

SAS Analytics for the Internet of Things



Overview for IBTTA



Communications



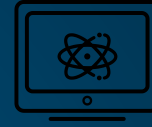
Smart Cities and Homes



Connected Customer



Surveillance



Avg. Internet User:
1.5GB Data/Day



Connected Car Transportation



Building Management



Connected Car:
4.0TB Data/Day



Energy



Agriculture



Insurance



Healthcare



Retail



Manufacturing



Connected Airplane:
40.0TB Data/Day

INTERNET OF THINGS

Internet of Things (IoT)

Walmart Example



All locations:
2.5PB Data/Hr



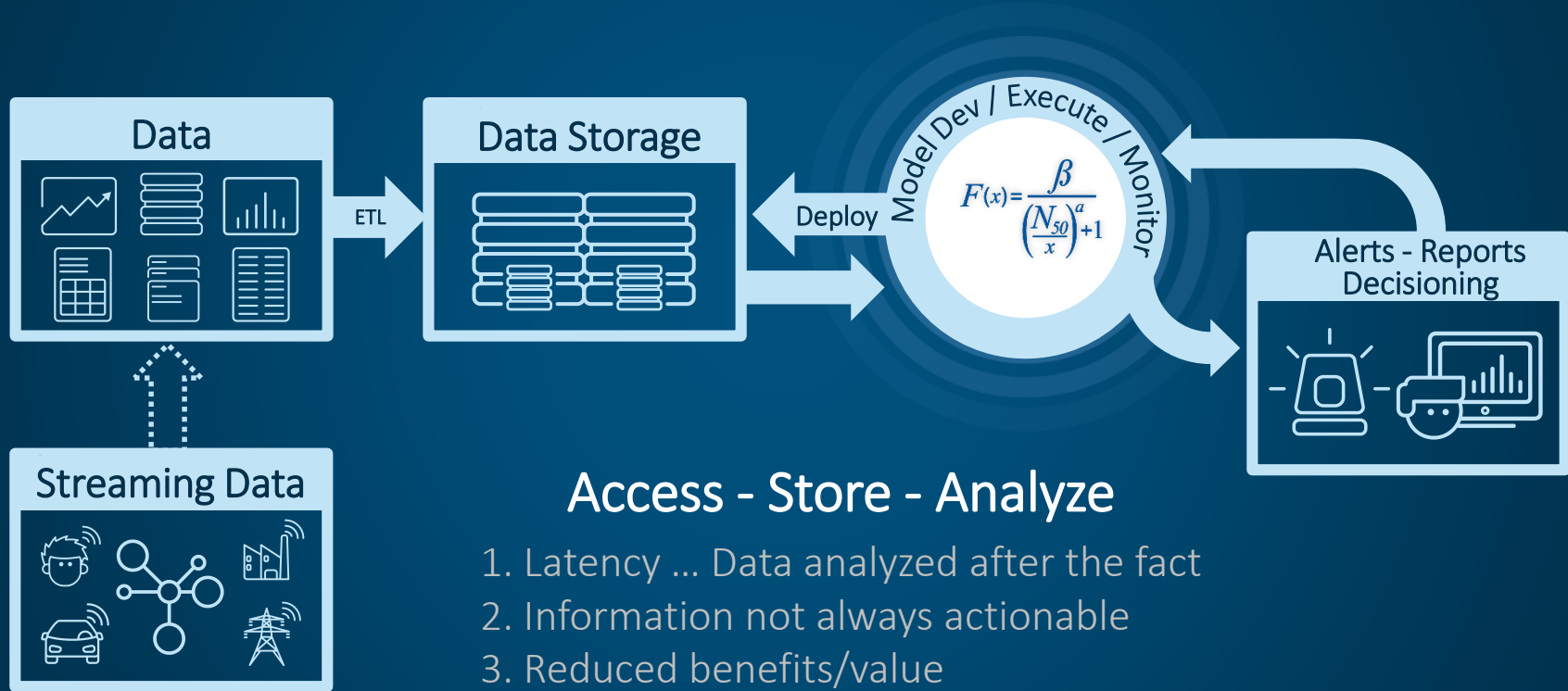
Data generated by 1 Million Customers per hour

