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INNOVATE WITH CONNECTED MANUFACTURING OPERATIONS

07-MAR-2017

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AGENDA

- HARMAN OVERVIEW
- INDUSTRY 4.0 AND BEYOND
- WORKSHOP
- CAPABILITIES

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INDUSTRIAL 4.0 & BEYOND

CONNECTED OPERATIONS INDUSTRIAL MANUFACTURING

INDUSTRIAL MANUFACTURING TRENDS

BIG DATA AND ADVANCED ANALYTICS: A combination of these technologies help manufacturers know when their machines will break down, when the market will pick up or how much inventory they need to buy next week. Most manufacturers are still in the beginning stages of their Big Data and IoT implementation process and a huge uptick is expected this year.

IOT-LED OPERATIONS: Since *Connected machines* will be the backbone of industrial manufacturing in the near future, manufacturers need to know how to manage the data coming from these sensors, integrated equipment and platforms, and process information in real time. They need to be able to use the data to improve equipment performance and open new revenue streams

MOBILE DEVICES AND WEARABLES (incl. smart scanners, AR, VR) can offer more insight into plant floors with access to job-critical data. They can also help enter and track inventory, display work instructions, at the right time, for the right users. ERP-integrated devices allow users to track and make changes anywhere, anytime to plant floor and process measurements, orders and so on.

GREEN MANUFACTURING: Through lean manufacturing, industrial manufacturers are always looking for methods to reducing waste, reduce energy consumption and emissions to achieve a green production environment. They are investing in technologies that checks all their boxes for environmental sustainability and also achieve costs savings on energy

CLOUD: *Connected factories and shop floors* are data-driven where all activities are connected by a unified information platform. Industrial manufacturers are leveraging the cloud to link machines, sensors and workers to gather and analyze new levels of information and translate them into insights.

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VALUE BEYOND REDUCED COSTS

HARMAN INDUSTRIAL IOT CAPABILITES

INDUSTRY 4.0 OFFERINGS	VALUE DRIVERS	INDUSTRY 4.0 CAPABILITIES				BUSINESS VALUE
SMART PRODUCTS	ASSET UTILIZATION	ROUTE OPTIMIZATION	CONDITION MONITORING	REMOTE MONITORING	PREDICTIVE MAINTENECE	• Reduced machine downtime • Optimizes Logistics costs
SMART SERVICE MANAGEMENT	INVENTORY	INVENTORY OPTIMIZATION	IN-TRANSIT AND SUPPLIER VISBILITY	MATERIAL TRACKING	CONSUMABLES MANAGEMENT	• Reduced Inventory costs • Improved material visibility
CONNECTED SUPPLY CHAIN	QUALITY	QUALITY MANAGEMENT	ADVANCED PROCESS CONTROL	M2M DATA INSIGHTS	CONDITION MONITORING	• Reduced Quality costs • Better Customer Satisfaction
SMART SHOP FLOORS	SUPPLY-DEMAND	DEMAND MANAGEMENT	CUSTOMER INSIGHTS	DEMAND FORECASTING	PRODUCTION PLANNING	• Improved Forecasting accuracy • Optimize Production
INTELLIGENT CUSTOMER INSIGHTS	AFTER SALES	SERVICE BOTS	PREDICTIVE DIAGNOSTICS	ASSET MONITORING	DISCOUNTS AND PROMOTIONS	• Reduce maintenance costs • Improve Customer Service
SMART BUILDINGS	TIME TO MARKET	APPLICATION CO-ENGINEERING	RAPID PROTOTYPING	CONNECTED EQUIPMENT INSIGHTS	SUPPLY CHAIN OPTIMIZATION	• Increased revenues • Reduced costs
SMART GRID	RESOURCES	INTELLIGENT LOTS	SENSOR-EQUIPPED FACILITIES	SMART ENERGY CONSUMPTION	REAL TIME YEILD OPTIMIZATION	• Improve throughput • Reduce energy costs and emissions
	PRODUCTIVITY	CONTROL AUTOMATION	REMOTE TRACKING	OPERATIONS INSIGHTS	FAULT MANAGEMENT	• Increased productivity • Streamlined Operations

SMART SENSORS | IOT PLATFORMS | WEARABLES | PREDICTIVE / PRESCRIPTIVE ANALYTICS | BIG DATA | MOBILE | GPS | M2M CONNECTIVITY | REAL TIME DATA | IT-OT INTEGRATION

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SMART FACTORY – DRIVING PARADIGMS

Smart Plants – Energy Optimization & Integrated Security

Demand Driven Supply Chain – Optimal Inventory Management & Procurement Cost

Efficient Distribution – Finished Goods Prediction & Delivery Management

Predictive Plant Maintenance And ROI On Plants, Insurance & Cost Management

Dynamic Workforce Planning & Management

In Plant Logistics & Robotics, MES & RFID Integration

Production line remote monitoring

Unified factory-wide interconnectivity

Predictive maintenance

Failure mitigation and safety control

Gateway apps and edge analytics

Centralized config data updates

Workforce tracking

Cloud-based data storage and analytics

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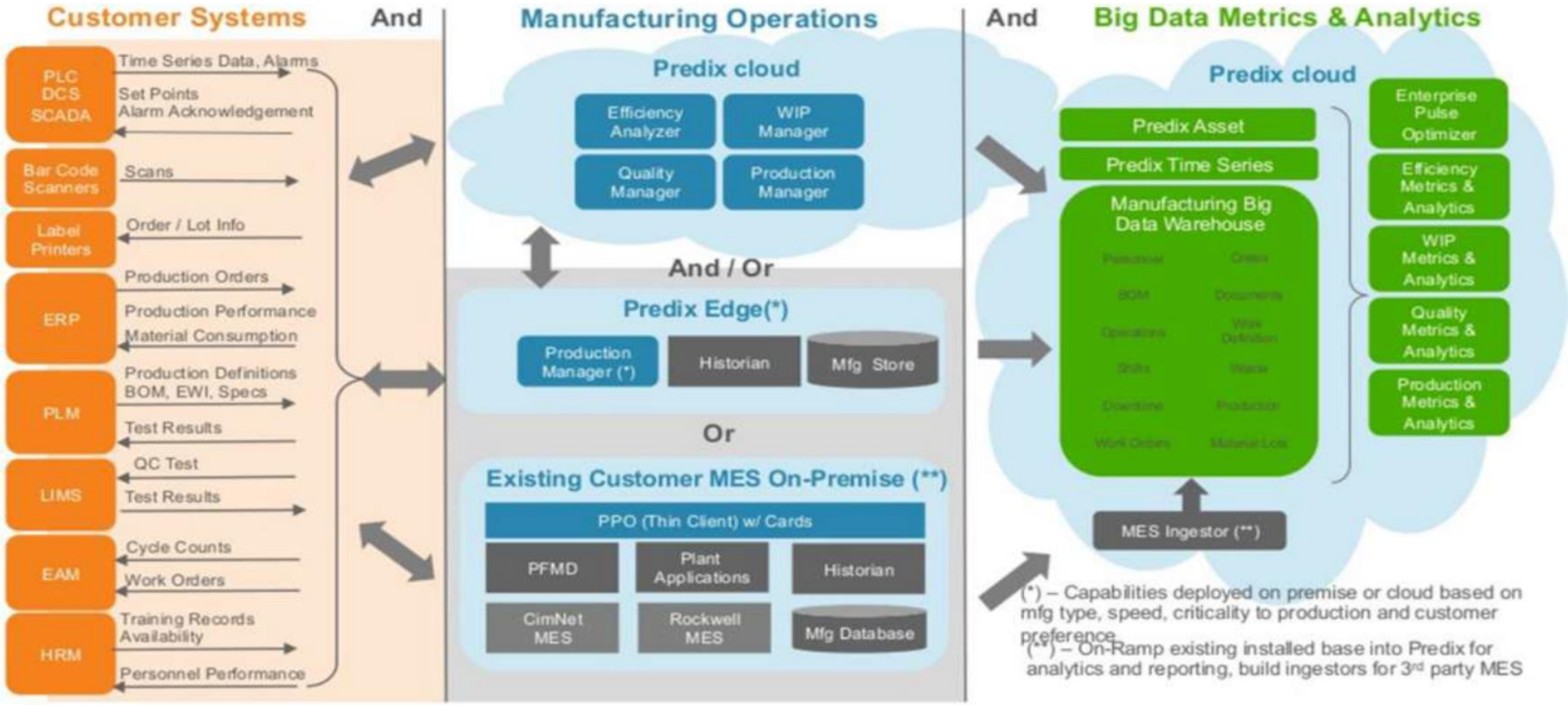
BRILLIANT MANUFACTURING LANDSCAPE



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BRILLIANT MANUFACTURING WITH POTENTIAL OUTCOMES

DESIGN

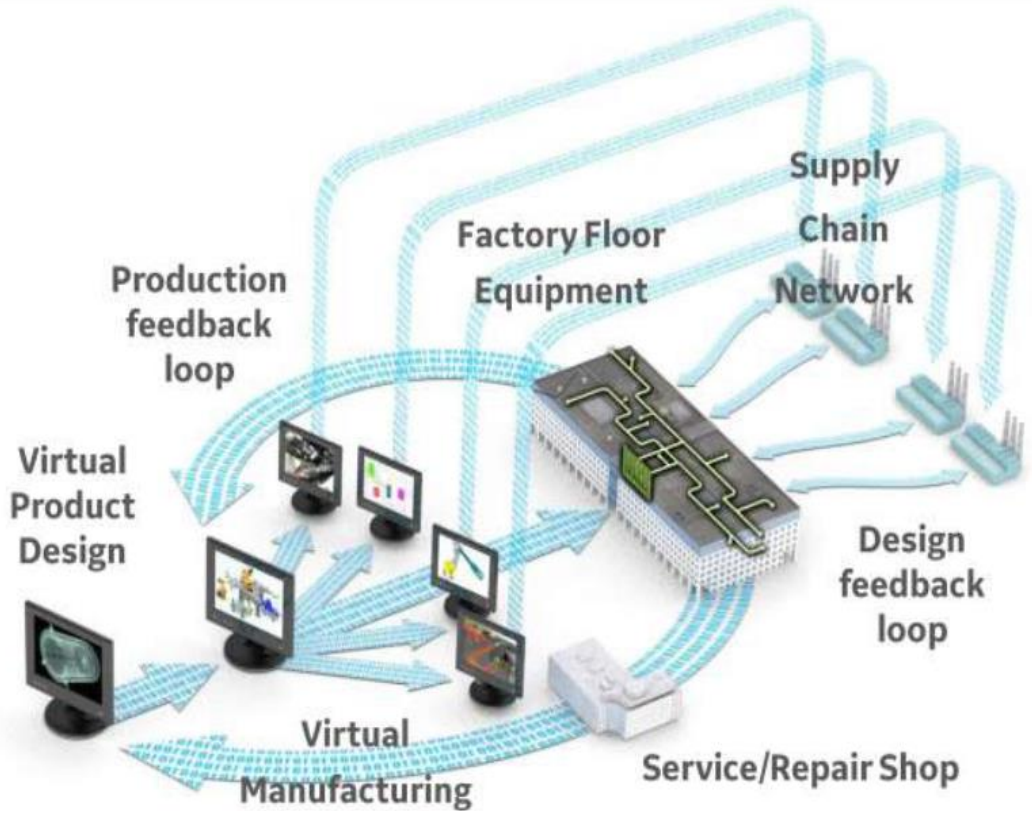
MANUFACTURING

QUALITY

OPERATIONS

EQUIPMENT

SUPPLY CHAIN



OUTCOMES

- ↓ Downtime 10-15%
- ↓ Labor costs 14%
- ↓ Inventory 30%
- ↓ Lead time 60%

- ↑ Quality
- ↑ On time delivery 58%
- ↑ Throughput

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ADDRESSES YOUR CHALLENGES WITH OUR INDUSTRY 4.0 APPROACH

HARMAN INDUSTRY 4.0 FOR CUMMINS

INDUSTRIAL MANUFACTURING CHALLENGES

- High Production Costs
- Enable Product Innovation
- IT Security Risks
- Tackle Energy & Environmental Issues
- Maintain Quality
- High time-to-market
- Optimize Productivity

