



GE “Digital Transformation Story”

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March 29, 2017

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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



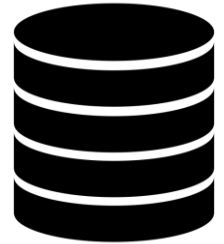
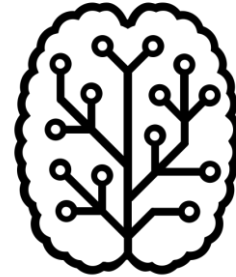
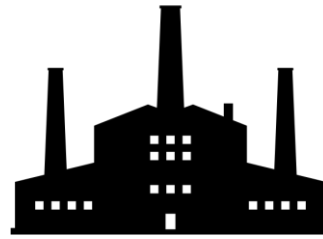
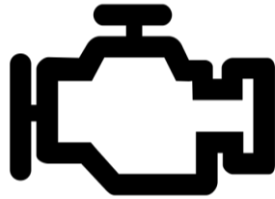
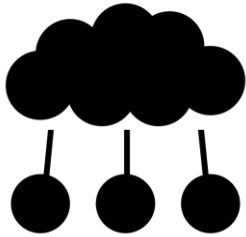
2010-...:
IoT, 빅데이터, 인공지능



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...



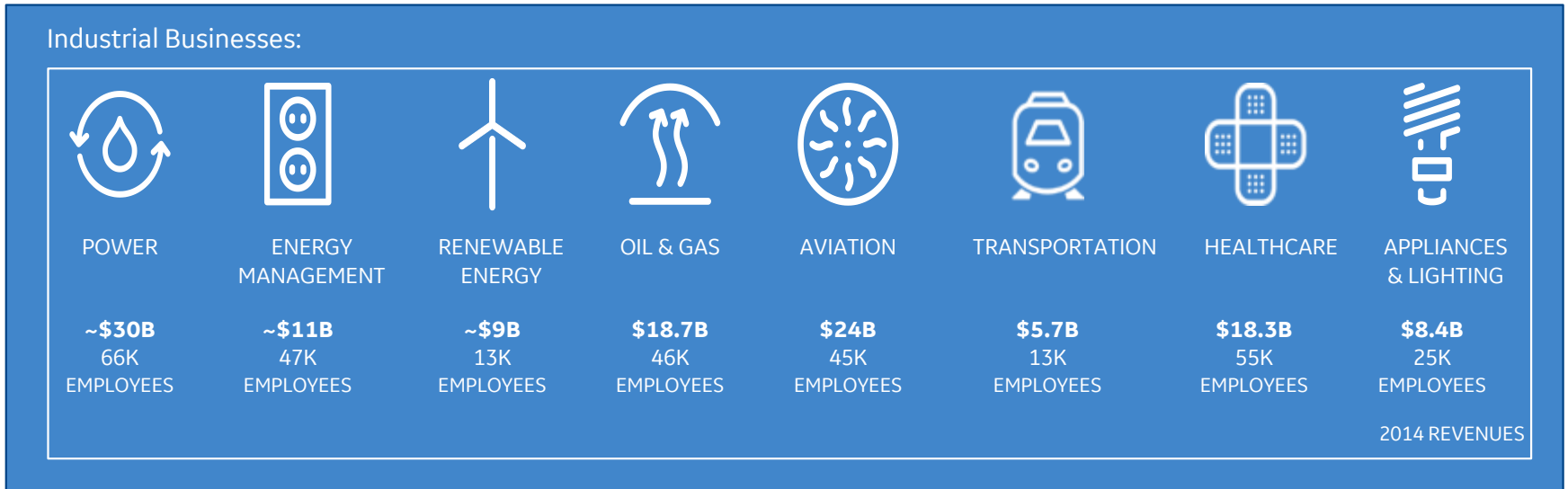
디지털 시대 - 산업데이터 분석 산업별 기대효과

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

