



ENGINEER  
NEXT

NIDays

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# Turning IIoT Data Into Actionable Information

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# What Information Do You Care About?

Priorities: 1-3 years	Aviation	Wind	Power Generation	Power Distribution	Oil & Gas	Rail	Manufacturing	Mining
Increase profitability through improved resource management	61%	71%	56%	59%	56%	67%	58%	55%
Gain a competitive edge	58%	55%	53%	69%	50%	50%	76%	48%
Improve environmental safety and emissions	39%	61%	50%	75%	59%	43%	52%	58%
Gain insights into customer behaviors, preferences and trends	58%	61%	47%	56%	38%	60%	70%	39%
Gain insights into equipment health for improved maintenance	55%	48%	34%	56%	47%	73%	67%	39%
Drive operational improvements and workforce efficiencies	42%	48%	41%	72%	44%	53%	55%	64%
Create new business opportunities with new revenue streams	45%	61%	34%	53%	47%	40%	52%	58%
Meet or exceed regulatory compliance	32%	39%	41%	63%	50%	33%	39%	39%

Source – [Industrial Internet Insights report by Accenture](#)

# Today's Topics

- Analytics 101
- Best practices for predictive analytics
- Case study

# Analytics 101

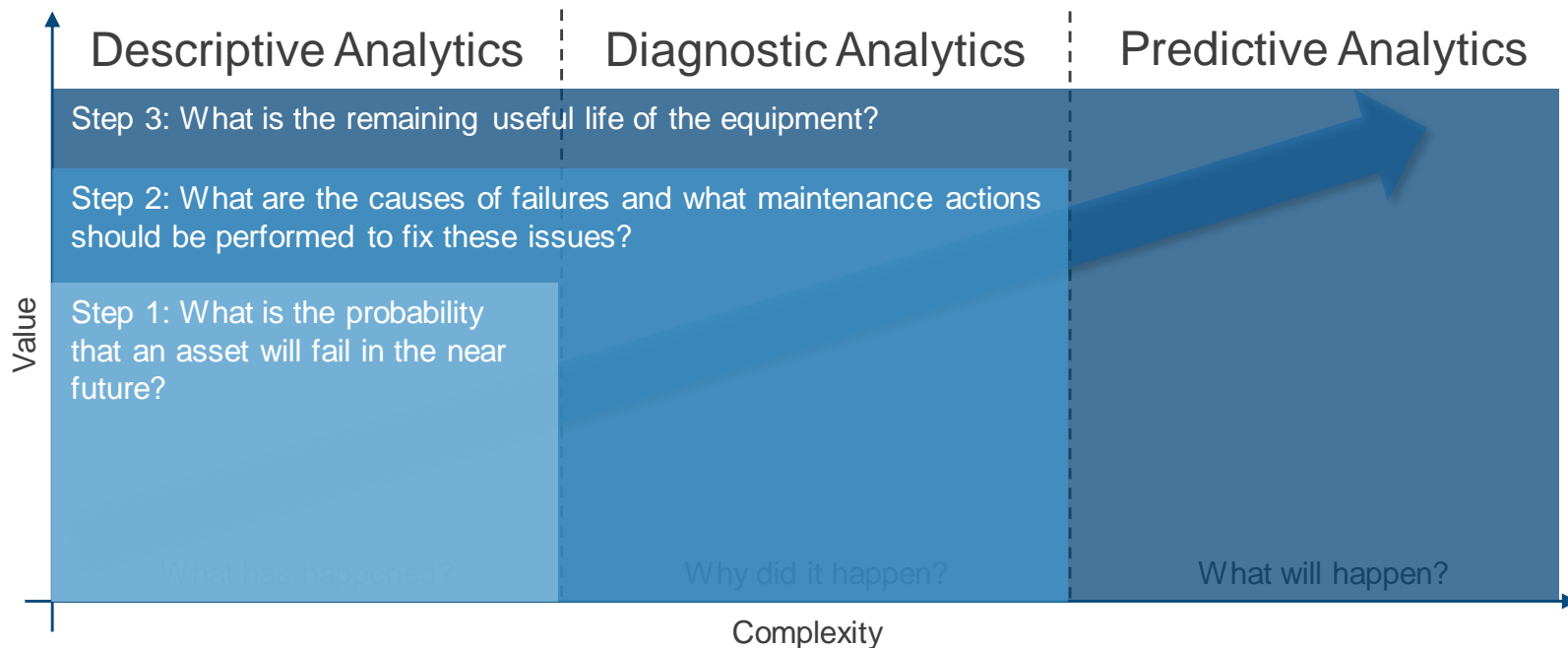
