IBM

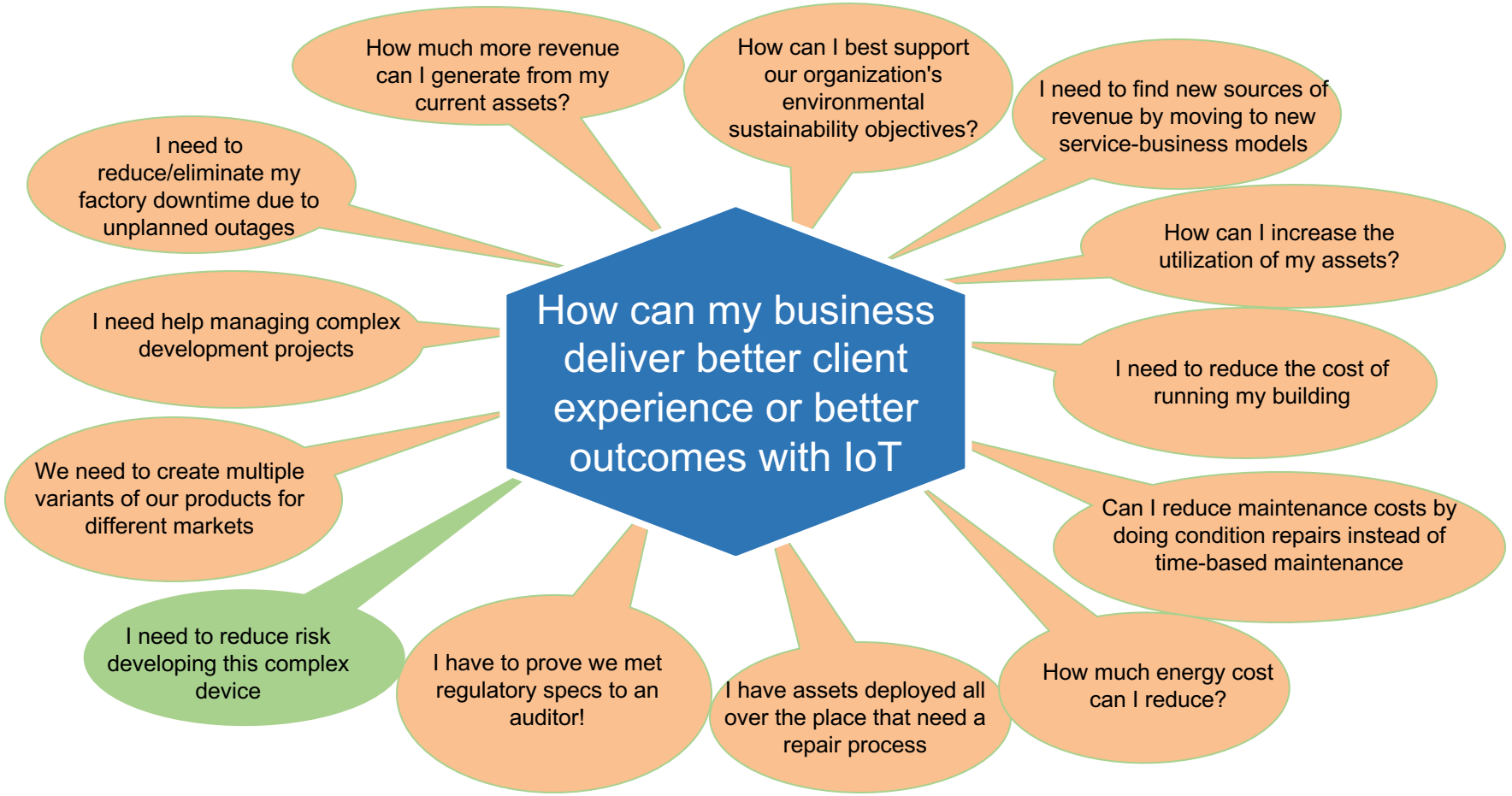
Cognitive Manufacturing

Jaikumar Subramanian

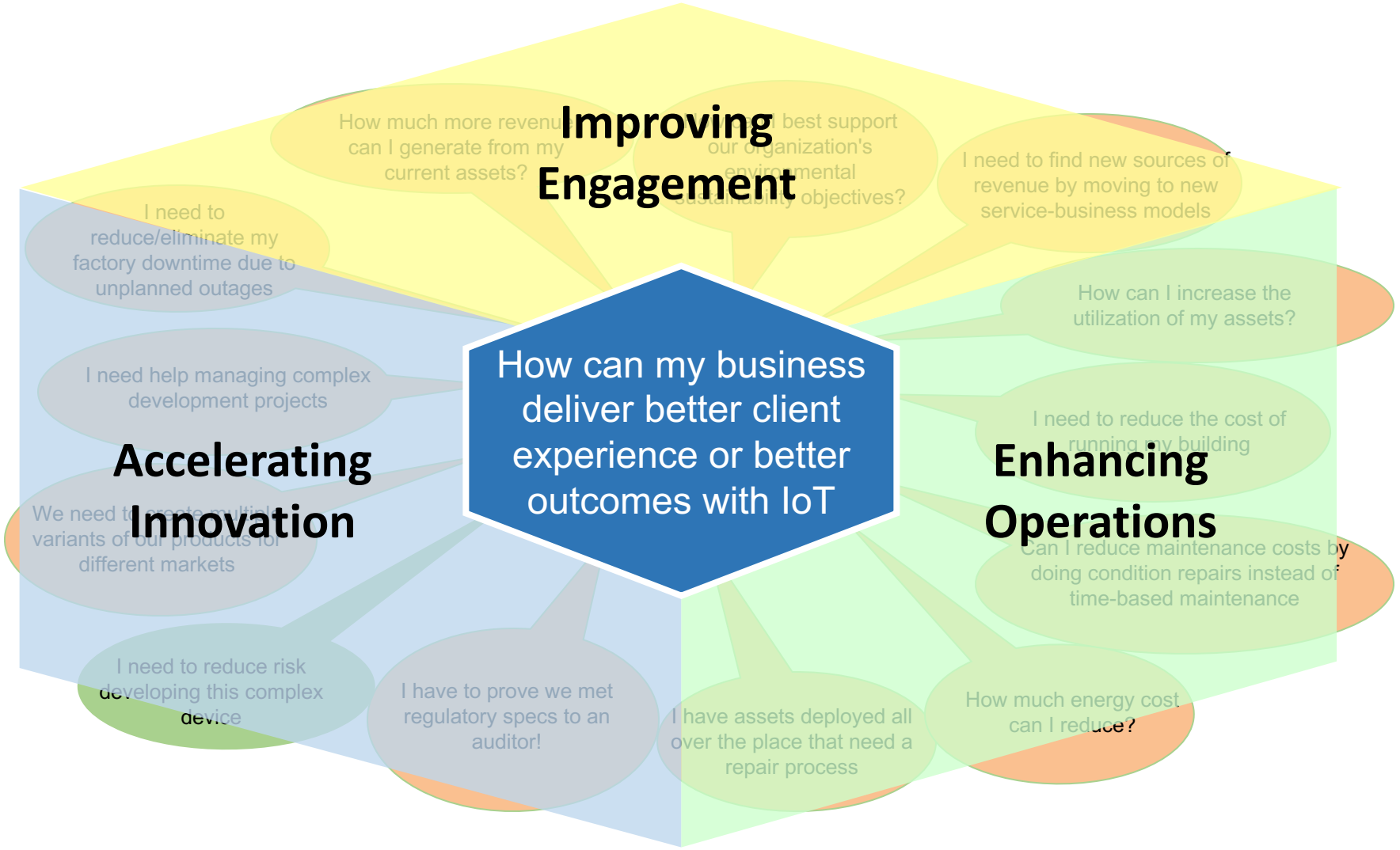
Associate Partner, Cluster Leader – Industrial Sector

Digital Operations in Manufacturing

Companies are becoming more competitive with new ways to drive better business engagement



IoT value creation is focused on delivering better outcomes through innovation, operation and customer engagement



Opportunities in Accelerating Innovation

Accelerating Innovation

Engineering Insight

Requirements Management

Systems Engineering

Embedded Software Development

Managed Continuous Engineering For IoT

Gain engineering insight from operational performance

Ensure connected products deliver targeted business value

Manage complexity of connected IoT systems

Capitalize on software as the primary means to deliver business value

Improve engineering time to value by deploying in a secure private cloud

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Gain engineering insight from operational performance

Solution:
Engineering Insight

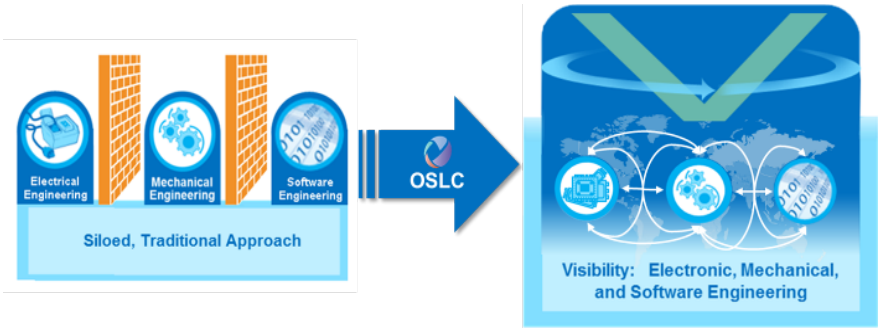
IoT Challenge:

The amount of operational data available from connected systems is overwhelming and my project engineering information is locked in isolated silos. How can I gain more value from my data to help my engineers innovate?

Priority industries

- Automotive
- Aerospace
- Electronics

Access, unlock and understand all engineering information no matter where it resides



Customer benefits/Case

- **Reduced impact analysis** from weeks to days
- **Increase visibility** into product-development processes, to effectively track and monitor production for product's lifecycle
- **Enhance scalability** to simplify integration of future data sources and other applications

It's about enabling the right decisions at the right times

Ensure connected products deliver targeted business value

Solution:

Requirements Management

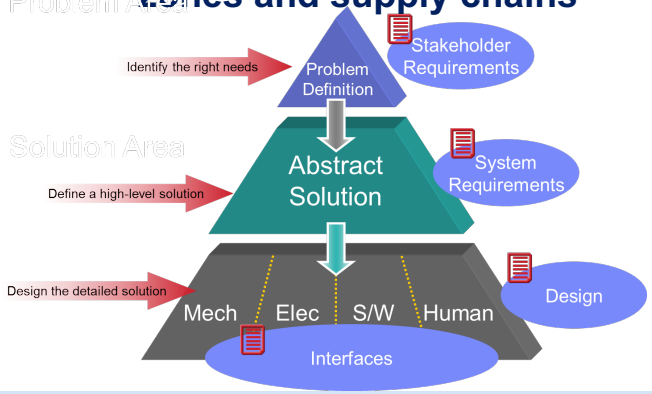
IoT Challenge:

In this world of growing complexity, how do I keep my global engineering team on the same page?

