



# The Power & Utility Analytics Primer

What Every Executive Needs to Know to Compete

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# 1 What Are Analytics?



**ANALYTICS** are the discovery, interpretation, and communication of meaningful patterns in data. Analytics relies on the simultaneous application of statistics, computer programming and operations research to quantify and predict performance.

(Source: Wikipedia)

## Descriptive Analytics

A look at past performance to determine what happened and why.

## Diagnostic Analytics

What is happening now based on incoming data.

## Predictive Analytics

Predict future outcomes with accuracy based on patterns observed in the past.

## Prescriptive Analytics

Recommended actions that should be taken based on descriptive, diagnostic and predictive analytics.

## MATURITY MODEL

			Make it happen!	Data and Integration
		What will happen?	Prescriptive analytics	
	What is happening?	Predictive analytics	Industrial platform OT/IT Edge to Cloud	
What happened?	Diagnostic analytics	Condition based monitoring some IT integration		
Descriptive analytics	Dashboard multiple systems			
Trends, reports single system				
Information			Optimization	

GE Brief: **2017 TOP DIGITAL TRENDS** for the EVN

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Webinar: **IMPROVING RELIABILITY WITH ANALYTICS**

Featuring: GE Power VP, Data Science & Analytics Ravi Malladi

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Article: **ANALYTICS 3.0**

by Thomas H. Davenport, *Harvard Business Review*

“One of the most dramatic conversions to data and analytics offerings is taking place at General Electric, a company that’s more than 120 years old. With sensors streaming data from turbines, locomotives, jet engines, and medical-imaging devices, GE can determine the most efficient and effective service intervals for those machines.”

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## 2 Analytics Are Everywhere

Accenture and the WEF estimate that the **digital revolution in electricity can unlock \$3.1 trillion** in industry and societal value over the next decade.<sup>2</sup>

We live and work in a world increasingly informed and enhanced by advanced analytics. We interact with analytics every day, from Amazon shopping recommendations to Facebook photo tagging. Our mobile phones are now powerful computers that are constantly running analytics applications.

A number of industries have been transformed by a digital wave of innovation driven by analytics, Big Data and digital platforms. **The power industry** is now experiencing a major digital transformation that will only accelerate. Analytics is being applied across the electricity value network today in areas such as these:



### POWER GENERATION

Effectively manage power generation to optimally balance goals, including availability, reliability, efficiency and environmental compliance.



### ACROSS THE GRID

Smart meters, equipment sensors and voltage meters can all be connected via digital platforms that use advanced analytics to solve problems in real time.



### COMMERCIAL ENERGY MANAGEMENT

Reduce energy cost, consumption and carbon footprint by using analytically-powered energy management, on-site power generation, storage and demand response.



Infographic: **ELECTRICITY VALUE NETWORK: Digital Transformation with GE Solutions**

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Video: **ACHIEVING OUTCOMES From the Edge to the Cloud**

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Video: **ELECTRICITY TRANSFORMATION With the Digital Power Plant**

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# Analytics: 3 The Brain of Big Data and the IoT



**THE INDUSTRIAL INTERNET OF THINGS (IIoT)** is the part of the IoT that brings together industrial machines, advanced analytics, and people. It's the network of a multitude of connected devices that monitor, collect, exchange, analyze, and deliver valuable new insights. These analytics-based insights are driving smarter, faster operational and business decisions for power companies.

The Internet of Things (IoT) is estimated to include more than **20 billion connected devices by 2020.**<sup>3</sup>

(Source: Gartner Press Release, February 2017)

“Without analytics, the Internet of Things would be like trying to hear a single voice in a crowd of millions. IOT relies on analytics ‘on the edge’ and in the cloud to fulfill the tremendous promise of our increasingly connected world.”<sup>4</sup>

(Source: Accenture)

## INTERNET OF THINGS (IoT)

The world is being reshaped today at breathtaking speed by the new wave of dominant technologies: **Analytics, Big Data, Mobile, Cloud, the IoT, digital platforms and Smart Machines.** The cumulative capability of analytics is now accelerating faster than ever before and has so much transformative potential that it is difficult to estimate its full, future impact.



Accenture/WEF report: **DIGITAL TRANSFORMATION OF INDUSTRIES** Electricity Industry

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GE White Paper: **GE DIGITAL TWIN: Analytic Engine for the Digital Power Plant**

[READ NOW](#)

News: See how **SALT RIVER PROJECT** uses analytics to predict asset failure across multiple plants

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What Happened in the Past:

# 4 Descriptive Analytics



### Examples:

Management reports that provide essential information about past asset performance, field service activities and production outages.