# Challenge With Industrial Analytics



# Machine Learning Key Words

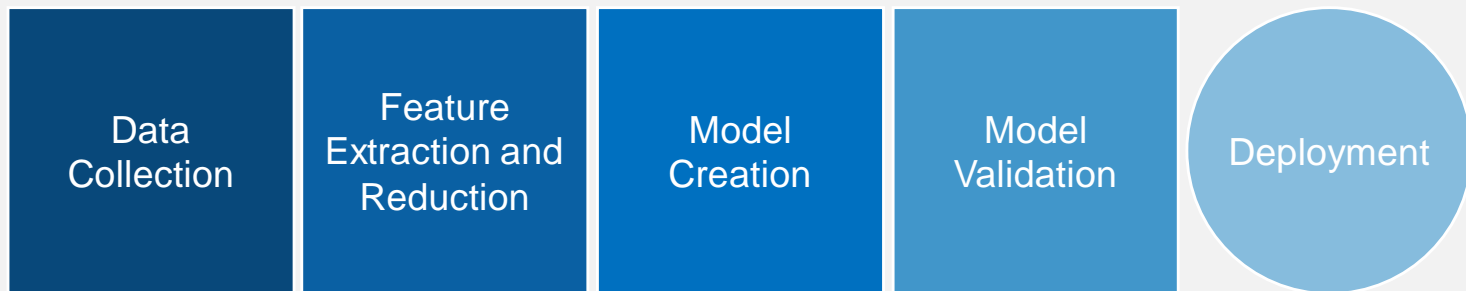
- Large amount of data
- Mathematical optimization
- Meaningful hidden patterns

# Condition Monitoring: Maximizing Uptime and Reducing Maintenance Costs



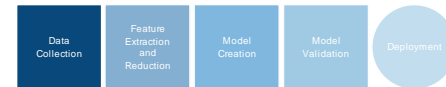


# Industrial Analytics Process

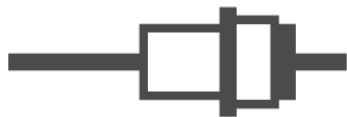


# Best Practices for Predictive Analytics

# What Data Sources Do I Need?



## Sensors



Industrial I/O Modules  
(C Series)

## Controllers



Industrial Protocols  
(OPC UA, Modbus, etc.)

## Data Storage



NI InsightCM™, Database  
Connectivity Toolkit, AWS  
Toolkit

# Getting the Right Mix of Data Is Challenging

Data  
Collection

Feature  
Extraction  
and  
Reduction

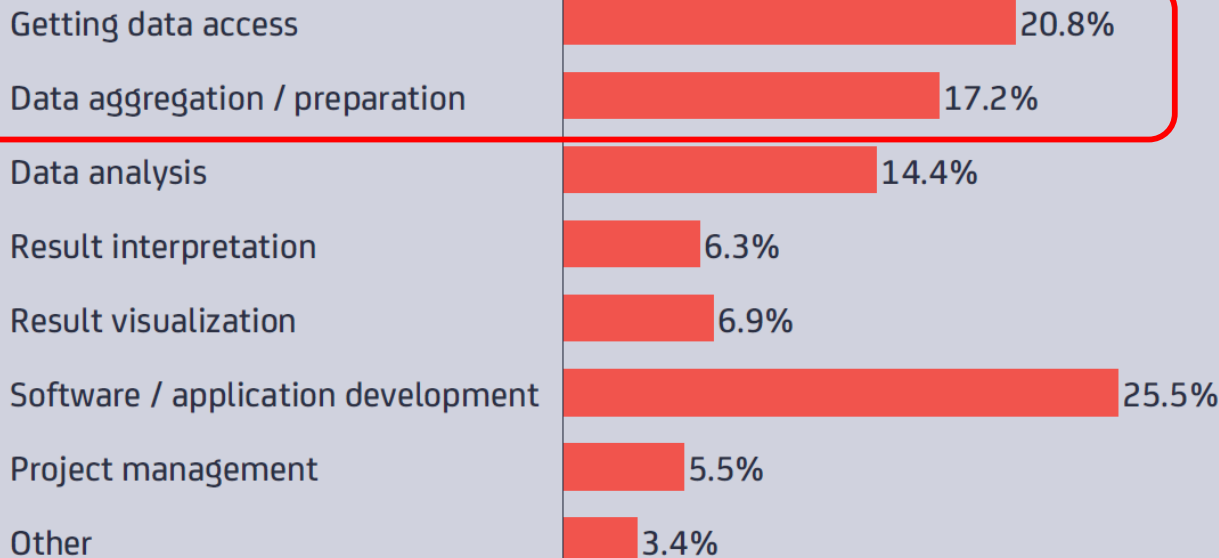
Model  
Creation

Model  
Validation

Deployment

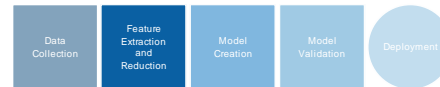
## EXHIBIT 18: Most Industrial Analytics related costs in software and application development

**Question:** *What percentage (%) of the industrial data analytics project budget goes to the following?*

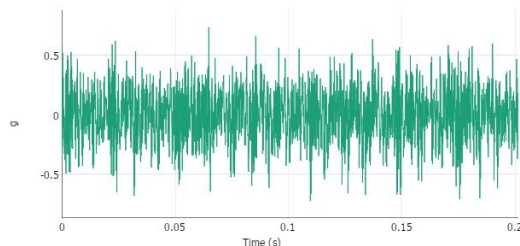


Source – [industrial analytics](#)  
2016/2017 - [Digital Analytics](#)  
[Association Germany](#)

