ibm.biz/Predictive_Maintenance_Quality

Prepared for:

September, 2015

the timeless concerns of the operations professional

Efficiency

"It is only through enforced standardization of methods, enforced adoption of the best implements and working conditions, and enforced cooperation that this faster work can be assured."

Frederick Winslow Taylor

Quality

"Understanding variation is the key to success in quality and business."

W. Edwards Deming

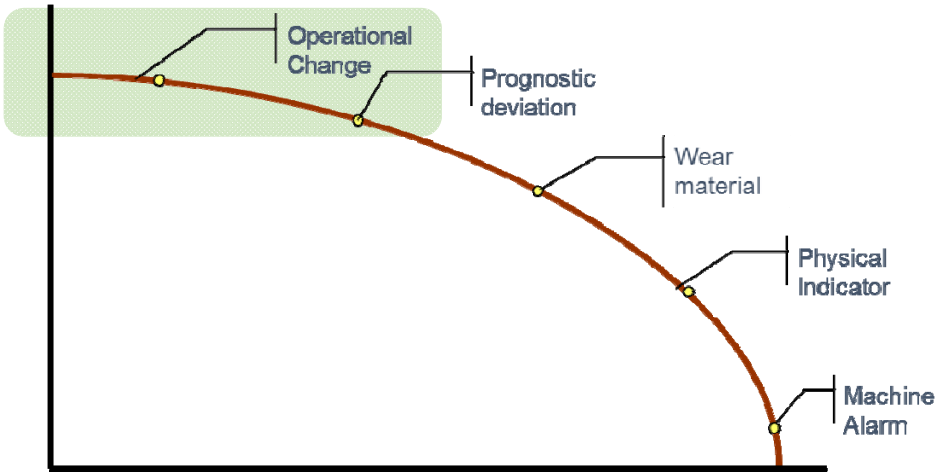
Maintenance

"Maintenance is terribly important."

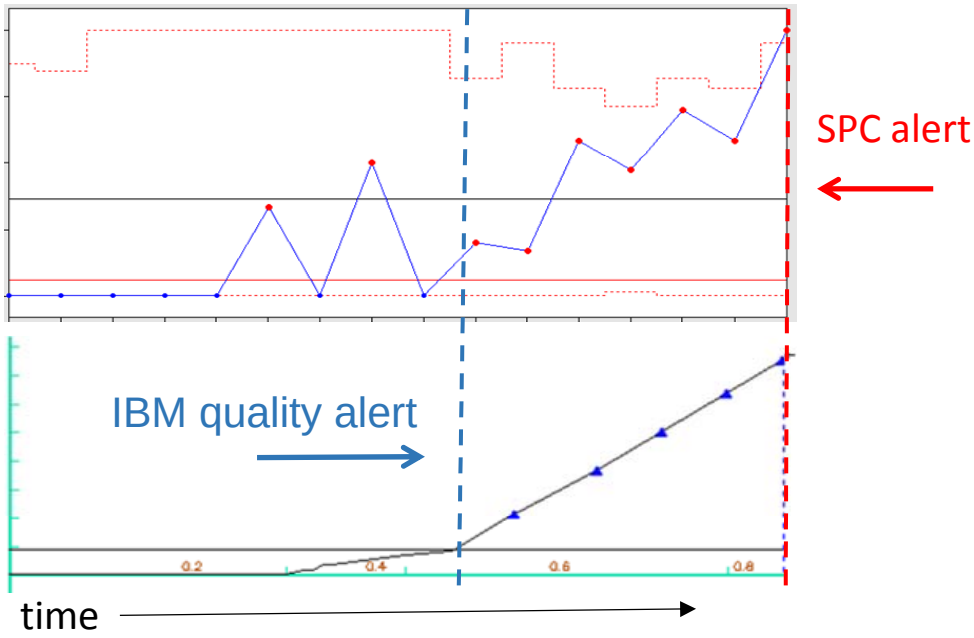
Manolo Blahnik

IBM Predictive Maintenance & Quality enables you to:

monitor, maintain and optimize assets for better availability, utilization and performance

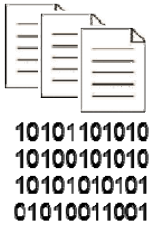


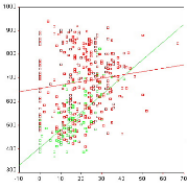
identify minute changes in material or product quality well in advance of traditional statistical process control methods

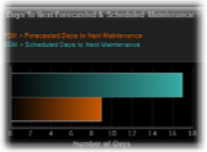


desirable capabilities to operationalize asset data





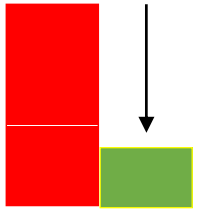





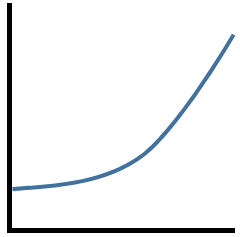
asset + instrumentation + data + connectivity + analytics + monitoring + reporting

real-time, fact-based understanding
of asset performance and usage

reduced unplanned downtime
lower maintenance costs
fewer warranty claims
lower parts and inventory costs



extended asset life
improved product quality
improved production yield
optimized maintenance schedule



gain significantly greater value from the data generated by assets you create, own and manage



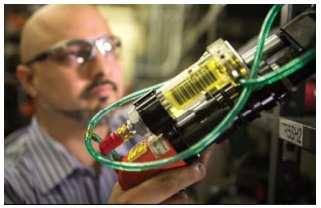


























employ asset data to make it easy to provide detailed, timely, relevant insight to lines of business

product design	are customers using the product in ways that we never imagined?
production engineering/design	is this machine/process operating as well as planned?
supply chain/procurement	how can we reduce supply and materials inventories?
production/manufacturing	where/when are we most likely to have asset failure?
quality control	what are the root causes of quality issues?
maintenance	how can I optimize maintenance schedules and resources?
operations	what are the primary causes of unplanned downtime?
customer service/warranty	what are the top predictors of warranty claims?
field service/repair	what are the optimum locations and quantity for spare parts?
health, safety, environment	are we at risk due to asset failures, product recalls, customer claims?
data scientist/statistician	how can I develop more accurate models of asset performance?

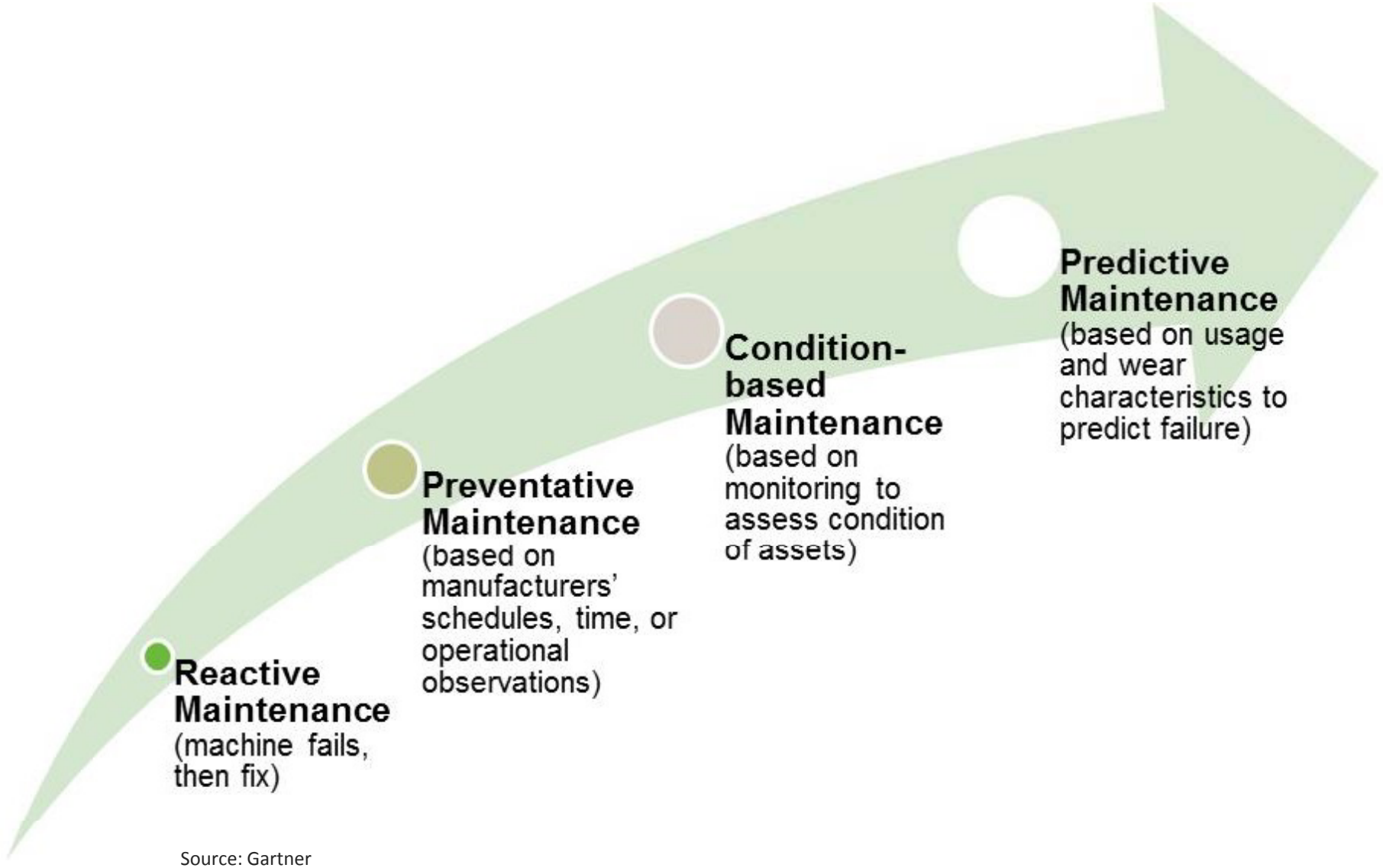
predictive capabilities benefit multiple lines of business

