain

through end-to-end visibility and seamless partner and supply chain communication

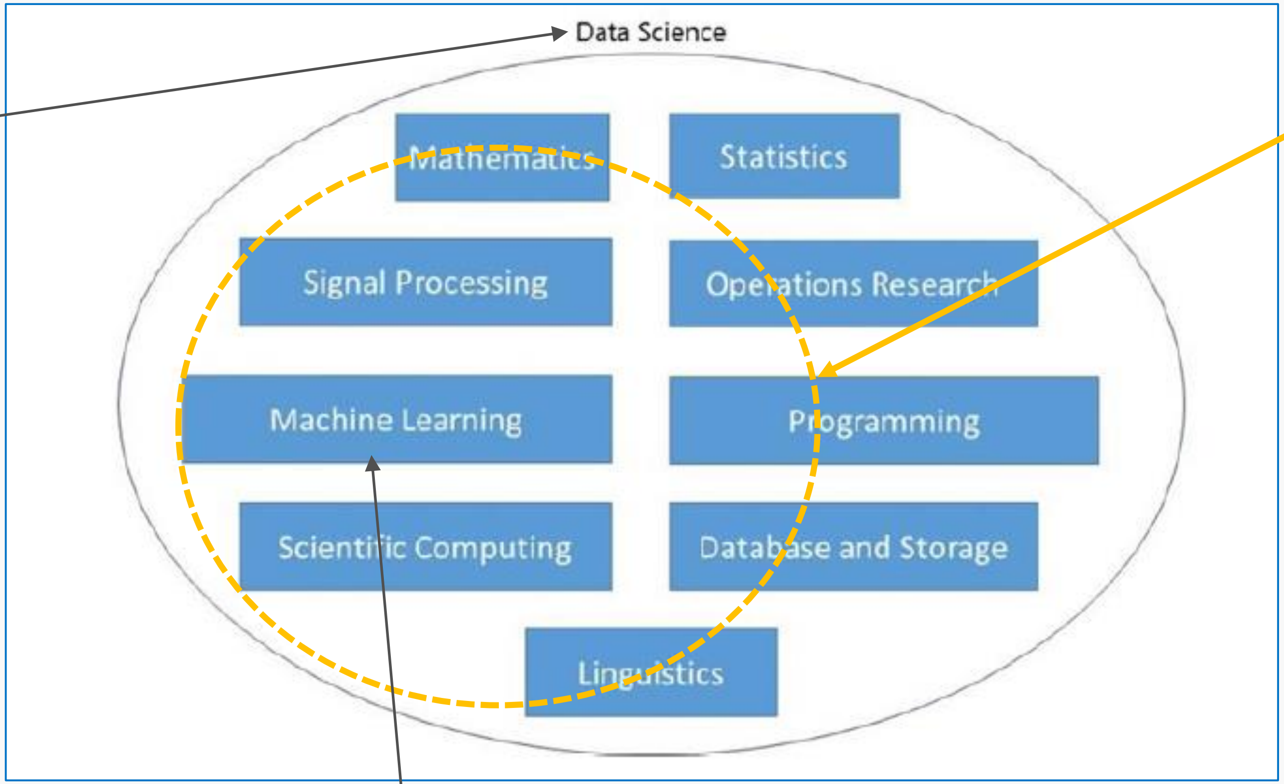
Optimize inventory management

using real-time predictive analytics and mobile devices to improve inventory transparency and anticipate customer and channel demand

Machine Learning Demystified

Data Science

[Data Science]
Set of disciplines that aggregates maths, statistics, ml etc…to get useful insights from data

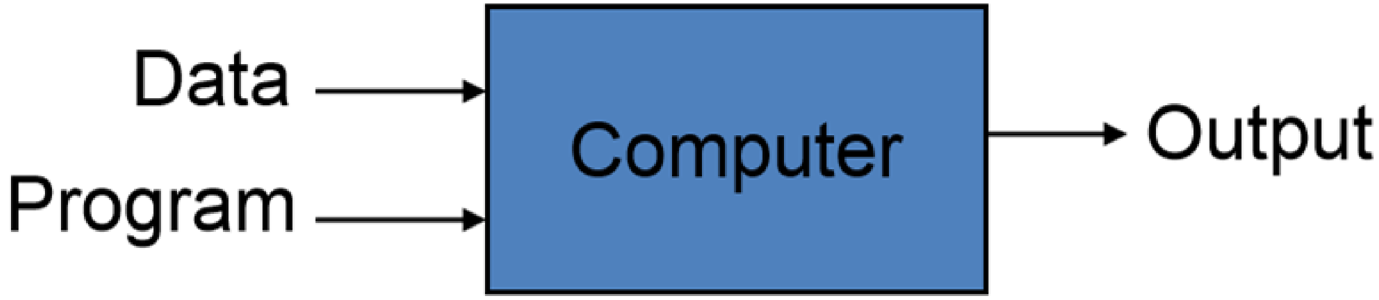


[Predictive Analytics]
Encompasses a variety of statistical techniques from [predictive modeling](), [machine learning](), and [data mining]() that analyze current and historical facts to make [predictions]() about future or otherwise unknown events

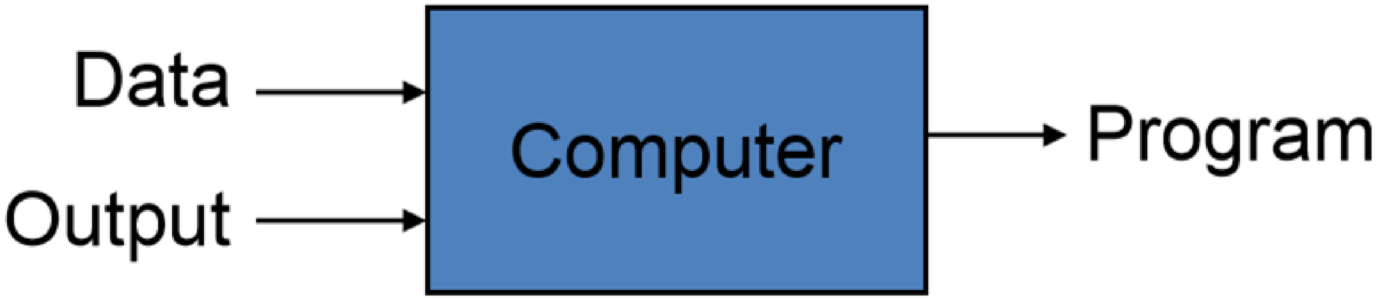
[Machine Learning]
Process of automated self learning from the data

Understanding Machine Learning

Traditional Programming



Machine Learning



The ML process

[**Define** business problem]

[**Acquire** and prepare data]

[**Develop**]

[**Deploy**]

[**Monitor**]

Jargon

[table] [database]

[data points] [rows][samples]

[features] [columns] [attributes] [variables]

[labels]

[algorithm]

Flu (2015)	Weight (Kgr)	Medicine (ml)	Class
Yes	10	5	M
No	17	10	F
Yes	25	15	F
Yes	12	6	M
No	37	25	F

Data should be

[Relevant]

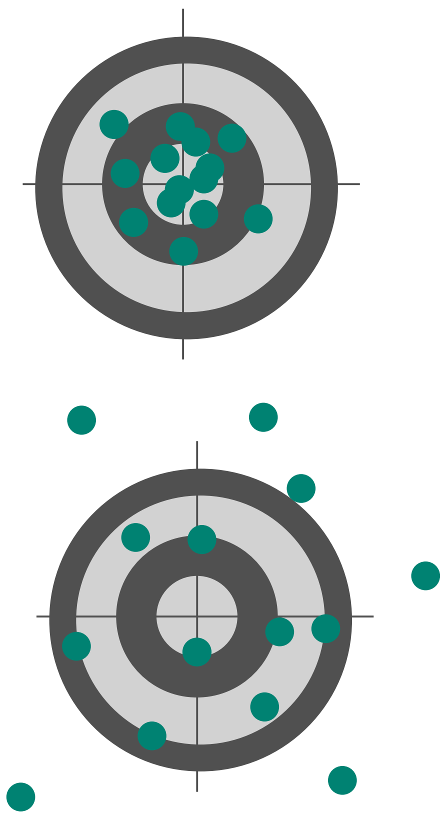
Flu (2015)	Weight (Kgr)	Medicine (ml)	Gender
Yes	10	5	M
No	17	10	F
Yes	25	15	F
Yes	12	6	M
No	37	25	F

[Connected]

Flu (2015)	Weight (Kgr)	Medicine (ml)	Gender
Yes	10	5	M
No	17	?	F
Yes	?	15	F
Yes	12	6	M
?	37	?	F

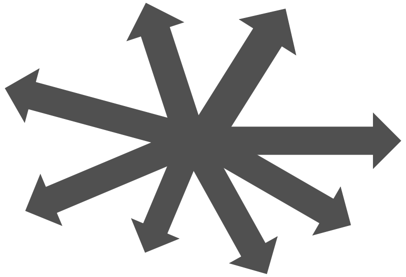
[**Missing Values**]

[Accurate]



~~Vague questions~~ vs. Sharp questions

Data is numbers and names



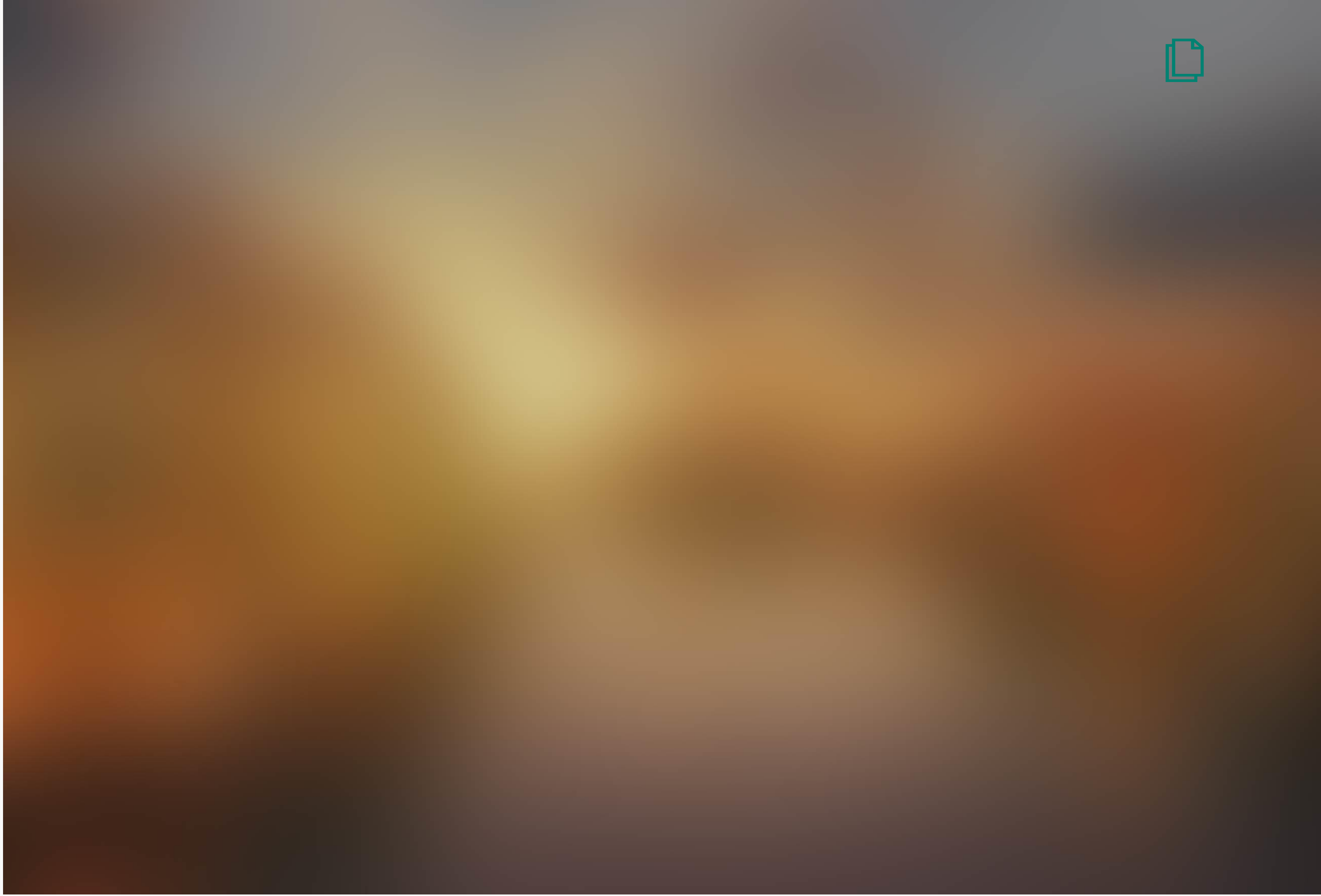
Can't be answered with a name or a number

- What can my data tell me about my business?
- What should I do?
- How can I increase my profits?

