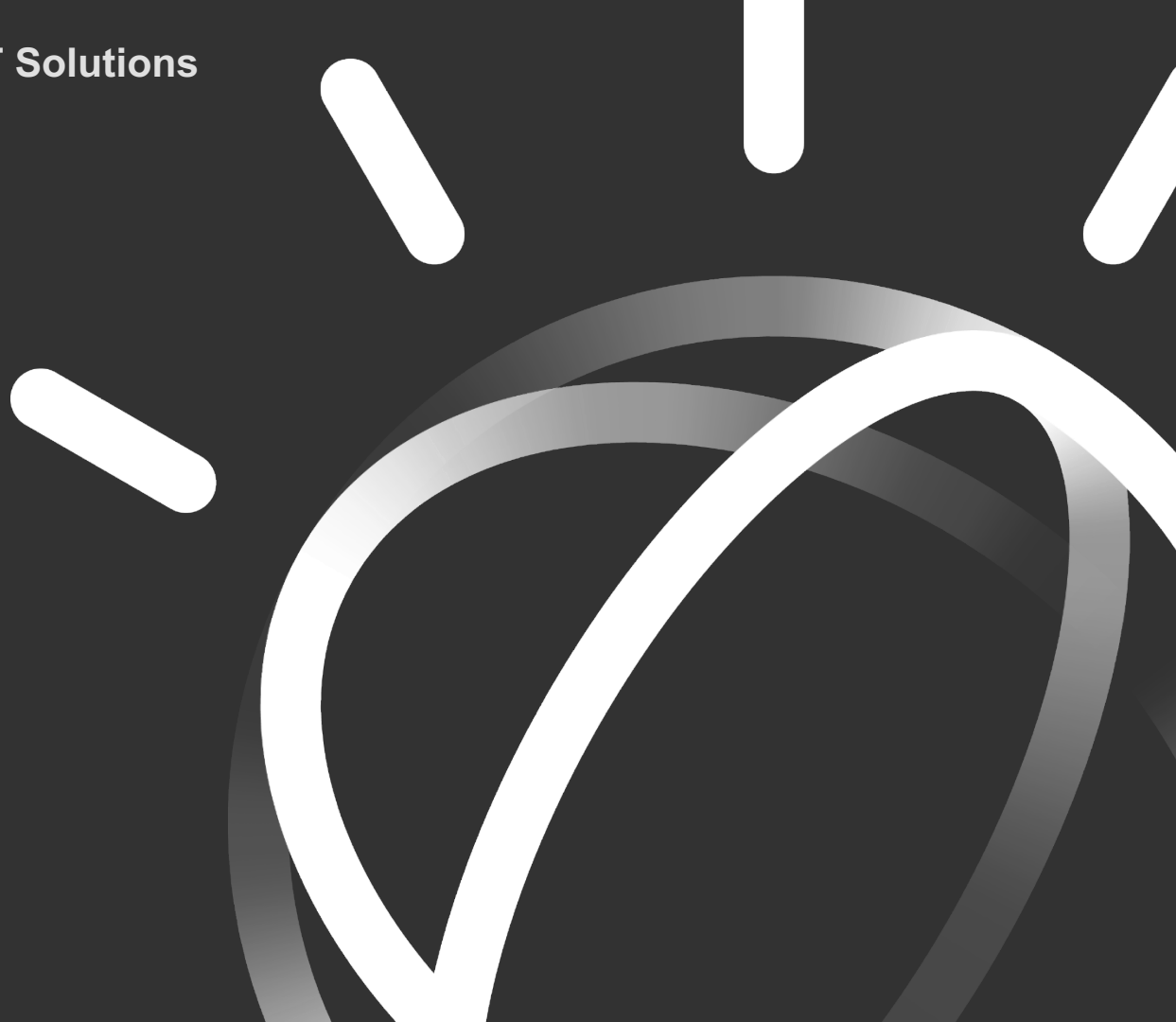
Developing enterprise-level IoT Solutions using Continuous Engineering tools and practice



Watson IoT

Daniel Moul & Fariz Saracevic
Watson IoT CE
Senior Offering Managers
IBM

Session Io04

IBM

IoT opportunities … and challenges

What should we do?

How should we do it?

“We need to be able to …”

Depend on our IoT solution

Innovate faster
than our competitors

Some IoT devices emit data (sensors → telemetry)

Lawsuit claims FitBit devices dangerously underestimate heart rate

Three plaintiffs say FitBits fail during exercise, worthless as heart monitors.
-ARS Technica Jan 6, 2016

TECH MAY 23 2016, 9:42 AM ET

Fitbit Trackers Are 'Highly Inaccurate,' Study Finds

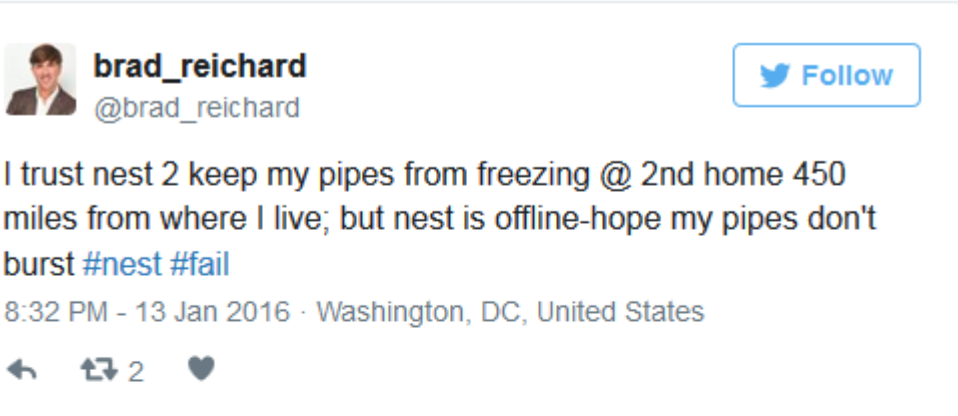
BY KALYEENA MAKORTOFF, CNBC

"… Fitbit devices miscalculated heart rates by up to 20 beats per minute on average during more intensive workouts."