	operations	procurement	production/ manufacturing	quality control	maintenance	process engineering/ reliability	product engineering/	finance &	service/	health, safety,	statistician/ analyst/ data scientist
reduce unplanned downtime, improve asset reliability, availability & utilization	●		●		●	●		●	●		
extend asset life; avoid new asset costs	●				●	●		●			
maintain or improve product quality	●	●	●	●		●					
reduce scrap & process variability; improve yield	●		●	●		●	●	●			
improve manufacturing/production process	●	●	●	●	●	●	●				
reduce maintenance costs	●				●	●		●			
optimize maintenance strategies & practices	●				●					●	
optimize spare/critical parts inventory	●	●			●	●			●		
monitor asset health; remote diagnosis; root cause analysis; predict pending failures	●		●		●	●	●		●	●	●
optimize supplies, materials, components inventory	●	●	●		●			●	●		●
reduce warranty & service costs	●			●	●		●	●	●		
develop new business models, proactive service	●				●				●		●
better analytical tools & algorithms	●	●	●	●	●	●	●	●	●	●	●
reduce risk & compliance exposure	●	●	●	●	●	●	●	●	●	●	●

clients report these benefits

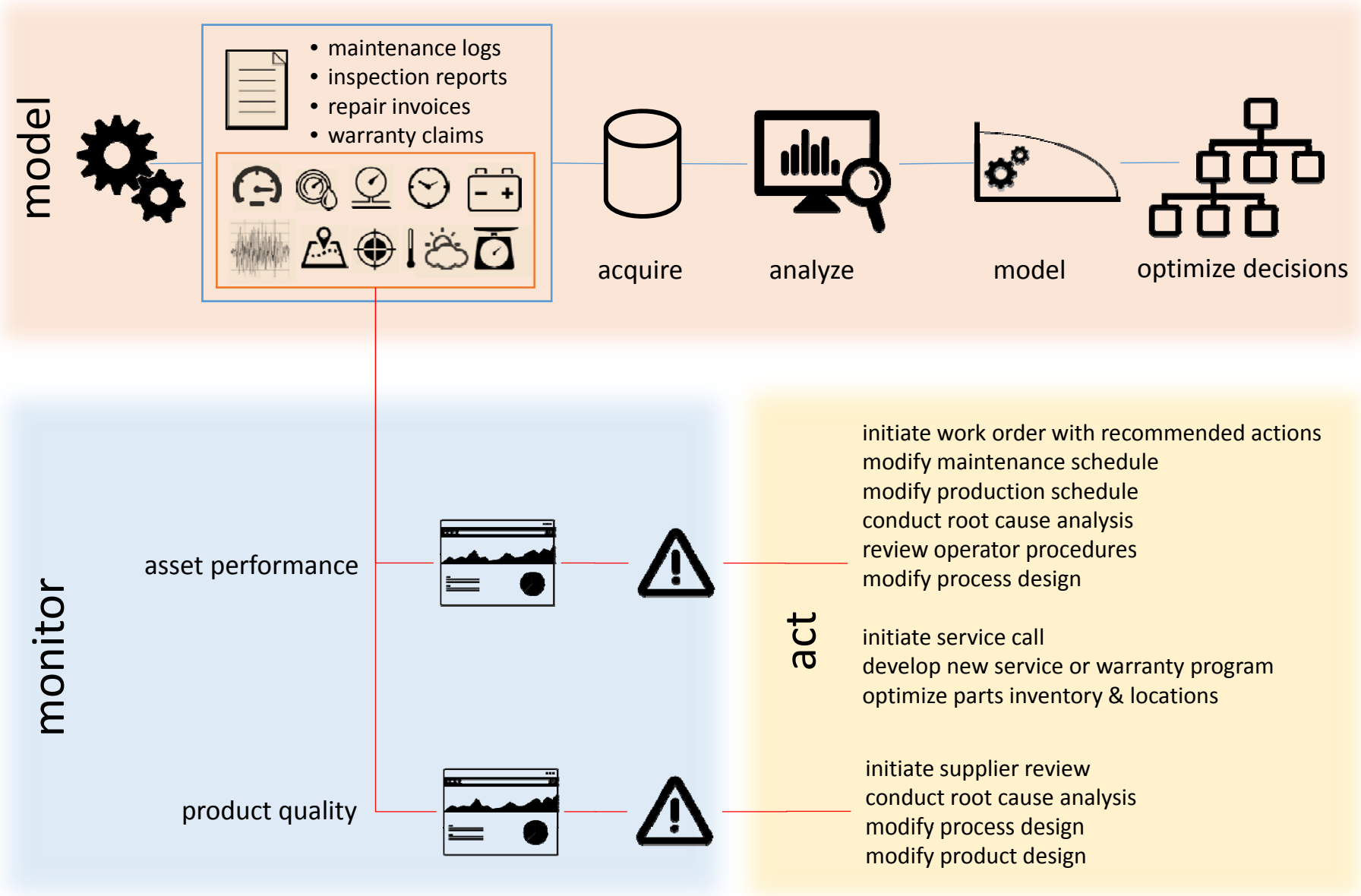
manufacturing	97% **fault recognition** for specific assembly operation
	97% ability to predict **delays & cancellations** within 12 weeks
maintenance	87% accuracy within 48-hour warning about **potential equipment failures**
data scientist/statistician	85% accuracy using analytical model to **predict stuck pipe** situations
customer service	60% ↓ redundant **service calls**
supply chain/procurement	49% ↓ of **average inventory**
maintenance	45.5% ↓ in **unplanned maintenance**
production	34% accuracy predicting **machine failures** 2+ hours ahead of event
product design	33% ↓ anticipated in equipment and vehicle **failures**
production	25% ↑ in overall **production line productivity**
	23% ↓ in **operating expenses**
warranty	20-30% ↓ in **warranty claim** processing times
finance	10%-15% ↓ in annual **OPEX** budget
quality control	10% ↑ in **paint yield**
	7 – 10% ↓ in plant **maintenance costs**
	5% ↓ in **aircraft-on-ground** events
	1%-3% ↓ in annual **CAPEX** budget
maintenance	1% ↓ in overall **maintenance costs**

predictive capabilities can significantly improve maintenance strategy and ability to anticipate pending performance issues

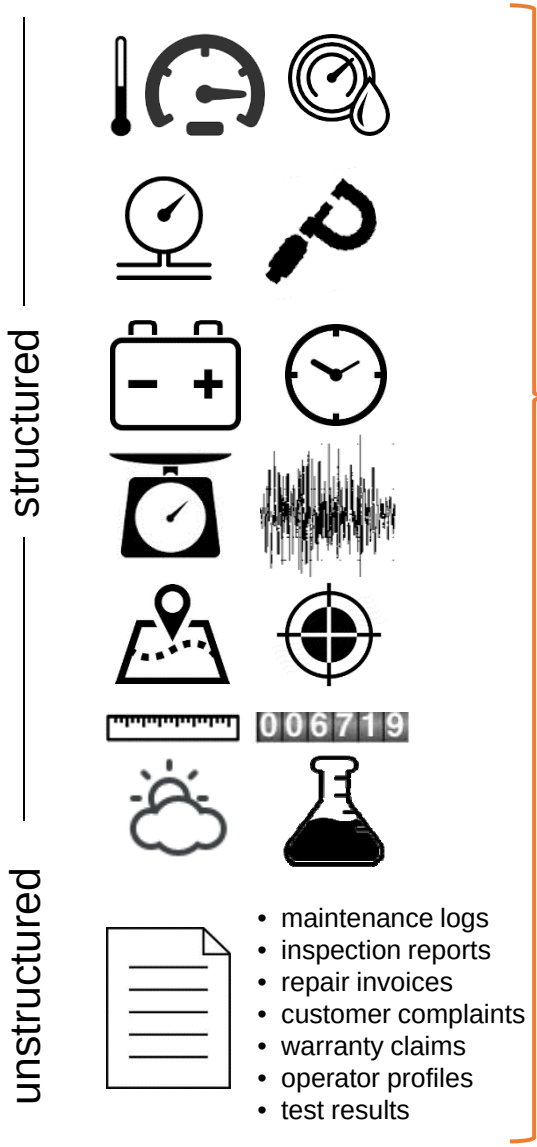


Source: Gartner

transform asset performance data into action



acquire data to gain understanding of asset performance



- Which data best predict performance?
- What are the main factors for failure?
- When is this asset most likely to fail?
- What is the optimum maintenance schedule?
- What are the most effective repair procedures?
- What are the key variables in manufacturing variance?
- Should we modify the warranty program?

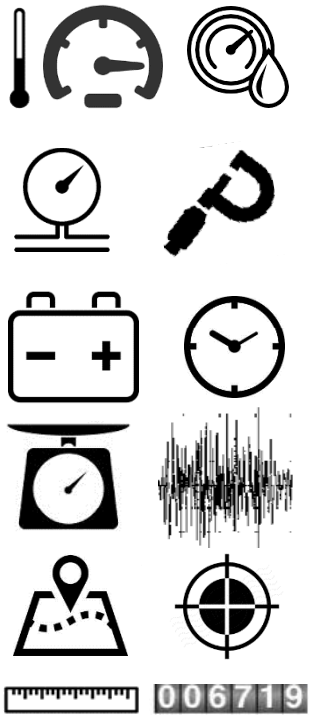
analyze data and develop predictive models

data sources

apply modeling algorithms

identify relevant data sources

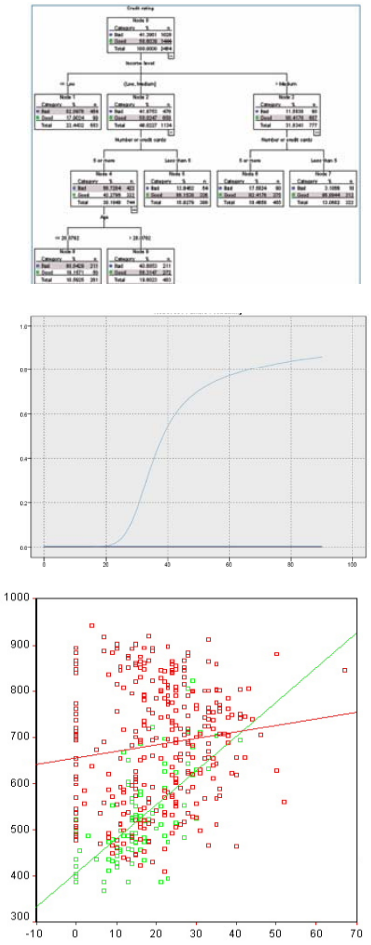
develop optimum model(s)



