

# Condition based monitoring - enabling efficient maintenance

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# Europe's largest producer of renewable energy

OWN CAPACITY

**19 300 MW**

PRODUCTION

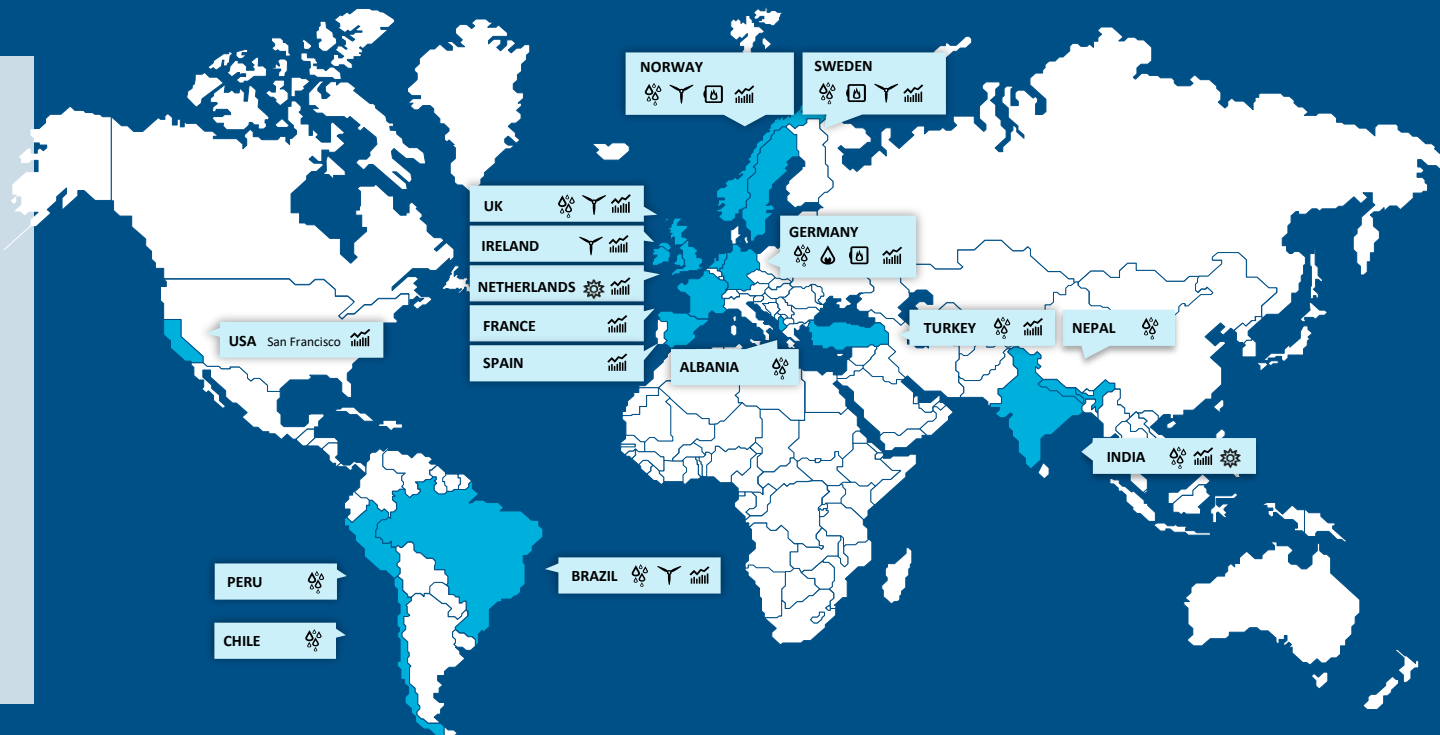
**62 TWh**

EMPLOYEES

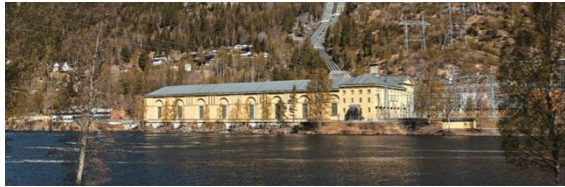
**3 600**

NET PROFIT

**13.4 NOK billion**



# Three main challenges in current operation



**Aging assets**



**1/3 of the work force retires  
within 10 years**



**Challenging market  
conditions**



A long-exposure photograph of a waterfall, creating a smooth, flowing motion blur effect. The water is a deep blue color, and the white foam of the falls is visible on the right side.