1 PB = 1 Million GB = 13.3 years of HD Video

Per Day = 25 PB or 130 years of HD Video

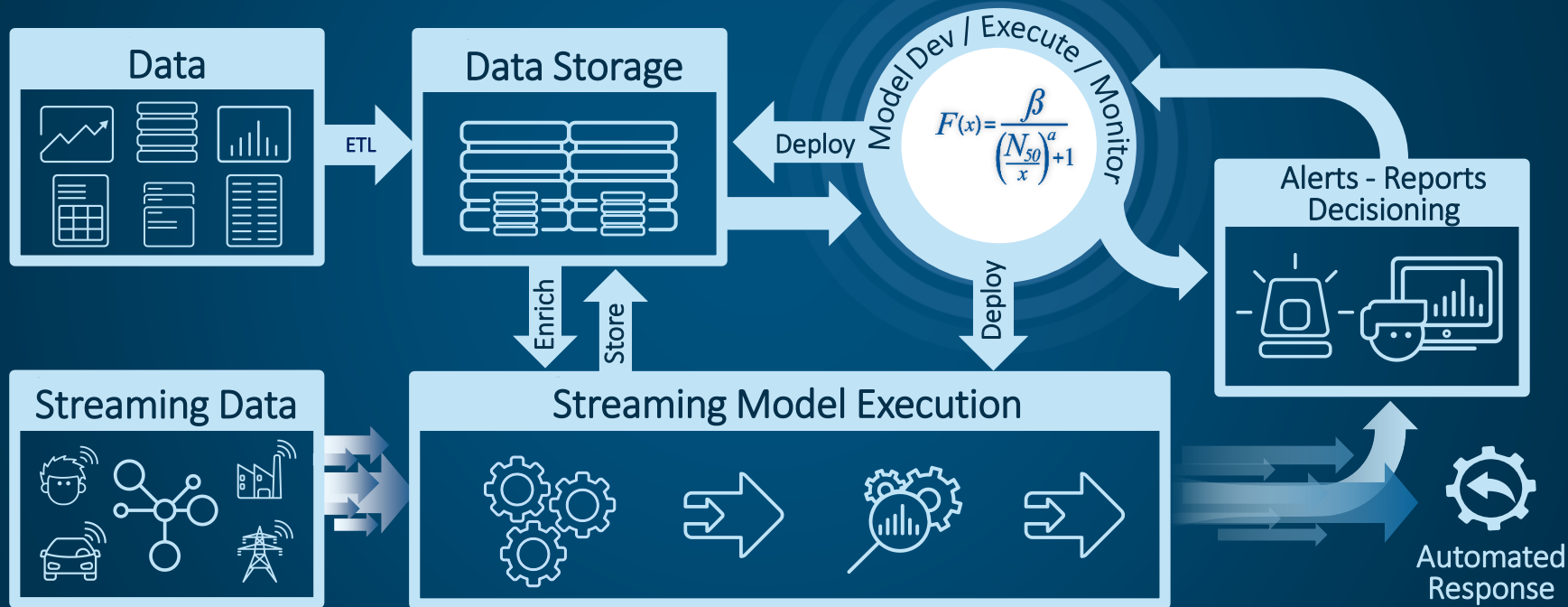
Traditional Analytics Lifecycle

Traditional Analytics Lifecycle



Analytics Lifecycle

IoT Analytics Lifecycle



SAS Analytics for IoT

What does this mean for Toll Authorities?



AT THE ROADSIDE

- Build trips
- Perform plate reads and match to DMV records to identify owner
- Can Immediately process transactions against prepaid or mobile accounts
- Can Immediately process transactions against email invoiced accounts
- Send only necessary records directly to cloud storage



SAS Analytics for IoT

What does this mean for Toll Authorities?



