Smarter Analytics Leadership Summit
Big Data. Real Solutions. Big Results.

Improving Operational and Financial Results through Predictive Maintenance

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Introductions

Jerry Kurtz
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John Ward
Global Industrial Sector Solutions Leader
IBM Predictive Analytics

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Predictive Asset Optimization
IBM Signature Solution

Jerry Kurtz
Vice President
Industrial Business Analytics
and Optimization

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IBM Signature Solutions bring together analytic industry expertise, reusable assets and delivery skills to address high-value client initiatives

A portfolio of outcome-based analytics solutions that address the most pressing industry and functional challenges by bringing together the breadth and depth of IBM's intellectual capital, software, infrastructure, research and consulting services to deliver breakaway results.

Tackle

High-value initiatives

Address industry imperatives and critical processes

Deliver

Proven outcomes

Built on a rich portfolio of analytics capabilities and IBM innovations implemented at clients worldwide

Accelerate

Time-to-value

Faster return on investment with short-term projects that support the long-term roadmap

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Predictive Asset Optimization — optimizes performance and improves quality by integrating IBM's industry, services, software and research expertise

Signature Solutions

Customer Next Best Action	Anti-fraud, Waste & Abuse	CFO Performance Insight	**Predictive Asset Optimization**

New Signature Solution: Predictive Asset Optimization

- Monitor, maintain and optimize assets for better availability, utilization and performance
- Predict asset failure to optimize quality and supply chain processes

Combined with user-friendly, industry dashboards, accelerators and methods

Manufacturing | Energy and Utilities | Oil and Gas

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Asset-intensive companies need help to solve complex operational and process issues

Asset Performance

- Lack of visibility into asset health
- High costs of unscheduled maintenance
- Inability to accurately forecast asset downtime and costs

Process Integration

- Difficulty separating the “signals” from the “noise”
- Lack of visibility of predictors across organizational silos
- Inability to leverage analytical insights for asset optimization

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Predictive Asset Optimization integrates Analytics Capabilities with Enterprise Asset Management (EAM)

Business analytics can provide insights and actionable events to improve operational efficiencies, extend asset life and reduce costs

Enterprise Asset Management

- Asset maintenance history
- Condition monitoring and historical meter readings
- Inventory and purchasing transactions
- Labor, craft, skills, certifications and calendars
- Safety and regulatory Requirements

Predictive Asset Optimization

Advanced Enterprise Asset Management

- Optimized maintenance windows to reduce operating expense
- Efficient assignment of labor resources
- Minimize parts inventory
- Improved reliability and uptime of assets

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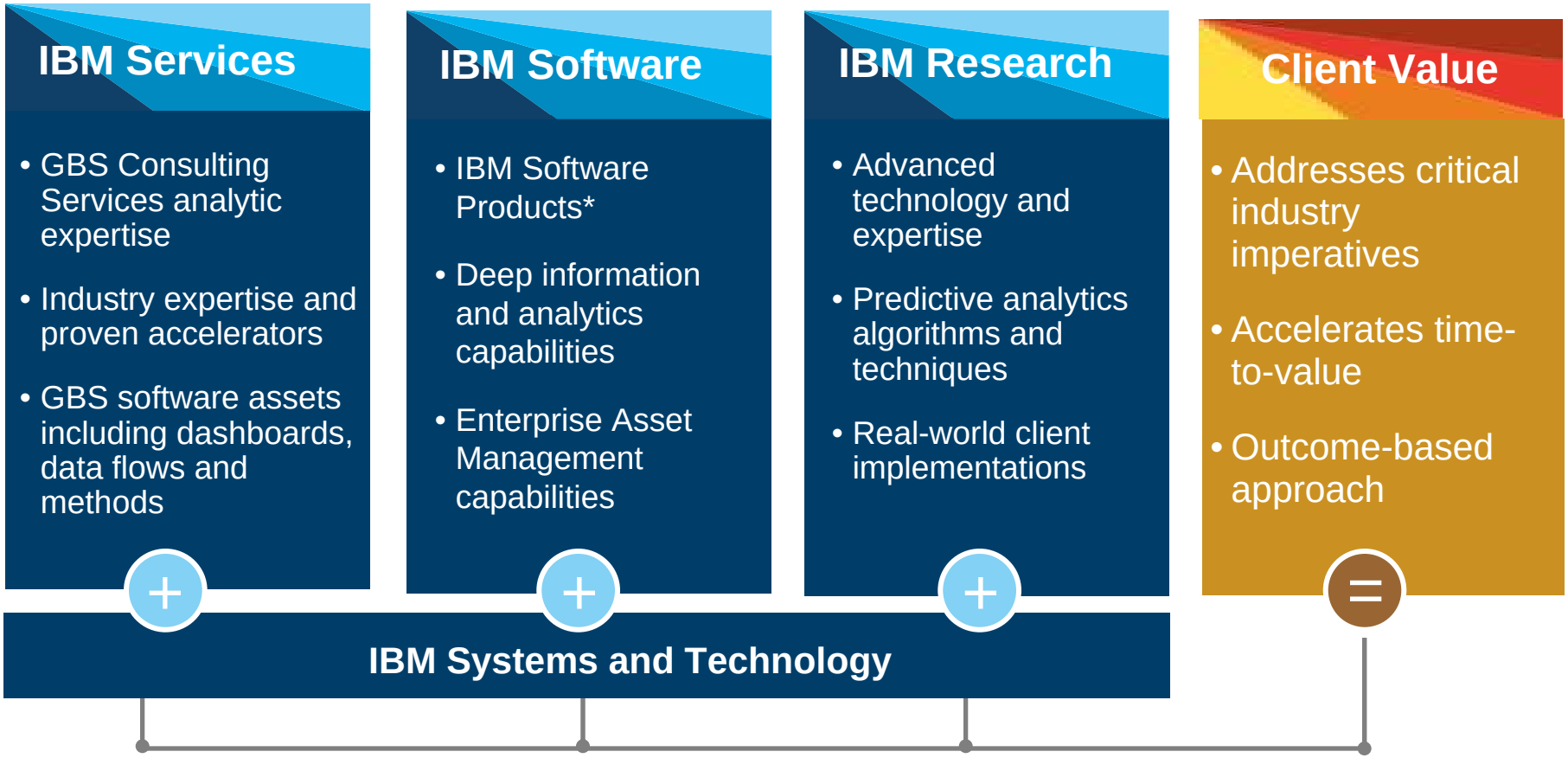
IBM delivers business value with extraordinary differentiation in analytics skills, products, innovation and marketplace experience



Smarter Analytics Signature Solutions bring together these capabilities

"…whole is greater than the sum of its parts."

* IBM SPSS, Cognos, InfoSphere, WebSphere, Maximo

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Why choose IBM's Signature Solution: Predictive Asset Optimization?