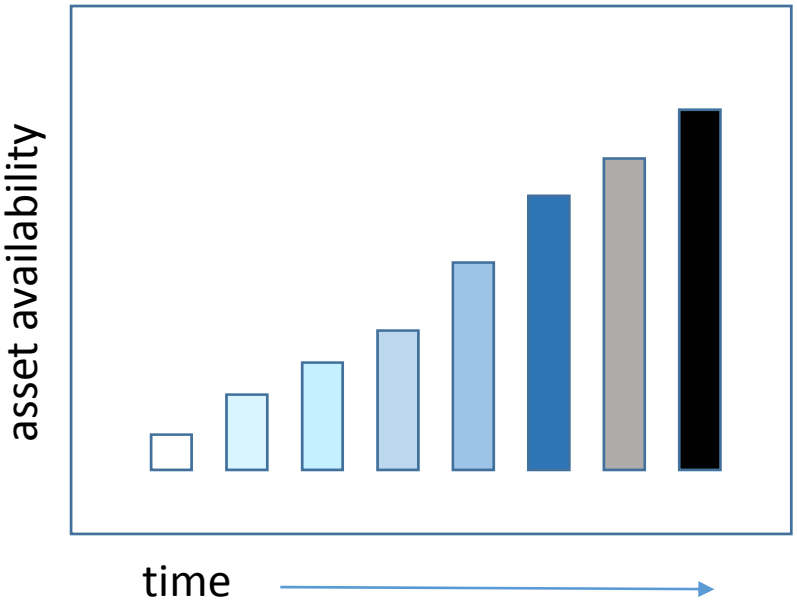
- maintenance logs
- inspection reports
- repair invoices
- customer complaints
- warranty claims
- operator profiles
- test results

maintenance
sensor health
top failure reasons
integrated health
feature based
custom
ensemble
industry-specific assets

- maintenance logs
- warranty claims



refine models to improve predictive accuracy

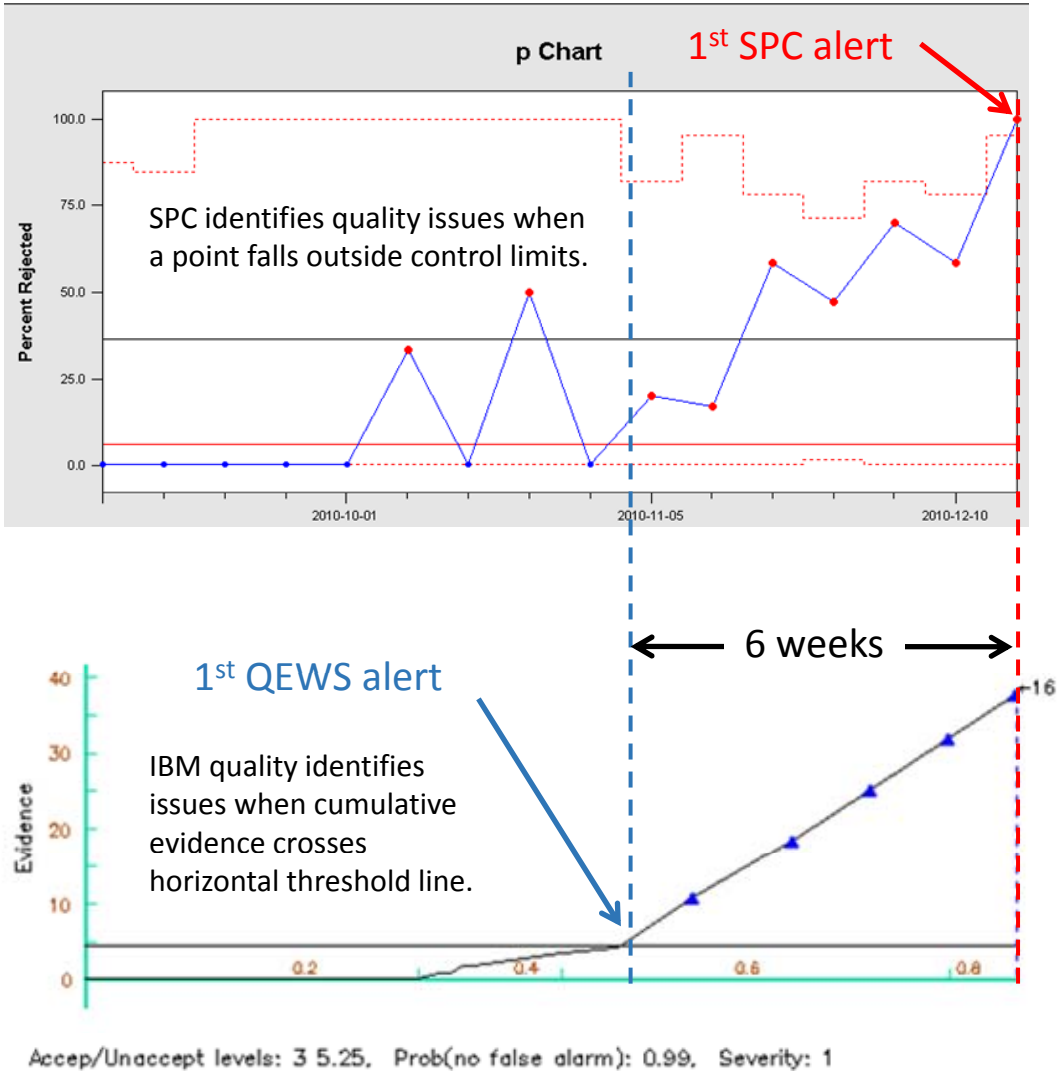


- Manufacturer MTBF
- Use Only Maintenance Records
- Account for Censoring
- Add Textual Info From Maintenance Records
- Add Condition Monitoring Data
- Add Operating Conditions Data
- Add Damage Modeling
- Add Physics-based Models

additional data increases accuracy of predictive models

advanced maintenance modeling techniques leverage combination of event, text analytics, wear, fatigue and cycle data, to provide a more accurate view of asset health

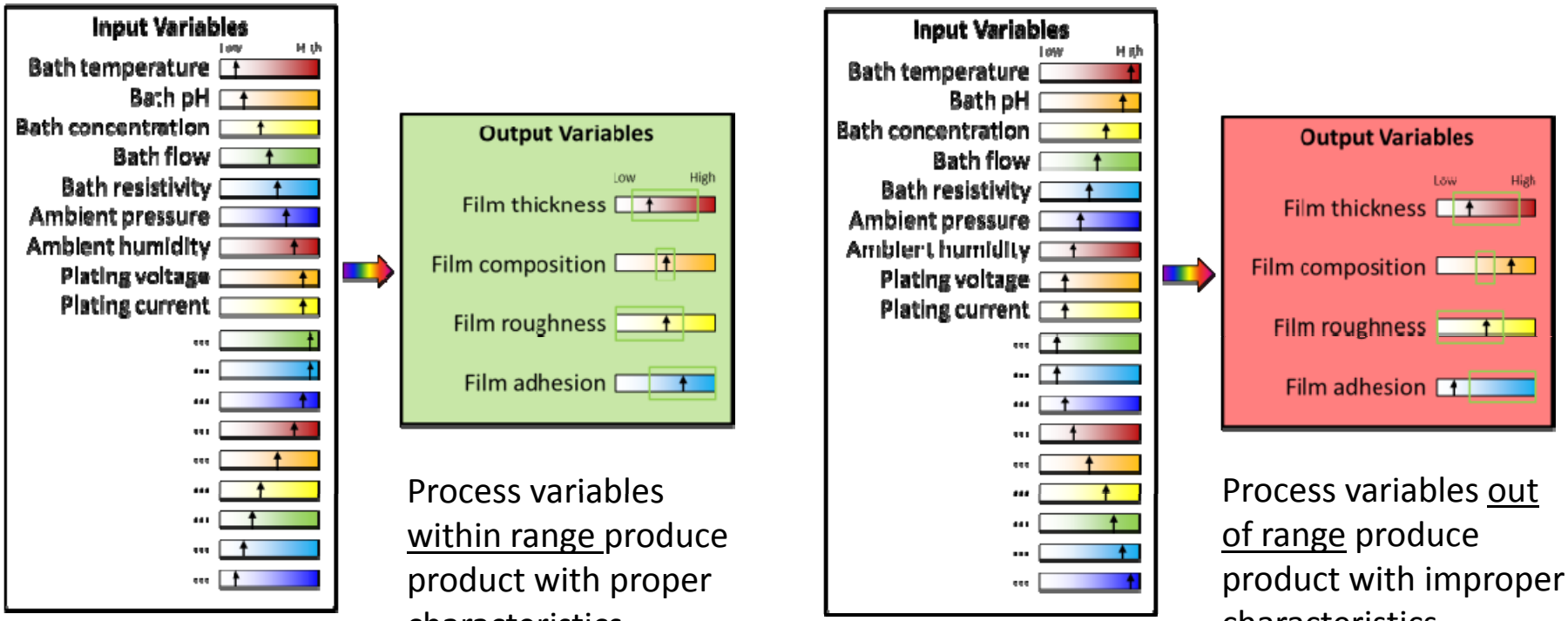
identify minute changes in material, process or product quality well in advance of traditional statistical process control methods



- Evaluate quality of supplier materials and components
- Determine whether sequence of process is adhering to normal operation limits
- Provide faster detection of manufacturing quality problems
- Gain better understanding of root causes of manufacturing issues
- Improve manufacturing/ production yields
- Improve manufacturing process quality to reduce warranty claims
- Optimize pricing for warranty programs

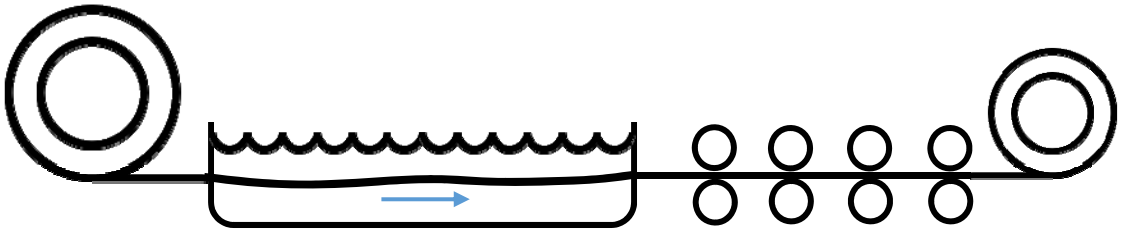
Timely detection of unacceptable process behavior while maintaining a pre-specified low rate of false alarms

determine optimum settings for process input variables to achieve requiredoutput results



