



# GE “Digital Transformation Story”

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# 글로벌 산업생산성의 감소



# 새로운 산업인프라의 시대

## 1차 산업혁명



1750-1830:  
스팀, 철도

## 2차 산업혁명



1880-1920:  
전기, 전화

## 3차 산업혁명



1960-2000:  
컴퓨터, 인터넷

## 4차 산업혁명



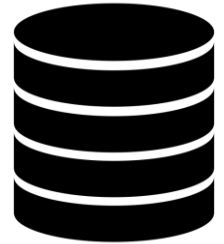
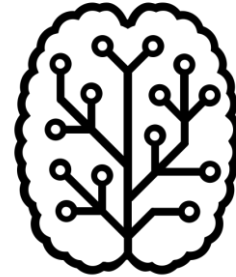
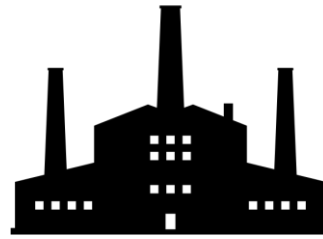
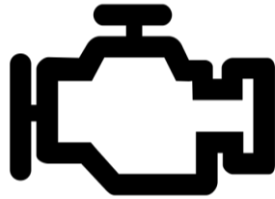
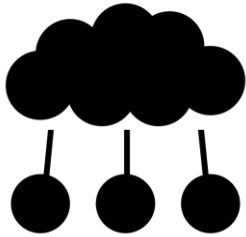
2010-...:  
IoT, 빅데이터, 인공지능



General Electric  
(1892)



# 디지털 시대 - 사물인터넷과 빅데이터



## 비용:

- 센서
- 스토리지
- 컴퓨팅
- 클라우드 서비스

## 센서:

- 설비당 센서 갯수
- 센서 활용 설비 갯수
- 산업데이터

## 머신러닝 & 첨단분석:

- 판단오류
- 예측오류
- 현황파악
- 니즈예측
- 공급예측

2020년에는 200-400억개의 장비가 인터넷을 통해 연결

**Winners will master data and insights ... At speed & scale**



# 디지털 시대 - Aviation 사례

## BEFORE

**1 KB / FLIGHT**

**30 PARAMETERS**

**3 SNAPSHOTS / FLIGHT**

Takeoff (average diagnostics)

Cruise (average diagnostics)

Landing (average diagnostics)



## NOW

**500 GB / FLIGHT**

**5,000 PARAMETERS**

**1 SNAPSHOT / SEC**

Air Speed Calibrated

Altitude

Cooling Valve Position

Exhaust Gas Temperature






Fuel Flow

Ground Speed

and more...



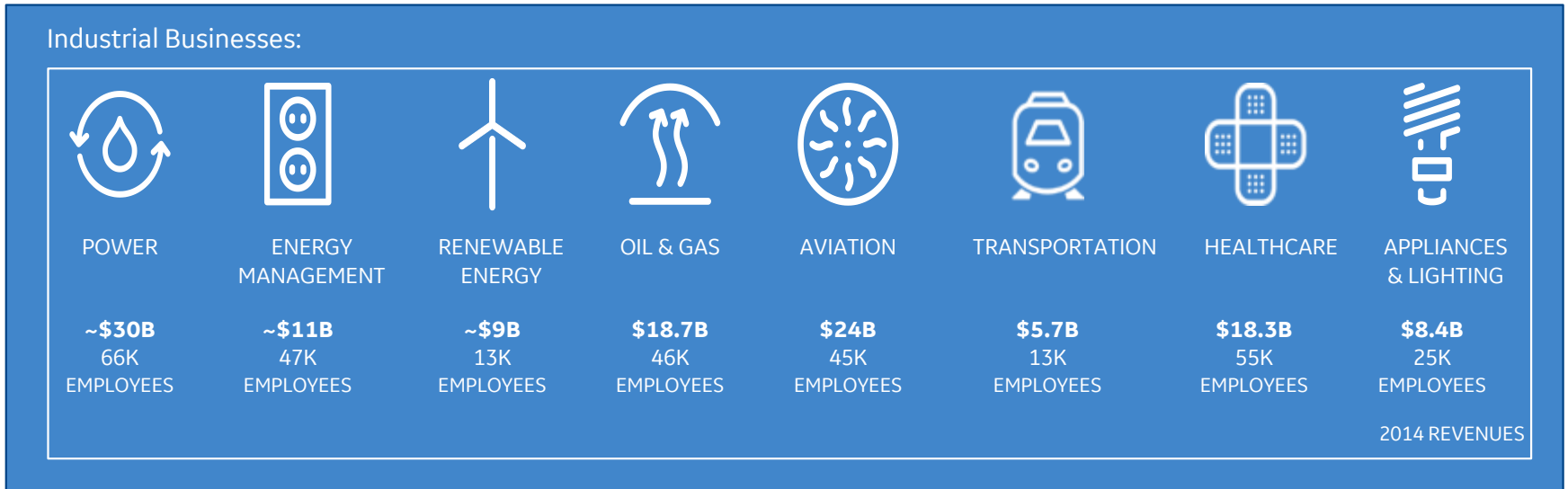
# 디지털 시대 - 산업데이터 분석 산업별 기대효과

	Industry	Segment	Type of savings	Estimated value over 15 years (Billion nominal US dollars)
	Aviation	Commercial	1% fuel savings	<b>\$30B</b>
	Healthcare	System-wide	1% reduction in system inefficiency	<b>\$63B</b>
	Rail	Freight	1% reduction in system inefficiency	<b>\$27B</b>
	Power	Gas-fired generation	1% fuel savings	<b>\$66B</b>
	Oil and Gas	Exploration and development	1% reduction in capital expenditures	<b>\$90B</b>

Note: Illustrative examples based on potential one percent savings applied across specific global industry sectors. Source: GE estimates