2 +

..... BNOK in investments  
and maintenance per  
..... year in Statkraft




The background is a dynamic, abstract composition. It features a deep blue color palette with glowing, ethereal light trails that curve and swirl across the frame. Interspersed within these light patterns are horizontal bands of binary code (0s and 1s) in a lighter blue or white, giving the impression of data flowing through a digital space. The overall effect is one of high-tech energy and digital connectivity.

Computing power

Storage capacity

Bandwidth



Artificial intelligence

Machine learning

Blockchain

Algorithms

Robotics

Big data

Cloud

IoT

...







# Start Simple to Gain Insights

## Maintenance Teams

### “Source of information”

- Dashboards trends
- Traffic light system

- Correlations of interest
- New sensor needs



- Condition monitoring, predictive models
- Virtual sensors replace static traffic lights

## Task Force Advanced analytics

- Discover patterns in data
- Support with predictive models

# Dashboard Solution Hydro

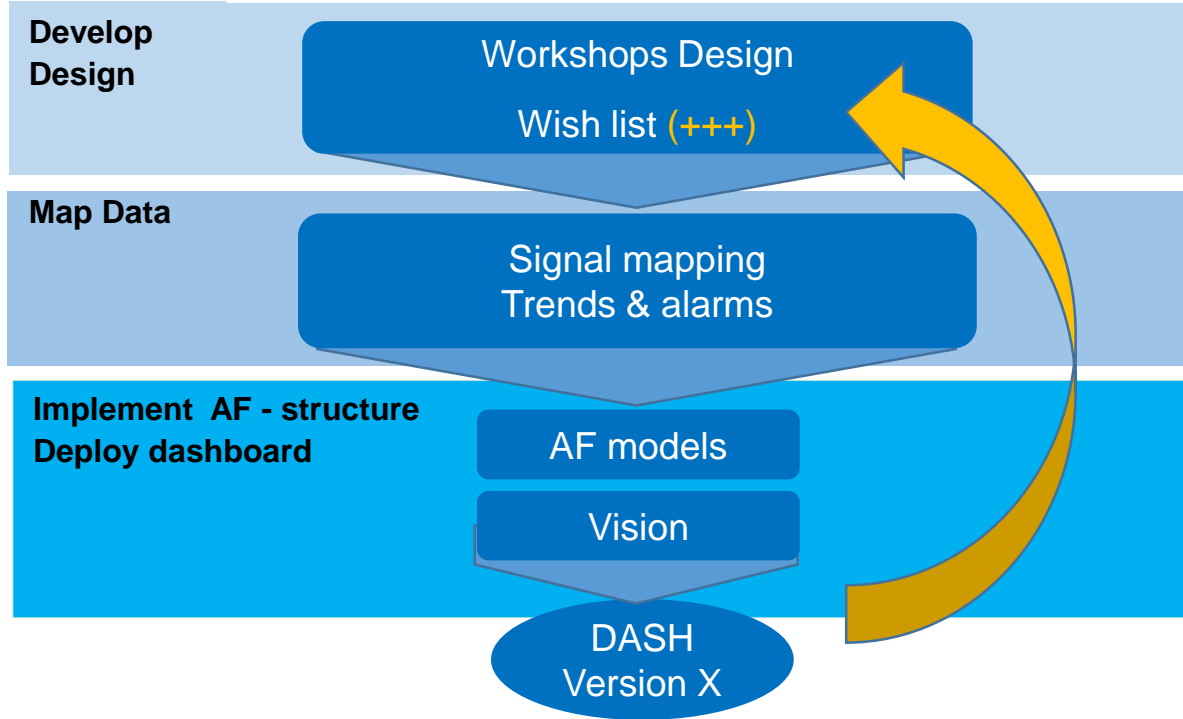
- Objectives

- Try out trend tool PI Vision
- Design and implement dashboard for 2 hydropower plants
  - General overview signal
  - Early detection system
- Create a generic template to ease rollout to new assets

- Strategy

- Sprint development
- Small scope
- Deploy and test
- Change according to feedback and then expand