# Calculating Features in the NI Platform

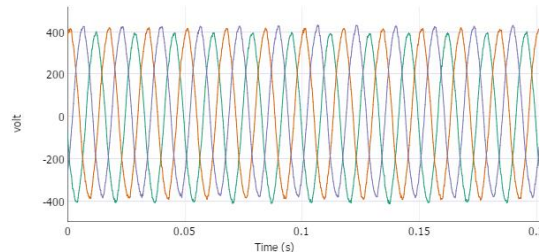


Thousands of Built-In Functions



## Vibration

Sound and Vibration Measurement Suite



## Electric Power

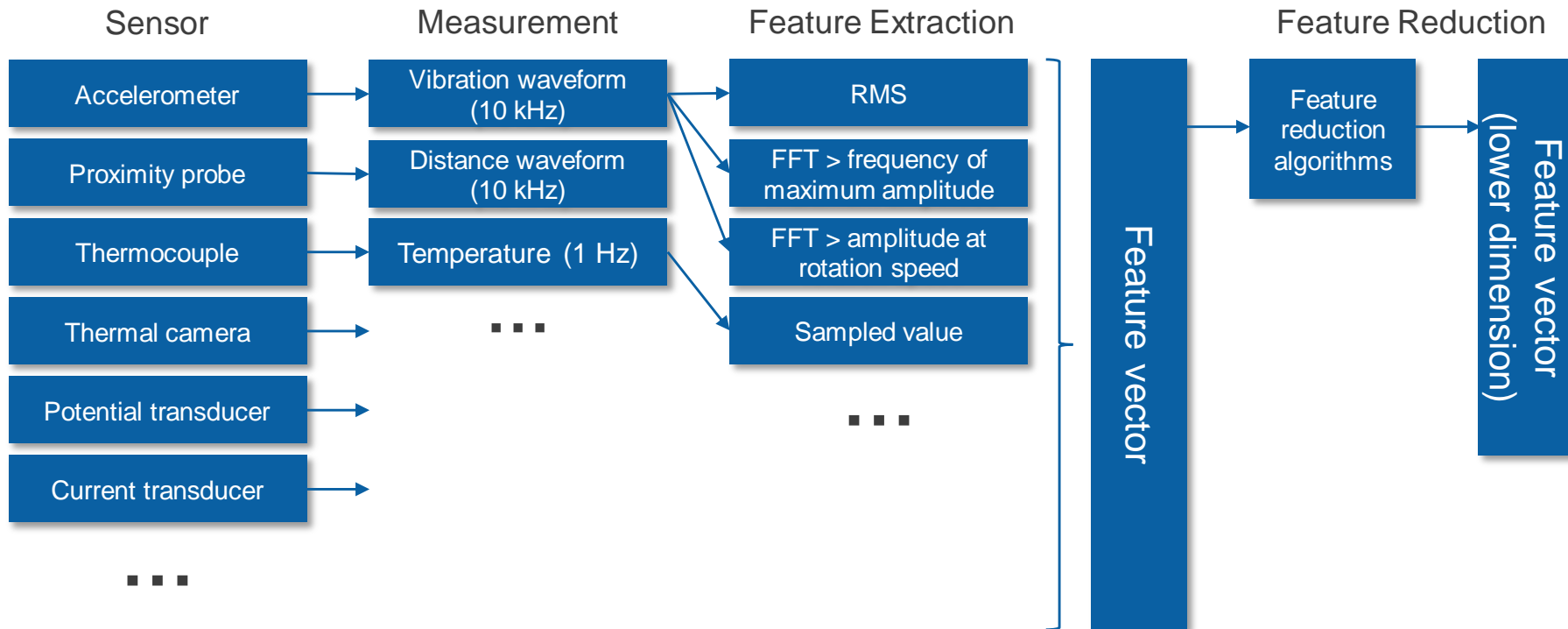
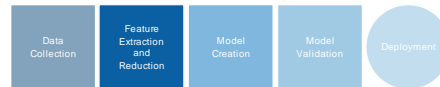
Electrical Power Toolkit