Some IoT devices do something (actuators → behavior)

Nest thermostat bug leaves owners without heating

-The Stack Jan 14, 2016



IoT pet feeder:
What could go wrong?

Dogs and cats left without food for an ENTIRE DAY as remote smart feeder PetNet fails to dispense meals after suffering 'server issues'

- Dogs and cats left hungry for 10 hours after app feeding devices failed
- The PetNet feeder devices, controlled with smartphones, broke down
- It was blamed on a malfunction in the company's computer program
- But customers took to Twitter to express their frustration at the situation

By SAM TONKIN FOR MAILONLINE
PUBLISHED: 03:04 EST, 29 July 2016 | **UPDATED:** 06:32 EST, 29 July 2016

http://www.dailymail.co.uk/news/article-3714186/Dogs-cats-left-without-food-remote-smart-feeder-PetNet-fails-dispense-meals-suffering-server-issues.html

Petnet(io) @Petnetio · Aug 1
An update to our customers regarding the recent server outage: bit.ly/2auzfhe.

1 1

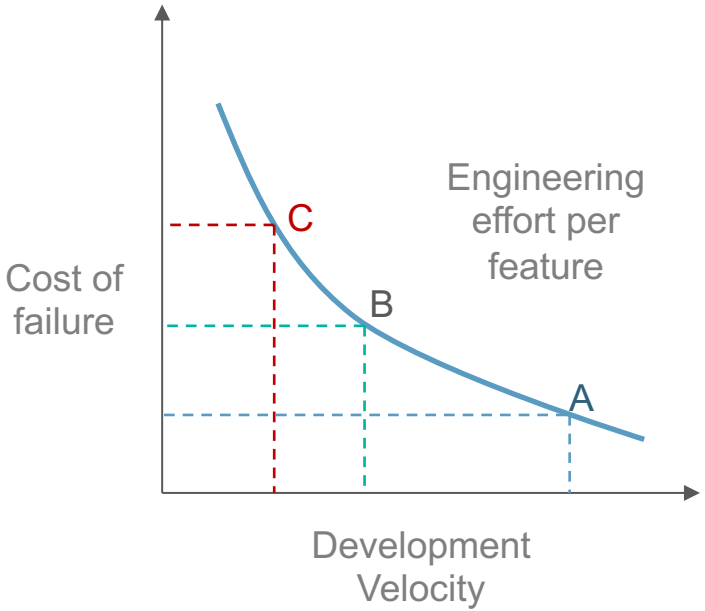
To our loyal Petnet family,

As you may know, our third-party servers suffered an outage late Wednesday evening, which temporarily disabled the ability to remote feed and edit feeding schedules for about 10 percent of our users. We immediately became aware of the issue and were back up and running in about eight hours. We sincerely apologize for any issues this may have caused.

As pet parents ourselves, we recognize that when it comes to our pets, even one hour is too long to wait when it's time for a feeding. That's why we were already working on a solution to prevent this issue from happening. The fix was ready, but still needed to be tested when this outage occurred. Our engineers were prepared to implement the solution and get your SmartFeeders back online as quickly as possible. Now that this update has been made, our platform is stronger and more reliable than ever. We have two fail-safes in place, making it virtually impossible for this to happen again and ensuring your pets will always be fed…

http://bit.ly/2auzfhe

How much dependability do you really need?



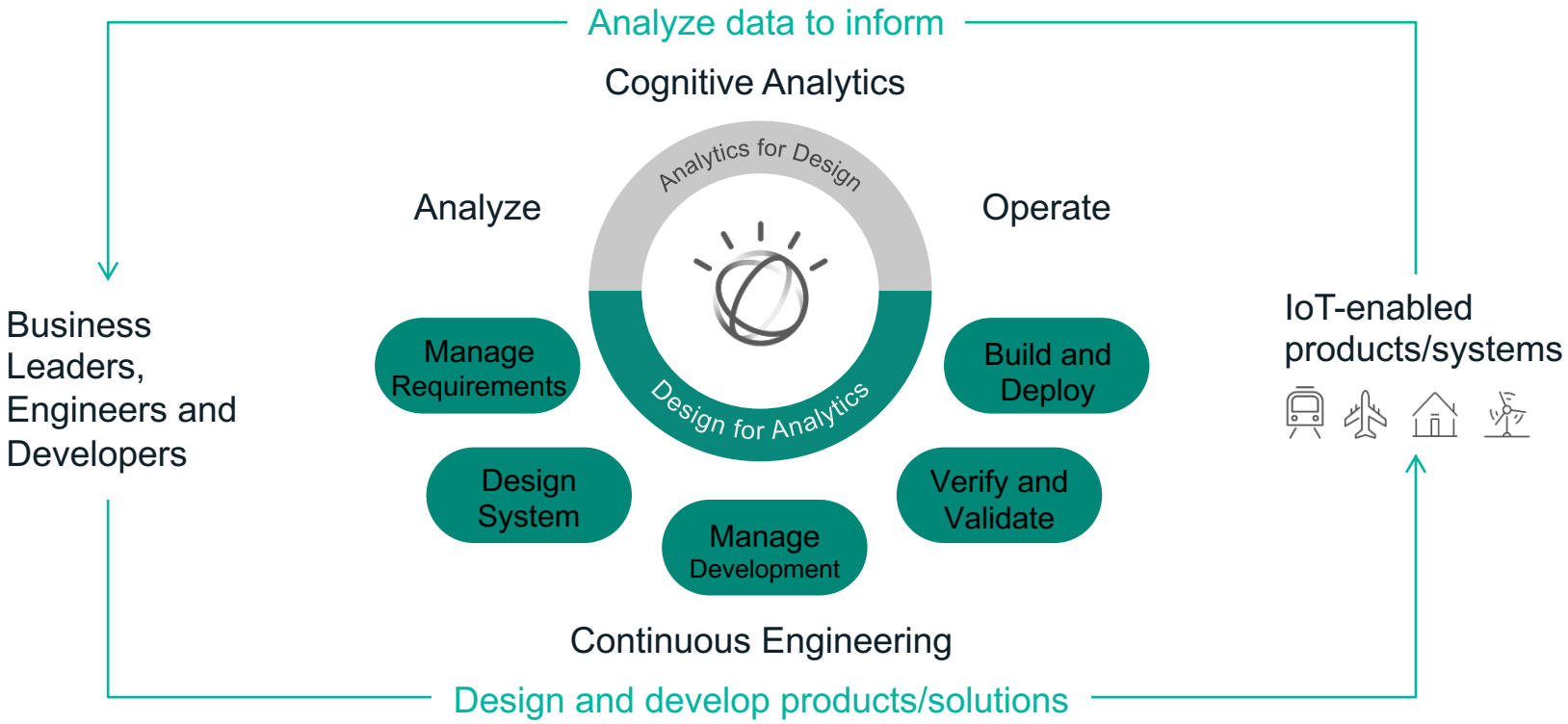
What kinds of dependability do you really need?