# 디지털시대 - GE 제조혁신



- \$50B+ Manufacturing Spend
- 400+ Plants
- 1% Efficiency > \$500M Cost Savings

**Manufacturing improvements are very important to GE**



# 최초 & 최대 디지털산업기업 GE



**“어제까지는 제조산업 기반의 회사였지만,  
이제는 데이터 및 분석 회사로 거듭나야 합니다.”**

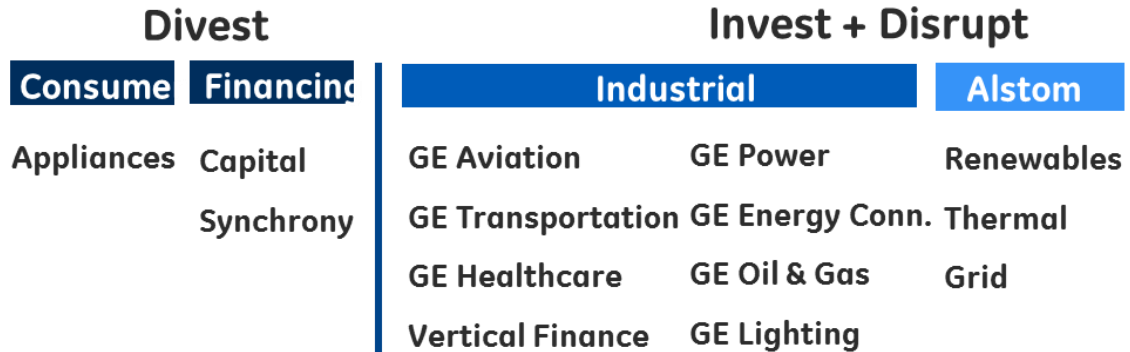
*Jeff Immelt, GE Chairman & CEO*





# 사업포트폴리오 디지털 재편

## Today, GE's New Portfolio



GE Digital

Culture + Transformation



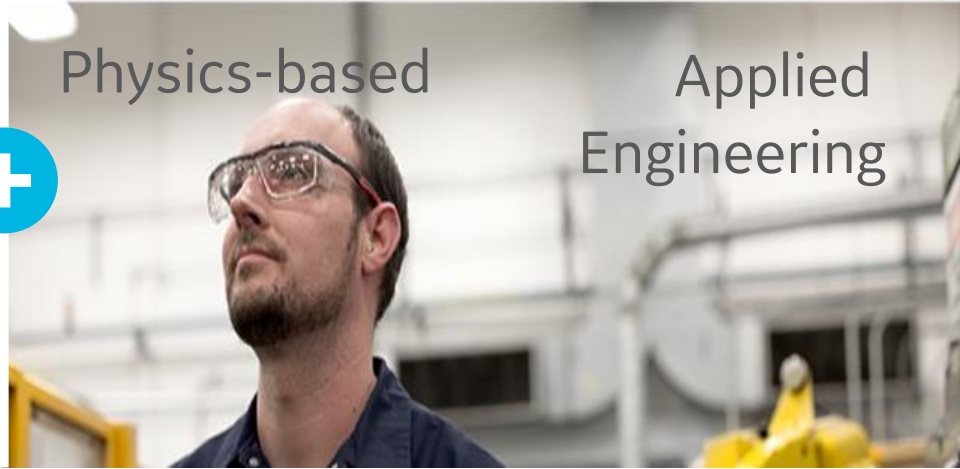
## Digital Industrial company



# GE Digital 융복합 연구센터

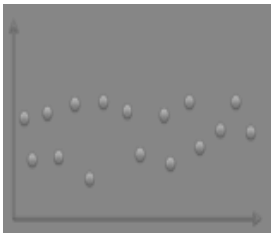


Advanced Data Science



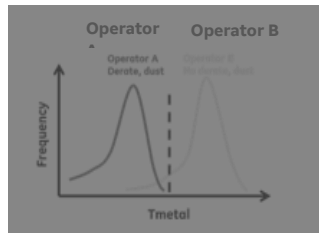
Physics-based

Applied Engineering



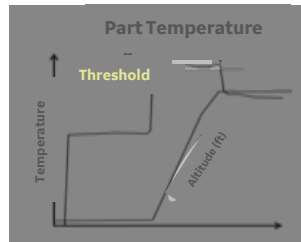
**Data**

Continuous, accessible



**Statistics**

Identify trends and anomalies



**Physics**

Apply asset and domain expertise



Industrial Outcomes

One platform for OT and IT teams to collaborate and innovate



# GE “Digital Transformation Playbook”

Our Play

**GE for GE**  
“Productivity”

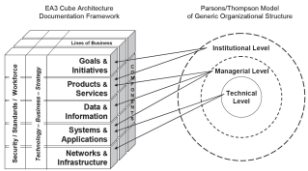
**GE for Customers**  
“Apps”

**GE for the World**  
“Platform”

How we Win

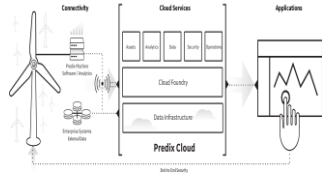
**1** Capabilities & Operating Model

*Change the Game*



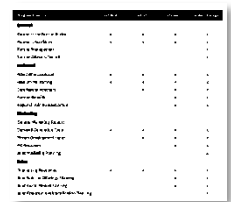
**2** Data and Connected Infrastructure

*Harness the Platform*



**3** Partner Ecosystem

*Go Together, Go Far*



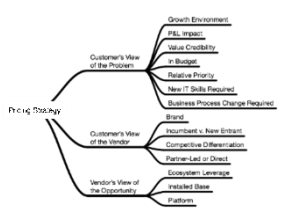
**4** Digital Talent and Culture

*Building Digital DNA*



**5** Business Model Innovation

*All About Outcomes*



# 1 Capabilities & Operating Model

## Re-think what capabilities to build to be a best in class digital company and organize to deliver

### Change the Game

#### Software as a Service Capabilities

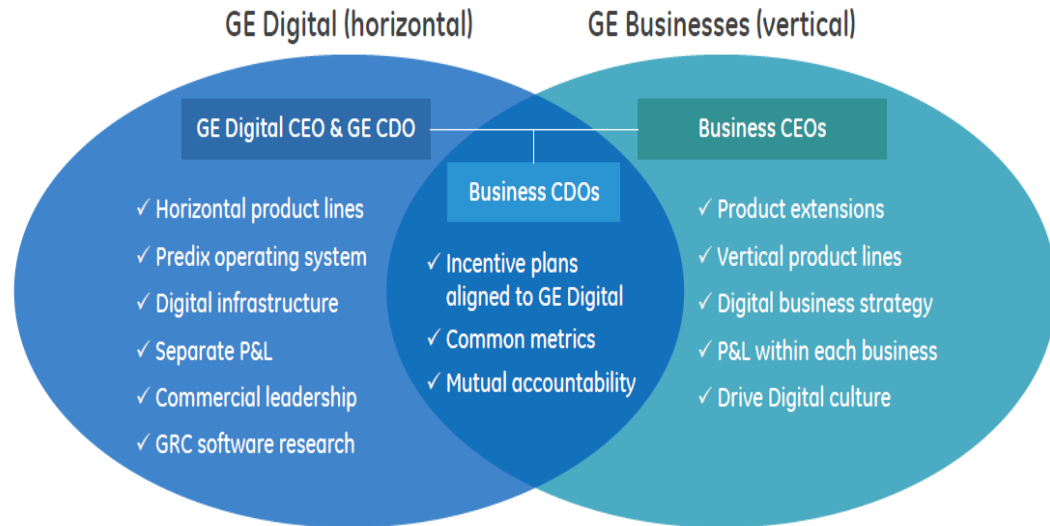
- Product Management
- Product Engineering
- Sales & Marketing
- Channels & Alliances
- Pricing & Packaging
- Order & Subscription
- CPQ Execution
- Licensing & Entitlement
- Service Operations
- Invoicing & Payment
- Revenue Management
- Customer Support
- Professional Services

#### Horizontal / Vertical Mix

- Determine where and how prioritized capabilities are executed (GE Digital vs. BU)

#### Organization Structure

- Align organization structure to implement the capabilities
- Power the CDO to drive mutual accountability



2

Data and  
Connected  
Infrastructure

*Harness the  
Platform*

## How does GE define Digital Industrial? 디지털 산업기업 주요 구성요소



### **Create a Digital Twin**

Serves as the digital foundation.