## Imaging

Vision Development Module

# Feature Engineering: Reduce Dimensions



# Machine Learning Algorithm Types



Find  
Unusual  
Values

## Anomaly Detection

Identify and predict  
unusual data points

Discover  
Structure

## Clustering

Separate data points  
into similar groups

Predict  
Categories

## Classification

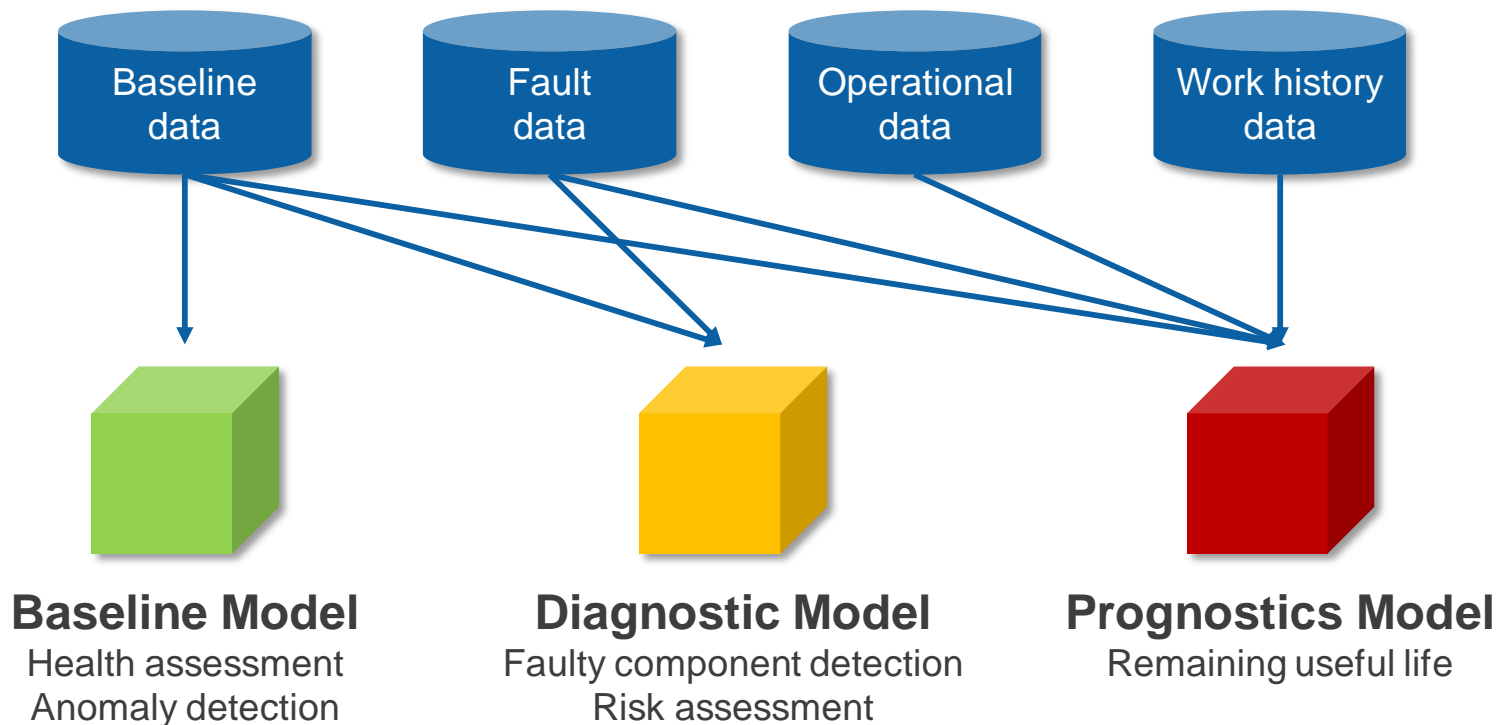
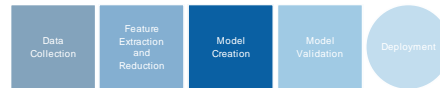
Identify categories new  
information belongs in

Predict  
Values

## Regression

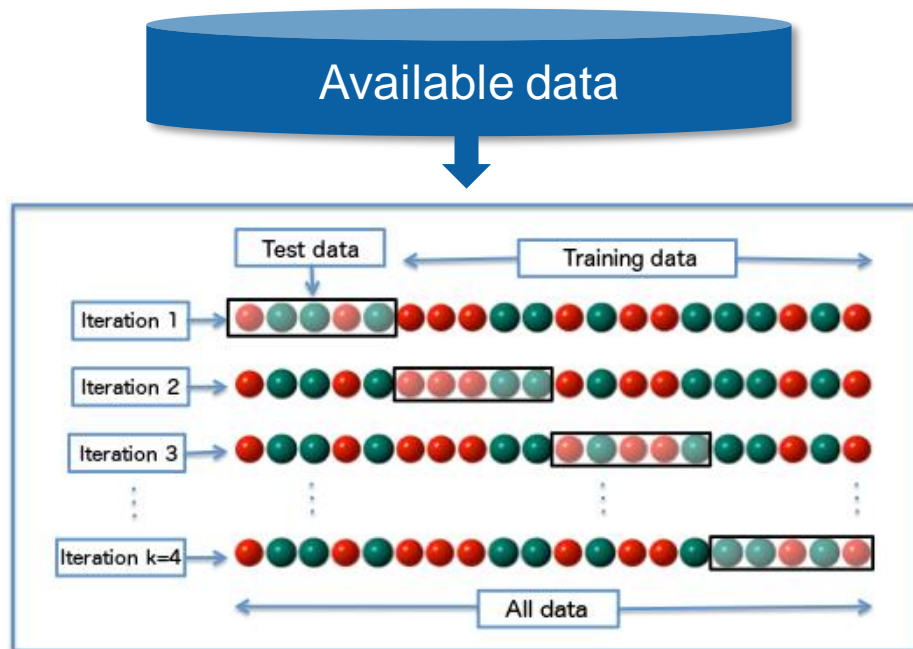
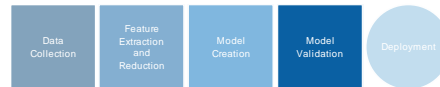
Forecast future by  
understanding  
relationships