# Approach



## Basic

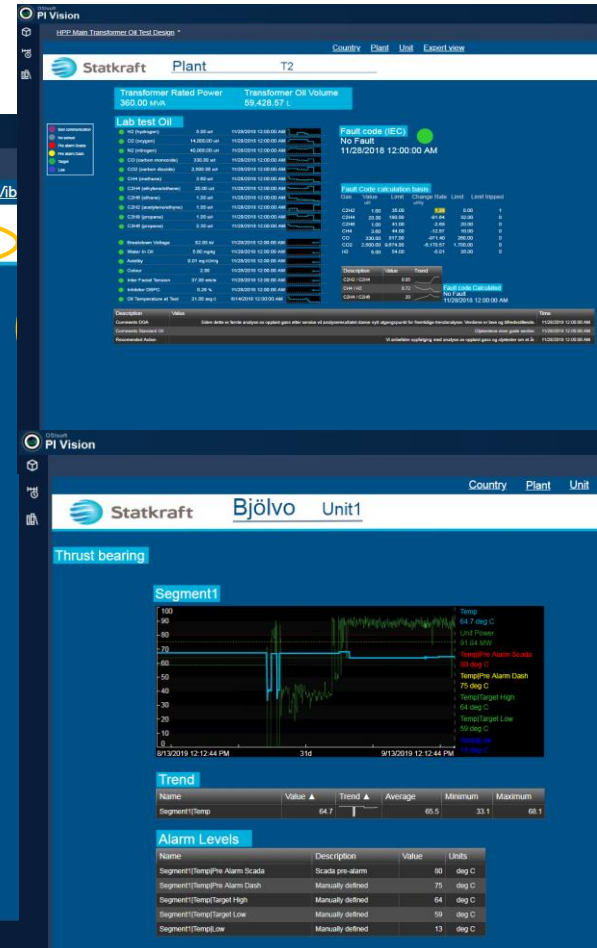
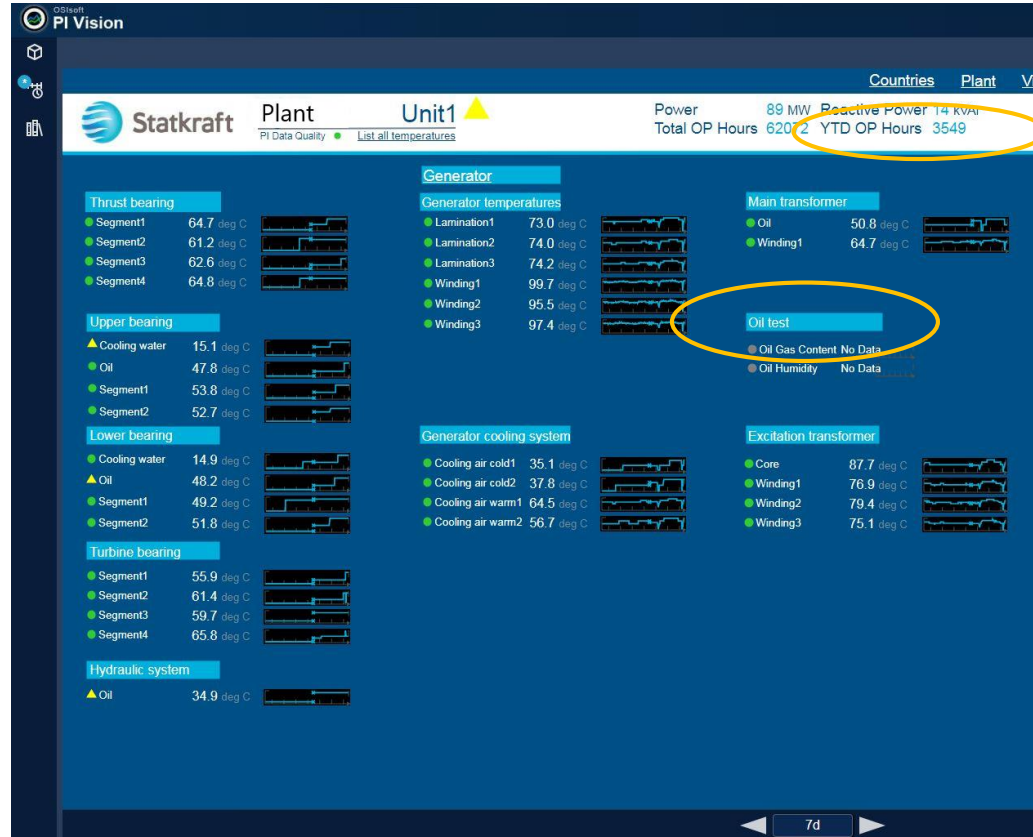
- Overview signals
- Traffic light system

## Testing features

- Notification to SAP PM
- Logical functions
- More advanced calculation (Custom extension)
- Combining of data sources.