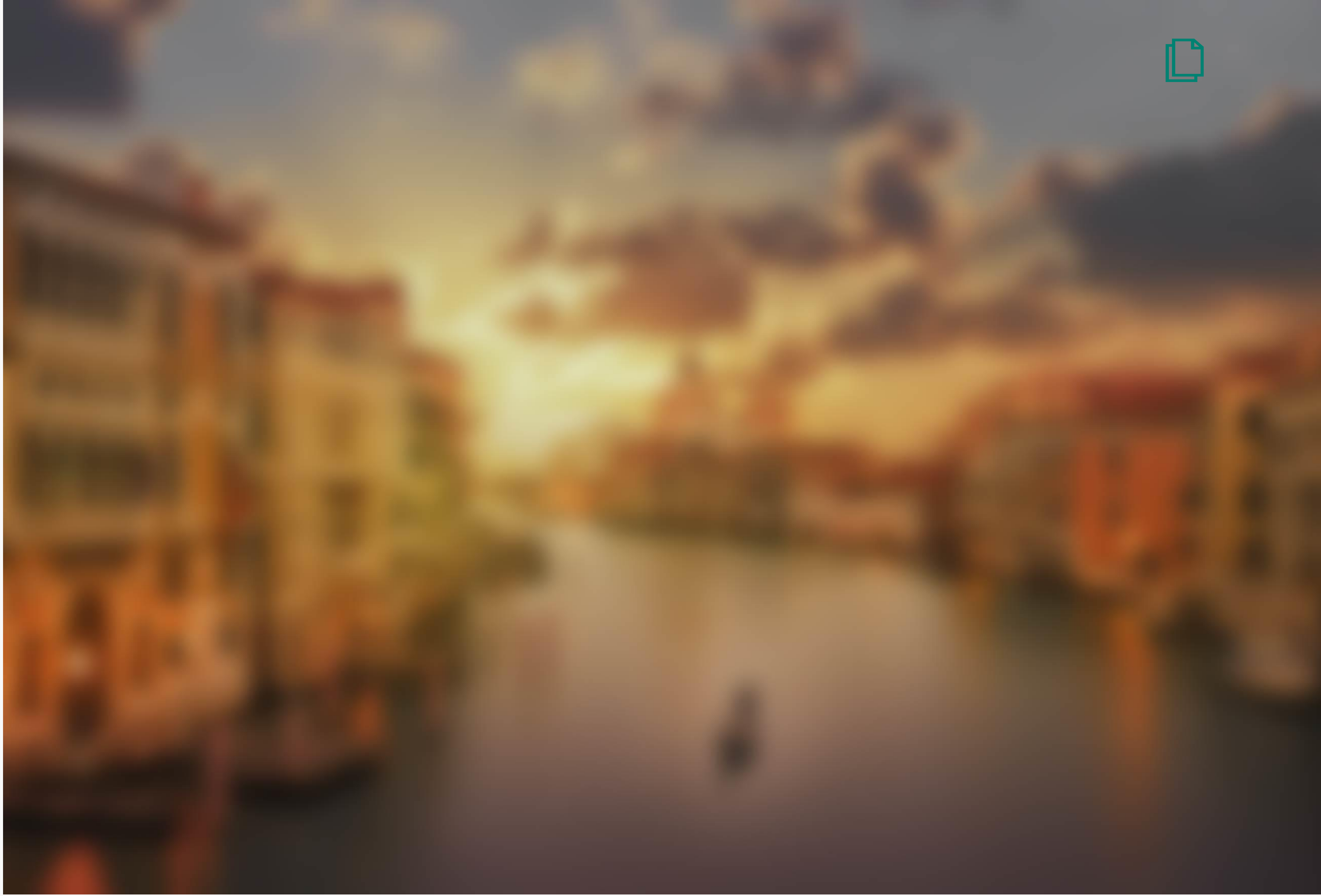
Can be answered with a name or a number.

- How many Model Q Gizmos will I sell in Montreal during the third quarter?
- Which car in my fleet is going to fail first?

Not enough data

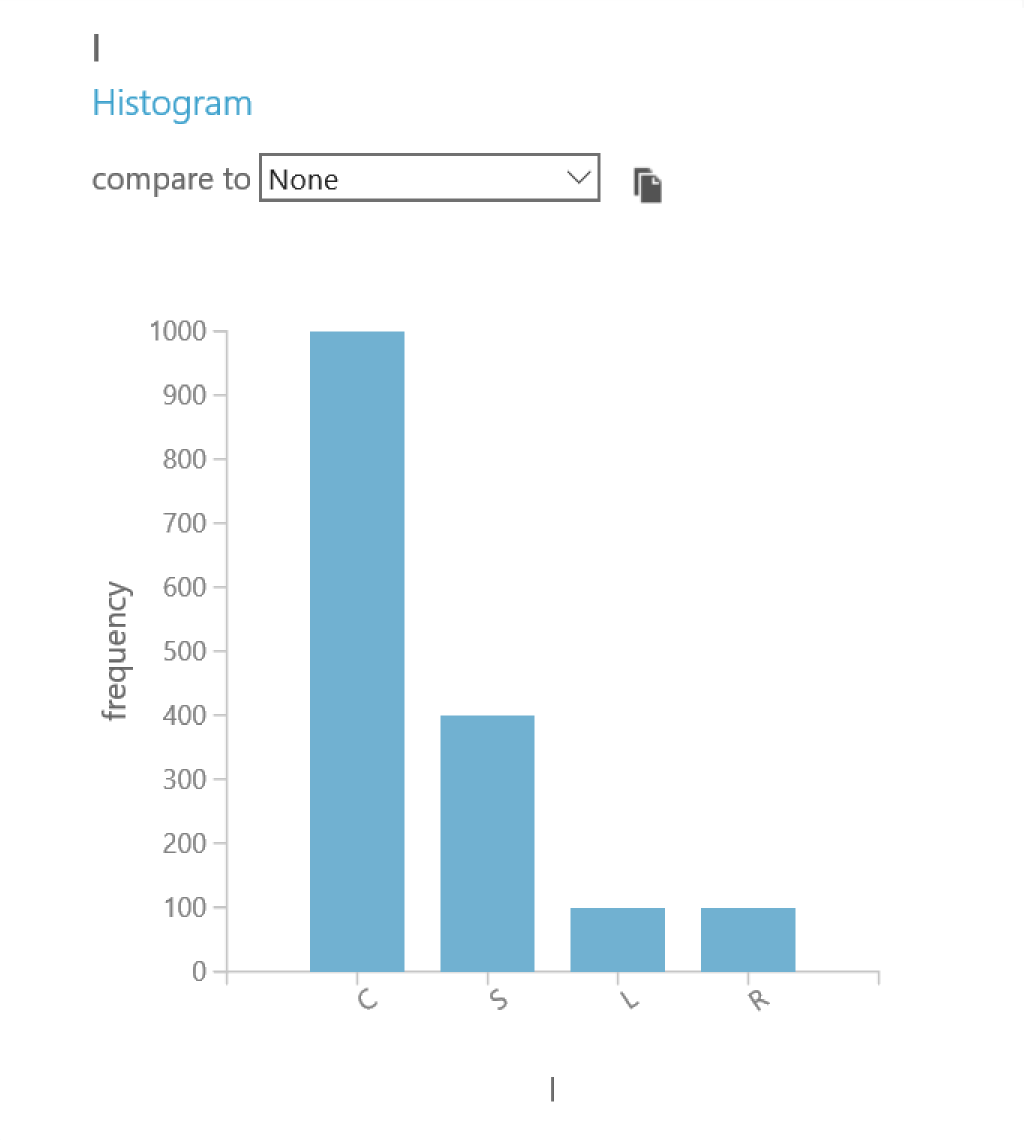


Barely enough data



Enough data

Visualize



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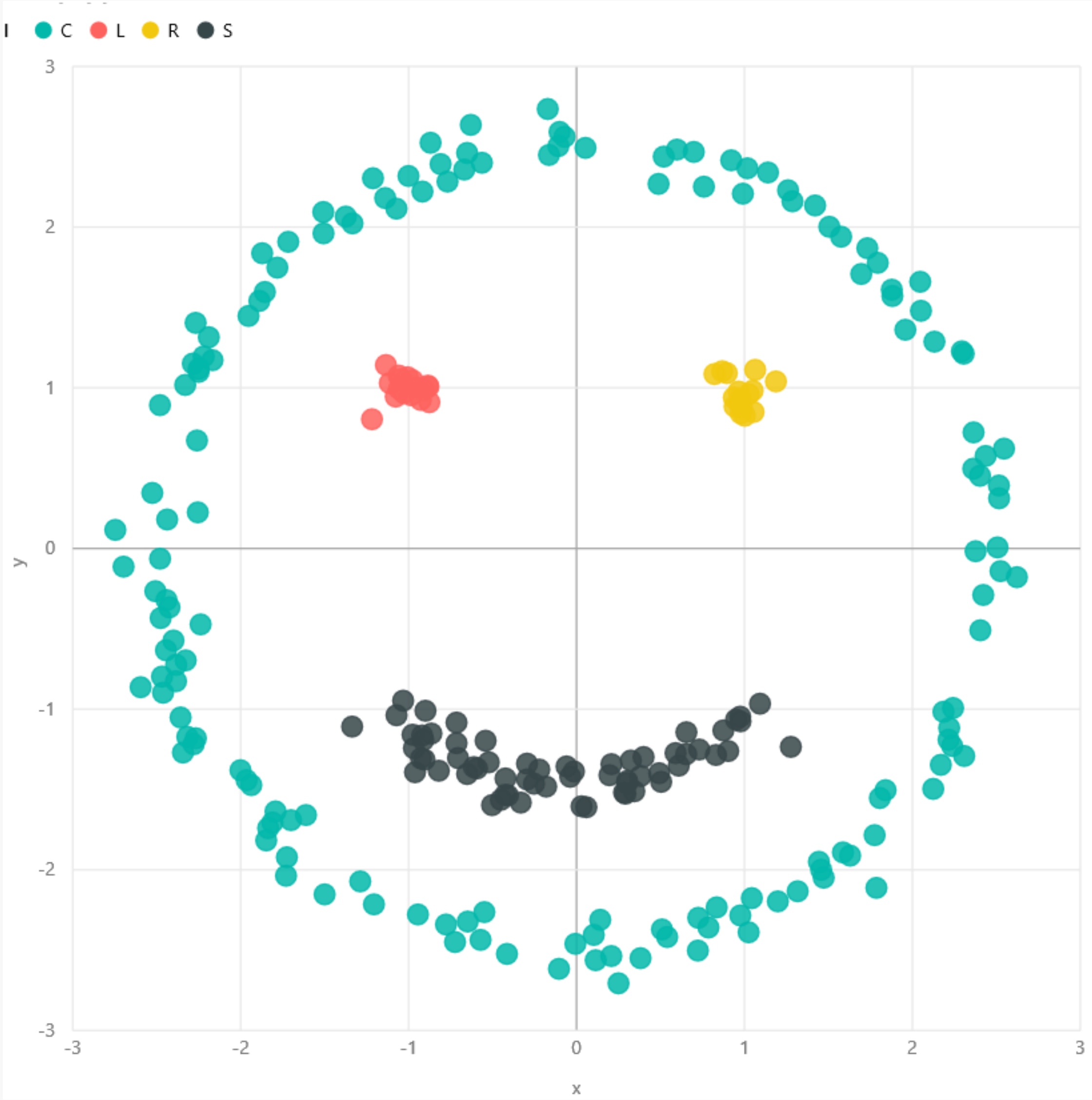

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Machine Learning alone is not Data Science

1. Data quality: Is it garbage?
2. Data exploration: What does it look like?
3. Feature Engineering: What does it mean?
4. Operationalization: How do I harvest data and deliver answers?

Machine Learning algorithms answers a question

Prediction: What value?

Classification: What class?

Clustering: Which group?

Anomaly detection: Is it weird?

Recommendation: Which option?

How much / how many?

- What will the temperature be next Tuesday?
- What will my fourth quarter sales in Portugal be?
- How many new followers will I get next week?

