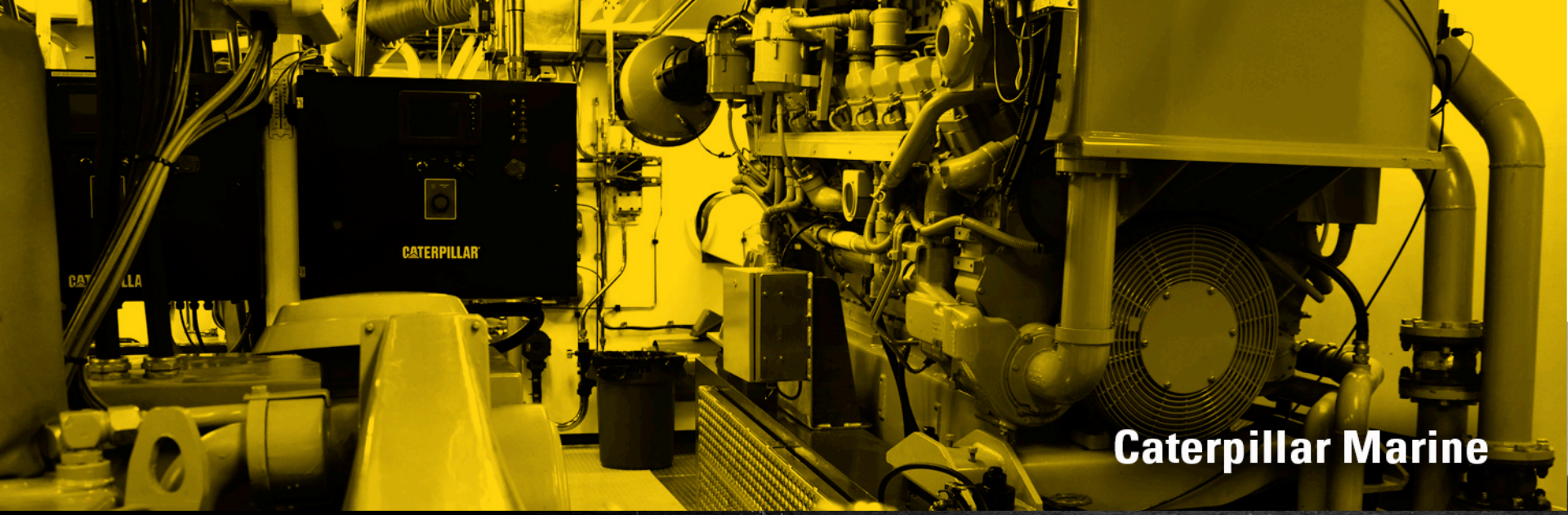


WODCON 2016

Using Big Data & Analytics to drive maintenance & operations improvement

Sam Santelises
Americas Sales and Business Development Manager
Caterpillar Marine Asset Intelligence

CATERPILLAR®

The global market is changing…

World's largest taxi company

UBER

…owns no taxis

Huge accommodation provider

Airbnb

…owns no real state

Retailer more valuable than Walmart

Alibaba

…has no inventory

Skype, WeChat & Whatsapp

Mega communication companies

…own no telecom infrastructure

World's largest movie house

NETFLIX

…owns no cinemas

LendingClub & SocietyOne

Fastest growing lenders

…have no actual money

…are you ready?

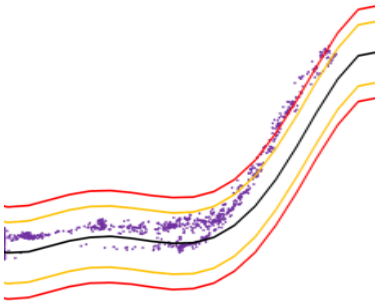
What I am going to talk about today…

1. Overview of Caterpillar Marine, Cat Connect & Asset Intelligence

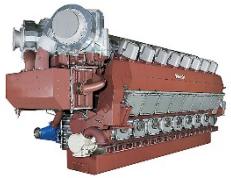
Cat® Asset Intelligence

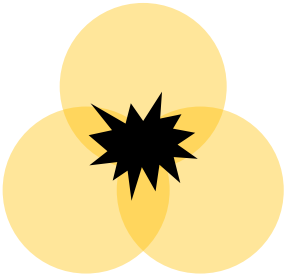
2. What is the Internet of Things or Industrial Internet of Things?

3. What is the difference between Remote Monitoring & Analytics?



4. What does this mean for the Dredge industry and my company?





5. Conclusions & Questions

Graphic source: www.KPCB.com

Introduction to Caterpillar Marine

PRODUCTIVITY EQUIPMENT MANAGEMENT SUSTAINABILITY SAFETY

How you might traditionally think of Caterpillar…

…where we are today and moving in the future

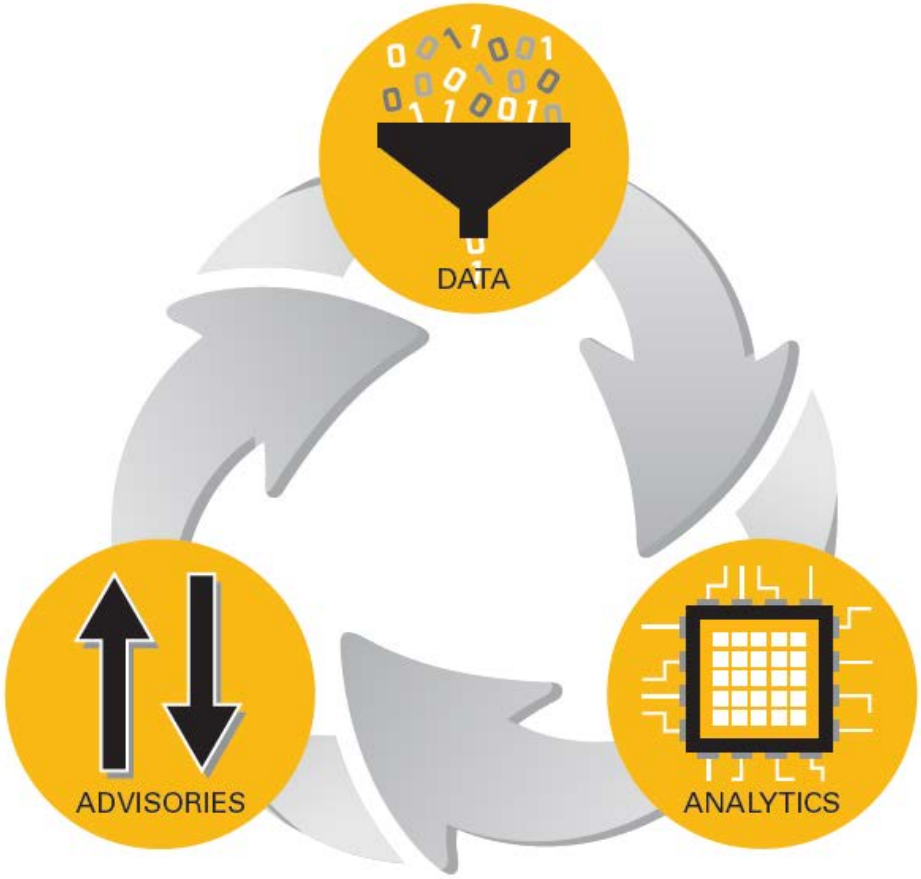
CAT® CONNECT

EQUIPMENT MANAGEMENT PRODUCTIVITY SAFETY SUSTAINABILITY

Uptime **Total Operating Cost**

What is the Industrial Internet of Things (IIoT)? What does it mean for me?

Machines & Sensors



Potential value in Workboat Industry

EQUIPMENT MANAGEMENT

- Avoid failures
- Reduce cost of maintenance

PRODUCTIVITY

- Reduce downtime
- Increase productivity
- Increase fuel efficiency

SAFETY

- Reduce unsafe operations & conditions

SUSTAINABILITY

- Ensure environ-mental compliance

Expert Advisors

Intelligent analytics

What is Big Data?
Data generated every second…

LinkedIn:
182
User searches

YouTube:
2 video hrs. uploaded

In the first second we spent on this slide… approximately 22,574 GB of data was transferred over the Internet.

Twitter:
11 Accounts created,
5,700 tweets

Facebook:
52,196 likes
2,314 video hrs. watched
54,976 posts
6 GB of data

Pinterest:
238 pins

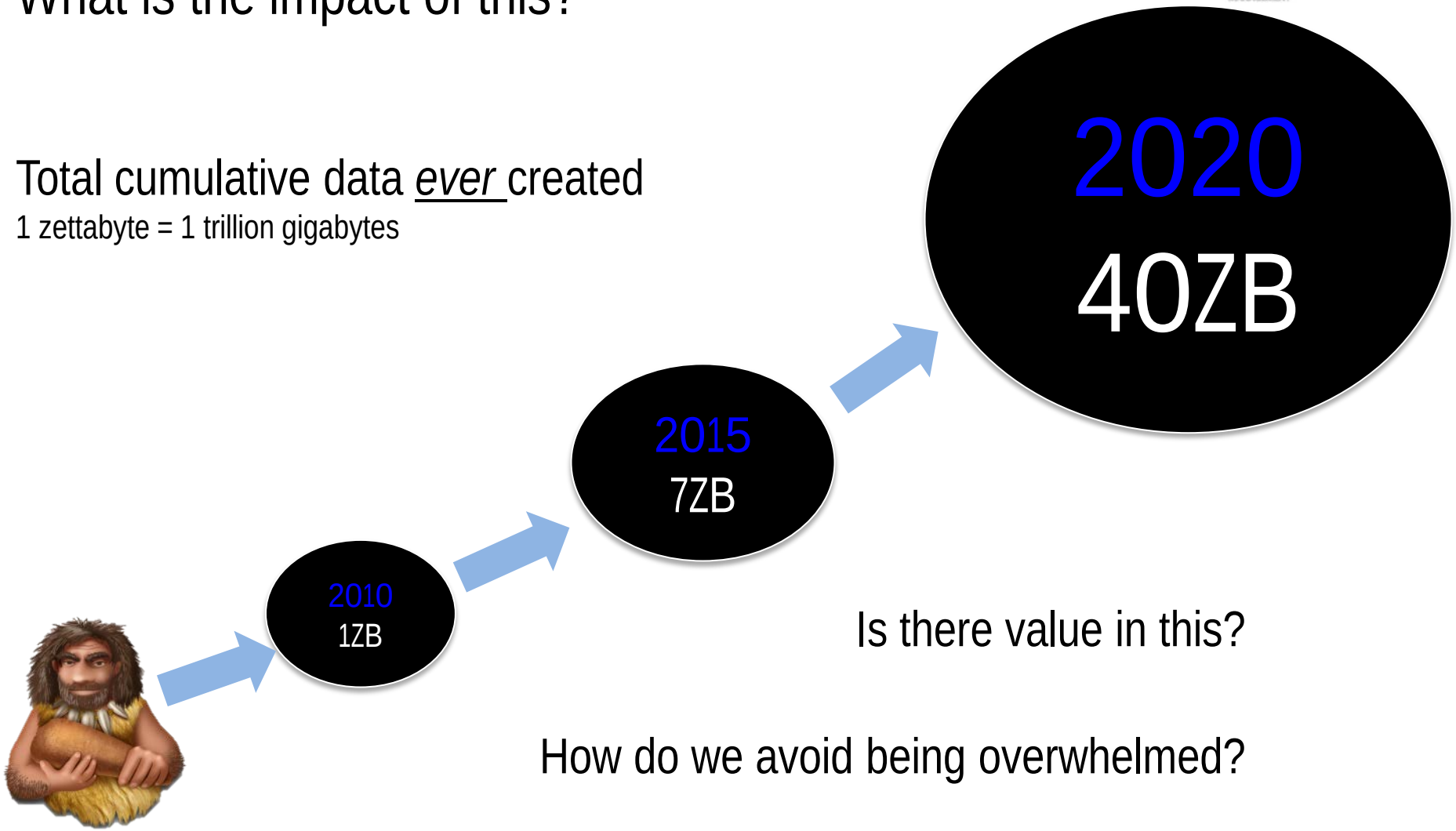
This is not just ‘social media’
1.7B pieces of industrial equipment expected to be ‘connected’ by 2020
23.6B sensors were shipped in 2014 (up from 4.2B in 2012)

Source: Peter Fisk, Genius Works, Gartner, World Economic Forum

What is the impact of this?