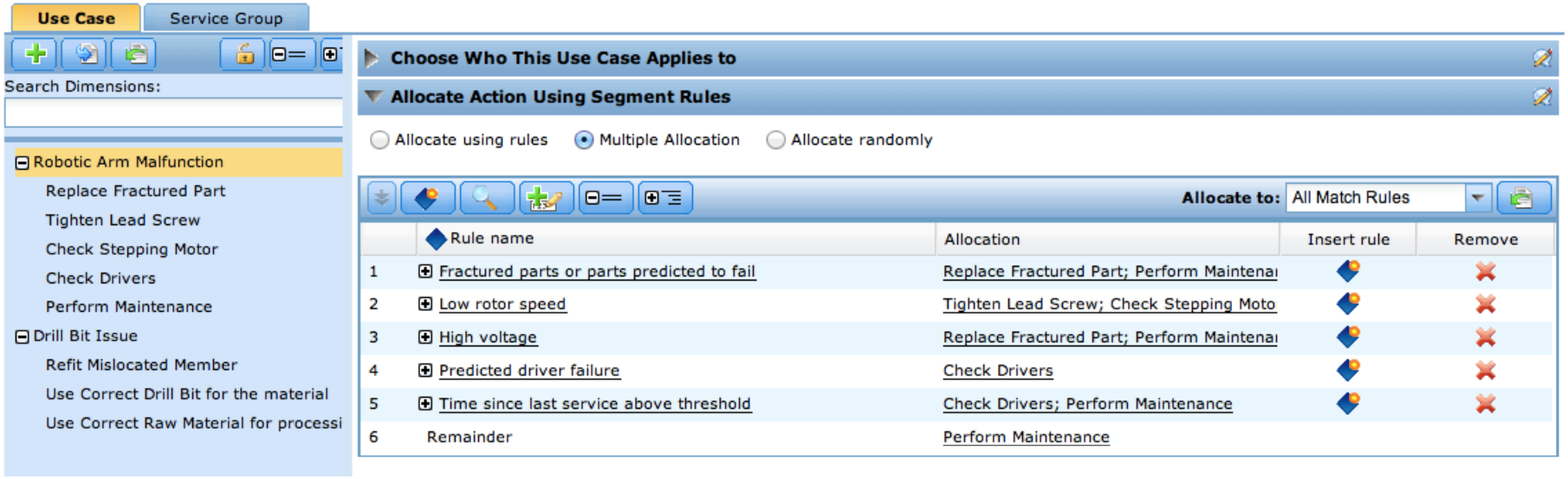
Process variables within range produce product with proper characteristics

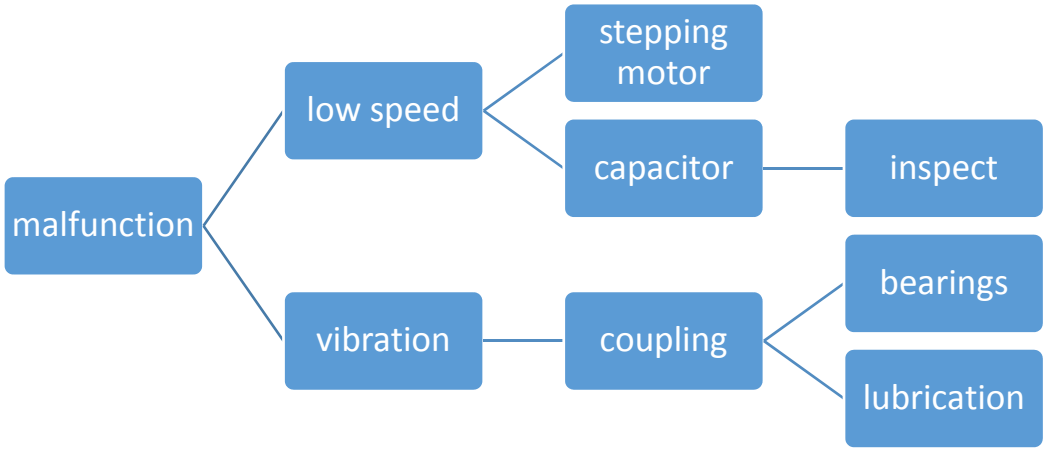
Process variables out of range produce product with improper characteristics



film manufacturing process

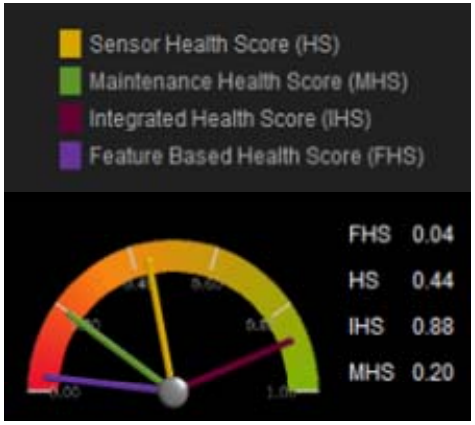
determine optimum response to an alert based upon asset health



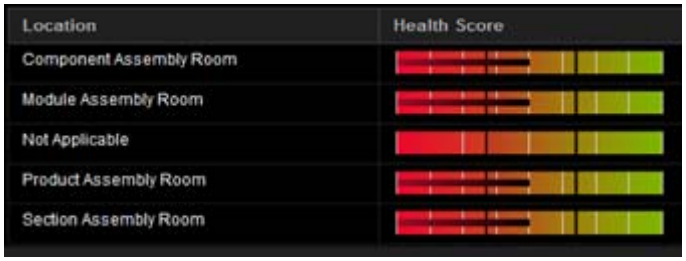


Apply knowledge of subject matter experts, best practices, OEM guidance, current asset health to develop the most effective responses

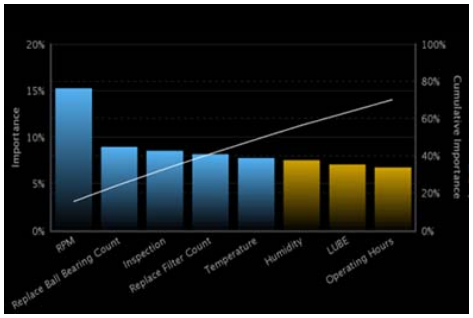
monitor asset health and performance, and product quality