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



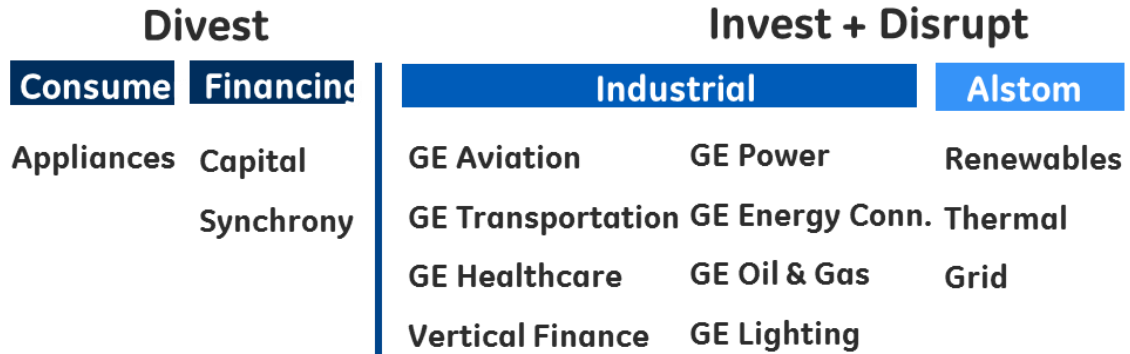
**“어제까지는 제조산업 기반의 회사였지만,
이제는 데이터 및 분석 회사로 거듭나야 합니다.”**

Jeff Immelt, GE Chairman & CEO



사업포트폴리오 디지털 재편

Today, GE's New Portfolio



GE Digital

Culture + Transformation



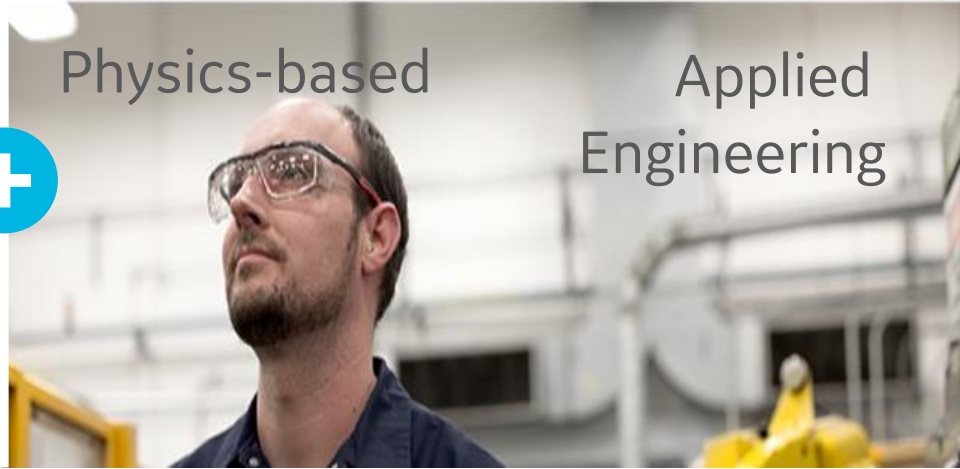
Digital Industrial company



GE Digital 융복합 연구센터

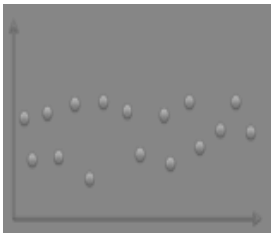


Advanced Data Science

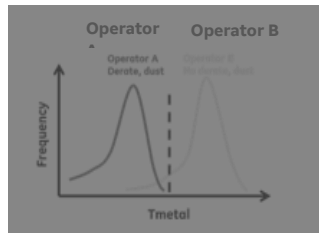


Physics-based

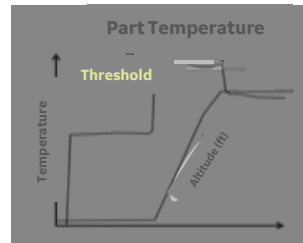
Applied Engineering



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”