# Different Model Types Exist





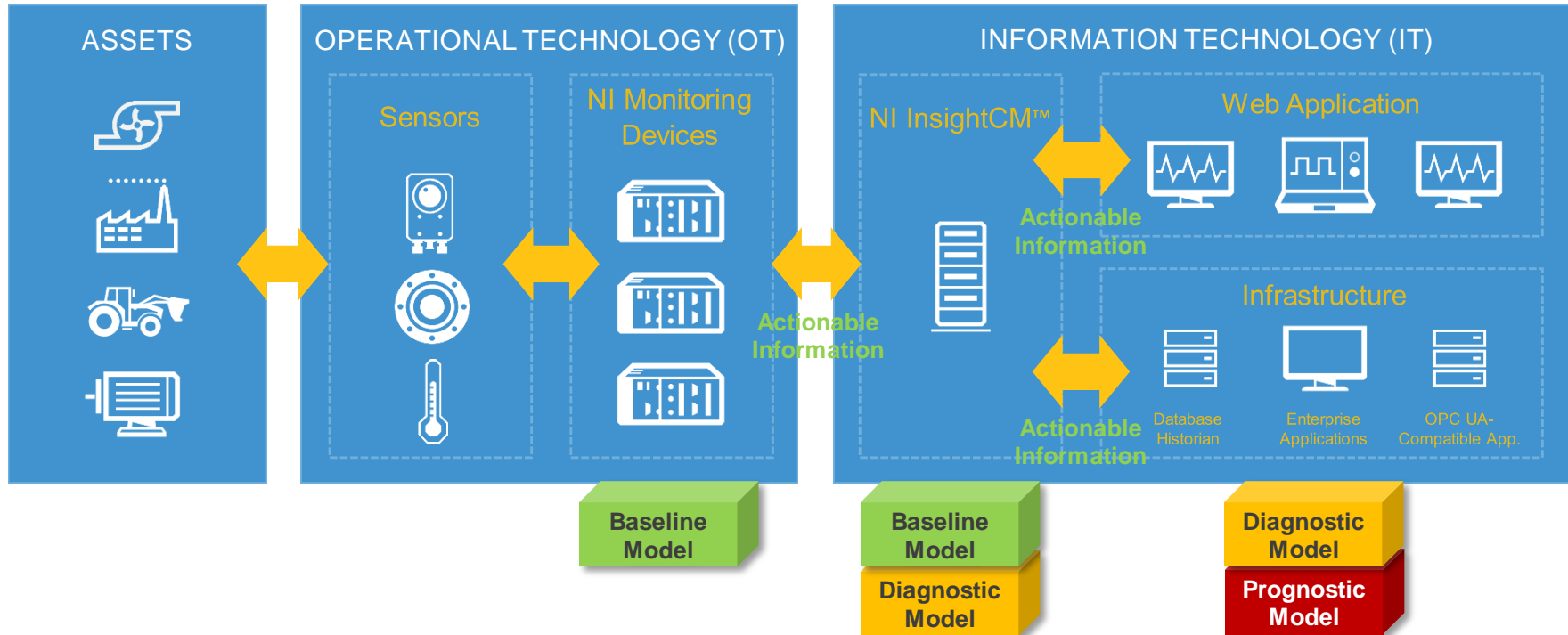
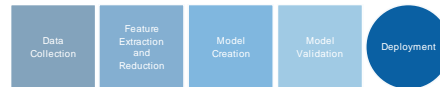
# Getting a “Good Enough” Model



## Metrics:

False alarm rate  
Davies-Bouldin index  
Precision  
Recall  
...

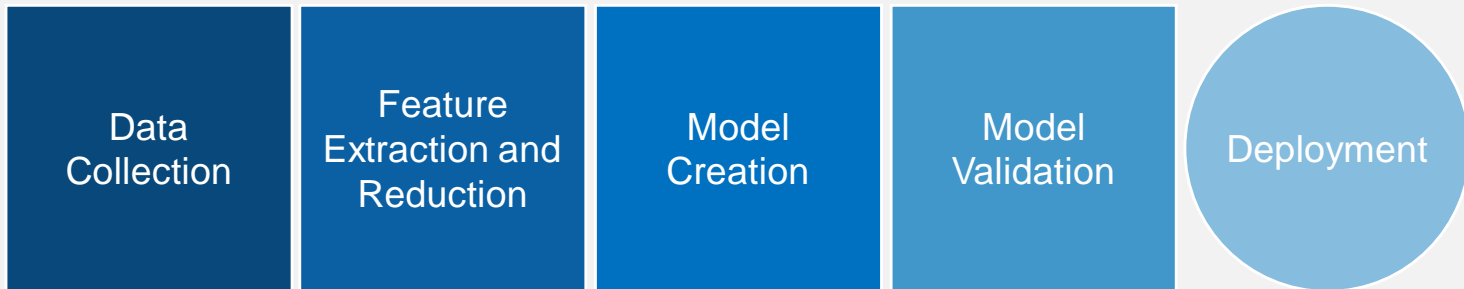
# Model Deployment Options



# LabVIEW Analytics and Machine Learning Toolkit

Integrate predictive analytics and machine learning algorithms in LabVIEW

- Algorithms for feature reduction, anomaly detection, clustering, and classification
- Train, test, and deploy models
- Targeted toward condition monitoring and predictive maintenance applications
- Includes getting-started and real-world examples