Priority industries

- Automotive
- Aerospace

A single platform for managing requirements so your teams can work more effectively across disciplines, time zones and supply chains



Customer benefits

- Reduce the amount of time required to create complex requirement specifications from months to weeks
- Helps enable processing 3,000 requirements per day with two people, compared with 1,000 requirements per day with five people
- Supports meeting ISO 26262 compliance and other regulatory requirements

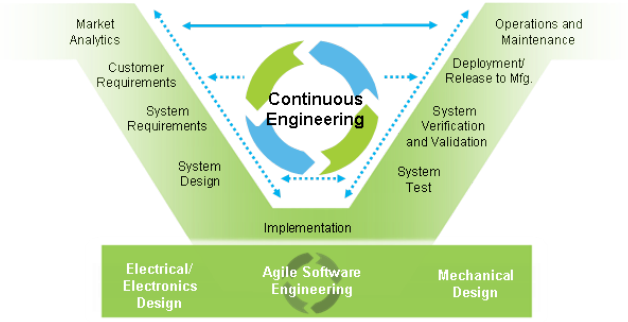
Bridge the gaps between customers, requirements and deliverables

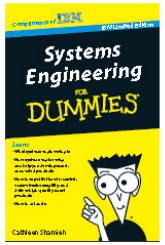
Manage complexity of connected IoT systems

Solution:

Systems Engineering

A structured and auditable approach to identifying requirements, managing interfaces and controlling risks throughout the project lifecycle."





Get a copy for yourself!

IoT Challenge:

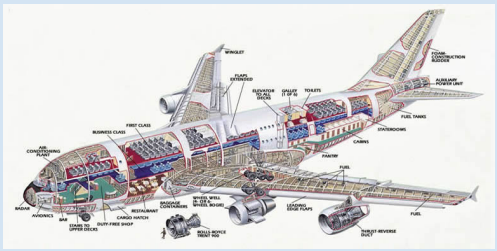
I'm combining new complex technologies with cloud infrastructure in ways never seen in my industry. How can you help me reduce my technical risk and still ensure I deliver a great customer experience?

Priority industries

- Automotive
- Aerospace
- Electronics

Customer benefits

- Engineer for continuous reuse in complex product lines or exploit simpler reuse patterns in line with your economic fundamentals
- Access, unlock and understand all engineering information no matter where it resides
- Verify throughout the product lifecycle to reduce rework and achieve faster time to quality



"Big Picture thinking, and the application of Common Sense to projects." INCOSE

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Capitalize on software as the primary means to deliver business value

Solution:

Embedded Software Development

IoT Challenge:

More than ever my product value is coming from the embedded software but I'm struggling to cope with the scale and complexity. How can I turn this challenge into a competitive advantage?

Priority industries

- Automotive
- Aerospace
- Electronics

Unite your product's architecture and intended behavior with the realities of its operating environment

Customer benefits

- Model driven software design can reduce development time by more than 50%
- Automation of code, test and documentation generation can reduce time to market by upto 40%
- Opportunities to reuse design elements cut cost of producing product variants by a factor of 10

Accelerate embedded software development to align with the speed of the market

Improve engineering time to value by deploying in a secure private cloud

Solution:

Managed Continuous Engineering for IoT

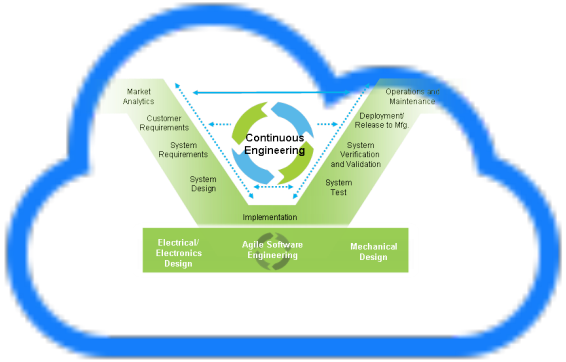
IoT Challenge:

I need my engineering team up and running right now and my IT dept cannot execute fast enough.

Priority industries

- Electronics
- Energy & Utilities
- C&P

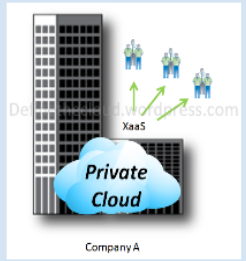
Accelerate time to value and reduce costs by deploying your engineering platform in a secure private cloud



Customer benefits

IBM SoftLayer

- Rapid, scalable access to a range of IBM technologies delivered in a secure, virtual private cloud.
- IBM expertise to oversee your deployment speeding time to value to ensure client success.
- Effective and secure engineering collaboration in the cloud allows greater supply chain collaboration



Innovate using continuous engineering in a scalable, secure, private cloud

Opportunities in Enhancing Operations

Enhancing Operations

Real Estate Optimization

Asset Performance Management

Operational Risk Management

Predictive Maintenance

Asset Reliability Management

Aviation maintenance

- Drive higher return on real estate and facility assets
- Increase asset productivity, uptime and capacity utilization
- Reduce operational risk for achieving operational targets
- Drive operational efficiencies for asset and facility management resources
- Adhere to, and exceed, environmental regulations
- Provide insights to makers for next-generation assets

IBM

Optimize real estate and facilities utilization people-sensing

Solution:

Real Estate Optimization

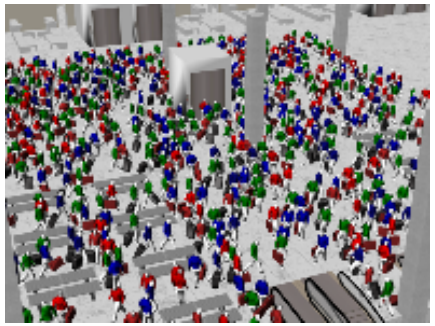
IoT Challenge:

We need to increase the utilization of our real estate and facilities, but lack an understanding of concentration patterns, movement and usage by people in our facilities

Priority industries

- Airports
- Commercial Real Estate
- Government

Monitor people movement and concentration patterns to modify space layout and optimize use of real estate assets



Customer benefits/Case

- Optimize space for high- and low-traffic areas
- Increase or decrease rent, based on usage patterns
- Prioritize capital project for real estate ROI
- Reduce facility maintenance expense

Increase space utilization, increase rent revenue, reduce facility expense

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Reduce operational costs with asset performance management

Solution:

Asset Performance Management

IoT Challenge:

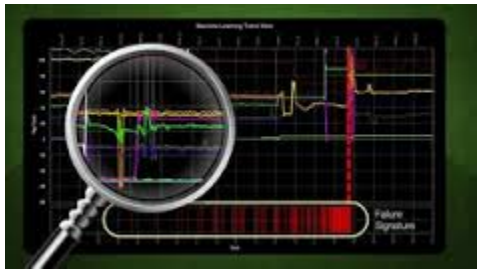
Unpredictable maintenance periods cause loss of production time and increased cost.

How can we improve maintenance agility, responsiveness, and increase operational availability by monitoring the health of our assets?

Priority industries

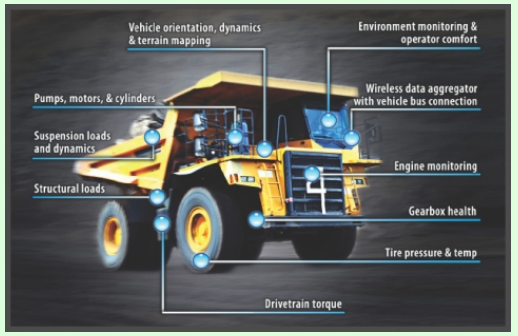
- Manufacturing
- Transportation
- Manufacturing

Condition-based maintenance (CBM) is based on using real-time data to prioritize and optimize maintenance resources



Customer benefits/Case

- Turn measured data into actionable knowledge about health of the asset
- Reduce asset failures, increase availability
- Minimize spare parts costs and system downtime



Helping to perform critical asset maintenance when the need arises

IBM

Reduce operational risk with health and safety automation

Solution:

Operational Risk Management

IoT Challenge:

We need to address the lack of organizational efficiency and inability to prepare/respond to future challenges

How can we best support our organization, identifying and reducing potential risks?

Priority industries

- Chemical & Petroleum
- Energy & Utilities
- Life Sciences

The objective of operational risk initiatives is to reduce overall risk, to comply with government regulations, and to create a safe, efficient operating environment

Customer benefits/Case

- Reduction of operational loss, eliminating plant downtime
- Lower compliance costs, avoiding fines
- Improved safety and preventing damaged reputations

Helping to Identify and Control Operational Risks, Reduce the Potential for Accidents, and Improve Overall Performance

IBM

Anticipate asset failures with predictive analytics

Solution:

Predictive Maintenance

IoT Challenge:

We need to ensure asset uptime and productivity by avoiding downtime of critical assets

Priority industries

- Automotive
- Transportation
- Utilities

Monitor asset indicators and analyze historical failure patterns to anticipate issues, and address with just-in-time work orders

Customer benefits/Case

- Increase asset production and capacity utilization
- Reduce unplanned downtime and excess maintenance costs
- Increase productivity and utilization of maintenance staff
- Improve capital planning and warranty management

Increase production, reduce downtime, increase efficiency

IBM

Improve asset reliability with real-time metrics

Solution:

Asset Reliability Management

IoT Challenge:

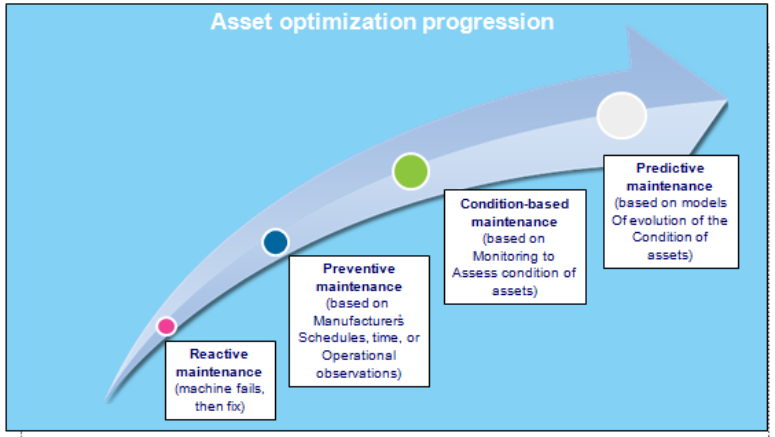
The production line equipment is highly automated, connected and delivers an overwhelming amount of data.

How can we use the increased information from these smart devices to gain operational efficiencies?