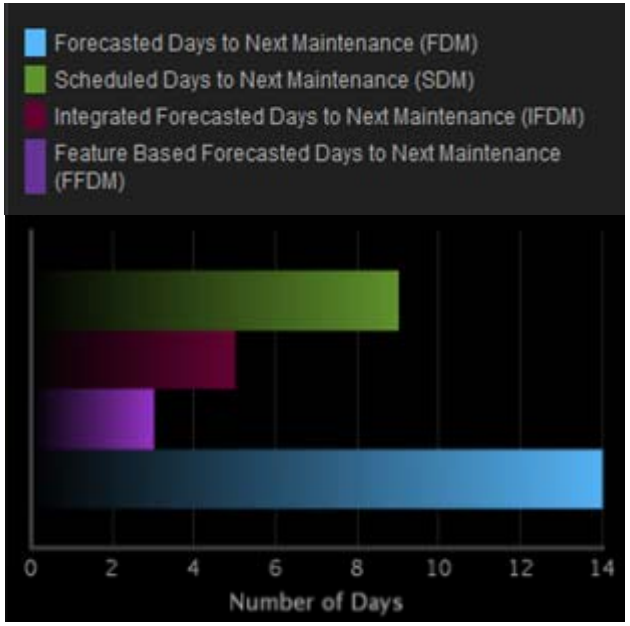
asset health score



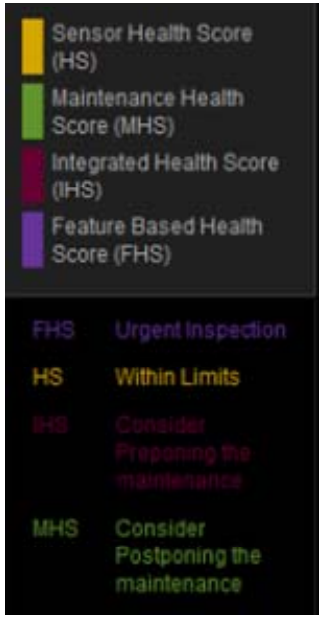
site health score



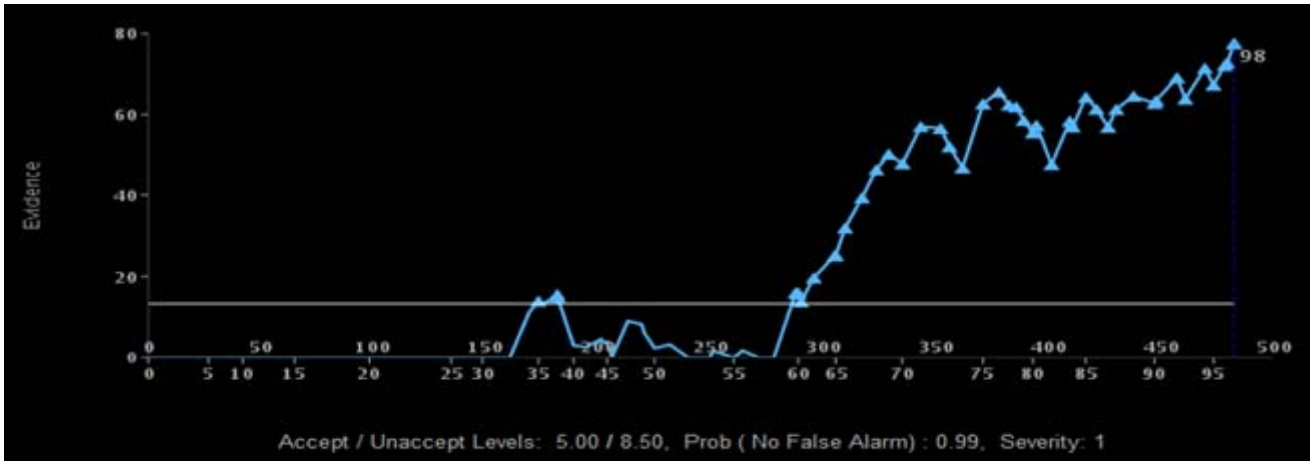
top failure reasons



maintenance schedule

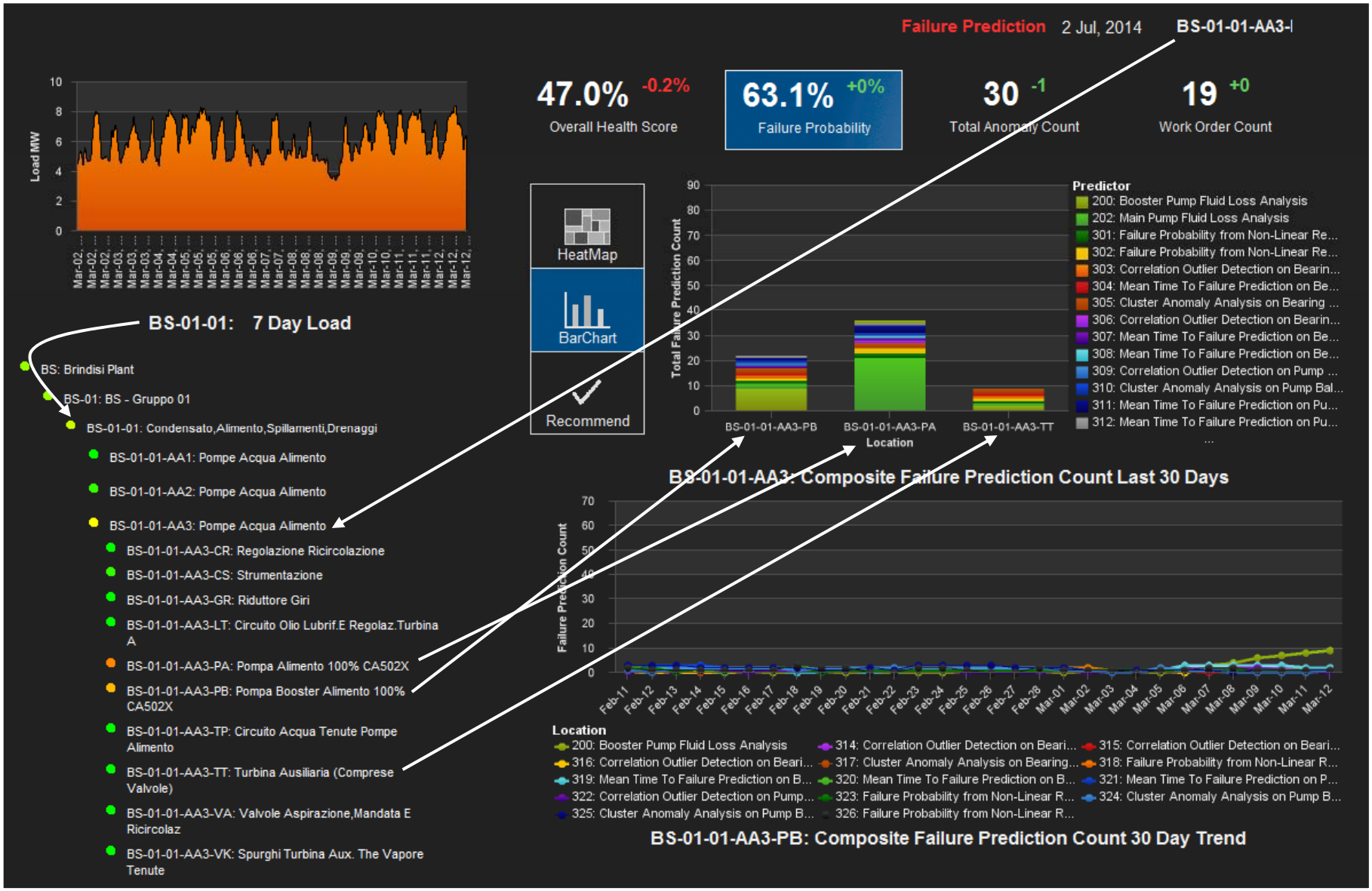


recommendations



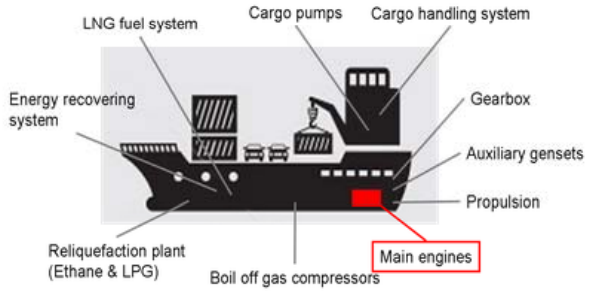
process & material quality

provide an overall view of process performance

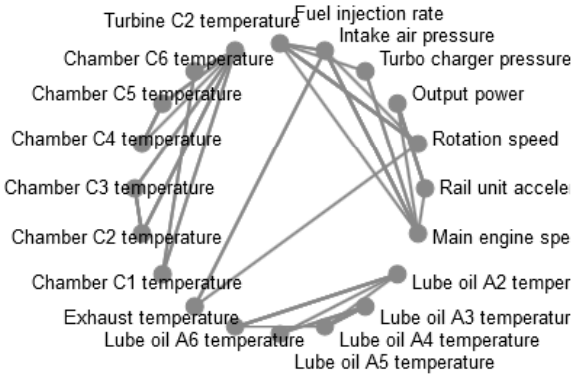


UNIT STATUS

Vessel Name: VLCC1098

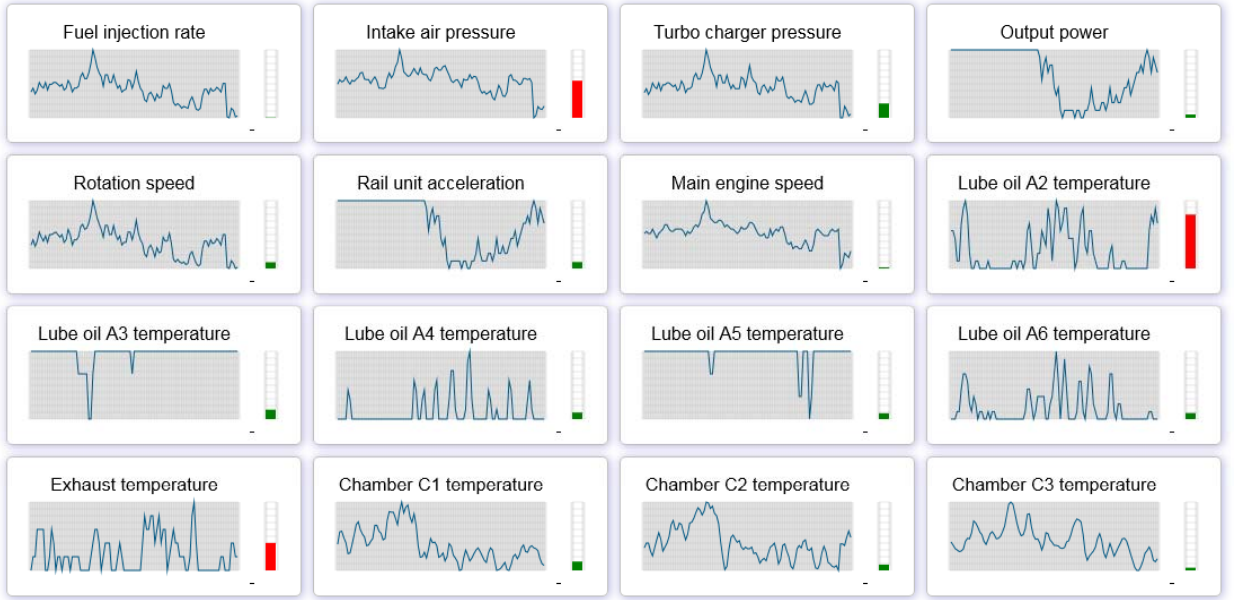


Dependency Graph Discovered



monitor, identify, assess, and respond to asset alerts

Sensor values and anomaly scores | Main engine (7RTA84TB) | Power unit A1 | VLCC1098



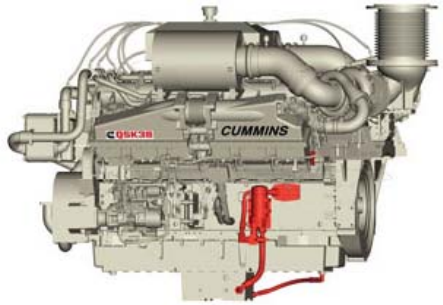
Error Parts List

Error Parts	Fault Probability	
1. Lube purifier unit		85%
2. Sea water cooling unit		66%
3. Fuel injection unit C4		54%
4. Fuel servo unit C4		32%
5. Fuel injection unit C1		22%
6. FCM20 #03 (Flex Control Module)		21%

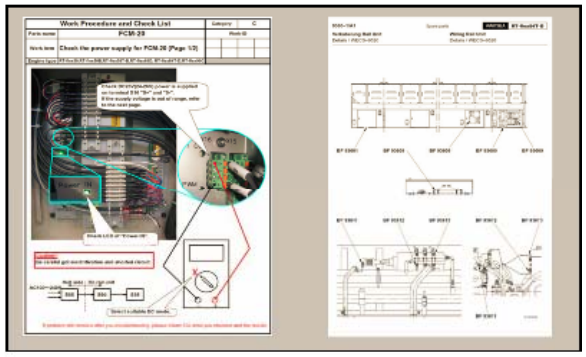
Check Point for Selected Parts

Check Point
1. Check lube pump pressure gauge
2. Check lube pump control unit
3. Check lube viscocity indicator
4. Check MF-Detector LED
5. Check coolant leakage
6. Check lube TMP record