## Unit Display



The screenshot displays the PI Vision interface for a plant unit, featuring several monitoring charts and data points.

**Top Bar:** OSsoft PI Vision logo and a "New Display" button.

**Navigation Bar:** Statkraft logo, "Plant Unit1", and a "New Display" button.

**Main Content Area:**

- Cooler 4:** A vertical bar chart showing "Warm Air 47.9 deg C" and "Cold Air 25.2 deg C". Below it, a "List all Cooler temps" link is visible.
- Corejoint 1:** A large oval-shaped chart area. It contains several data points:
  - Slot 33: 80.106 deg C
  - Slot 37: 68.4 deg C
  - Slot 39: 109.3 deg C
  - Slot 41: 80.106 deg C
  - Slot 111: 88.773 deg C
  - Slot 109: 66 deg C
  - Slot 111: 105.31 deg C
- Corejoint 2:** A large oval-shaped chart area. It contains several data points:
  - Slot 111: 88.773 deg C
  - Slot 109: 66 deg C
  - Slot 111: 105.31 deg C
- Cooler 1:** A vertical bar chart showing "Warm Air 49.5 deg C" and "Cold Air 25.5 deg C". Below it, a "List all Cooler temps" link is visible.
- Raw water:** A vertical bar chart showing "Warm Air 49.5 deg C" and "Cold Air 25.5 deg C". Below it, a "List all Cooler temps" link is visible.
- Virtual sensors:** A section on the left side of the main content area, listing four sensors:
  - Condition Cooling
  - Condition Heat Stator
  - Condition Vibrations
  - Condition Corejoint
- Charts:** Multiple line charts are displayed, showing "Vibrations RAD, TAN" and "Unit 1 Current". These charts include data for "Slot 33", "Slot 37", "Slot 39", "Slot 41", "Slot 111", and "Slot 109".

# Conclusions and Going Forward

## Tool

- PI Vision has proven to be stable, fast and flexible
- But not a plug and play tool
- Develop features to include

## Business Value

- Prove Business Value through Evaluation
- Expand scope – new customers
  - Discipline experts; dams, turbine, generator, transformer..
- When each sprint is successful roll out across fleet



# Digitalisation will have a positive impact on our KPI's



**HSSE**



**CAPEX**



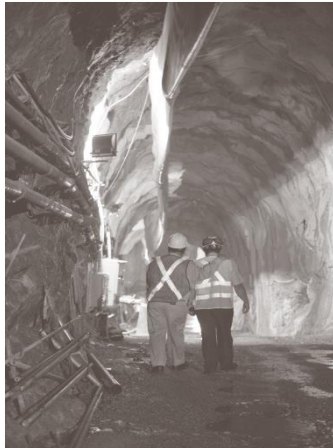
**OPEX**



**MARKET  
ADJUSTED  
AVAILABILITY**

What if this picture is relevant across the portfolio?

## Faulty Stator: costs and risks



**HSSE**

Generator  
investment 35  
years earlier than  
planned

30 units (same  
generation and  
supplier) at risk

**CAPEX**

Minor fault:  
Unforeseen  
corrective

Risk mitigation  
action: Planned  
maintenance:

**OPEX**

Operational  
restrictions

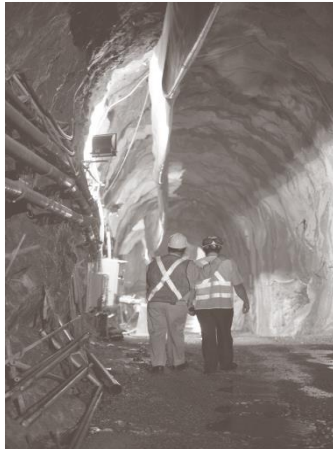
Forced outage

Planned outage

**MARKET  
ADJUSTED  
AVAILABILITY**

What if this picture is relevant across the portfolio?

