SMART CONNECTED WORLD

THINGWORX TECHNOLOGY PLATFORM

Bruce Brown
Principal IoT Presales Technical Specialist

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DATA IS THE NEW OIL

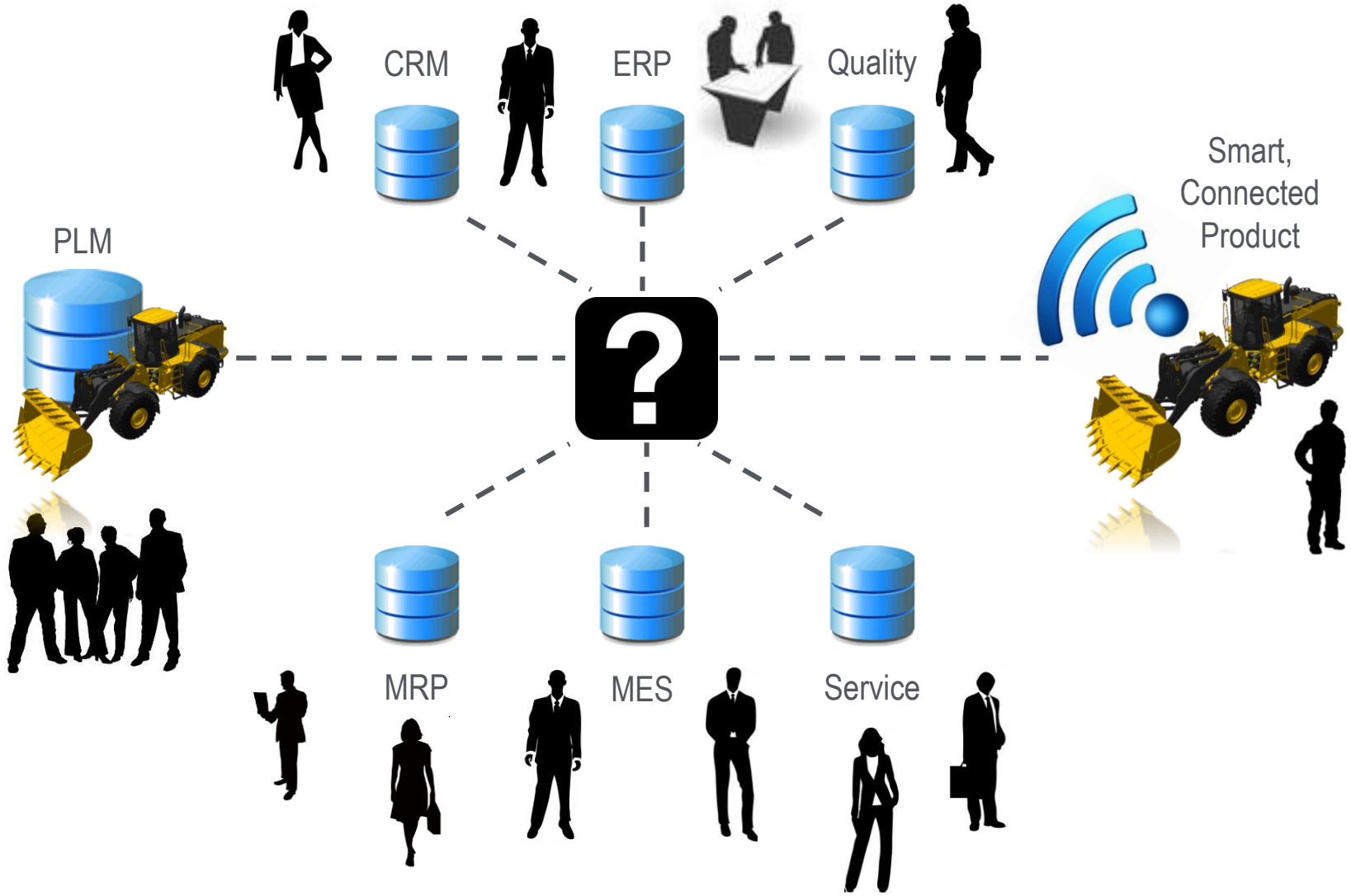
- Every Product Company has an unchangeable base of massive scale IT investments that lock away critical product **data** in poorly integrated, hard-to-use silos. Users are frustrated. Value is missed.
- Leading companies have found the only way to address this problem in a reasonable timeframe is to provide a layer of modern technology that accesses and integrates product data from many sources with great usability -- enabling greater agility and rapid innovation
- Only PTC has the technology and the knowledge of product-related processes, data, use cases and experience to deliver on the promise of ready access to critical product data with the speed and simplicity of OOTB software.

Customer Challenges

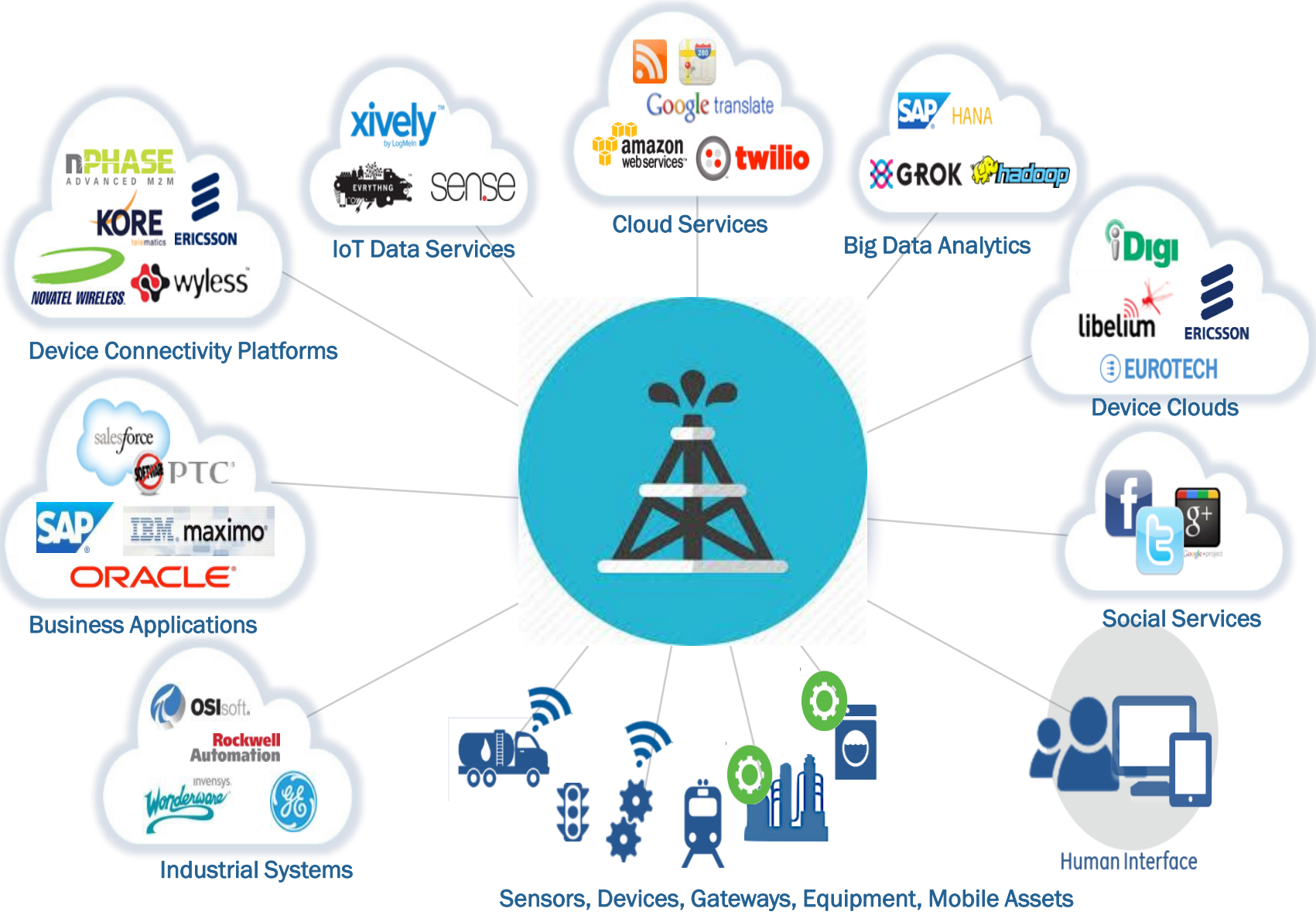
Siloed Product Data in the Enterprise

ThingWorx A PTC Business

Silos reduce **Productivity**, **Time To Market**, and **Collaboration** across multiple roles



THINGWORX UNITES THE CONNECTED WORLD

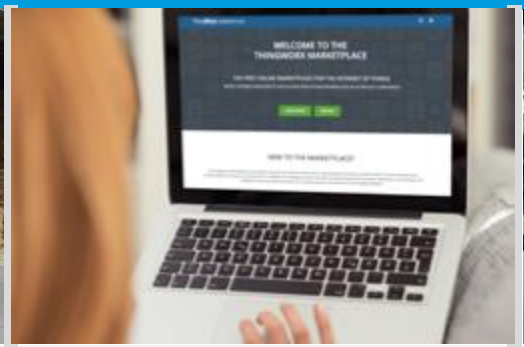


ThingWorx
A PTC® Business

Who is ThingWorx?