- Availability
- Reliability
- Safety
- Security

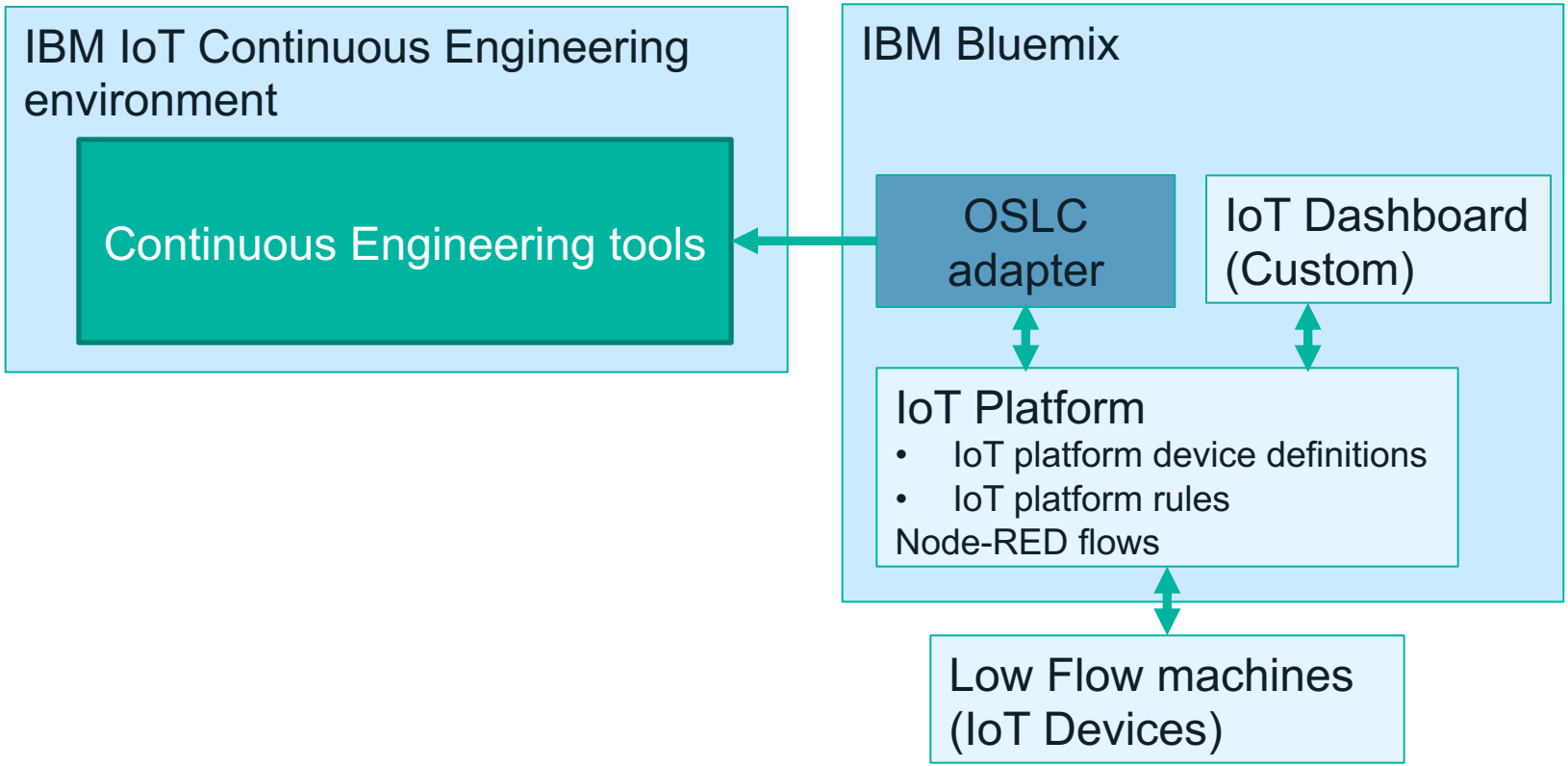
The only way to win is to learn faster than anyone else.