Priority industries

- Manufacturing
- Chemicals & Petroleum
- Energy & Utilities

Increased Asset performance drives reliability & contributes to the bottom line



Customer benefits/Case

- Improve the efficiency and reliability of your assets, delivering increased revenue
- Reductions in unplanned downtime significantly improves asset utilization
- Capital expenditure decreases and frees up funding for transformational investment or direct savings

It's about processes that drive uptime to new levels, reduce unplanned maintenance, and improve customer satisfaction

Improve aviation operational efficiency with analytics

Solution:

Aviation maintenance

IoT Challenge:

We need to increase the utilization of very complex, capital intensive aircraft while maintain the highest safety standards

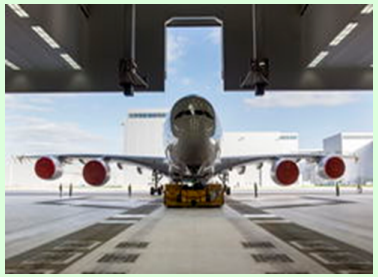
Priority industries

- Aviation
- Aerospace and Defense

Monitor aircraft utilization and use analytics to increase aircraft readiness, utilization and safety

Customer benefits/Case

- Automatic validation of the software and hardware configuration for each aircraft before it is released to operations
- Reduce the time on the ground for scheduled maintenance activities
- Reduced maintenance time by ensuring that the required skills and components are available at the aircraft maintenance location



Increase aircraft productivity while reducing maintenance expense

Opportunities in Improving Engagement

Improving Engagement

IoT Platform as a Service

Connected Vehicles

Connected Products

Smart Buildings

Continuous Services

Operations Insights

Deliver features that act as extensions of peoples' connected lives

Easily scale with demand while allowing it to lower operating costs

Rapidly compose new applications, apply analytics, and securely scale to meet operational requirements

Achieve stated or regulated energy reduction goals in smarter buildings

Address complex operations and automatically interact with the underlying infrastructure

Uncovering new insights enabled by IoT data with composable analytic solutions delivered as a Service for rapid adoption

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Dynamically compose and deploy IoT applications

Solution:

IoT Platform as a Service

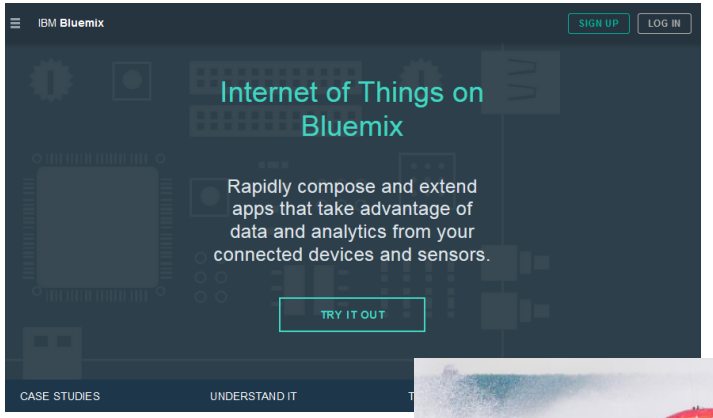
IoT Challenge:

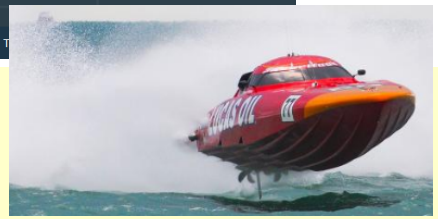
We need a digital innovation platform to rapidly compose new applications, apply analytics, and securely scale to meet operational requirements.

Priority industries

- Cross-industry

Digital innovation platform, harnessing broad range of composable services and deployment models to build what you need, when you need it





Customer benefits/Case

SilverHook Powerboats uses the IoT Foundation service within Bluemix, enabling real-time data collection and analysis in the cloud . Racers can now get real-time insights during the race, improving their decision making and competitiveness.

It's about speed and economics of innovation

Connected Vehicles – Extending, Analyzing, Linking

Solution:

Connected Vehicles

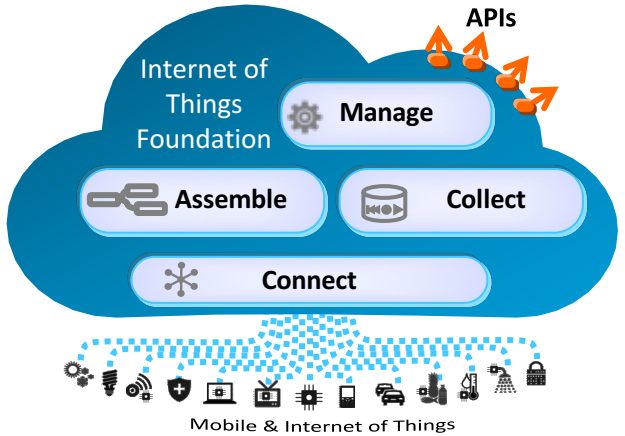
IoT Challenge:

We need to create a solution to deliver features that act as extensions of peoples' connected lives, linking the next generation of vehicles to the Internet of Things

Priority industries

- Automotive
- Electronics

Easily model real-time vehicles and traffic in a city, including people, buildings, and smart infrastructure



Customer benefits/Case

- **50% reduction** in CO2 emissions by commercializing EV technology
- **improvement** in design by analyzing massive amounts of operating data
- **Greater visibility and safety** by extending what the driver is aware of

It's about maximizing awareness and improving efficiency and productivity

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Connected Products – scaling for heterogeneous devices

Solution:

Connected Products

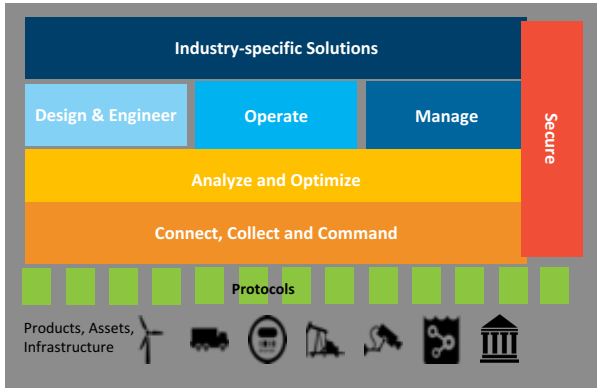
IoT Challenge:

Need an infrastructure that could easily scale with demand while allowing it to lower operating costs to remain price-competitive in a challenging market.

Priority industries

- Electronics
- White Goods
- Home & Health

Interacting in a society where mobile is ubiquitous and customer satisfaction is key



Customer benefits/Case

- **40% reduction** in operating costs
- **Improvement** in customer satisfaction
- **Near-real-time** scaling to meet demand as well as cyclical and unplanned spikes in usage

It's about creating an infrastructure that can easily scale and remain price competitive

A Smarter Building to reduce energy consumption and costs

Solution:

Smart Buildings

IoT Challenge:

Achieving stated or regulated energy reduction goals required multi-pronged:

Energy management such as monitoring and fault detection

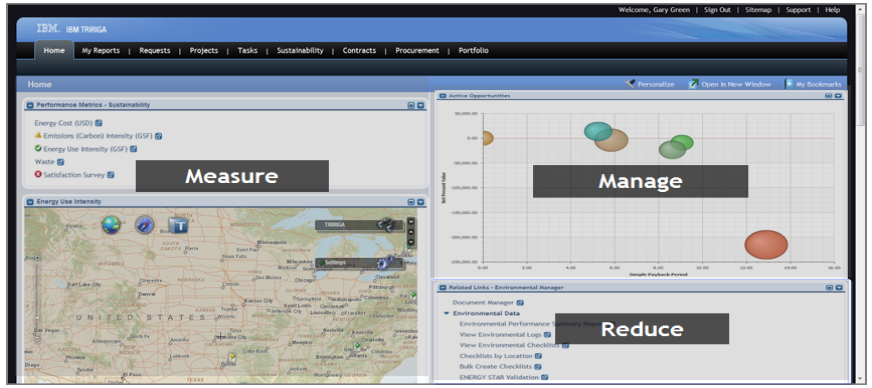
Operational improvements such as continuous commissioning & building retrofit projects

Improved facility utilization such as space planning and optimization

Priority industries

- Retail
- Government
- Large corporate campuses

Organizations that prioritize facility energy efficiency are more likely to combine real-time energy data with operational improvements to correct operating abnormalities



Customer benefits/Case

- As operating anomalies are identified and resolved, **energy consumption fell by 16%** when compared to baseline
- The number of **work orders fell to 16% below** the baseline.
- Combining information collected from sensors, business rules and asset data, technicians **completed corrective work 49% faster**.

It's about achieving facility energy reduction goals by executing three parallel approaches using big data and analytics

Improving availability and safety with an integrated approach

Solution:

Continuous Services

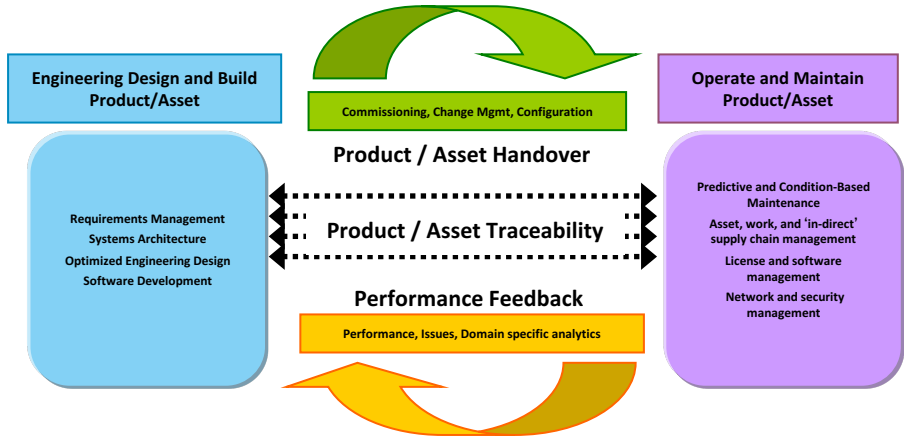
IoT Challenge:

We need to address complex operations, empowering businesses to understand and automatically interact with the underlying infrastructure

Priority industries

- Utilities
- Aerospace
- Government

Analytics, Predictive Maintenance, and Integration across facilities



Customer benefits/Case

- **50% reduction** in forced outages
- **7% Increase** in plant reliability
- **Significantly Improvement** in plant revenue

It's about maximizing investment by analyzing, predicting and integrating

Uncovering new insights enabled by IoT data with composable analytic solutions

Solution:

Operations Insights

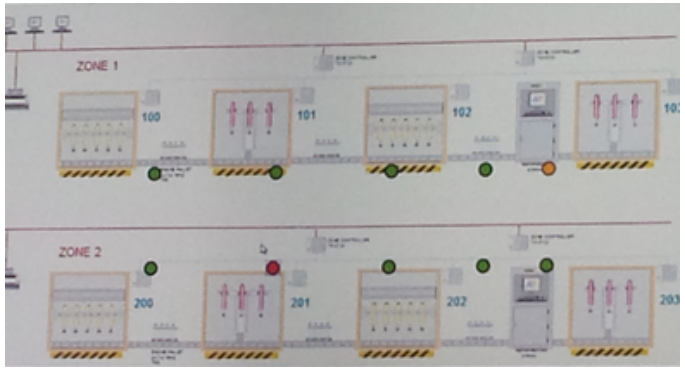
IoT Challenge:

Develop and deploy new analytic techniques, without a deep bench of data scientists, as your organization moves along it's IoT journey

Priority industries

- Cross-industry

Utilize and configure purpose built analytics to mine IoT data for insights, delivered as a service for rapid deployment and adoption



Customer benefits/Case

- Turn measured data into actionable insights for operational improvements and or client experience
- Improve visibility to emerging operating abnormalities
- Minimize time and cost to develop and deploy new analytic capabilities in support of IoT strategy

It's about speed and economics of innovation to drive measureable business impact

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Cognitive Systems go beyond traditional analytics and automation to deliver more capability

Manufacturing with Analytics and Automation	Manufacturing with Analytics, Automation, and Cognitive
Addresses predefined issues/problems	Enables detection of new or unseen issues through patterns
Provides accurate and definitive answers	Provides answers and alternatives with margin of error
Built on known meanings and relationships	Is able to learn semantics and taxonomy and expand upon them
Improves productivity in defined ranges	Continuously understands, assesses, and redefines productive ranges
Interacts in formal means (commands, screens)	Enables interactions with human language and sensory inputs
Automation can actually degrade human skills	Cognitive is always learning and sharing to prevent “knowledge failure”

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Cognitive Manufacturing – Value Proposition and Benefits

Intelligent Asset and Equipment	Cognitive Process and Operations	Smarter Resources and Optimization
Value Proposition: optimizes "things" or equipment on the plant floor by utilizing the IoT and cognitive capabilities to sense, communicate and self-diagnose issues so they can optimize their performance and reduce unnecessary downtime.	**Value Proposition:** bring more certainty to business by analyzing a variety of information from workflows, context and environment to drive quality, enhance operations and decision-making, optimizing "processes" to drive higher yield	**Value Proposition:** utilize the IoT and cognitive insight to optimize resources (worker, energy, expertise) through location, individual, usage and environmental data along with analytics, optimizing "people" and resources to drive higher efficiency
Benefits: • Prevent production delays and improve production line performance • Reduce equipment downtime and increase process efficiency with industry models • Expedite equipment repairs through predict and cognitive analytics **Metric improved:** Reliability, Uptime, Performance	**Benefits:** • Increase yield of manufacturing operations and processes • Improve productivity of your manufacturing line with early quality detection • Expedite service calls and repairs and reduce warranty costs **Metric improved:** Quality, Yield, Productivity	**Benefits:** • Improve worker safety and gain better workforce management • Increase worker productivity and expertise • Reduced energy consumption of your facilities and buildings **Metric Improved:** Cost, Efficiency, Safety

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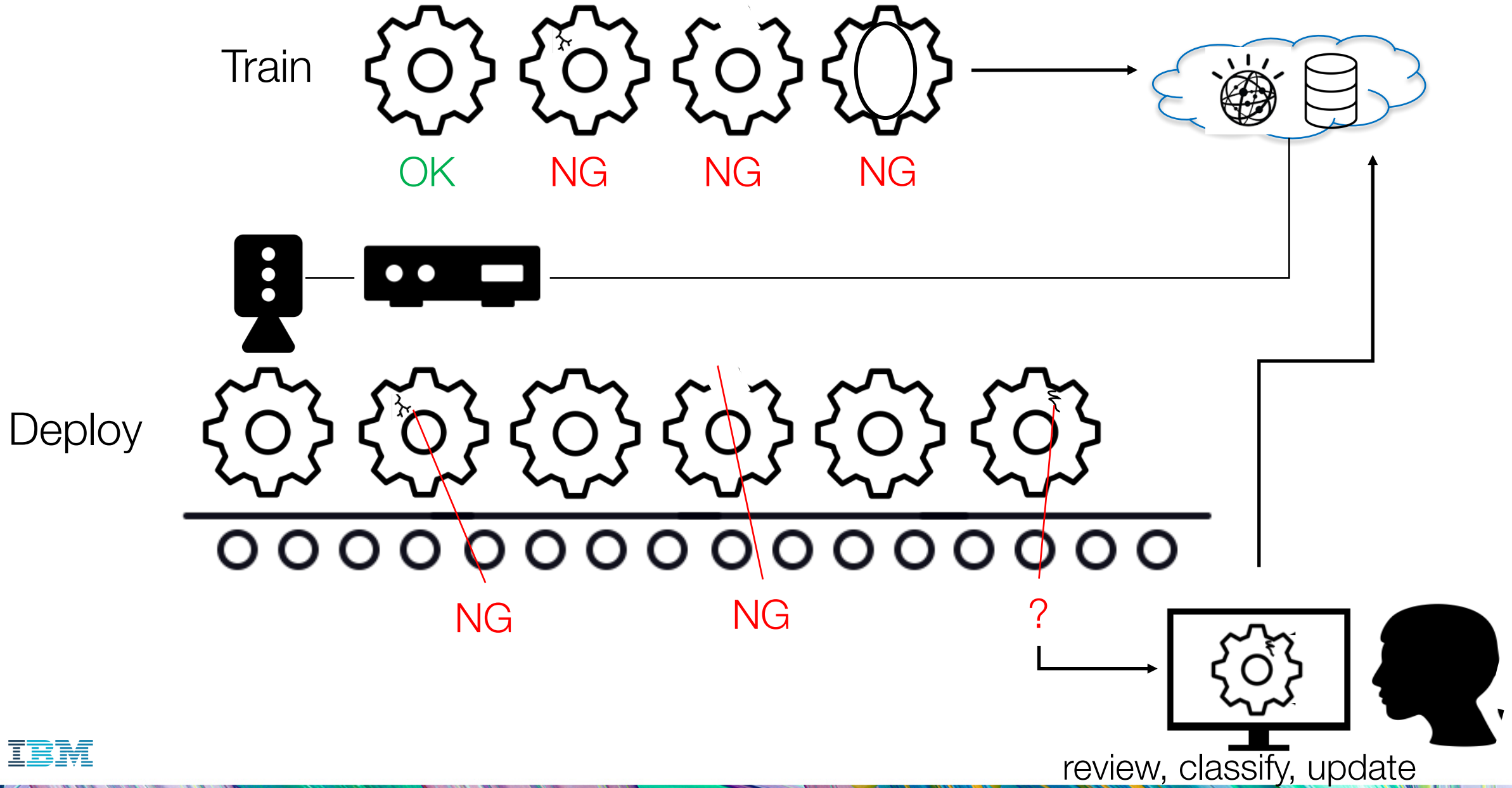
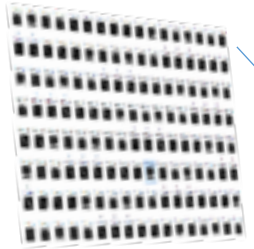
Cognitive Visual Inspection



Process

Images captured using existing imaging capture system



Defects compared against library of past images and trained algorithms on edge system

Real-time monitoring
Quality Analytics and reporting for daily, weekly, per shift reports

Machine Learning system
crawls through library and attempts to improve algorithm accuracy over larger data set.

Variation of past case?
Reuse previously trained algorithms and retrain to handle new variations

Entirely new case?
Develop new image analytics and train on sample sets to have high accuracy

Update image and algorithm library and deploy to edge system

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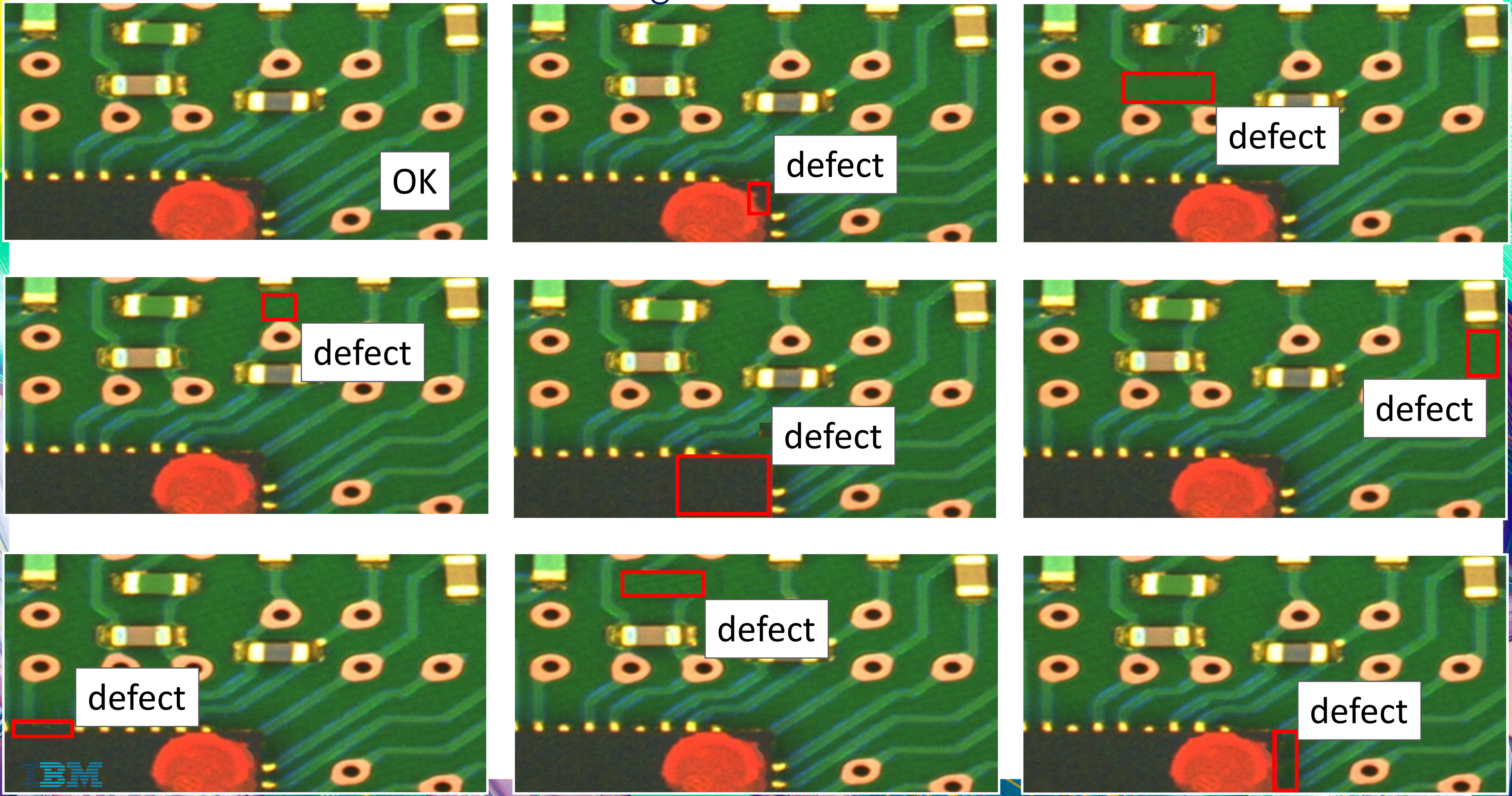
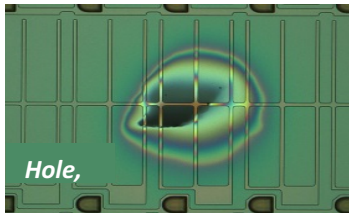
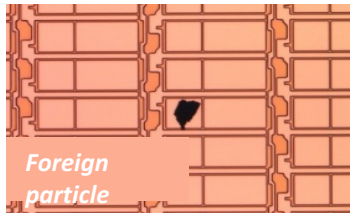
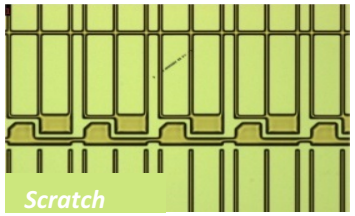
A collection of “OK” and defect images