# Case Study

## Anomaly Detection in NI's Central Plant



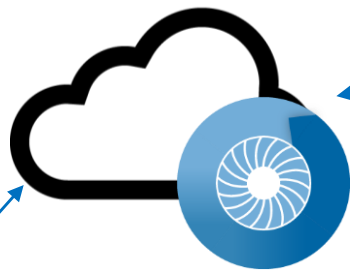
<http://www.ni.com/try-insightcm>

# Data Collection



NI Monitoring Devices  
installed at NI

62 features extracted per pump  
(vibration and temperature)



NI InsightCM™  
hosted in the cloud

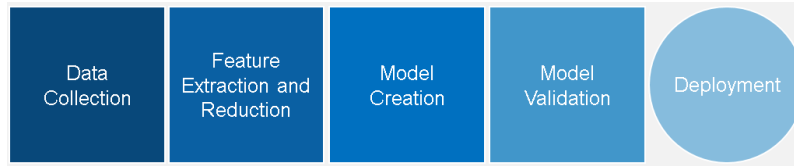


Web UI

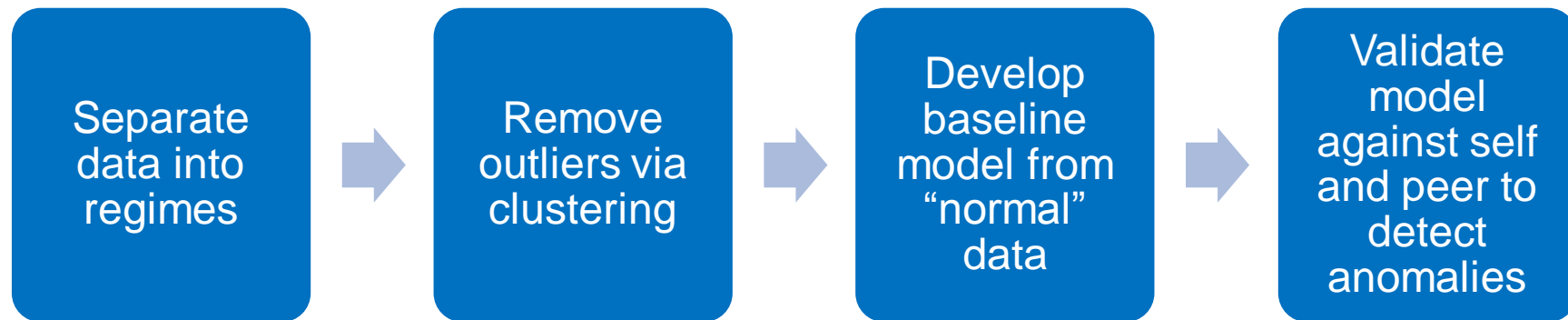


LabVIEW™

Analytics and Machine Learning Toolkit

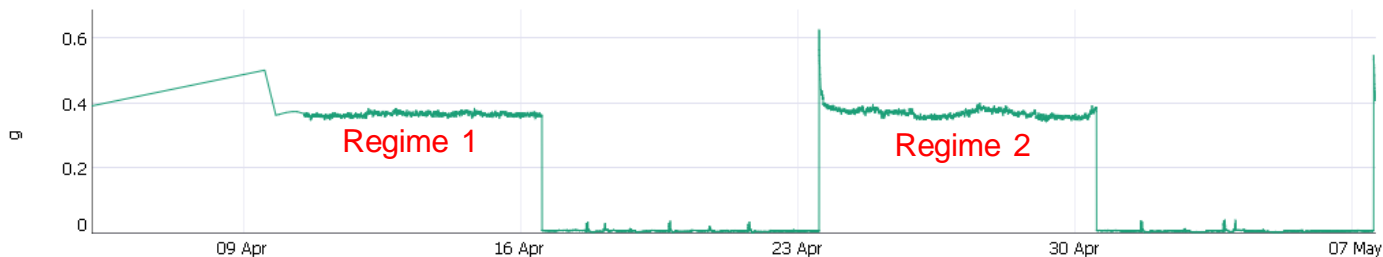


# Model Development Process

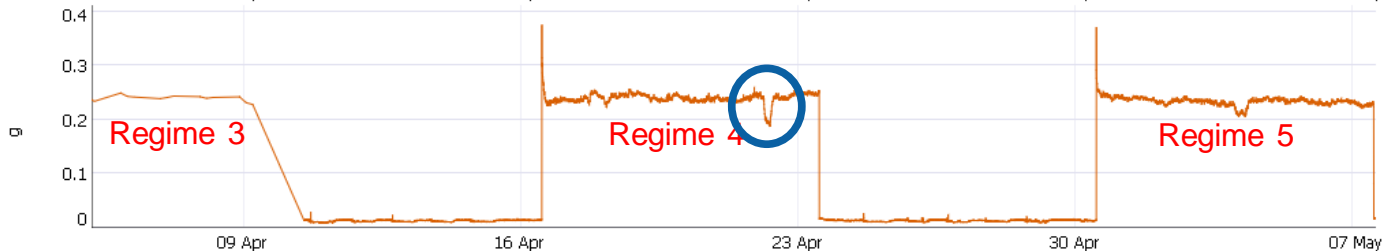