- A business unit of PTC®
- 800+ employees dedicated to IoT
- Thousands of ThingWorx-compatible partners and solutions
- Award-winning technology for the Internet of Things
- $700MM+ invested in acquisitions, development and integration of leading IoT technologies

THE MOST COMPLETE IoT PLATFORM ON THE MARKET



Connect

- Edge Connectivity
- Native Device Cloud
- 3rd Party Device Cloud Support
- Protocol Adaptors

Build

- Rapid Development Tools
- Mobile App Development
- Enterprise Extensions and process management
- 3rd Party System Connectors
- “Thing” Management and Optimization
- 3D “Thing” builder

Analyze

- Automated Machine Learning Technology
- Rules, Alerts & Notifications
- Pattern & Anomaly Detection
- Automated Predictive Modeling & Scoring
- Prescriptive Intelligence

Experience

- Digital Twin Experience
- Augmented Reality

Collaborate

- Developer Community
- Developer Zone
- Marketplace
- Industry-Leading IoT Specific Events

THINGWORX ARCHITECTURE

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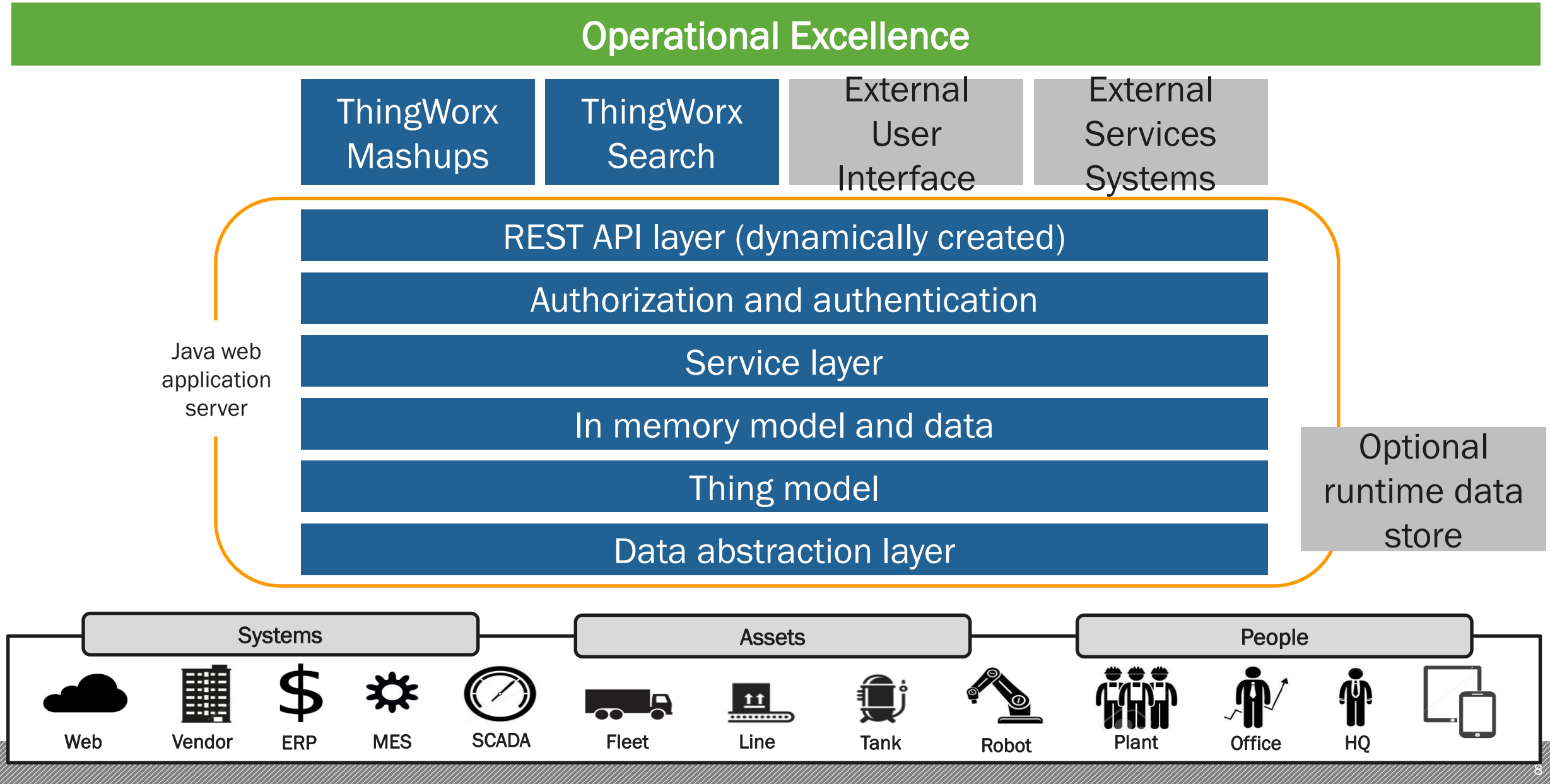
THINGWORX ARCHITECTURE



THINGWORX COMPREHENSIVE PLATFORM AND ECOSYSTEM

PTC

Custom Built Innovative Apps

Apps Delivered by Partners

Apps Delivered by PTC

IoT-Enable & Operate

Pre-Built Extensions

- ✓ Centralized hub for real-time product data
- ✓ Best practices based data model
- ✓ Out-of-the-box utilities
- ✓ Synergistic marketplace of apps

Build

Rapid Application Development Environment

- ✓ Purpose built for IoT
- ✓ Model-based & code-less development
- ✓ Combines people, systems, & things
- ✓ Social and collaborative
- ✓ Integrate bus. systems & cloud svcs.
- ✓ Leverage ecosystem

Manage

Device and Data Management

- ✓ Scalable - millions of connected devices
- ✓ Proven value at hundreds of customers
- ✓ Secure end-to-end solution
- ✓ Flexible cloud or on-premise delivery

Connect

IoT Connectivity Middleware

- ✓ Secure agents & gateways
- ✓ Largest ecosystem of partners & devices
- ✓ Support for hybrid networks
- ✓ Always-on connectivity

BUSINESS ENTERPRISE SYSTEMS

BIG DATA ANALYTICS

CLOUD SERVICES

THINGWORX
MODEL BASED DESIGN

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THING DEFINITION

Properties

Services

Send SMS or email
Initiate Service Ticket in SFDC

Events

Low Battery
Over Temperature Fault
Fan Failure
Hard Drive Capacity

Subscriptions

Subscribe to a service

AC/DC in
Battery Voltage
Fan Status
Usage Hours
Image Mode
Storage Capacity

Customer Name
Deployment Date
Warranty Type/Status
GPS Location

Other Data

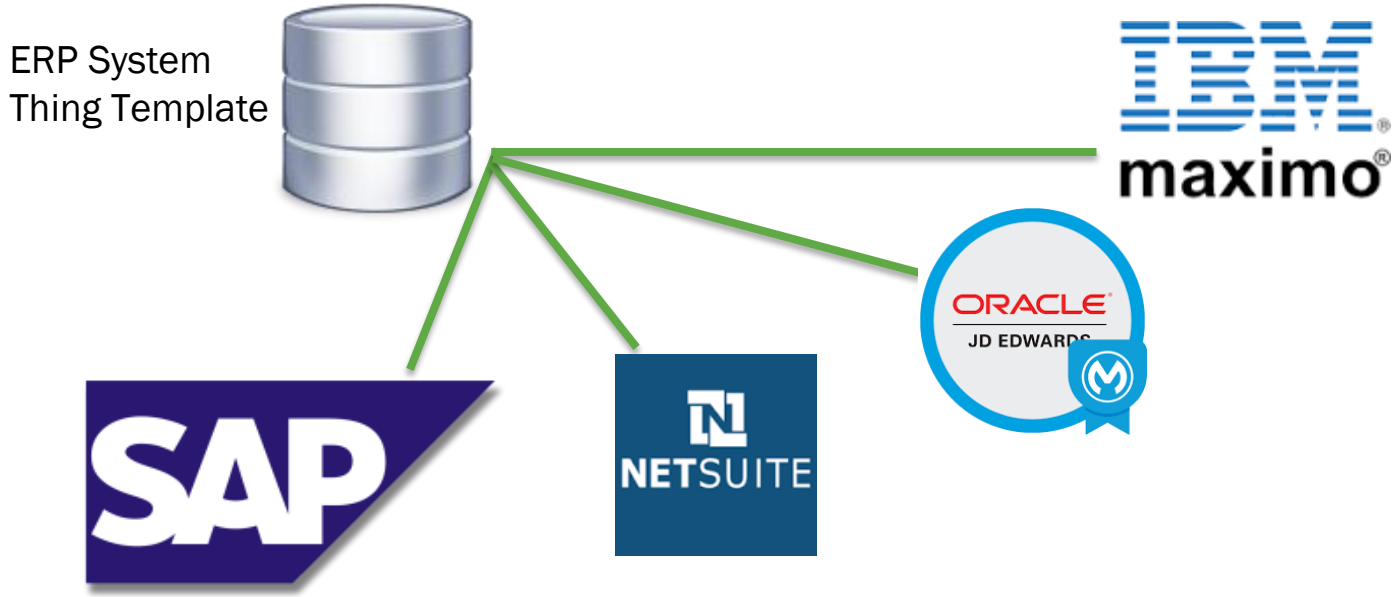
Other ERP System or Database

HOW DO YOU MAKE THINGS?