Total cumulative data *ever* created

1 zettabyte = 1 trillion gigabytes



Is there value in this?

How do we avoid being overwhelmed?

What does this mean for the Workboat Industry?

Source: Peter Fisk, Genius Works

Innovation is also accelerating!

Capitalizing on the age of IIoT

Focus on using technology to create value from growing data…

Organizational changes

- New departments with senior leaders
- Goal of building an ecosystem of internal and external technology solutions

Acquisitions / Investments

Traditional marine companies expanding through tech acquisition; examples include:

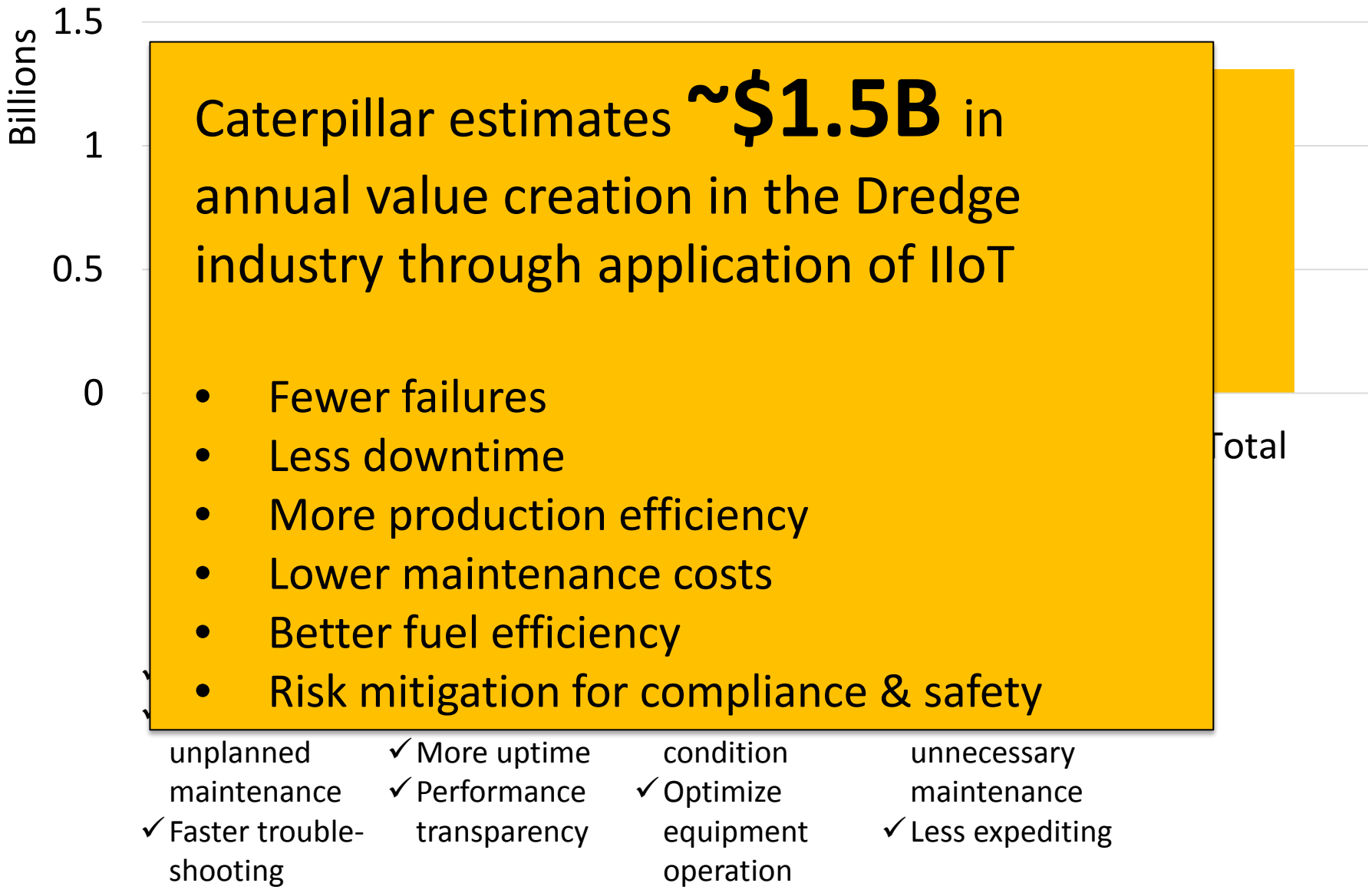
- Caterpillar acquisition of ESRG to form MAI, PEPR in Oil & Gas
- Wartsila acquisition of L3-Marine/SAM
- ClassNK acquisition of NAPA and Helm
- Many making investments in telematics, analytics, applications

Partnerships

Automation, equipment OEMs, class, shipyards, universities, software companies working together, examples include:

- Caterpillar partnerships with University of Illinois, GTUIT, Modustri
- Hyundai Heavy Shipbuilding partnership with Accenture
- Lloyd's Register partnership with University of Southampton

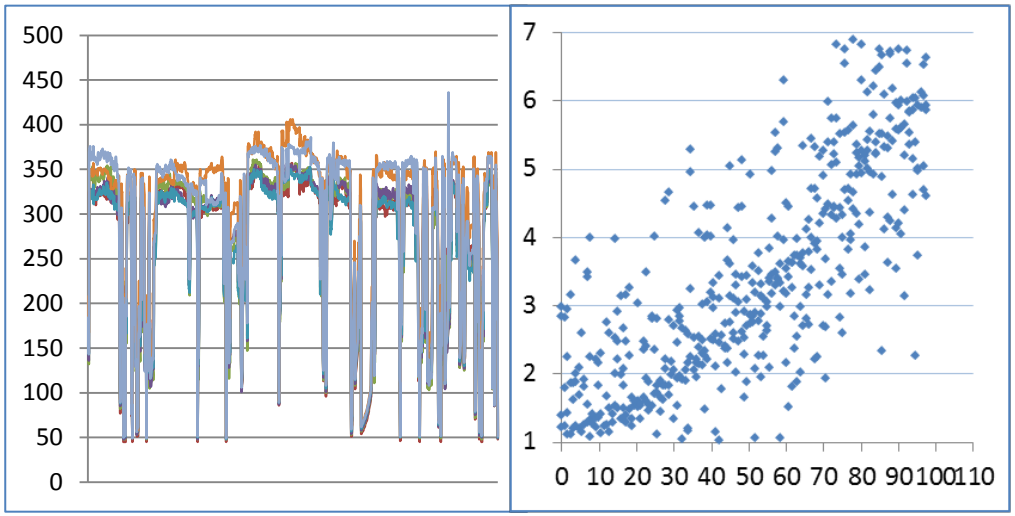
What value can all this bring to the Dredge industry?



What is analytics? Is it different from remote monitoring?

PRODUCTIVITY EQUIPMENT MANAGEMENT SUSTAINABILITY SAFETY

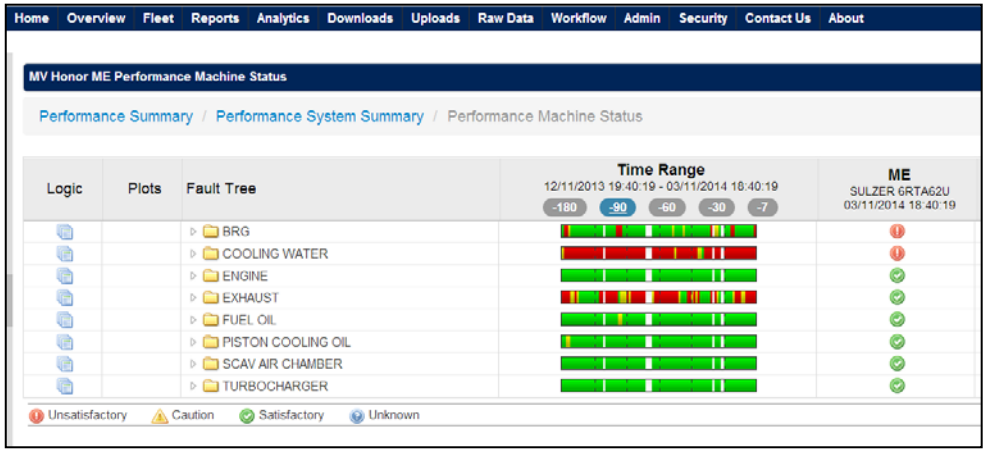
Raw data (including Transient, noise, etc)



Automated analytics transform raw data into actionable information

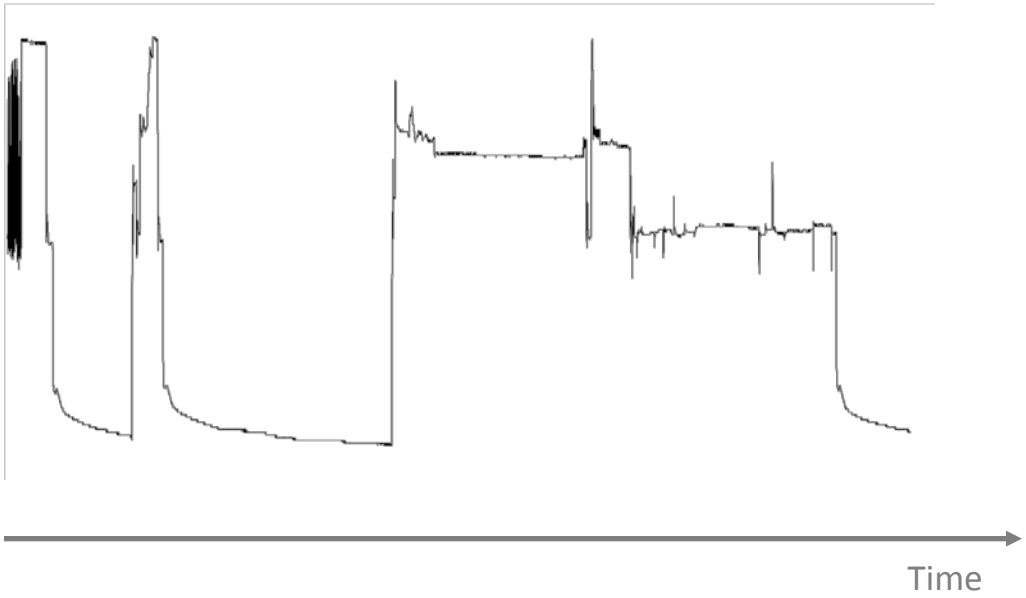
- **Data qualification**
- **Automated algorithms**