–Eric Ries, *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*

Learn and innovate faster with an IoT feedback loop



Continuous Engineering for IoT Solution Details



Demo

Project Dashboard: Low

https://saaspoc.clm.ibmcloud.com/ccm/web/projects/Low%20Flow%20Washer%20%28Change%20Management%29?oslc_config.context=https%3A%2F%2Fsaaspoc.clm.ibmcloud.com%2Fgc%2Fconfi

Apps | Bookmarks | IBM | RPE | MS_SaaS | IoT | Home | OM | GMA | CALM Home | CH | iRAM ALM | ALM for IT | ALM | FP ALM | Tiny URL | CLM Builds | RTC IT | RTC IoTW | Other bookmarks

Change and Configuration Management (/ccm)

Low Flow Washer (Change Management)

My Stuff | Elizabeth

Project Dashboards | Work Items | Plans | Source Control | Builds | Reports | Search Work Items

All Low Flow Washer (Change Management) Dashboards >

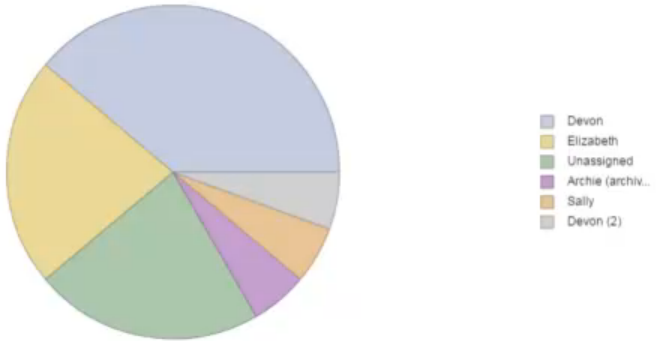
Low Flow Washer (Change Management)

Auto-save | Save

General | Add Widget

All Work Items (18) Priority

All Work Items (18) Owned By



Alerts (3)

- 107: Average Water Usage Target Exceeded
- 106: Excess detergent residue detected
- 105: Check Low Flow Mode Utilization

Bookmarks

IoT Dasbhoard

My Projects (4)

Change and Configuration Management (/ccm) (1) hide
- Low Flow Washer (Change Management)
- All Projects

Design Management (/dm) (1) hide
- Low Flow Washer (Design Management)
- All Projects

Global Configuration Management (/gc) (1) hide
- Low Flow Washer (GCM)
- All Projects

Quality Management (/qm) (1) hide
- Low Flow Washer (Quality Management)
- All Projects

Project Events

Define a new build (90) Yesterday

What we saw

- Engineering team “**designed IoT in**”
  - Designed for operational feedback and analysis

- Engineering team **detected problem** and **responded quickly**
  - Combining engineering and operational information

- Business manager **used IoT data** to confirm that problem was fixed
  - Sentiment analysis and user behavior data

- Team solved problem with a **remote software update**
  - No service visits needed

Not shown: extensions to the scenario that can improve product quality and team productivity

Improve test coverage with automated testing

- Functional testing of solution …
  - Components on-device and in the cloud
  - Scenarios across the solution components
- Simulation of devices and services not yet available
- Performance testing devices and the system

Not shown: extensions to the scenario that can improve product quality and team productivity (2)

Find problems faster with continuous delivery pipeline

- Automated build / deploy / test
- Components and cross-component scenarios

Bonus: makes it easy to create test environments

Not shown: extensions to the scenario that can improve design

Improve testing and design assumptions

- Compare test results in the lab with real-word operational data (including failures)
- Analyze warranty and service call data to improve design

Not shown: extensions to the scenario that can improve design (2)

Model-based engineering (MBE)

- Systems engineering (MBSE) and Model-driven development (MDD)
  - Define complex systems in models using multiple viewpoints (e.g., business, user, functional, implementation)
  - Design device state machines, logic, and system interactions
  - Validate designs in simulated software or virtual HW+SW
  - Models → code

With thanks to Persistent Systems Ltd – IoT Flywheel services

Innovation sandbox

- Reference implementation of IoT Flywheel, for production-grade Watson IoT on Bluemix
  - From data collection to useable applications

2-3 month engagement

- Delivered by IBM and Persistent professional services
  - Agile dev with mutually-agreed upon sprint schedule

Decision support

- Advice on enterprise-wide deployment architecture
  - Proposal for phased development and operations

Used in this demo:
- ✓ IoT Dashboard

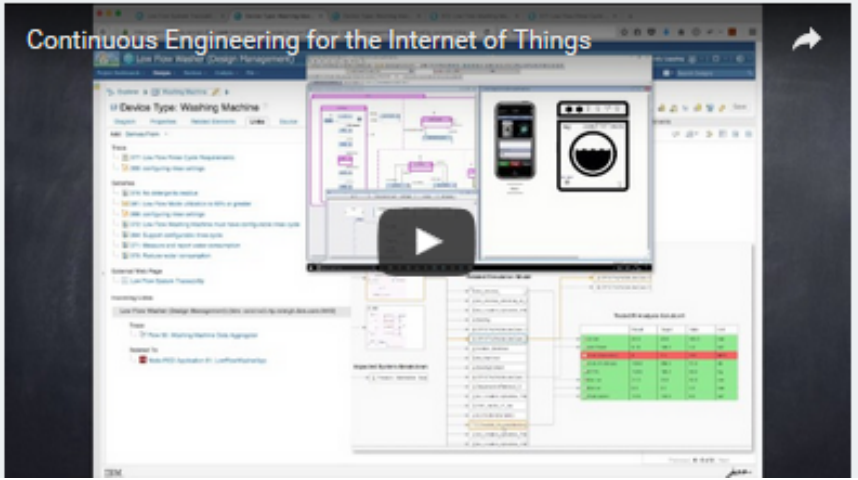
Not shown
- ✓ Work item creator
- ✓ RQM test execution adapter

OSLC Adapter

Internet of Things Adapter

Internet of things (IoT) solutions are systems of systems that include components designed and developed by multiple teams using multiple technologies and deployment platforms -- just the kind of challenge our Jazz initiative was created to address.