Can be used to find correlations among different field issues after the fact — to determine the root cause of a problem and correct it moving forward.



### Benefits:

Data is viewed on a single dashboard, giving a bird's eye view to determine where priority action is needed.

A clear view is created to help segment power outage events and see most impacted areas requiring immediate attention.

**DESCRIPTIVE ANALYTICS** or data mining is valuable for organizing and examining data around past events. Using descriptive analytics, you can condense big data into smaller, more useful representations of information. It allows you to understand what happened in the past to inform current decisions.

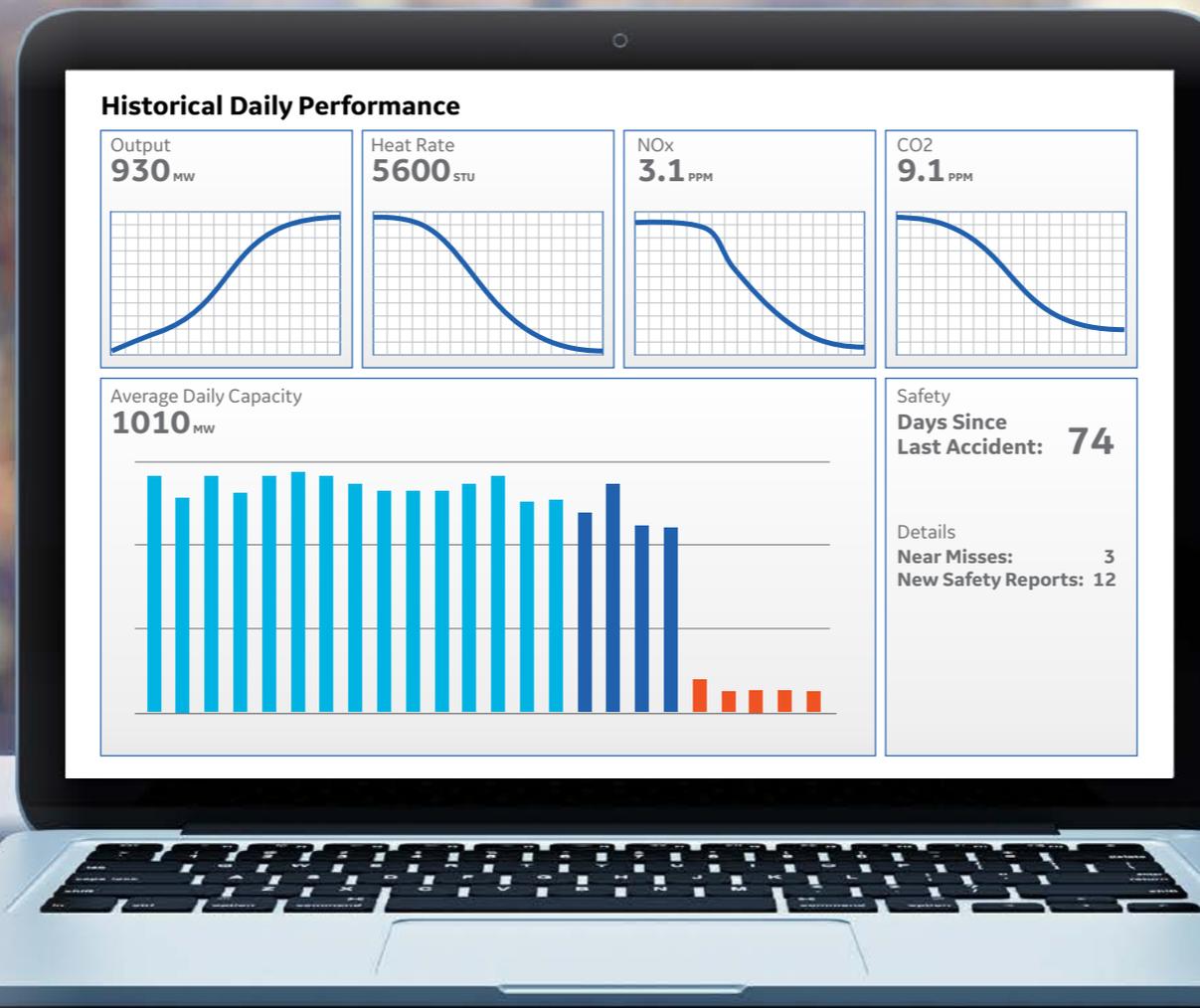


### Limitations:

No insight as to why issues or trends are occurring

No intelligence into the likelihood of events in the future

The interpretation of the data is left to the individuals examining reports/dashboard.