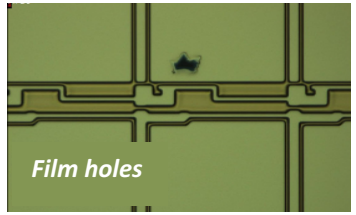


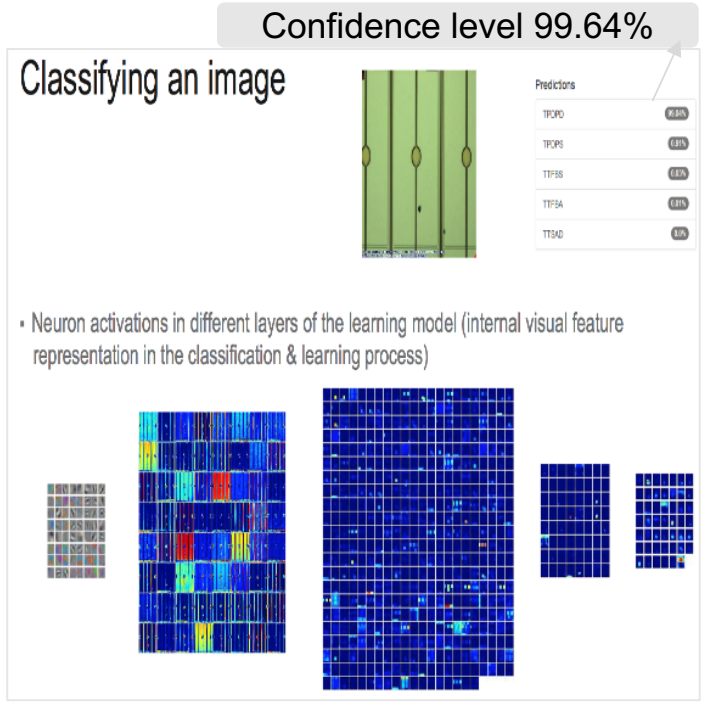
Cognitive visual inspector



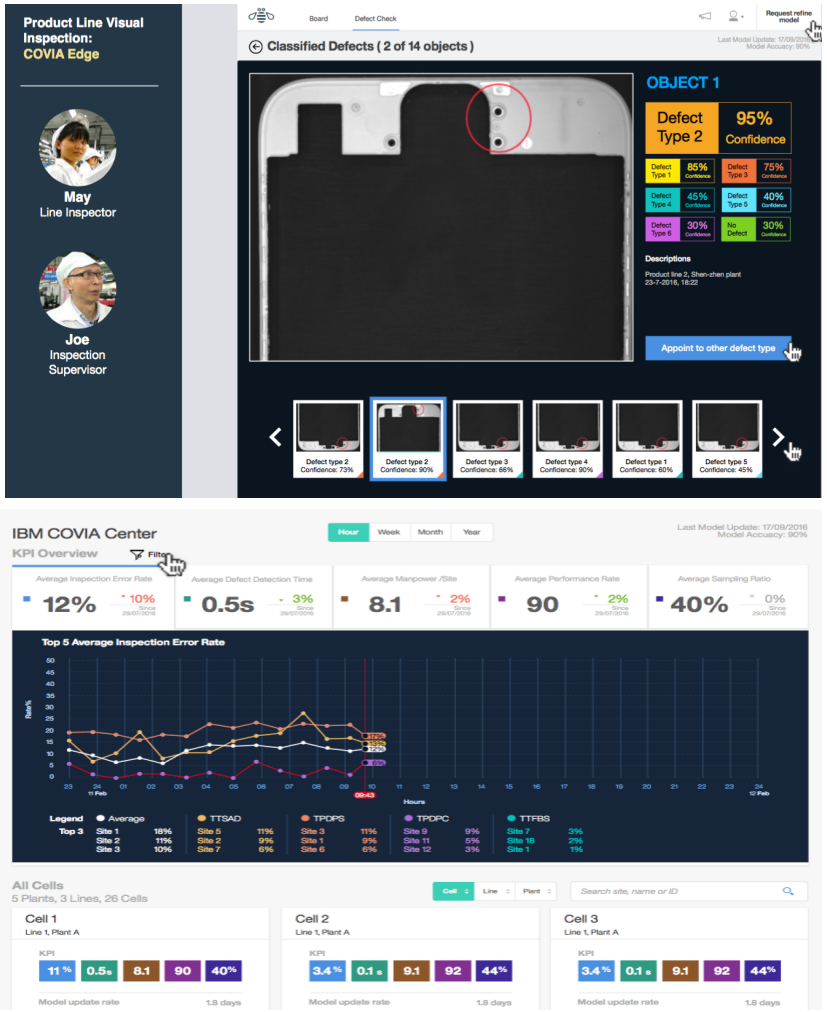








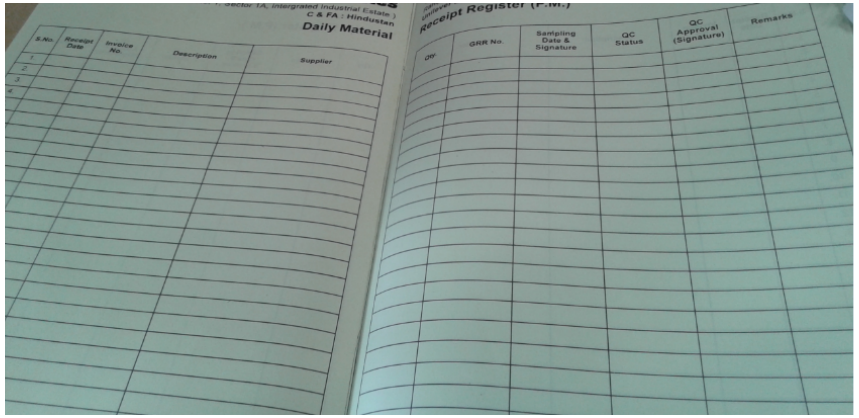
Cognitive Engine



Result

Data capture in shop-floor

From



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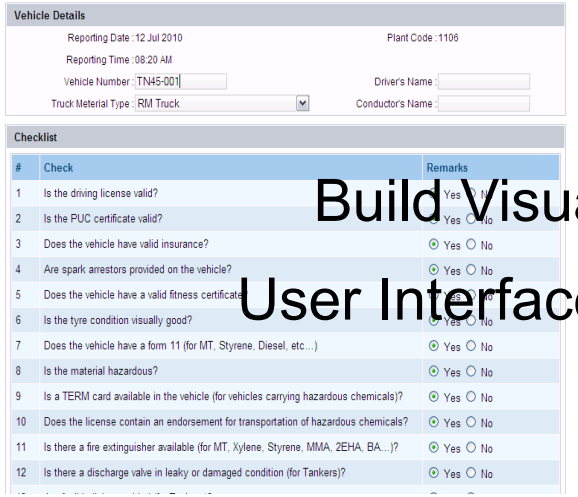
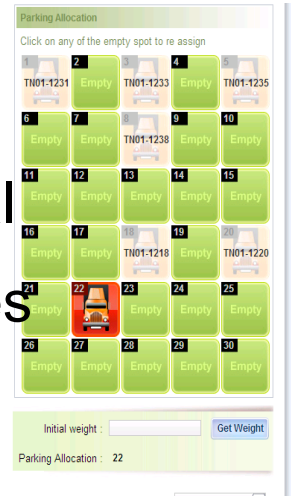
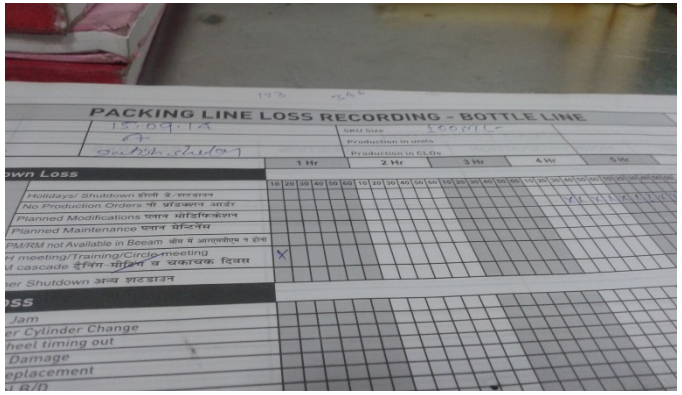