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- SMART SHOP FLOOR
- CONNECTED SUPPLY CHAINS
- SMART SERVICE MANAGEMENT

INDUSTRY 4.0 DESIGN PRINCIPLES

INTEROPERABILITY

- IT-OT, MES Integration
- IoT Gateway and Network
- M2M Connectivity and Comms.

INFORMATION TRANSPARENCY

- End-to-end data security
- Connected Operational Insights
- Cloud-based information processing

TECHNICAL ASSISTANCE

- VR/AR, Robotics
- Automation
- Powerful Operations Dashboards

DECENTRALIZED DECISION MAKING

- Big Data
- Control Automation
- Predictive/Prescriptive analytics

- Reduce downtime risk
- Secure Systems
- Improved Quality
- Increased Productivity
- Faster Time to Market
- Better Supplier Collaboration
- Energy Savings and Low Emissions
- Improved Safety
- Improved Speed and Flexibility

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SMART SHOP FLOOR

SMART SHOP FLOOR POV

Unified Operations View

Connect factory assets and ERP/MES systems to provide role-based views or connected applications to deliver work instructions and quality capture in-context for increased operator productivity and production quality.

Consumables Management

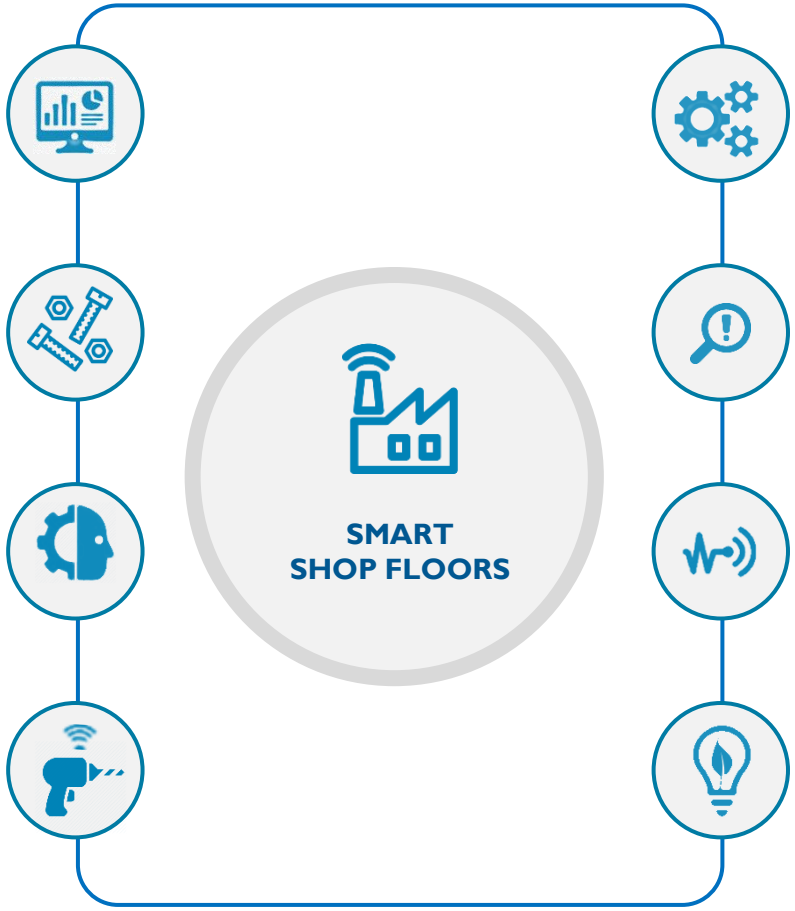
Sensor data generated by tools help capture consumables used, and when integrated with inventory management systems it can ensure consumables are always stocked by sending real time alerts to personnel when stocks are low

Control automation

Sensors measure Operations parameters (temperature, pressure etc.) at a process level and syncs with remote controllers, which can sense deviations from presets and auto-adjust to the process. Near real-time feedback loops can reduce major human intervention and time lags.

Geofencing and Asset Tracking

Apart from asset tracking, geofencing helps ensure that only the right tool with the right configuration is used in the designated work cell. The right tool configuration can be automatically activated in real time.



Connected Operational Insights

Combine, analyze, and deliver insights from disparate and diverse silos of assets, operators, and enterprise systems into unified real-time visibility of KPIs for increased operational performance and improved decision making.

Fault Management

Connected tools capture the torque applied to a specific part, the specific tool used, when it was last calibrated and who used it. Faults can be detected in real time and the cloud helps trace every defect back to the root cause.

Safe Shop Floors

Bluetooth beacons can help forklifts and their operators on shop floors detect employees and obstacles nearby and provide alerts or even auto-apply brakes to ensure safety.

Energy management

Sensors (motion, HVAC) and demand-response systems allow shop floors to minimize energy usage. HVAC appliances connected to power/energy meters measure energy usage data at a device/plant level in real time, analyze it on IoT platforms and generate recommendations

SENSORS/RFID	CONNECTIVITY & TELEMATICS	MOBILE APPS	INVENTORY MANAGEMENT	REAL TIME DATA ANALYTICS
ASSETS & ENERGY MONITORING	OPERATIONAL ANALYTICS	LOCATION-BASED AWARENESS	API INTEGRATION	RECOMMENDATION ENGINE

CLOUD

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CONNECTED SHOP FLOOR OPERATIONS

AWARE OF AND CAN REACT TO:

Plant, Asset and Product Design or Configuration 5,8

Inventory levels and flow 1,3,4,8,12

Quality performance 4,9

Asset performance 5

Internal and External Operating Conditions

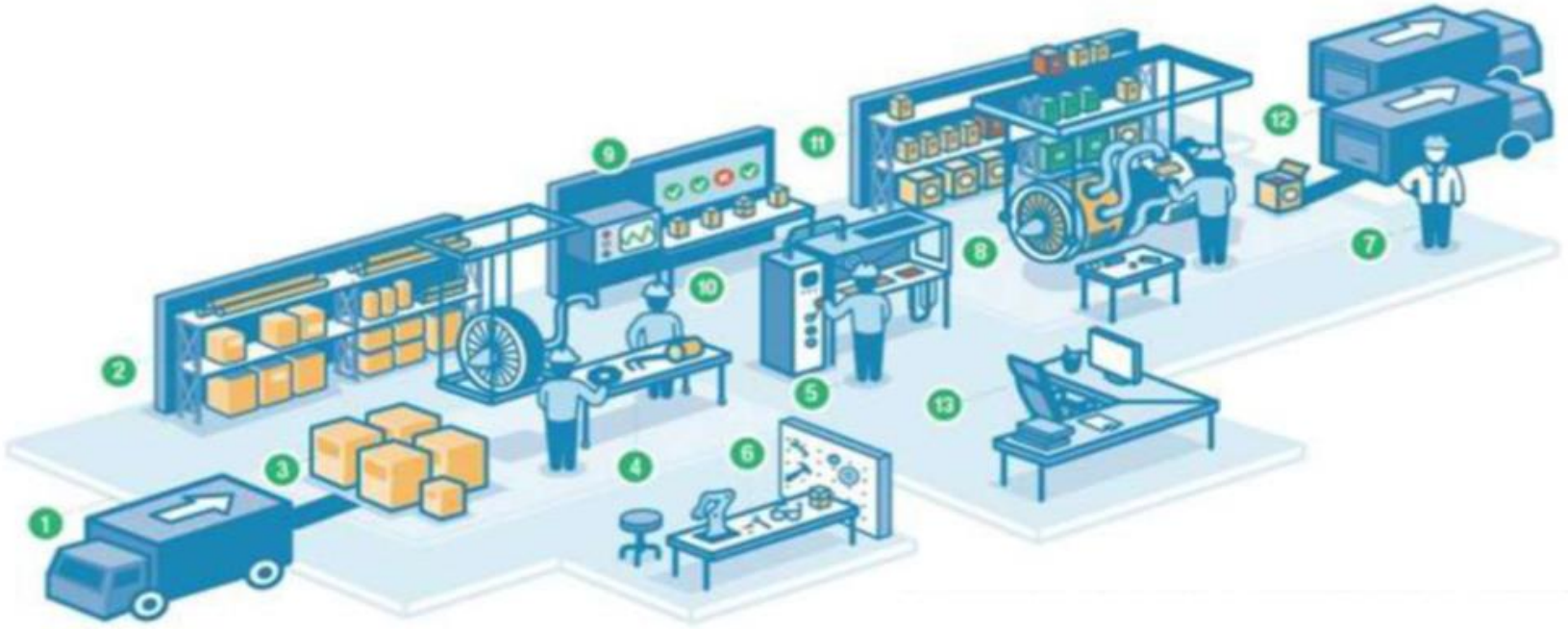
Supplier Performance 1

Customer Demands and Requirements 12

Environmental Impact

Mobile enabled employees with collaboration and optimal decision making 7,13

Closed loop business process 13



SMART CONNECTED OPERATIONS

Integrated Assets, Operations and Business Systems

REALTIME > PREDICTIVE > AUTONOMOUS

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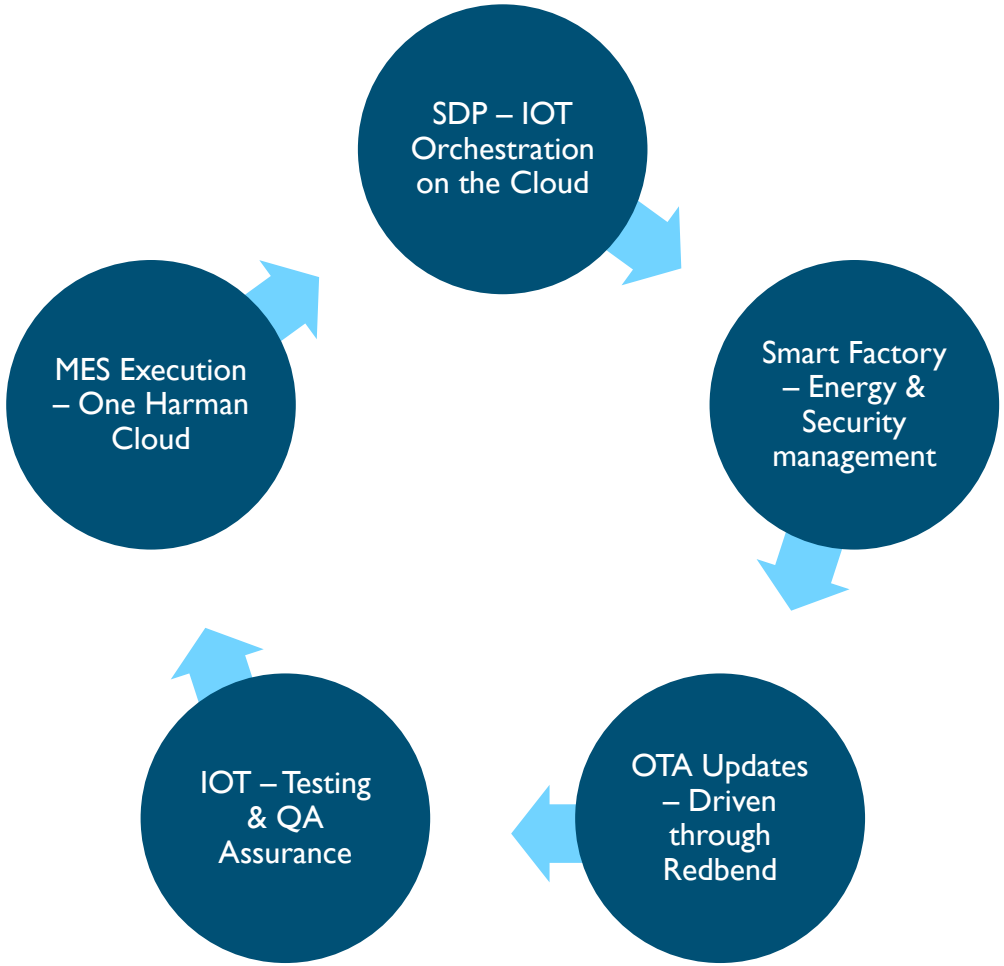
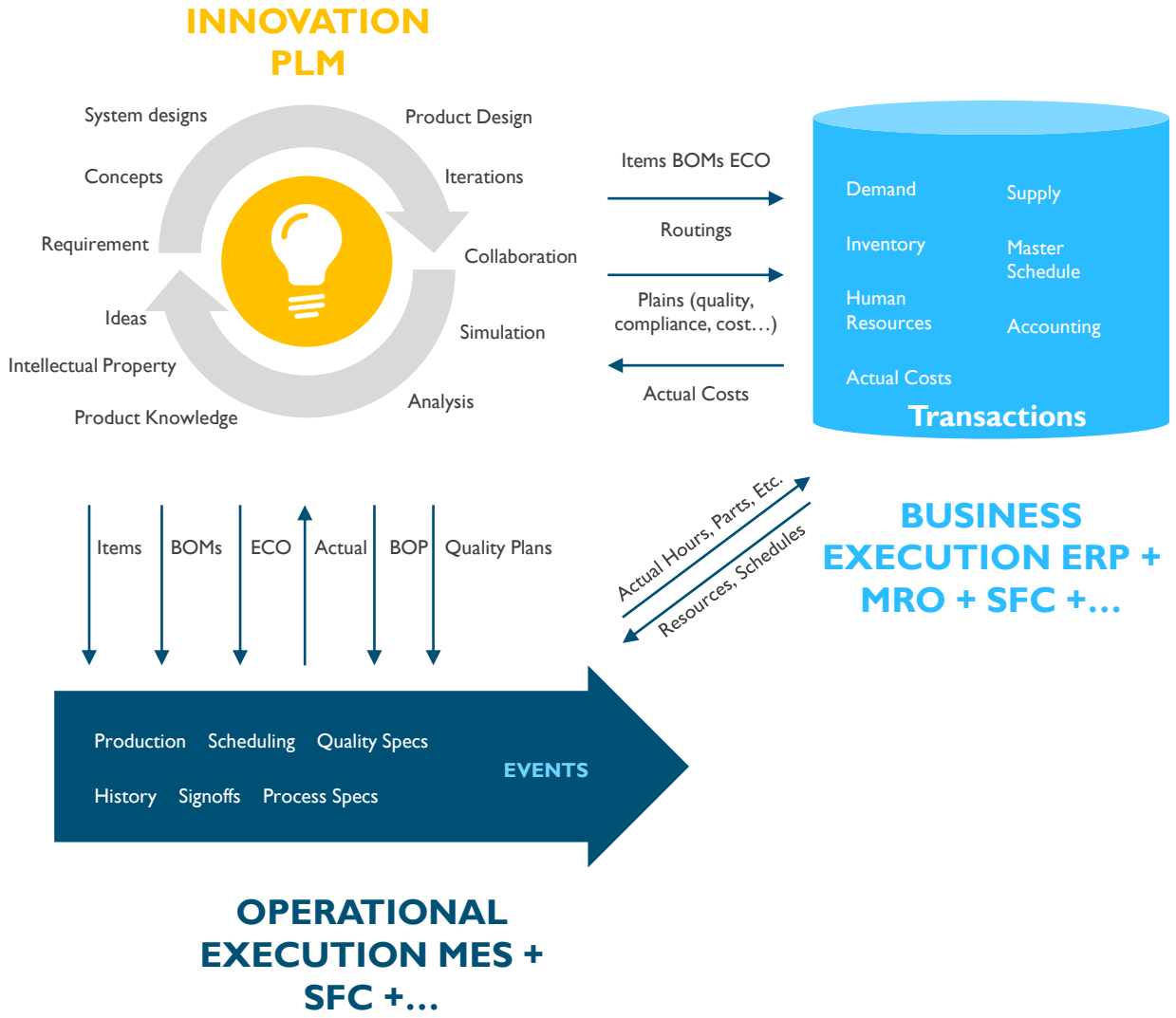
IIOT & SMART FACTORIES

OUR OFFERINGS





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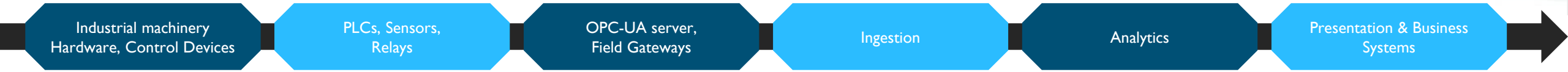
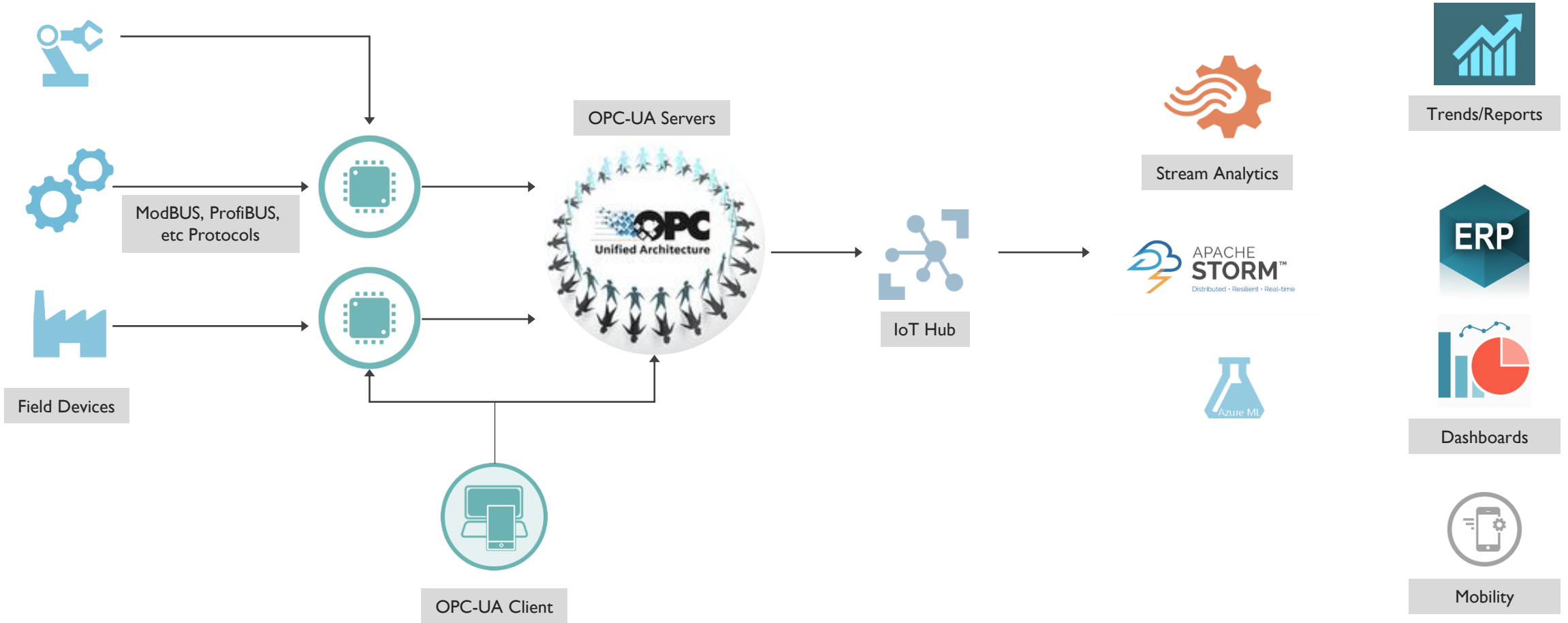
INDUSTRIAL IOT ENABLEMENT WITH OPC-UA





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PLATFORM FOR EQUIPMENT CONDITION MONITORING

A Leading Silicon Chip Design Manufacturing Company

The client wanted to monitor industrial equipment's performance to understand the deterioration, plan period maintenance and minimize downtime. This required continuous monitoring of the equipment condition to identify potential faults.

Helped the customer with Industrial IoT gateway development to acquire data and perform edge analytics. Developed cloud hosted software to enable advanced analytics, visualization and alarm reporting.