- Directly Create for “One-Offs”

- Generate from a “ThingTemplate”
  - Encapsulate Reusable Functionality
  - Normalize data from disparate systems

- Hierarchical model
- Object oriented
- Portable
- Re-usable



APPLICATION COMPOSITION

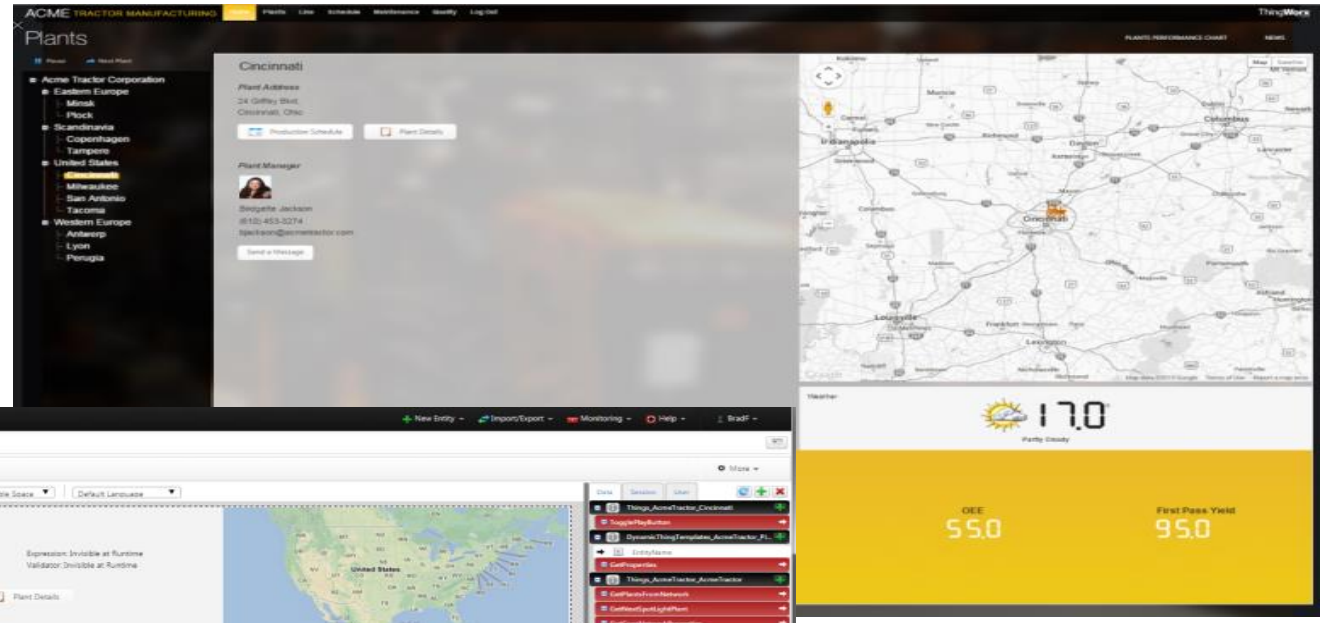
APPLICATION COMPOSITION

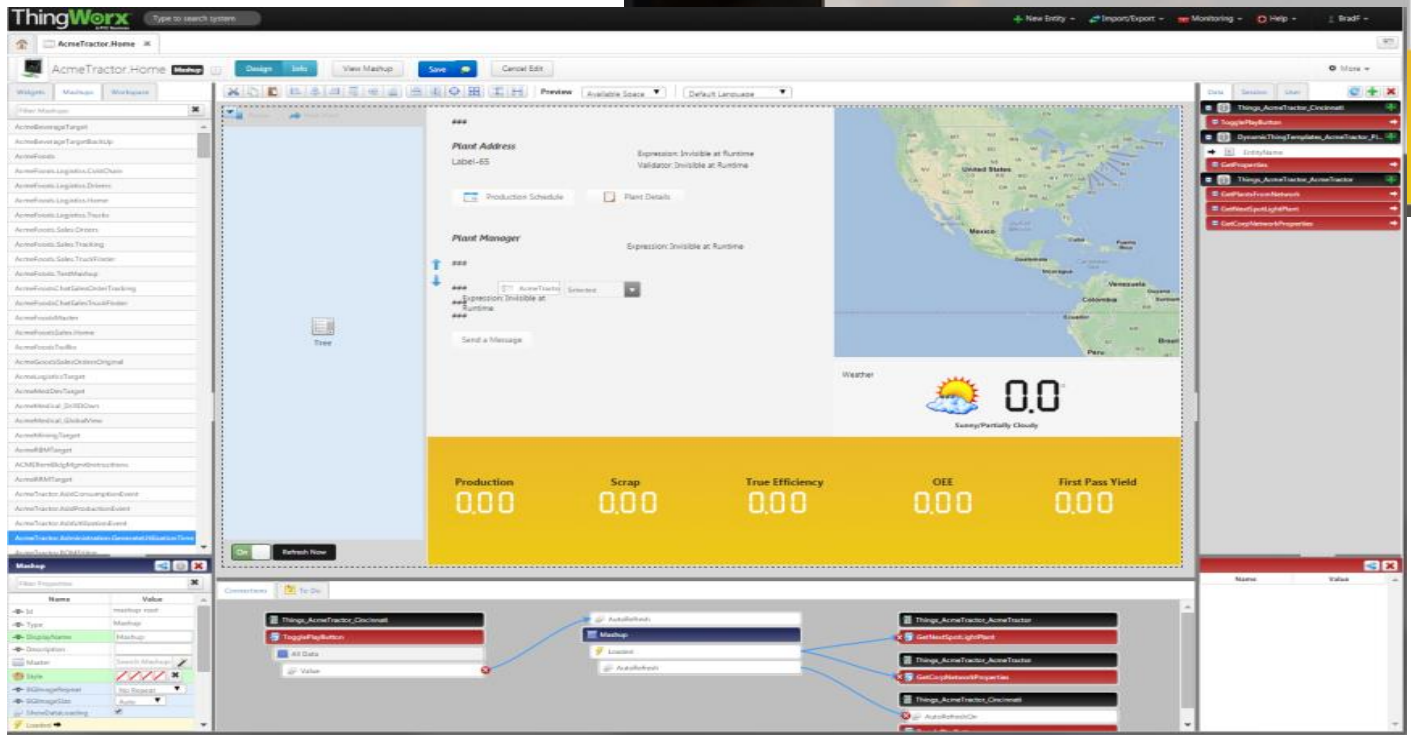
Business users quickly and easily compose software applications

- Access configuration environment and mashups via browser
- Cleanse, monitor, and analyze data enabling insights
- Enable functional user roles to easily build solutions
- Object oriented enabling development and ongoing support efficiencies
- Enable the creation of a Service Oriented Architecture
- Native robust search capability across volumes of unstructured data
- Enable collaboration between people, systems, and equipment
- Native applications for mobile operating systems (iOS and Android)

THINGWORX COMPOSER –RAPID APPLICATION DEVELOPMENT

- Customer Portals
  - Mashup of Data Sources
- Mobile Applications
  - Smartphone and Tablet Applications to enhance Product Experience
- New Internal Applications
  - Field Service Applications