Industry Expertise

- Predictive models for a number of specific industry use cases

Big Data, Predictive & Advanced Analytics

- An enhanced advanced analytics methodology, tailored to the needs of the predictive asset/maintenance space

Accelerators

- Pre-configured dashboard/visualization templates
- Pre-integrated software tools, with connectors to a variety of asset management solutions

Talent

- A resource pool of highly talented advanced analytics SMES and Industry experts with Predictive Asset Optimization experience

IBM Investment	
R&D	$6B
Analytics acquisitions	$14B
Analytics business acquired	28
Advanced mathematicians	200
Research scientists	> 400
Analytic solution centers	8
Analytics consultants	9000

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Trends in Predictive Maintenance

Paul Hoy, CPIM
Global Industrial Sector Executive
IBM Business Analytics

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Analytic solutions enable optimization of asset performance

3x

Organizations that lead in analytics outperform those that are just beginning to adopt analytics by 3 times

83%

83 percent of CIOs cited analytics as the primary path to competitiveness

Asset Performance

- Improve quality and reduce failures and outages
- Optimize service and support

Source: IBM Institute for Business Value and MIT Sloan Management Review, “Analytics: The New Path to Value”

Process Integration

- Optimize operations and maintenance
- Enhance manufacturing and product quality

Source: IBM CIO Study, "The Essential CIO"

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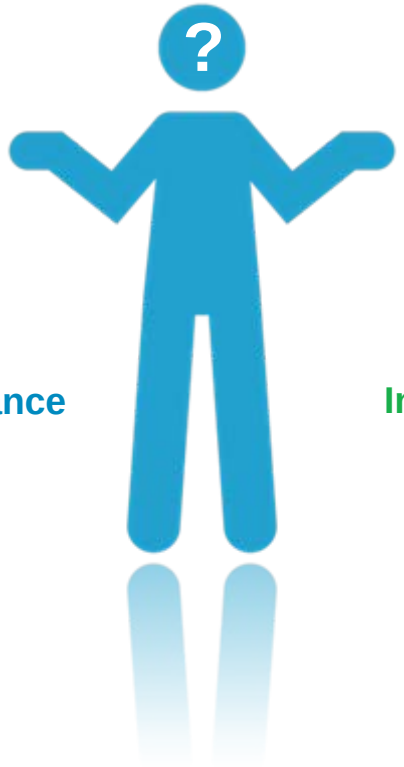
Answering the questions associated with better asset and process performance

How can I perform in depth root cause failure analysis on my process and equipment?

How can I optimize my maintenance plan?

How can I detect warranty issues sooner?



What is the life expectancy of an asset's component or part?

How can I predict an impending equipment failure and the cause?

How do I achieve optimal equipment efficiency and availability?

Asset Performance

Process Integration

How can do I create highest quality products?

How can I reduce process variability?

How can I ensure supply is aligned with demand?

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Predictive Maintenance Use Case – Key Examples

➢Predictive Maintenance for Assets

- **Predictive Production Line Continuity**
  - Utilize predictive analytics to identify when internally used production machinery, equipment, and assets are likely to fail or need service, and perform preventive maintenance in order to maximize production uptime and minimize disruptive, costly unscheduled downtime.

- **Predictive Optimization of assets in the Field**
  - Utilize predictive analytics to identify when equipment in the field is likely to fail or need maintenance in order to maximize uptime/in-service time for equipment sold to customers or used to deliver service.

➢Predictive Quality and Warranty Performance

- Utilize predictive analytics to identify when goods and equipment sold to customers is likely to fail in order to identify root cause for problem correction, and to proactively address issues to reduce warranty cost and improve customer satisfaction.

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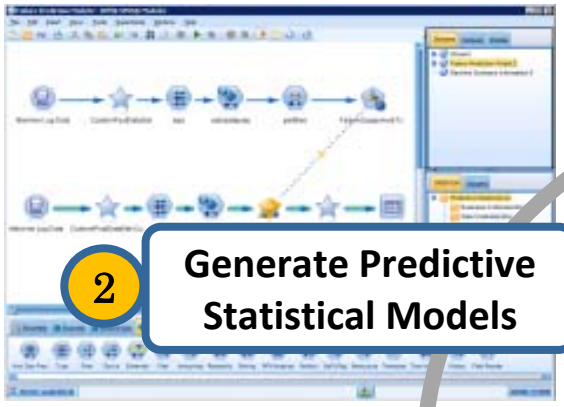
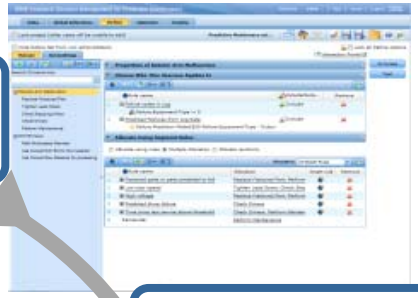
Predictive Asset Optimization analyzes data from multiple sources and provides recommended actions, enabling informed decisions



1 **Collect & Integrate Data**
Structured, Unstructured, Streaming

2 **Generate Predictive Statistical Models**

3 **Conduct Root Cause Analysis**



4 **Display Alerts and Recommend Corrective Actions**

5 **Act upon Insights**

Predictive Asset Optimization

- Data agnostic
- User-friendly model creation
- Interactive dashboards
- Quickly make decisions

Asset Performance

Process Integration

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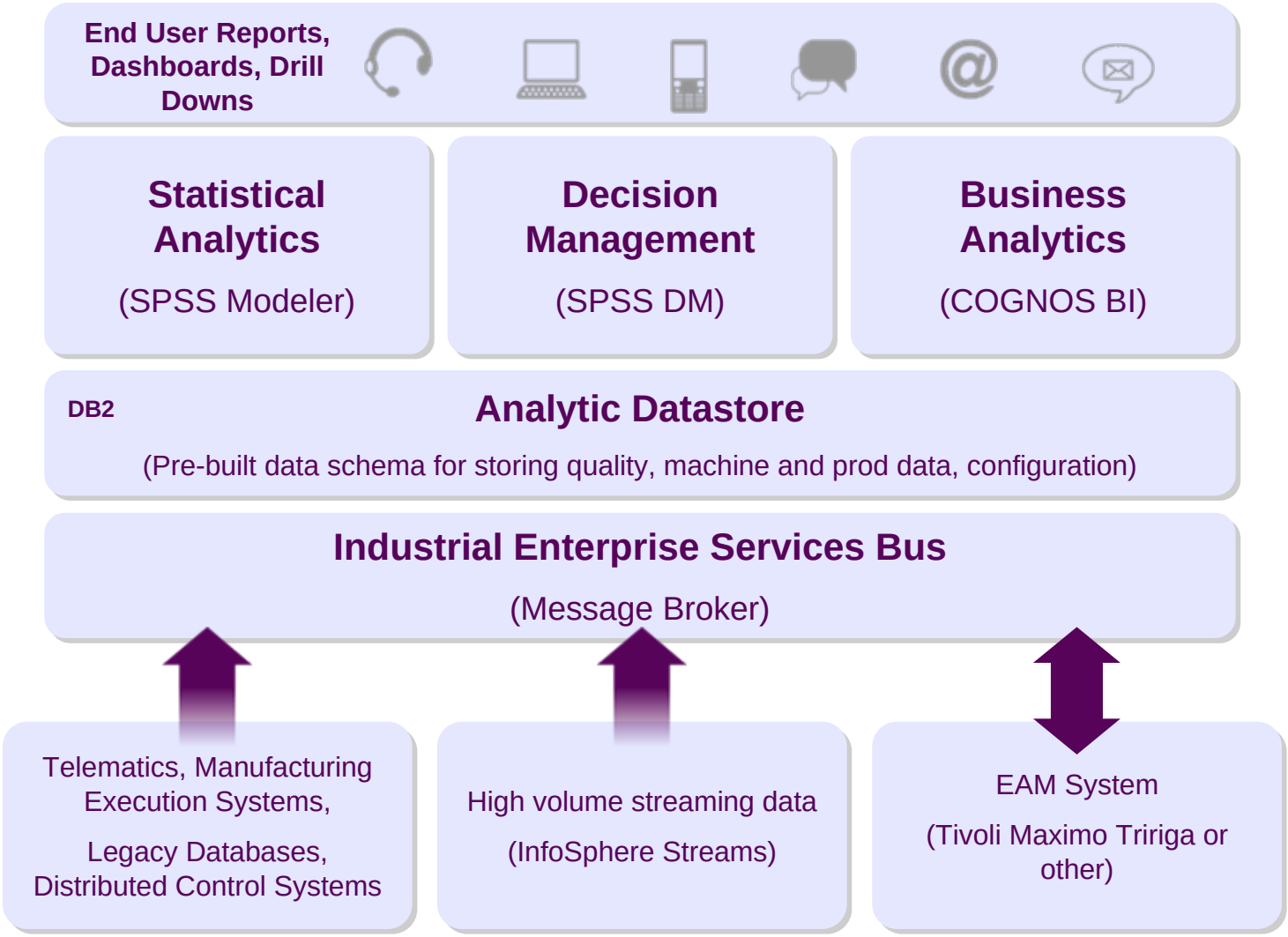
Predictive Asset Optimization Architecture