- Completed the product definition and architecture
- Developing the server software to provide in depth visualization and analytics of the equipment condition
- Developing the embedded software to acquire vibration data in real time and perform real-time data analysis.
- Helping in User Experience and Visual design as well as development of Modbus interface for SCADA integration.

REDUCED EQUIPMENT TCO

REDUCED EQUIPMENT DOWNTIME

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EVOLVE EXISTING PRODUCTS TO DIVERSE AND EMERGING TECHNOLOGY PLATFORMS

BUSINESS CONTEXT

The client is a leading distribution management software provider for wholesalers, distributors and manufacturers. Their market and business partners were demanding newer product versions.

USER CONTEXT

Their customers were demanding highly mobile workplaces with real time organization information flows. Also, they wanted adapt technology changes while maintaining Enterprise legacy applications. The product reengineered is Advanced Warehouse Management System.

OBJECTIVES

They wanted to elevate product engineering capabilities; evolve existing products to diverse and emerging technology platforms; enable professional services framework for customers using Enterprise legacy; employ user centered product design principles to create user friendly solutions.

ADVANCED WAREHOUSE MANAGEMENT SYSTEM REENGINEERED

SOLUTION HIGHLIGHTS

- Developed new features - temporary address for sales orders & managing sales order acknowledgement
- Developed Installer & cleaned up database to reduce implementation time
- Proposed a 3 tier architecture - application server layer - for better data security & control

- Developed a POC to move to SSAS (Cube) to provide flexibility to users for developing custom reports
- Defined and refined the upgradation process to achieve smooth upgradation
- Developed POC on IOS app to provide Cargo tracking for end users

SOLUTION SHOWCASE

- Reduce time taken to implement & configure WMS to 5 days
- Value demonstration with proactive issue identification & solution recommendation

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CONNECTED SUPPLY CHAINS

CONNECTED SUPPLY CHAINS

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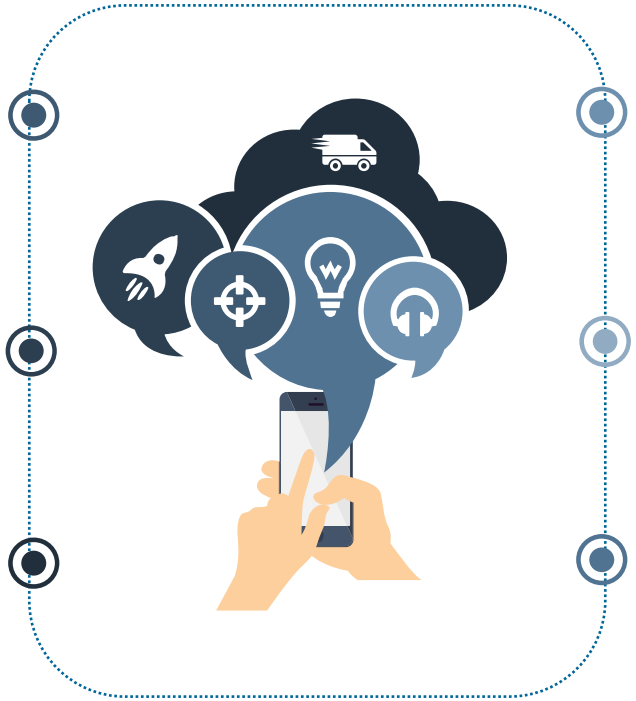
New Age Data – Ability to collect & manage the new age data from sensors, telematics, wearables from across the supply chain processes in real-time.

Advanced Analytics - Use advanced predictive & prescriptive analytics to drive process automation and derive insight from planning and transactional data inside and outside of the organization.

Mobility to Democratize Decision Making – Enable supply chain executives to access the information and insights in real-time on their mobiles and wearable to make instant decisions.



Product to Platform Modernization – Offering platform for supply chain areas enable a more service led approach driven by usage-based pricing.

Scalability with Cloud Option – Ability to meet changing business needs and scope demands cloud platforms to deliver scale, integration, collaboration and multi-enterprise capabilities to users.

Integration For Connected Supply Chain Network. - Ability to integrate the supply chain products with other existing systems to ensure end-to-end supply chain visibility.

SENSORS/RFID	CONNECTIVITY & TELEMATICS	MOBILE APPS	ADVANCED ANALYTICS	VIRTUAL REALITY
DESIGN_LED PLATFORM ENGINEERING	SUPPLY CHAIN ANALYTICS	LOCATION-BASED AWARENESS	API INTEGRATION	RECOMMENDATION ENGINE

CLOUD

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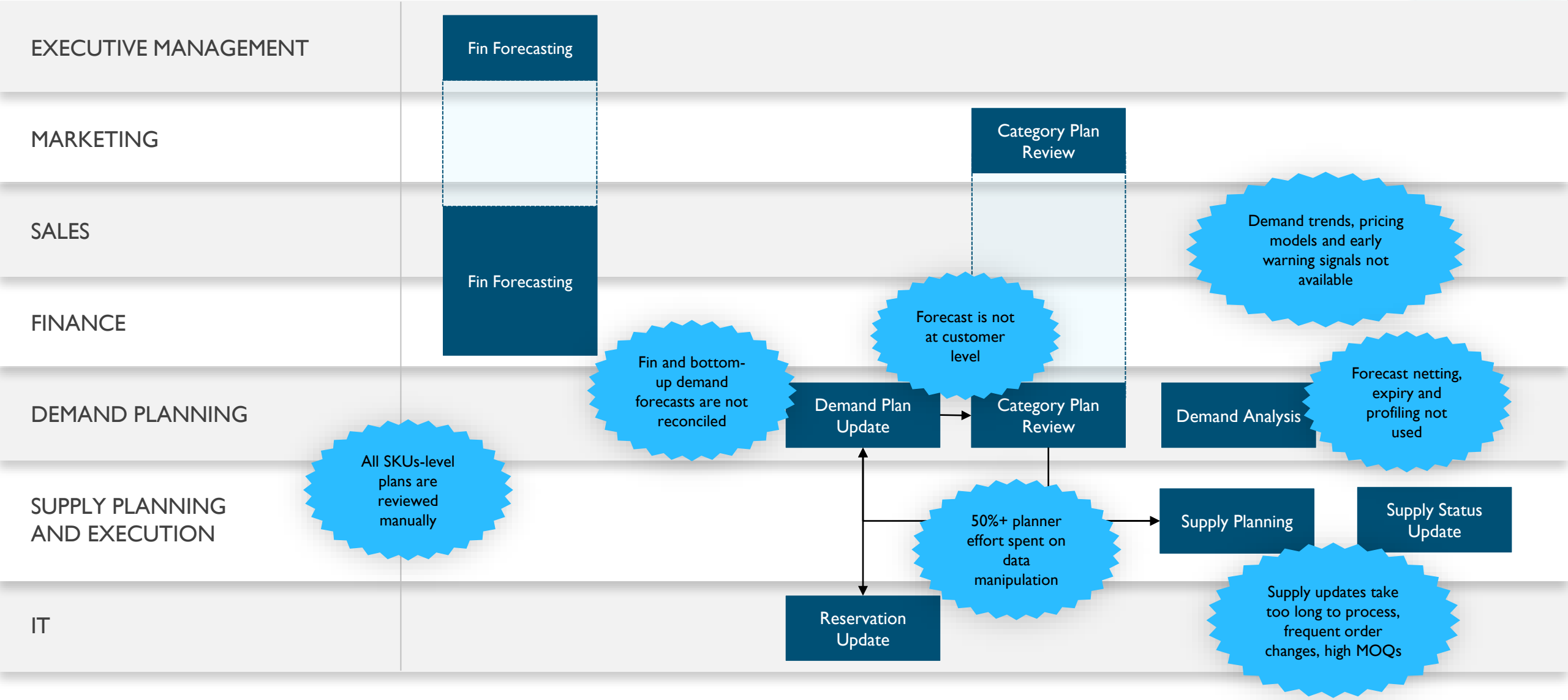
DEMAND AND SUPPLY PLANNING PROCESSES – TYPICAL CHALLENGES



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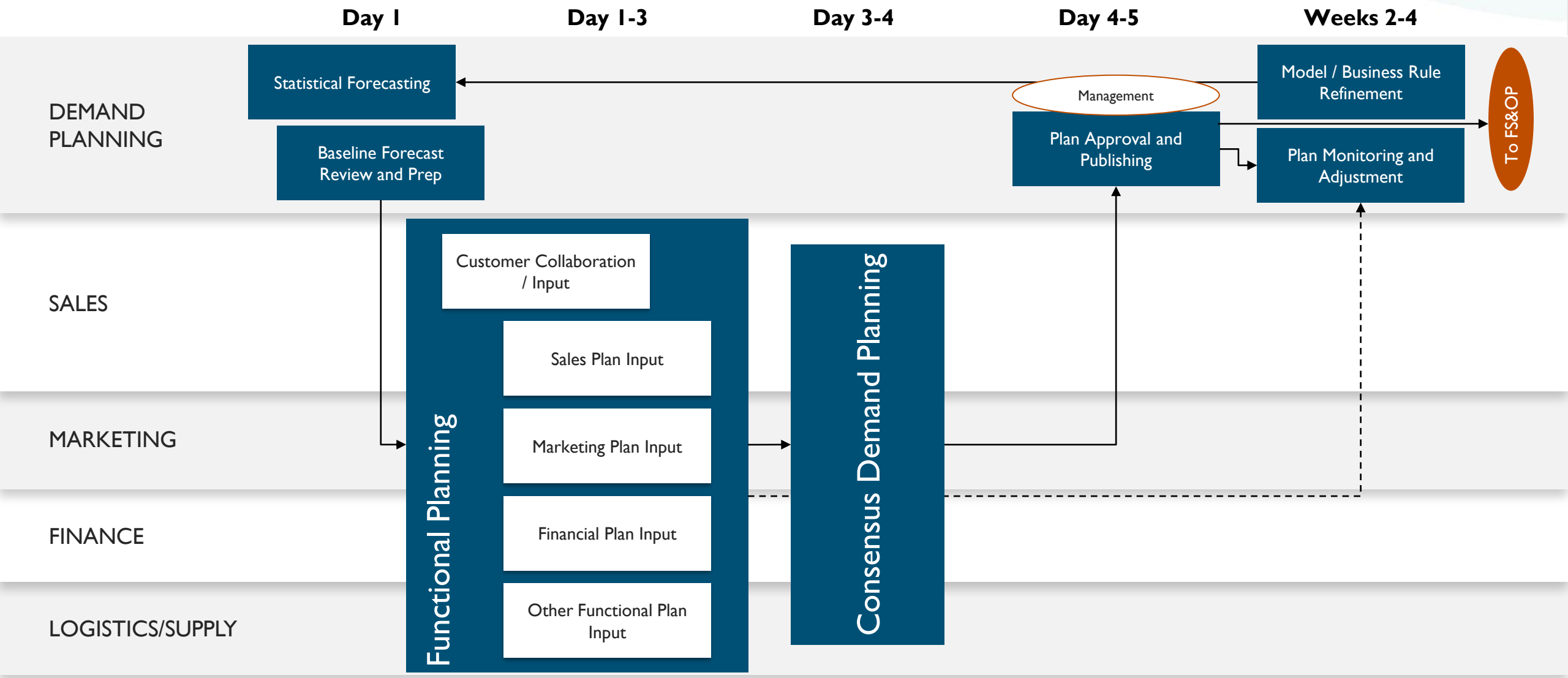
TYPICAL DEMAND PLANNING PROCESS FLOW