What Is Happening Now:

# 5 Diagnostic Analytics



**DIAGNOSTIC ANALYTICS**, a form of advanced analytics, are used for discovery or to determine why something is occurring. These analytics are characterized by techniques such as drill-down, data discovery, data mining and correlations.

(Source: Cornerstone)



### Examples:

Monitor plant assets to determine if any equipment problems are occurring in near real-time, so corrective action can be taken.

Remotely monitor and detect issues with assets distributed across a wide geographic area, such as transmission and distribution systems.



### Benefits:

Remote asset monitoring and early detection of anomalies that allow plants to avoid forced outages or part damage, reducing asset degradation and maintenance costs.

## GE'S DIAGNOSTIC ANALYTICS IN ACTION

### Challenge:

A GE customer used diagnostic analytics to determine that heat rate and output power are beyond the red threshold for a gas turbine. The ISO rating that corrected output power had degraded approximately 12.6 MWs, compressor efficiency had dropped 3.5% and heat rate had escalated 724 Btu/Kw-hr. Diagnostic analytics indicated the unit was starting to experience compressor fouling.

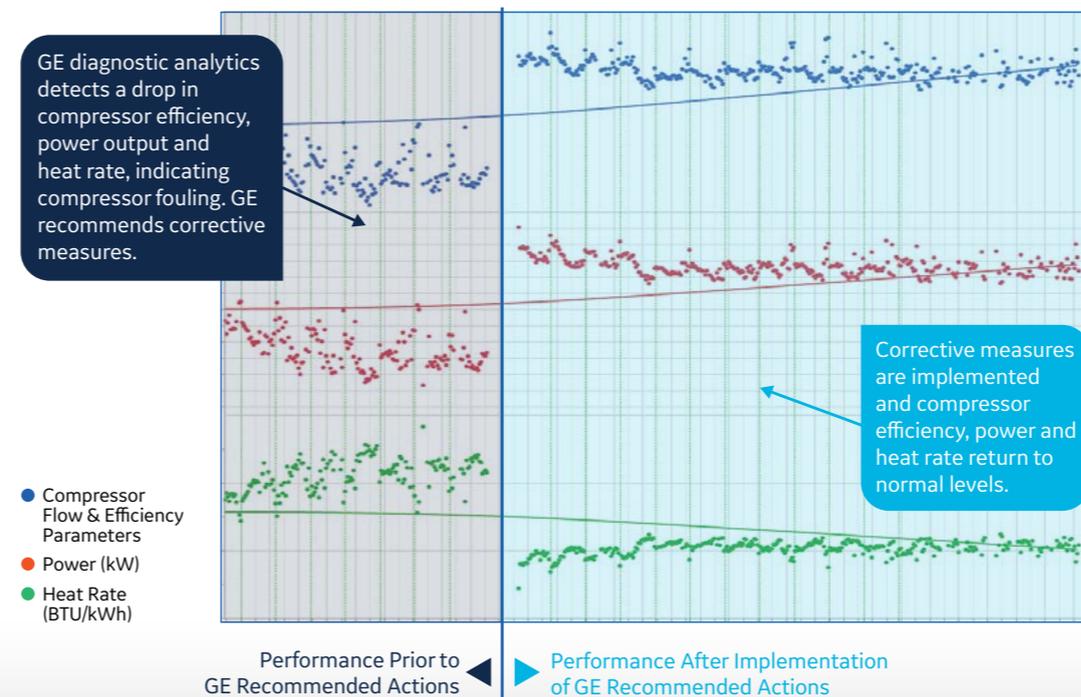
### GE Solution:

GE recommended the customer implement an offline water wash (OWW), but first conduct IGV and ROs inspections as well as inspect the inlet filter house for gaps that allow unfiltered air to pass into it.

### Results:

These actions were implemented and corrected the issues, bringing power output, compressor efficiency and heat rate back to normal levels resulting in customer savings of \$226K.