CLOUD PROCESSING AND STORAGE



- Operational and Commercial Back Office Functions



- Allows for shared services across many agencies by subscription



- Combine operational data with real time third party data for greater customer insights



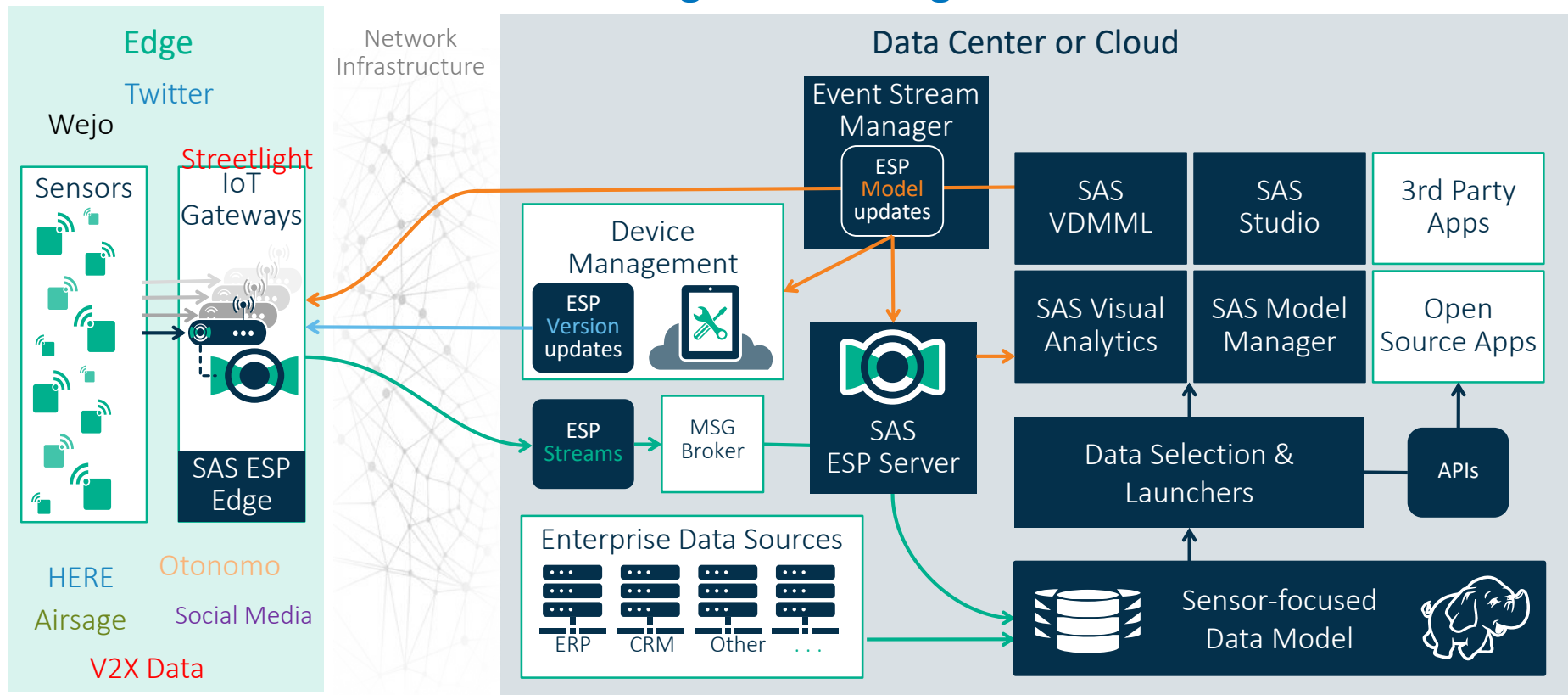
- Supports streaming data from connected vehicles