Analytical Output



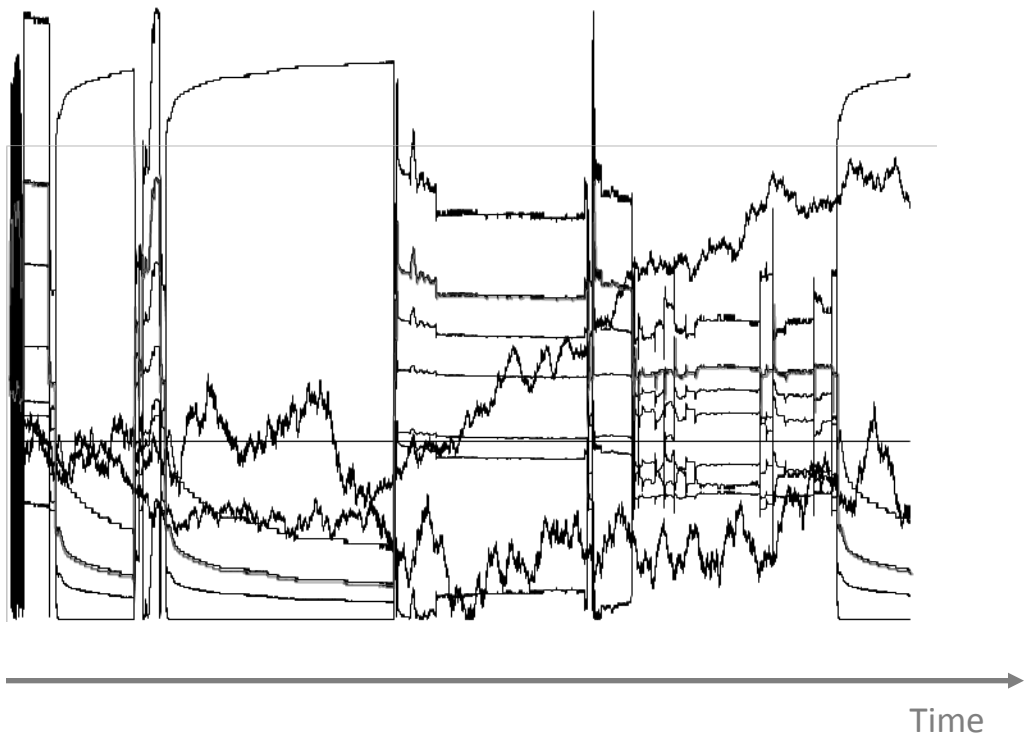
Diagnostics, Predictive Analytics, & Prognostics
Efficiency analytics, reports & dashboards

Analytics walk-through



24 hours
86,400 data points

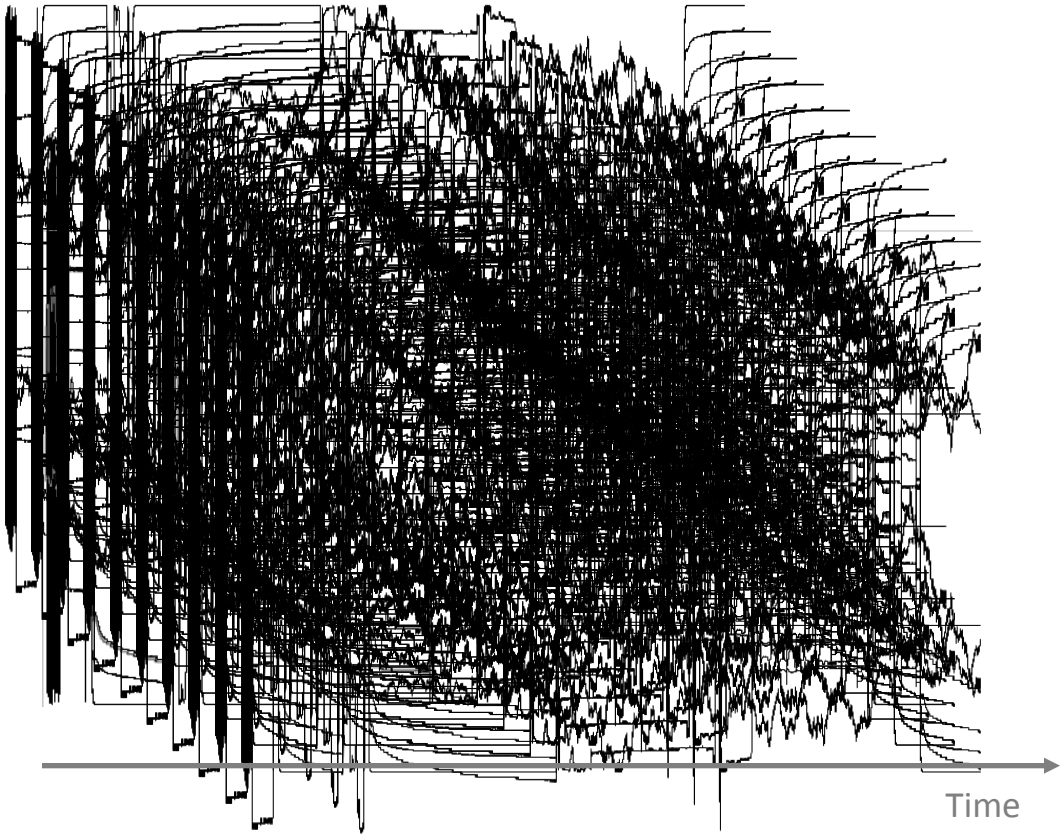
Analytics walk-through



24 hours
86,400 data points

x10 sensors
860,400 data points

Analytics walk-through

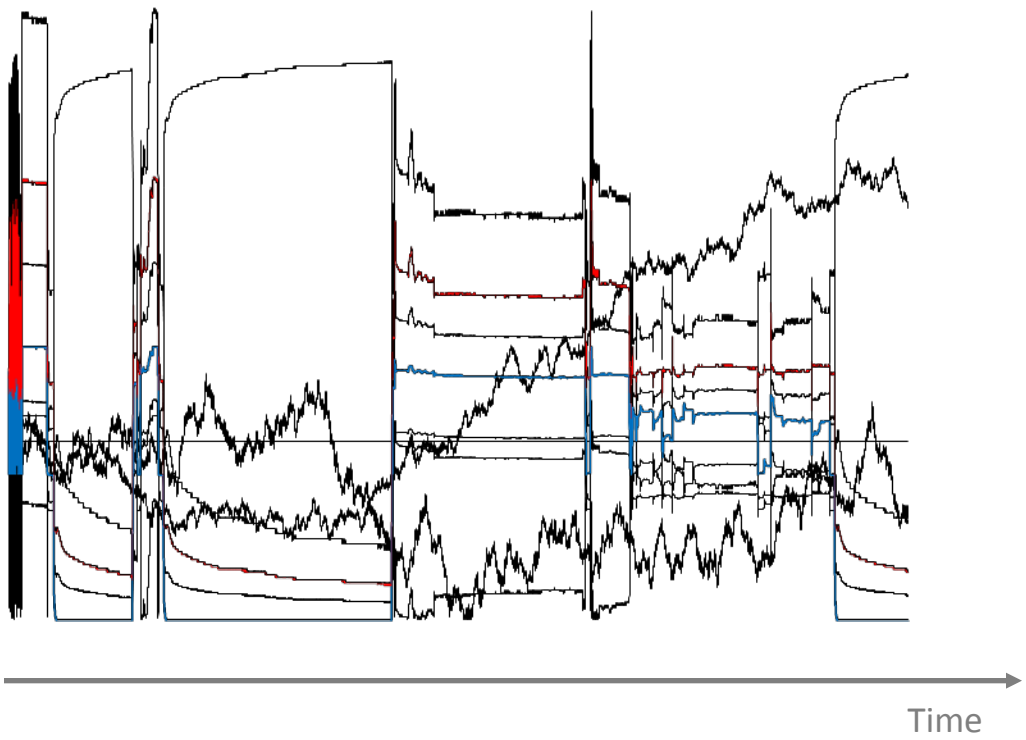


24 hours
86,400 data points

x10 sensors
860,400 data points

x100 sensors…
x1000 sensors…
x100 ships

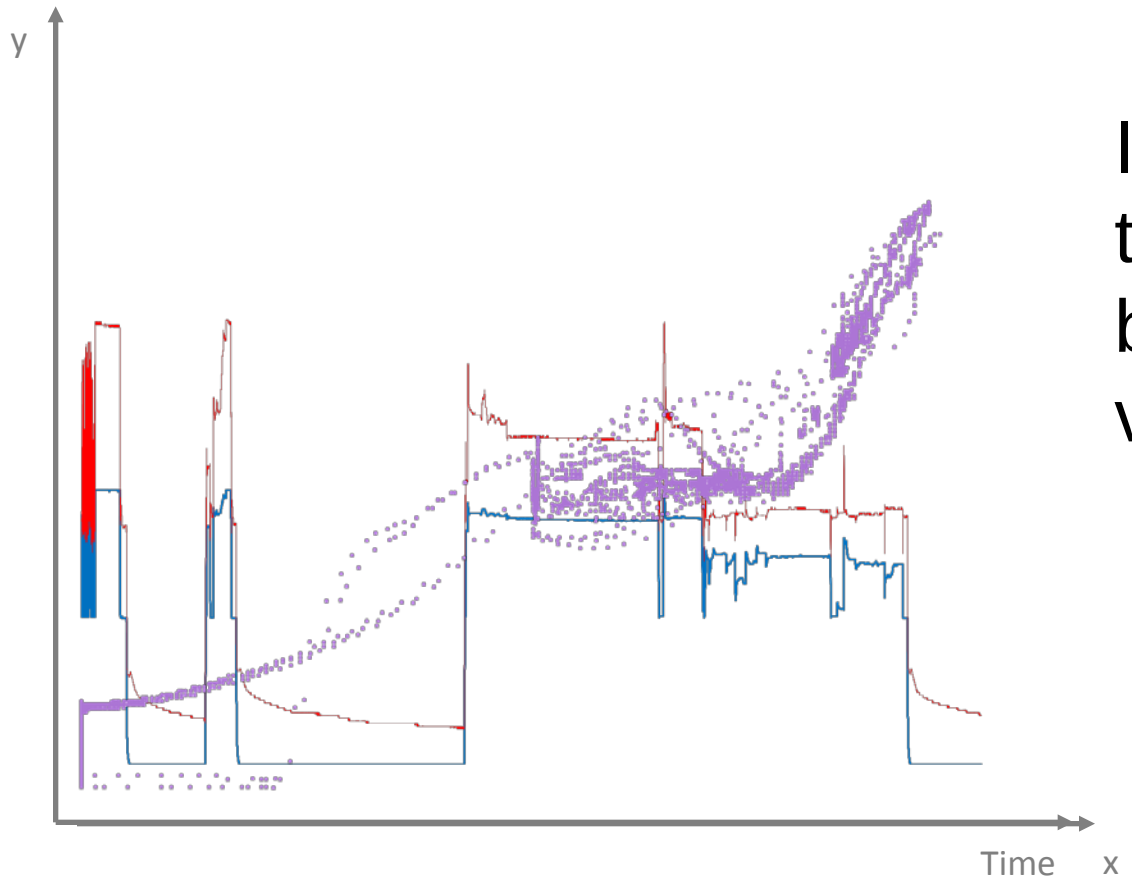
Analytics walk-through



Which data do I need for this specific purpose?