### RECOMMENDED ACTIONS AND RESULTS



In the News:  
**GE TO POWER UP** Qatar's future smart city

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Case Study: **KAHRAMAA**

**Challenge:** Kahramaa, the sole T&D system owner and operator for the electricity and water sector in Qatar, wanted to monitor the condition of all electrical assets across their distribution substations to identify and prioritize asset replacements.

**Solution:** Kahramaa worked with GE to implement its APM solution to monitor all electrical assets across its fleet using diagnostic, predictive and risk analytics, resulting in a **reduction of 50%** of substation faults and an **ROI of 180%** after just two years.

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What Will Happen in the Future:

# 6 Predictive Analytics



## Examples:

Predicts when assets are likely to fail, so proactive action can be taken to prevent failure, order new parts and schedule maintenance.

Predict day-ahead and seven day-ahead forecasts for wind generators to improve real-time ramp prediction, understand margin price spreads and reduce O&M cost by optimizing maintenance schedules.



## Benefits:

Forecast across a wide range of areas and navigate huge data sets of dizzying complexity to provide a clear view of what will happen in the future so people can make better operational and financial decisions.

**PREDICTIVE ANALYTICS** use many techniques including data mining, statistics, modeling, machine learning, and artificial intelligence to analyze current and historical data to make predictions about the future.

(Source: Predictive Analytics Today)



**CHALLENGE:** Scottish and Southern Energy (SSE) partnered with GE for early detection of potential failures and to implement condition-based maintenance.

**SOLUTION:** SSE used GE's Asset Performance Management (APM) solution to build an Equipment Performance Center (EPC) that continuously monitors the health of more than 1,000 assets over 11 different locations.

**RESULT:** SSE has experienced a significant reduction in plant failures, saving £3MM per year from early failure detection and £6 MM per year from reduced insurance costs.



**CHALLENGE:** E.ON Climate Renewables (EC&R) partnered with GE to get more power from their existing fleet.

**SOLUTION:** GE PowerUp analyzed tens of thousands of data points per second on each wind farm, totaling 469 wind turbines, and used predictive analytics to increase power output, service productivity and create new revenue streams for customers.

**RESULT:** The solution increased annual energy production (AEP) by 4% in the just the first year.

Video:  
**HOW SSE IS OPTIMIZING**  
Equipment Performance

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Executive Brief:  
See How **ANALYTICS**  
**IMPROVES** Asset  
Performance

GE Partner  
Ecos  
GE EVN  
Extensions  
GE Digital  
APM  
Basic  
Moni

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Case Study:  
**E.ON AND GE: A Power**  
Up Story

Wind Power  
an E.ON and GE

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Video:  
What Is A **DIGITAL**  
**WIND FARM?**

HUB HEIGHT  
MW RATING  
BLADE LENGTH

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# 7 What Action Should I Take: Prescriptive Analytics



**PRESCRIPTIVE ANALYTICS** are an advanced version of predictive analytics that uses simulations to automate complex decisions and tradeoffs to make predictions and recommend optimal actions based on those predictions. Over the past 10 years the accuracy and reliability of prescriptive analytics have been enormously successful due to the rise of Big Data and high speed computing.



### Examples:

For a single combined cycle power plant with multiple generating assets prescriptive analytics can be applied to determine how to simultaneously optimize dispatch and achieve reliability goals guaranteed to the customer on a given day, week, month or year.