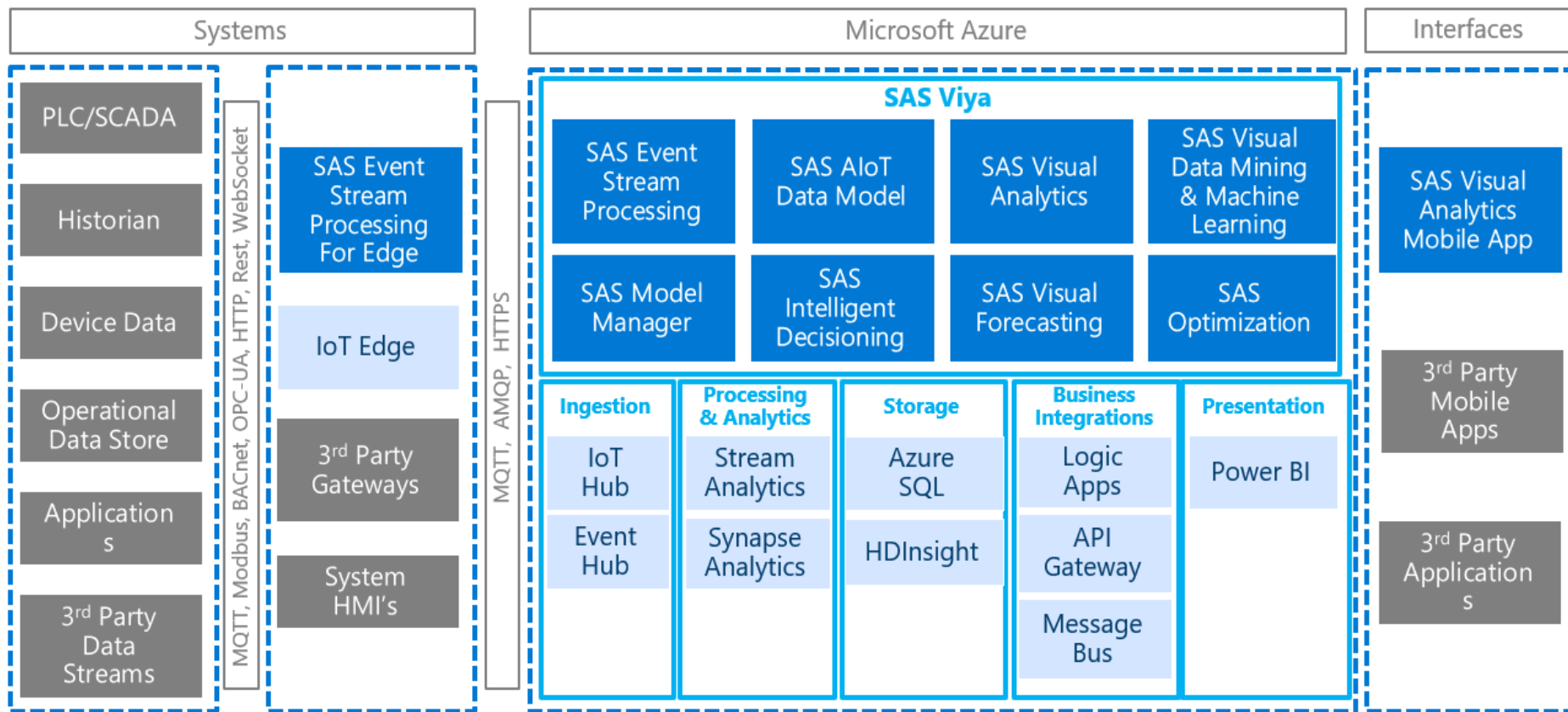
- Support Containers and Microservice Architecture