Arrangement of Selected Parts

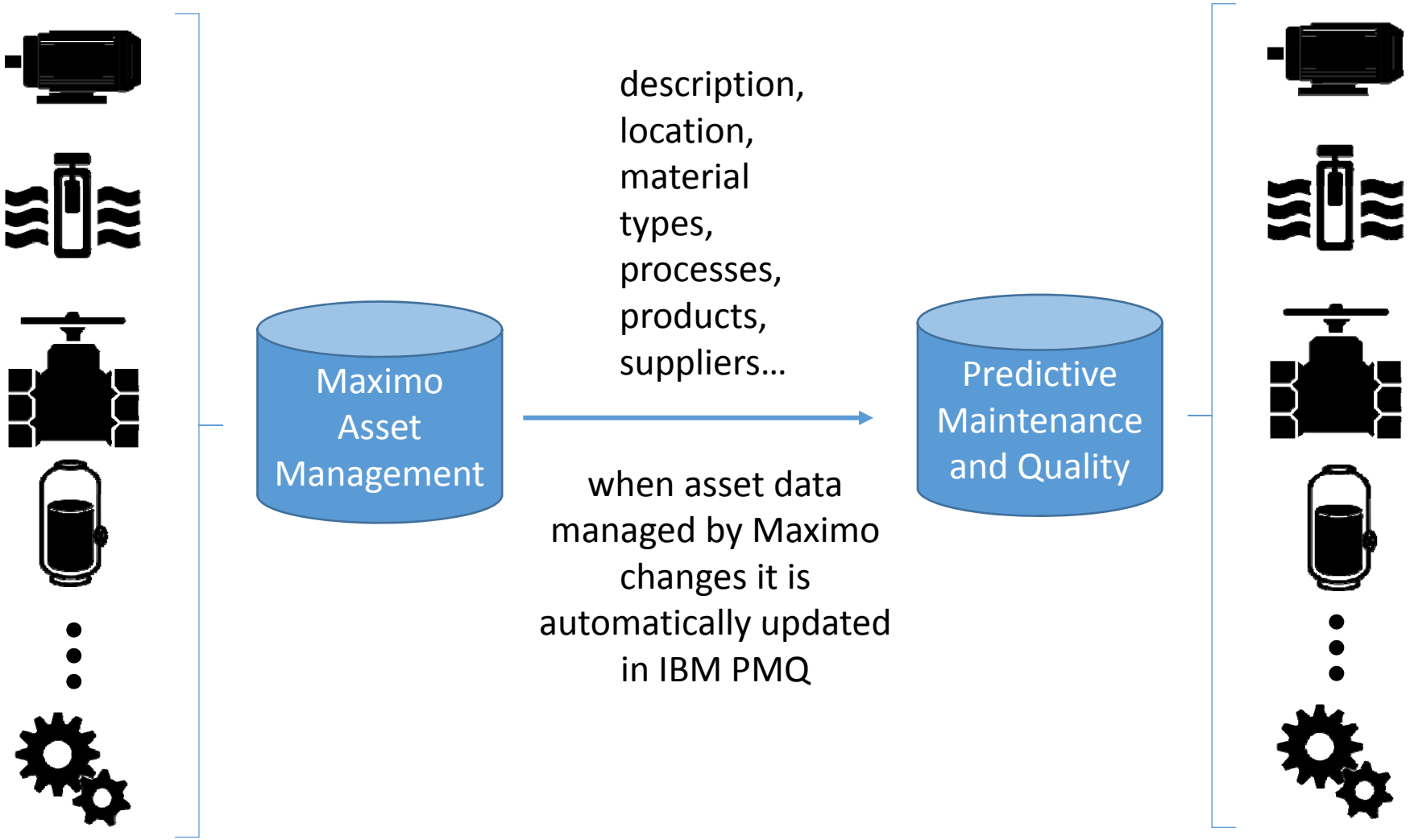


Work Procedure and Check List



integrate with EAM systems

accelerate implementation by importing asset master data from Maximo



analyze Maximo work orders to understand asset failure and optimize maintenance schedules

Work Order	Description	Location	Asset	Status	Priority	Site
1000	Relocate Guard Rails Around Compressor	BR300	11300	WAPPR	2	BEDFORD
1008	Repair Damaged Conduit Feeding Generator	BR230	11230	WAPPR	7	BEDFORD
1004	Generator Overhaul	BR230	11230	INPRG	1	BEDFORD
1006	Feedwater Pump Service	BR450	11450	APPR	7	BEDFORD
1002	Rebuild Feedwater Pump	BR450	11450	APPR	3	BEDFORD
1008	Repair Damaged Conduit Feeding Generator	BR230	11230	WAPPR	7	BEDFORD
1004	Generator Overhaul	BR230	11230	INPRG	1	BEDFORD
1006	Feedwater Pump Service	BR450	11450	APPR	7	BEDFORD
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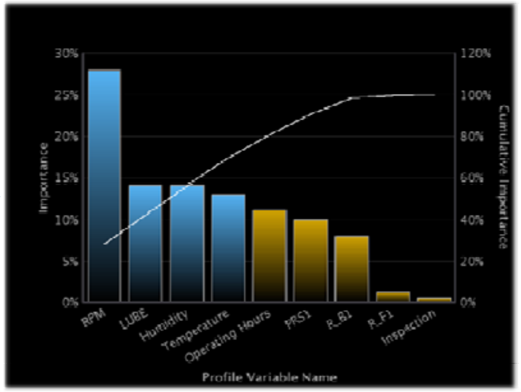
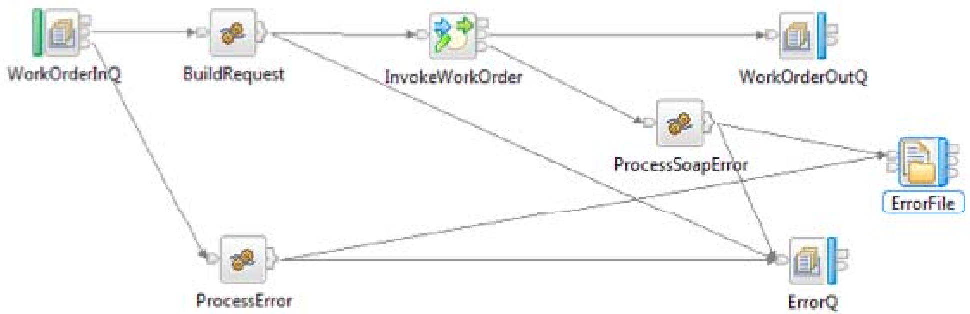
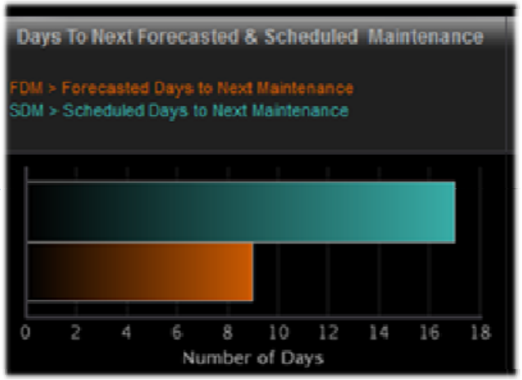
1002	Rebuild Feedwater Pump	BR450	11450	APPR	3	BEDFORD