### Benefits:

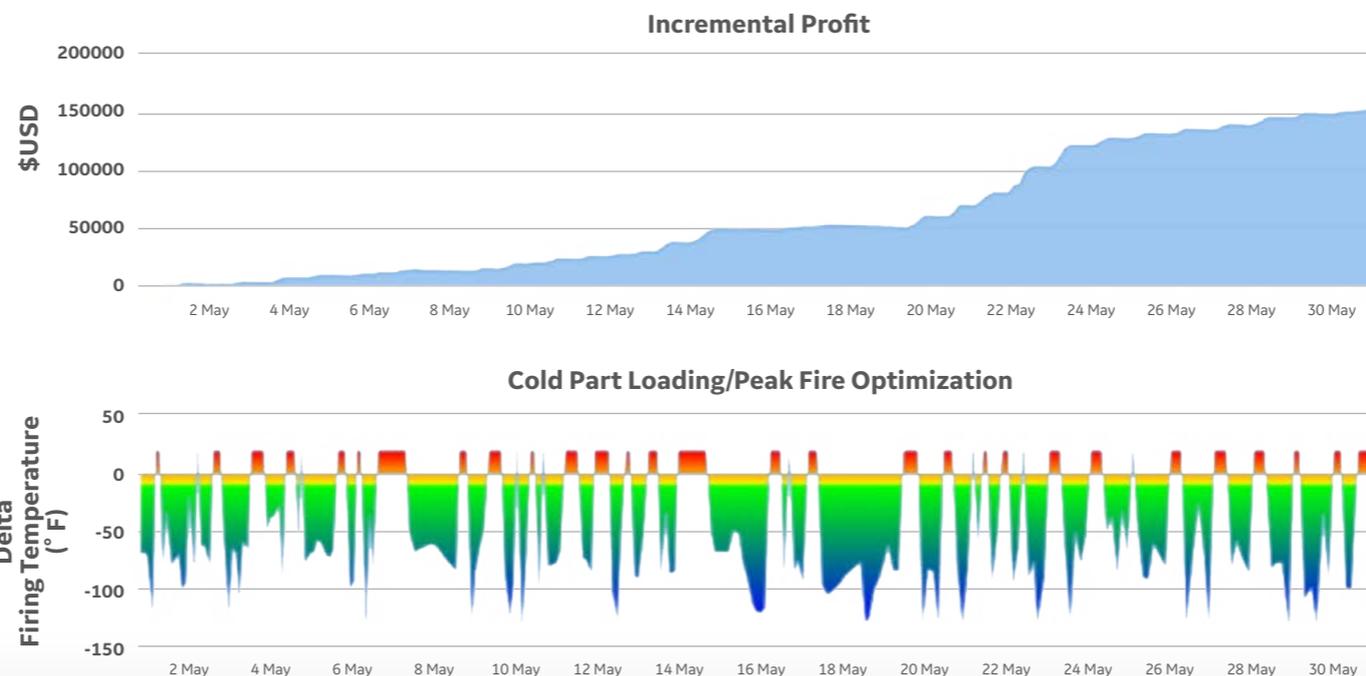
Go beyond controlling financial downside (unplanned downtime, failures, etc.) to enabling financial upside (optimally balancing risk and reward).

Solve the most complex, high value challenges because prescriptive analytics are designed to consider not only past, current, and forecasted future data, but also overall business goals and objectives.

## DISPATCH OPTIMIZER

For example, GE's Dispatch Optimizer solution uses prescriptive analytics to enable a power plant to optimize short and long-term dispatch decisions. This allows plant operators to dramatically improve dispatch economics and increase plant profitability.

### Digital Twin – Dispatch Optimization



### Case Study: NRG ACHIEVES OPTIMAL BALANCE

**CHALLENGE:** NRG turned to GE to achieve the optimal balance between asset life and performance to maximize profitability.

**SOLUTION:** NRG used GE's Operations Optimization solution, resulting in 2-3% output improvement, \$5 million increase in revenue per 32K hours and zero impact to plant outage schedules.

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### Executive Brief: ACHIEVING COAL PLANT EFFICIENCY & Emissions Control with Digital

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### Ebook: DISCOVER THE POWER OF DIGITAL: Customer Stories