### **Enable the Digital Thread**

Creates a virtuous loop of continuous improvements.



### **Business Model Innovation Runs Through the Plant Floor**

Create the OT and IT capabilities that enable innovation.



2

Data and  
Connected  
Infrastructure

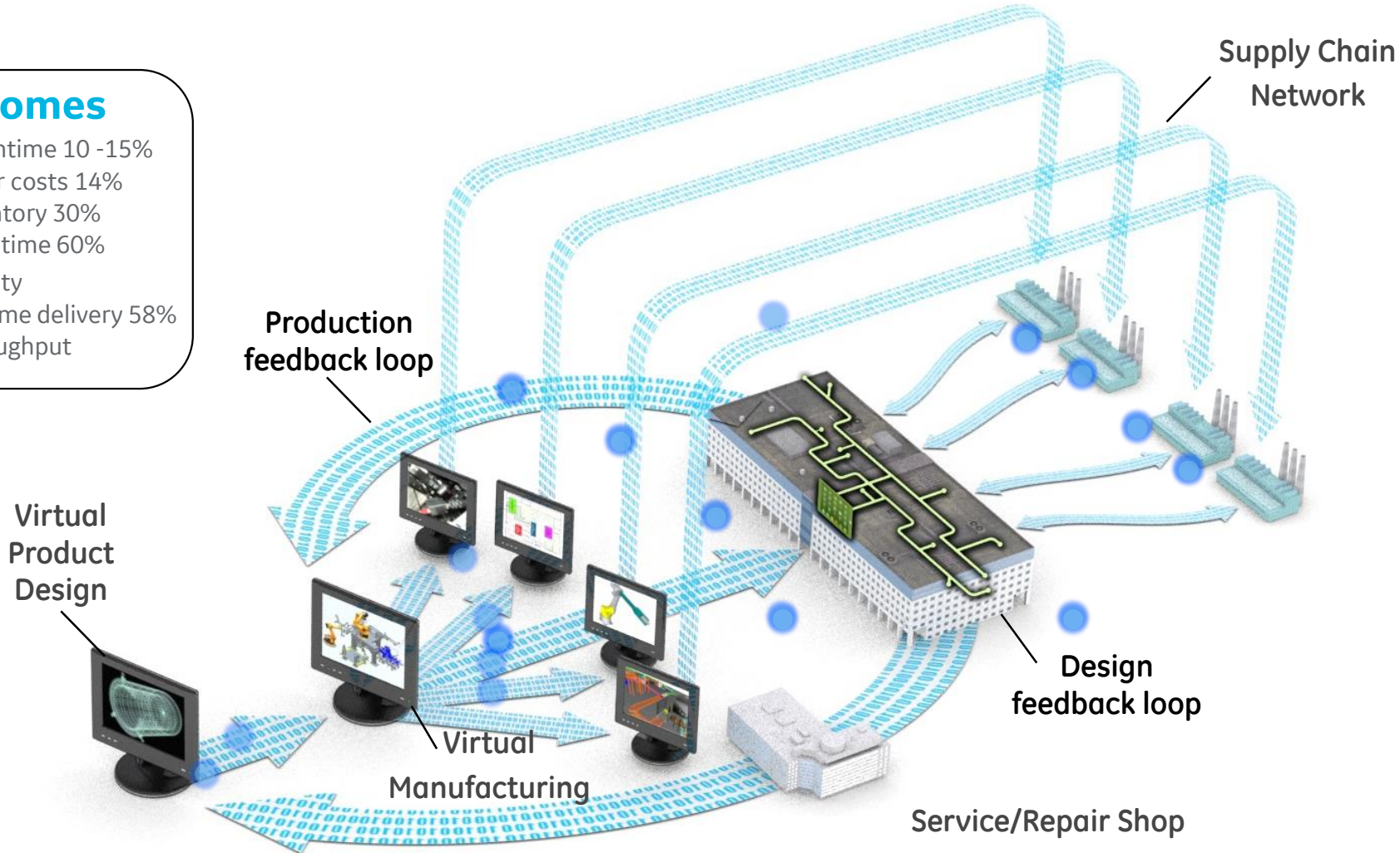
*Harness the  
Platform*

# GE Brilliant Factory

자율 개선 에코시스템을 위한 디지털 트윈 & 디지털 쓰레드 구성

## Outcomes

- ↓ Downtime 10 -15%
- ↓ Labor costs 14%
- ↓ Inventory 30%
- ↓ Lead time 60%
- ↑ Quality
- ↑ On time delivery 58%
- ↑ Throughput