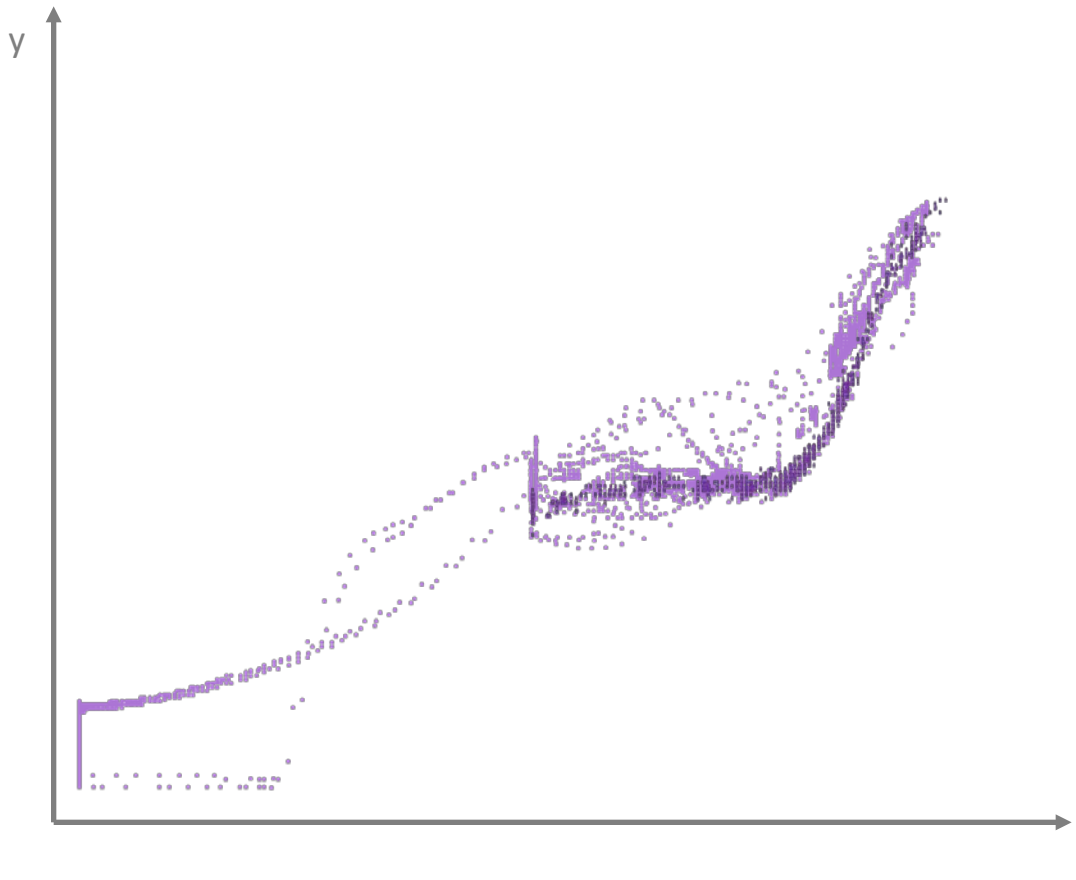
In this case:
-Exhaust Temperature
-Engine Speed

Analytics walk-through



I actually care about the relationship between these two variables

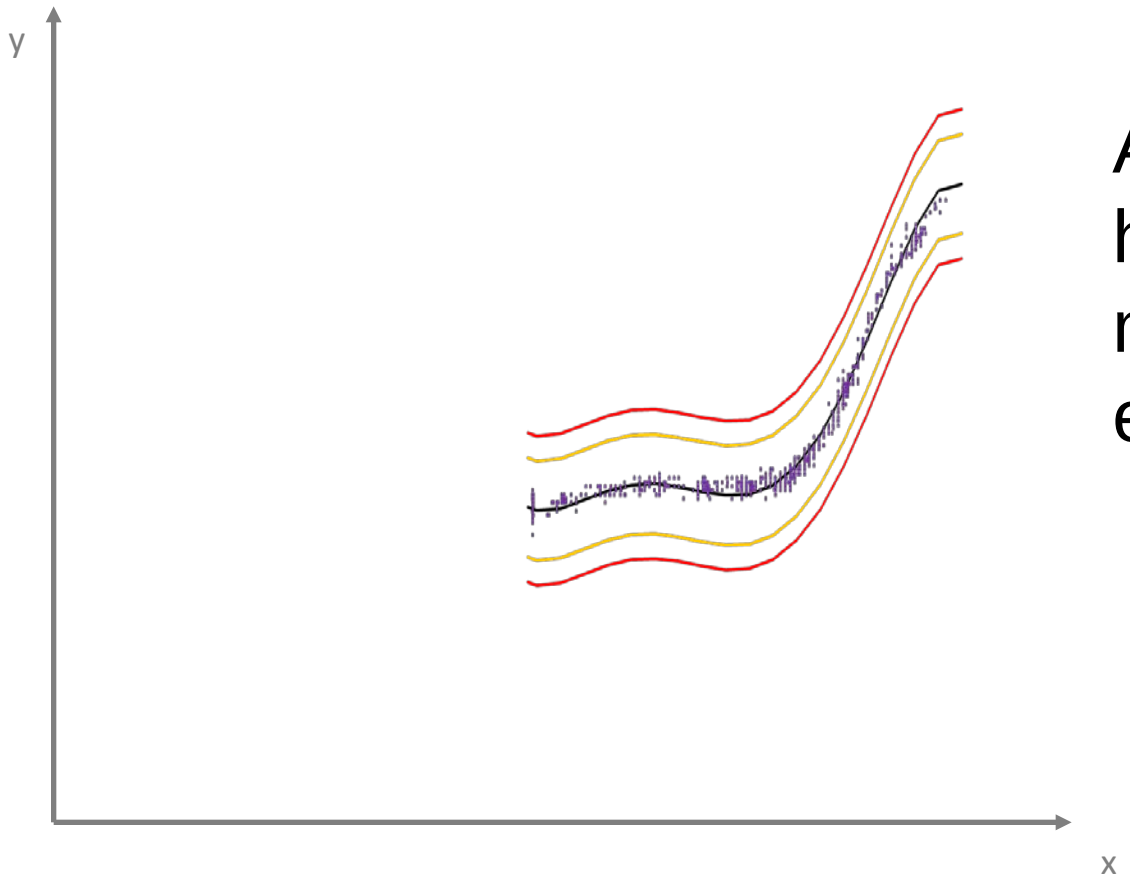
Analytics walk-through



And to evaluate the health, I care about specific operating modes (machine states)

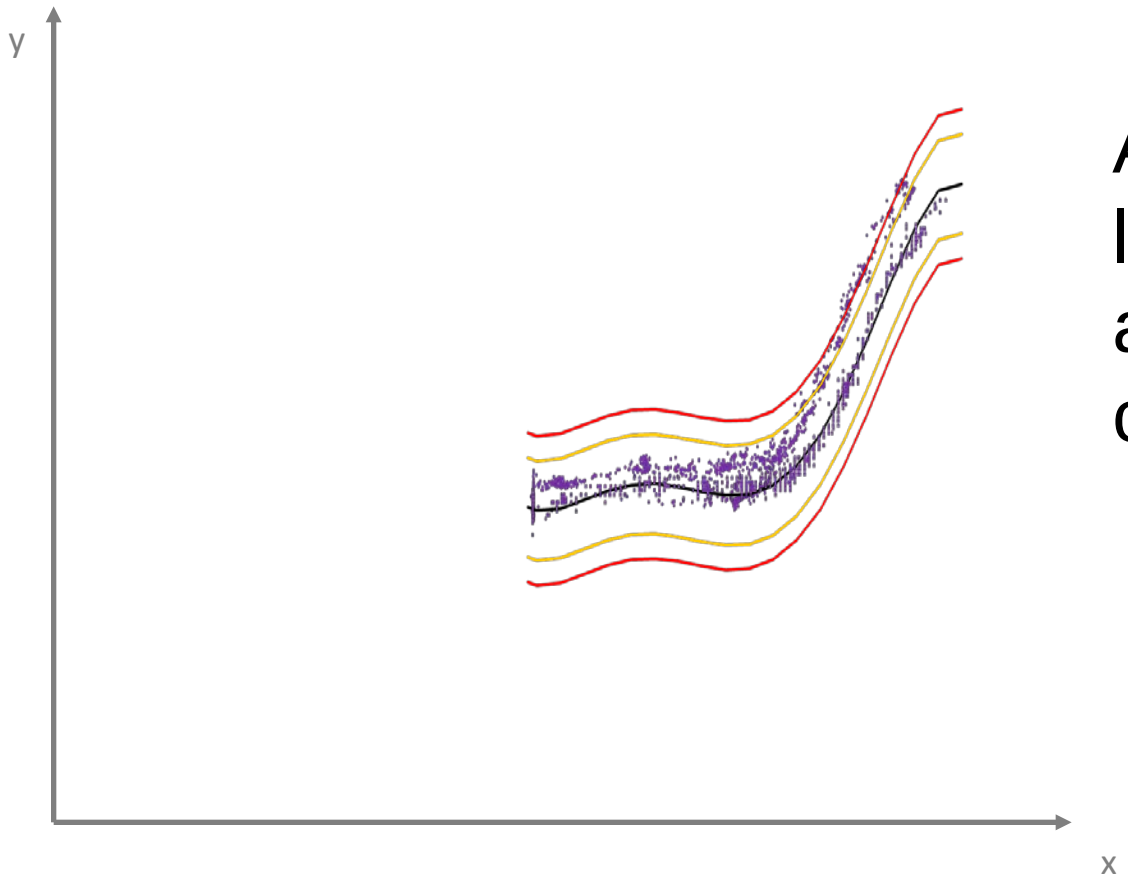
In this case, ‘steady-state’

Analytics walk-through



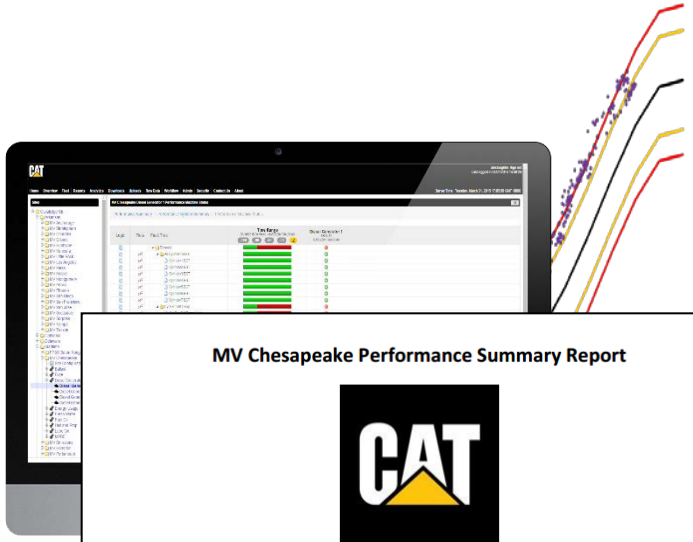
And then the current health of the machine is evaluated

Analytics walk-through



And then a forward looking (prognostic) analysis is conducted

Analytics walk-through



MV Chesapeake Performance Summary Report

Date Created: 09/27/2013

System	Last Data Date	Reviewer				
Ballast	09/27/2013 07:15:40	Kevin Nelson	31	0	0	0
Bilge	08/28/2013 15:59:43	Kevin Nelson	0	0	3	0
Energy Usage	09/27/2013 07:58:25	Kevin Nelson	4	0	5	0
Fresh Water	09/27/2013 07:15:40	Kevin Nelson	5	0	0	0
Fuel Oil	09/27/2013 07:15:40	Kevin Nelson	52	0	0	0

And this then is simplified to ‘Red-Yellow-Green’ status

And expert advisories

y

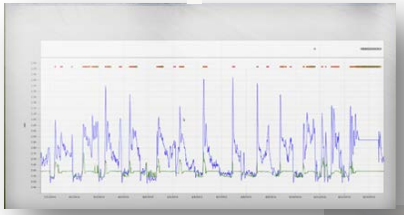
x

Traditional approach to Predictive Analytics

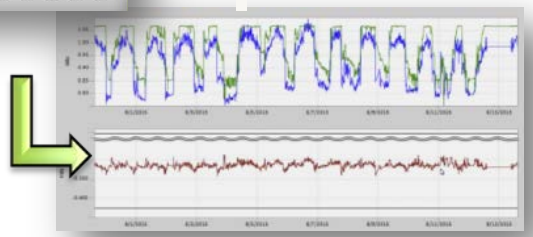
PRODUCTIVITY · EQUIPMENT MANAGEMENT · SUSTAINABILITY · SAFETY

Data Acquisition → **Data Manipulation** → “ A lot of Data “ → **Prognostic Assessment** → **Advisory Generation**