## Plant: Operational hours runner – calculated



**HSSE**

End of lifetime estimate based on operational hours according to load and no of start and stops (sensitive to fatigue)

**CAPEX**

Overview «true» hours until inspection.

Guarantee inspections after refurbishment and yearly controls

**OPEX**

Adjusted planned outage

**MARKET  
ADJUSTED  
AVAILABILITY**



## CHALLENGES

- Low accessibility data
- Multiple data sources
- No early detection system for maintenance

## SOLUTION

- PI System
- Dashboards maintenance teams
- Task Force advanced analytics

## BENEFITS

### Qualitative

- Changing ways of working «5S for data»

### Quantitative - 6 months testing in 2 maintenance teams

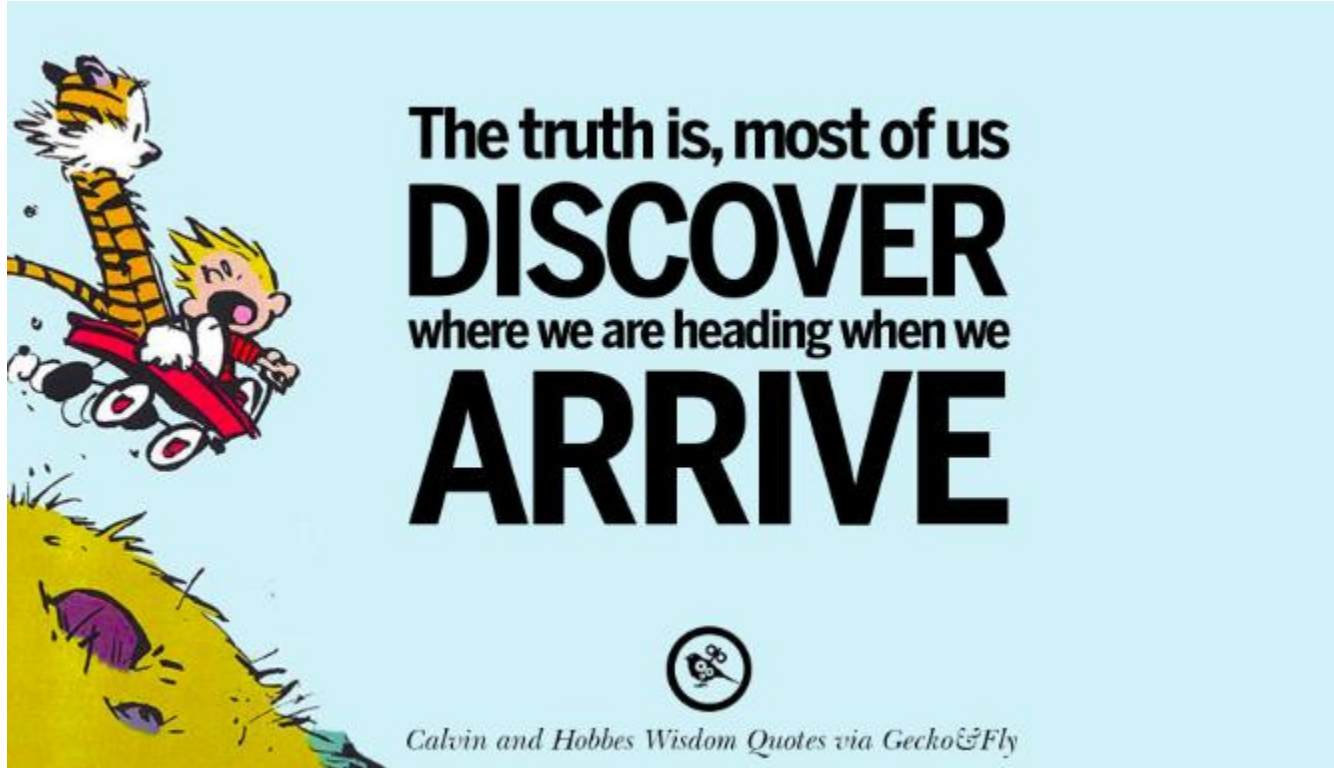
- 14 minor improvements
- 1 failure development to monitor
- ++ new inquiries