RAPID APPLICATION DEVELOPMENT PROCESS

THINGWORX CONNECTIVITY

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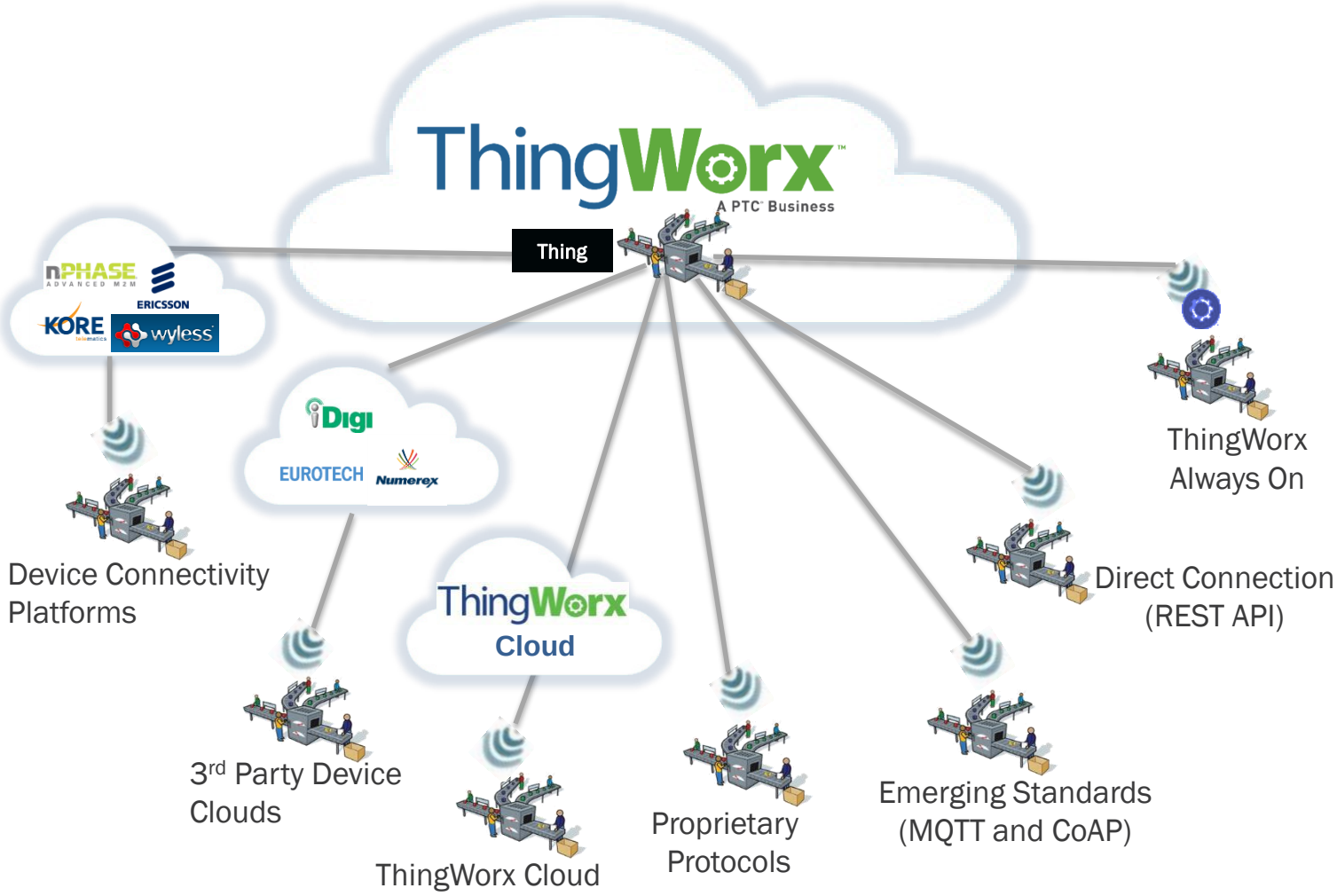
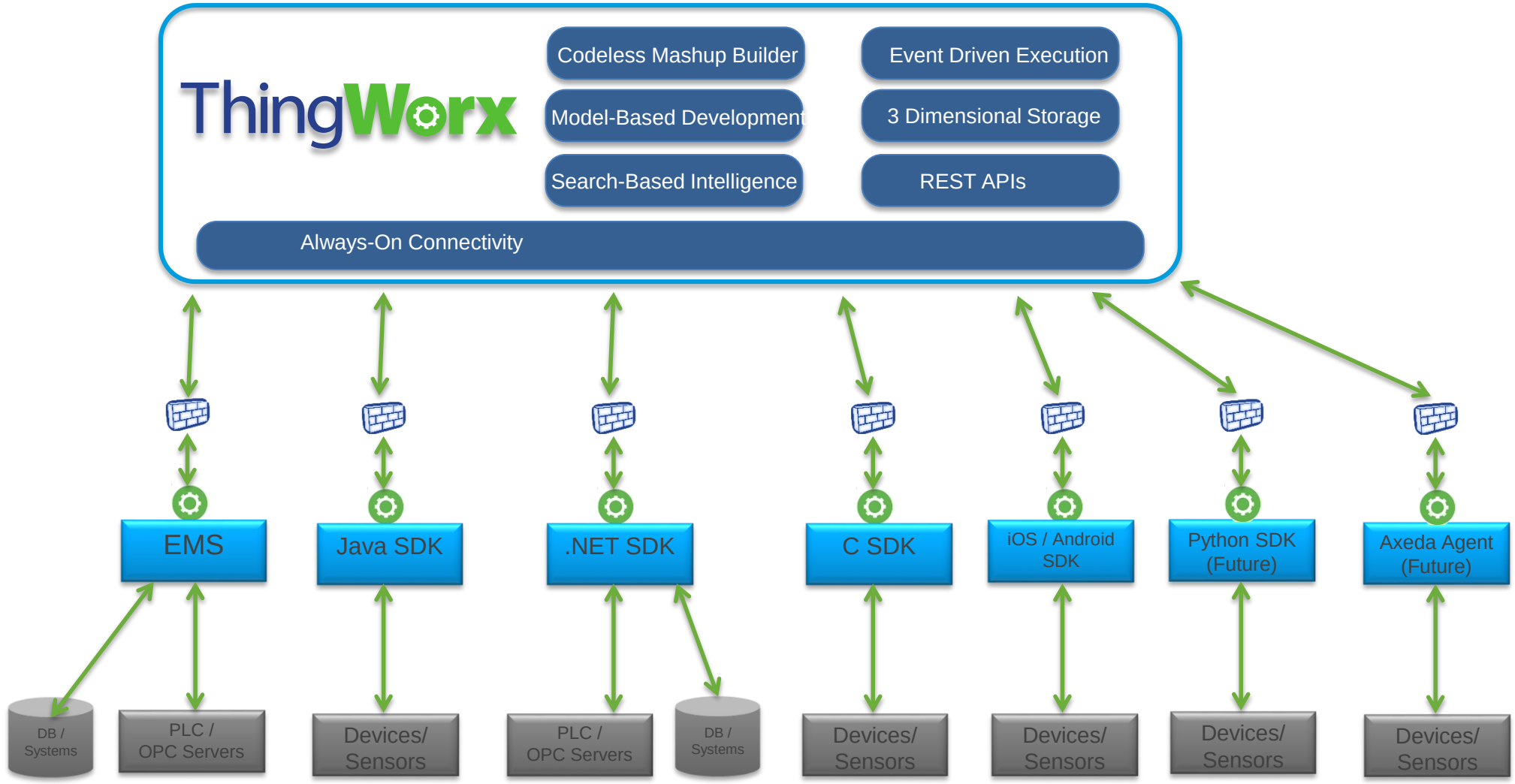
HOW DO THINGS CONNECT?



Devices can connect wired, wireless or cellular depending on the device

THINGWORX ALWAYS-ON OPTIONS



THINGWORX EXTENDING EXISTING SYSTEMS INVESTMENTS

ThingWorx A PTC Business

Typical Landscape

External — Sensor, Web

Level 4 ERP — ERP, PLM

Level 3 MES — MES, LIMS

Level 2 Control — SCADA, Historian

Level 0 1 Device

Extended with ThingWorx

Communicate

- Edge
- REST API

SDKs
- .Net
- Android
- C
- Java
- iOS

Extensions
- ADO
- CSV
- File Transfer
- JDBC
- Mail Server
- Modbus
- MQTT
- Microsoft SQL
- MySQL
- OPC
- ODBC
- SAP Hana, MII

Store

- Time-series
- Structured
- Unstructured
- Context
- Search
- Neo4j
- PostgreSQL
- Cassandra
- Other

Compose

- Model based
- Hierarchical
- SOA
- Security
- JavaScript
- Extensions
- SDKs
- HTML5
- Mobile OS
- Mashups
- Dashboards
- Collaboration
- Alerts
- Workflows

Analyze

- Artificial Intelligence
- Machine Learning
- Patterns
- Scoring
- Simulation
- Explain
- Predict
- Influence

DATA EXCHANGE

Exchange data, events, and services with systems and devices

- Secured, bi-directional connectivity to devices, equipment, and systems
  - Beyond enterprise: cloud analytics, social networks, web services for weather and messaging
  - Business systems: ERP, PLM, EAM, MES, LIMS
  - Operations systems: Historians, SCADA, DCS
  - Equipment and devices: sensors, robots, PLCs, testing devices
- ThingWorx offers a flexible approach via several connectivity methods:
  - Edge MicroServer agent technology (devices, gateways, smart sensors)
  - Software Development Kits (Java, .NET, C, iOS, Android, etc.)
  - REST APIs to allow other systems to easily interface through web service transactions
  - Configurable ThingWorx extensions such as Microsoft SQL Server, Oracle database, fieldbus technologies, and more
  - Standards such as OPC, MTConnect, ZigBee, and more

Secure WebSockets

ThingWorx MARKETPLACE

DATA STORAGE

DATA STORAGE TYPES

Activity Streams

Streams with optional structured data payloads
10X Faster than RDB

DataTables

For storage requiring typical SQL functions (insert, delete, etc)