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Predictive Asset Optimization generates business value

Business Use Case	Business Value
Predict Asset Failure/Extend Life	
➢Determine failure based on usage and wear characteristics	➔Optimize Enterprise Asset Management maintenance, inventory and resource schedules
➢Utilize individual component and/or environmental information	➔Increase return on assets
➢Identify conditions that lead to high failure	➔Estimate and extend component life
Predict Part Quality	
➢Detect anomalies within process	➔Improve customer service
➢Compare parts against master	➔Improve quality and reduce recalls
➢Conduct in-depth root cause analysis	➔Reduce time to identify issues

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Deriving Value From Predictive Asset Optimization

Key Metric	Business Benefit	How Advanced Analytics Enables Value
Maximize Revenue ***Competitive Advantage***	Products and Services	New Products and Services. Up Sell Opportunities, Higher product quality
	High Availability	Better Asset Utilization, More Production Cycles
	Lower Start Up Costs	Fewer Reworks, Fewer Installation Repairs
Cost Savings ***Increased Reliability***	Less Un Planned Downtime	Fewer Failures, Faster Problem Identification, Better process throughput
	Better Productivity	Issues Cost Avoidance, Faster Root Cause, Higher equipment utilization
	Better Quality	Proactive Monitoring, Predictable Performance, Identification of factors likely to result in diminished quality
O & M Costs ***Increased Efficiency***	Non Production Costs	Fewer Failures, Fewer Emergencies, Less need for excess MRO inventory
	Shorter Maintenance	Predictive Maintenance, Better Planning
	Lower Warranty Costs	Fewer Part Failures, Shorten Issue Resolution
Customer Experience ***Increased Satisfaction***	Proactive Management	Fewer Surprises, Proactive Communication
	Individual Experience	More Focused Communication, Holistic View
	Better Collaboration	Information Integration Across Industry, Better Insight Across Silos

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Customer Case Studies

John Ward
Global Industrial Sector
Solutions Leader
IBM Predictive Analytics

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Predictive Quality and Warranty Performance BMW

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Case Study Overview: BMW

Customer Overview

- German manufacturer of quality vehicles for worldwide markets
- Manufacturing plants in Germany and elsewhere
- Service / Warranty agencies worldwide

Business Challenges

- Needed to gain deeper insights into the causes and combinations of circumstances which led to warranty issues in each geography
- Needed to increase customer satisfaction through increased product quality and reduced warranty issues

Solution Implemented

- Implemented a data mining capability to gain actionable insights across a wide range of warranty issues
- Fed back issue findings into product design process for improvements and modified service patterns where these were demonstrated to have contributed to warranty issues

Proven Business Value

Reduced warranty cases from 1.1 to 0.85 per vehicle

5% reduction in warranty cases

Annual savings of €30m approx.