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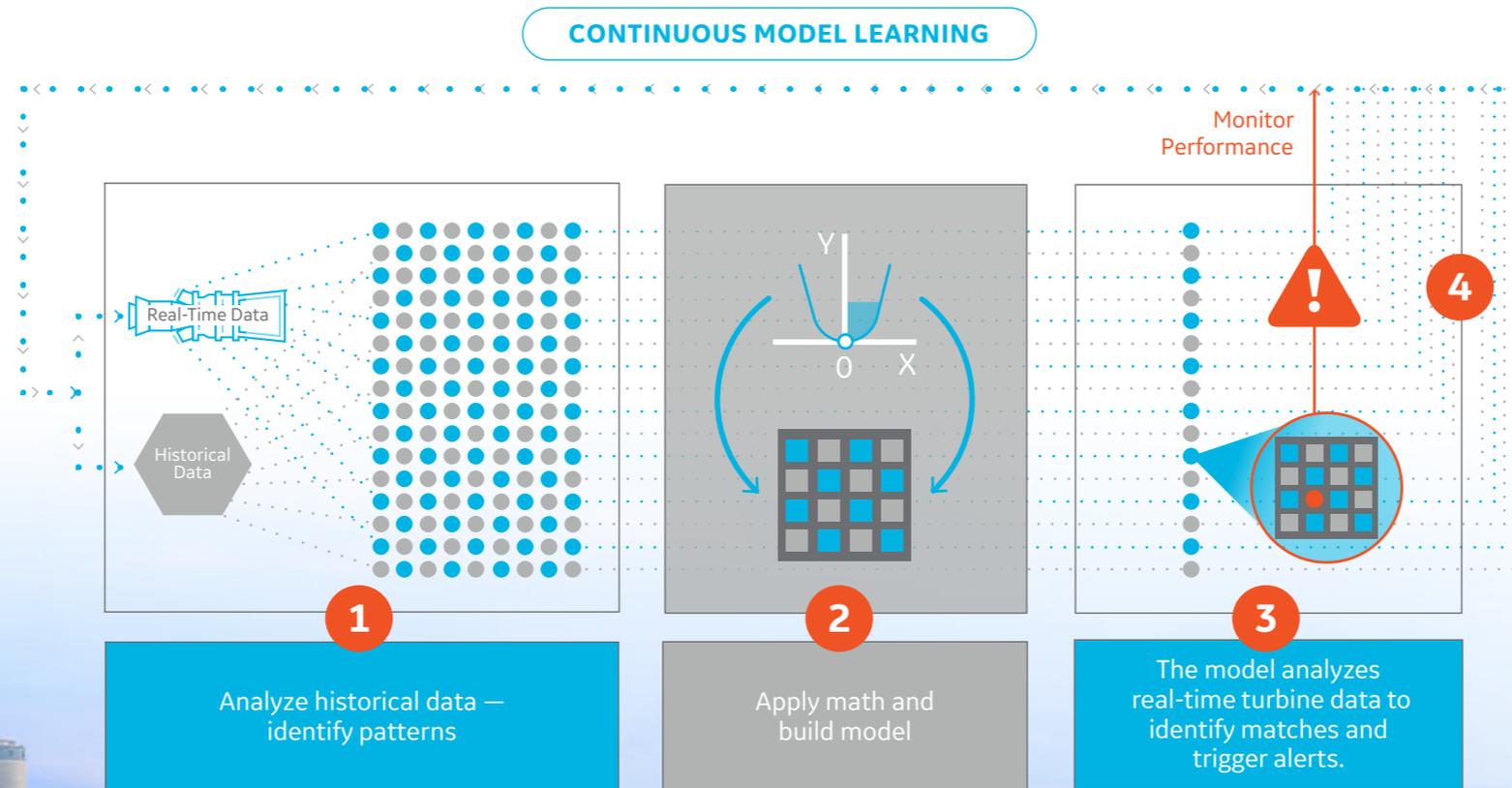
# 8 What Is an Analytic Model?

## Why is it difficult to build analytic models for the power and utility industry?

Data scientists must examine vast amounts of data (terabytes in some cases) to search for patterns. Building effective analytic models for the power and utility industry requires experienced people, physics-aided deep learning and machine learning, powerful model building tools, a global installed base, large partner ecosystem, Digital Twin, Predix\* platform and Cloud + Edge capabilities.

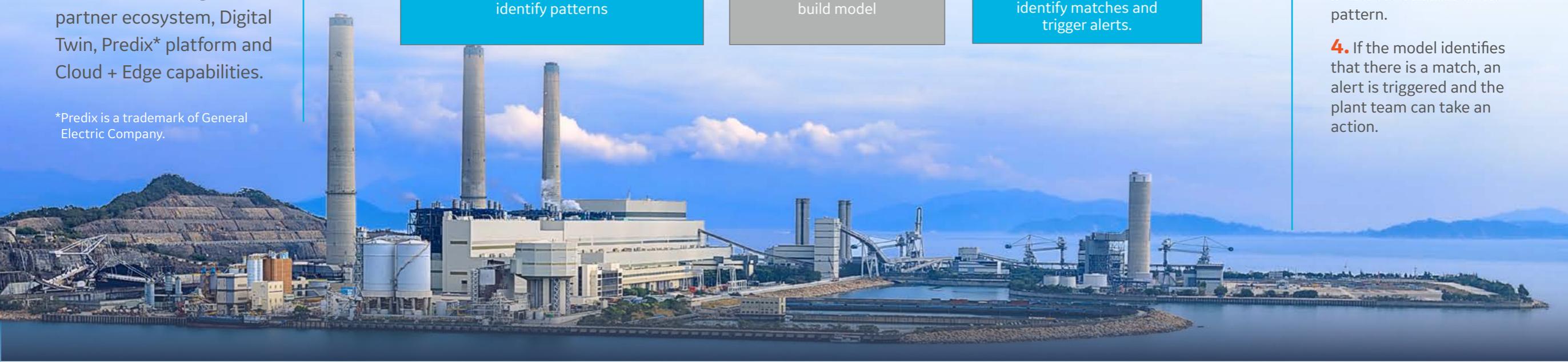
\*Predix is a trademark of General Electric Company.