[regression] Example: Sales Forecast

EXPERIMENT

Retail Forecasting: Step 1 of 6, data preprocessing

Microsoft • published on March 18, 2015

Open in Studio

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Summary

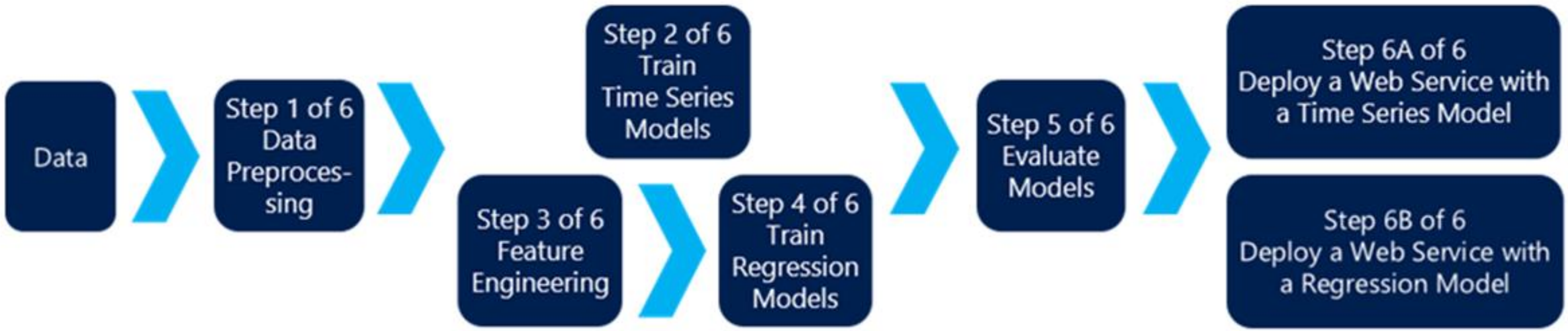
Accurate and timely forecast in retail business drives success. It is an essential enabler of supply and inventory planning, product pricing, promotion, and placement. As part of Azure ML offering, Microsoft provides a template letting data scientists easily build and deploy a retail forecasting solution.

Description

Retail Forecasting Template

Accurate and timely forecast in retail business drives success. It is an essential enabler of supply and inventory planning, product pricing, promotion, and placement. As part of the Azure Machine Learning offering, Microsoft provides a template letting data scientists easily build and deploy a retail forecasting solution. In this document, you will

Forecasting Template Workflow



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Microsoft Azure

Forecasting - AutoRegressive Integrated Moving Average (ARIMA) API built with Azure Machine Learning

Data

Published by: Azure Machine Learning

Categories: Machine Learning

Date added: 10/9/2014

Get support for this offering

Forecasting - AutoRegressive Integrated Moving Average (ARIMA) API is an example built with Microsoft Azure Machine Learning that fits an ARIMA model to data input by the user and subsequently outputs forecasted values for future dates.

Will the demand for a specific product increase this year? Can I predict my product sales for the Christmas season, so that I can effectively plan my inventory? Forecasting models are apt to address such questions. Given the past data, these models examine hidden trends and seasonality to predict future trends.

25,000
Transactions/month

$0.00
per month
SIGN UP

Sample Web App
A sample web app for testing the ARIMA web service.

Documentation
Documentation of creation as well as consumption of web service.

Which category?

- Which customer will churn?
- Which aircraft is causing this radar signature?
- What is the topic of this news article?

[classification algorithm]

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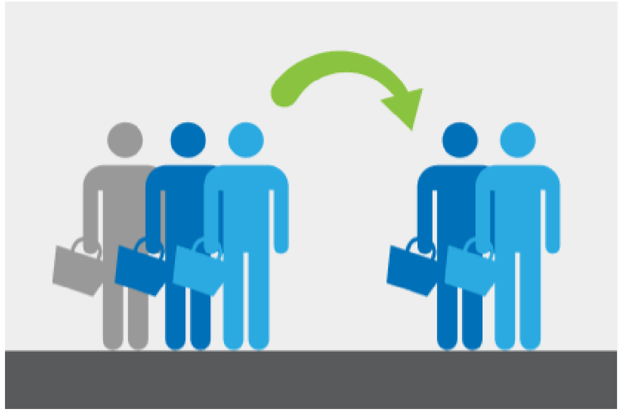
Retail Customer Churn Prediction Template

Microsoft • published on October 1, 2015



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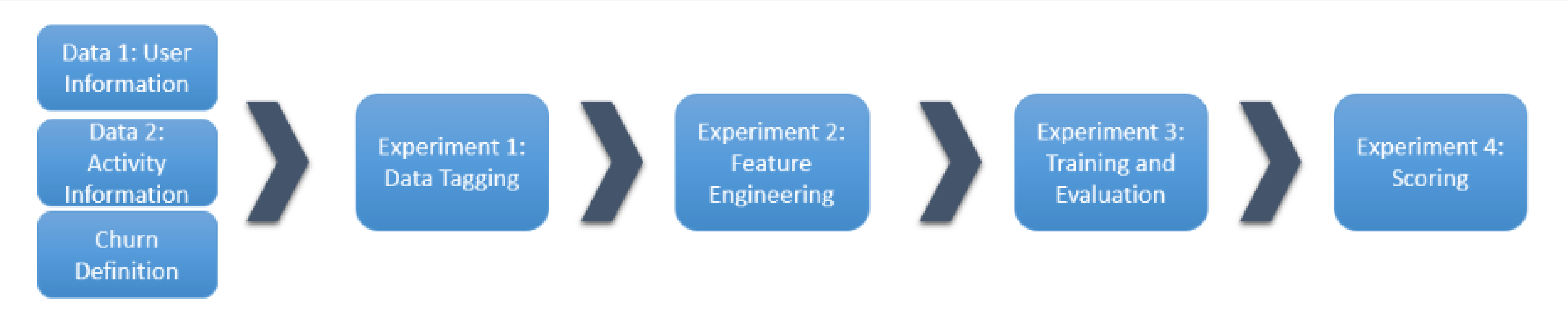
Summary

This collection of experiments demonstrates the Retail Customer Churn Template on how to build and deploy a retail churn prediction model.

Description

Predicting customer churn is an important problem for banking, telecommunications, retail and many others customer related industries. As part of the Azure Machine Learning offering, Microsoft is providing this template to help retail companies predict customer churns. This template provides pre-configured machine learning modules along with custom Python scripts in the **Execute Python Script** Module for solving the customer churn prediction problem for the Retail Stores. This template focuses on binary

Churn Template Workflow



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COLLECTION

Modeling Price Elasticity - Demo Experiments in the Cortana Analytics Webinar for Retail Pricing

Xueshan Zhang • published on October 13, 2015

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532 views

Summary

This collection includes demo experiments used in the Cortana Analytics Webinar for Retail Pricing.

Description

Price elasticity is the foundation of price optimization. Experiments in this collection use transaction data to show how to determine price elasticity. Starting from the basic example in Experiment 'Part 1' which demos a product's own price elasticity, users will learn how to add cross-item effects in Experiment 'Part 2'. They will get to know how to deal with combos and add external information including weather and holiday into the model in Experiment 'Part 3'. After finishing the series, users are equipped with the proper knowledge to deal with real-world datasets.

Related Resources: Check the video of the Cortana Analytics Webinar for Retail Pricing which is hosted

Price Elasticity - Coffee Example

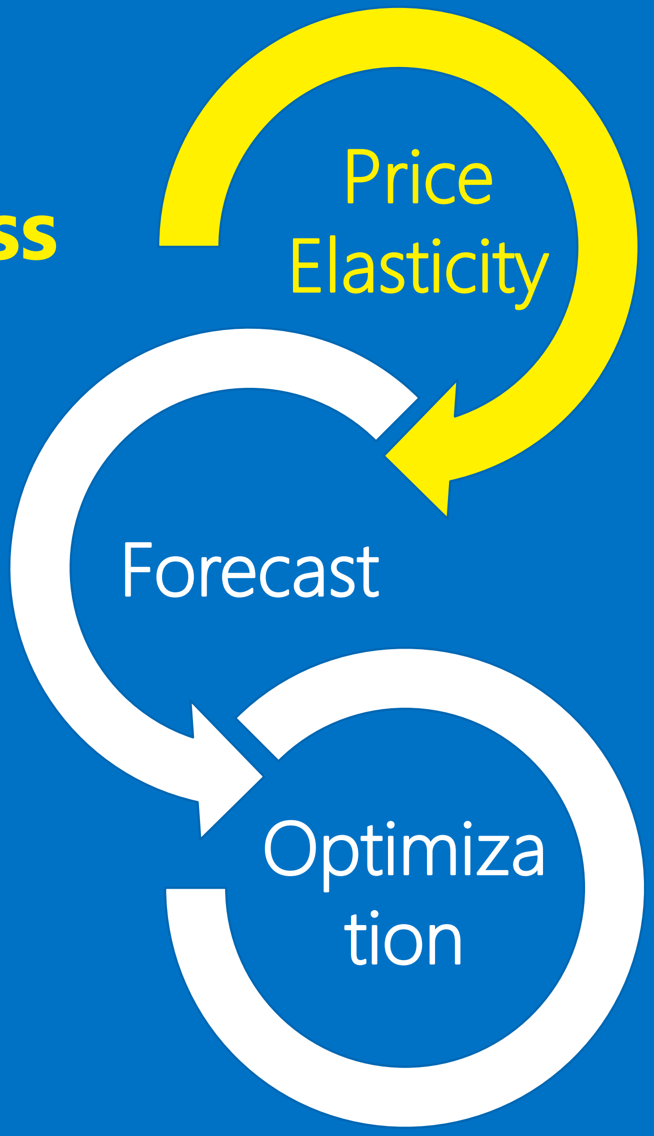
$$\text{Price Elasticity} = \frac{\text{\% Change in Demand}}{\text{\% Change in Price}}$$

Definition

- **Estimate Price Elasticity in Business**
  Identify sensitive stores and items

- Forecast Demand and Revenue

- Optimize Prices



Do I have the right price?

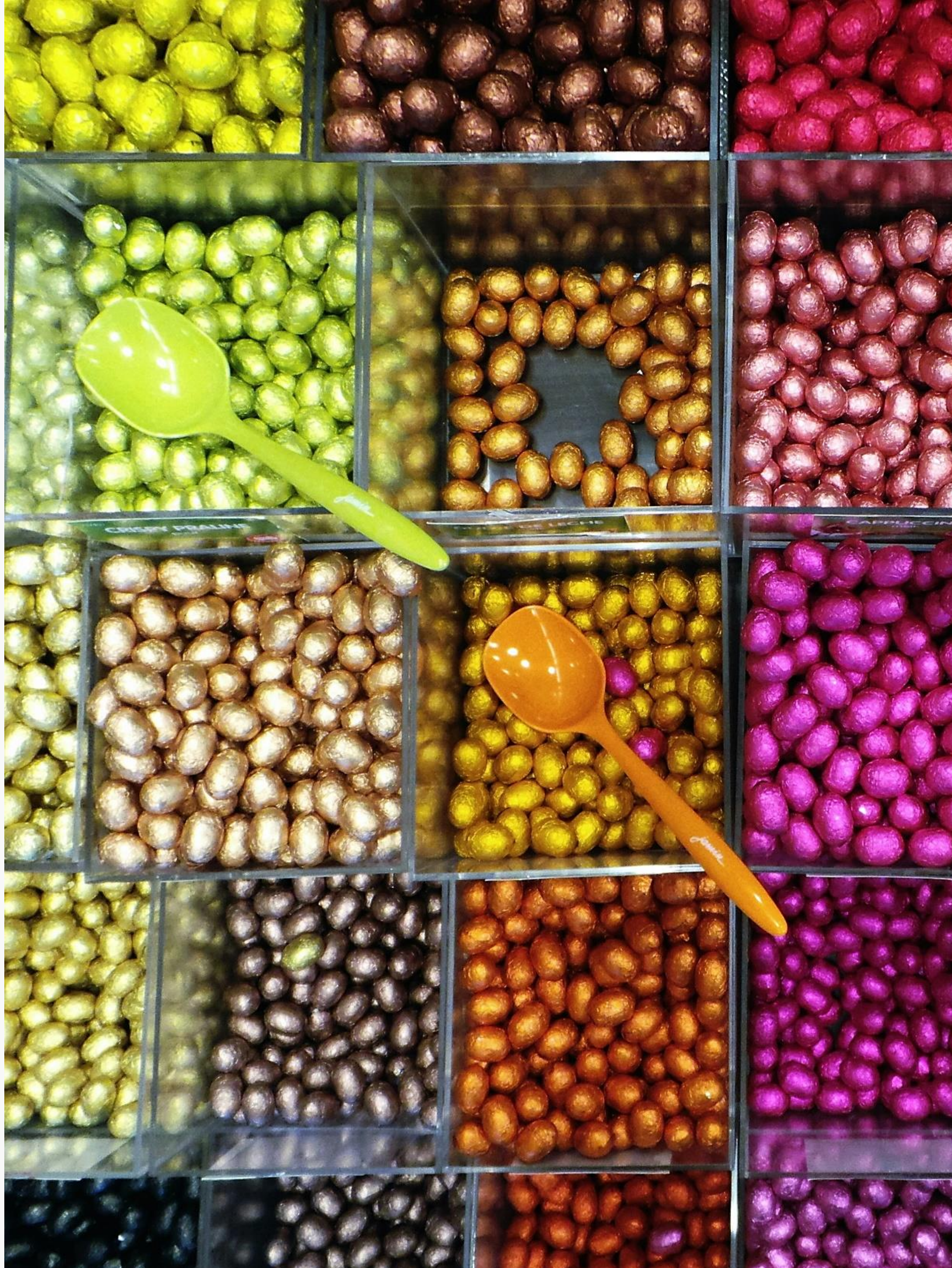
- Number of eligible price combinations is limited.