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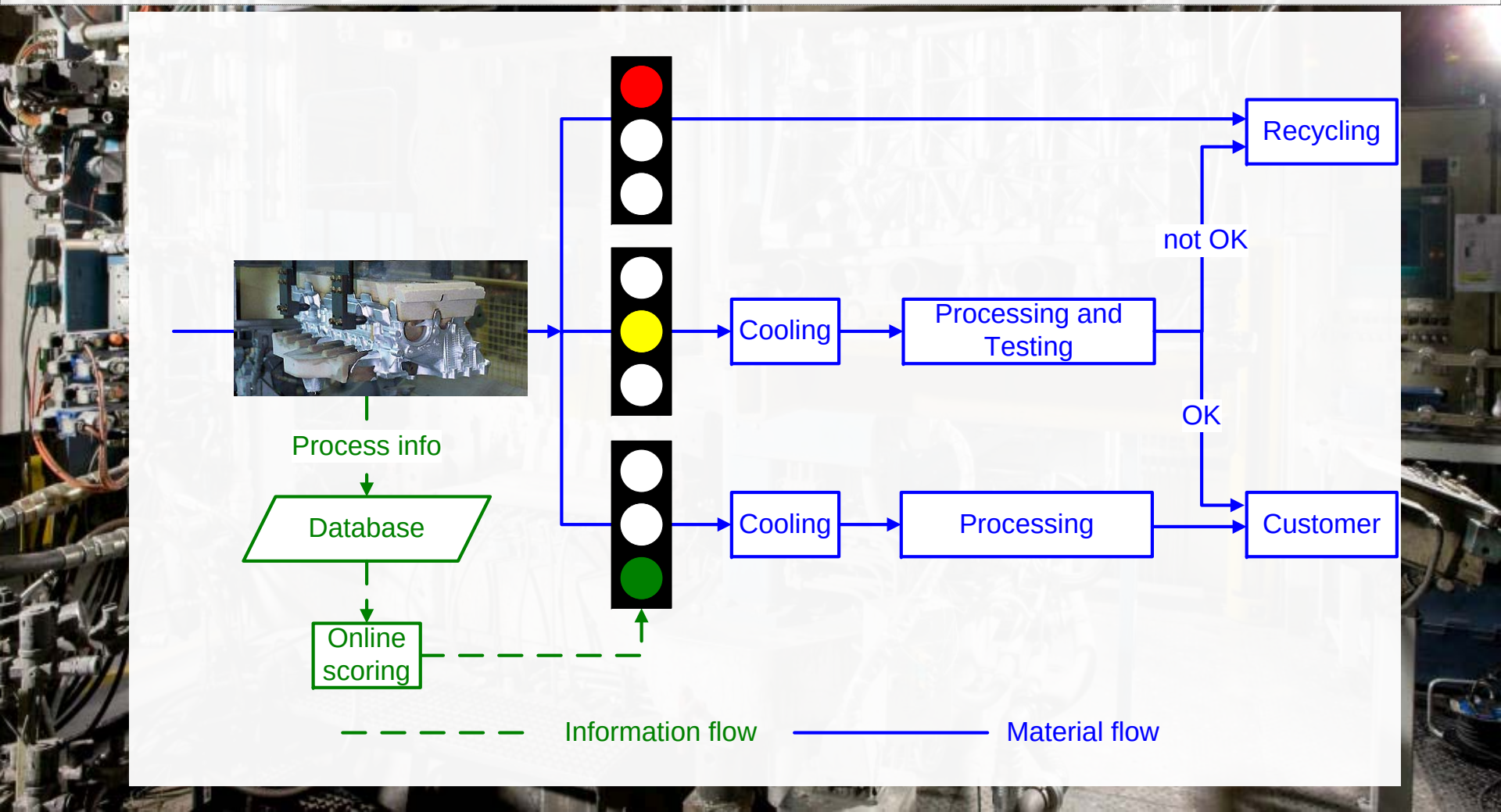
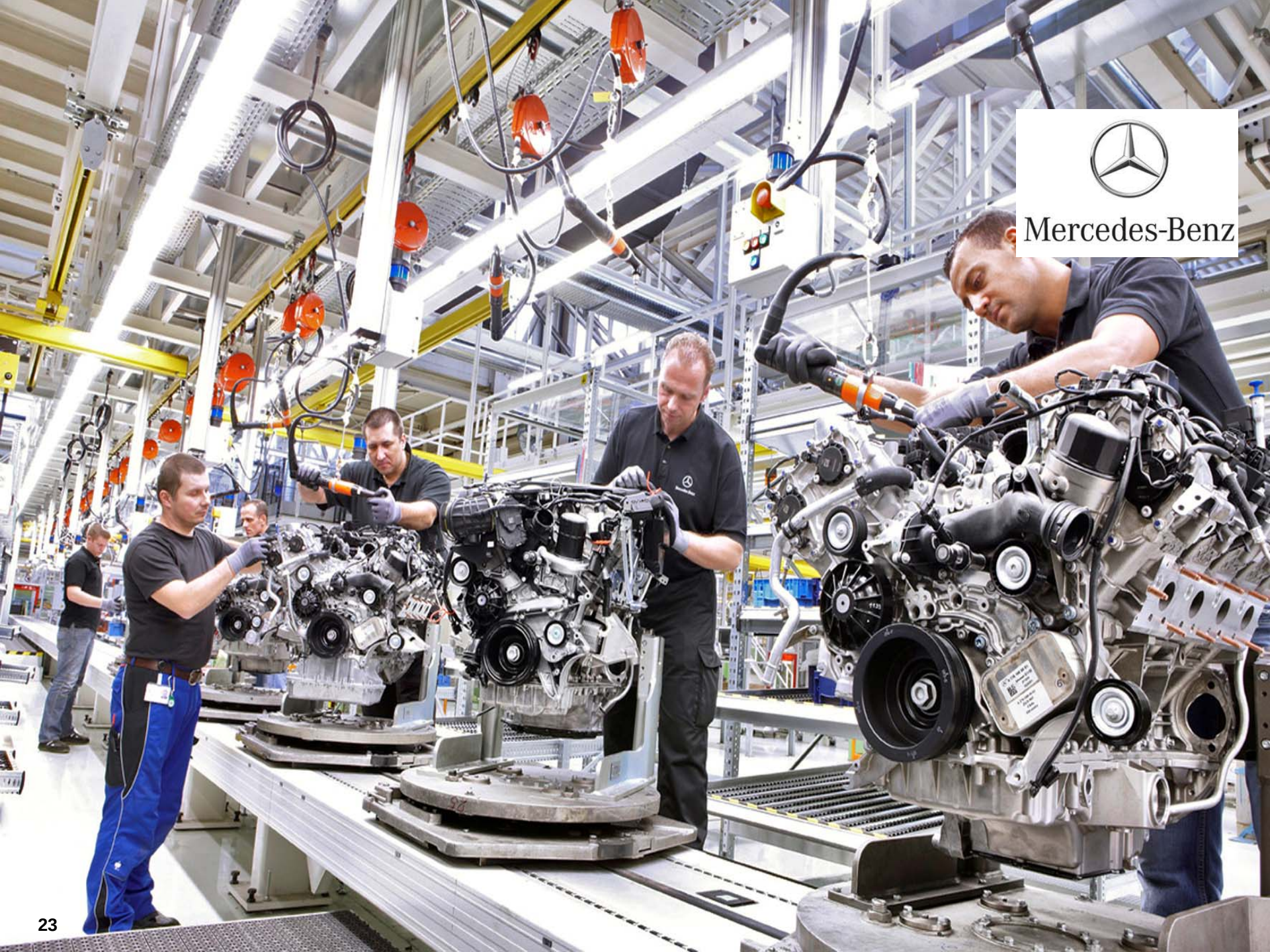
Predictive Quality: IBM Predictive Asset Optimization (PAO) is used in the BMW light-alloy foundry for the production process to better understand and eliminate problems quickly.

Reduced scrap rate by 80% in 12 weeks



Predictive Maintenance: Reduce warranty claims for new cars by analyzing historical information and vehicle data using **IBM Predictive Asset Optimization (PAO).**

Reduced warranty costs by 5%, Repeat repairs by 50%


Mercedes-Benz

Predictive Optimization of Assets in the Field A Large Construction Equipment Manufacturer

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Predictive Asset Optimization for Heavy Equipment

A condition monitoring system that will:
- Combine multiple data sources associated with a piece of equipment
- Apply predictive analytics to highlight possible problems
- Utilize interpretive expertise to confirm the problem and identify a solution

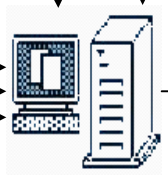
Machine Data

Wired or Wireless

Work Orders

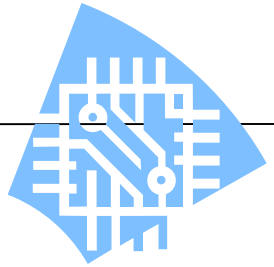
Inspections and Fluid Samples

Events / Trends / Payloads



Condition Monitoring Elements

1. Machine Data
2. Fluid Analysis
3. Inspections
4. Site Conditions
5. Repair History



Off-board Analytics To Detect Slower Moving Problems

SPSS

View 5 CM Elements and make Maintenance and Repair Recommendations

Dealer Condition Monitoring Analyst

COGNOS

Recommendations Fed into Maintenance & Repair (M&R) Process

Analysts Validate Recommendation Effectiveness

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Typical PAO Heavy Equipment Use Cases

Priority	Model Description	Business Value	Modeling Techniques	Data Sources	Business Questions Addressed
1	Predict Major Component Failures	Machine health score used to predict impending failures	Classification Models	Repair History (Dealer Source TBD), Fluid Analysis, VIMS, Events, Other	Are there indications that a major component failure is likely to occur in the immediate future?
2	Predict Component Life Based on Specific Machine History	Understand impacts of individual low level failures, estimate component life	Regression Models	Repair History (Dealer Source TBD), Events	How do low level failures cumulatively affect the life span of components? What are the site specific effects?
3	Identify Failures that Often Occur Together	Based on history, identify machines that have a high probability of experiencing similar failures	Association Models	Warranty Data, Repair History	What kinds of failures are likely to occur together (e.g., failure x happens n hours after failure y, failure x is usually followed by y and z, failure x happens every n hours, when failure x happened, condition y is usually present)?
4	Detect Anomalies within the Fleet	Detect groups of machines experiencing anomalous behavior	Clustering Models	(Trends, Fluid, Events) or Other Electronic Data Source	What machines are behaving differently from the others in the fleet or at a site?
5	Utilize Statistical Process Control	Detect statistically rare conditions that bear further investigation	Runs Chart, Range Chart	Trends or Other Electronic Data Source	What are the rules by which observed changes in electronic data will trigger alerts?
6	Predict Component Life Based on Population	Extend component life, better MARC analysis	Weibull Analysis	Warranty Data, Repair History	How can component life history data be used to make decisions about PM or PCR intervals,

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Predictive Maintenance Demonstration

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Lester McHargue
Business Solutions
Industrial Business Analytics and Optimization

Predictive Asset Optimization
Large / Capital Equipment Manufacturers

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Capital Equipment Manufacturers

Manufacturers need to be able to identify potential component failure as well as machine health of in-service equipment by identifying early signs of potential downtime and enterprise component issues.