An **ANALYTIC MODEL** uses data and mathematics to better understand and explain a system, to study the effects of different components of that system and to make predictions about its behavior.



When data scientists build a predictive analytic model for asset management they:

- 1.** Examine a large pool of historical data and look for patterns. For example, three months after a certain vibration happens on an asset and the temperature rises above a specific threshold for a period of time, the probability that an asset will failure increases.
- 2.** Once they identify and understand these patterns, they program these into the model.
- 3.** In real time, data from the power plant flows through the model to see if there is a match to the pattern.
- 4.** If the model identifies that there is a match, an alert is triggered and the plant team can take an action.

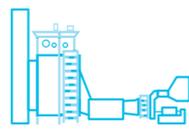


# 9 Digital Transformation of Power

“Utilities’ traditional business models are under attack, directly and indirectly. Utilities are racing to reinvent their roles and have started a profound transformation journey. The industry will be reborn in 3D: decentralized, divergent, and digital.”

— Roberta Bigliani  
IDC Energy Insights

The **ELECTRICITY INDUSTRY** is undergoing a rapid transformation. Distributed generation, renewables, smart grids, storage and prosumers are accelerating the rate of change. By embracing digitalization — analytics, Big Data and digital platforms — companies can apply unprecedented insights and innovative business models to create new sources of value and competitive advantage.



## FOSSIL

Predictive maintenance, advanced control systems, maximum flexibility, forecasting, cyber security.



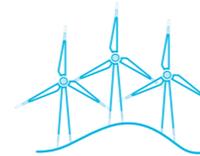
## COAL

Optimizing plant operational and financial performance, improved operational control.



## NUCLEAR

Optimally balance plant total efficiency, predictive models that enhance operating designs.



## WIND

Fleet-wide view of turbines’ state, status and health, accurate week, day and real-time weather forecasting, farm- and fleet-wide optimization.



## HYDROELECTRIC

Plant and fleet optimization, condition monitoring, forecasting, outage management, cyber security.



## TRANSMISSION & DISTRIBUTION

Optimize power flow, reduce outages and restore power faster, advanced workforce management.



## END CONSUMER

Reduce energy costs, provide control, Intelligent Environments, demand response.

News: **NYPA** to use analytics to monitor 16 plants and network

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Customer Story: See how **PSEG** optimizes operations with analytics and software

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Video: **DISCOVER HOW DIGITALIZATION** is Improving Performance Across the Electricity Industry

Listen to panelists:  
**Steve Bolze**  
President & CEO — GE Power  
**Chris Crane**  
President & CEO — Exelon  
**Gil Quinones**  
President & CEO  
New York Power Authority

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# 10 Seize Your Analytic Advantage



Although analytics are widely used in the power industry today to solve critical problems and improve performance, their use is rapidly accelerating. Analytics are no longer optional for the power industry, but a requirement to remain competitive and to meet operational and financial goals in a rapidly transforming industry.