Store 1 \ 2	14	14.5	15	15.5
15.5		Y	Y	Y
15	Y	Y	Y	Y
14.5	Y	Y	Y	Y
14	Y	Y	Y	

Which groups?

- What could be Cross-selled/Up-selled?
- What is frequently bought together?

[clustering] [recommendation]



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MACHINE LEARNING API

Recommendations

Microsoft • published on April 22, 2015

Description

The Recommendations API built with Microsoft Azure Machine Learning helps your customer discover items in your catalog. Customer activity in your digital store is used to recommend items and to improve conversion in your digital store.

The recommendation engine may be trained by uploading data about past customer activity or by collecting data directly from your digital store. When the customer returns to your store you will be able to feature recommended items from your catalog that may increase your conversion rate.

Microsoft Azure Machine Learning's Recommendations supports 3 common scenarios:

Frequently Bought Together (FBT) Recommendations

In this scenario the recommendations engine will recommend items that are likely to be purchased together in the same transaction with a particular item.

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EXPERIMENT

Frequently bought together - market basket analyses using ARULES

Martin Machac • published on December 23, 2015

Open in Studio

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Summary

Example of using Arules R libary for associations mining.
This library can be used for e.g. Market Basket Analyses , Recommendations

Description

It can be used for finding Frequently bought together item-sets.This example used "single" transactions format where each data row contains TransactionID and ItemID. One transaction is on multiple records as when going through check out in a supermarket. R device port shows Item frequency plot. Data used are from publicly available data from R library (data("Groceries")).Support and confidence parameter can be entered in a Enter data manually module.

Demand Forecasting

ARCACONTINENTAL

Current Situation

Current Situation

- Current demand forecasting process has limitations and lacks in its ability to explain correlations and causality
- No knowledge/capability to systematically understand business drivers and impact (e.g. promo profitability and package discounts)
- Promotions are managed in a manual fashion and with limited insight into effectiveness
- Senior leadership believes that big data and advanced analytics provide an opportunity to increase sales, grow market share and become more profitable

Challenges/ Risks

- Access to data outside the ERP systems
- Lack of data science resources and skill sets
- Infrastructure considerations

Typical drivers of demand for beverage sales

Exploratory Investigation

Weather can depress/ increase demand

Promos can drive demand

Tax can depress demand

Holiday buying can increase demand

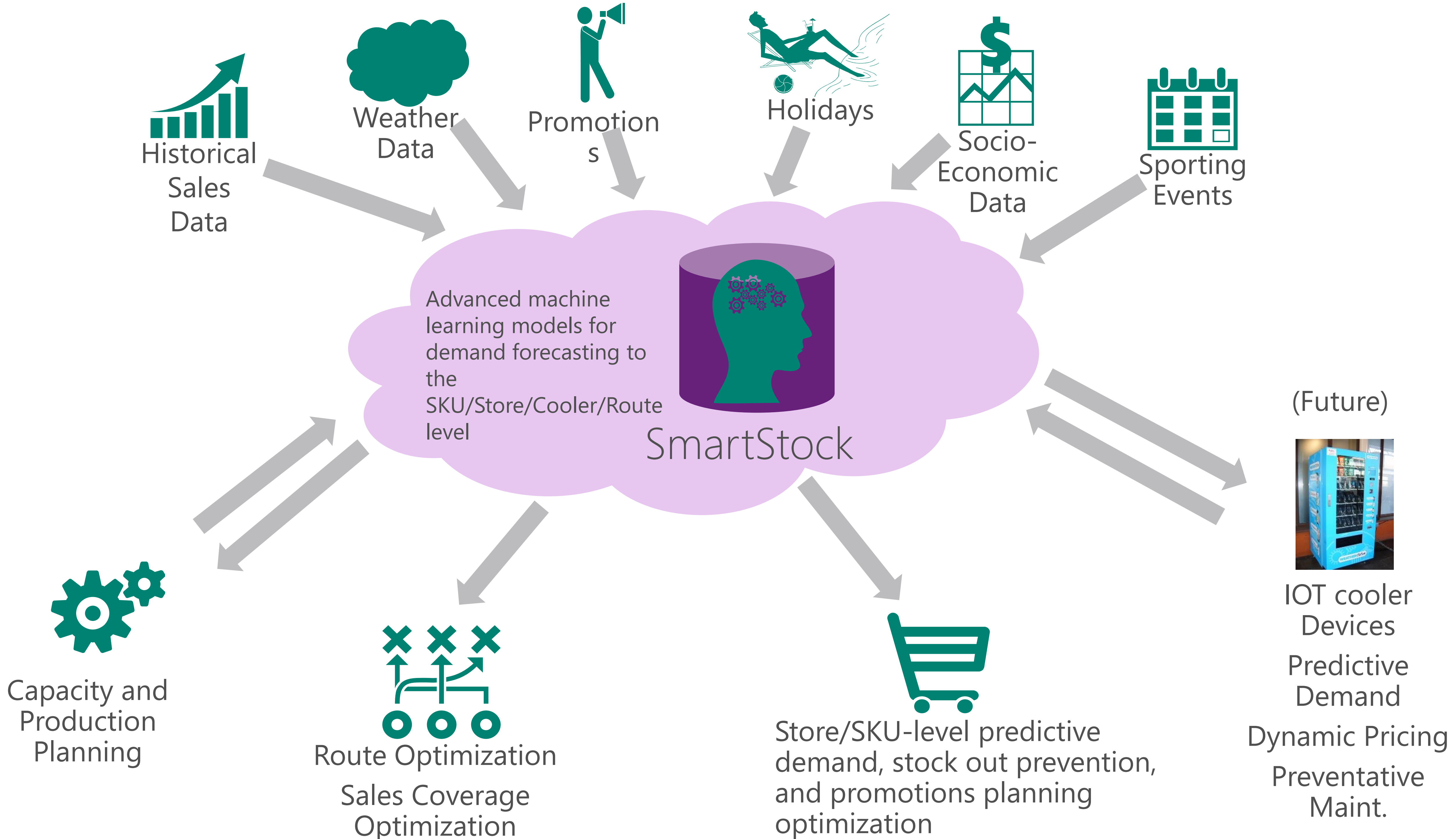
Sales

Coverage can depress/ increase demand

Price can depress/increase demand

Competition can depress demand

Socio-economic factors can depress/increase demand

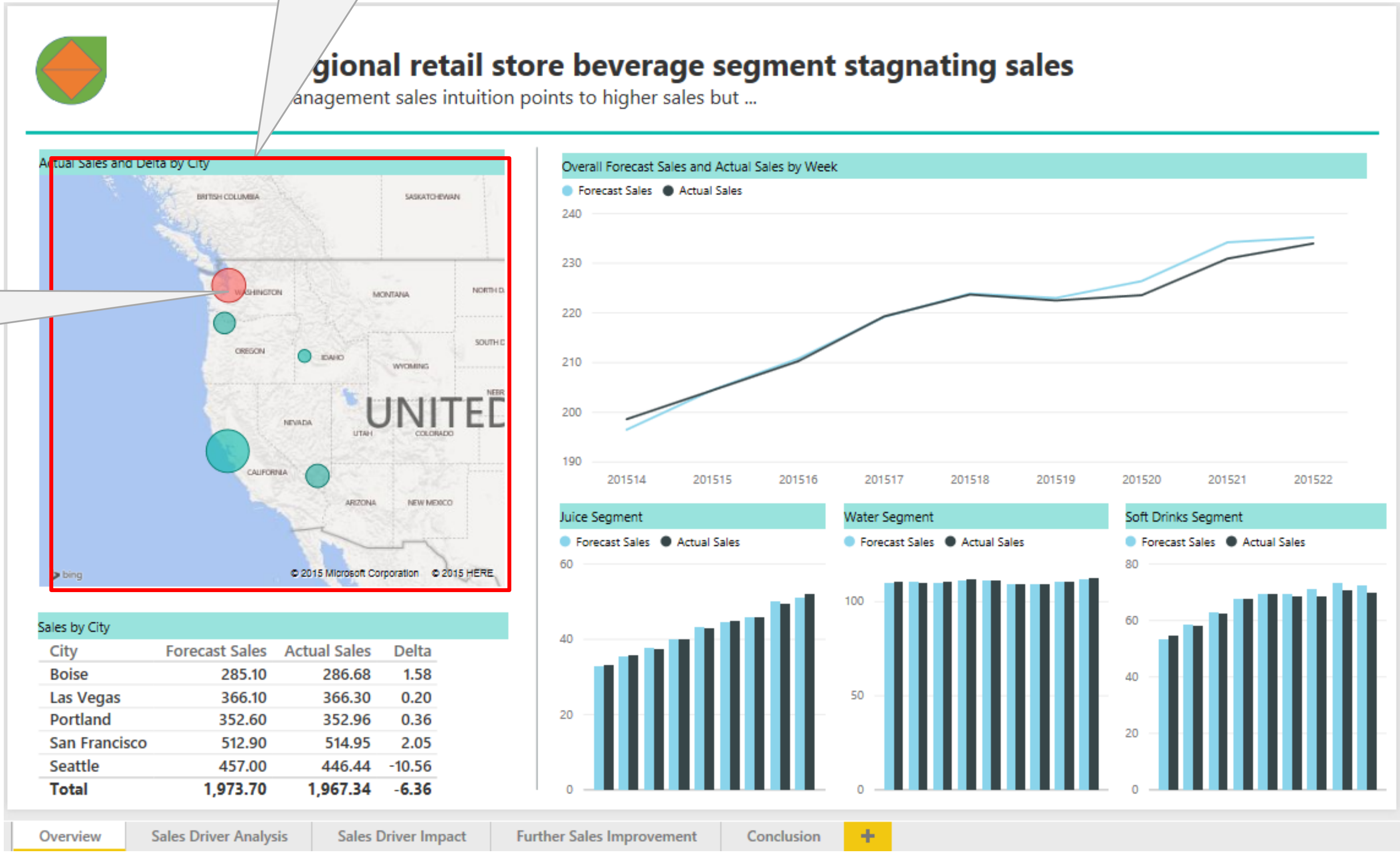

Historical Sales Data
Weather Data
Promotions
Holidays
Socio-Economic Data
Sporting Events
Advanced machine learning models for demand forecasting to the SKU/Store/Cooler/Route level
SmartStock
(Future)
IOT cooler Devices
Predictive Demand
Dynamic Pricing
Preventative Maint.
Capacity and Production Planning
Route Optimization
Sales Coverage Optimization
Store/SKU-level predictive demand, stock out prevention, and promotions planning optimization

Regional Retail Store Beverage Sales Overview – 1

Seattle is facing sales problems

1 Sales for Northwest Territory retailer

2 Problem: Seattle is not selling to forecast



Sales Driver Analysis – 2

Add external data to and now the model accuracy is improved

1

Transaction dataset in AML experiment

2

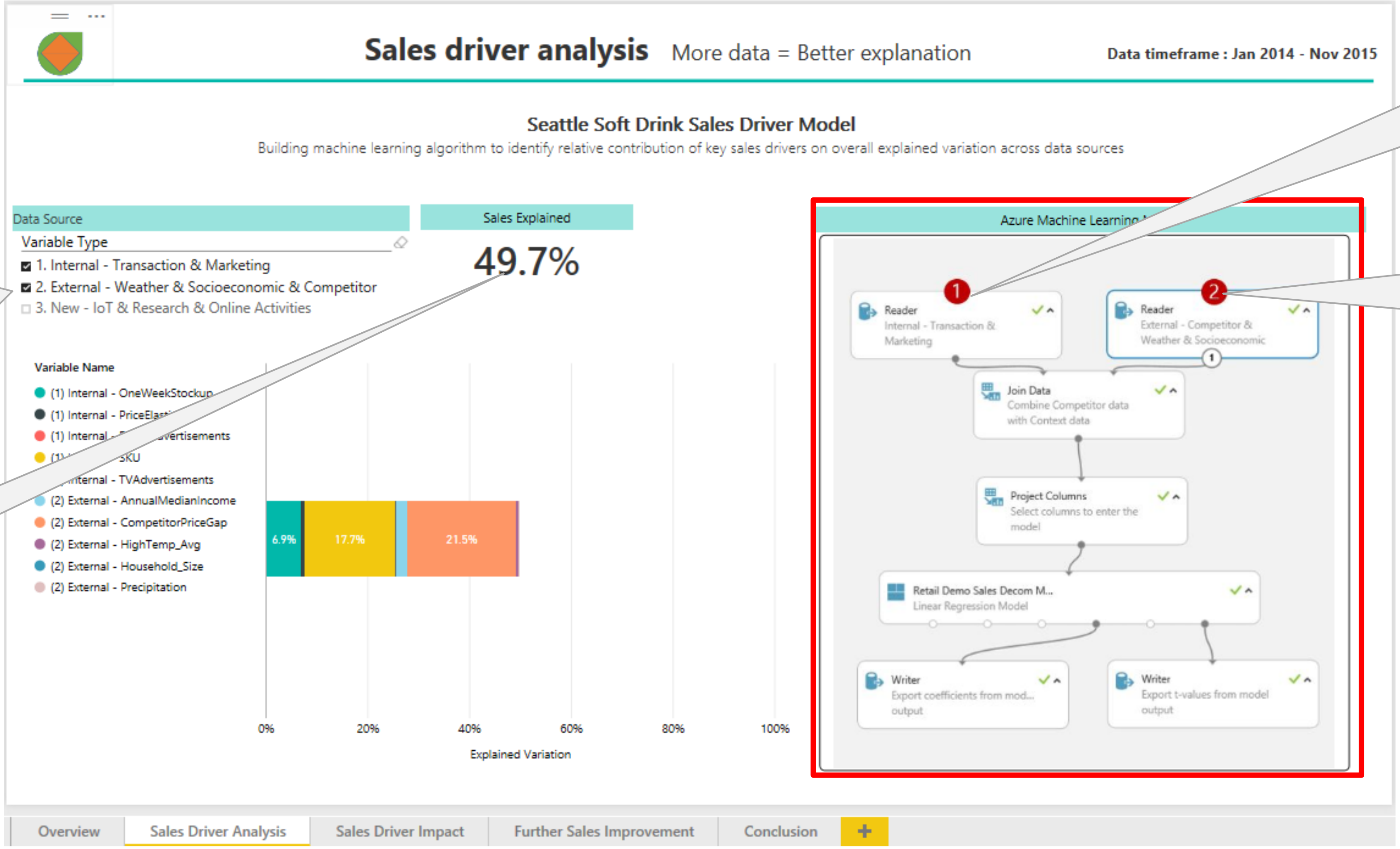
External dataset enters the model in AML experiment