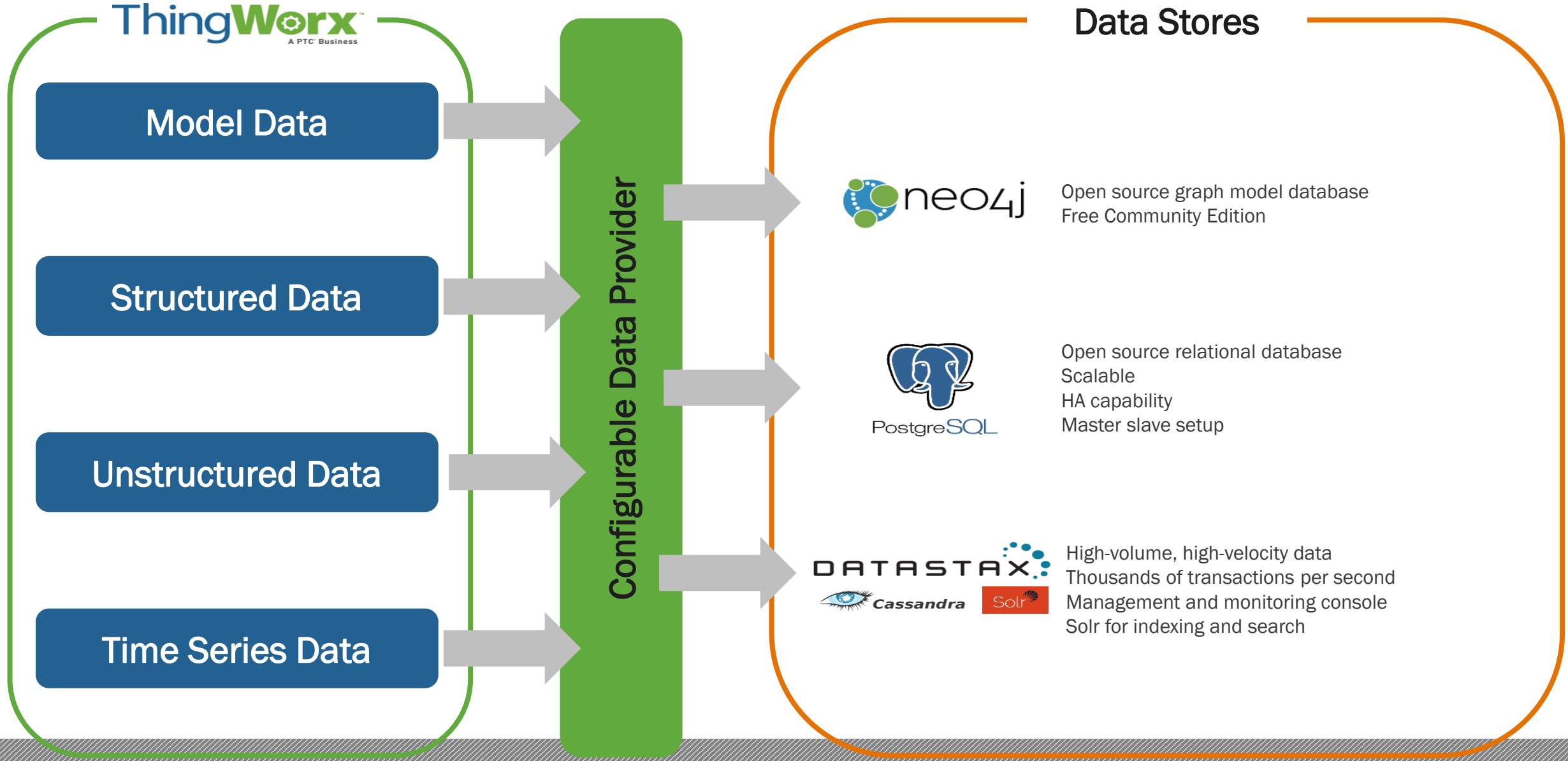
Collaboration

System modeled for blogs, wikis, discussion forums

External Databases

Access/Store external database located locally or behind firewalls

DATA STORAGE LOCATIONS

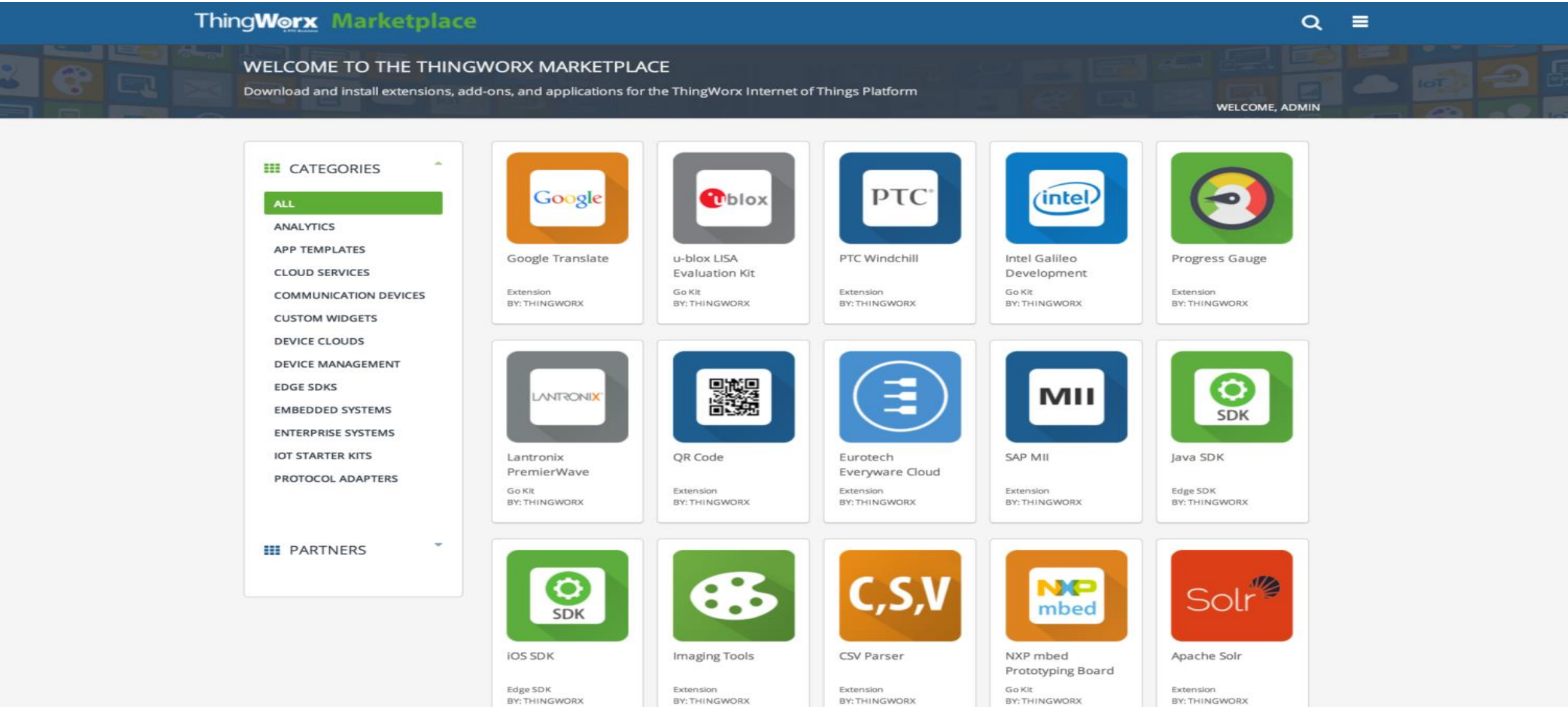


THINGWORX MARKETPLACE

PTC®

THINGWORX MARKETPLACE

The ThingWorx Marketplace lets you browse, download, and install extensions and 3rd party software components to plug into your existing ThingWorx IoT Application (search by category, type, popular, highest rated)



Benefits with PTC Solutions and Lifecycle Management

THE CONNECTED ENTERPRISE

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Product Cloud

PLM
SLM
ALM
IoT
CRM
CAD
ERP
MES
SCM

FINANCE
SERVICE
SALES
ENGINEERING
OPERATIONS
DELIVERY

- ✓ Usages-based Billing
- ✓ Subscription Services
- ✓ Warranty Management
- ✓ Point-of-Sale Payments

- ✓ Automated Service
- ✓ Remote Service
- ✓ Self Service
- ✓ Predictive Maintenance
- ✓ Product as a Service

- ✓ Design for Continuous Innovation
- ✓ Usage-based Requirements Analysis
- ✓ Remote Software Management
- ✓ Connected Quality

- ✓ Connected Manufacturing Intelligence
- ✓ Consumables
- ✓ Asset Tracking & Management

- ✓ Marketing / Lead Generation
- ✓ Account Management
- ✓ Up-sell, Cross-sell
- ✓ New Offerings / New Markets

Gartner **#1**

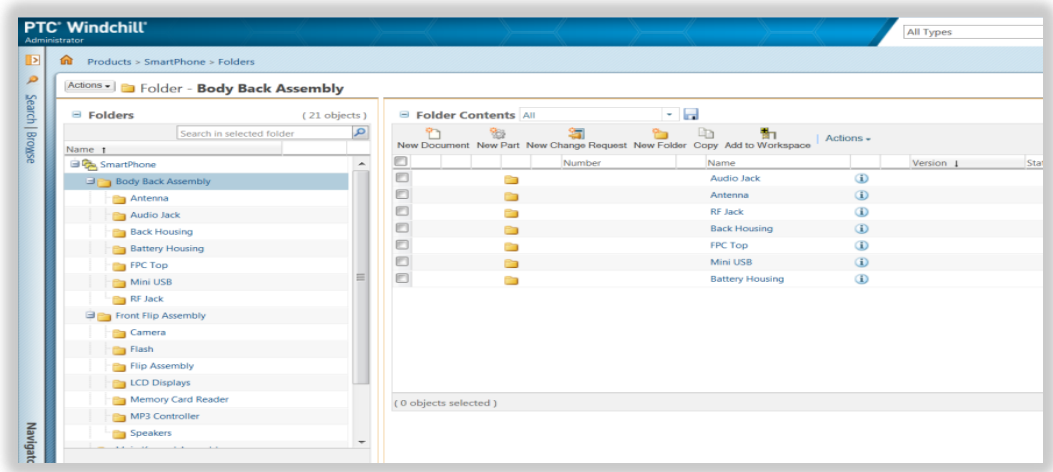
Manufacturing industry will be the #1 industry sector by share of global economic value-add.