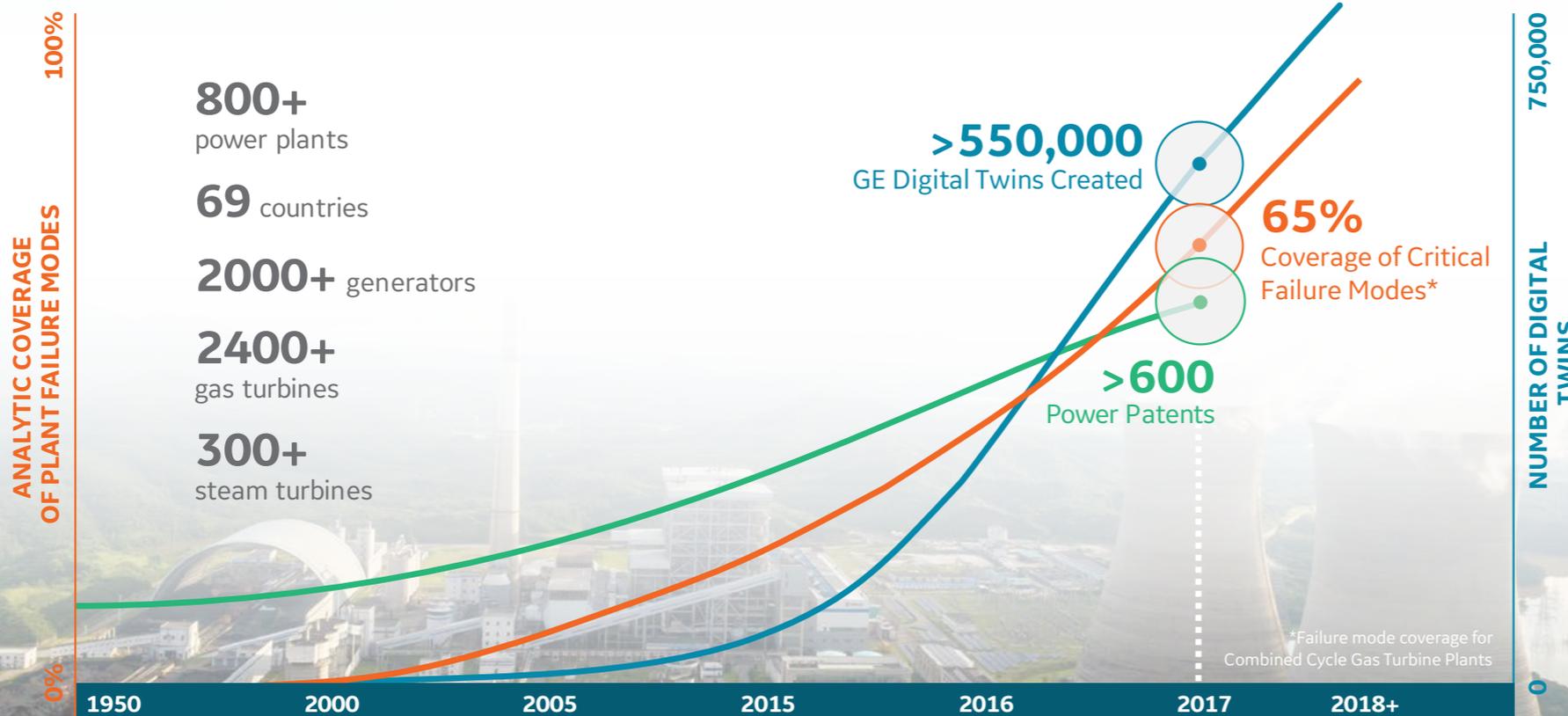


Website: **FOR MORE INFORMATION:**  
on GE Digital Twin

[VISIT WEBSITE](#)

GE has invested heavily in analytics for decades and has helped its customers achieve the outcomes they are striving for every day through thousands of successful analytic implementations.

**Deep Power Expertise, Physics-Aided Machine and Deep Learning, Cloud + Edge, Digital Twin, Predix, Powerful Model Building Tools, Partner Ecosystem, Global Installed Base**



Video: **Exelon & GE:**  
Accelerating Digital Transformation

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Learn how GE can help your organization harness the power of analytics to achieve your goals, supercharge your competitive advantage and succeed in a time of industry transformation.

## Contact Us

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## Footnotes

1. *Analytics 3.0*, **Harvard Business Review**, Tomas H. Davenport, December 2013
2. *Digital Transformation Initiative In collaboration with Accenture*, **World Economic Review**, January 2017; <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-executive-summary-website-version.pdf>
3. *Gartner Says 8.4 Billion Connected "Things" Will Be in Use in 2017, Up 31 Percent From 2016*, **Gartner Press Release**, February 2017; <http://www.gartner.com/newsroom/id/3598917>
4. **Accenture Analytics**; <https://www.accenture.com/us-en/internet-of-things-analytics>
5. *IDC FutureScape: Worldwide Utilities 2017 Predictions*



Website: **FOR MORE INFORMATION**  
on GE Analytics and GE Power  
Digital Solutions

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Brochure: **ELECTRICITY VALUE NETWORK**: Digital Solutions for  
Power & Utilities

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