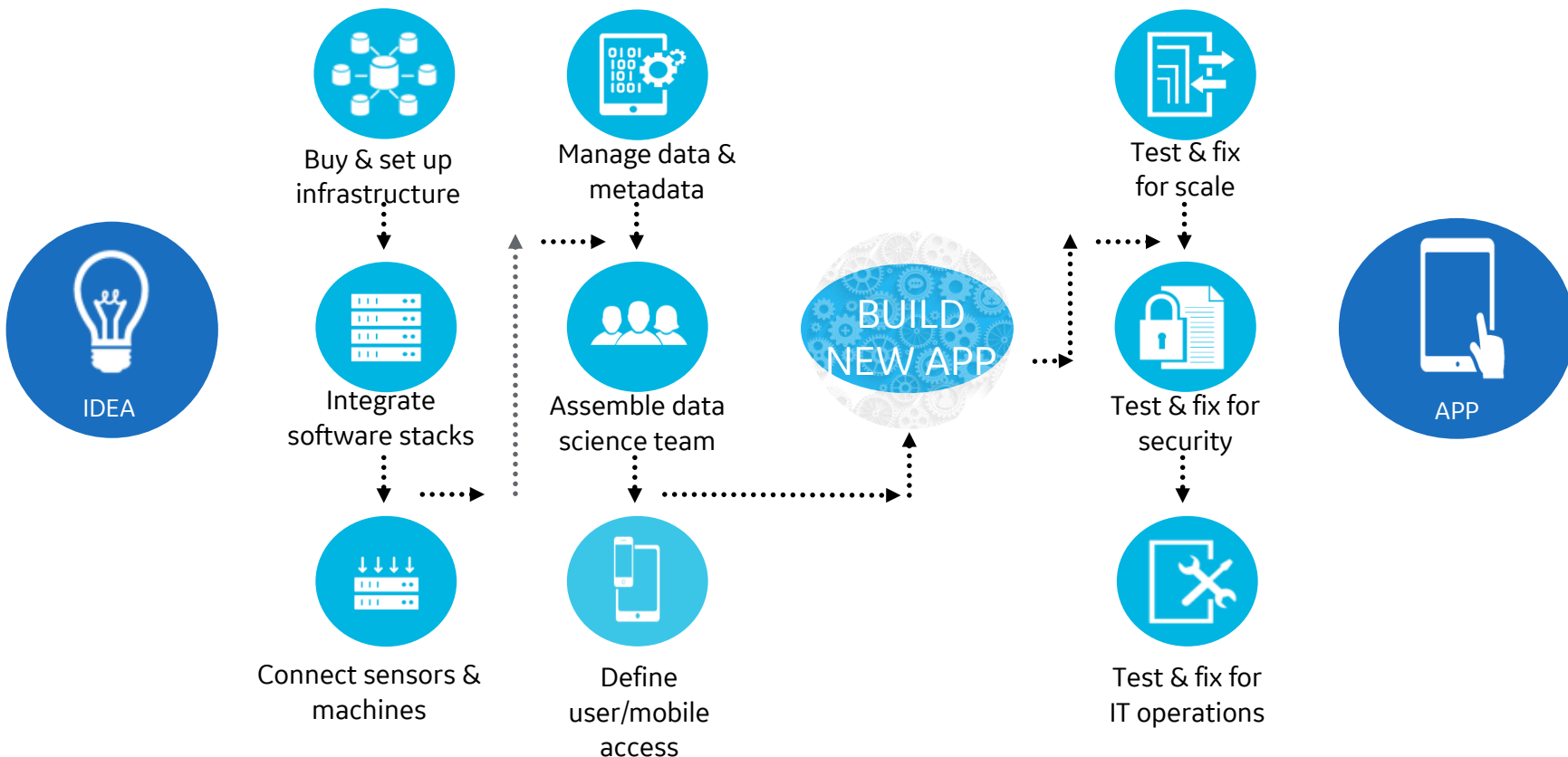
2

Data and Connected Infrastructure

Harness the Platform

Build Your Own 방식은 혁신보다는 시스템 통합 측면의 업무가 많습니다.

Slow & Expensive & Risky & Ineffective



Work completed over 12+ months



2

Data and Connected Infrastructure

Harness the Platform

플랫폼 기반의 Approach를 통해 통합작업에서 혁신활동에 집중해야 합니다.

20% INNOVATION



80% INTEGRATION

- Mostly "waterfall"
- 통합
- 서비스 관리
- 타 시스템 연동
- 보안 및 확장

30% INNOVATION



70% INTEGRATION

- "Water-scrum-fall"
- 타 시스템 연동
- 보안 및 확장
- 기능 개선
- 협업 구상

80% INNOVATION



20% INTEGRATION

- 빠른 프로토타입 도출
- 개발 최적화
- 산업용 PaaS (platform as-a-service)
- 산업용 마이크로 서비스

Note: Industry / GE estimates





2

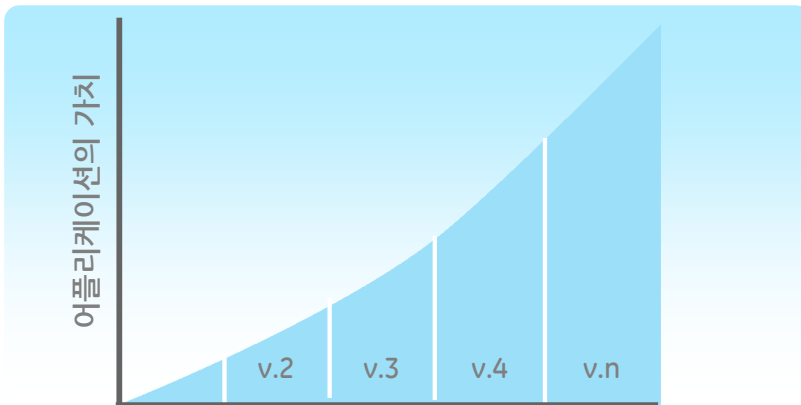
Data and  
Connected  
Infrastructure

Harness the  
Platform

# 산업용 SW플랫폼 기반의 애플리케이션 구축 마이크로서비스 생태계를 활용한 신속한 개발과 배포

## YESTERDAY

Industrial APPLICATIONS

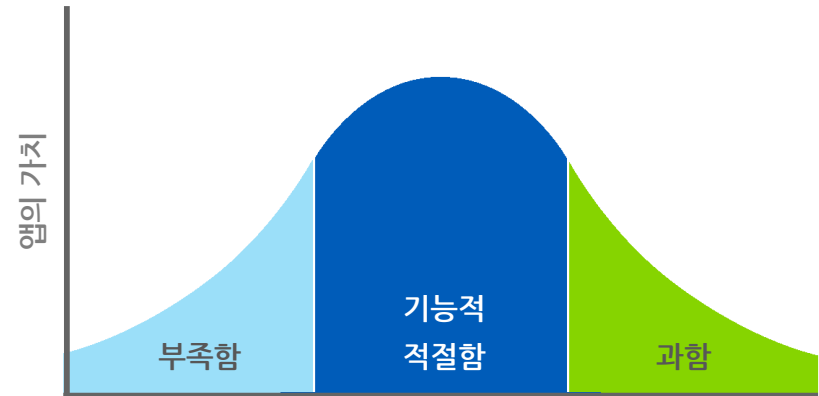


제공 기능의 수량  
적용 가능여부가  
중요하였습니다.