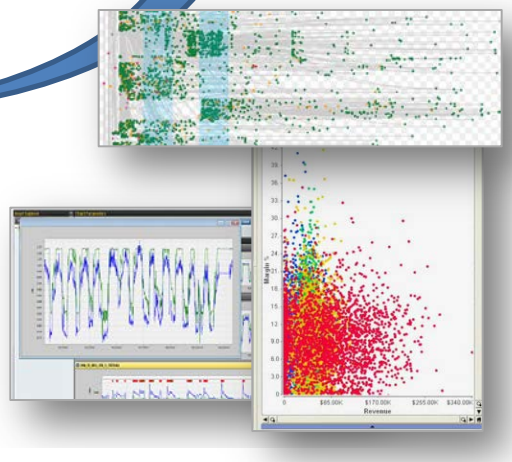
Skipping these steps seems to be a short cut, but actually costs more in the end

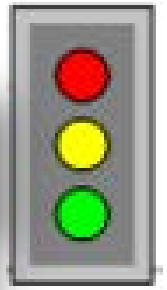


- 86k points, per tag, per 24 hours
- Time series
- Red & Blue



- 86k points per tag
- Red vs. Blue





Advisory Provided

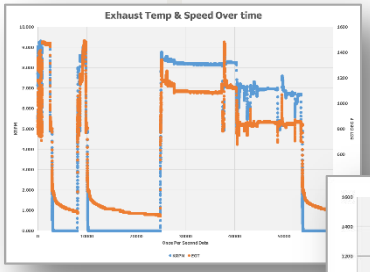
Traditional Approach Challenges:

- High false positive rate
- Requires highly skilled analyst that are in short supply (show empty chairs with dollar signs to illustrate the expense)
- Most SME’s analyzing data are not Marine subject matter experts
- Visualizations are often complicated and difficult to interpret

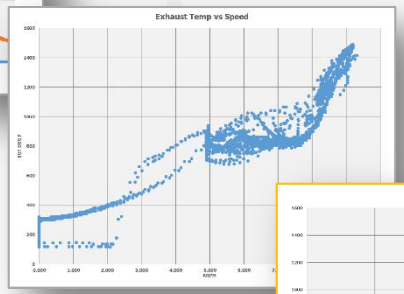
Smarter Predictive Analytics help drive real action

PRODUCTIVITY · EQUIPMENT MANAGEMENT · SUSTAINABILITY · SAFETY

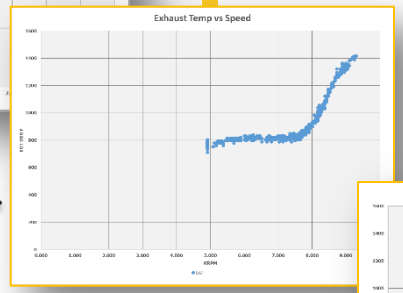
Data Acquisition	Data Manipulation	State Detection	Health Assessment	Prognostic Assessment	Advisory Generation



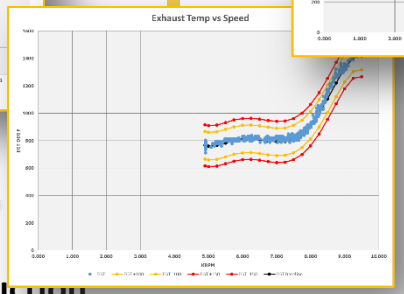
- 86k points pe tag
- 24 hrs of data
- Time series *Red & Blue data*



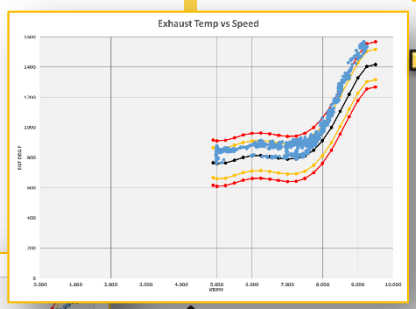
- 172k points
- 24 hrs of data
- X vs Y view *Red vs. Blue data*



- **913 points**
- **5 months data**
- **X v. Y series**
- **> 99% bandwidth reduction**

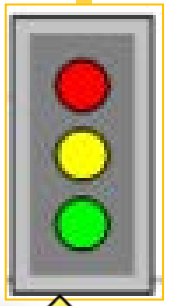


- 913 points
- 5 months data
- 2 Sigma alarm



- 913 points
- 5 months data
- Anomaly predicted

"Right Data"



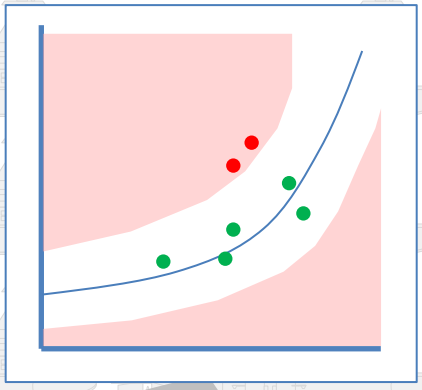
Advisory Provided

Info vs. Data

Combination of analytics & traditional data sources…

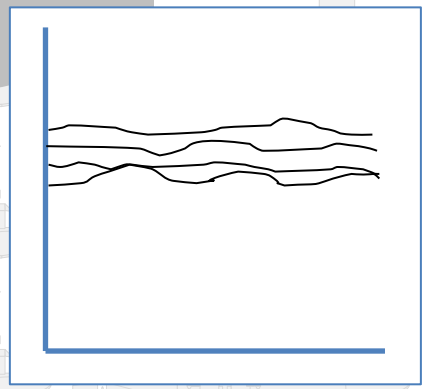
PRODUCTIVITY EQUIPMENT MANAGEMENT SUSTAINABILITY SAFETY

Equipment Conditions Compared to a Standard



Equipment Conditions Compared to Itself

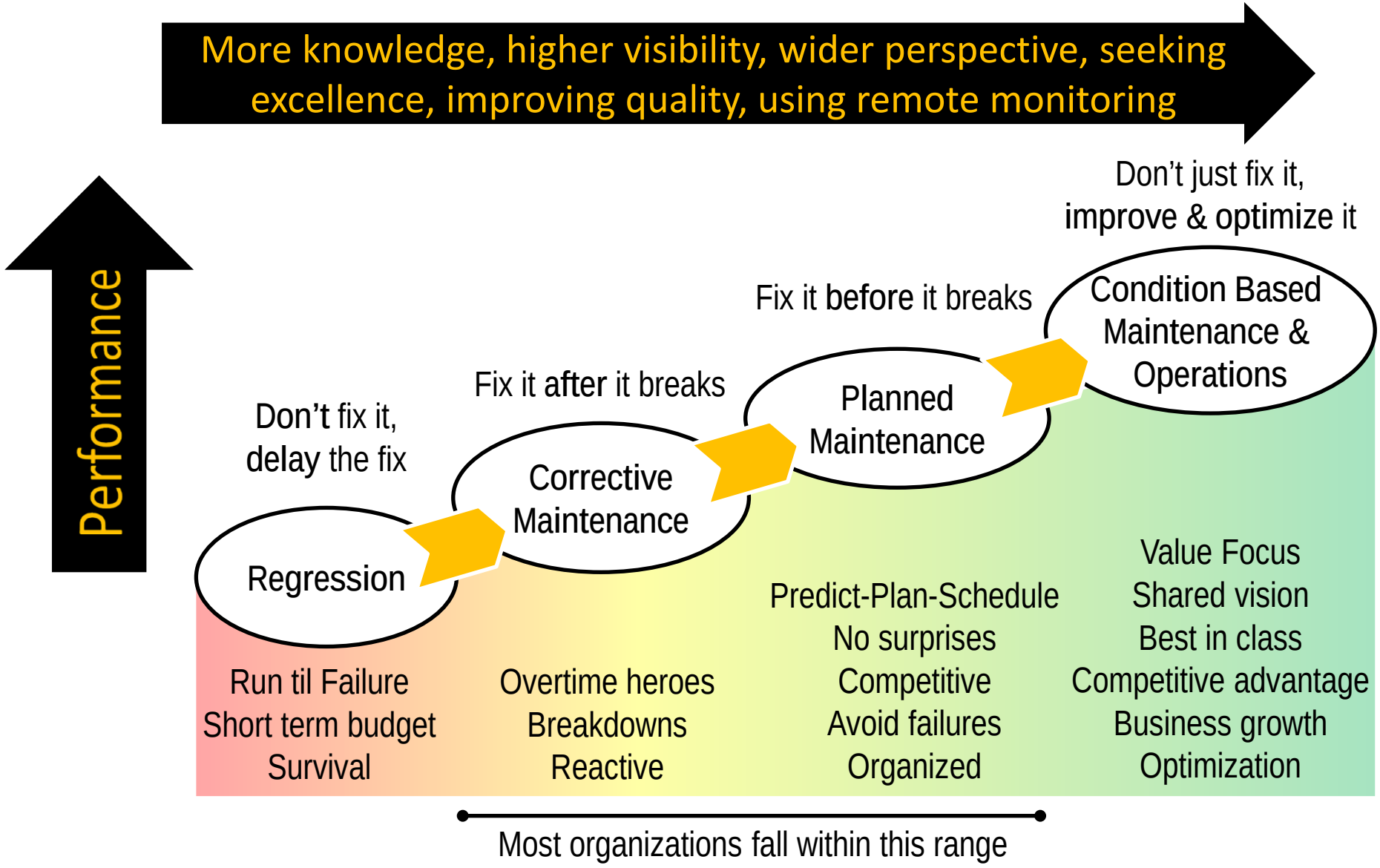
Equipment Conditions Compared to Similar Equipment



Inputs:

• Electronic Data • Repair History • Fluid Analysis • Site Conditions • Inspections

...help drive real performance improvement



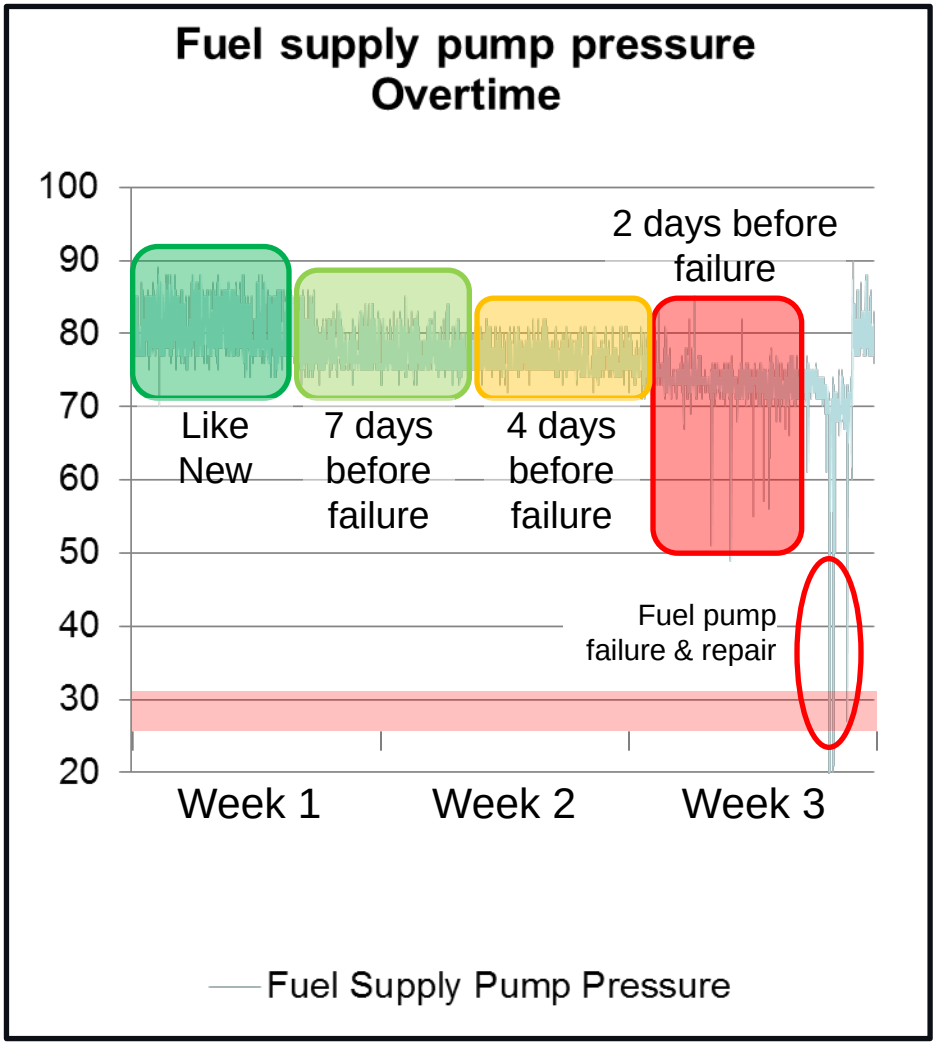
Examples of how the IIoT is being applied by Cat® Asset Intelligence in the marine industry