Build Visual User Interfaces



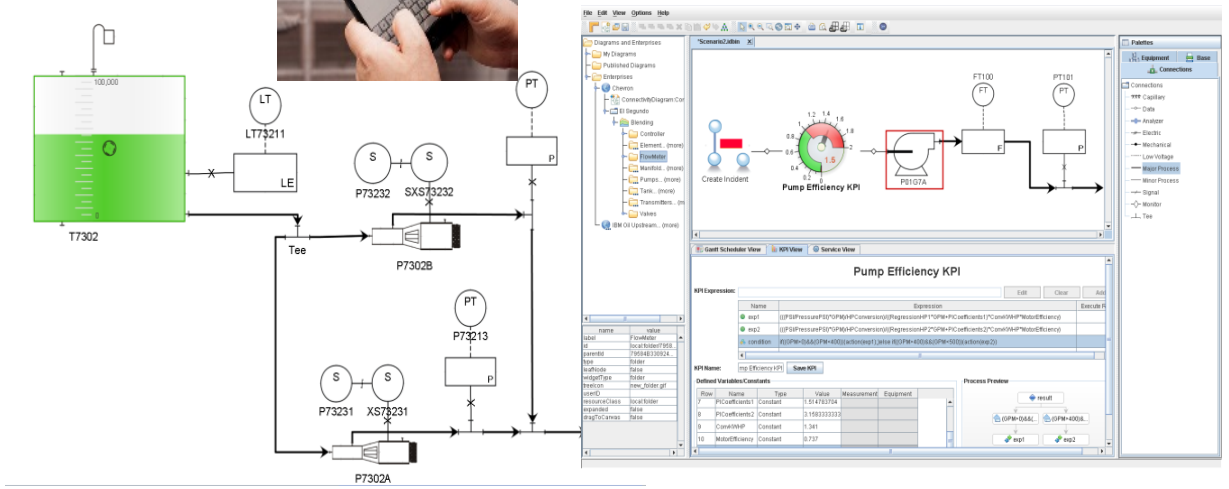
Data capture in shop-floor

From



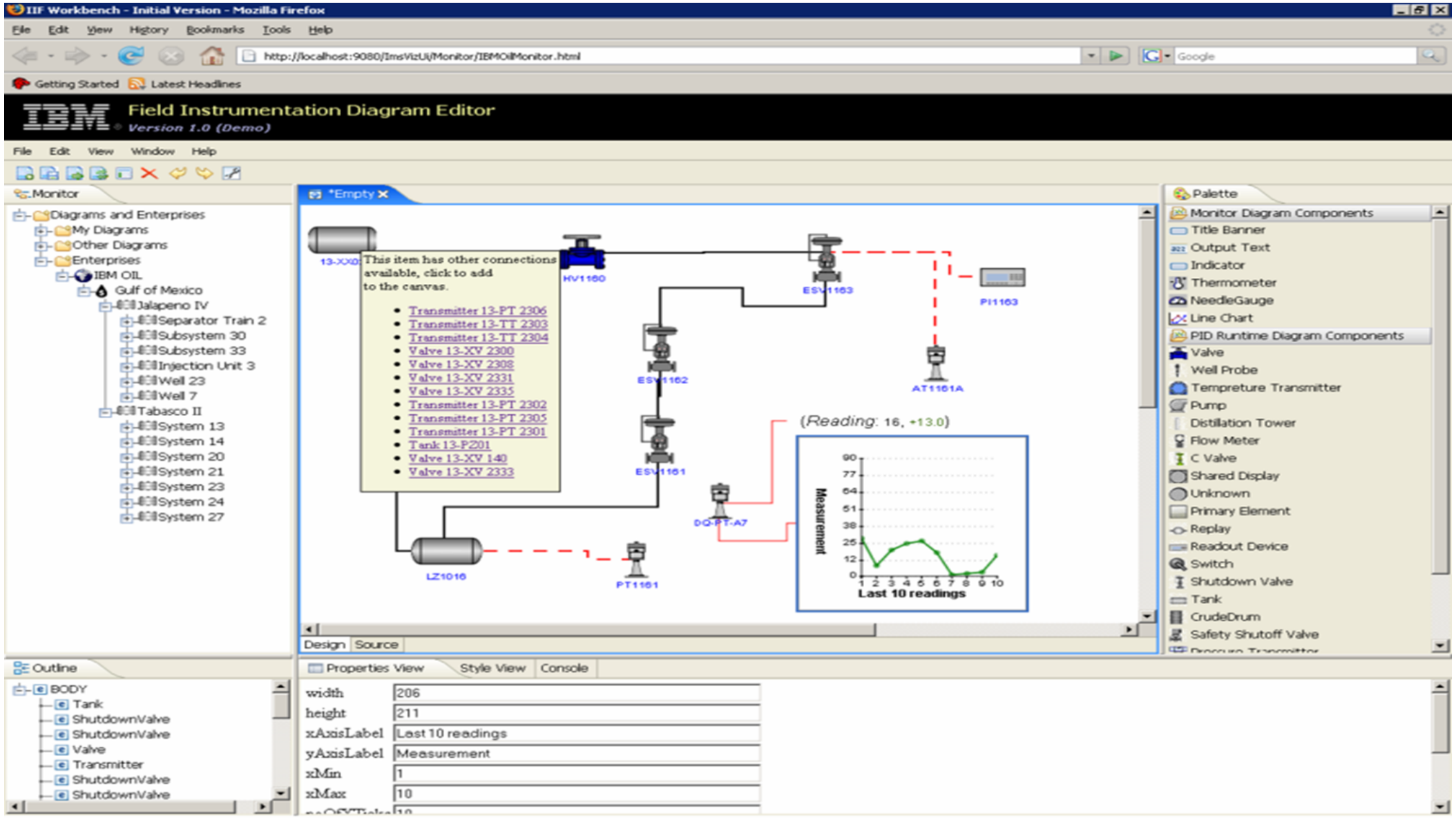
To

Enable Equipment and Line faults data entry online with Mobile

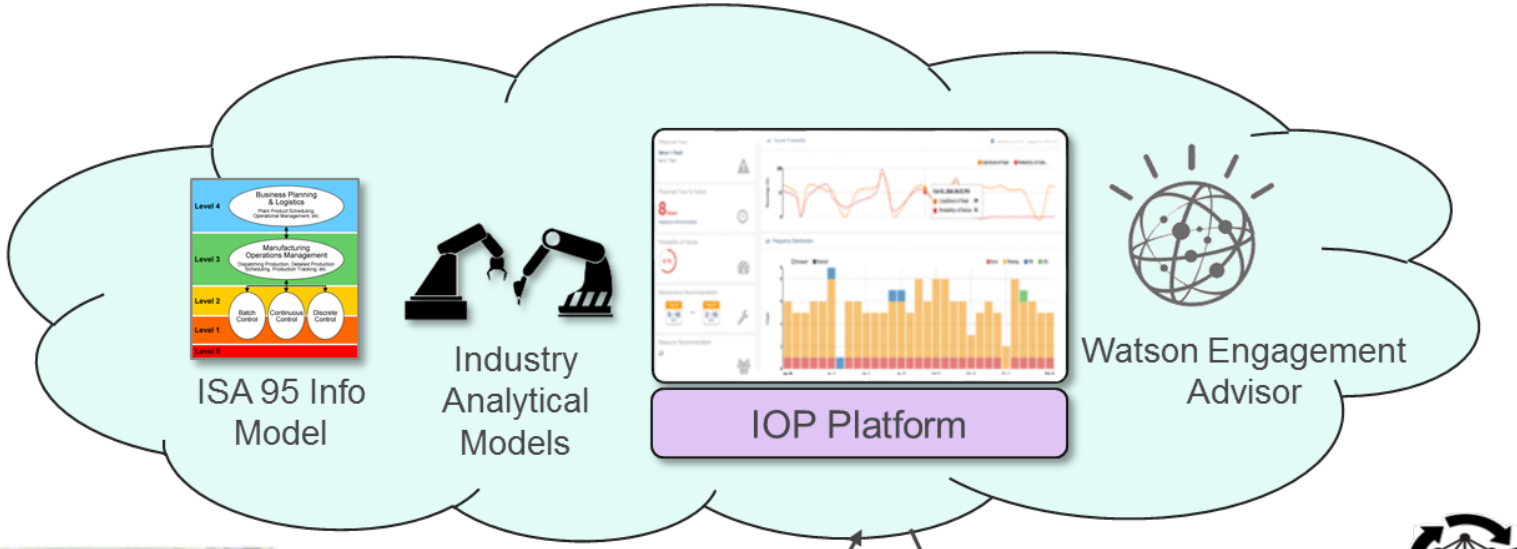


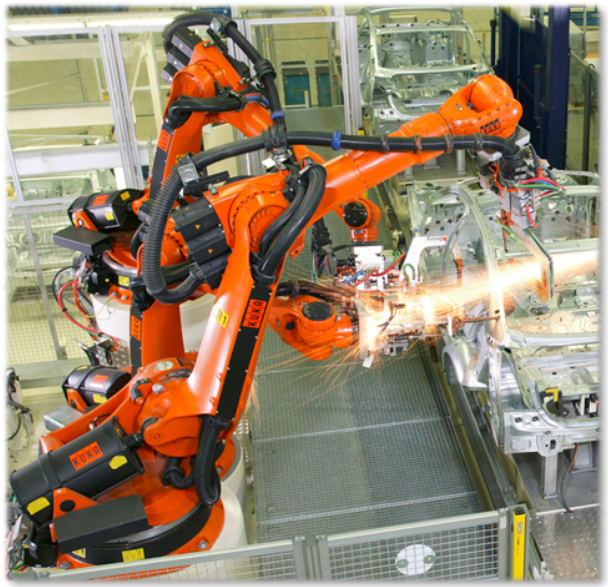
- Process Flow Diagrams fully animated with real time information, to discern status alerts, events and equipment oriented faults
- Visual configuration of Process Events, Service Connections and Engineering calculations/KPIs
- Visual paradigm to connect measurements to calculations, assets to calculations
- Graphical definition and scheduled or event initiated execution of business processes and services.

Plant Performance Analytics



Plant Performance Analytics





Cycle time
Positional
Parametric
Events

Transactions
EAM
CMM
Production Plan

Plant OE

Overtime
Maintenance
Material

Predictions

Prescriptions

Availability

[↓ Downtime Constraints]
[↑ Asset Utilization]

Performance

[↓ Performance Constraints]
[↑ Throughput]