3

External weather, demographic, and competitor data include variables as:
- Temperature
- Precipitation
- Household size
- Annual Income
- Competitor Price Gap

4

Variations explained improves to near 50%

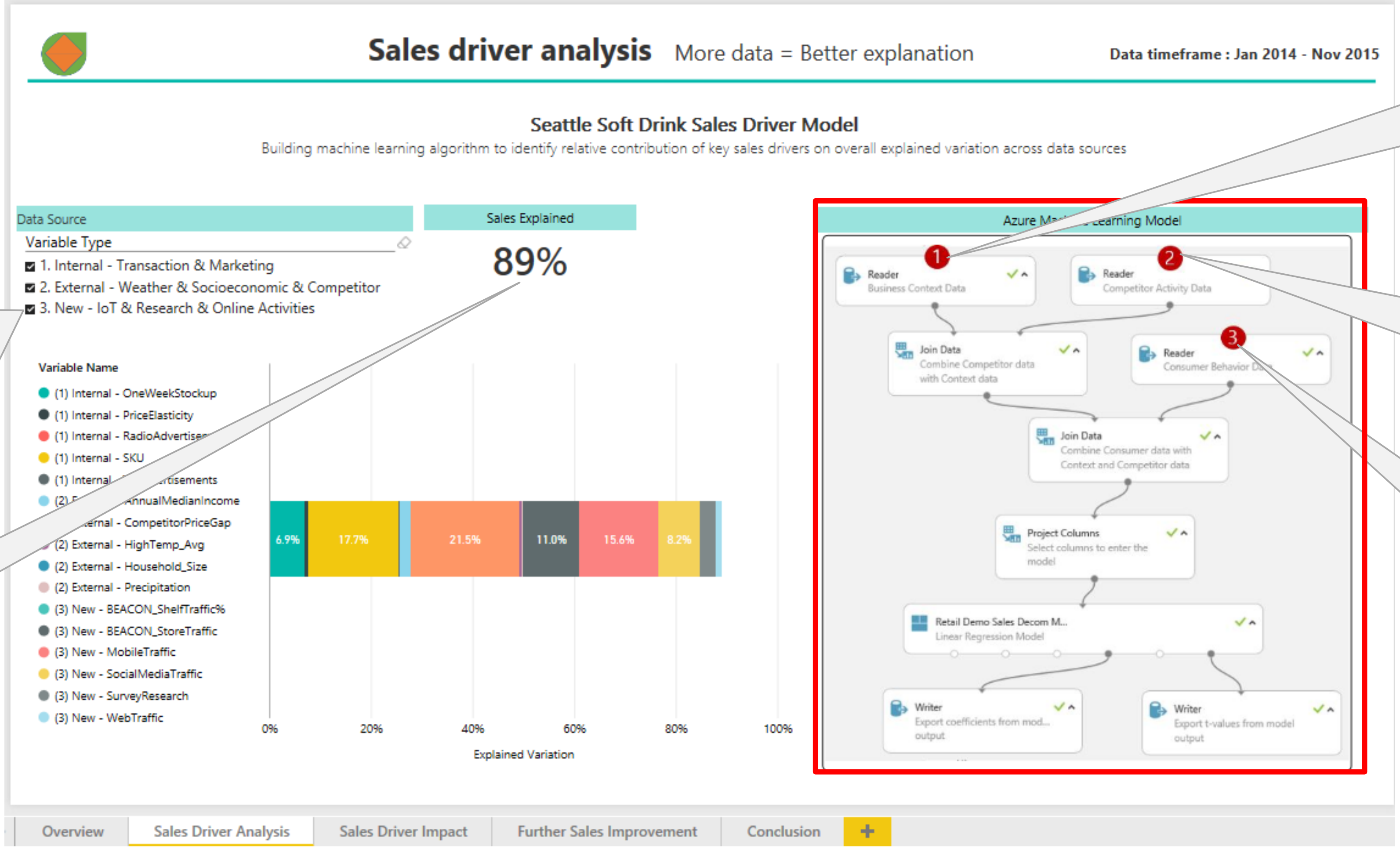


Sales Driver Analysis – 3

With IoT, research, and online activity data, we can build sales models of unprecedented power for end users

4

New IoT, research and online activity data include variables as:
- Survey research
- Web traffic
- Social media traffic
- Mobile traffic
- Store traffic
- Shelf traffic



5

Variations explained improves to 89%

1

Transaction dataset in AML experiment

2

External dataset enters the model in AML experiment

3

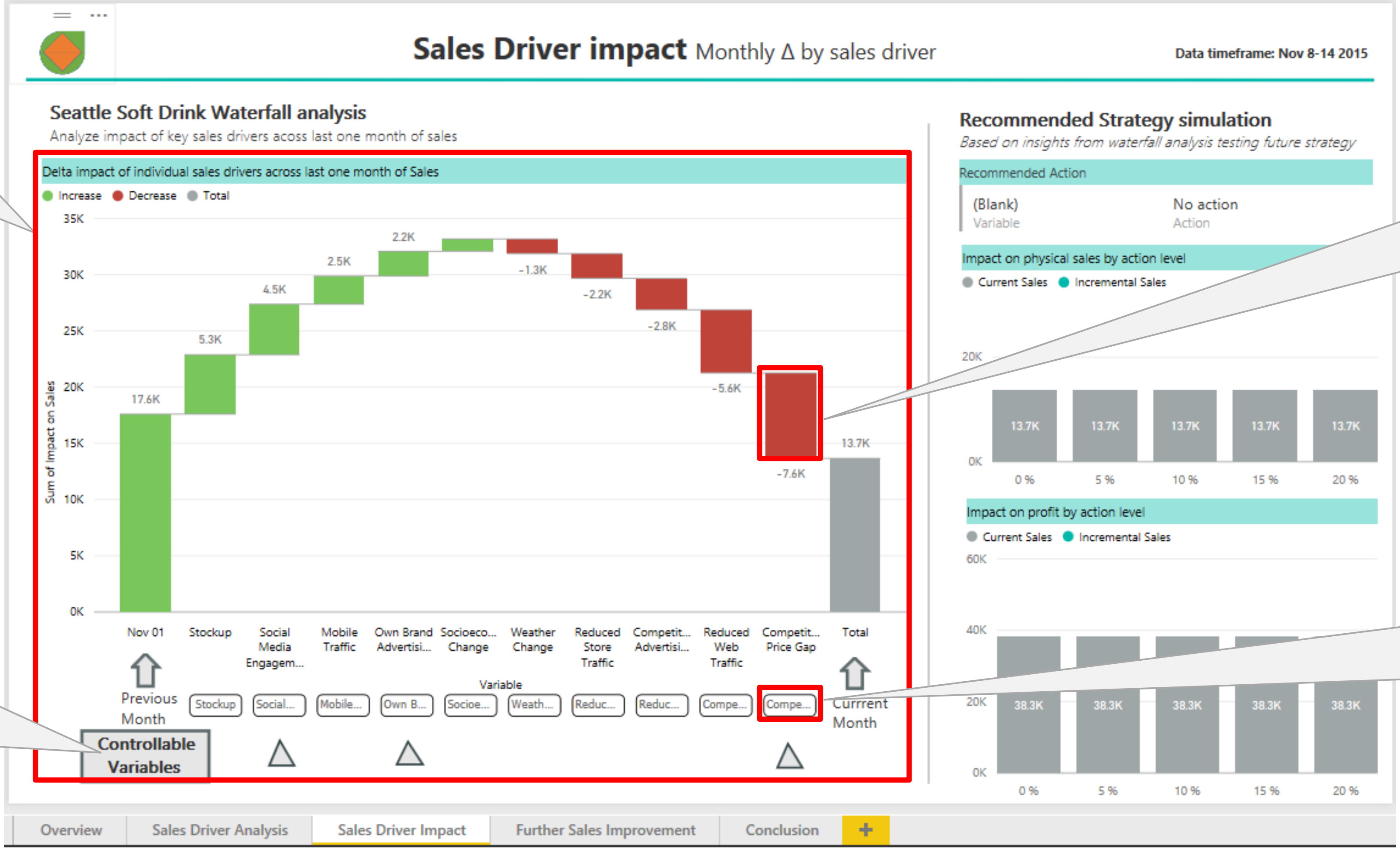
IoT dataset enters the model in AML experiment

Sales Driver Impact - 1

Analyze impact of key sales drivers over the last one month

1

Monthly Δ by sales driver



2

Competitor price gap caused 7,598 less units sold than previous month

3

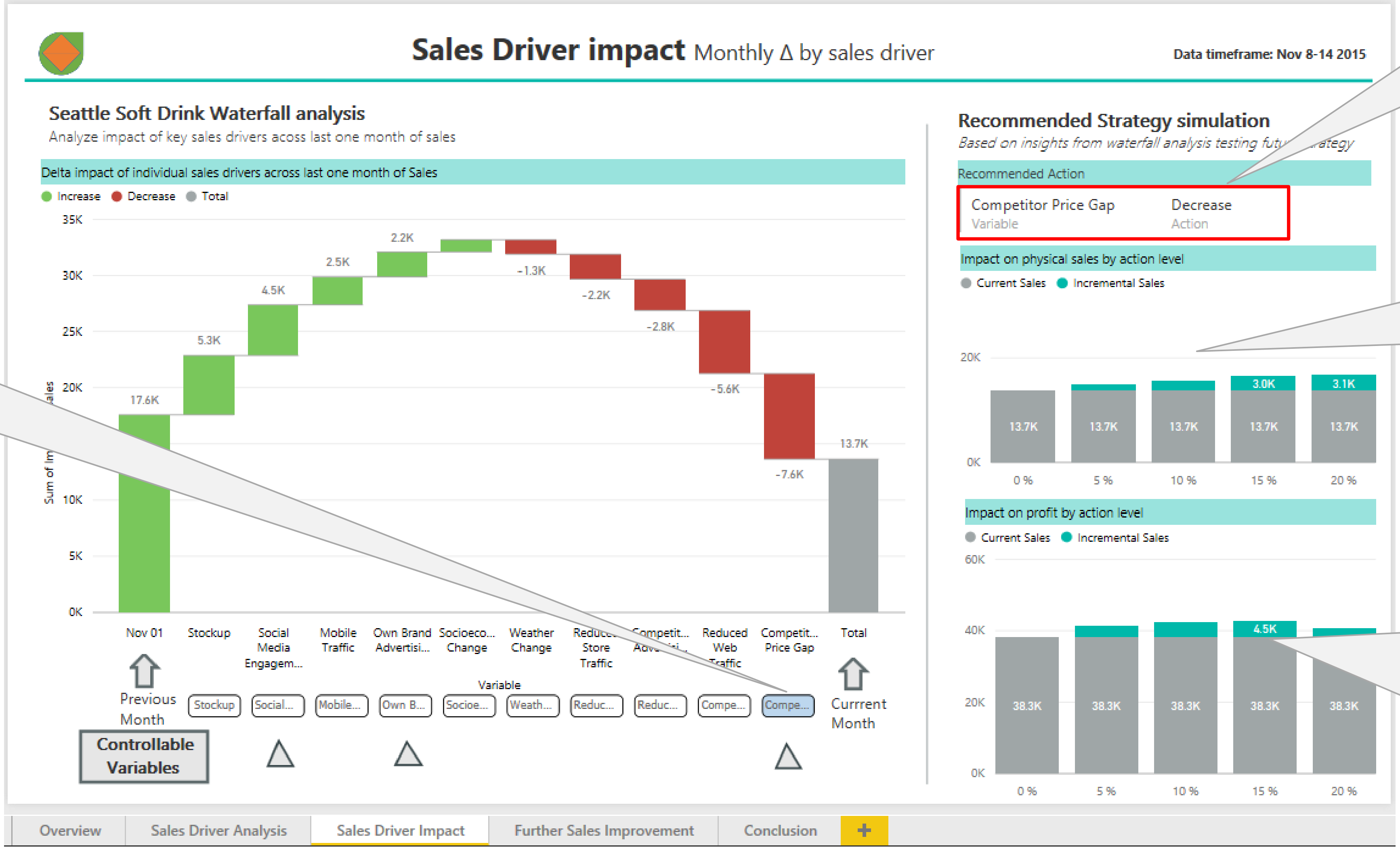
Click one of the controllable variables to see what would happen if we take some actions

4

Let's first zero in on the sales impact of price gaps, as they are the biggest problem

Sales Driver Impact - 2

What would be the impact on sales if I adjust my pricing?