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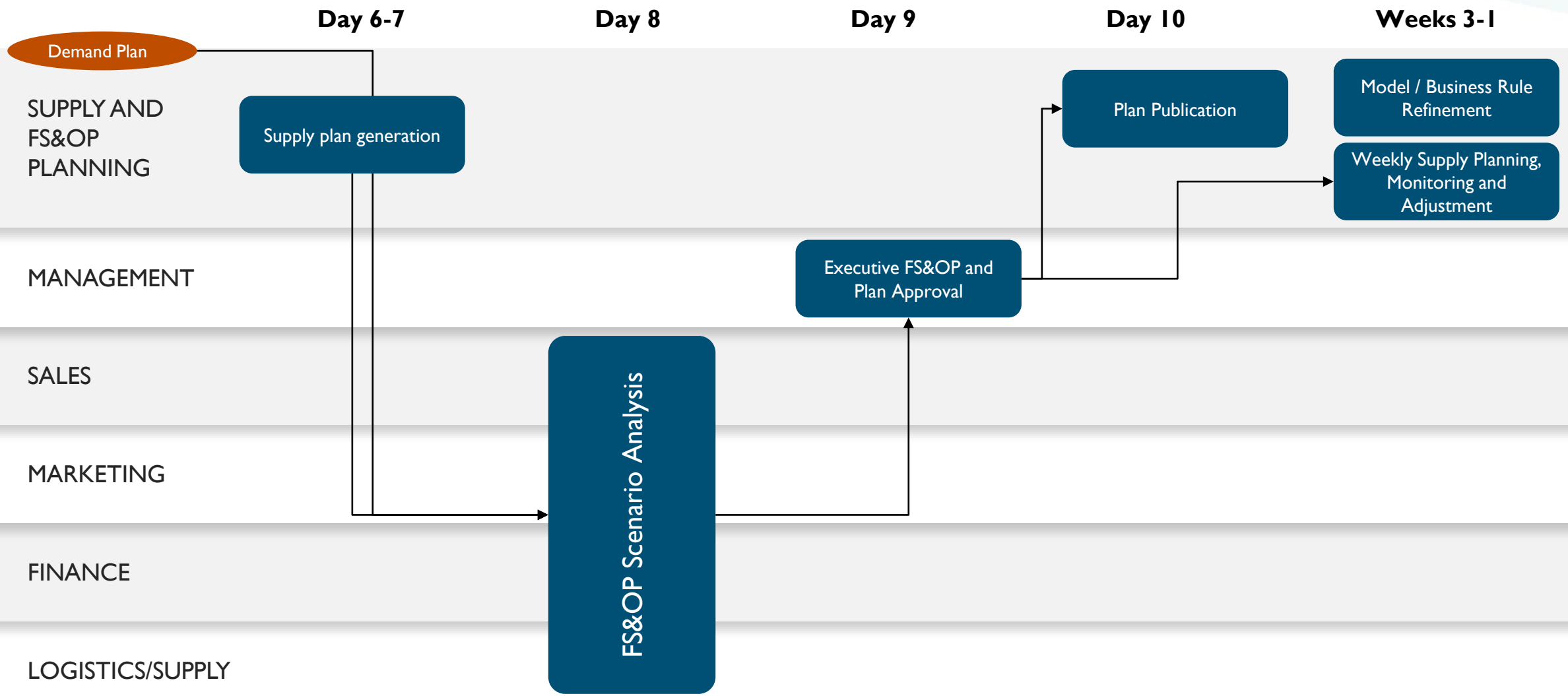
TYPICAL SUPPLY AND FS&OP PLANNING PROCESS FLOW



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FORECASTING SPARE PARTS REQUIREMENT TO OPTIMIZE INVENTORY MAINTAINING LOS

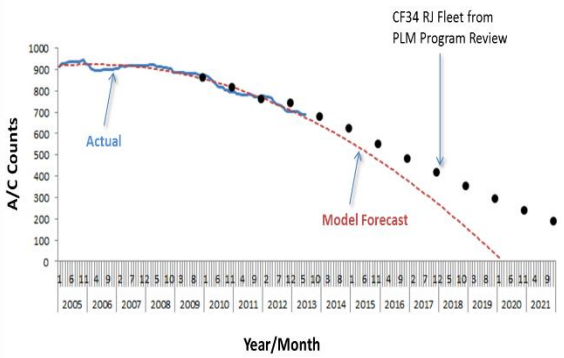



ADVANCED DEMAND FORECASTING

Customer: World's largest provider of new aviation parts and related aftermarket services. The client wanted to reduce inventory per aircraft ensuring high levels of service i.e., aircrafts are not grounded due to the non-availability of spare parts.

Solution: Integrated advanced planning solution to maintain profitable growth and maximize margins while continuing to improve customer satisfaction.

- Analyzed the inventory levels w.r.t to various product lines
- Segmented the spare parts based on sales, lead time, margins etc. to predict shop visits and forecast requirement
- Predicted the duration of stocks and the revenue generated to enable financial planning
- Considered their level of service (LOS) across manufacturers to adjust contracts based on sales



4% REDUCED INVENTORY HOLDING COSTS
IMPROVED SERVICE LEVELS
IMPROVED PRODUCT AVAILABILITY

TOOLS/TECHNOLOGY: INFORMATICA, SYMPHONYRPM, R
ALGORITHMS: MULTIPLE LINEAR REGRESSION, NON NEGATIVE LEAST SQUARES, NON LINEAR SQUARES
DATA VOLUME: 2 M PARTS, 40 SERVICE CENTERS, 3M RECORDS

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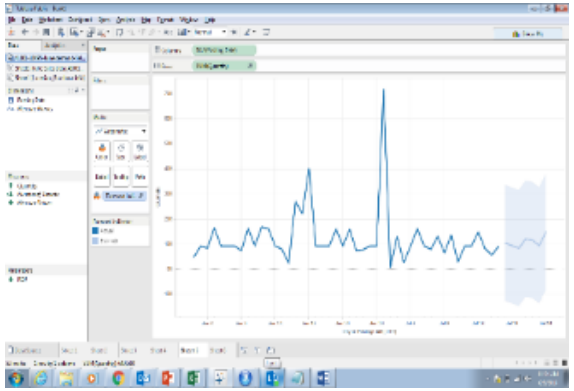
STOCK MANAGEMENT




ACCURATE DEMAND FORECAST TO ENHANCE INVENTORY MANAGEMENT

Customer: World's third largest private oil and metals trader. The client wanted to enhance their inventory management with accurate demand forecasts and timely alerts to enable replenishment of stocks.



Solution:

- Predicted the demand a product at a particular location based on sales data
- Estimated the re-order level of the product for each location based on the lead time and demand data
- Generated custom alerts on reaching the re-order level to avoid stock-outs

80+% ACCURATE FORECASTS
STREAMLINED SUPPLY CHAIN PLANNING
90% REDUCED STOCK-OUTS

TOOLS/TECHNOLOGY: R, TABLEAU
ALGORITHMS: TIME SERIES TECHNIQUES – EXPONENTIAL SMOOTHING, ARIMA; CAUSAL TECHNIQUES – REGRESSION

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BUILD A HOLISTIC SUPPLY CHAIN MOBILE EXPERIENCE

BUSINESS CONTEXT

The client, a leading beverage distribution company in US was struggling to improve its bottom lines and efficiently manage its distribution services .They wanted to innovate the whole distribution network and ensure savings, improve employee productivity and customer satisfaction.

USER CONTEXT

A delivery personal were finding it difficult to meet the required delivery targets each day as they didn't have access to real-time information on the order status, customer status, invoice corrections, and route optimization.

OBJECTIVES

Their objective was to develop a holistic mobile enterprise application that is personalized and target the right focus group members.They wanted to use real time data synchronization for data collected from sales, customer center, distribution, and shipping.

ACCELERATE DELIVERY, IMPROVE CUSTOMER SATISFACTION, DRIVE BOTTOM LINE SALES

SOLUTION HIGHLIGHTS

- Home page with integrated map component that allows drivers to look at orders for the day.
- Ability to view by region and customers orders
- Real time tracking of an order.
- Fastest route information with driver aid that provides weather warning or any hazards that could be experienced during the way.

- Ability to view customer information.
- Ability to either call or email customer incase any delays
- Change invoice on the fly, the status indicators drive order success ratio

- Ability to directly sign on an the tablet, this allows the backend systems show a signed version of the invoice.
- Signed invoices could be queried from a backend system for analytics.

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SMART SERVICE MANAGEMENT

SMART SERVICE MANAGEMENT

POV

Intelligent Service Bots

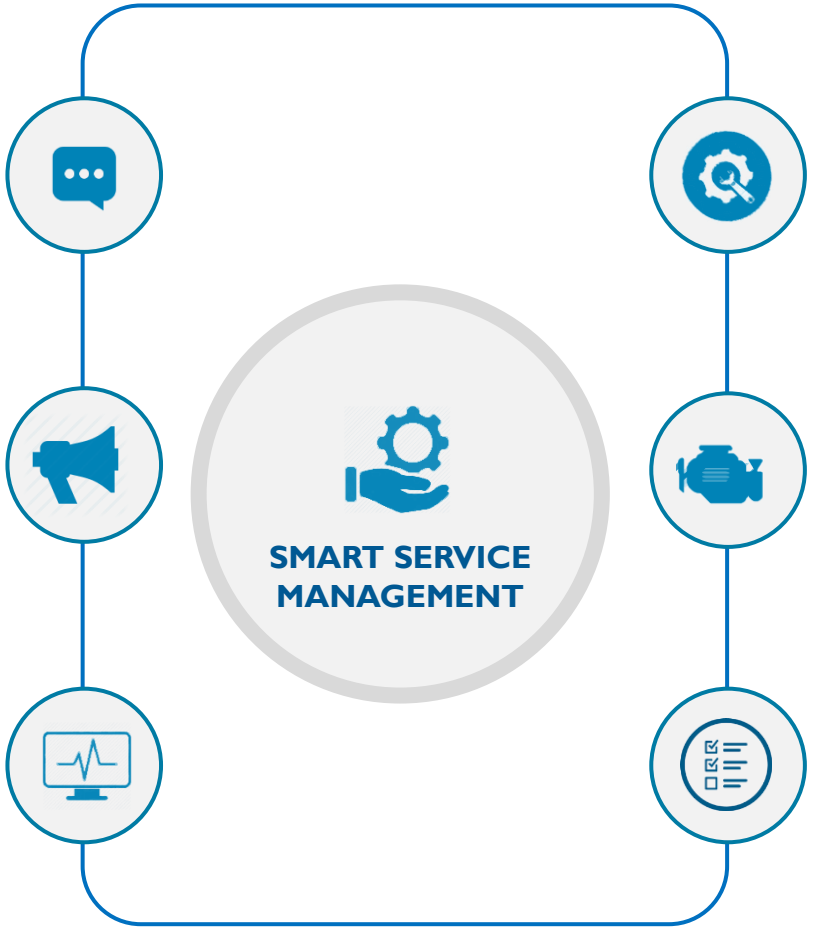
These bots will act as a first line of support to schedule remote service activities and automate service execution. They can alerts/trigger respective stakeholders with contextual insights.