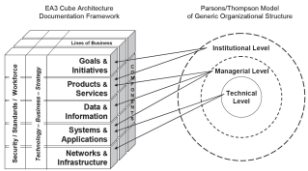
GE for Customers
“Apps”

GE for the World
“Platform”

How we Win

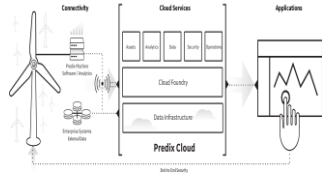
1 Capabilities & Operating Model

Change the Game



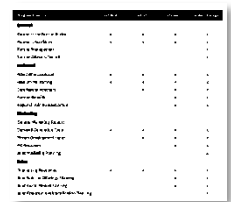
2 Data and Connected Infrastructure

Harness the Platform



3 Partner Ecosystem

Go Together, Go Far



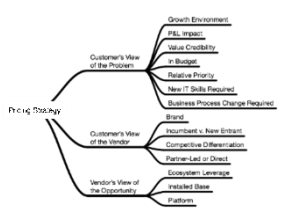
4 Digital Talent and Culture

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

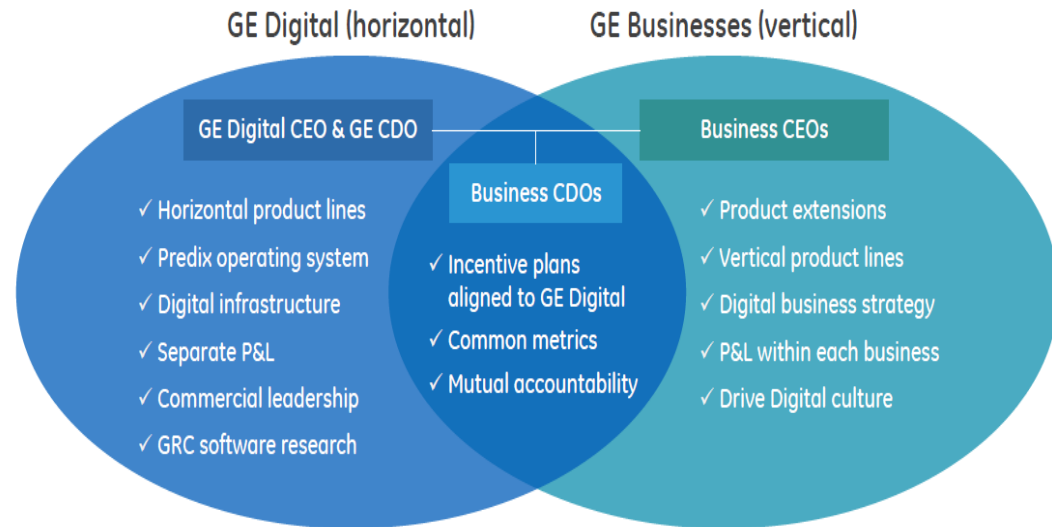
- Product Management
- Product Engineering
- Sales & Marketing
- Channels & Alliances
- Pricing & Packaging
- Order & Subscription
- CPQ Execution
- Licensing & Entitlement
- Service Operations
- Invoicing & Payment
- Revenue Management
- Customer Support
- Professional Services