- Want to know when our IoT Adapter is available? Sign up now!
- Learn more about the Internet of Things
- Learn more about the IBM Watson IoT Platform
- Learn more about product development for the Internet of Things



https://jazz.net/products/iot-adapter/

Thank You

Bonus charts (Backup)

Scenario overview: Keep a business initiative on track with IoT feedback

Bob
Business Manager

Elizabeth
Engineering Manager

IoT-connected machines are in operation

Engineering team receive system-generated alert when operational performance does not match specification

Engineering team finds likely cause and proposes solution

Business manager reviews and approves

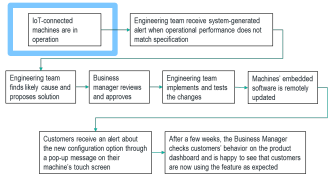
Engineering team implements and tests the changes

Machines' embedded software is remotely updated

Customers receive an alert about the new configuration option through a pop-up message on their machine's touch screen

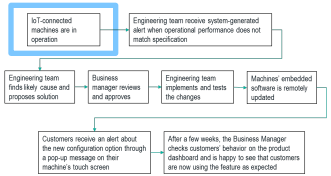
After a few weeks, the Business Manager checks customers' behavior on the product dashboard and is happy to see that customers are now using the feature as expected

JKE Appliances introduced a new Low Flow Washing Machine to increase revenue and market share



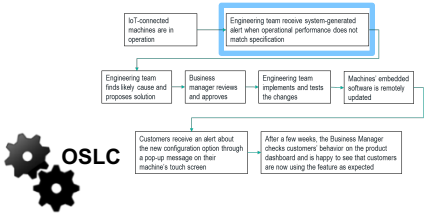
- Wash in half the time with half the energy and water
- Competitive differentiator

JKE Appliances “designed IoT in” so they could take advantage of the IoT feedback loop

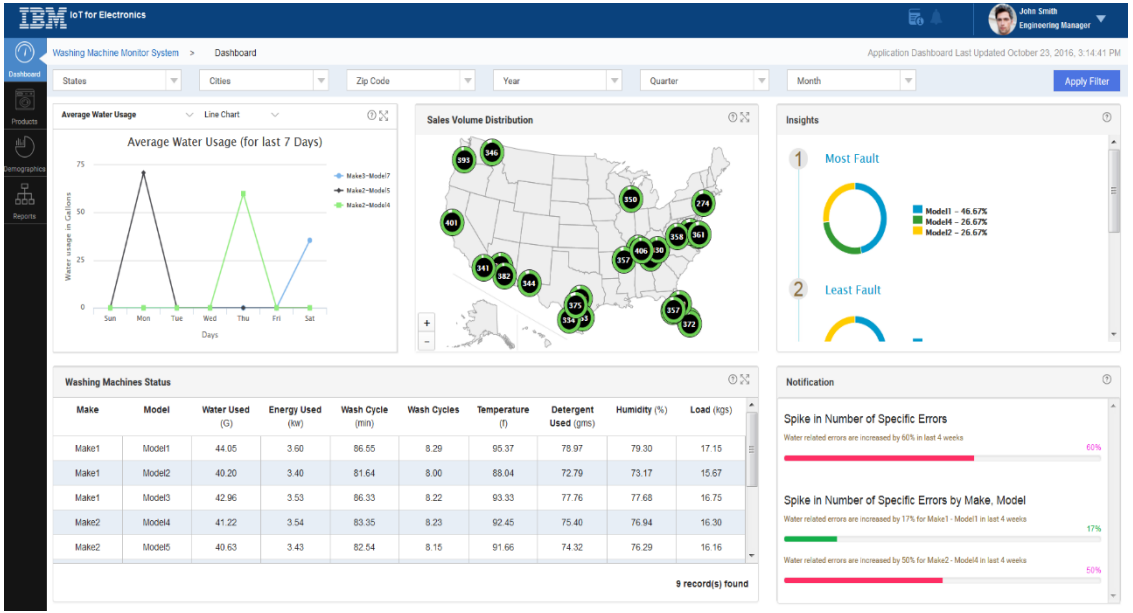


- Designed with Continuous Engineering
- The business team identified KPIs
- The engineering team defined and tested “plant model”
- Sensors in the machines collect the data for both and to adjust system behavior automatically
- Data sent to IBM IoT Platform

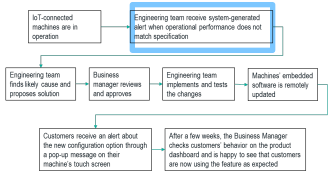
The engineering and business teams use IoT Dashboard to understand machines in operation