➢ The Opportunity

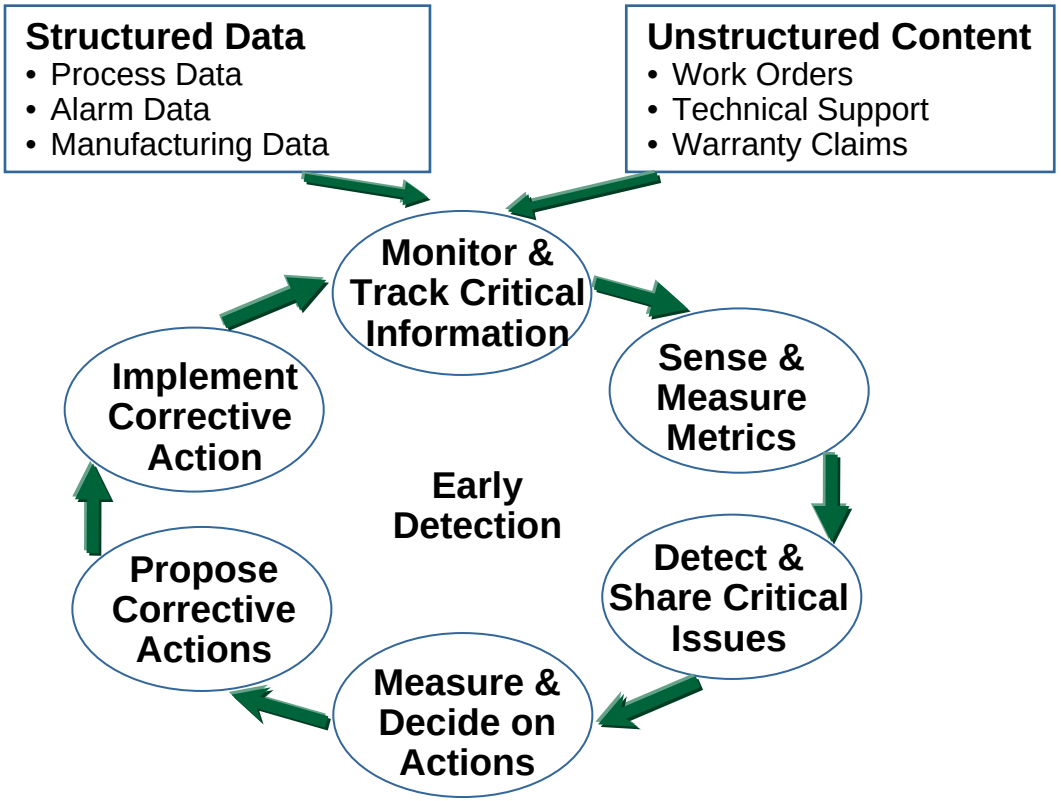
- Difficulty in separating the signal from the noise to detect enterprise component problems
- Unscheduled maintenance and downtime are critical issues costing the end customers from Hundreds of Thousands to Millions of Dollars per hour
- Most relationships with the user community if reactive in nature. Quality issues are often identified at the site.

➢ Business Case

- Early identification and mitigation of enterprise component and quality issues
- Provide insight to the health and probability of failure for in service equipment maximizing uptime
- Establish a proactive relationship with the user community to increase asset availably, reduce costs, and create new product and service offerings
- Better maintenance planning
- Identification of new product and proactive services.

➢ What Makes it Smarter

This system uses a variety of Advanced Analytical techniques to monitor Time-Series Machine Data, Site Conditions and Service History to predict component well as system failure



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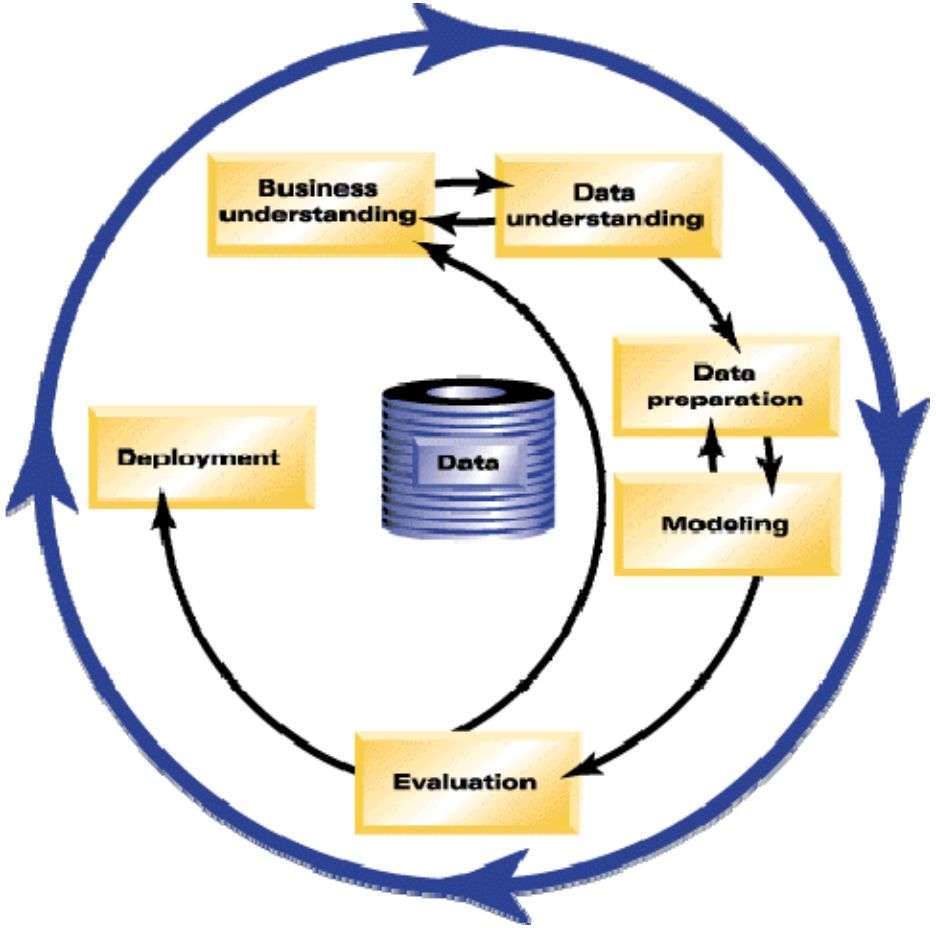
Capital Equipment Manufacturers -Overview of Cross-Industry Standard Process for Data Mining (CRISP-DM)

- The methodology include six phases:
  - Business Understanding
  - Data Understanding
  - Data Preparation
  - Modeling
  - Evaluation
  - Deployment
- The first phase, "*Business Understanding*," is critical for successfully turning qualitative and quantitative data into **valuable insights** that lead to **value-added actions**.
- Phases 2 through 5 can occur in any order and almost always include multiple iterations back to the Business Understanding stage.
- The methodology by itself, however, does not guarantee success with advanced analytics.
- Success requires deep expertise and experience in evaluating and using a wide range of advanced analytical techniques.