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

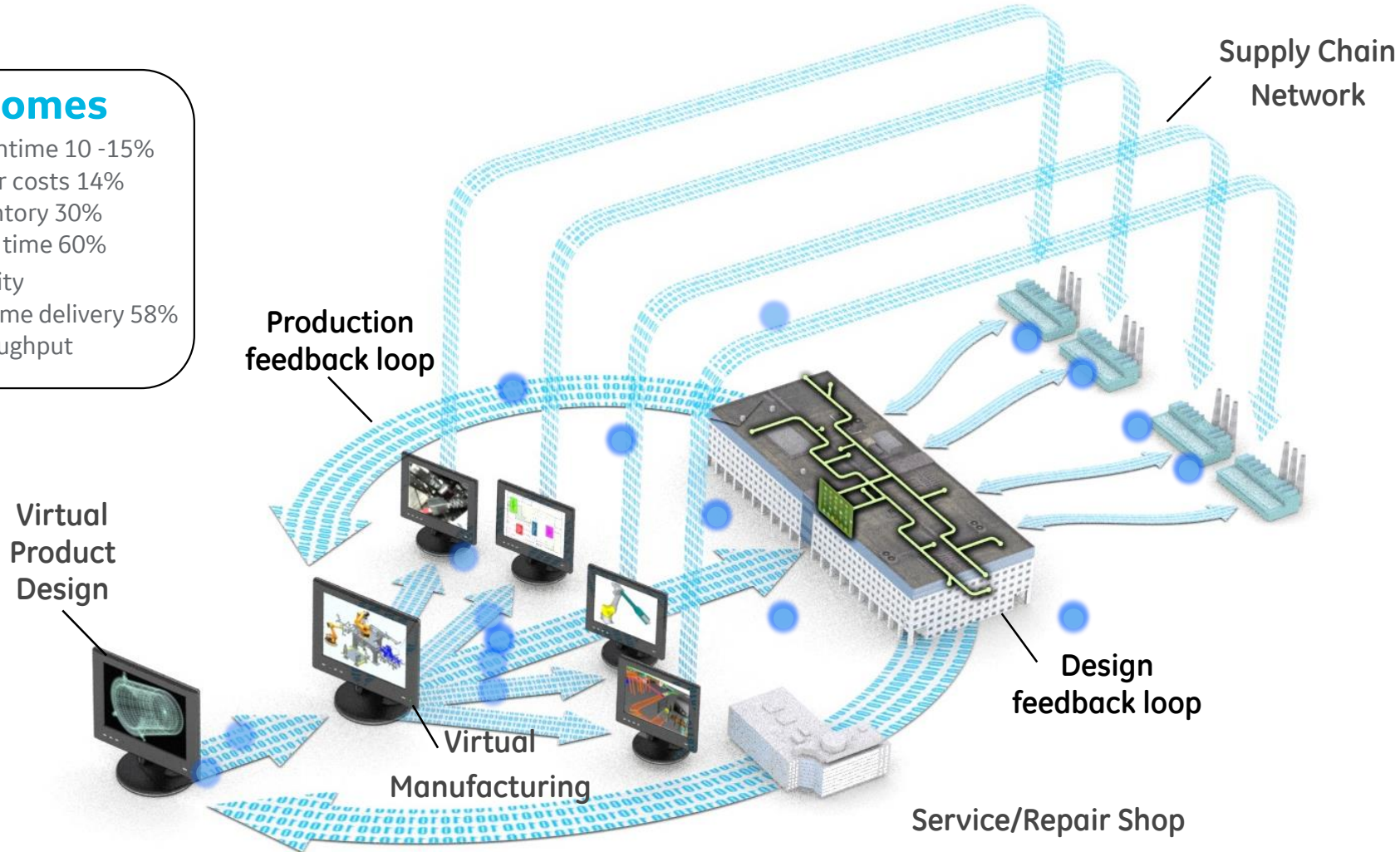
Harness the Platform

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