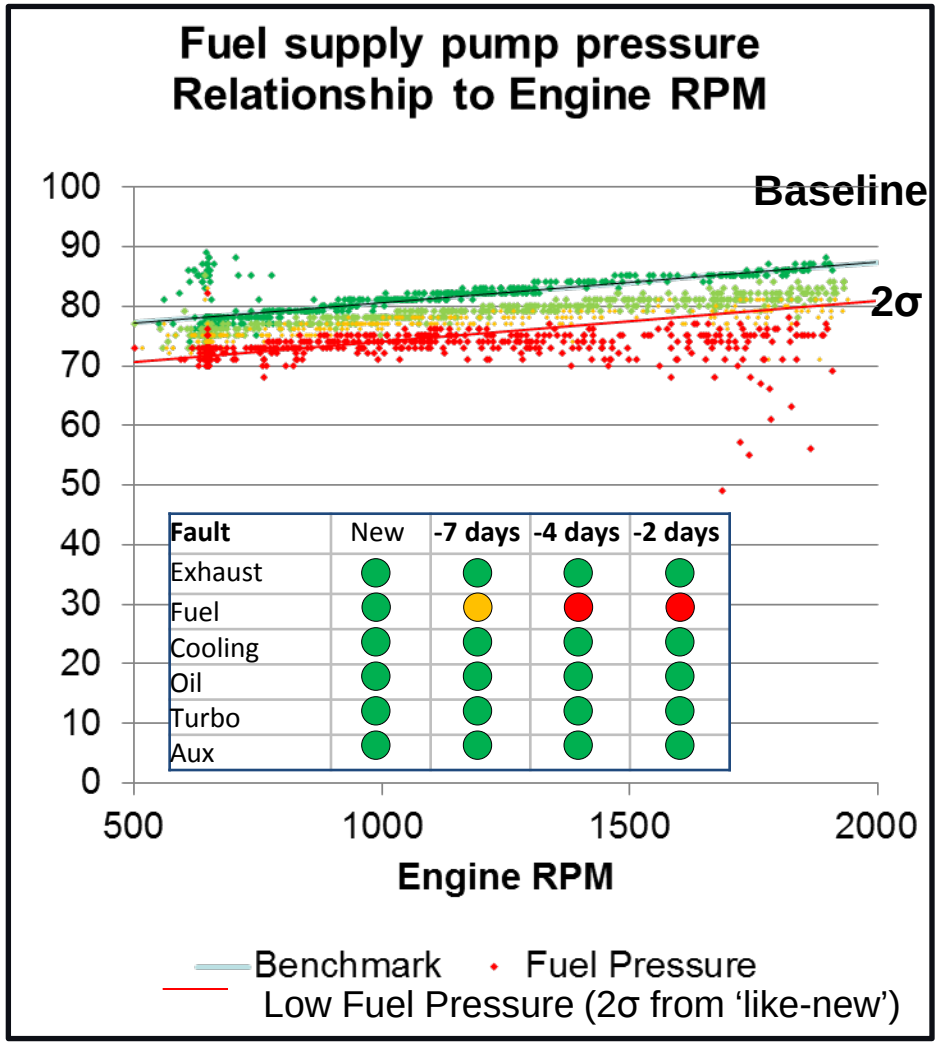
Diesel Engine Health: Predict and prevent engine failure

Critical Bearing: Predict failure in advance to avoid downtime

Operations: Optimize operations to reduce idle and waste

Case study - Avoiding Fuel Pump Failure



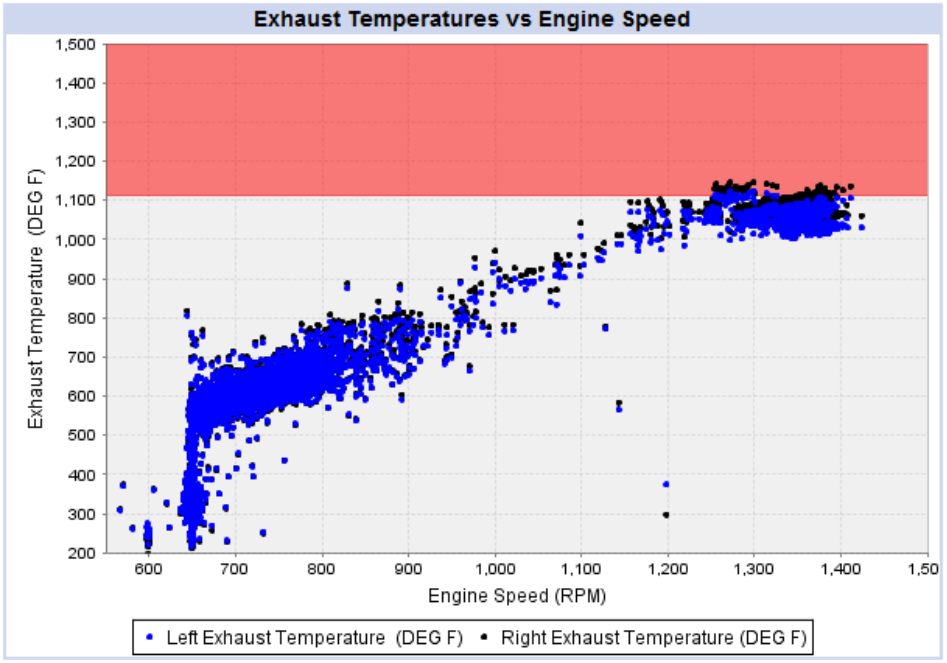


Potential Impact: $20k/day rev loss + $15k add'l for offsite repair (vs. preventative) = **$35,000 per failure**

Case Study – Faulty Fuel Injector

Issue

- Automated analytics identified fuel injector issue
  - High right exhaust bank temperatures
  - Erratic low speed RPM
  - Higher fuel consumption compared to other engine



Impact

- Replaced faulty fuel injectors:
  - **Avoided potential catastrophic failure**
  - **Improved fuel efficiency, resulting in $175/day in fuel savings (>$50,000 per year)** - fuel savings based on observed operational duty cycle

Case Study – Cat AI predicting bearing failures

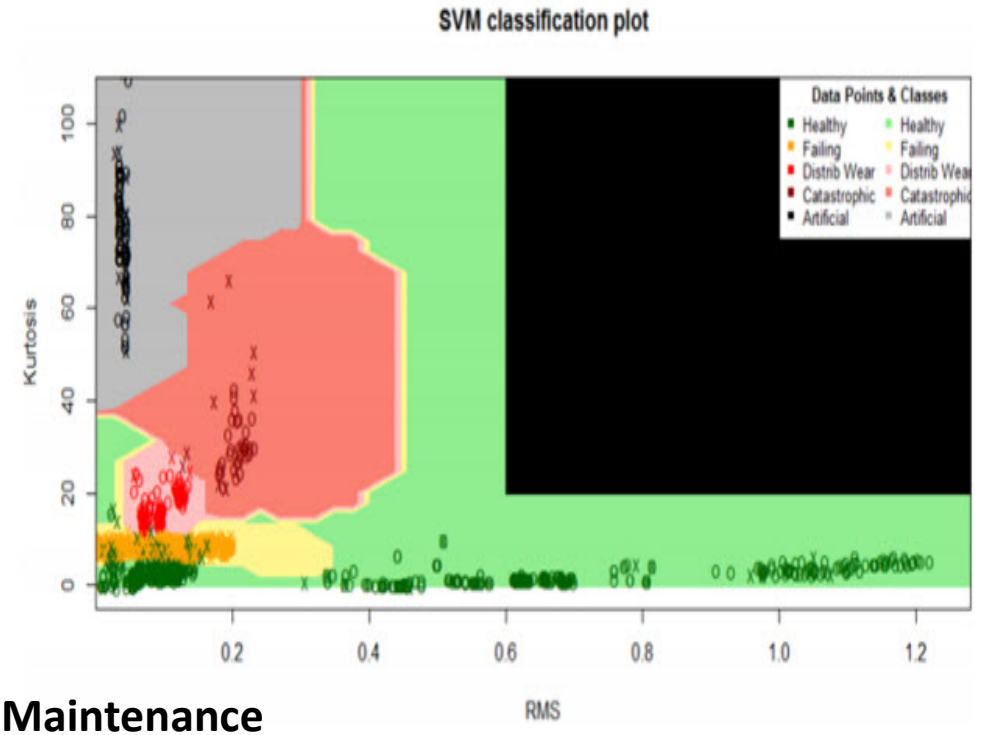
Process industry example: Cat Asset Intelligence was used to help a food-packaging company implement prognostics and predict the **time of failure** at component level

Customer focused on specific servo motor bearing

- Typical MTBF ~25k hours, some failures at 2k
- High part cost, **high cost of downtime**

Goal of 60 days advance warning

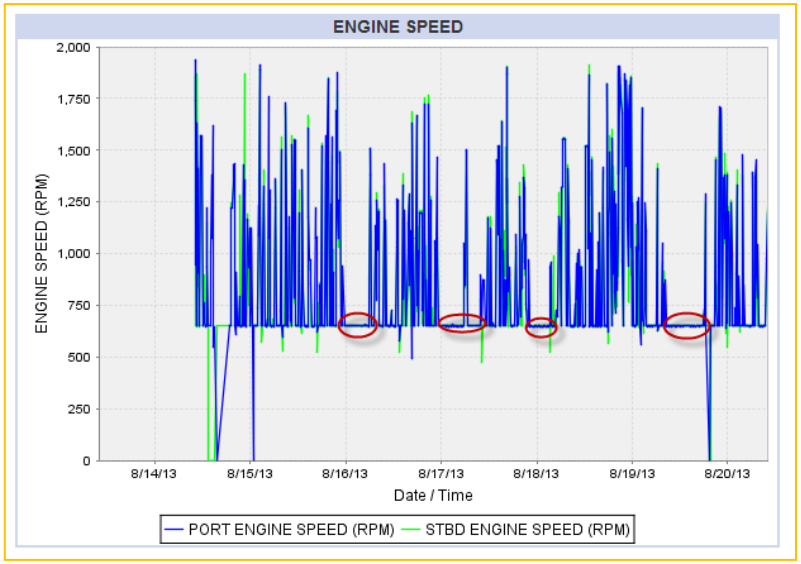
- Selected Support Vector Machines (SVM) method as best predictor
- Accurately predicted real failures **~150 days in advance**