A large equipment manufacturer saved $1 million in just two weeks by using predictive maintenance to proactively identify problems and take action before failure occurred. By minimizing downtime and repair costs across all its manufacturing operations, the manufacturer achieved a 1400% return on investment in just four months.

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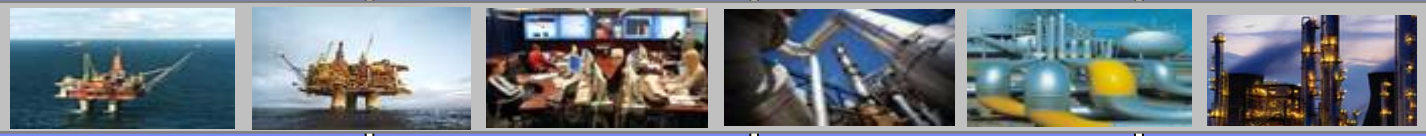
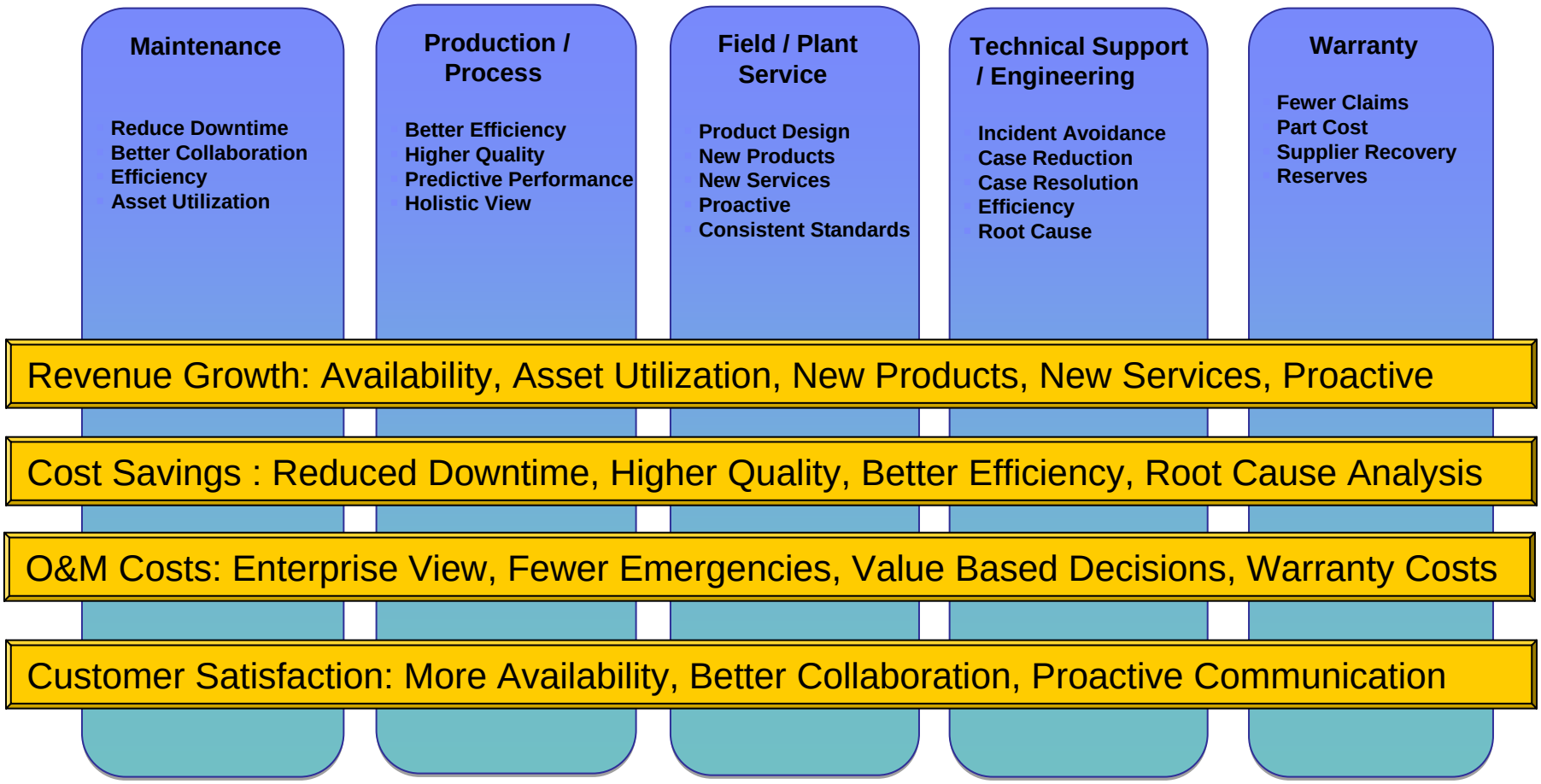
Capital Equipment Manufacturers - Creating Client Value Through Integrated Operations

	Visibility	Prediction	Collaboration	Optimization
Integrated Operations Services	Production and Performance Reporting	Technical Support And Engineering	Maintenance and Service	Warranty and Quality	Collaborative Decision Making	Others…
Business Solutions	Turnaround Optimization Consumables Inventory Planning Downtime Optimization	Predictive Modeling & Maintenance Planning Early Event Warning Data Mining for Anomaly Detection	Maintenance Service Optimization Enterprise Asset Management Enterprise Document Management	Warranty Analytics Advanced Analytics and Discovery Knowledge Management	Others…
Unstructured Content	Downtime Reports	Standards	Maintenance Reports	Trade Publications	Manuals	Call Logs	Service Records
Real-time Data Capturing and Actuation	DCS, PLCs Historians	RFID & Remote Sensing	MES Application & Facility Monitor	Engineering Equip & Process Doc
Physical Assets				

US Capital Equipment Manufacturers: A Matrix/Horizontal Approach To Analytic Value