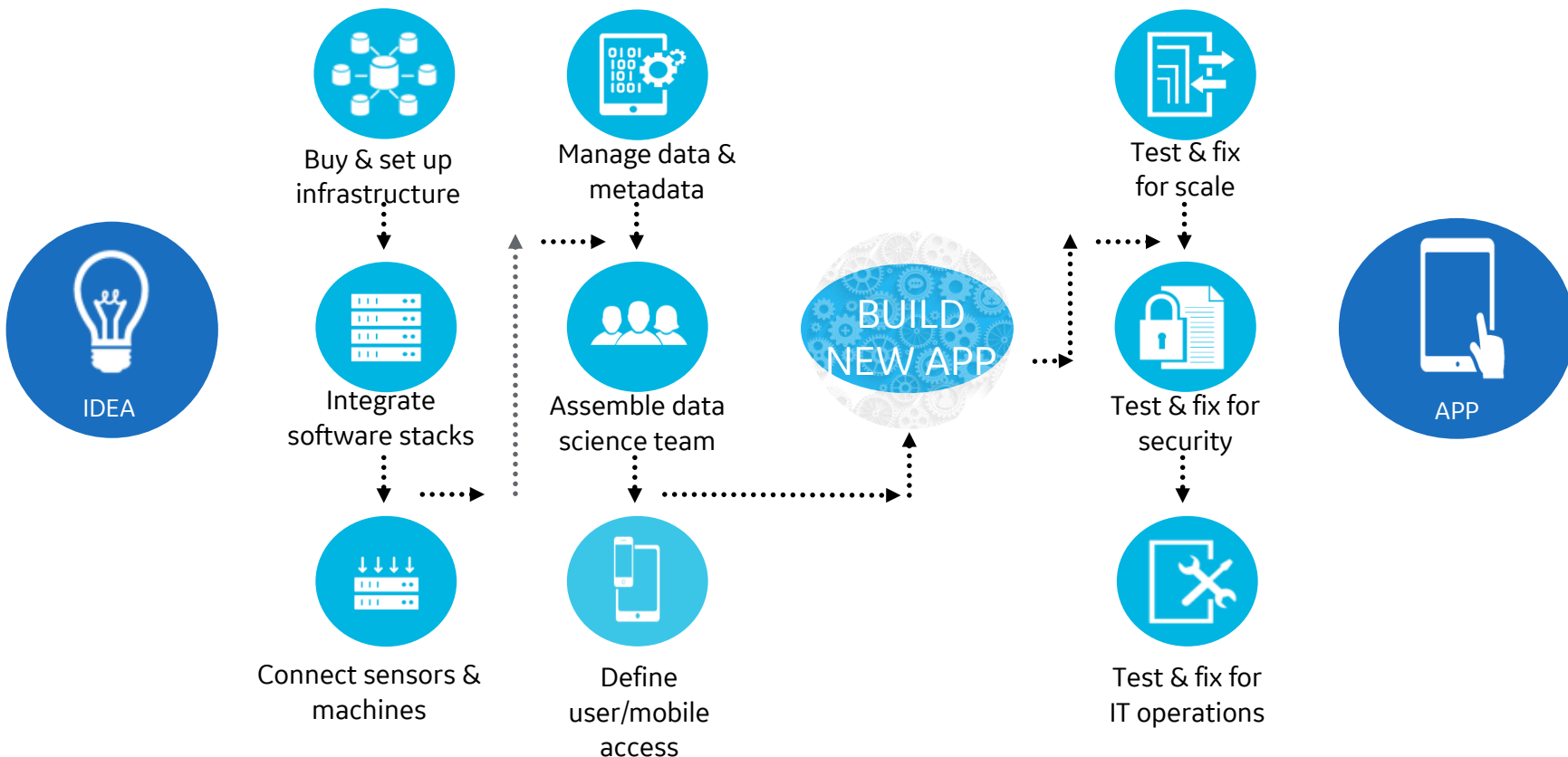
2

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

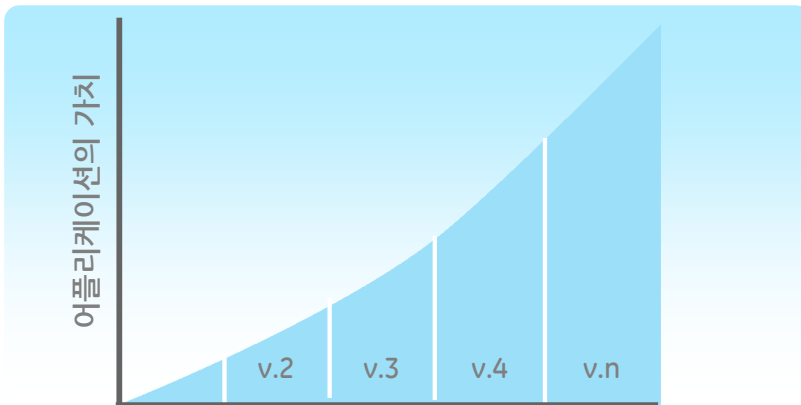
Data and
Connected
Infrastructure