1 Select competitor price gap as it is a controllable variable

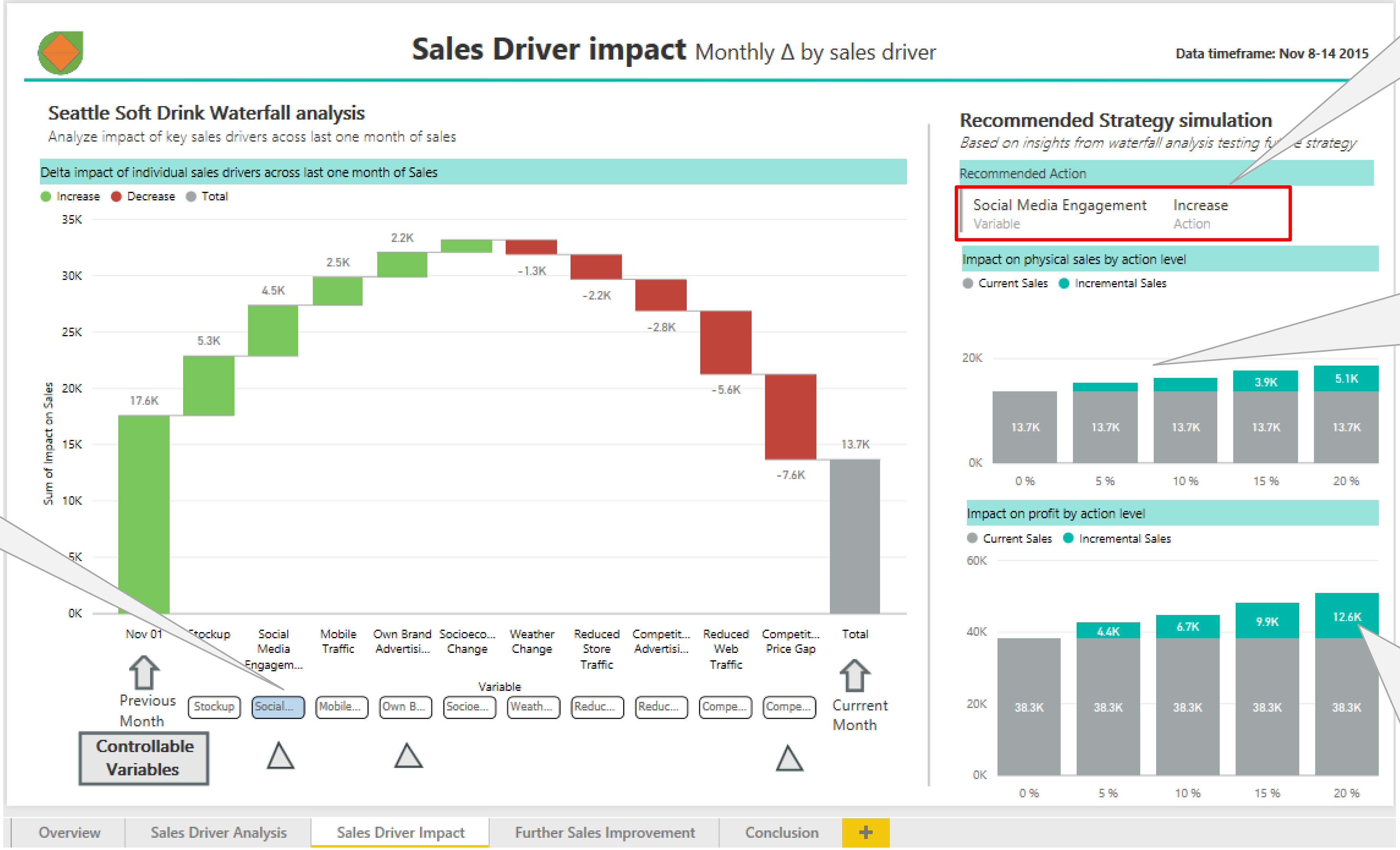
2 It would be recommended to decrease the competitor price gap

3 See the impact on physical sales if we reduce the price gap by different levels

4 See the impact on profit if we reduce the price gap by different levels. When it is reduced by 15%, we would be able to achieve 4.5K incremental profit.

Sales Driver Impact - 2

What would be the impact on sales if I adjust my pricing?



1

Select Social Media Engagement as it is a controllable variable

2

It would be recommended to increase social media engagement

3

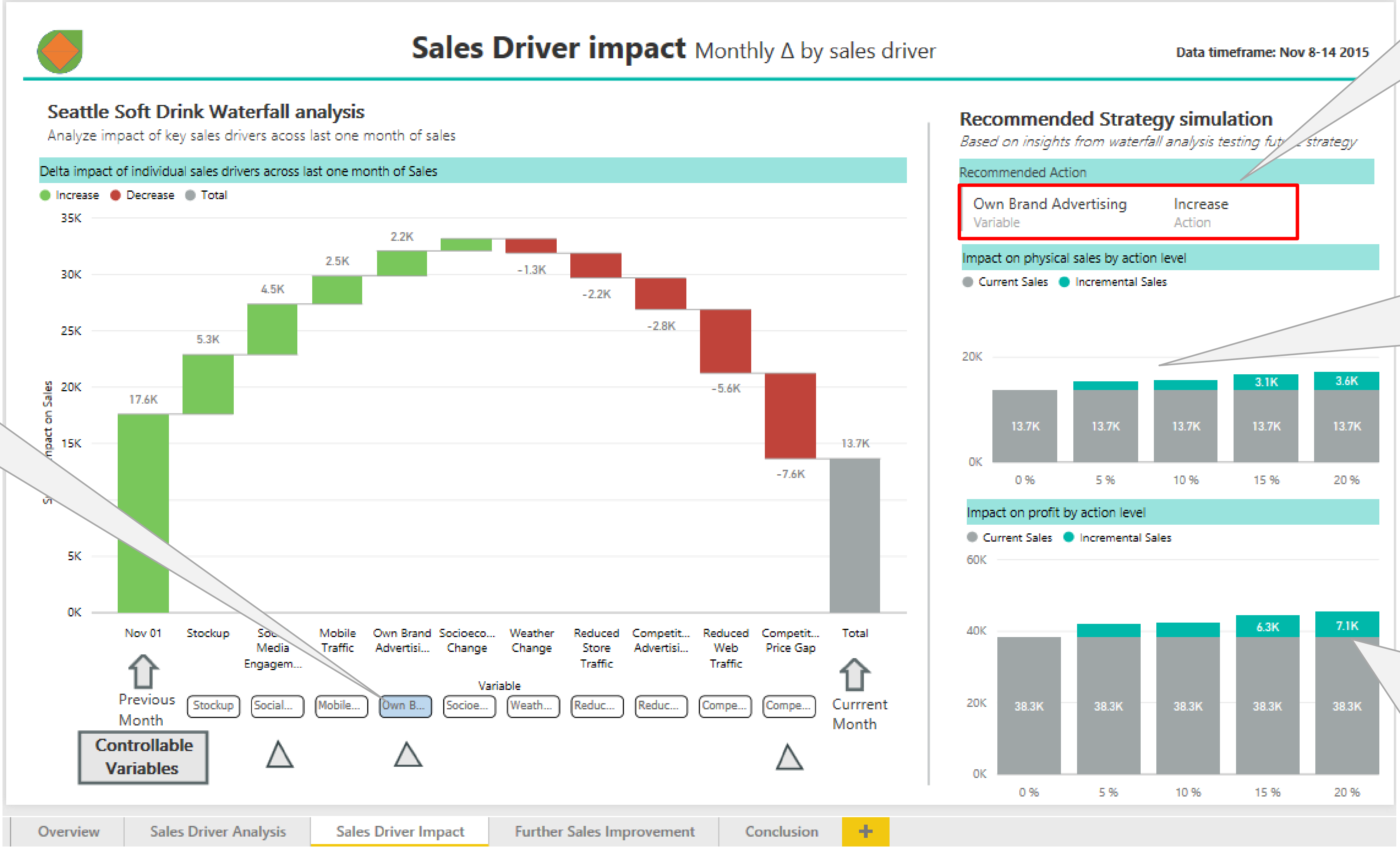
See the impact on physical sales if we increase social media engagement by different levels

4

See the impact on profit if we increase social media engagement by different levels. When it is increased by 20%, we would be able to achieve 12.6K incremental profit.

Sales Driver Impact - 2

What would be the impact on sales if I adjust my pricing?



1 Select Own Brand Advertising as it is a controllable variable

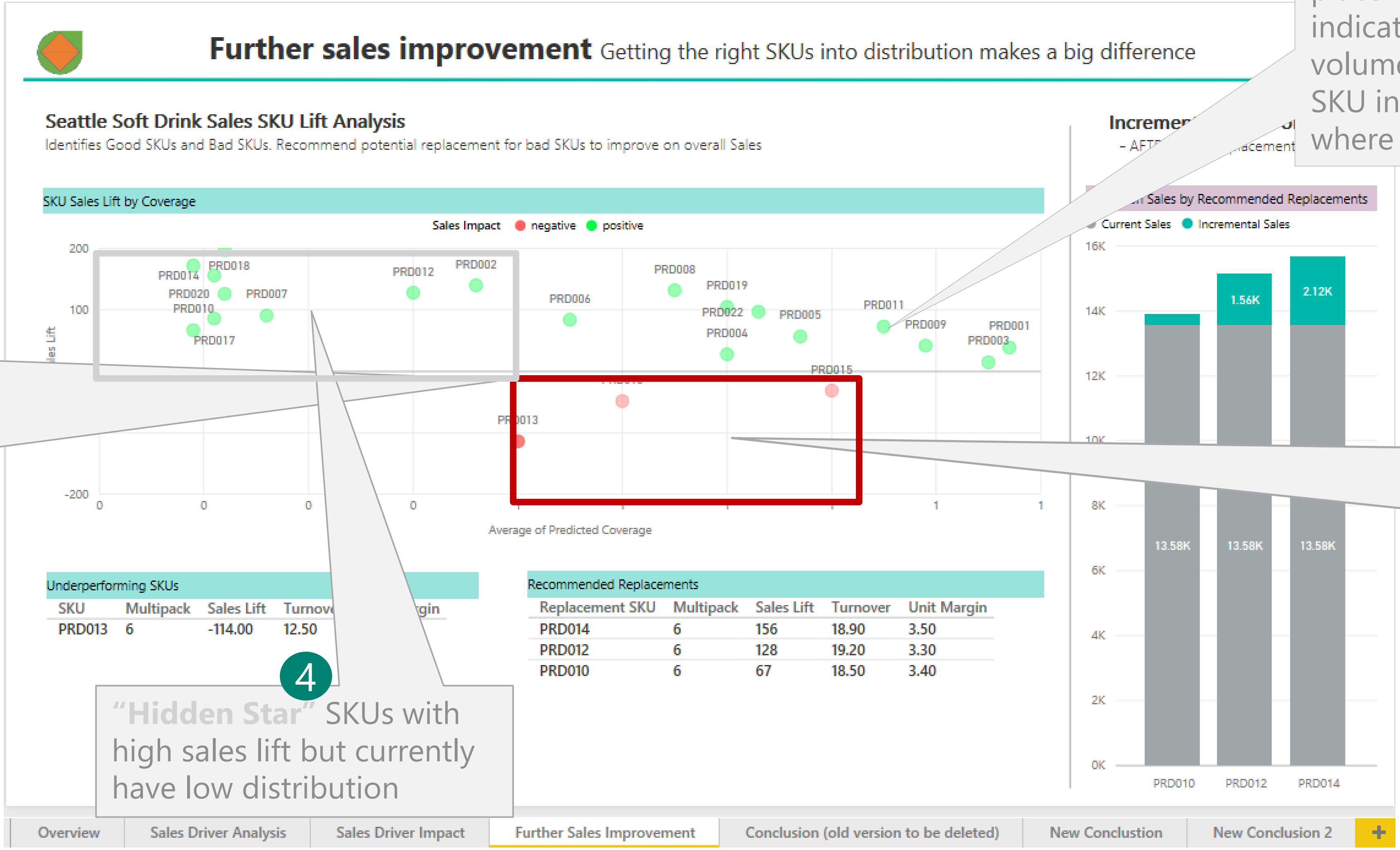
2 It would be recommended to increase our own brand advertising

3 See the impact on physical sales if we increase advertising by different levels

4 See the impact on profit if we increase advertising by different levels. When it is increased by 20%, we would be able to achieve 7.1K incremental profit.