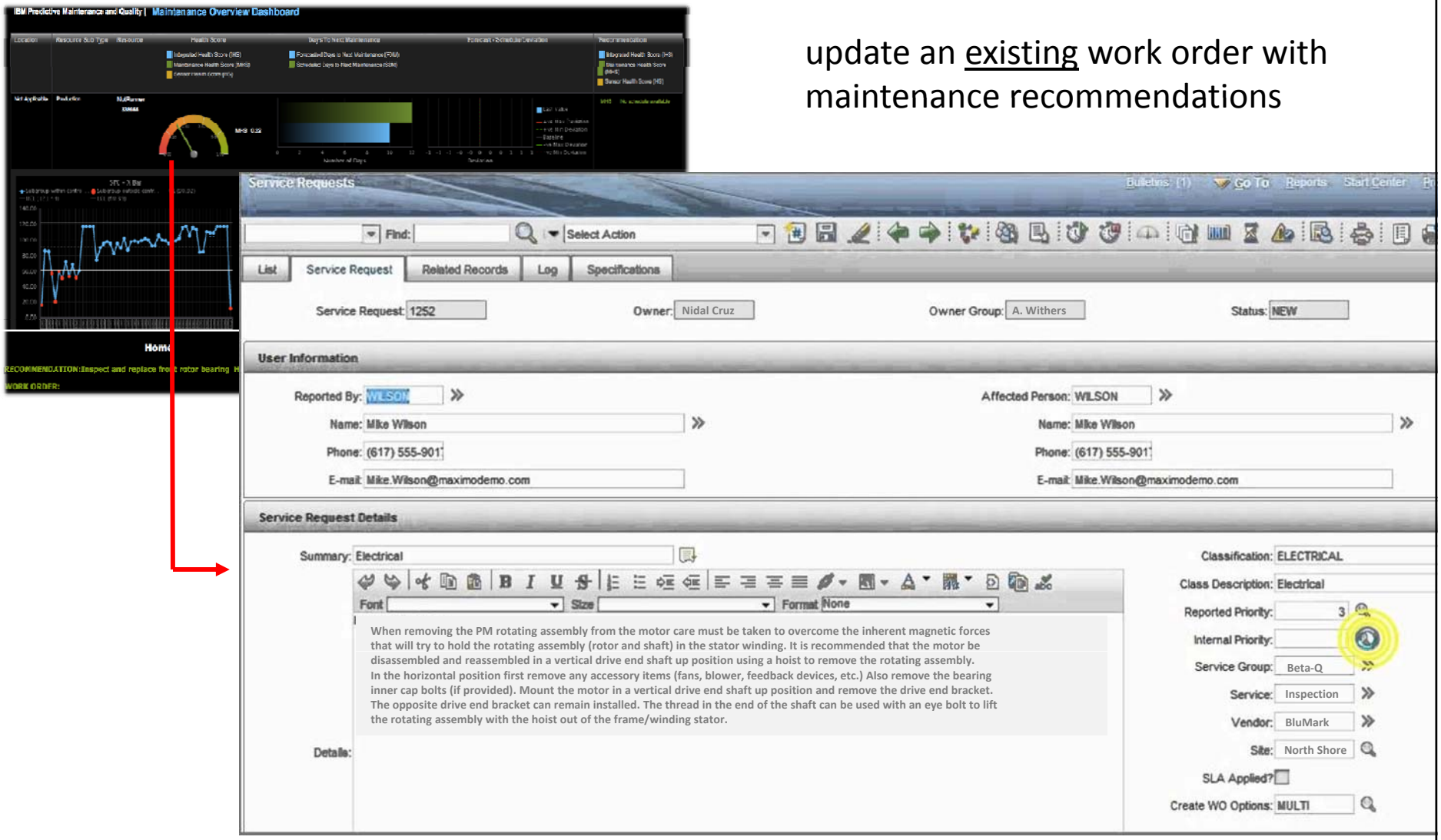
top failure predictors





optimized maintenance period

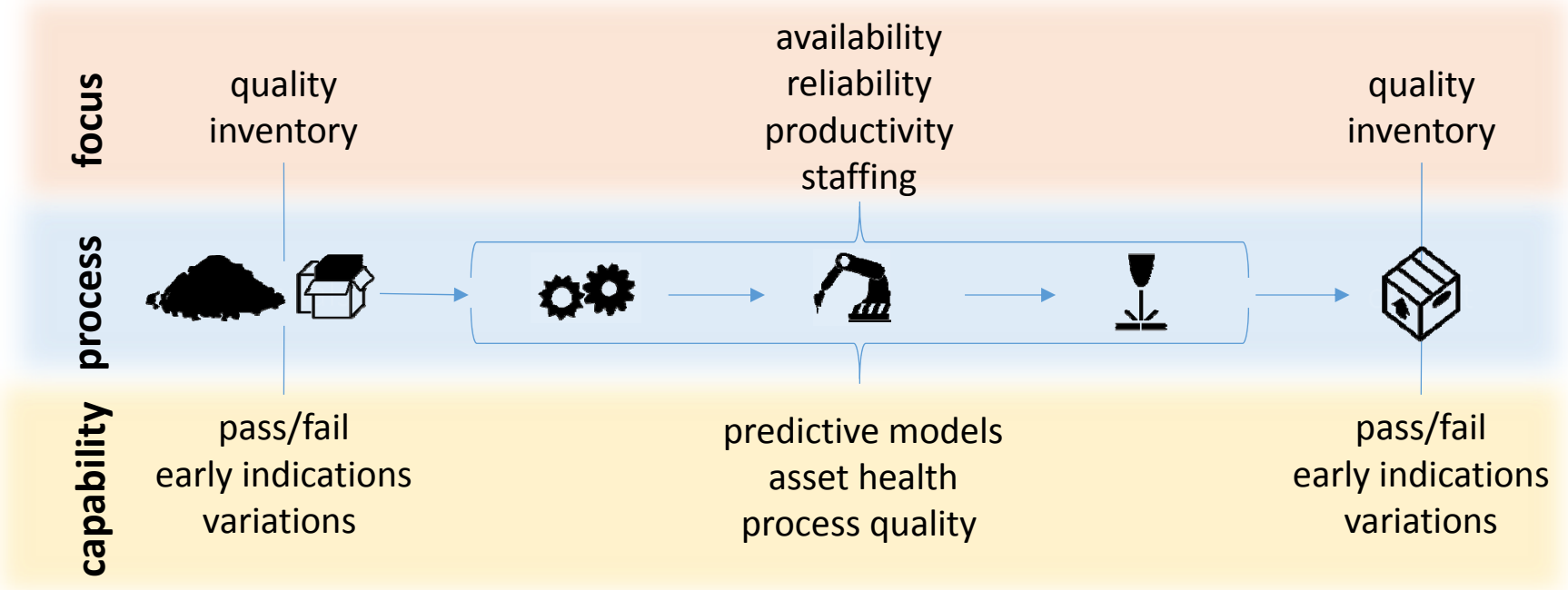
automatically initiate Maximo work orders with recommended actions



update an existing work order with maintenance recommendations

Production Line Manager

Maximize efficiency of production resources



- Meet production and budget targets
- Reduce process variability
- Reduce/eliminate scrap, increase yield
- Avoid unplanned downtime

- Optimize inventory levels
- Reduce operational risk / improve process safety
- Streamline processes and improve OEE
- Optimize resource scheduling

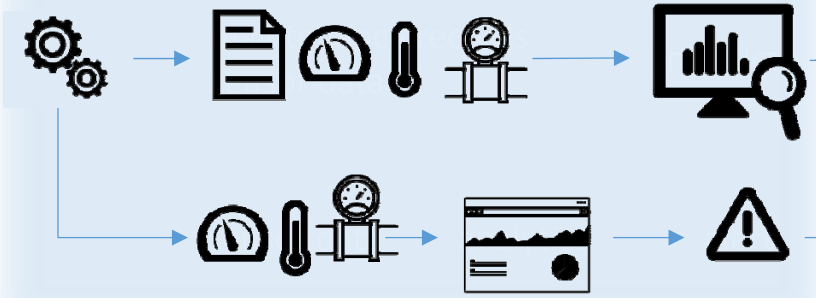
Maintenance Manager

Minimize unplanned production line downtime

focus

maintenance schedules
parts availability
diagnosis
technical skills
efficiency
procedures

process



capability

most frequent failures
predictive models
asset health score
root cause analysis
what-if scenarios

recommendation → work order

- Eliminate or reduce unplanned maintenance
- Optimize maintenance schedules and resources
- Reduce spare parts/materials inventory
- Optimize spare parts/materials location
- Avoid cost of expedited parts deliveries
- Reduce maintenance costs
- Extend asset life; avoid new asset costs
- Reduce health, safety and environmental risks

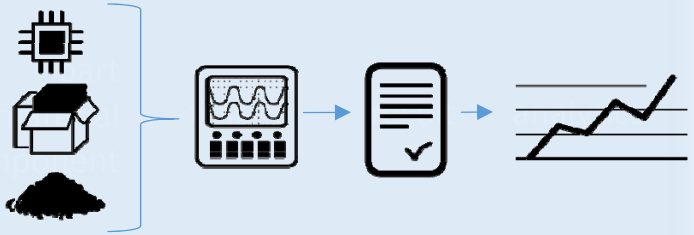
Quality Control

Minimize scrap, returns, service calls, warranty claims

focus

part, material, component quality
process quality
product quality
health, safety, environmental risk
analytical accuracy

process



capability

pass/fail
parametric
SPC
mean shift
early indications*

- Reduce/eliminate scrap
- Reduce costly re-work
- Reduce returns
- Reduce warranty costs

- Reduce process variability to improve yield
- Identify root causes of quality problems
- Identify substandard materials/ supplies/components
- Reduce risk associated with poor quality

*IBM research algorithms

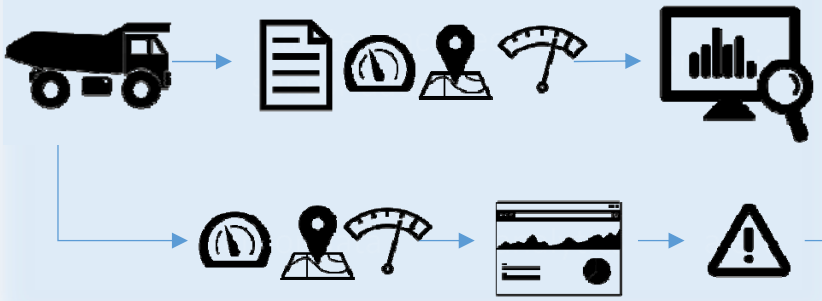
Field Asset Manager

Maximize availability of field assets

focus

asset availability
parts availability
diagnosis
technical skills
efficiency
procedures
repair time

process



capability

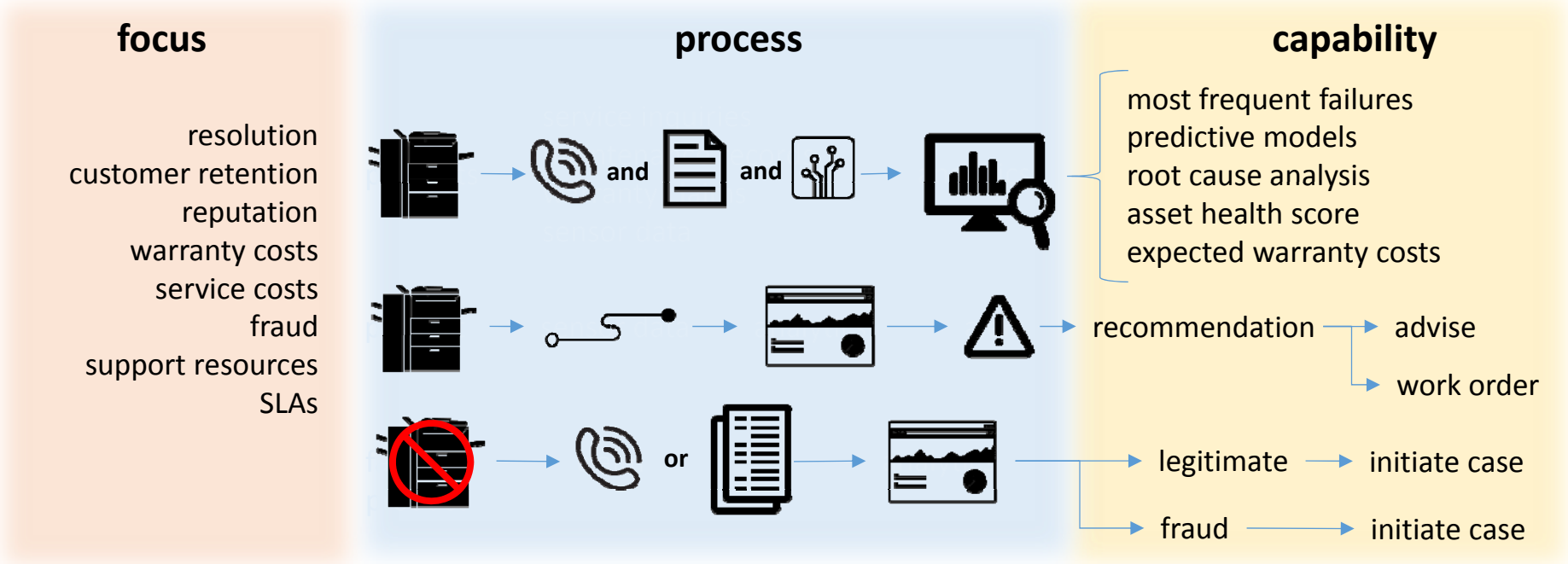
most frequent failures
predictive models
asset health score
root cause analysis
what-if scenarios

recommendation → work order

- Increase asset availability
- Reduce unplanned maintenance
- Reduce maintenance costs
- Optimize maintenance schedules and resources
- Reduce spare parts/materials inventory
- Optimize spare parts/materials location
- Avoid expedited parts delivery costs
- Comply with safety, regulatory, legal requirements