Quality

[↓ Quality Constraints]
[↑ Product Yield

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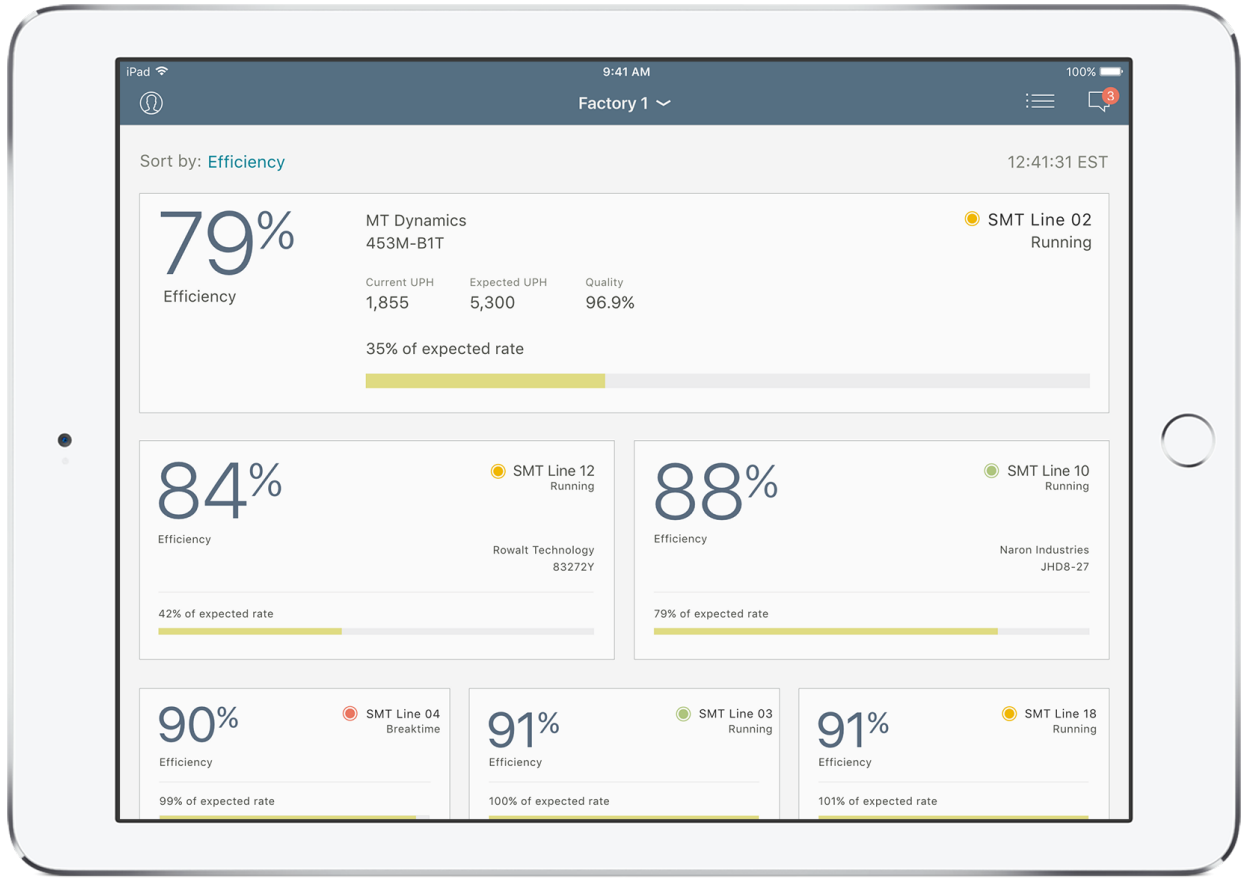
MAINTAINED APP

Expert Factory

Empower production operators in real-time to raise the throughput, equipment efficiency, and quality of a production line in manufacturing plants

This app will empower production engineers to raise the quality, throughput and equipment efficiency of a production line in manufacturing plants. Production Engineers can now respond instantly to incidents, inefficiencies and changes in production demands. The app uses analytics to suggest opportunities to improve efficiency, quality and throughput

- Improves production efficiency
- Reduces time to market
- Increases customer satisfaction



https://www.ibm.com/in-en/marketplace/expert-factory-electronics-ios-app#product-header-top

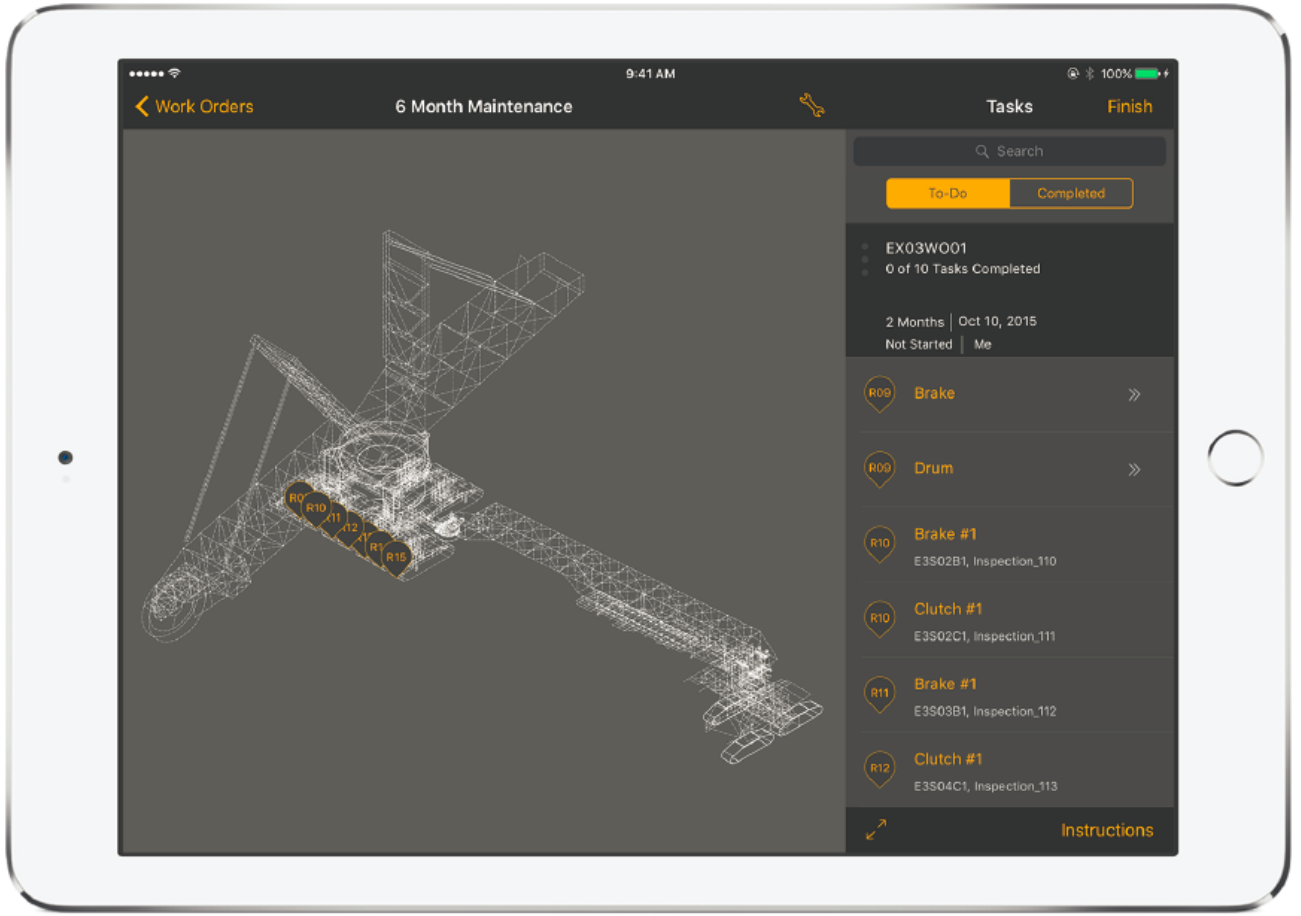
MAINTAINED APP

Asset Care

Asset Care enables preventative maintenance technicians to keep complex equipment in optimal operating condition.

Key Benefits:

- Prioritize tasks based on location, due date and operational state of the equipment
- Replace paper based processes for real time visibility and increased productivity
- Presents work instructions as well as the asset maintenance and repair history
- Generate repair orders at anytime
- Capture rich inspection information including structured measurements and annotated photos
- Full off-line support for areas with limited or no network connectivity



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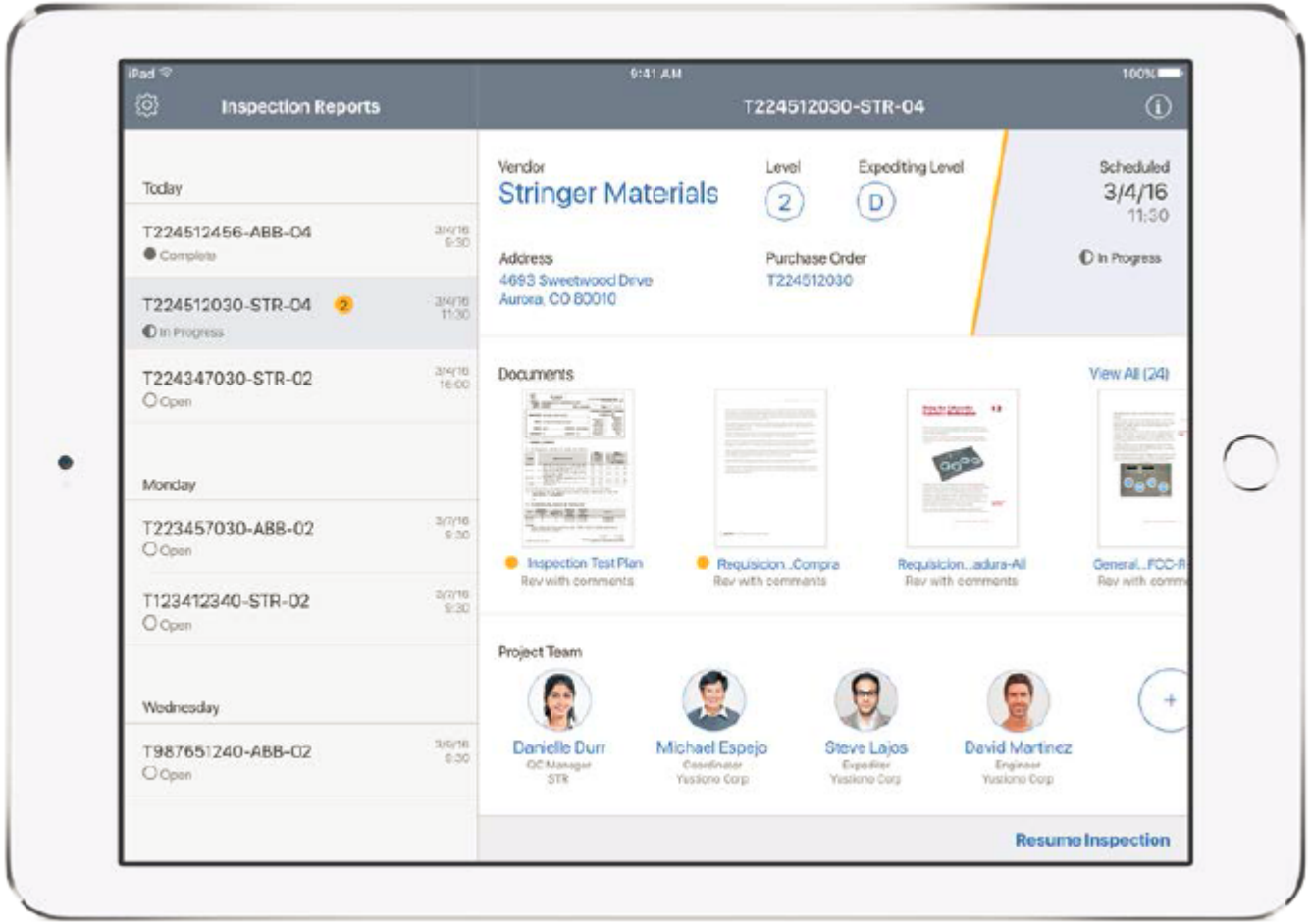
https://www.youtube.com/watch?v=8rn3FLmQjj0&list=PLRrOvPN-xqYONT5wAvQg2V5mfqJ6LHVAl&index=19

MAINTAINED APP

Material Inspect

Material Inspect enables Material Inspectors to prepare and conduct the inspection of materials and suppliers effectively and accurately, and in collaboration with various parties involved.