Integration of Analytics Across Functional Areas Yields the Best Results

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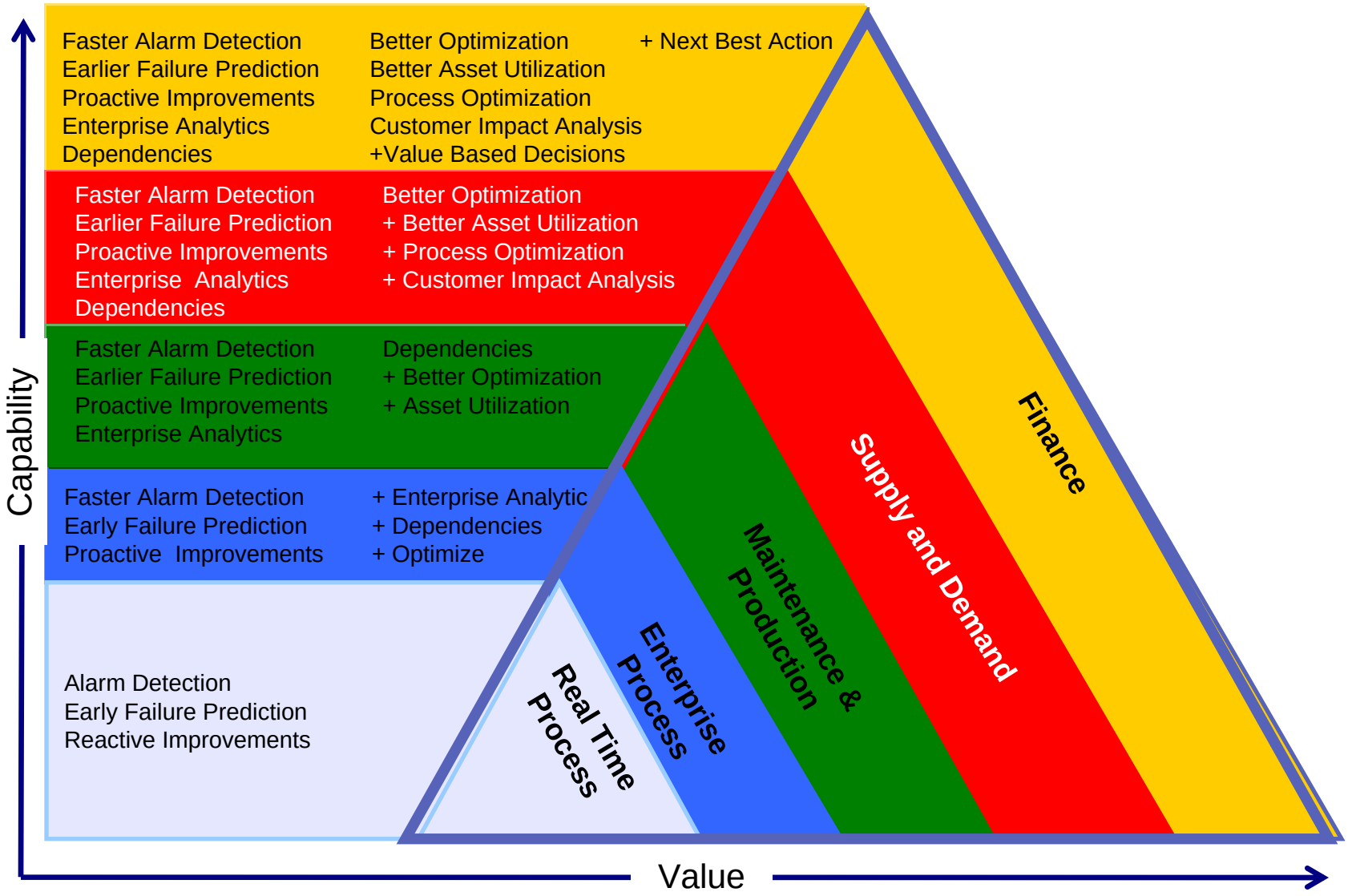
Value of Integrated Analytics



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Some Example Results

Use Case	PAO Approach	Results
Provide Early Detection of factors impacting availability	Combine operational, environmental, and maintenance information to identify causal factors	Identification of the leading factors impacting up time
Provide Early Detection of Enterprise Wide component failures, impacting warranty, and asset availability.	Integrate process, technical support, and warranty information to identify enterprise wide patterns in component failures	10 to 13 month early detection
Provide Early detection of trends that impact quality and performance	Integrate process, technical support, and maintenance information to identify multivariate patterns that lead to poor results	Identification of primary and secondary causal factors
Provide an indication to the health of in-service equipment, and the probability of failure between maintenance windows	Integrate process, environmental, operational, maintenance, and engineering support information for a complete picture to health of an asset.	80% to 90%+ accuracy in predicting equipment downtime.
Enable proactive customer management through better understanding of individual equipment issues	Integrate process, technical support, maintenance, and warranty information to provide individualized products and services	Identification and proactive delivery of products and services. Direct and through dealers

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Predictive Asset Optimization
Implementation Methodology

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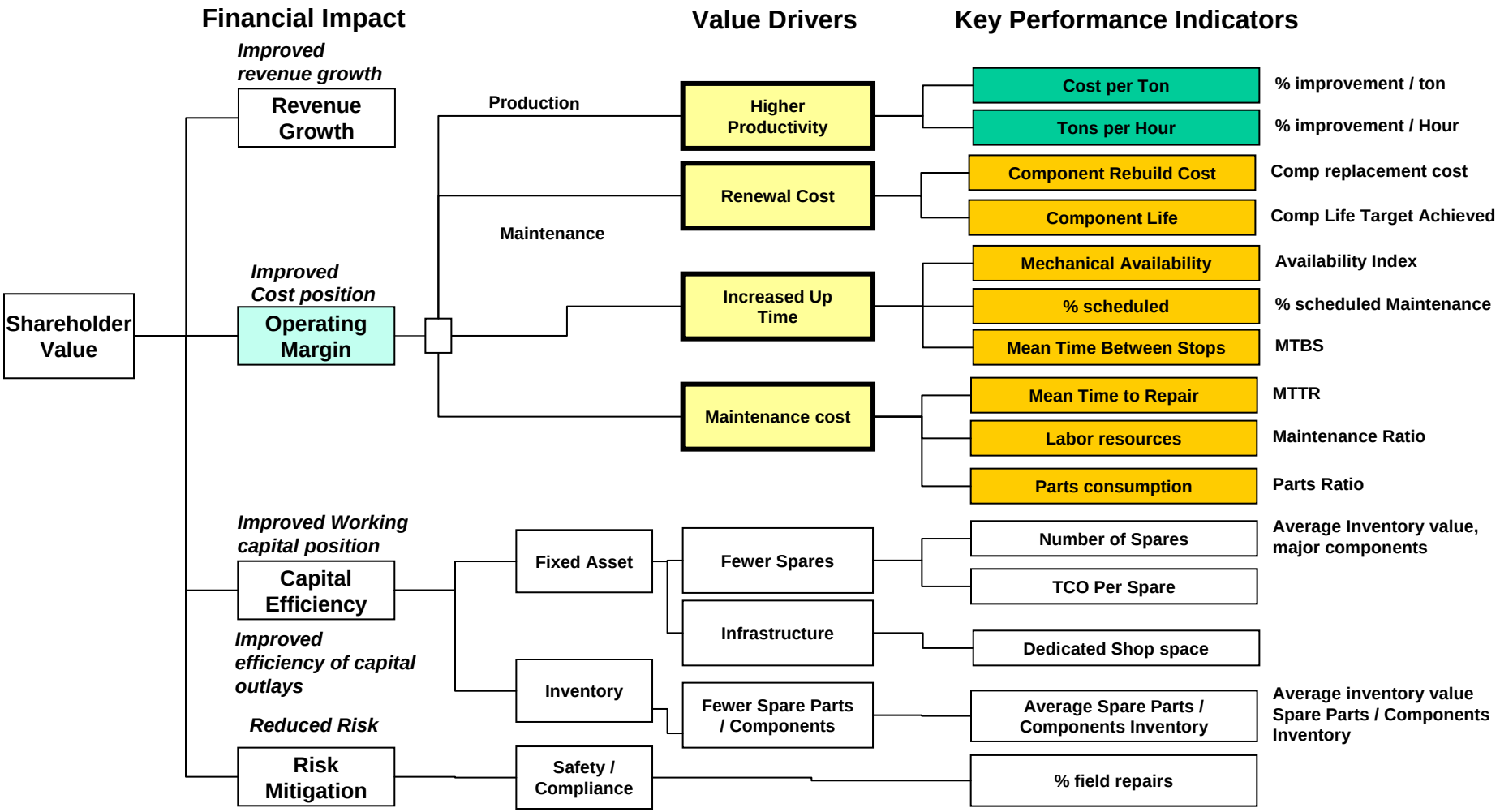
Predictive Maintenance Value