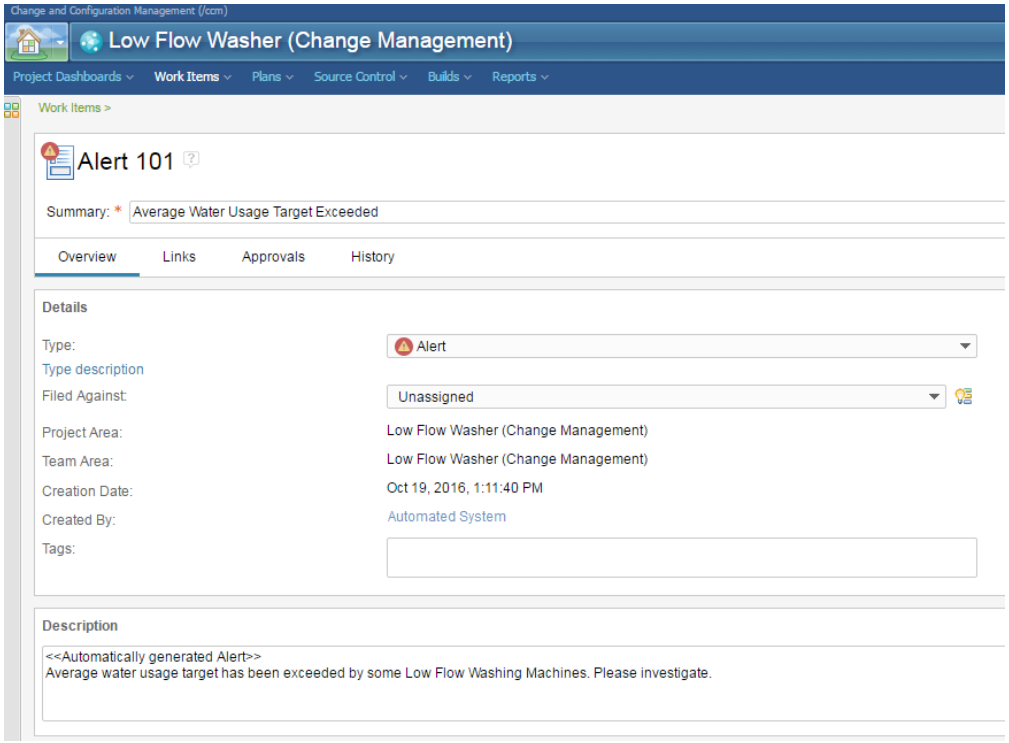


- The IoT Platform collects and analyzes data from the machines and other sources
- Automatic alerts for business and engineering teams, so they can respond quickly
- The IoT Dashboard to explore system operation, utilization and correlations
  - Status
  - Location by region
  - Usage times and modes
  - User sentiment



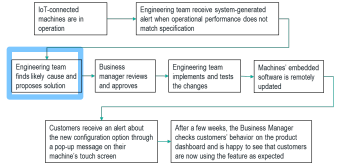
After two months of operation, the engineering team receives an alert indicating average water usage is exceeding its target in some regions





- The IoT Platform raises an alert as the Average Water Usage exceeded 40 liters per load
- An IoT Platform rule automatically creates an engineering work item to notify the team that an operational requirement is not being met

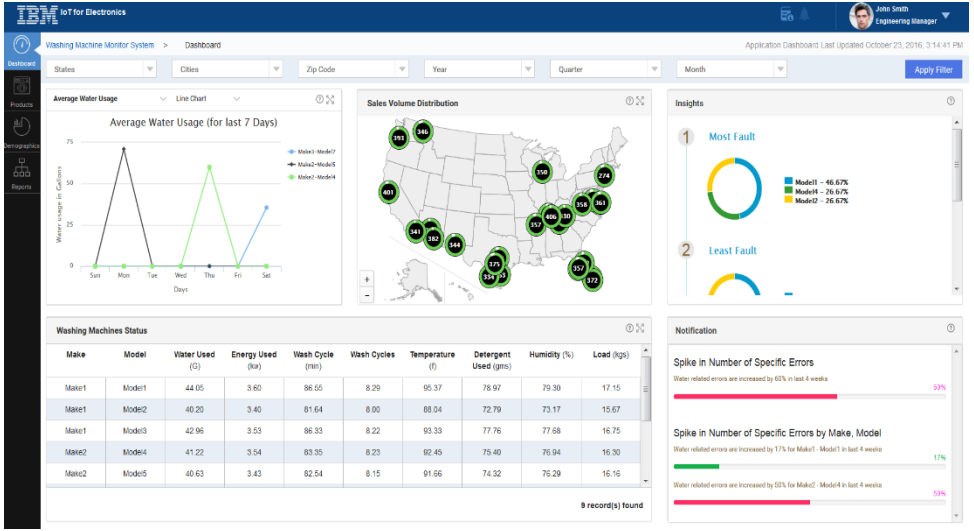
Using the IoT Dashboard, the engineering manager discovered that the issue is occurring in areas with exceptionally cold water



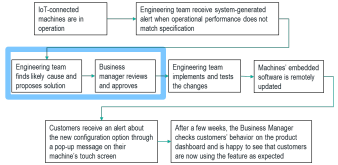
IoT Dashboard shows sensor values:

- Average water usage target

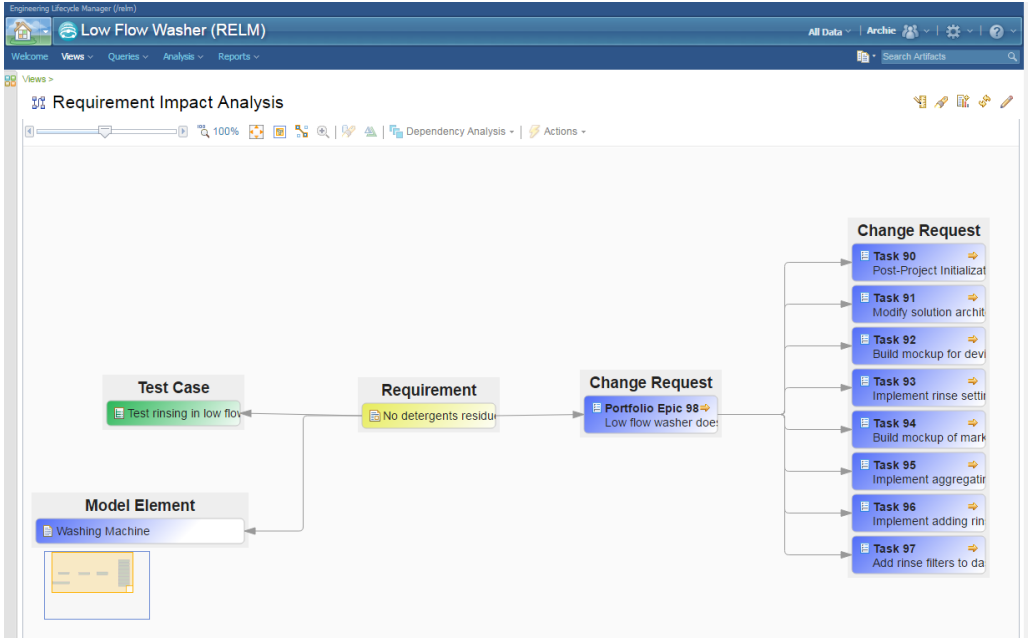
- Cold rinse water temperature is causing excessive detergent residue on clothes
- High average water usage is caused by users manually adding additional full rinse cycles



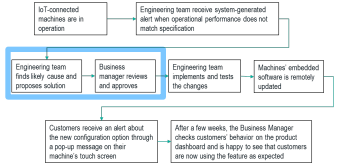
Engineering Manager explores how they missed this during development and QA



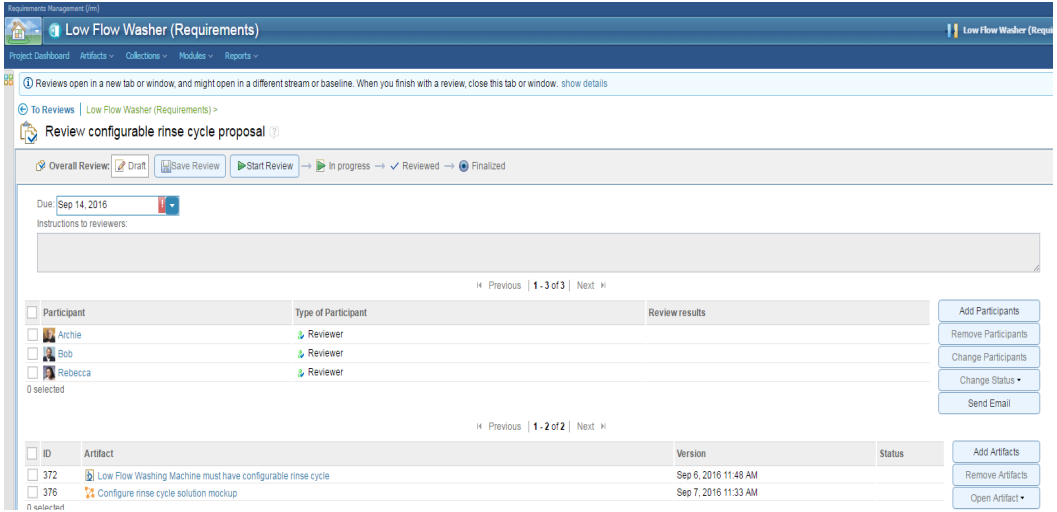
- Traced the requirement to the related test cases and examined results
- Test case did not account for excessive cold water temperature since temperature information was not available during development
- Design for the Low Flow Washer is not sufficient for regions with very cold water

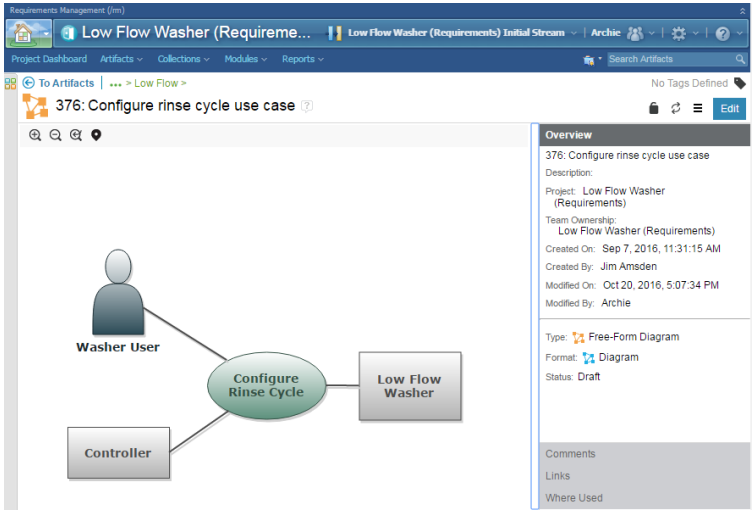


The engineering team reviews the design and proposes a solution which is approved

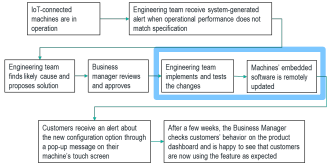


- Proposal to use multiple, shorter rinse cycles in regions with extreme cold water
- Update an existing requirement and related test criteria
- Team reviews updates, and performs on-line review/approval