Further Sales Improvement - 1

Getting the right SKUs into distribution makes a big difference



1

Each dot represents a different SKU. The Y axis placement of each dot indicates the physical volume increased by each SKU in the store-weeks where it is present

2

We can use the SKU sales lift to see where we have "dog" SKUs that decrease overall sales, and were we have high potential "hidden stars" to replace them with

3

"Dog" SKUs with negative sales lifts can be replaced as they decrease total sales because of cannibalization

4

"Hidden Star" SKUs with high sales lift but currently have low distribution

Further Sales Improvement - 2

Getting the right SKUs into distribution makes a big difference

1

Click PRD013 as it has the lowest sales lift

2

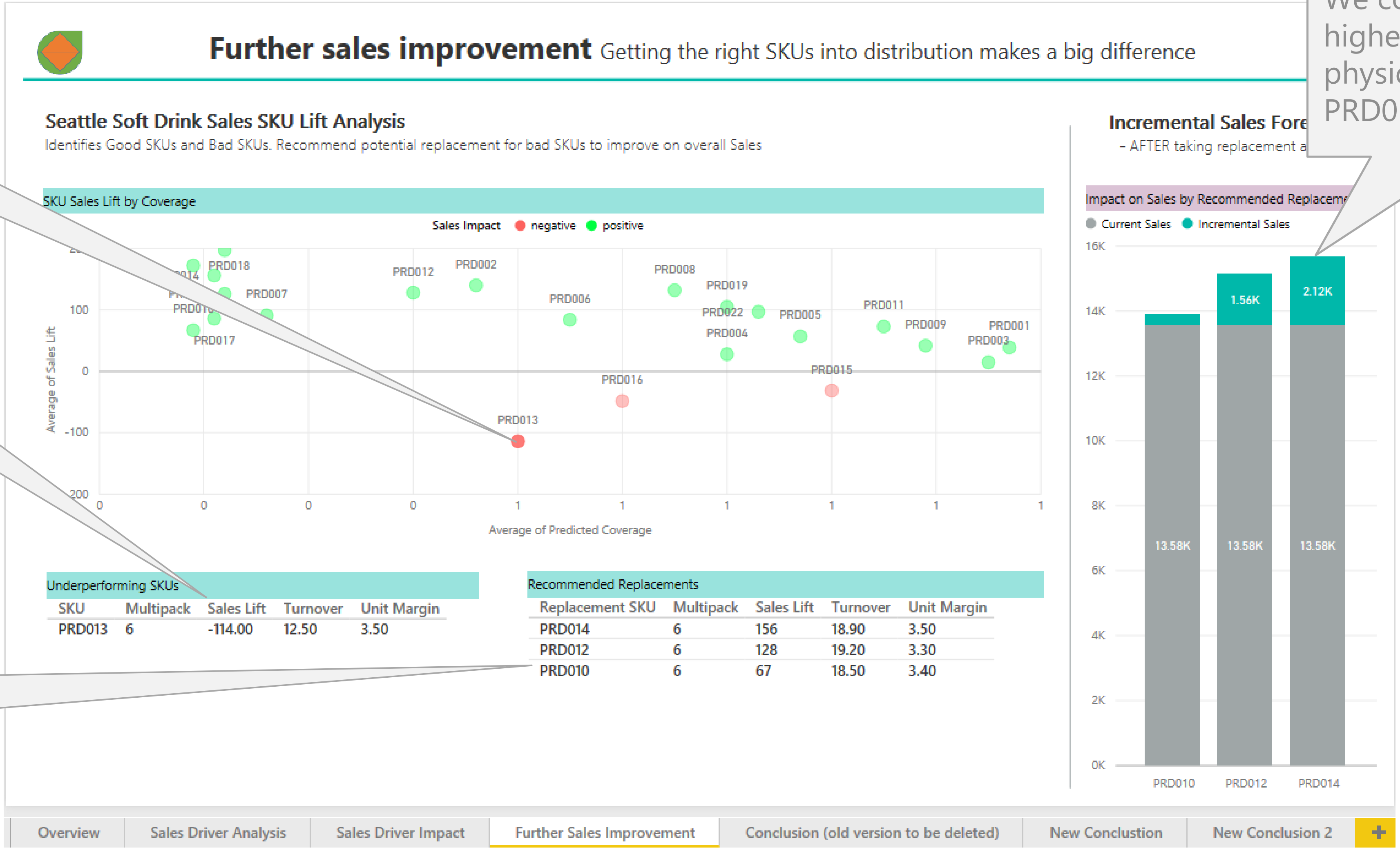
See more details about PRD013

3

See what the recommended replacements are

4

We could achieve the highest incremental physical sales if replace PRD013 with PRD014



Further Sales Improvement - 2

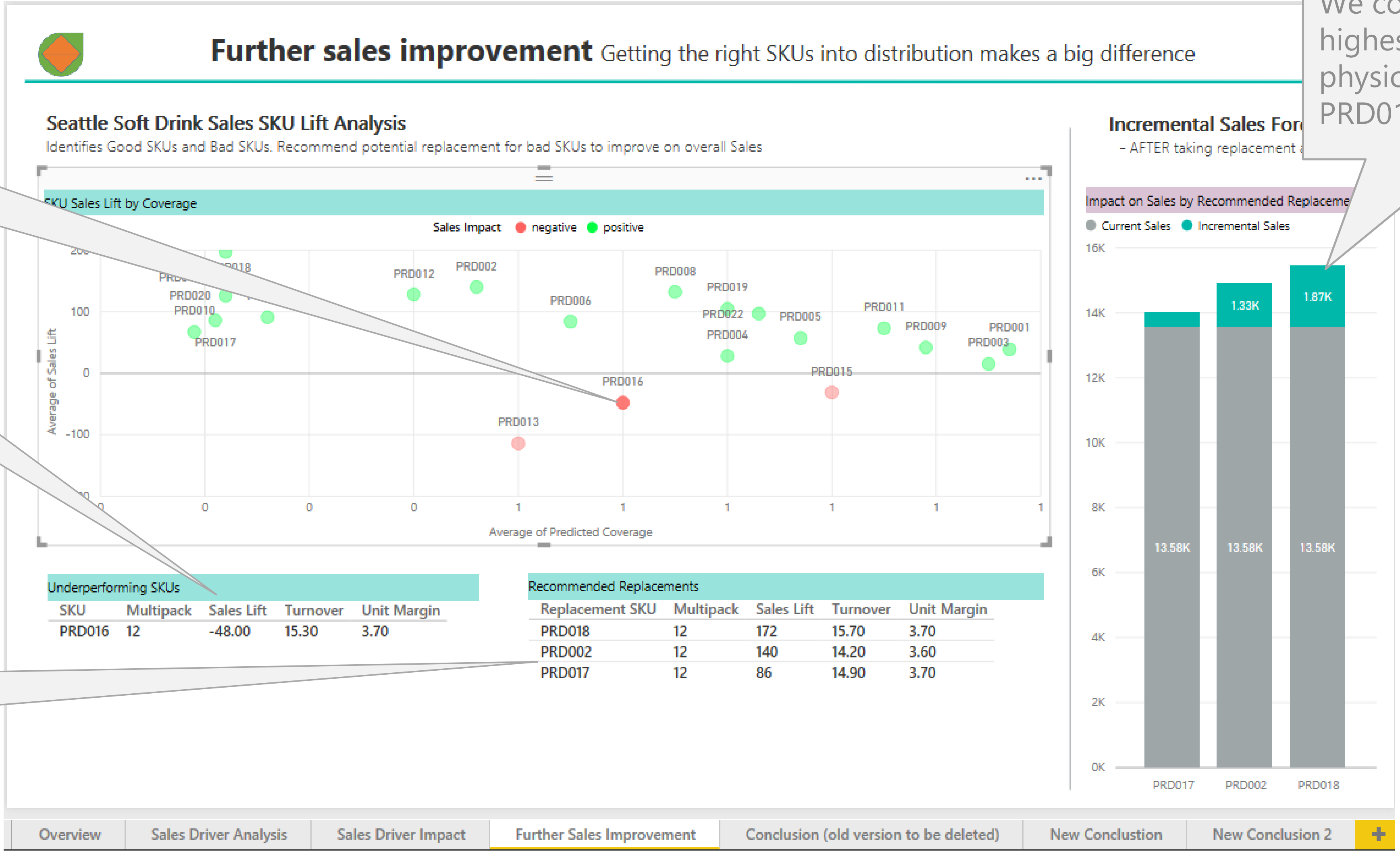
Getting the right SKUs into distribution makes a big difference

1 Click PRD016 as it has the second lowest sales lift

2 See more details about PRD016

3 See what the recommended replacements are

4 We could achieve the highest incremental physical sales if replace PRD016 with PRD018



Further Sales Improvement - 2

Getting the right SKUs into distribution makes a big difference

1

Click PRD015 as it is another “dog” SKU

2

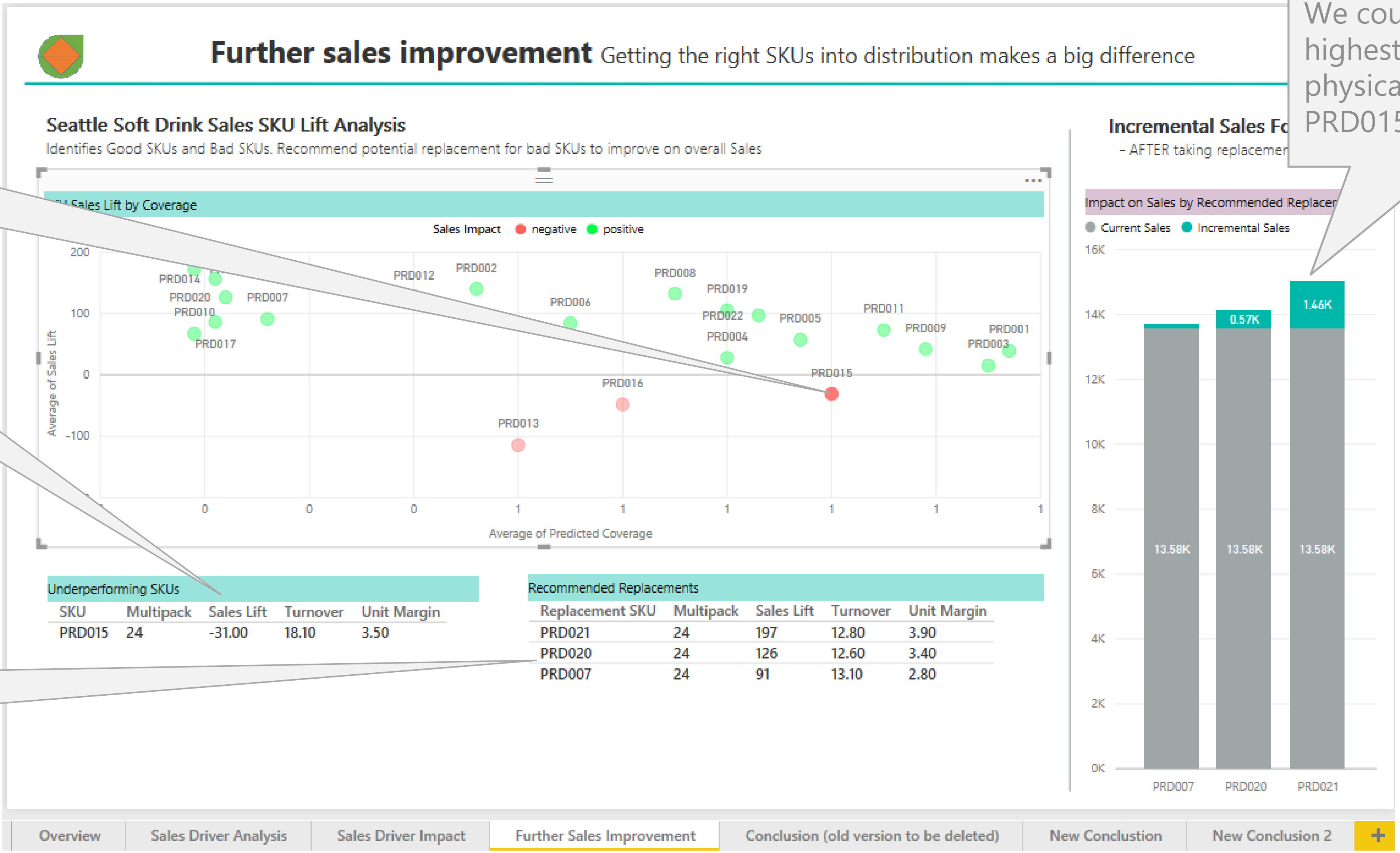
See more details about PRD015

3

See what the recommended replacements are

4

We could achieve the highest incremental physical sales if replace PRD015 with PRD021