Customer Service & Warranty

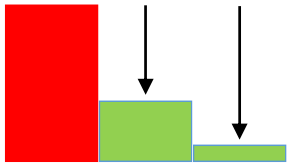
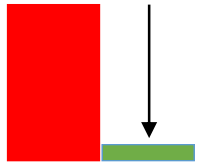
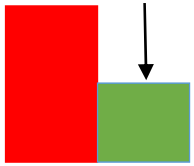
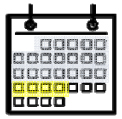
Efficient resolution & cost effective program



- Optimize warranty terms and programs
- Reduce service costs
- Reduce fraudulent claims

- Optimize warranty and service resources
- Optimize parts inventory and locations
- Transform from product- to service-based model

potential range of impact by employing predictive maintenance and quality

expense	potential improvements*
annual cost of unplanned downtime	reduce 60% to 90% 
excess capacity to compensate for unplanned downtime	reduce up to 90% 
scrap or re-work	reduce up 50% 
asset useful life	extend life 5% to 15% 
cost of failure	annual cost x probability of failure
recall exposure	# of recalls x cost of recall

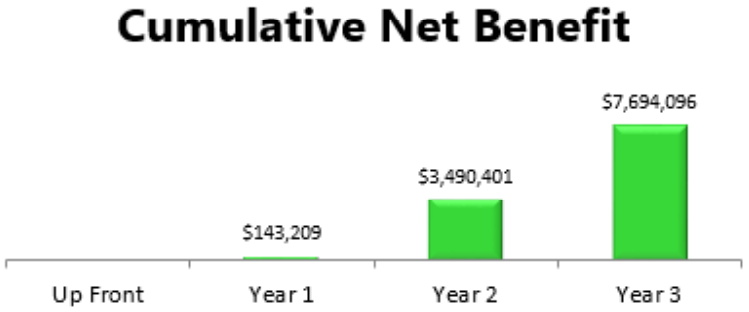
* Based on Nucleus Research analysis

estimate your potential return on investment

Financial Analysis

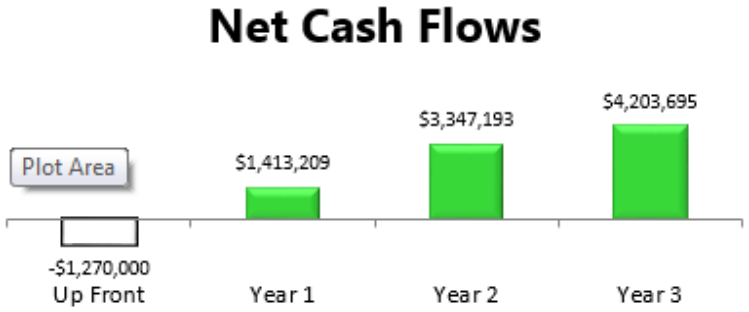
Financial Analysis for: ABC Corporation

Payback Period	**1.0 years**	or	**11.4 Months**
Annual ROI	**155%**		
Net Present Value	4,066,153		
Internal Rate of Return (IRR)	109%		
Average Annual Net Benefit	2,564,699		



Cost : Benefit Ratio | **1 : 5.7**

Total Benefits		Up Front	Year 1	Year 2	Year 3
	Direct	$ -	$ 1,278,209	$ 3,372,193	$ 4,260,695
	Indirect	$ -	$ 140,000	$ 140,000	$ 140,000
Total Costs					
	CAPEX	$ 920,000	$ -	$ -	$ -
	OPEX	$ 350,000	$ 5,000	$ 165,000	$ 197,000
Net Cash Flows		$ (1,270,000)	$ 1,413,209	$ 3,347,193	$ 4,203,695

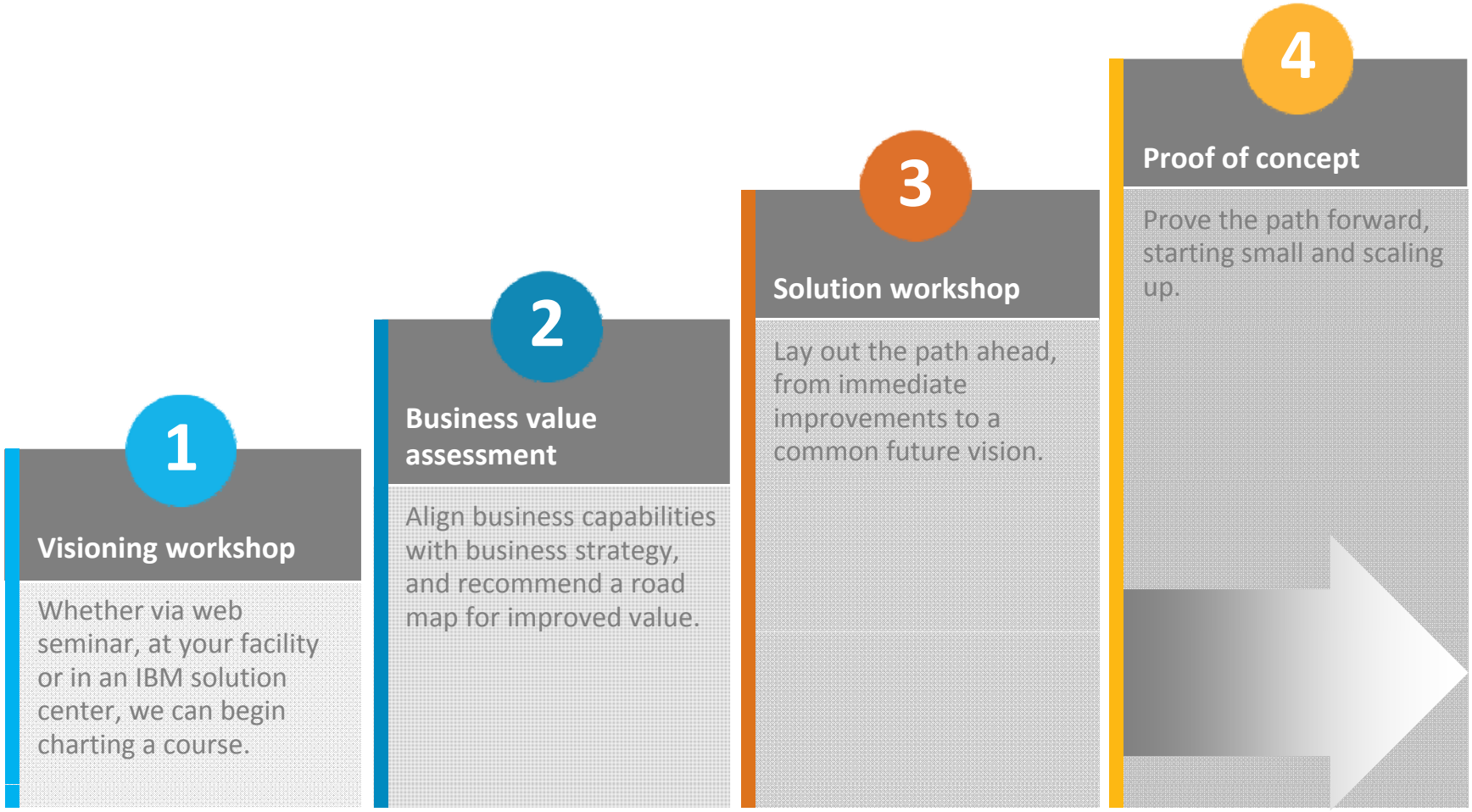


Platform Developer

Customize, extend content for customer environment
Build content for industry-specific assets

focus	capability	benefit
integration	APIs, connectors	integrate with: systems of record & engagement, sensors, PLC, SCADA, EAM, MES, ERP
data	asset- & industry-specific schema, extensible schema	accelerate implementation time with out-of-the-box schema; customize schema to meet asset-specific requirements
models	asset- & industry-specific, predictive maintenance, sensor health, top failure reasons, integrated health, quality early warning system, optimization, custom, automated model refresh	accelerate time to value using standard models; create custom models to meet asset-specific requirements; identify most relevant data describing asset performance; continually improve model accuracy
analytics	runtime ingestion (streaming or batch), aggregation, calculation, scoring, rules	accurately assess asset or process health in real-time; optimize responses to alerts
orchestration	real-time, batch, event detection & handling	immediate detection of critical events; automatically invoke other systems to respond to events
monitoring	configurable dashboards & reports: site overview, product quality, real-time and historic performance, quantitative & qualitative KPIs, recommendations	accelerate time to value using standard dashboards and reports; customize to meet specific line of business needs

Take the next steps to realize the benefits of IBM Predictive Maintenance and Quality for your organization.

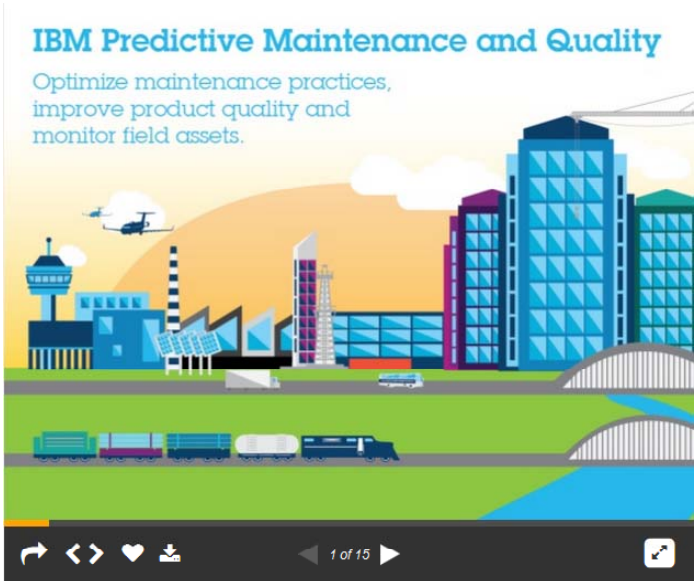


learn more about the breadth and depth of IBM Predictive Maintenance and Quality capabilities

[IBM Predictive Quality Maintenance Helps Predict the Future]

[Maximize asset productivity and operational performance]

[Aberdeen Analyst Report]



[Predictive Maintenance and Quality Slideshare]

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