– Forecast: The IoT, Worldwide, 2013

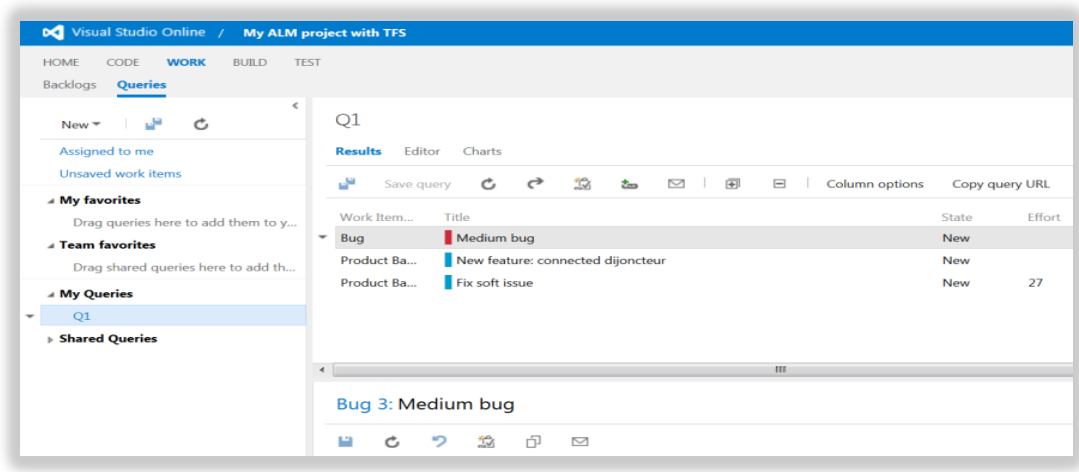
BEFORE:
MULTIPLE APPLICATIONS CONTAIN PIECES OF PRODUCT INFORMATION

Product developers must get information from multiple systems to complete tasks

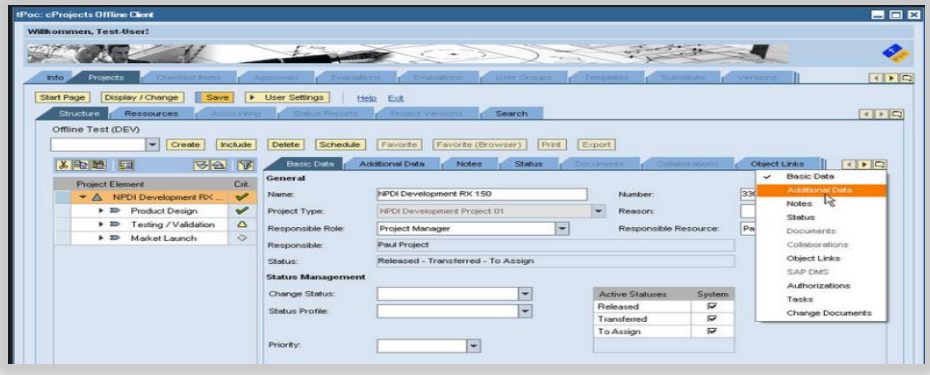
PLM: Physical Structure Information



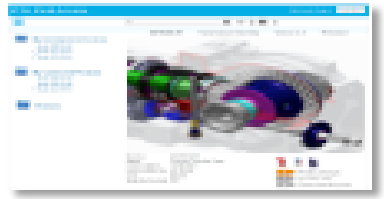
ALM: Software Component Information



ERP: Cost and Manufacturing Information



IMPACT ON PTC SOLUTIONS AND LIFECYCLE MANAGEMENT



Role/Task Based Applications

ThingWorx

Connect | Create | Analyze | Experience | Collaborate

3rd Party
- SAP
- MES
- Other

CREO
- Performance Advisor
- Digital Twin & Augmented Reality

Windchill
- Global Quality
- Global Platforms (GP)
- Digital Manufacturing (MPM)
- Product Support (SIM/SPI)

Integrity
- Requirements & Test
- Software Engineering

Integrity Modeler
- MPSE + MBPLE + Asset

Servigistics
- Parts Management & Pricing
- Knowledge Management

Information Delivery

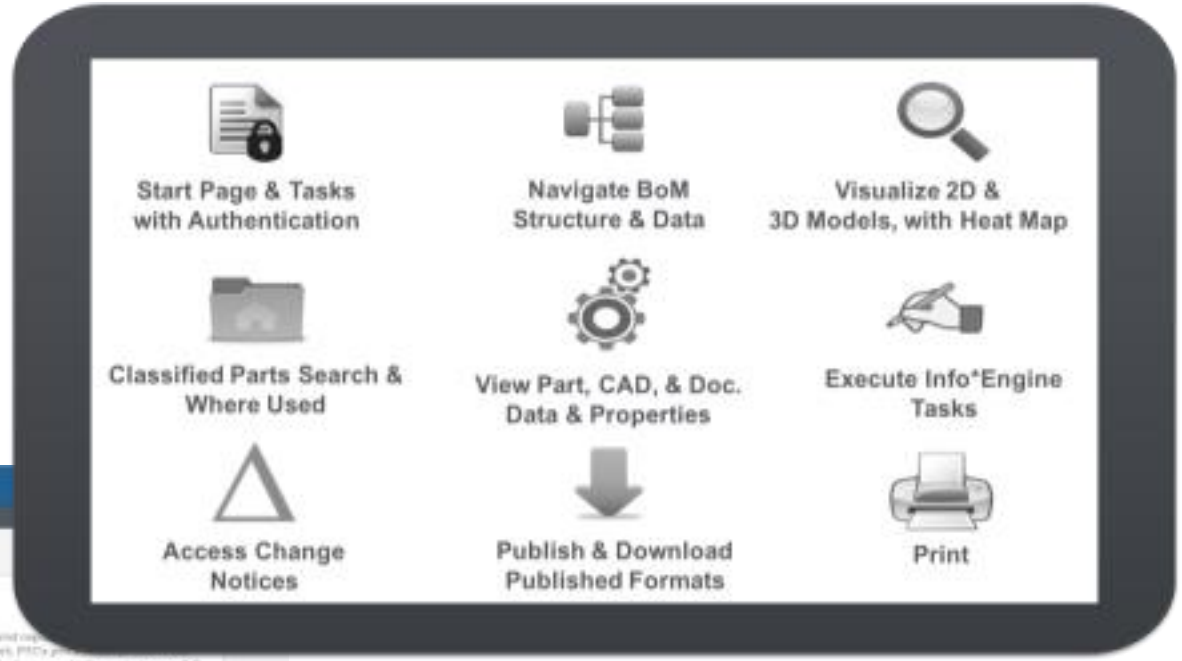
Integrity Process Director
- Process Authoring
- Process Metrics
- Adoption & Feedback

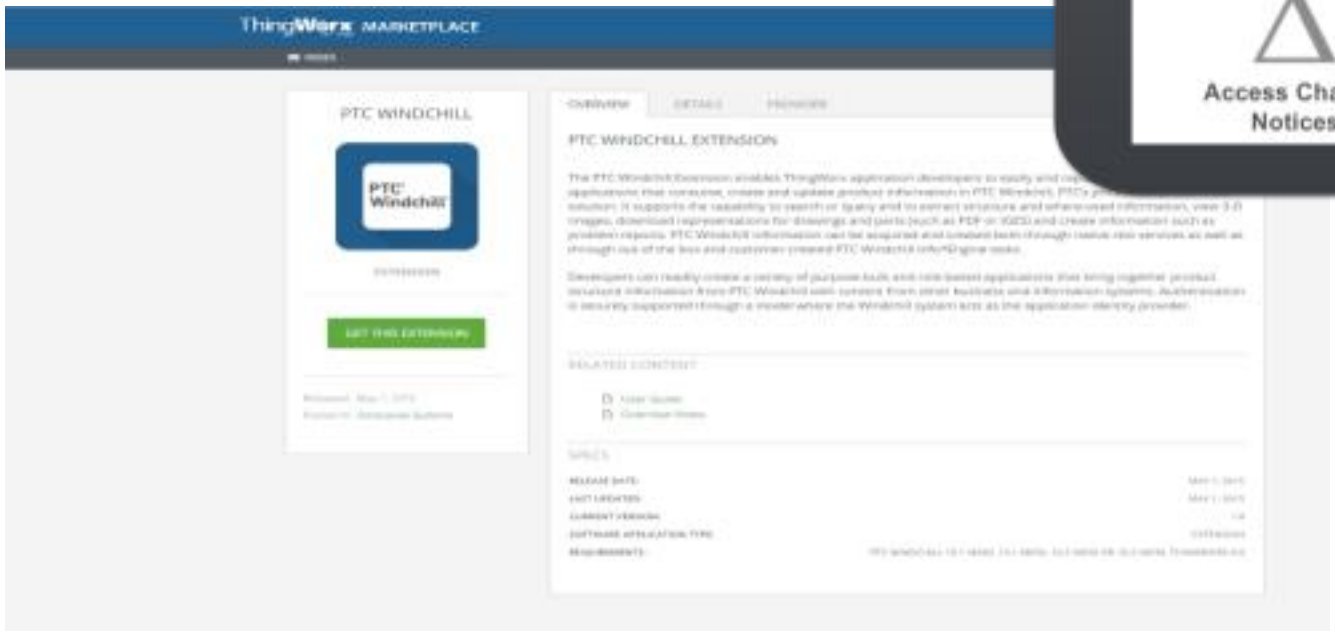
PTC WINDCHILL EXTENSION – AVAILABLE NOW

Download from ThingWorx Marketplace Today:

- No cost for Windchill Extension
- Customer must have requisite Windchill and ThingWorx licenses to support capabilities exposed

http://marketplace.thingworx.com/downloads/ptc-windchill





PTC WINDCHILL EXTENSION – CAPABILITIES

- Content Summary
  - Native REST services
    - Retrieve Part, CAD document and wt document structures from Windchill
    - Obtain property information
    - Support multi-level where-used queries for parts, CAD documents and Office documents (wtDocuments)
    - Execute saved search queries to quickly retrieve indexed information from Windchill
  - Widgets
    - Structure Tree Table
      - Show CAD document, part and document structures
      - Show mashup of information of other systems (such as ERP in context of structure from Windchill)
    - Creo-View Visualization
      - Show thumbnails and 3-D viewables
      - Visually navigate 3-D model and highlight item in BOM and show properties
      - Dynamically color content based on attribute values or events
      - Launch Creo View Light
      - Download Windchill-published formats (PDF, IGES, STL…)
  - Info*Engine task service wrappers
    - Execute out of the box Info*Engine Tasks
    - Execute custom Info*Engine Tasks
  - Authentication
    - Windchill acts as identify provider for users that log into ThingWorx application that accesses Windchill content