Discounts and Promotions

Prescriptive analytics can help Cummins' inside sales and customer support to send specific offers and alerts on specific products based on customer interaction

Real-time Asset Monitoring

Field service on Cummins' products (say, power systems) based on actual real time product performance data can help improve customer satisfaction and time-to-repair metrics.



Predictive Maintenance

Remote diagnostics of manufacturing equipment can trigger and proactively initiate maintenance teams to minimize downtime and identify maintenance and quality problems before they occur.

Product design

Actual data from sensor-enabled products (say, engines) can create early warning and detection signals and give insights into drive future design changes in the next generation of products.

Quality control

Remote diagnostics, condition monitoring of connected products (even remote fixes) helps boost customer loyalty & lifetime value and maintain product quality standards across product life cycle

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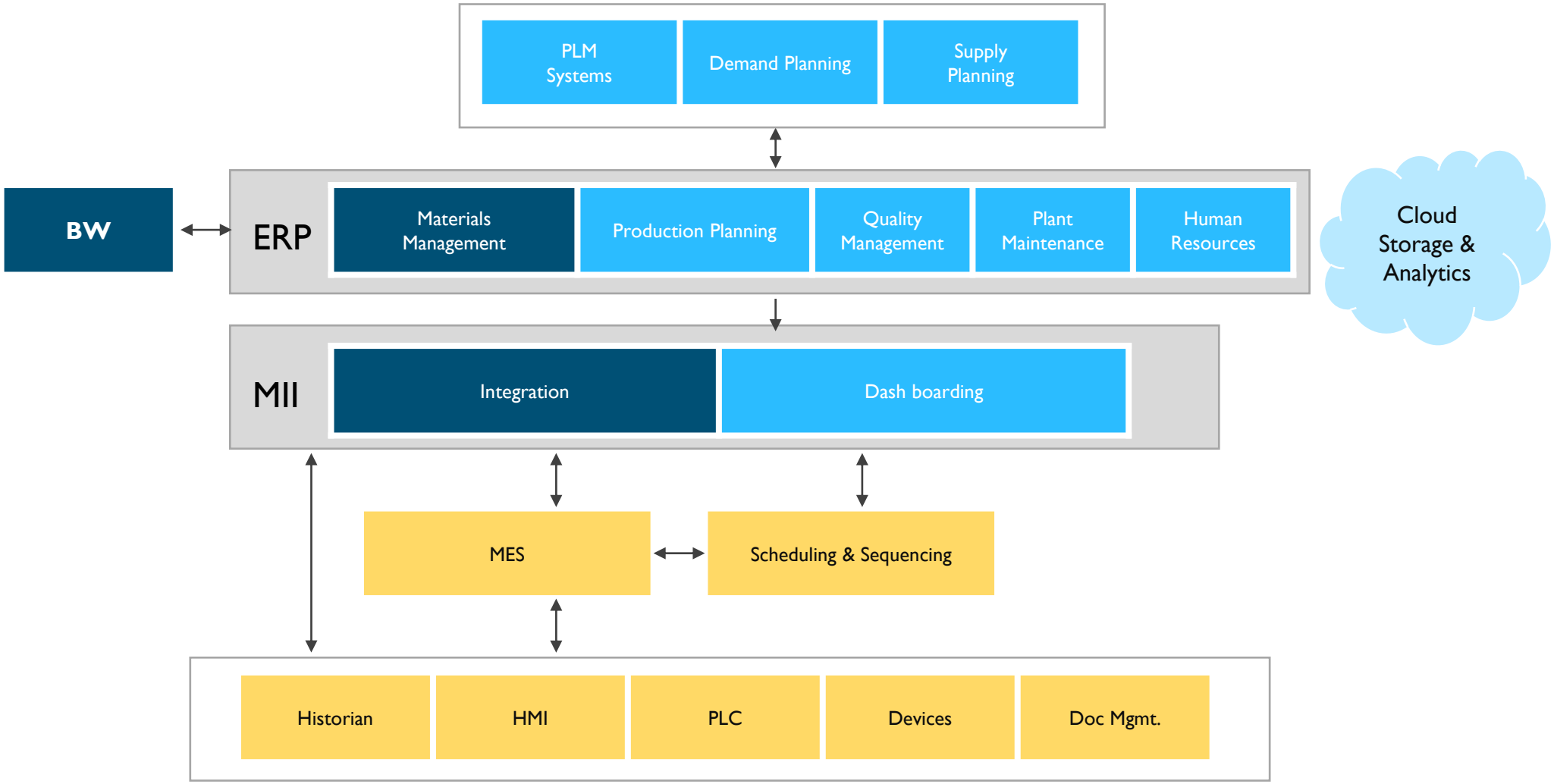
MANUFACTURING OPERATIONS SYSTEMS INTEGRATION



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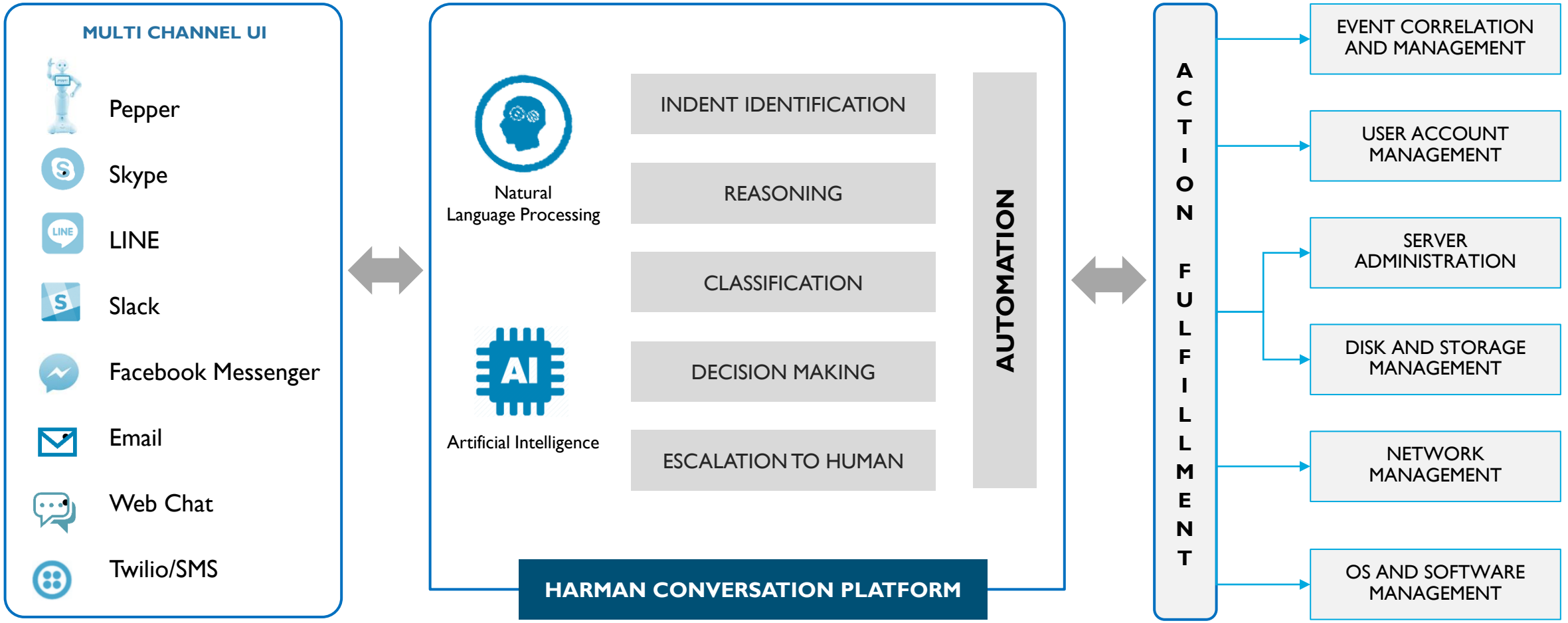
INTELLIGENT CUSTOMER SERVICE