### 10 애플리케이션

## TODAY

Industrial APPS



제공 기능의 수량  
목적이 가장 중요합니다

### 100+ 앱



2

Data and  
Connected  
Infrastructure

*Harness the  
Platform*

# 산업인터넷 SW플랫폼 - GE Predix

산업플랫폼 기술과 산업노하우의 접목

## Cloud-based platform for Industrial Internet

Connected Assets

Industrial Data Management

Industrial Data Science

Cloud & Mobile



## Optimized for Industrial Requirements

Asset Performance Mgmt

Operations Optimization

Industrial Analytics

Digital Twin



### Reliability

Increase availability and  
longer asset life



### Cost Reduction

Lower operating costs  
with greater  
efficiencies



### Risk Mitigation

Lower operations and  
financial risk



### Profitable Growth

Increase production for  
market advancement



2

Data and  
Connected  
Infrastructure

*Harness the  
Platform*

# 산업인터넷 SW플랫폼 - GE Predix

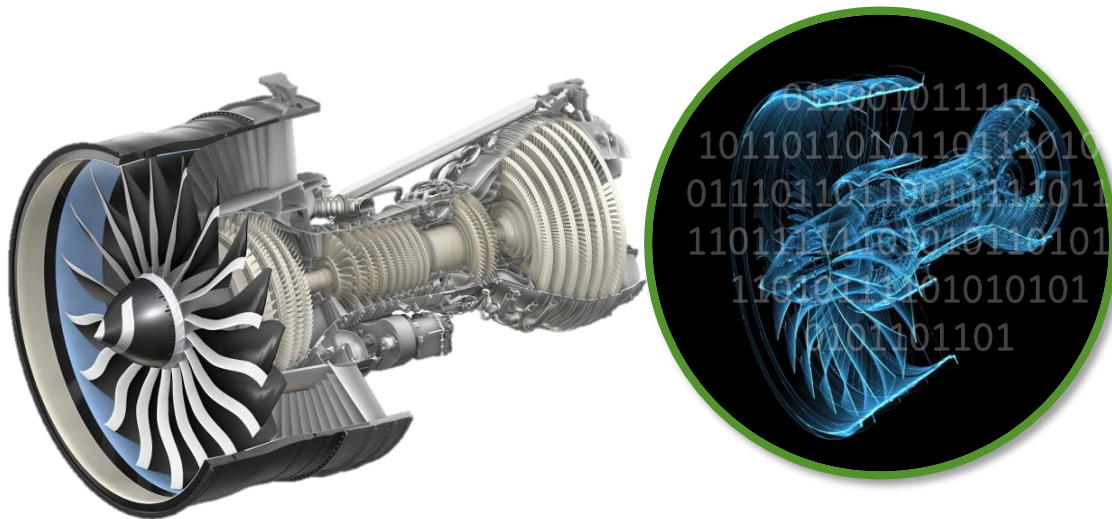
산업인터넷 공통 과제에 대한 산업 알고리즘 제공

How to connect  
securely to any  
asset from any  
vendor?

How to manage  
and analyze  
massive data sets  
cost-effectively?

How to deliver  
real-time  
information to  
operators?

How to protect  
data and comply  
with regulations?



## Common software platform for OT and IT teams



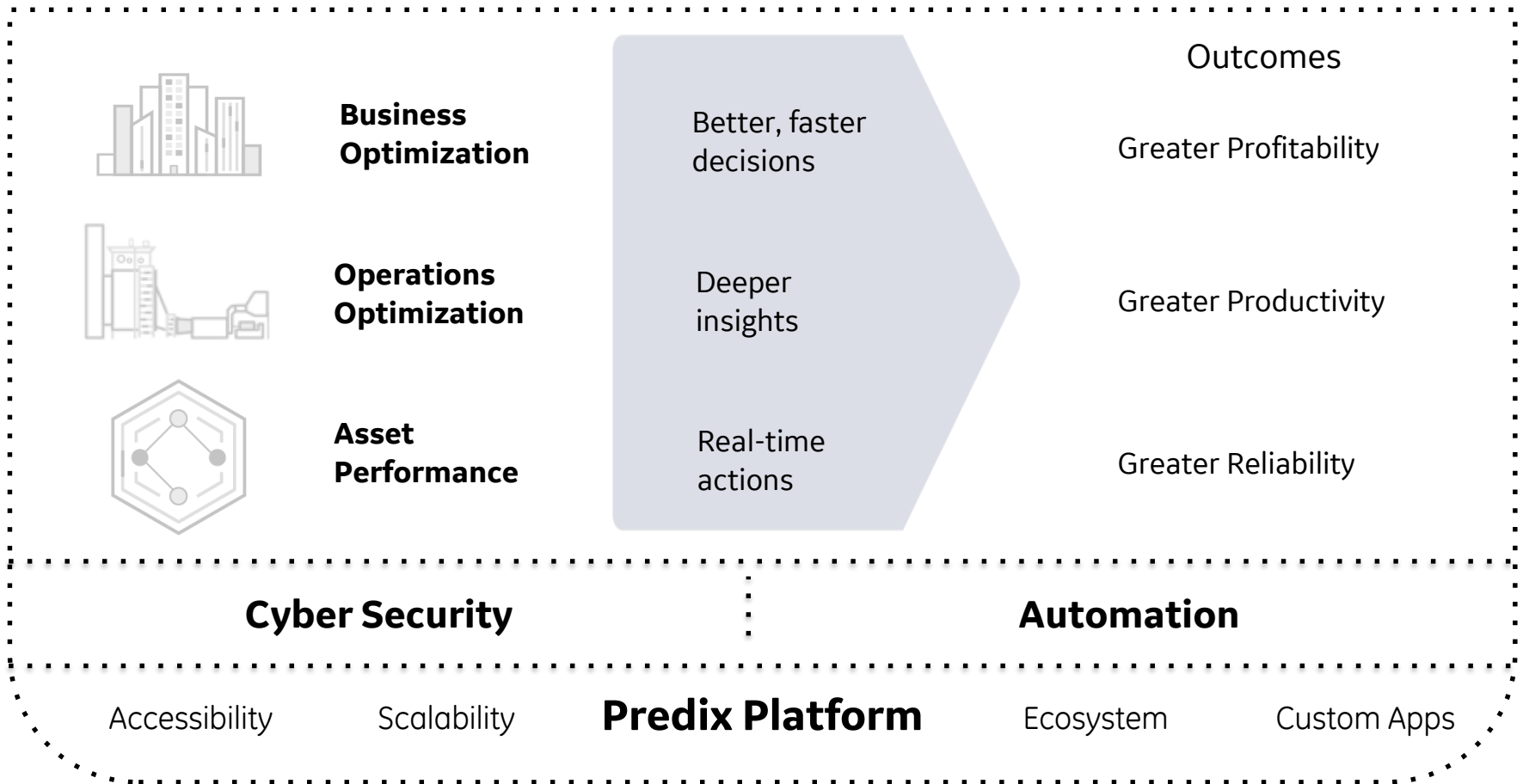
2

Data and  
Connected  
Infrastructure

*Harness the  
Platform*

# 산업인터넷 SW플랫폼 - GE Predix

산업별, 설비별, 니즈별 Outcome기반 솔루션 제공



# Catalog

Services

Analytics

Filter Categories

## ANOMALY DETECTION

### Trend Anomaly Detection

Manage critical time series trend detection.

PREDIX

### High-Dimension Anomaly Detection

Check multiple sensors for key time series anomaly detection.

PREDIX

### Low-Dimension Anomaly Detection

Maintain machine health with this critical time series anomaly detection.