SYSTEMS ENGINEERING AND THINGWORX

Future

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PTC Integrity Modeler – Automated ThingWorx Code Generation

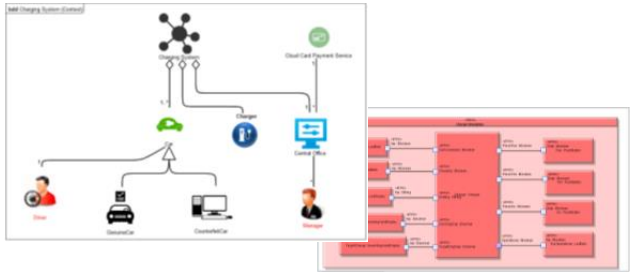
Layer

PTC Integrity™ Modeler™ System Design

Live ThingWorx System

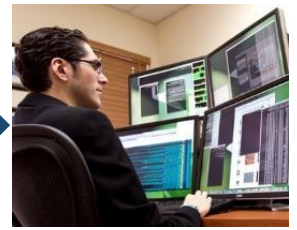
Real World

SoS/ ThingWorx Mashup

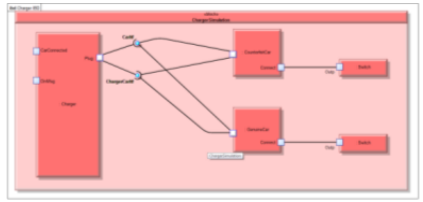


Mashup

Deployed



Thing Shapes



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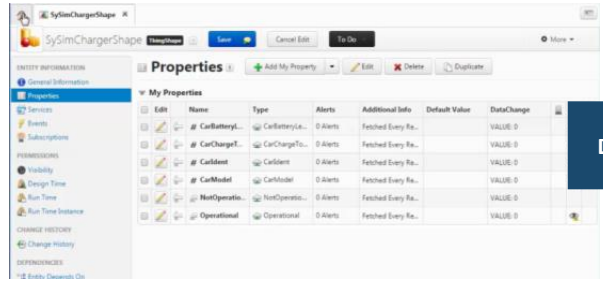
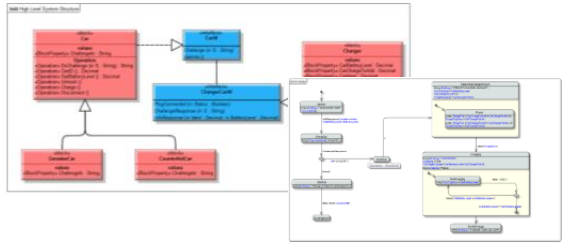


Deployed

Edge Devices



Device Code

```
        Private Started As Boolean
        Public Shared Function GetConfigurator() As
com.thingworx.communications.client.ClientConfigurator
            Dim Ret As New com.thingworx.communications.client.ClientConfigurator
            Ret.Uri = "ws://172.31.1.39:8443/Thingworx/WS"
            Ret.ReconnectInterval = 3
            Ret.Claims =
com.thingworx.communications.common.SecurityClaims.fromAppKey("74f630e5-bb5d-47bd-b151-
068d6d5ca3b2")
            Ret.Name = "ChargerSimulation"
            Ret.ConnectTimeout = 3000
            Ret.ConnectRetries = 3
            Ret.DisableCertValidation = True
            Return Ret
        End Function

        Public Sub ClientStart()
            If Not Started Then
                Me.start()
                Started = True
```

Deployed

Prototype driving requirements for Integrity Modeler 8.3

APP EXAMPLE 1 – ENGINEERING DESKTOP OR DASHBOARD

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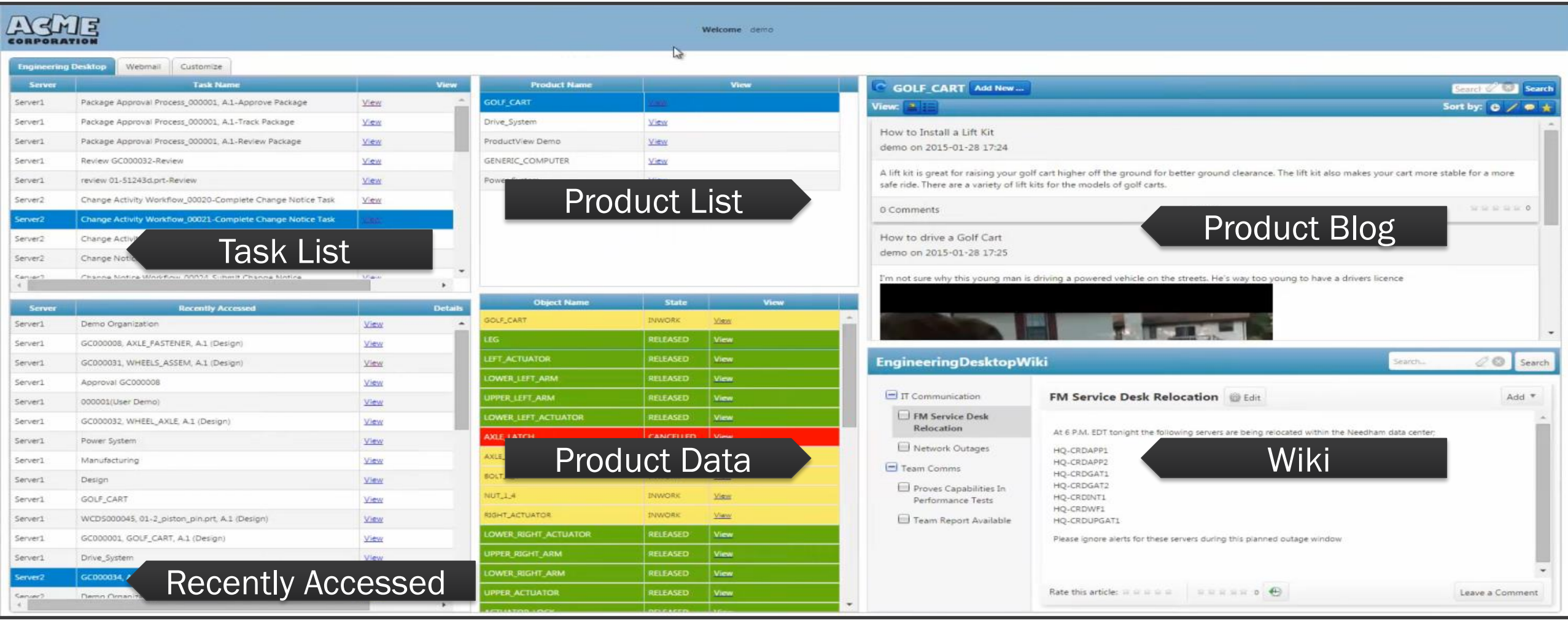
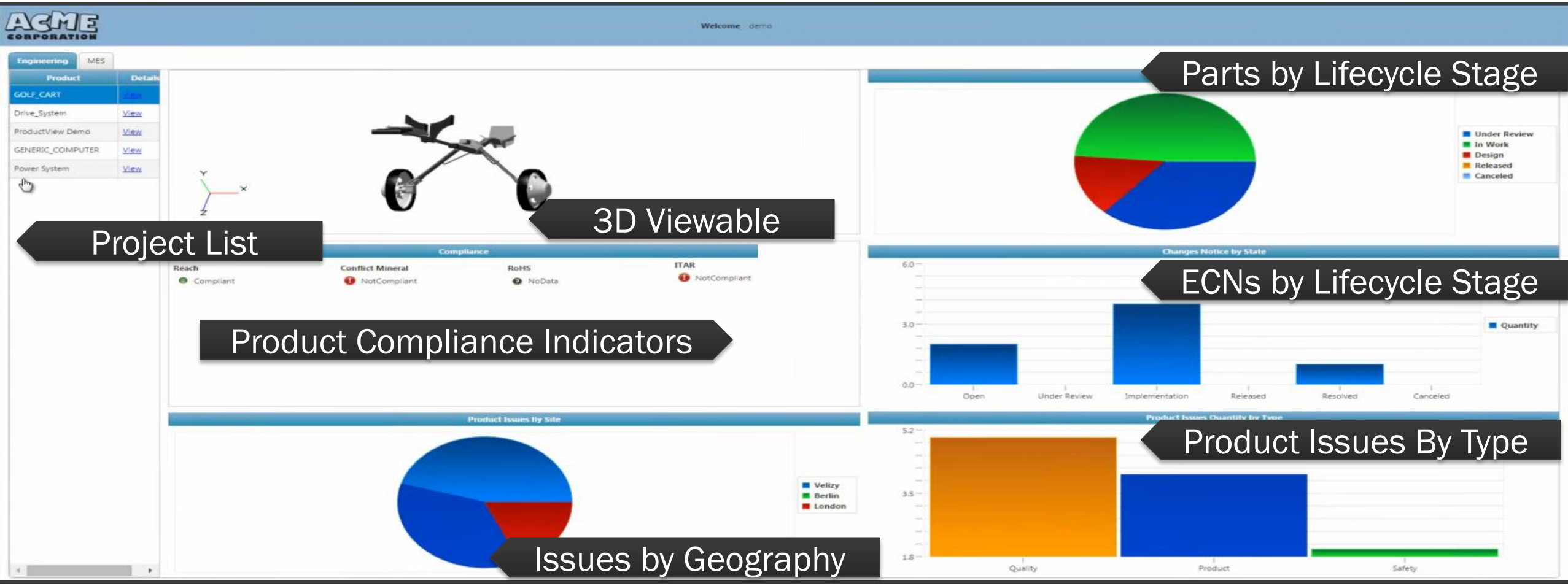
"Engineering Desktop" MashUp