# Is the Pump Normal?

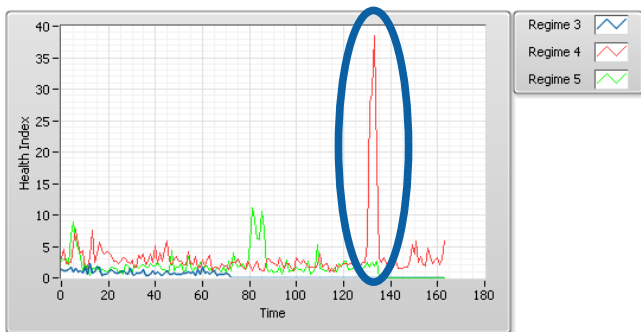
Chilled Water Pump 1



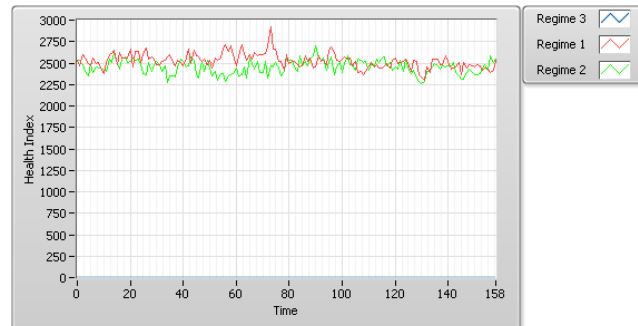
Chilled Water Pump 2



Self Comparison



Peer-Peer Comparison

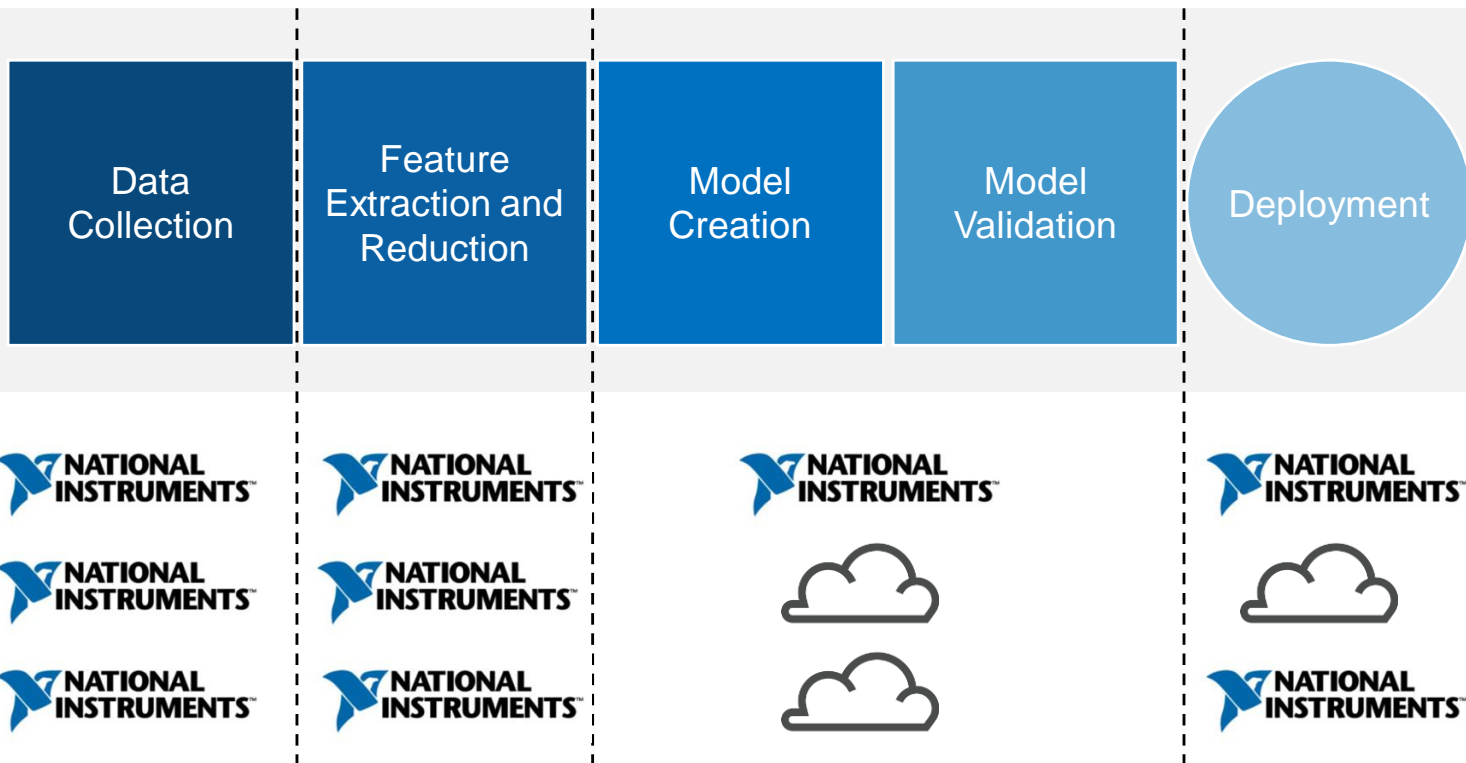




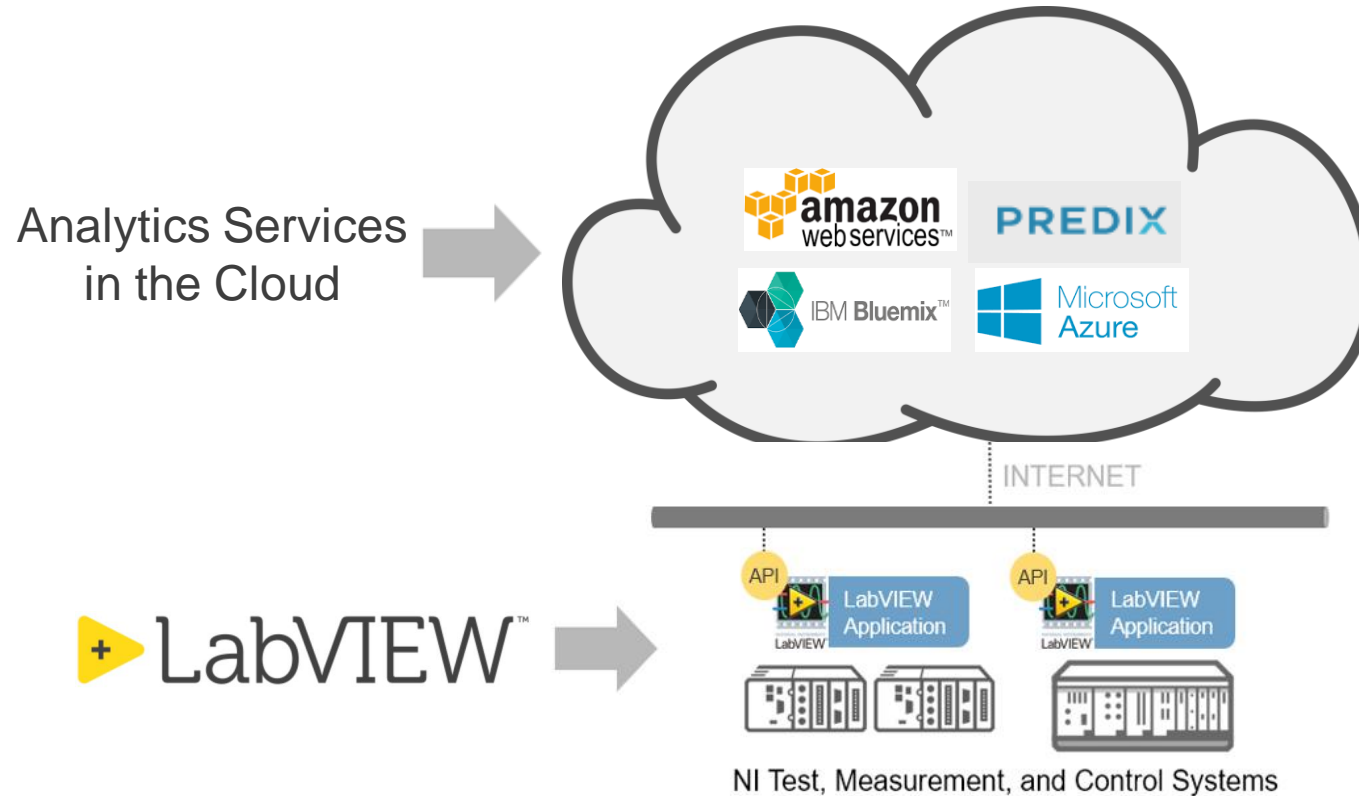
# Improving Results

- Add more features
  - Exterior environmental conditions (e.g., temperature)
  - Electrical signals
  - Features aligned with faults (e.g., bearing fault frequencies)
- Incorporate operational and maintenance history
- Iterate on model as new data becomes available

# Different Analytics Workflow and Deployment Types



# Working With the Cloud



# Summary

- Machine learning holds the promise of extracting actionable information from large amounts of data.
- The NI platform is the best solution for feature extraction and communicating with different data sources.
- The LabVIEW Analytics and Machine Learning Toolkit is an option to develop predictive analytics and machine learning models.



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