Harness the
Platform

산업용 SW플랫폼 기반의 애플리케이션 구축 마이크로서비스 생태계를 활용한 신속한 개발과 배포

YESTERDAY

Industrial APPLICATIONS

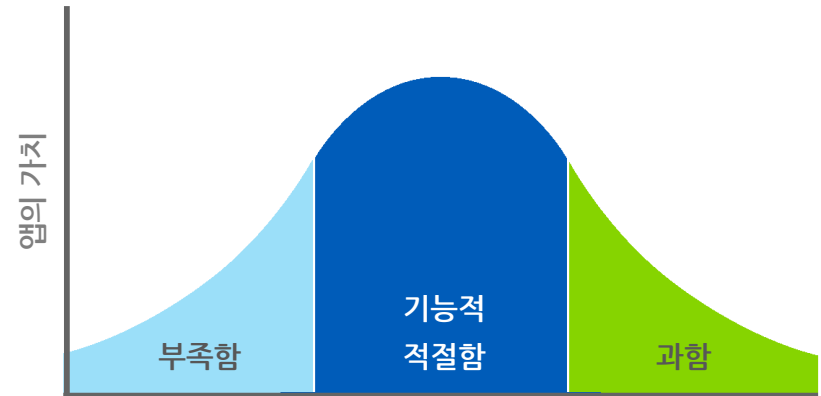


제공 기능의 수량
적용 가능여부가
중요하였습니다.