Analytics for IoT Logical Architecture: Edge Processing



SAS AIoT Reference Architecture on Microsoft Azure



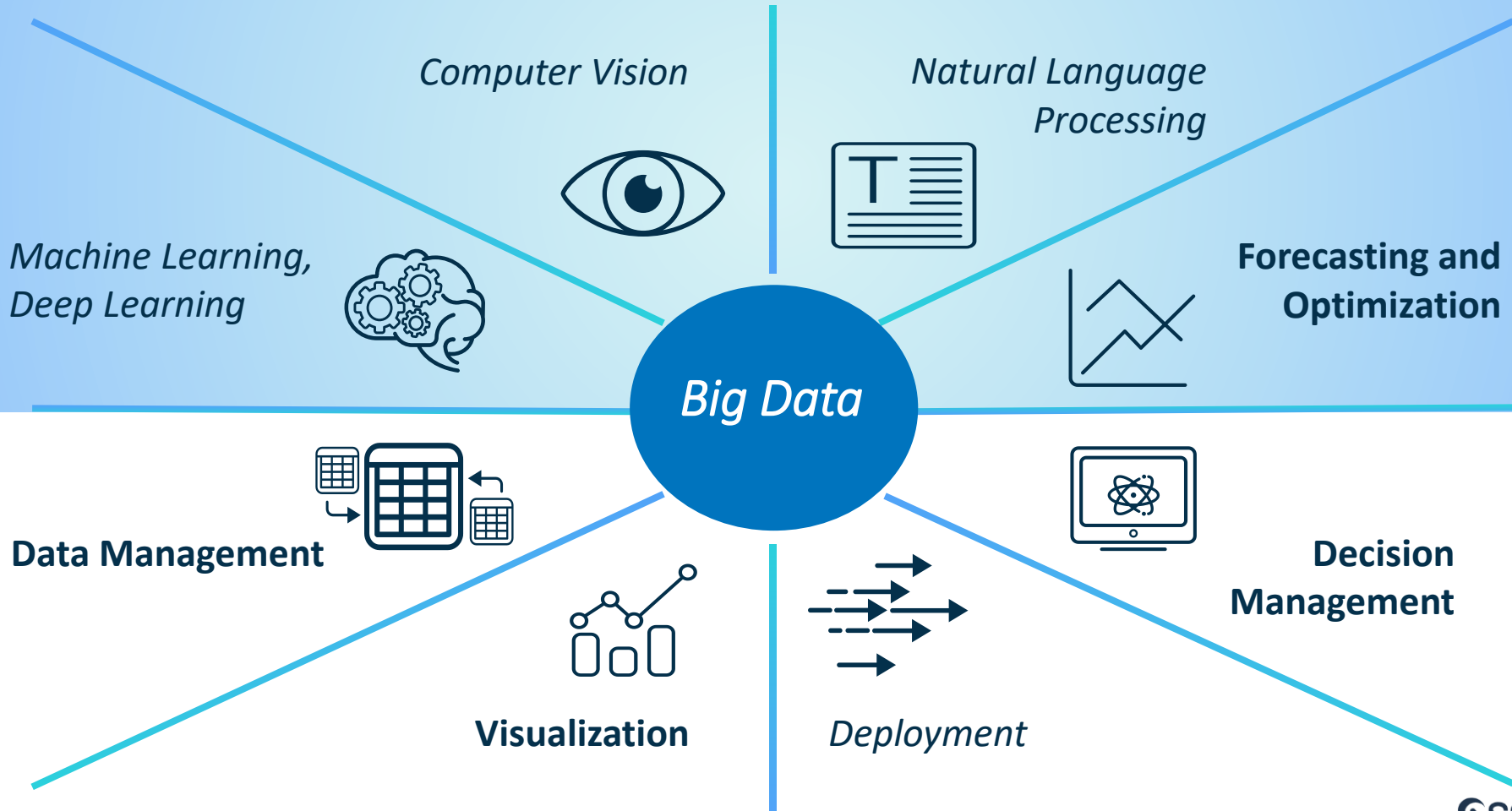
Existing systems

Azure Services

SAS Products

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Data

MEGACORPS_4M

Search data

Hierarchy (1)

Geo-Hierarchy

Measure (22)

- Employees Used
- Expenses
- Expenses (capital)
- Expenses (material)
- Expenses (operational)
- Expenses (staffing)
- Facility Age
- Product Material Cost
- Product Price (actual)
- Product Price (target)
- Product Quality
- Profit
- Revenue
- Unit Age
- Unit Capacity
- Unit Downtime
- Unit Lifespan
- Unit Lifespan Limit
- Unit Reliability
- Unit Yield (actual)
- Unit Yield (rate)
- Unit Yield (target)

Property Value

Name

Classification

Model type

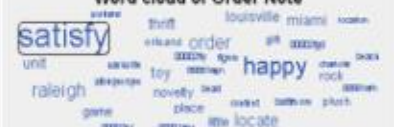
Format

Aggregation

Visualization 4

+satisfy, happy, +6 1,916 2,070 11

Word cloud of Order Note



Results Topics Documents Analysis

Total Documents: 671 Filter by

Order Note Sentiment Relevance

Customer: 0000202, Location: Portland, 1 unit(s) of Toy Plush

(s) were ordered. 0000202 is satisfied with us.

0.69 0.22

Showing top 20 of 6,494 paths by frequency of path.