Conclusion

ales improved and it is time to recalibrate management expectation

1

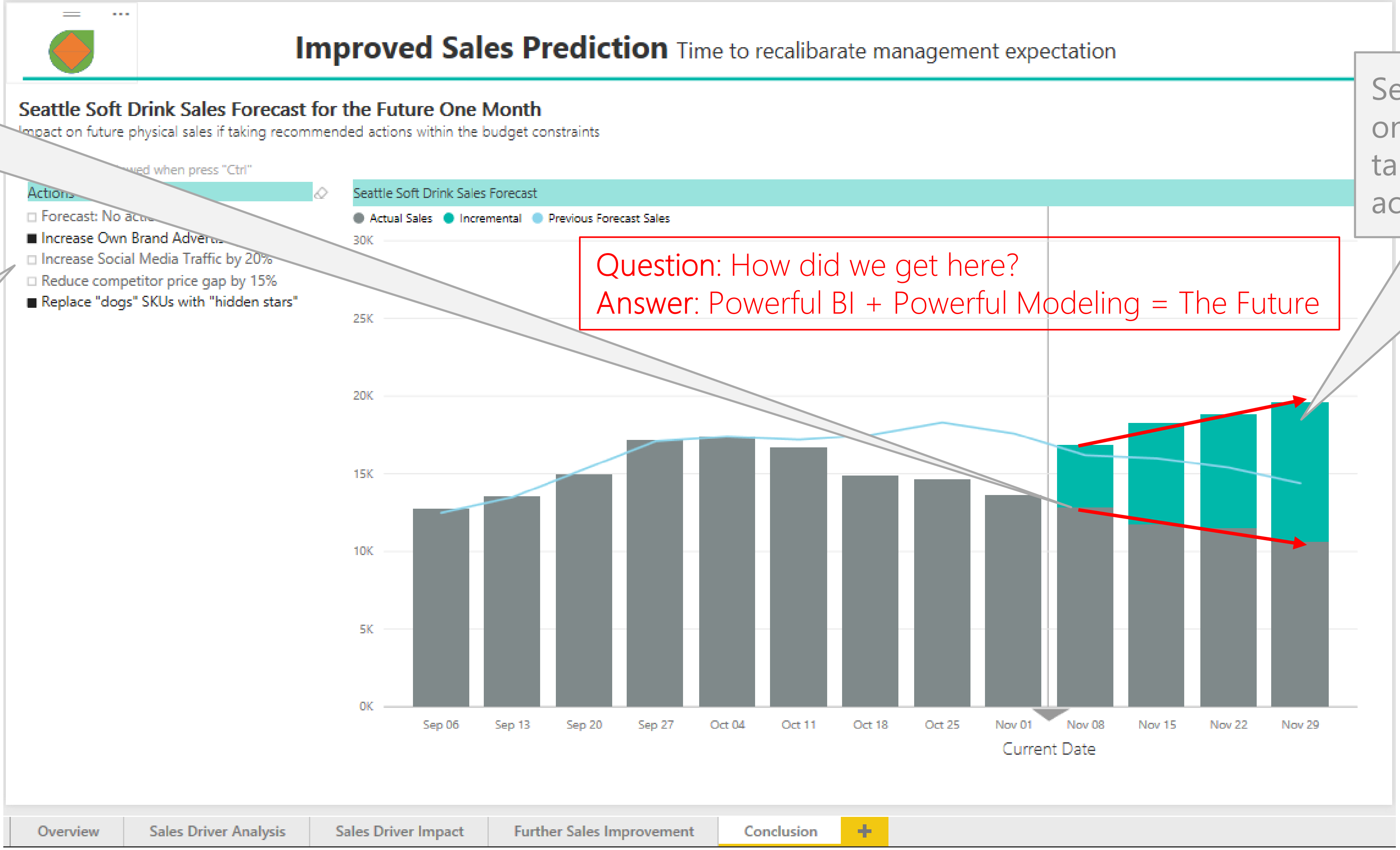
The sales will continue sliding down if no actions are taken

2

Within the budget constraints, select the recommended actions

3

See the overall impact on physical sales if we take the recommended actions

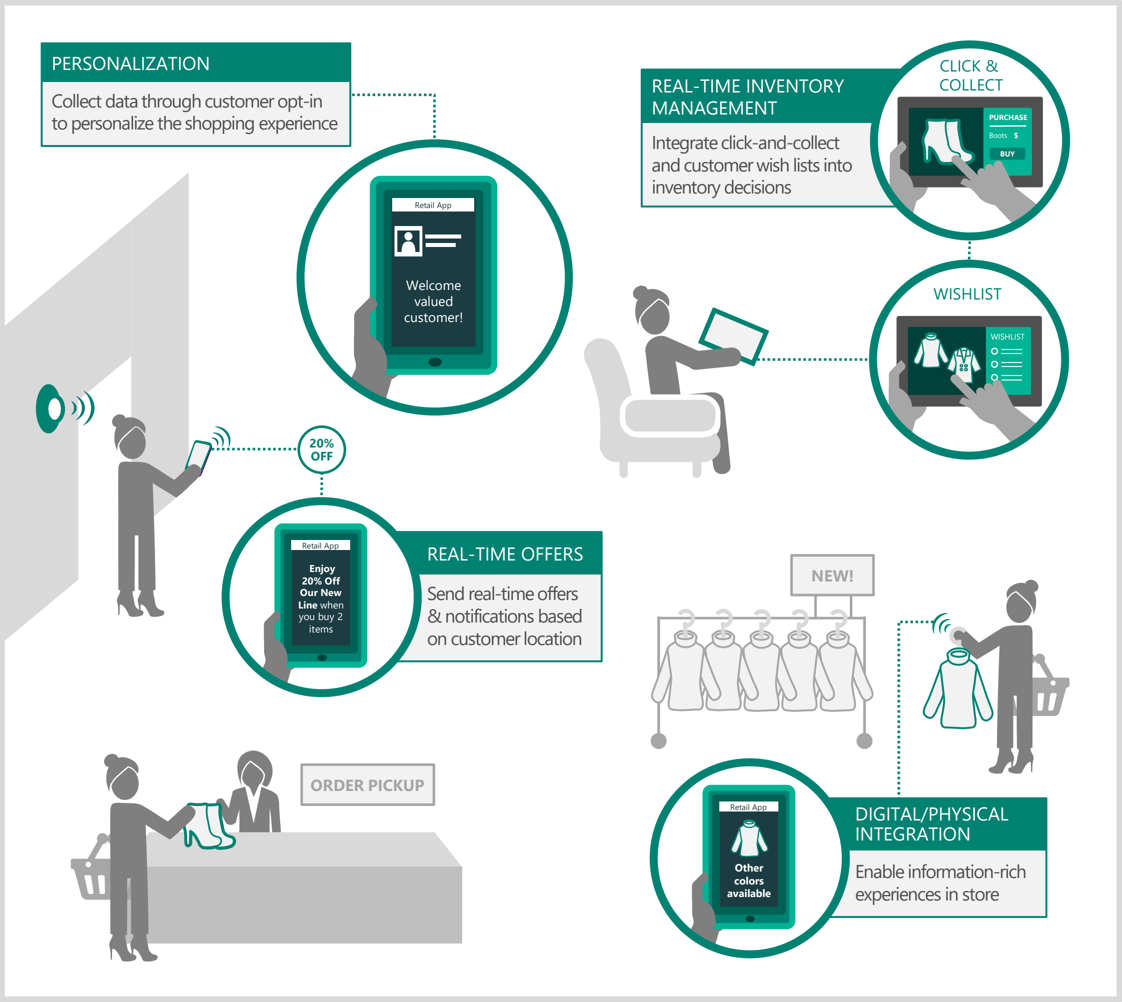


Delight your customers with personalized shopping experiences

VP of Stores

CMO

Delight your customers with personalized shopping experiences



Connect with customers at the right time, right place with the right offers

by gathering data from various points of customer contact to understand customer behaviors and respond with relevant offers

Predict what customers want before they tell you

using predictive analytics solutions to create relevant cross-sell and upsell opportunities throughout the customer journey

Deliver engaging in-store experiences

by combining technologies that give customers rich information when they shop online with the in-store experiences of trying out products and engaging with informed sales associates

Harness the power of your data to gain a competitive edge

Merchandising Director

COO

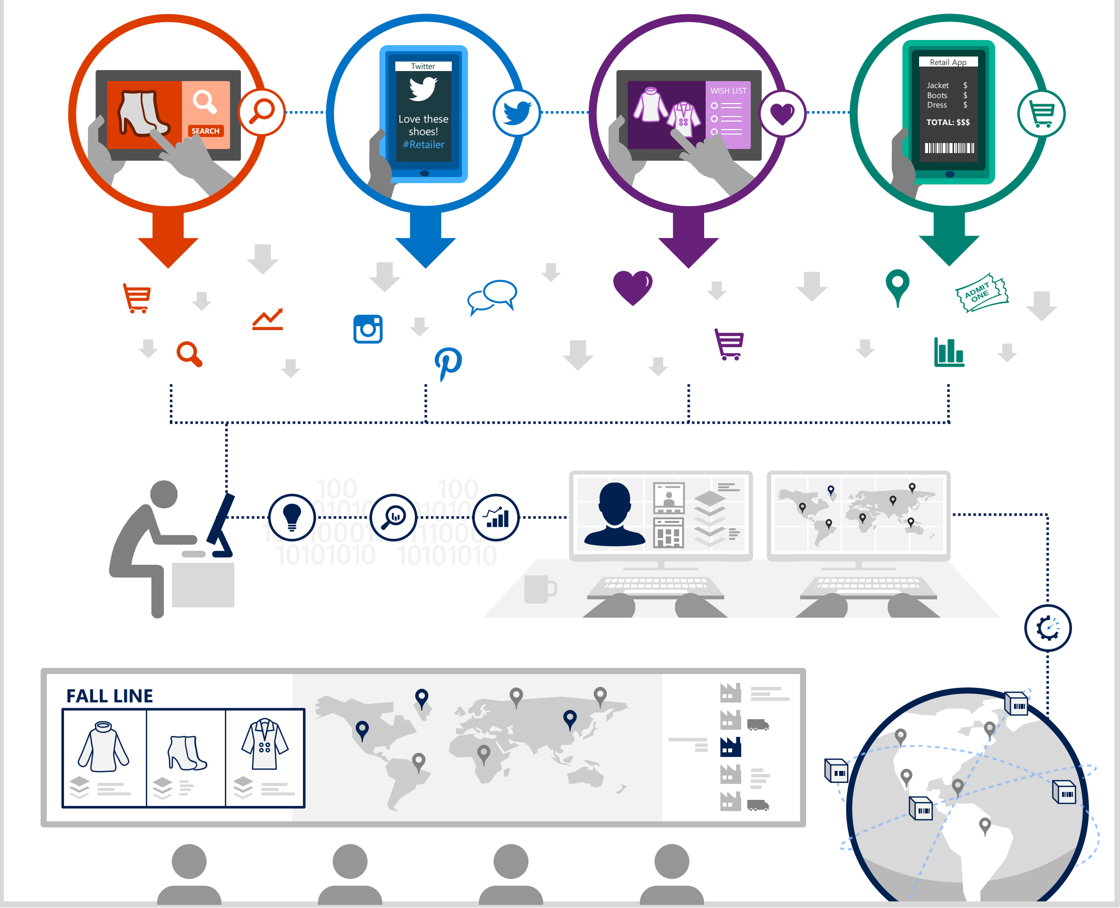
VP of Stores

CMO

CIO

Harness the power of your data to gain a competitive edge

$94B data opportunity for retail[1]



[1]Source: IDC and Microsoft Corporation, The Data Dividend

Become an insight-driven organization to differentiate from the competition

by learning from the valuable data you already have—every device, sensor, upload, tweet, purchase, shipment and keystroke

Evolve from reactive to proactive to help build, monitor and improve your brand

through advanced visibility into what your customers are saying and the ability to offer innovative customer experiences

Keep pace with rapid change and innovate to give customers what they want

by leveraging advanced analytics to transform your data into intelligent action

Enjoy data-driven retail with Microsoft

Optimize your forecasting and react faster

Modernize your supply chain with analytics-driven operations

Empower your workforce to provide a differentiated customer experience

Delight your customers with personalized shopping experiences

Harness the power of your data to gain a competitive edge

Microsoft