APP EXAMPLE 2 – PROGRAM DESKTOP/DASHBOARD

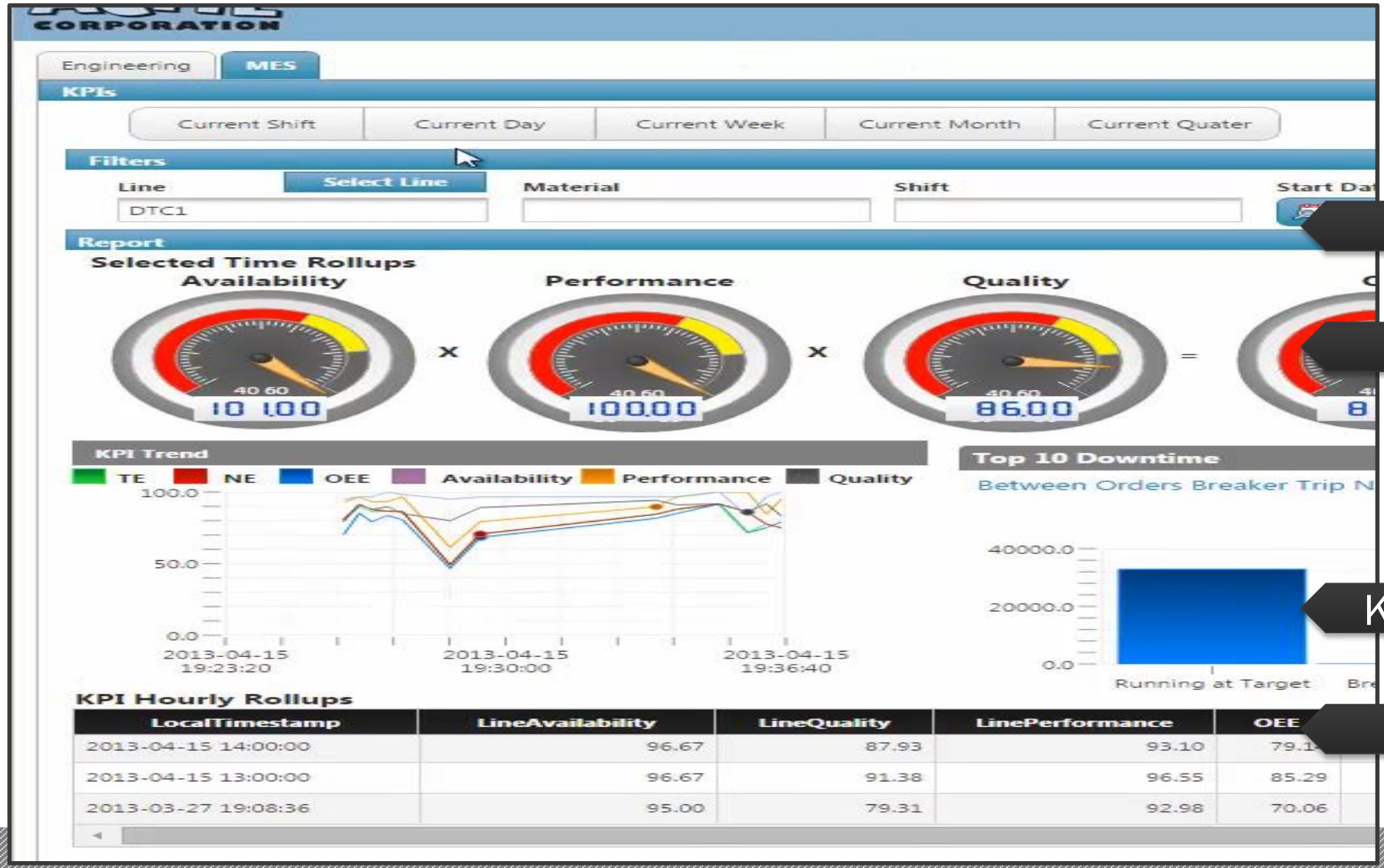
PTC

"Program Manager Desktop" MashUp



APP EXAMPLE 3 – PROJECT MANAGER DASHBOARD

"Project Manager Dashboard – Manufacturing View" MashUp



Select a Product Line

View Up-to-date Data

Key Performance Indicators

Detailed Information

PERFORMANCE ADVISOR FOR PTC CREO – AVAILABLE NOW

PTC®

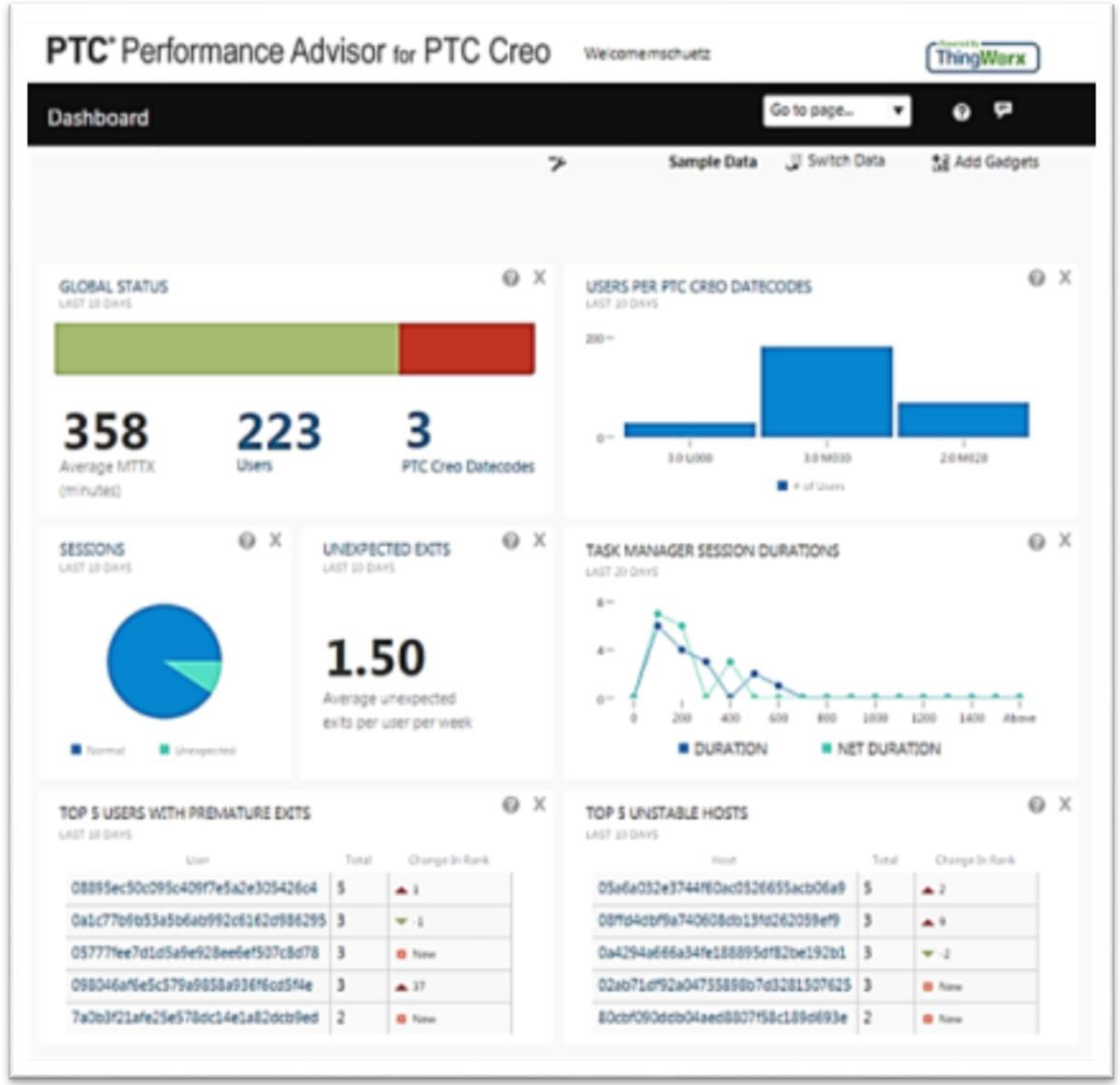
System health monitoring to guarantee uptime and proactive technical support

Solution Concept:

- proactively detecting performance issues and providing PTC recommended and proven corrective action to customers before their users are affected

Benefits

- Increased personnel and enterprise productivity
- Lower the cost of IT through reduced issue volume and reduced time doing non-value-add activities.
- Optimized asset management.
- Running Secure and scalable applications reducing the business's risk in using PTC Applications.



http://support.ptc.com/appserver/support/product_documentation/performance_advisor.jsp

DEMONSTRATION

PTC®