HARMAN SMART SERVICE MANAGEMENT



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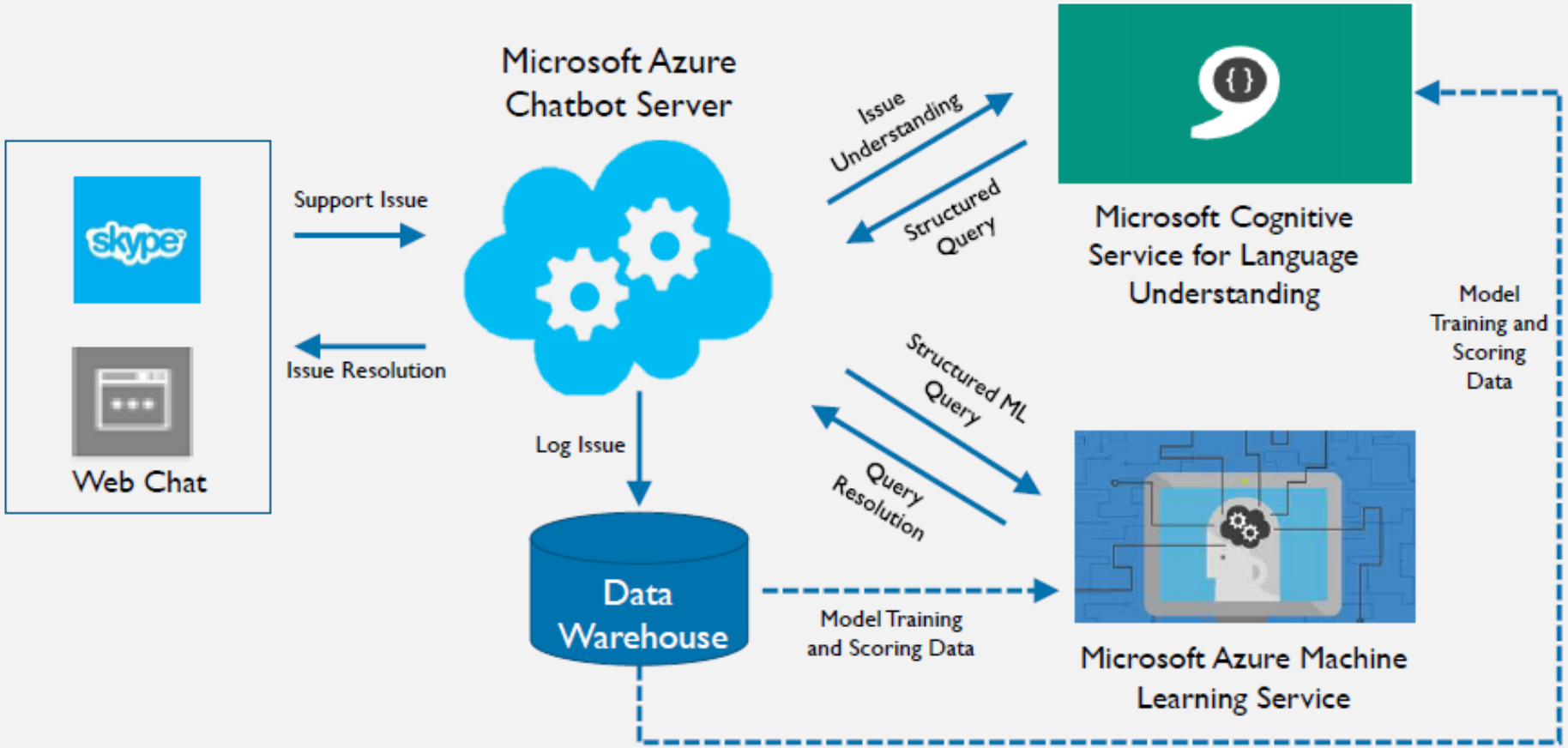
ON AZURE

INTELLIGENT CUSTOMER SERVICE



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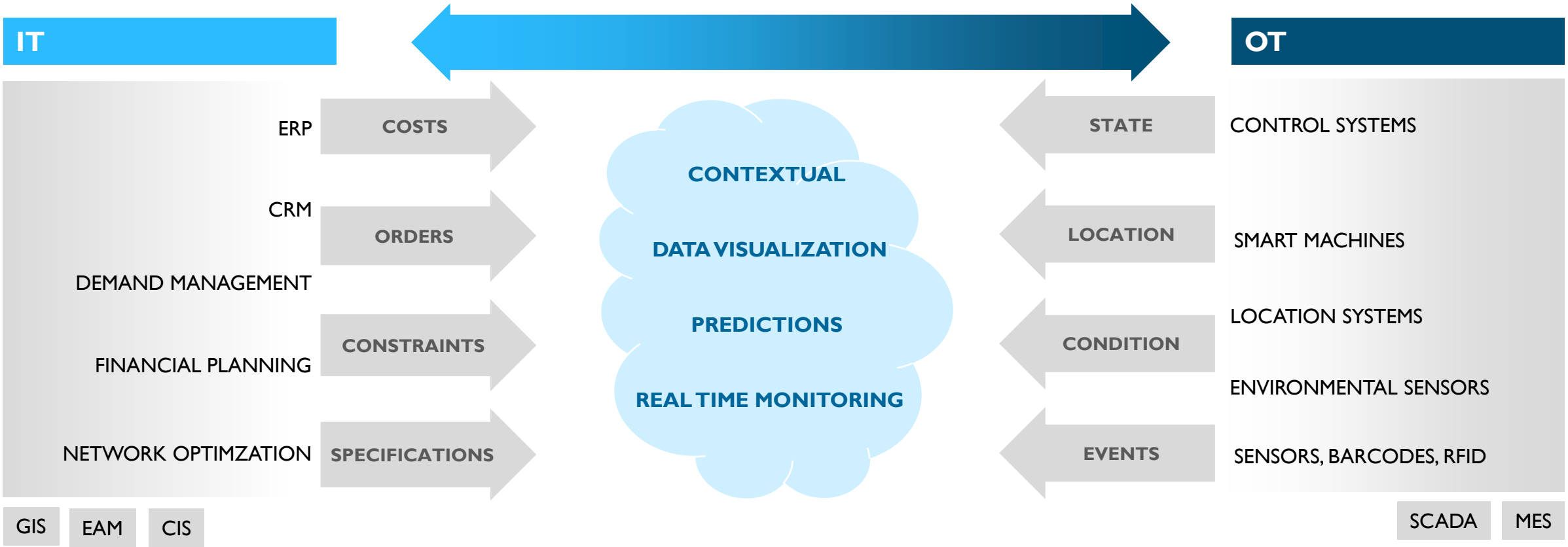
SEAMLESS INTEGRATION OF IT/OT SYSTEMS

HARMAN IT-OT INTEGRATION



Stages of IT-OT Integration

MONITOR	DIAGNOSE & CONTROL	MANAGE	OPTIMIZE
• Identify convergence • Sense and manipulate production process	Monitoring, supervisor control and automatic control of the production process	Alignment of how to manage OT with how to manage IT	Integration of IT/OT systems and integrate infrastructure resources and management

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OUR CAPABILITIES

WE ARE FUSING PROCESSES & DEVICES FOR CONNECTED WORLD

CONNECTED WORLD AND HARMAN

HARMAN is fusing processes and devices to make smarter solutions, operations that will allow minimal investment in physical industrial infrastructures.

Process to Device

- Interlink millions of things on cloud
- Sync entire value chain
- Smarter applications

Cognitive Intelligence

- Voice and Speech Recognition
- New age algorithms, real time insights.

Operations Efficiency

- Decentralize control
- 1-click automation
- Virtual testing/ certification

Richer Customer Experience

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“Connected” experiences for commercial real estate

JLL is a financial and professional services firm specializing in commercial real estate services. It aims to lead the transformation of the real estate industry by making a positive impact both within and beyond their business.

Developed a building automation solution which seamlessly integrates with different systems, equipment and field devices that control access, occupancy, heating, ventilation and air conditioning (HVAC), energy consumption, lighting, water, electrical equipment, HRMS.

Business Need

- Transform the way space utilization is monitored and managed
- Improve occupant ambience, real –time situational aware-ness and analysis
- Enhance security and safety

Solution Highlights

- Real Time Situational Awareness and Analysis. Use data from 10+ categories of sensors - Motion, Grid Eye, Door, Temperature, Humidity – to enable prescriptive analytics for various use cases.
- Secure/Scalable communication with Azure IoT Services and enterprise scalable Cloud architecture - Event Hub, Stream Analytics, Hadoop, Machine Learning.

Solution Showcase

- Real time data from HVAC systems reduced costs on scheduled maintenance and improved the workforce productivity.
- Showcased our capability to provide an integrated and end-to-end IoT solution for their business problems

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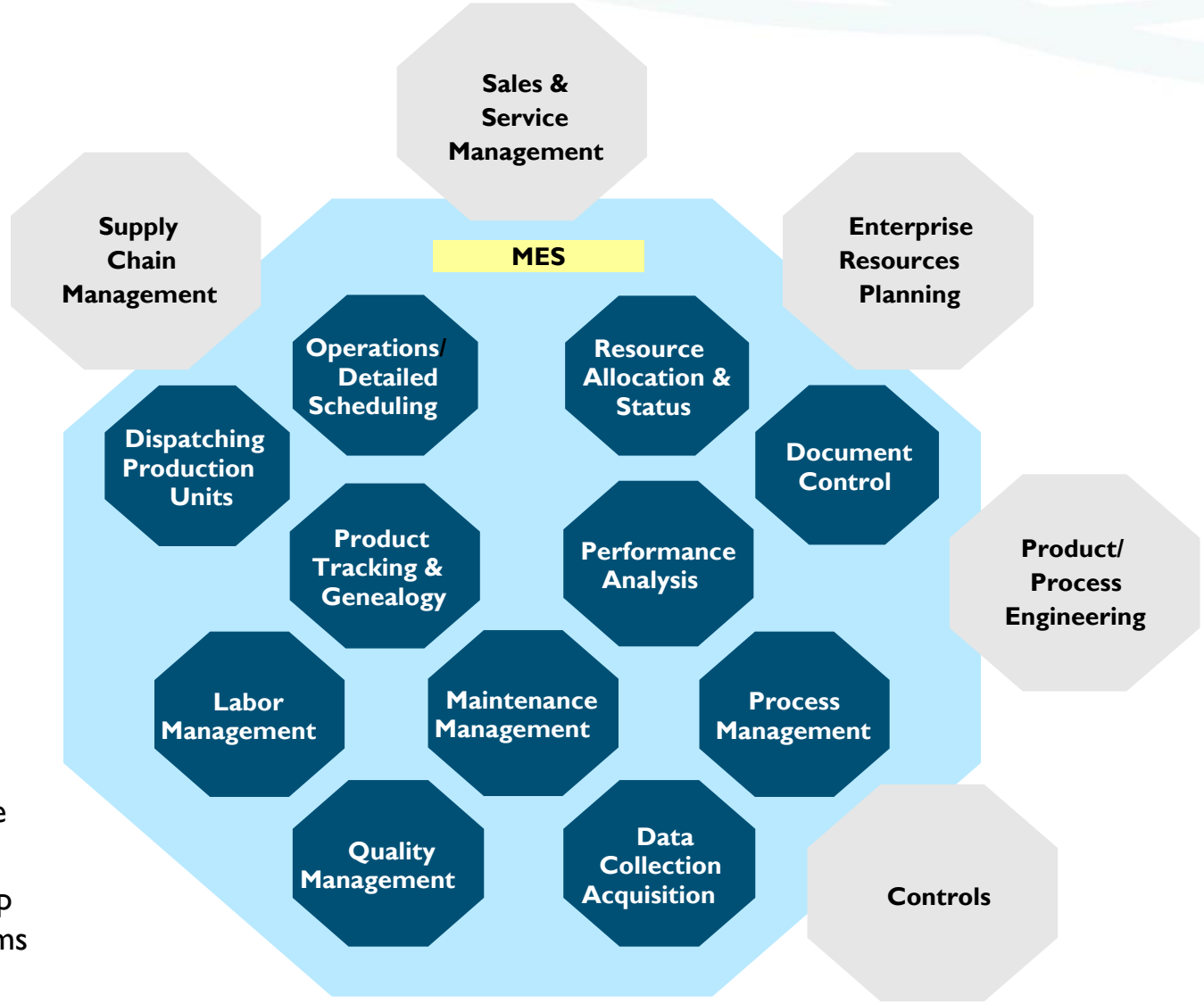
MES