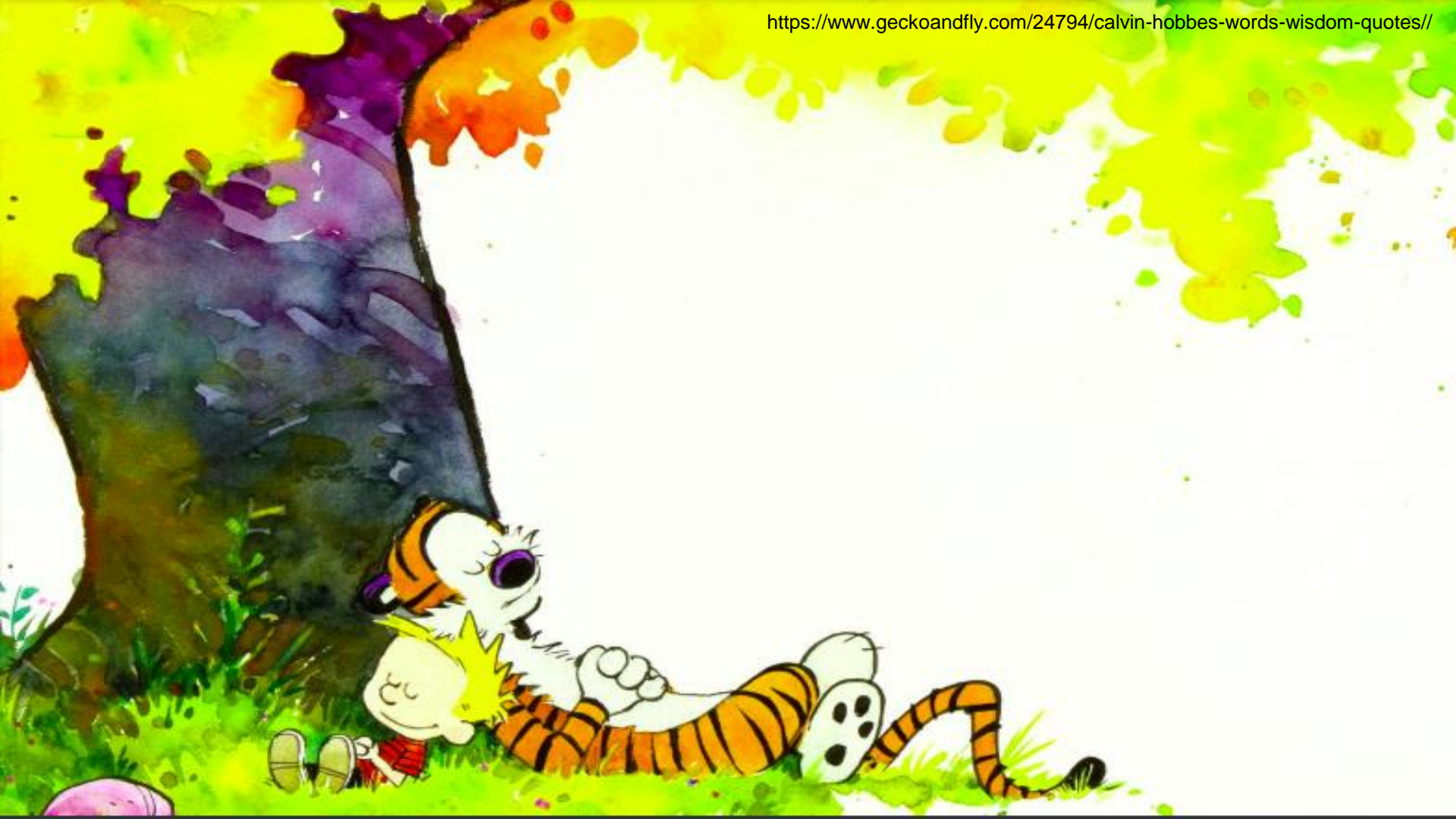


We have seen the engagement rise with the maintenance teams when we supply them with the information and tool the need in order to have the component condition inight they wish. Sometimes hard to quantify the value across fleet, but we believe the potential to be substantial when we use data in a structured way



# Artificial intelligence, Machine learning, Blockchain, Algorithms, Robotics, Big data...





# Thank You



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# Questions?

Please wait for  
the **microphone**

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**name & company**



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mobile agenda for survey