Banking Demo

Forecast of Expenses (capital) by Date by Month

Expenses (capital) (Sum)

Aug2009 Apr2010 Dec2010 Aug2011 Apr2012 Dec2012

Date by Month

Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

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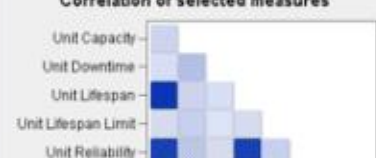
Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Visualization 1

Correlation of selected measures



Unit Capacity Unit Downtime Unit Lifespan Unit Lifespan Limit Unit Reliability Unit Yield (actual) Unit Yield (rate) Unit Yield (target)

Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ...

Weak Strong

Unit Capacity Unit Downtime Unit Lifespan Unit Lifespan Limit Unit Reliability Unit Yield (actual) Unit Yield (rate) Unit Yield (target)

Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ...

Unit Capacity Unit Downtime Unit Lifespan Unit Lifespan Limit Unit Reliability Unit Yield (actual) Unit Yield (rate) Unit Yield (target)

Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ...

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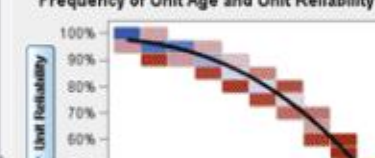
Unit Capacity Unit Downtime Unit Lifespan Unit Lifespan Limit Unit Reliability Unit Yield (actual) Unit Yield (rate) Unit Yield (target)

Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ... Unit ...

Unit Capacity Unit Downtime Unit Lifespan Unit Lifespan Limit Unit Reliability Unit Yield (actual) Unit Yield (rate) Unit Yield (target)

Visualization 2

Frequency of Unit Age and Unit Reliability



Unit Reliability

Unit Age

Best Fit Line

Frequency

4,790.0 274,932.5 545,077.0

Unit Reliability

Unit Age

Best Fit Line

Frequency

4,790.0 274,932.5 545,077.0

Unit Reliability

Unit Age

Best Fit Line

Frequency

4,790.0 274,932.5 545,077.0

Unit Reliability

Unit Age

Best Fit Line

Frequency

4,790.0 274,932.5 545,077.0

Unit Reliability

Unit Age

Best Fit Line

Frequency

Visualization 5

Decision Tree of Failures



Unit Capacity

Unit Downtime

Unit Capacity

Unit Downtime

Unit Capacity

Unit Downtime

Unit Capacity

Unit Downtime

Unit Capacity

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Unit Downtime

Unit Capacity

Unit Downtime

Visualization 3

Forecast of Expenses (capital) by Date by Month

Expenses (capital) (Sum)

Aug2009 Apr2010 Dec2010 Aug2011 Apr2012 Dec2012

Date by Month

Expenses (capital) (95% confidence)

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Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Expenses (capital) (95% confidence)

Visualization 6

Network Diagram of Geo Hierarchy

UNITED STATES

MEXICO

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Volvo Trucks and Mack Trucks

Volvo Trucks and Mack Trucks are both subsidiaries of the Swedish Manufacturer AB Volvo.



Key Challenges

- Enhance remote diagnostics and monitoring of critical engine, transmission and after-treatment trouble codes.
- Minimize unplanned downtime - which creates a tremendous toll on fleet operators and their customers who depend on timely deliveries.
- Improve vehicle efficiency and uptime to keep trucks running – or ensure the least disturbance to the business if something happens on the road.

How SAS® supported the process



Results

- 175,000 trucks are supported with remote diagnostics.
- Millions of records are processed instantaneously - reducing diagnostic time by 70% and repair time 25%.
- Thousands of sensors on each truck collect streaming IoT data in real-time to provide the context needed for more accurate diagnosis.
- SAS enables Volvo and Mack to maximize vehicle uptime and minimize the costs of service disruptions by servicing connected vehicles more efficiently, accurately and proactively.
- Able to help customers recover from problems faster while preventing problems from arising in the first place.

Powered by

AI-Embedded IoT Analytics for IoT from SAS®

“With SAS, we’re working smarter – we’re seeing things that exist in our information that we couldn’t find before, so we can do things more efficiently and effectively, and drive better results for our customers.” –David Pardue, VP of Connected Vehicle and Uptime Services for Mack Trucks

“Our engineers can now see issues before they impact customer operations and change the truck’s design, so we have the best product on the road.” –Conal Deedy, Director of Connected Vehicle Services for Volvo Trucks North America



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