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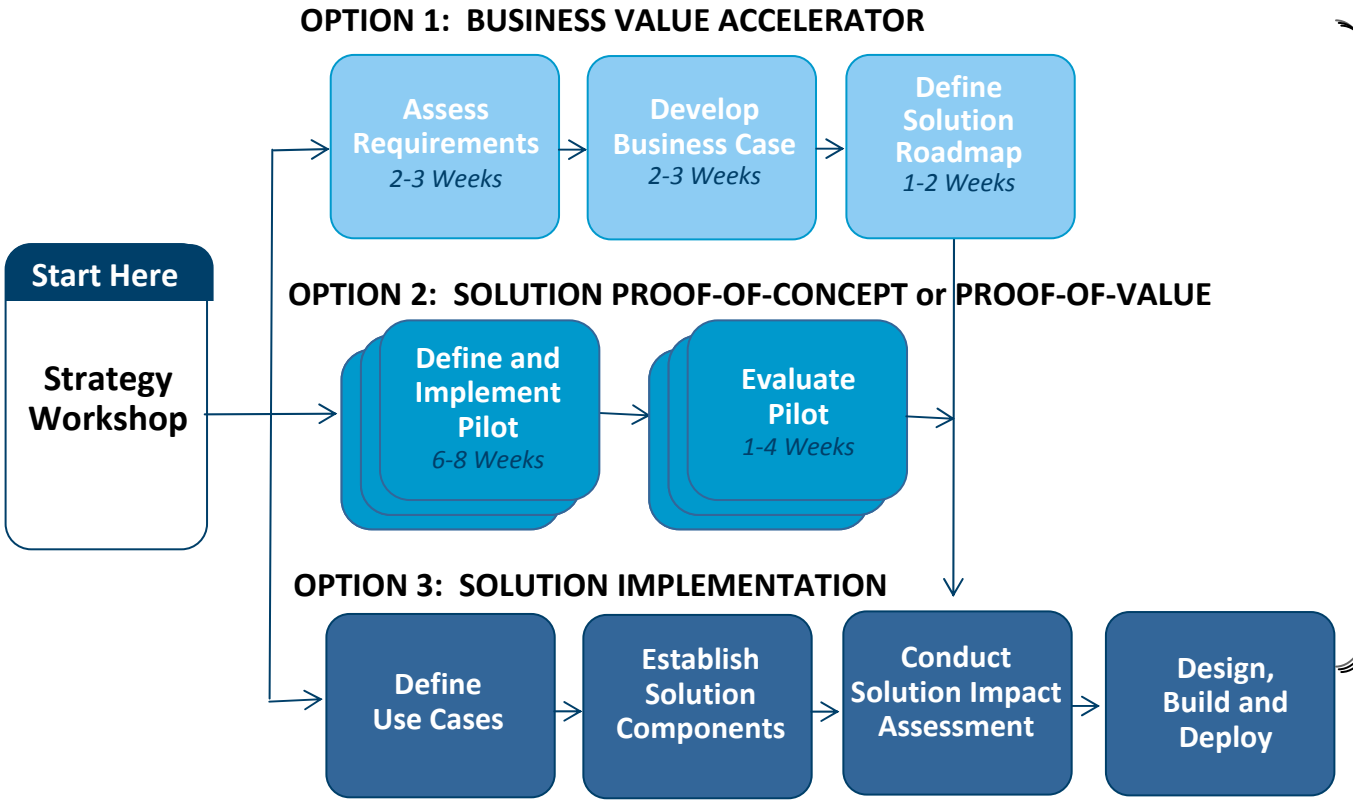
Predictive Asset Optimization's pre-integrated solution offers flexibility to meet your company's needs

Flexible Deployment



Flexible Purchases

Options

- Pre-configured individual products and services, or as
- GBS hosted solution

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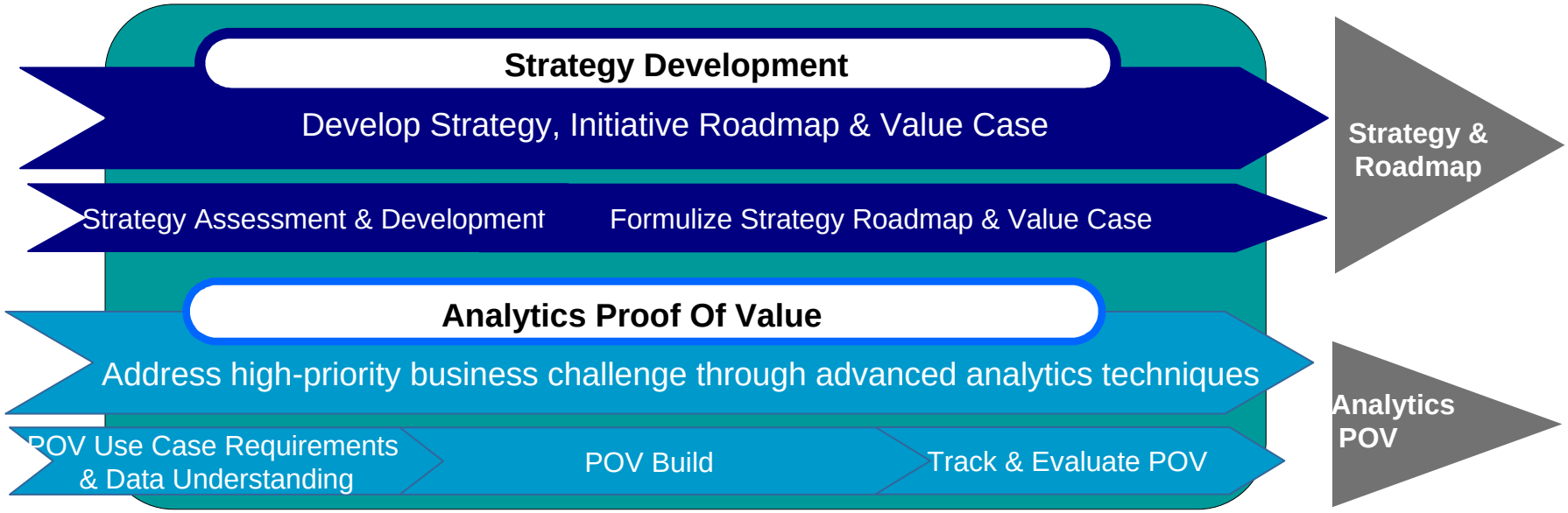
IBM Proven Methodology: A Parallel Approach

IBM's approach is tailored to deliver immediate value via a Proof of Value (POV) application as well as provide short and long-term strategic development for initiative planning and capabilities development.



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How to learn more

- For additional information including whitepapers and demos, please visit:

- IBM.com Predictive Maintenance

http://www-01.ibm.com/software/analytics/solutions/operational-analytics/predictive-maintenance/

- Smarter Predictive Analytics:

http://www.ibm.com/analytics/us/en/predictive-analytics/

- Smarter Analytics Signature Solutions

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