MES FOCUS AREAS

- Product Tracking & Genealogy
- Data Collection/ Acquisition
- Dispatching Production Units
- Quality Management
- Operations/ Detail Scheduling
- Process Management
- Resource Allocation & Status
- Maintenance Management
- Human Resource Management
- Document Control
- Performance Analysis

- Integration with Business Systems like ERP/SCM/CRM
- Integration with Shop Floor Control Systems



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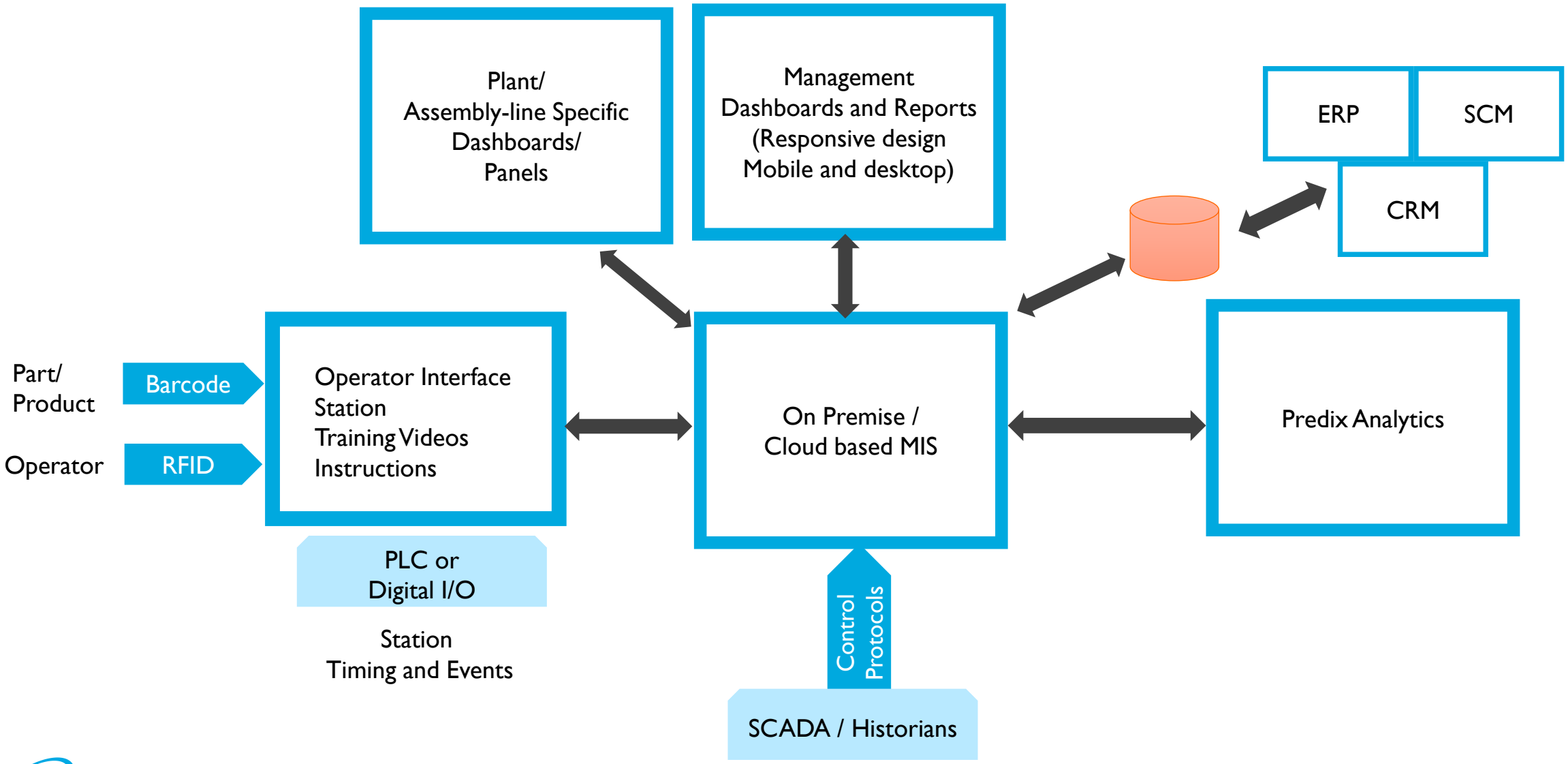
MES MODULAR ARCHITECTURE



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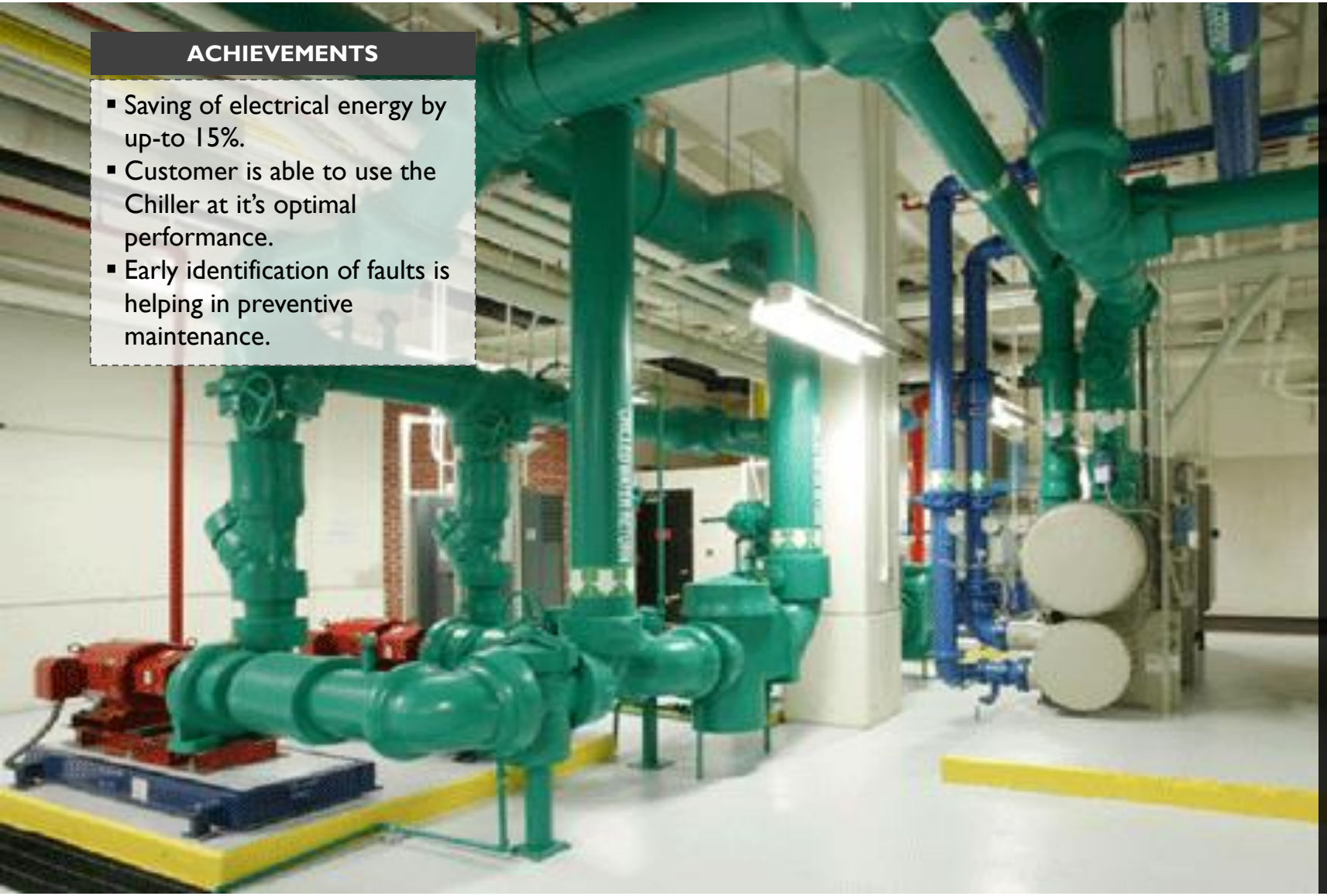
KEEPING YOUR CHILLERS RUNNING (CASE STUDY)



ACHIEVEMENTS

- Saving of electrical energy by up-to 15%.
- Customer is able to use the Chiller at it's optimal performance.
- Early identification of faults is helping in preventive maintenance.

MCQUAY INTERNATIONAL IS A GLOBAL CORPORATION THAT DESIGNS, MANUFACTURERS AND SELLS HEATING, VENTILATION AND AIR CONDITIONING PRODUCTS, SYSTEMS, PARTS AND SERVICES FOR COMMERCIAL BUILDINGS

- Study of existing Chiller system was done and the performance parameters were identified for monitoring.
- Parameters like various pressure conditions, temperatures, motor amps and pump on off conditions were sensed.
- Acquisition of these key parameters was done from Chiller through MCS-8 Controller.
- An intelligent data communication box iAPT acts as a device server and makes this data available locally as well as to a remote Smart Machines web server.

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PREDICTING POTENTIAL NETWORK FAULTS AND DOWN TIME

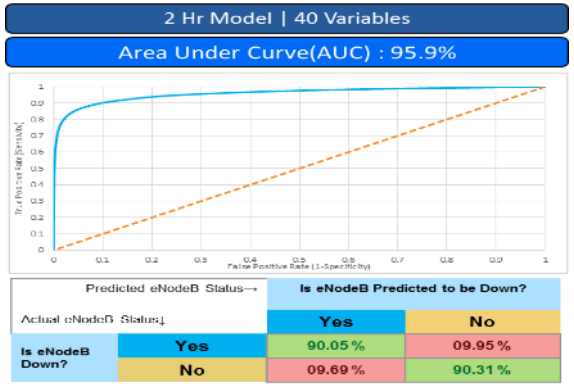



ADVANCED NETWORK FAULT PREDICTION

Customer: Multinational provider of communications technology and services. The client wanted to predict the potential network faults and down time with 1 hr and 2 hrs. of lead time.

Solution: Built 2 robust production grade models to accurately predict network downtime, faults, incidents etc. from eNodeB, MME & third party data. This enabled to generate actionable recommendations and prioritize actions based on operator's business needs.

- Analyzed operator business and network operations in detail.
- Predicted business-impacting network incidents and their causes in advance.
- Developed prioritized and actionable recommendations based on operator business value.



94% ACCURATE PREDICTION OF NETWORK FAULTS & DOWN TIME

TOOLS/TECHNOLOGY: R
ALGORITHMS: SMOT, DECISION TREE, REGRESSION MODEL, BAGGED CLASSIFICATION AND REGRESSION TREE(CART), RANDOM FOREST
DATA VOLUME: 400 MN RECORDS, 2.56 TB DATA (600+ COUNTERS , ALARMS ETC. - 1000+ VARIABLES) EVERY 6 HRS

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THANK YOU

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