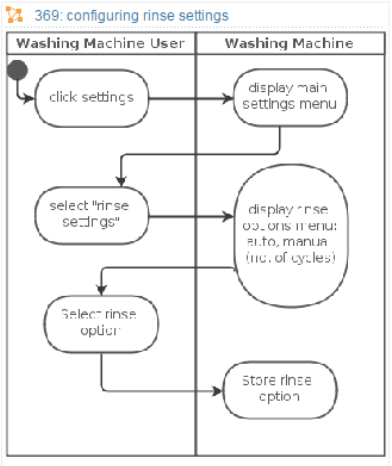


Engineering team does design analysis and elicit additional requirements for impacted solution components

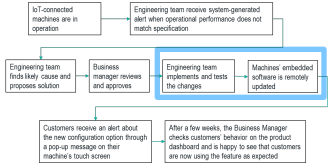


- Design view and its associated rules and application used to determine additional implementation details
- A new washer property needed
- Use suspect links to see impact of adding new property
- They agree: significant potential business impact; must act quickly.

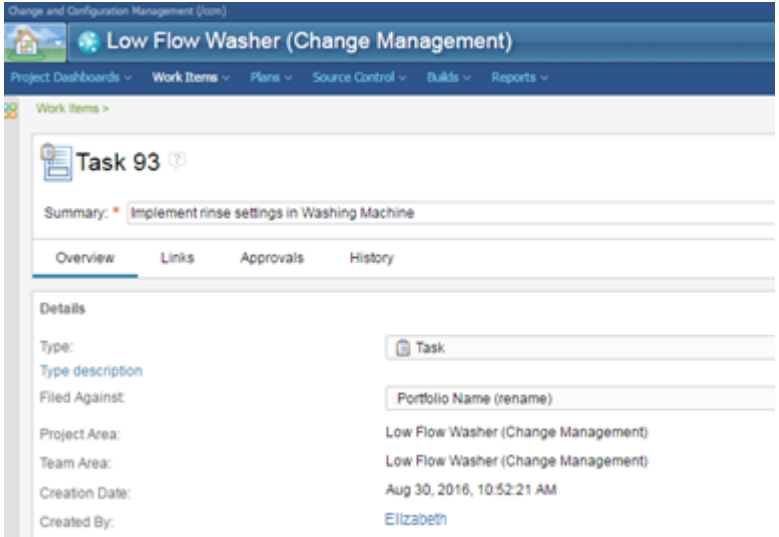
ID	Contents
378	**1 Rinse Cycle Configuration Requirements**
372	The default low flow rinse cycle is not adequately rinsing the clothes resulting in users avoiding the Low Flow mode or manually adding additional rinse cycles. This appears to correlate with regions where there are high TDS, or reasonably hard water. This may be the reason for excessive detergent residue in low flow mode rinse cycles.
364	The user shall be able to configure the number of rinse cycle and their duration (default, by weight, or number of minutes). This will require an additional property in the device, an update to the device controller flow, and an update to the device UI.
	369: configuring rinse settings
365	The washing machine shall send the rinse settings to the cloud data aggregator app.
366	The data aggregator app shall log the rinse settings in the database for further analysis by the cloud analysis app
367	The cloud analysis app shall add the last rinse settings of users who express sentiments

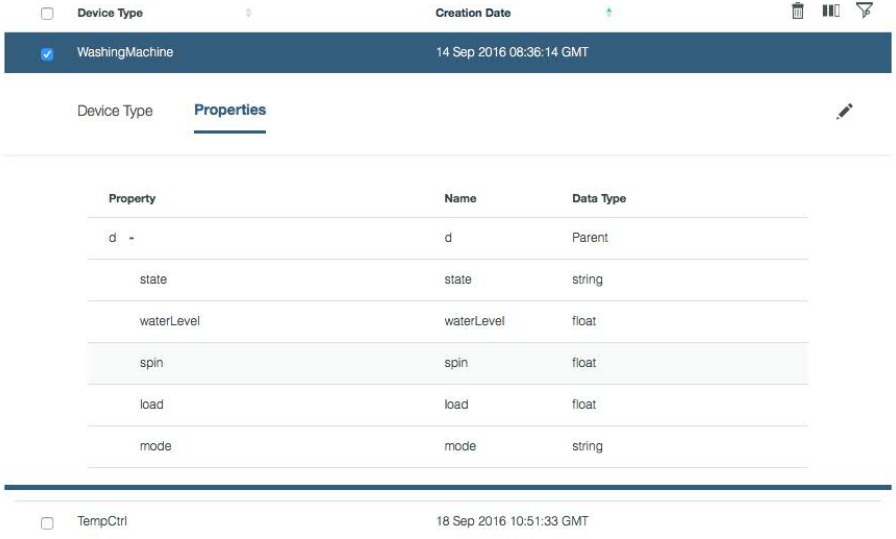


The development team implements changes in the embedded software and the IoT application

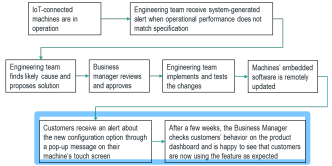


- Embedded systems developer implements the approved changes by adding a new property to the washing machine and other solution components (IoTP, Node-RED flows, etc.); builds new firmware
- Test team verifies the solution
- Firmware ready for delivery to the washing machines





The update was deployed to selected Low Flow machines, and JKE Appliances used IoT data to confirm that the update solved the problem



- The firmware update is made available to machines in affected areas (limited roll-out)
- A pop-up on the touch screen alerts users:
  - “Better rinsing now automatic”
  - “Try it tweet your results with #LowFlowWasher to enter drawing for Amazon gift card”
- After two weeks the business manager checks the IoT Dashboard to confirm problem is fixed

With connected products you can …