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

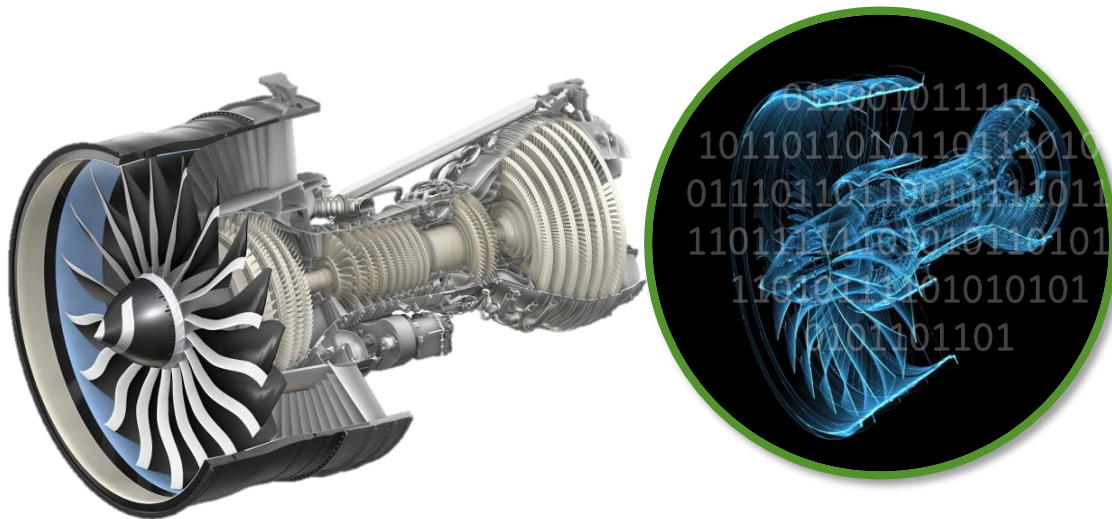
산업인터넷 공통 과제에 대한 산업 알고리즘 제공

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



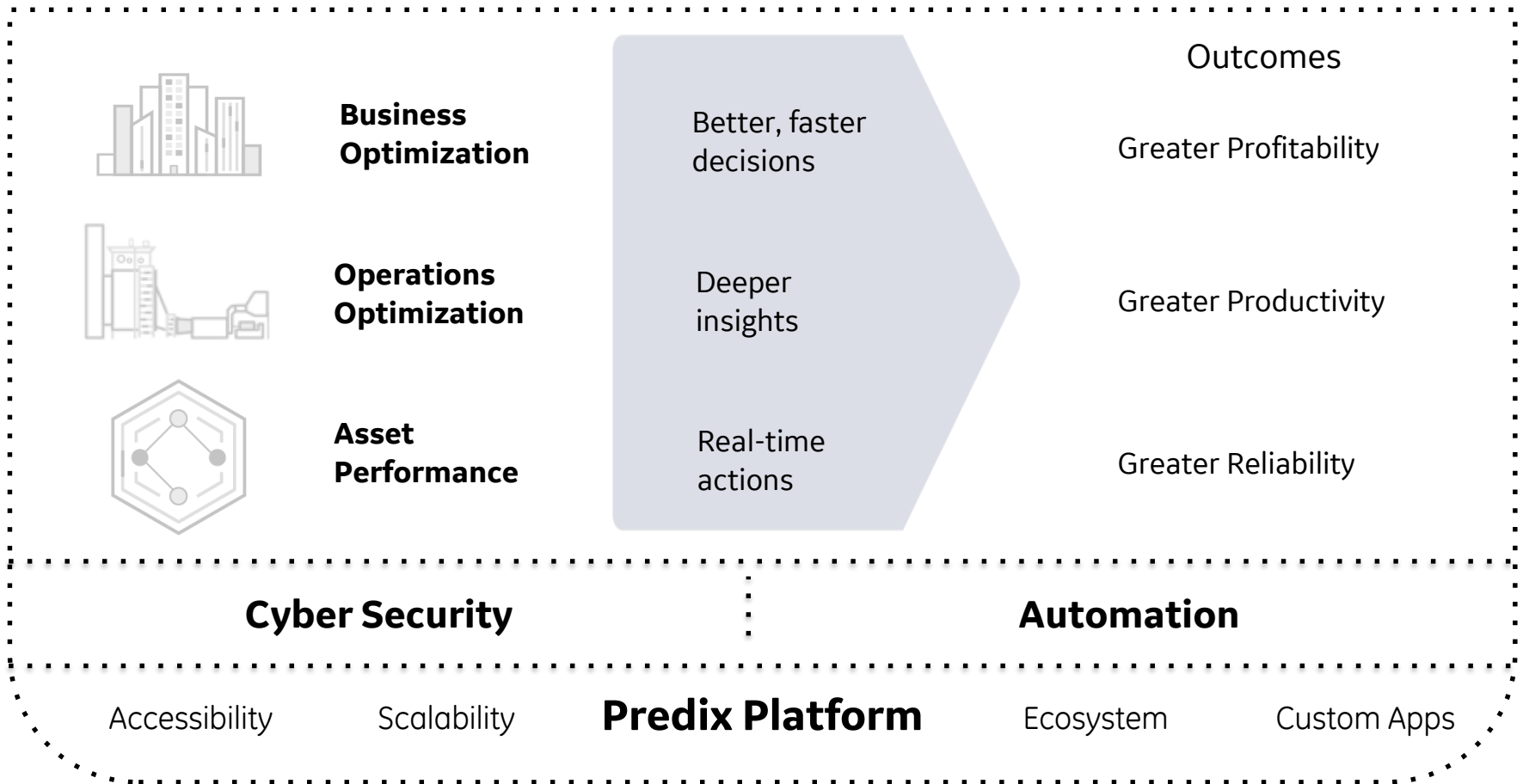
2

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 based on historical data.