PREDIX

### Shift Anomaly Detection

Enable key time series shift detection.

PREDIX

### Image-Based Diagnosis

This analytic uses image features to segment the images through clustering techniques.

PREDIX

## TIME SERIES

### Moving Average Using Time Series

Use analysis and forecasting methods from an input time series having uniform time intervals.

PREDIX

### ARMA Using Time Series

This method performs forecasting of time series data without trend or seasonality where parameters are optimized.

PREDIX

### Time Series Clustering

This analytic uses a k-shape clustering algorithm similar to k-means to produce clusters of time series.

PREDIX

### Feature Reduction Using ANOVA

This analytic uses Pearson correlation coefficients to reduce the features that are present for any given population.

PREDIX

### Exponential Smoothing

Perform forecasting of time series data with trend and seasonality using exponential smoothing.

PREDIX

## MACHINE LEARNING

### Logistic Regression Classifier

Logistic regression is used for classification, and is powerful for predicting classes that are linearly separable.

PREDIX

### Db Deduplicator

This analytic compares similarities of rows in a loosely defined database.

PREDIX

### Random Forest Classifier

Random forest is an ensemble classifier of many decision trees, and outputs the class that is the mode of the output by individual trees.

PREDIX

### Energy Price Prediction

This supervised method predicts the energy price for a future 5 days based on the historical trend of hourly prices.

PREDIX

### K-Nearest Neighbors Classifier

The KNN classifier is a non-parametric supervised learning method for classification problems.

PREDIX

## PREDICTIVE MODELS

### Work Order Topic Detector

This analytic finds the main topics from a corpus of many work orders.

PREDIX

### Jump Diffusion Model Fit

This analytic is used for calibrating a process with mean reversion and jump diffusion.

PREDIX

### Robust Regression - Training

Robust regression training is an alternative to least squares regression.

PREDIX

### Wind Power Analytics

This analytic calculates energy output of a grid-connected utility scale wind farm.

PREDIX

### Spare Forecast Analyzer

This forecasts spares for a bill of materials based on the variance of the confidence and turn-around-time by part number.

PREDIX

## STATISTICAL METHODS AND ANALYSIS

### System Maintainability Prediction

This analytic uses a regression model to predict system maintainability.

### Residual Analysis

This analytic can be used to visualize and

### Maximum Variance Feature Analysis

This analytic uses a regression model to predict system maintainability.

### Student T-test

This analytic employs a commonly used

### Finding K for Cluster Analysis

This device determines the number of

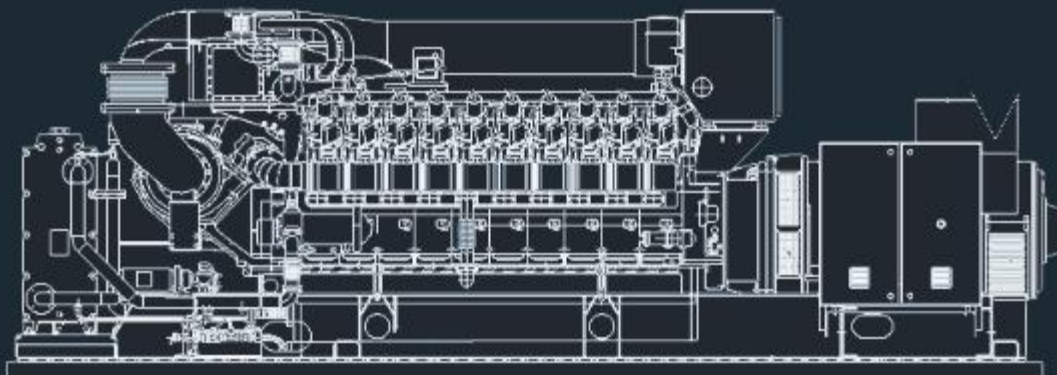
# Waukesha Engine

VHP L7044GSI  
Franciszka Karpińskiego, 15-001 Białystok, Poland

## Context

<b>Manufacturer</b>	<b>Part Number</b>
GE	P257681
<b>Asset Model</b>	<b>Company</b>
VHP L7044GSI	X Energy Corp
<b>Serial Number</b>	<b>Description</b>
45023067	Waukesha Engine in Białystok, Poland

[More](#)



## KPIs

Availability



Reliability



Uptime



Utilization



(Last 24 hours)

[More](#)

● In Good Shape ● Replace Soon ● Replace Now



⚠ Replace plug 5R within 3 days

## 9ha Gas Turbine (50 Hz)

RUNNING



Turbine

### Cases

Sort by



Filter



**Turbine Shaft Over Rotated**

Lorem ipsum dolor sit amet, consectetur ing elit, sed diam nonummy euismod

**Vibration Increase**

Lorem ipsum dolor sit amet, consectetur adipis ing elit, sed diam nonummy nibh

**Turbine Shaft Over Rotated**

Lorem ipsum dolor sit amet, consectetur ing elit, sed diam nonummy euismod

**Turbine Shaft Over Rotated**

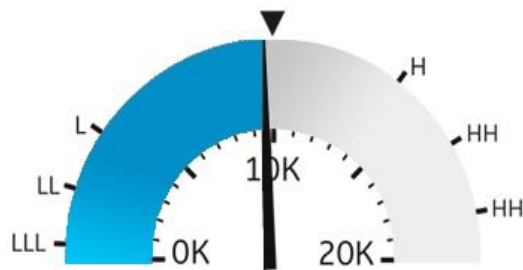
Lorem ipsum dolor sit amet, consectetur



The 5100/3600 RPM ratio speed reducing gear is installed on the generator base plate, between the gas turbine and the generator, and provide with the following auxiliary facilities: Quill shaft with torque limiting device between the gearbox and generator.