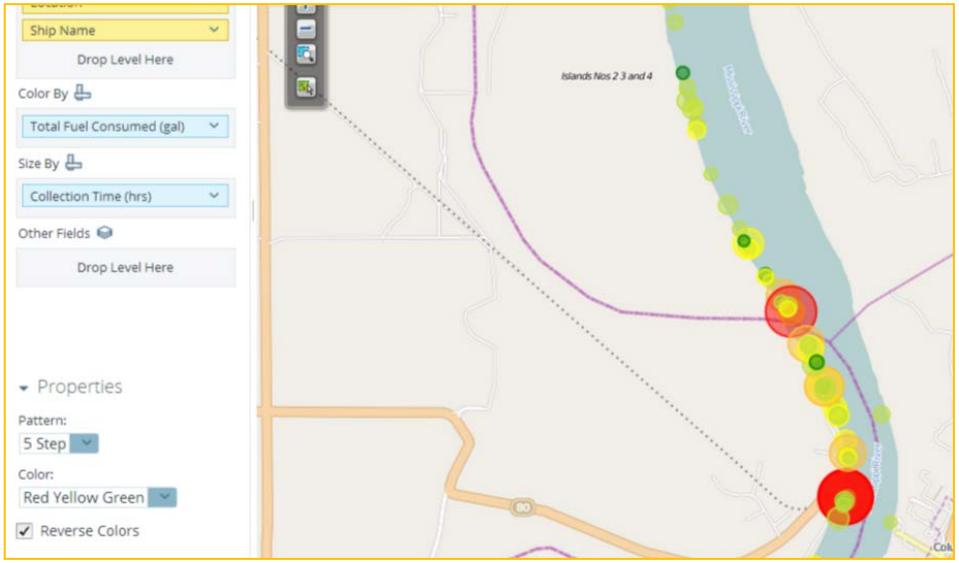


Impact: Move from Unplanned to Planned Maintenance

- Predict and plan the maintenance, have all parts on hand
- Reduce downtime to absolute minimum
- Have back-up production assets on hand if necessary
- Plan for lowest impact period

Case study - Reducing idle time





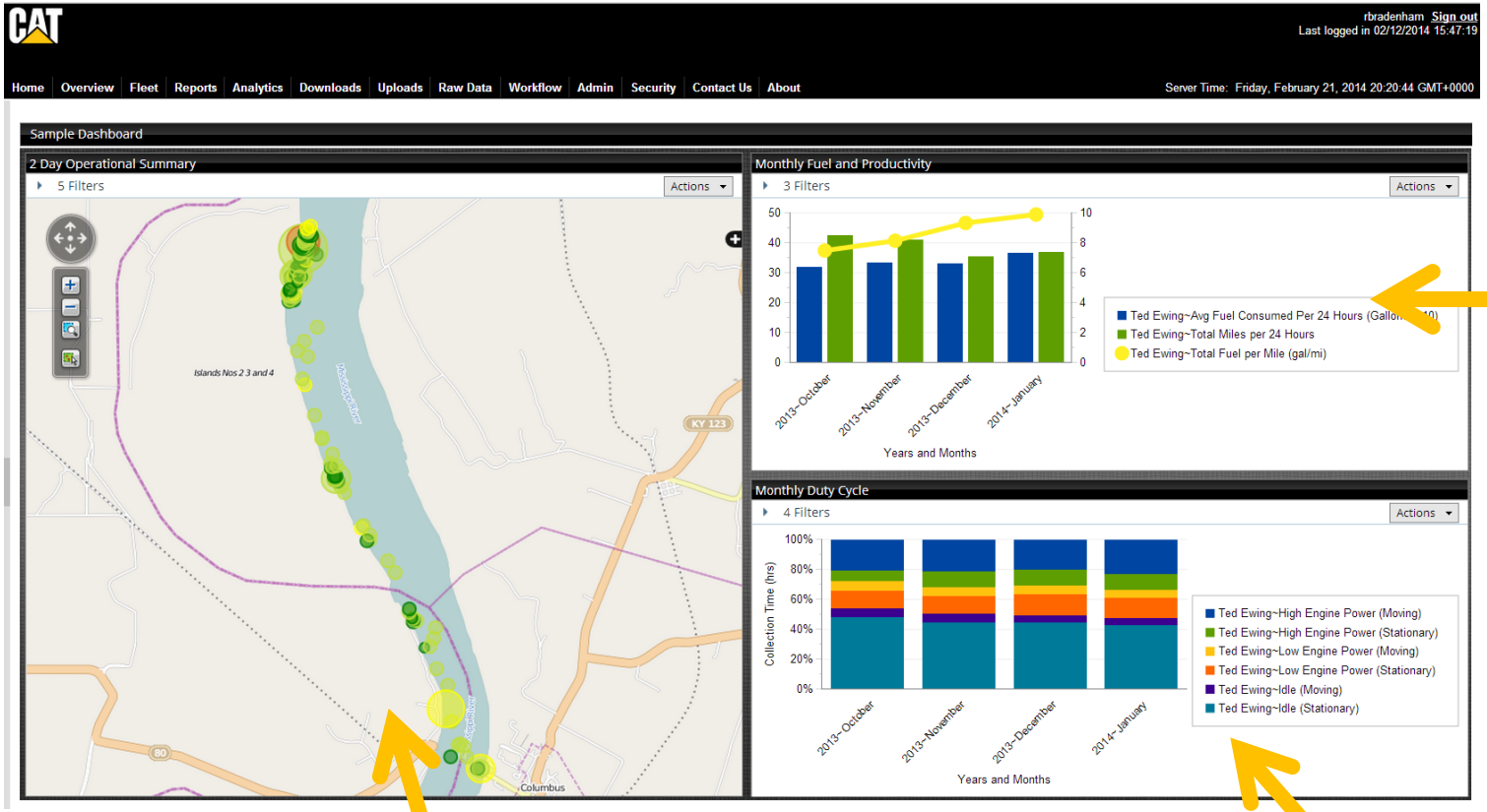
Issue

- Extended periods (8+ hours) at idle while stationary alongside pier
- Multiple occurrences per week

Impact

- Configured Asset Intelligence analytics to automatically identify periods greater than 3 hours
- Reducing just one of the extended idle periods per week saved $15,000 per vessel in fuel – over $2M when extrapolated across entire fleet
- Additional benefit of reducing engine hours, etc

Case Study – Production Transparency & Benchmarking



Productivity & fuel analysis enables comparison of assets and trending over time

Recent operations including position, course, speed, production, fuel burn, etc.

Duty cycle analysis shows different phases of operations, productivity, fuel consumption

Analytics application across critical dredge assets

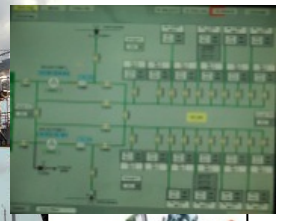
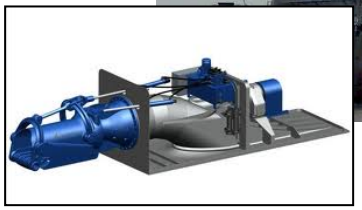
PRODUCTIVITY EQUIPMENT MANAGEMENT SUSTAINABILITY SAFETY