Key Benefits:

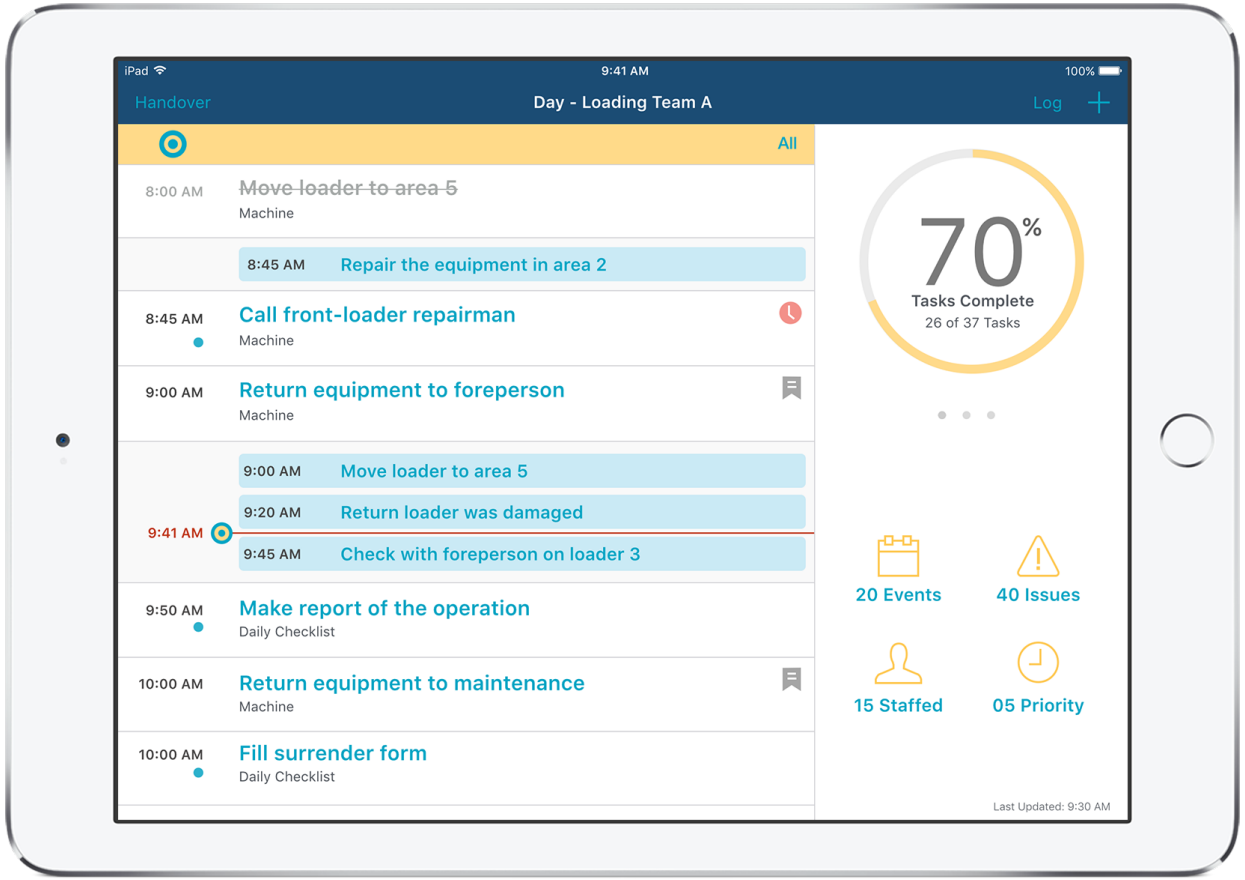
- Productivity enhancement will reduce total inspection time, number of inspectors, average time per reporting, reduced lead time on the overall supply chain
- Better quality of materials employed, reduced safety risks and less errors and low-value administrative time

https://www.ibm.com/in-en/marketplace/material-inspect-industrial-ios-app

DEVELOPED STARTER APP

Rapid Handover

Rapid Handover enables foreman to manage and handover work shift tasks, events, and issues information. Issues recorded (incidents, maintenance, permit information, etc.) are picked up seamlessly by the next shift foreman.



Key Benefits:

- Optimizes the handover process (input & analytics) using the information captures and analytics/KPI provided for decision making
- Increases Productivity & enhances safety of workers with multi-media
- Enables audit & review of previous shifts
- Compliance Adherence (Permits, etc.)

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https://www.youtube.com/watch?v=2MclV94f6V4&list=PLRrOvPN-xqYONT5wAvQg2V5mfqJ6LHVAl&index=54

DEVELOPED STARTER APP

Safe Site

Safe Site enables foreman to report an incident (unsafe condition & near miss) while onsite by immediately reporting the incident quickly and easily, leveraging mobile technology, including GPS and photos.

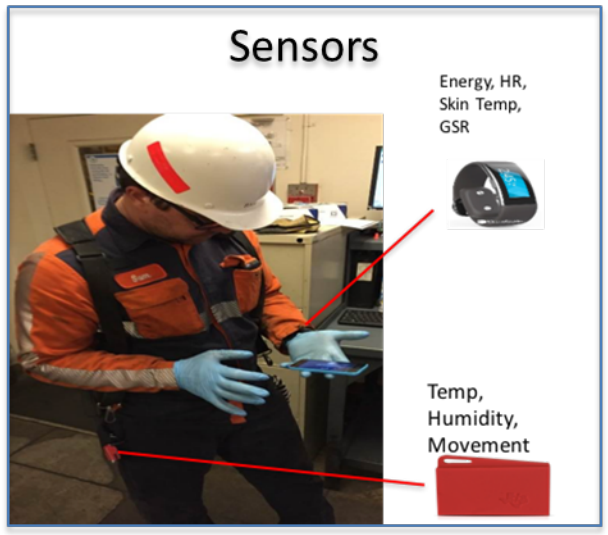
Key Benefits:

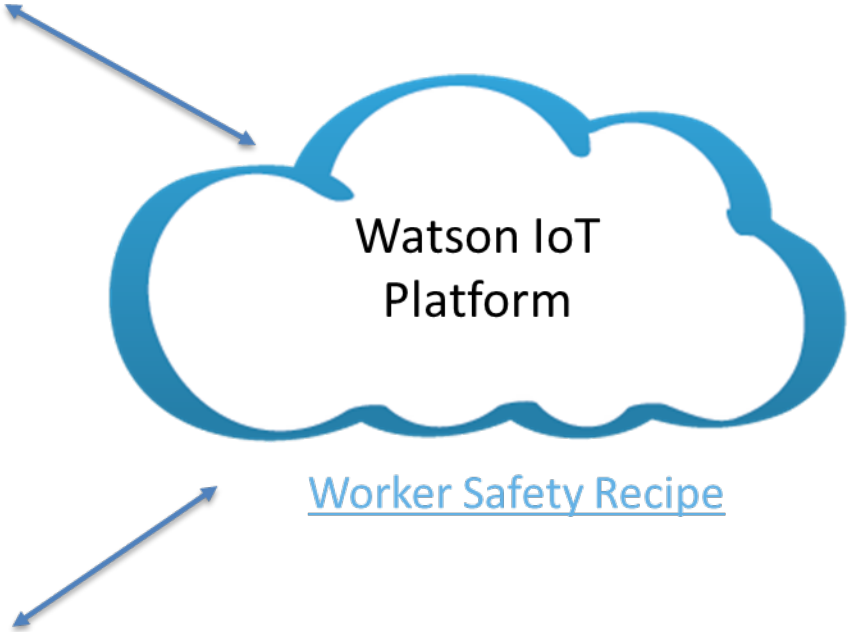
- The field worker can self-report the HSE event
- Take corrective actions as recommended by the app.
- The workers less dependent on supervisor intervention.
- Improved quality of information reported with reduced effort and error.

https://www.youtube.com/watch?v=8ZA6AD3EYN4&list=PLRrOvPN-xqYONT5wAvQg2V5mfqJ6LHVAl&index=20

Worker Safety Solution

Improve worker safety and gain better workforce management





- Continuously monitor the worker's body temperature, heart rate, and level of activity, correlated with external sources of ambient temperature and humidity
- Provide overall risk level during stay in confined space or hazardous area
- Alert worker and supervisor of health risk

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Cognitive Enterprise Approach – Call for Action

Digital Strategy and Roadmap for your factories and business

Connect and Collect – Sensor to Platform integration

Use of Apps in robust tabs

Value Stream Mapping – Quick Digitization areas

Our PoV - Cognitive Enterprise

Decision Support Automation – Cognition

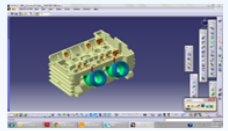
Watson

Analytical Dashboard at Decision Making Level

Focus on KPI driven business excellence….

KPI driven Business Excellence

Managing Product Lifecycle



Change Organization culture to Analytics driven Transformation….

Industry 4.0

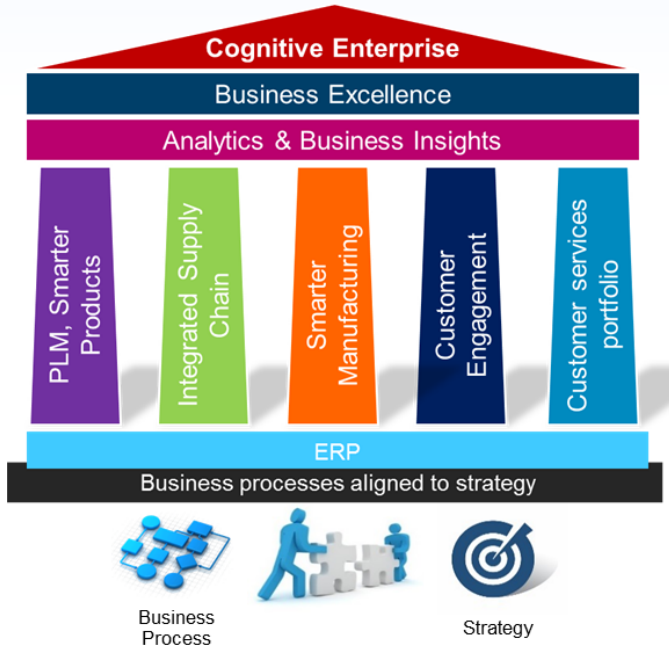
Seamlessly Integrated Mfg Execution System

Bluemix

Integrate Shop-floor Data for Analytics

Collaborative Supply Chain

Drive Collaboration by integrating Systems with Vendors & Customers



Start with Business Processes….

Internet of Things

Employee Engagement for collaborative work environment

Robotics and Automation

Deploy Effective Systems of Engagement ….

Mobile

Social Engagement

Customer Relationship Mgmt

Compliance | Cost Reduction | Revenue Maximization | Competitive Advantage

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Thank You

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