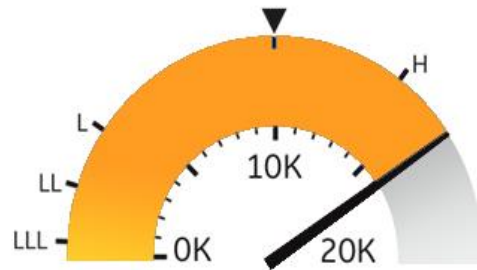
50/60	50 HZ
SC Net Output	397-470 MW
SC Net Heat Rate	8220 Btu/KWh, LHV
SC Net Heat Rate	8673 kJ/KWh, LHV
SC Efficiency	41.5% LHV
CP Ratio	21.8 X:1
Firing Temp Class	>2600/>1430 °F/°C
Exhaust Temp	1146/619 °F/°C
Exhaust Energy	1933 MMBtu/hr

### OUTPUT 1



9,965 BTU/KWh  
Ideal Heat Rate: 10,000

### OUTPUT 1



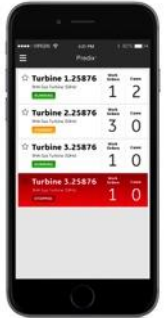
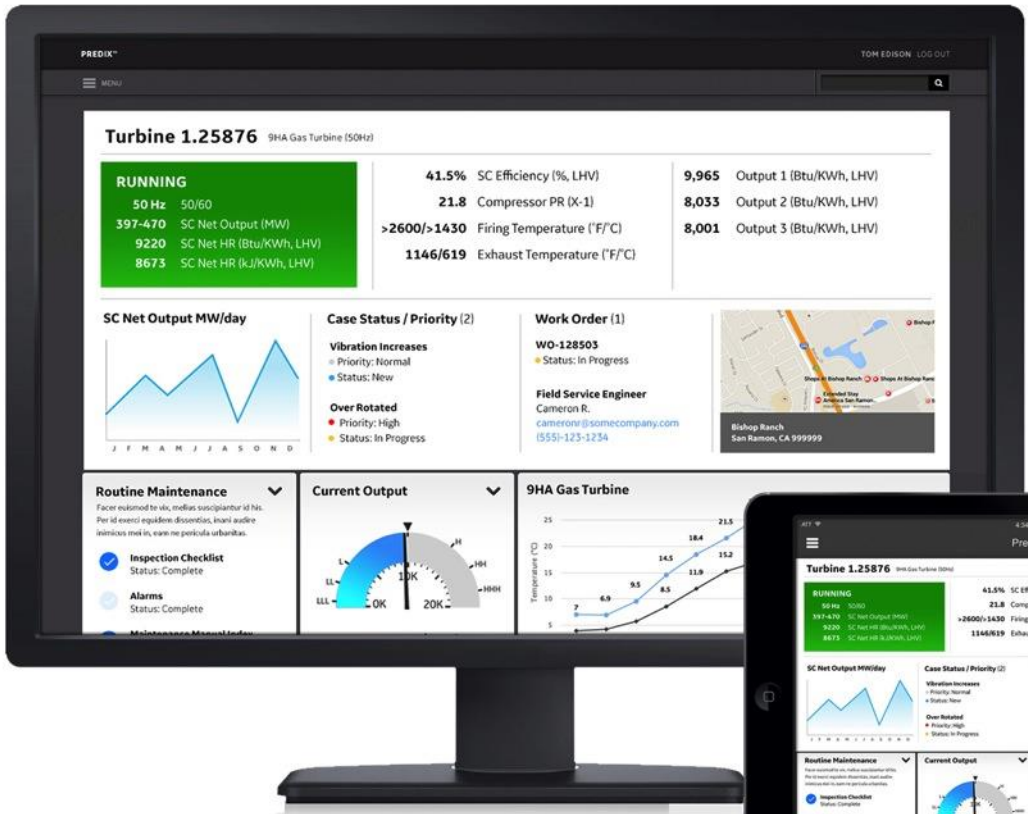
8,033 BTU/KWh  
Ideal Heat Rate: 5,000