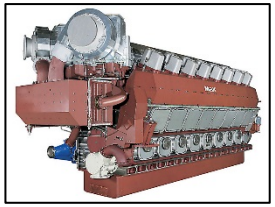




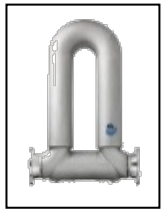


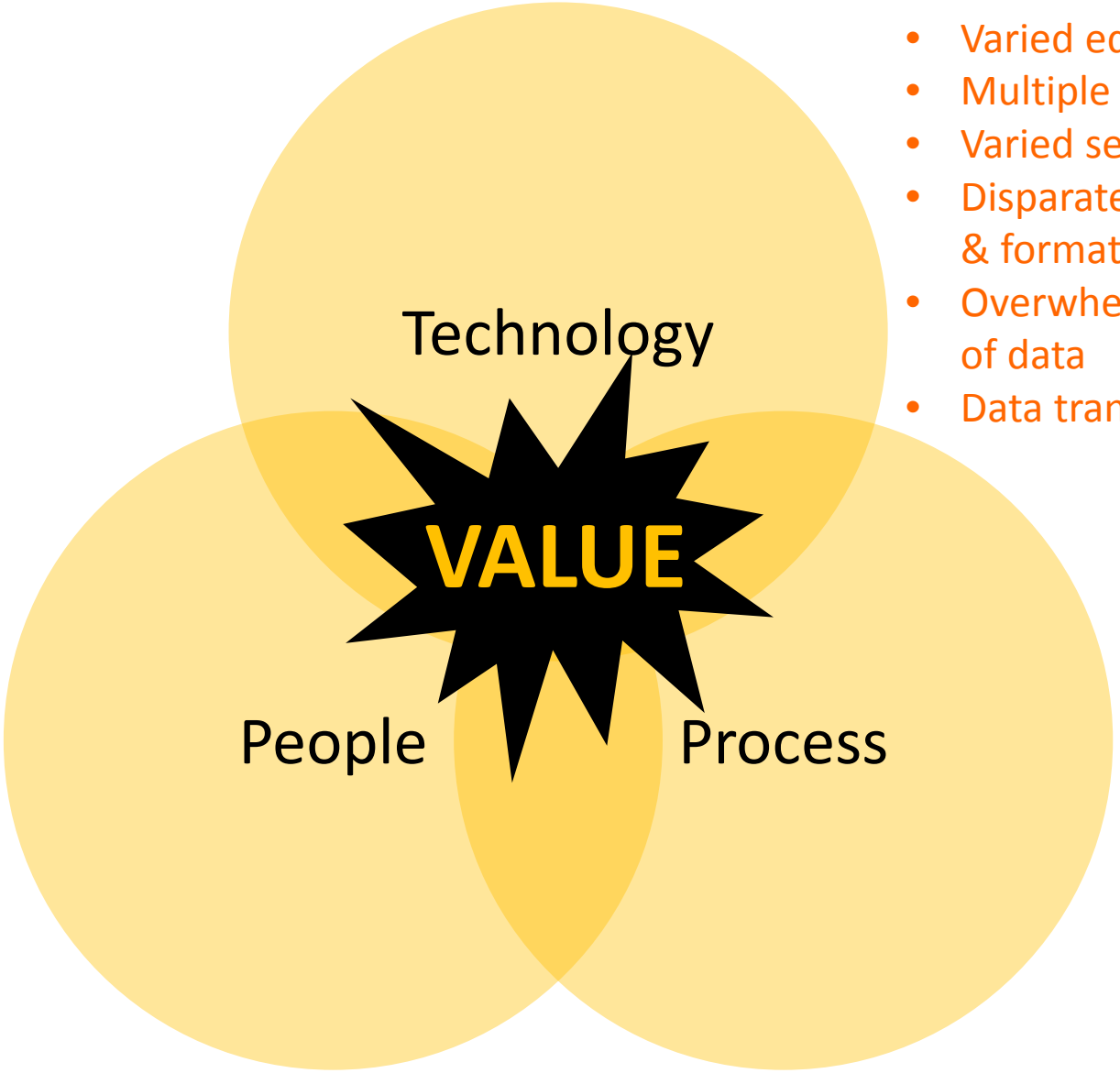








This is not just about technology…

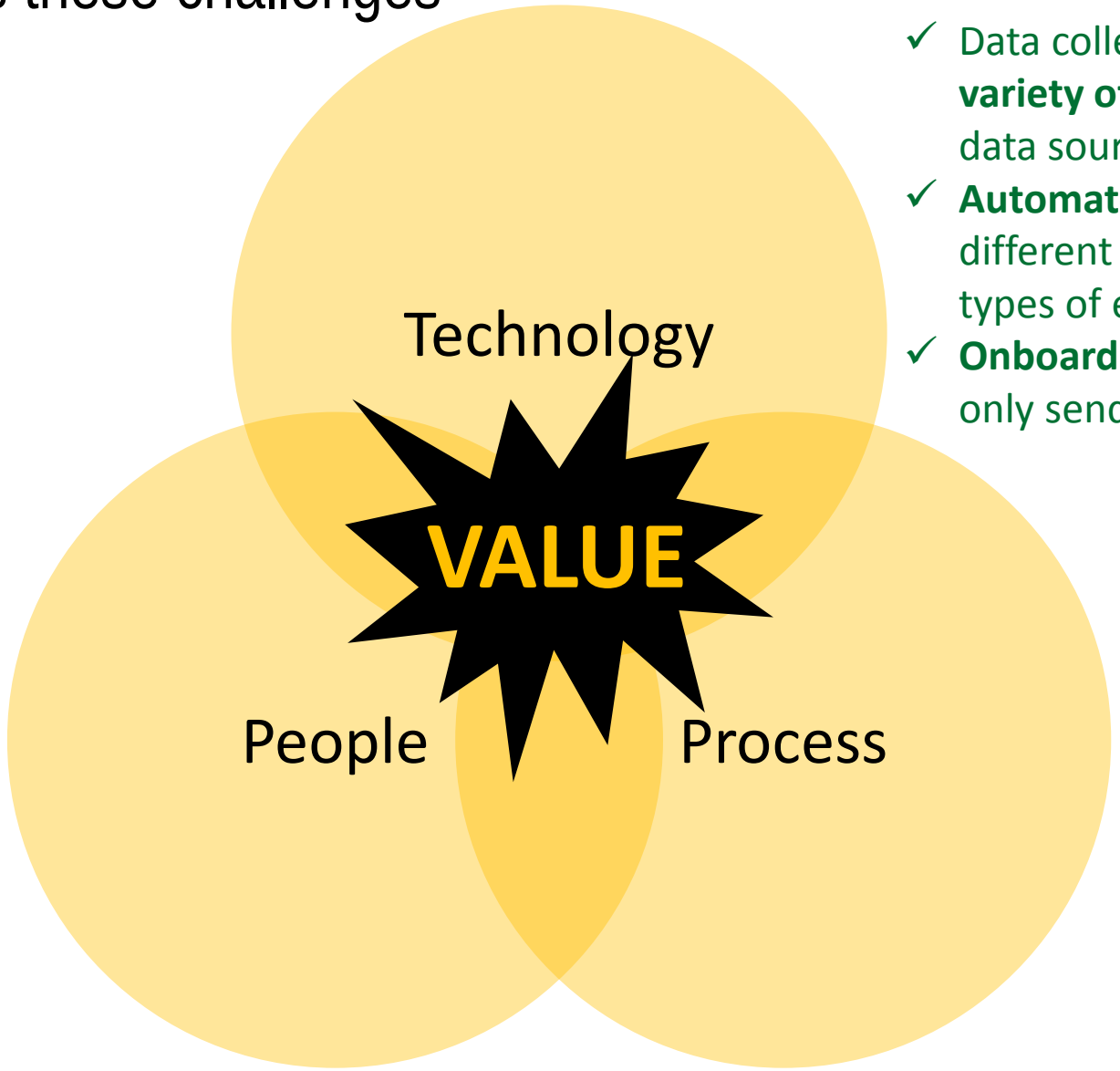


- Varied equipment
- Multiple OEMs
- Varied sensors
- Disparate data sources & formats
- Overwhelming volume of data
- Data transmission

- Different skill sets
- Lack of capacity
- Training
- Limited onboard capabilities

- Existing systems & processes
- Change management

How Caterpillar Marine Asset Intelligence addresses these challenges

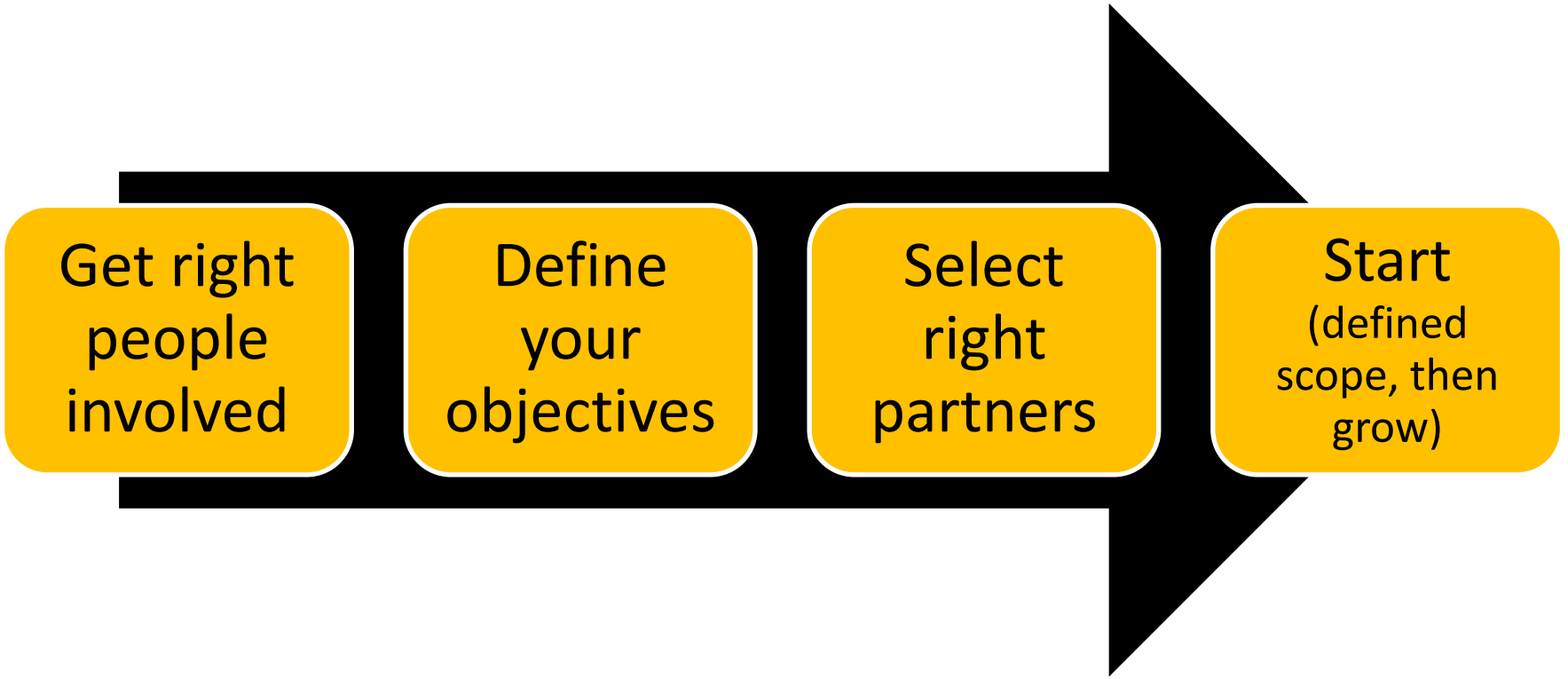


- ✓ Data collection for **wide variety of equipment** & data sources/formats
- ✓ **Automated analytics** for different OEMs and types of equipment
- ✓ **Onboard analytics** to only send valuable data

- ✓ Caterpillar experts & Fleet Advisors
- ✓ Expertise across range of equipment
- ✓ Enable both onboard & shore teams
- ✓ Local Dealer support

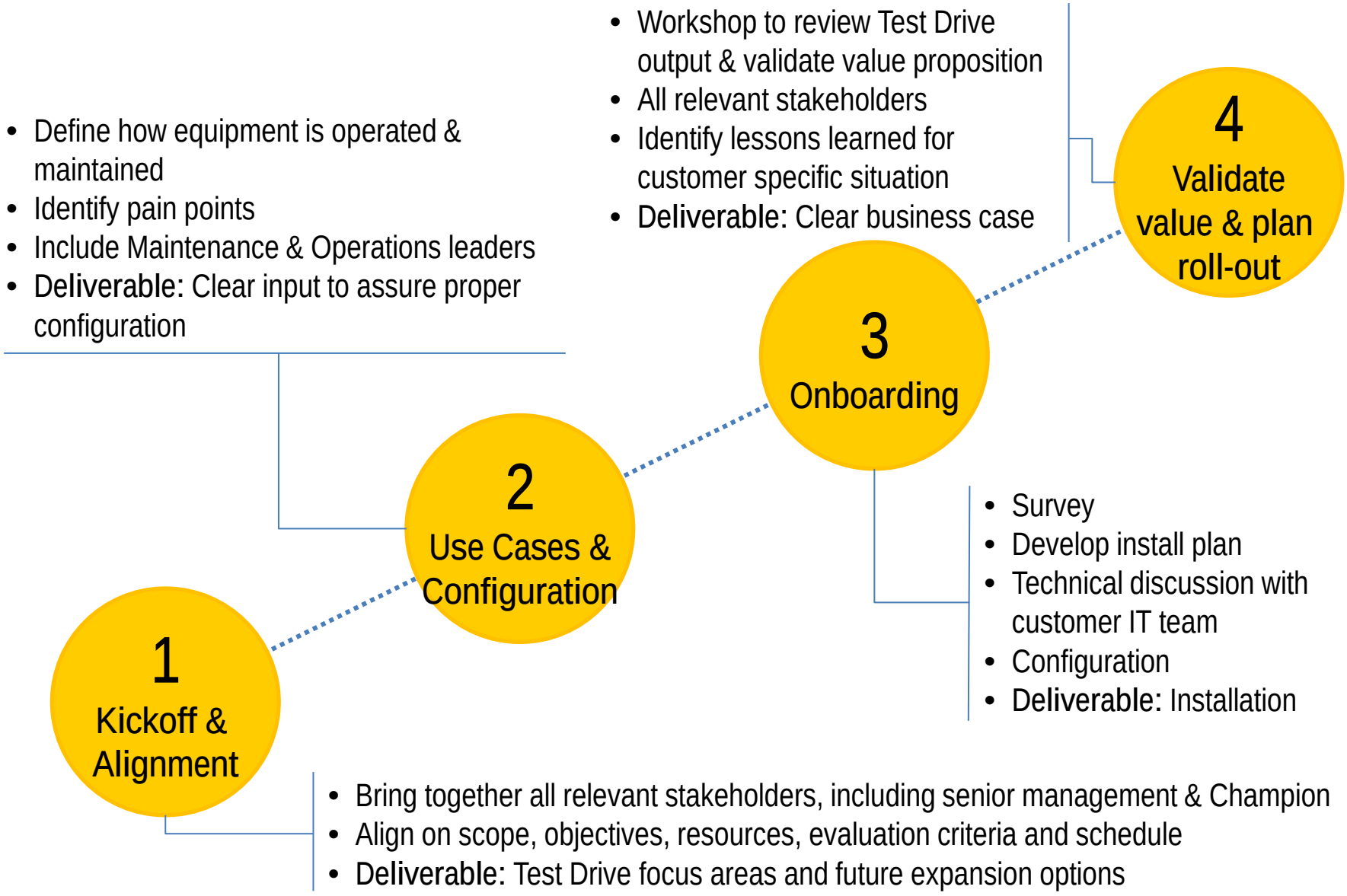
- ✓ Flexibility to integrate with existing systems (CMMS)
- ✓ *Test Drive* to build your business case, engage stakeholders, and develop process

What is needed to get started?



…Caterpillar has defined
a ‘Test Drive’ process to help get started

Caterpillar Marine Asset Intelligence Test Drive helps customers get started and be successful



- Bring together all relevant stakeholders, including senior management & Champion
- Align on scope, objectives, resources, evaluation criteria and schedule
- **Deliverable:** Test Drive focus areas and future expansion options

- Define how equipment is operated & maintained
- Identify pain points
- Include Maintenance & Operations leaders
- **Deliverable:** Clear input to assure proper configuration

- Survey
- Develop install plan
- Technical discussion with customer IT team
- Configuration
- **Deliverable:** Installation

- Workshop to review Test Drive output & validate value proposition
- All relevant stakeholders
- Identify lessons learned for customer specific situation
- **Deliverable:** Clear business case

Asset Intelligence brings IIoT to Dredge Industry

Conclusions:

- *Early Adopters:* "We've tried this and are struggling" – Advanced Analytics may help you solve your 'Big Data' challenges

- *New to Technology Enabled Solutions:* "This sounds interesting" – Before you try this on your own, look for partners with domain expertise and analytics background

THANK YOU FOR YOUR ATTENTION & PLEASE VISIT US AT THE CATERPILLAR EXHIBITION BOOTH!

BUILT FOR IT.