the power of the drop  
THE ENERGY TO TRANSFORM

INTERNATIONAL LNG SHIPPING CONFERENCE 2015  
FEBRUARY 24 -26







3

Partner Ecosystem

Go Together,  
Go Far

# 다양한 파트너사와 공동혁신 Open Innovation을 통한 공동성장

## 원칙가이드

- 차별화된 기술개발
- 신규시장 개척
- 최고의 파트너와 협업
- 위험과 성공 공유

산업인터넷컨소시엄  
창립멤버



# 수평적&디지털 기업문화로 혁신

빠른 실패를 권장하고 코칭문화를 통한 자기계발

What we  
believe  
in

How we  
do what  
we do

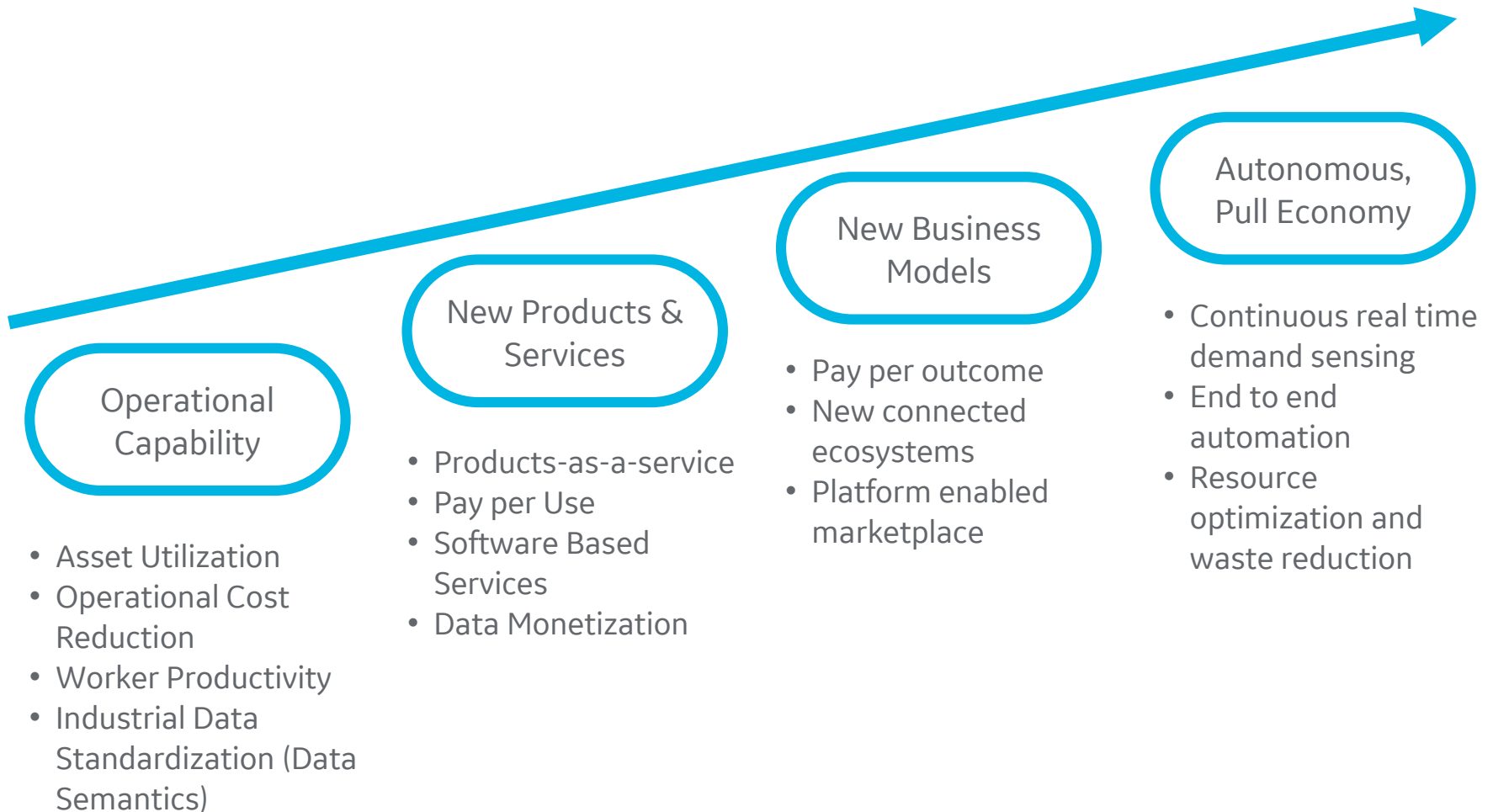
How we  
measure  
our  
success

GE BELIEFS



PD@GE

## 성숙도 모델(Maturity Curve)에 근거한 로드맵 수립



# Getting Started—How we can work with you

## Who we are?



## Digital Expertise

Software developers and architecture • User experience design • Product management • Solution architecture • Data science • Cybersecurity analysts

## Industrial Expertise

Mechanical, electrical, chemical, and industrial engineering • Material science • Computer science • Physics • Product management

<http://www.ge.com/digital>



# Getting Started—How we can work with you

## Who we are?



### OIL & GAS

- Maximize Production
- Predictive Maintenance
- Remote Collaboration
- Reduced Risk
- Environmental Control

### POWER GENERATION

- Maximize Production
- Longer Repair Intervals
- Reduce Emissions
- Predictive Maintenance
- Longer Asset Life

### POWER DISTRIBUTION

- Revenue Protection
- Meter Health
- Power Quality
- Load Forecasting
- Predictive Maintenance

### WIND

- Maximize Farm Power
- Wind Wake Protection
- Outage Detection
- Continuous Operation

### WATER

- Operational Integrity
- Minimize Water Use
- Control Emissions
- Minimize Cost

### AVIATION

- Maximize Fuel Use
- Risk Management
- Predictive Maintenance
- Efficient Operations
- Customer Satisfaction

### RAIL

- Maximize Fuel Use
- Enhanced Operation
- Network Velocity
- Predictive Maintenance
- Supplier Collaboration

### HEALTHCARE

- Patient Experience
- Improved Hand Hygiene
- Cost Reduction
- Efficient Operations
- Regulatory Compliance

### MANUFACTURING

- Cost Reduction
- Consumer Protection
- Efficient Operations
- Regulatory Compliance
- Predictive Maintenance

### MINING

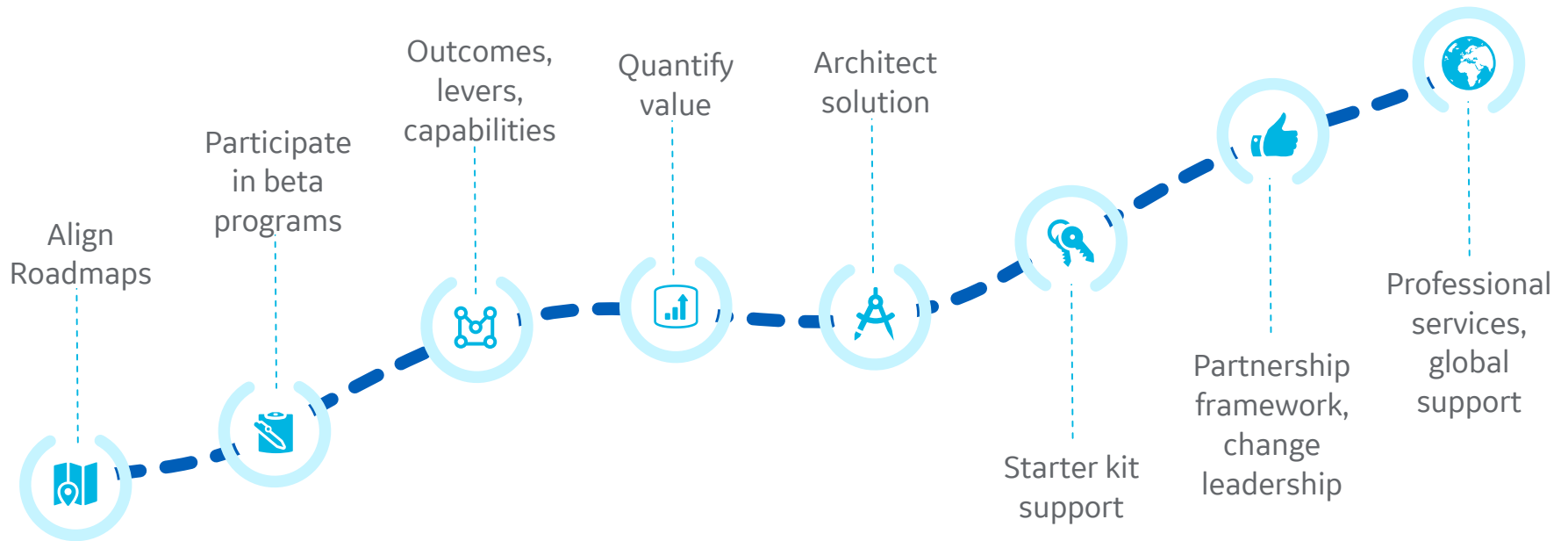
- Maximize Production
- Efficient Operations
- Safe Operations
- Predictive Maintenance

<http://www.ge.com/digital>



# Getting Started—How we can work with you

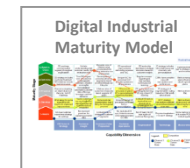
Trusted Partner for your industrial digital transformation journey



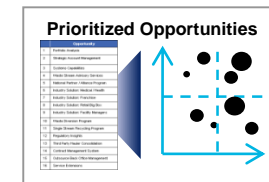
# Getting Started—How we can work with you

## 3 Steps to Get Started

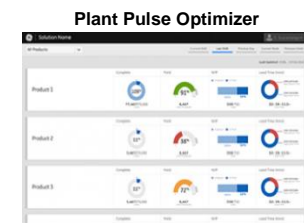
**1** Baseline Current Digital Industrial Capabilities



**2** Build out Vision + Roadmap with Milestones



**3** Generate Quick Wins



# Getting Started—How we can work with you

## Digital Transformation Blueprint Advisory Service

### Value Proposition

- Strategic offering for customers who want to build a roadmap for Digital Transformation
- Deep technical/operational discovery, benchmarking against peers, clear ROI
- A clear vision for what is possible

### Deliverables

- Survey + peer benchmarking results
- Multi-generational + implementation plan that get's customer to desired future state
- Value case/ROI