Residual Analysis

This analytic can be used to visualize and analyze the residuals of a regression model.

Maximum Variance Feature Analysis

This analytic uses principal component analysis to identify the most important features in a dataset.

Student T-test

This analytic employs a commonly used statistical test to compare the means of two groups.

Finding K for Cluster Analysis

This device determines the number of clusters in a dataset.

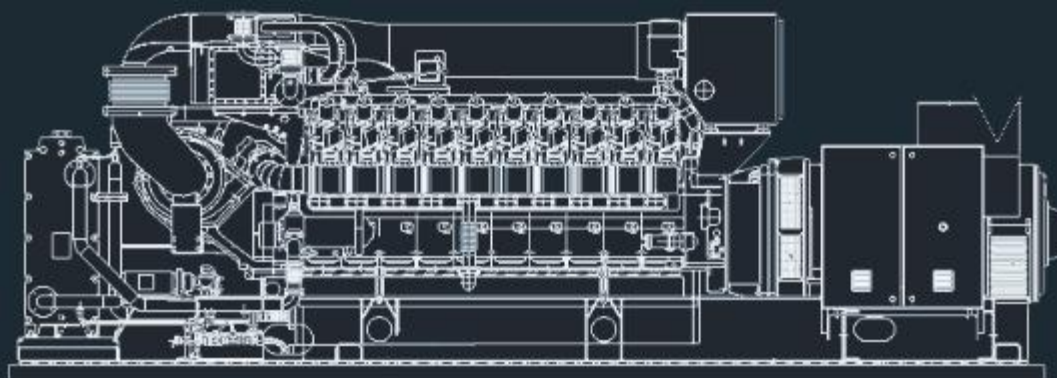
Waukesha Engine

VHP L7044GSI
Franciszka Karpińskiego, 15-001 Białystok, Poland

Context

Manufacturer	Part Number
GE	P257681
Asset Model	Company
VHP L7044GSI	X Energy Corp
Serial Number	Description
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

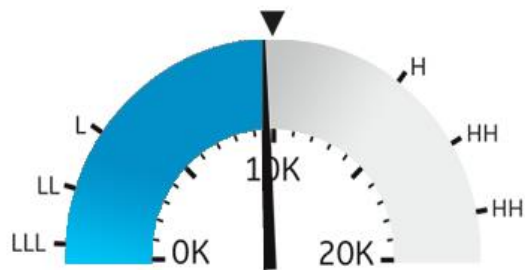
Lorem ipsum dolor sit amet, consectetur



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.

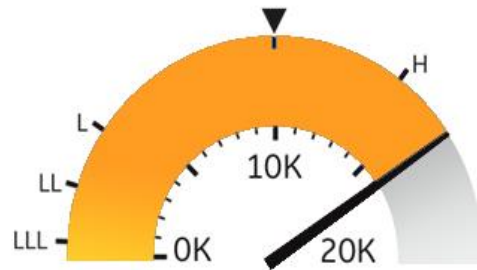
50/60	50 HZ
SC Net Output	397-470 MW
SC Net Heat Rate	8220 Btu/KWh, LHV
SC Net Heat Rate	8673 kJ/KWh, LHV
SC Efficiency	41.5% LHV
CP Ratio	21.8 X:1
Firing Temp Class	>2600/>1430 °F/°C
Exhaust Temp	1146/619 °F/°C
Exhaust Energy	1933 MMBtu/hr

OUTPUT 1



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

OUTPUT 1



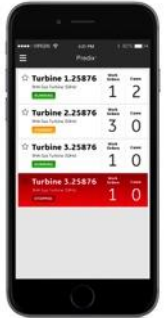
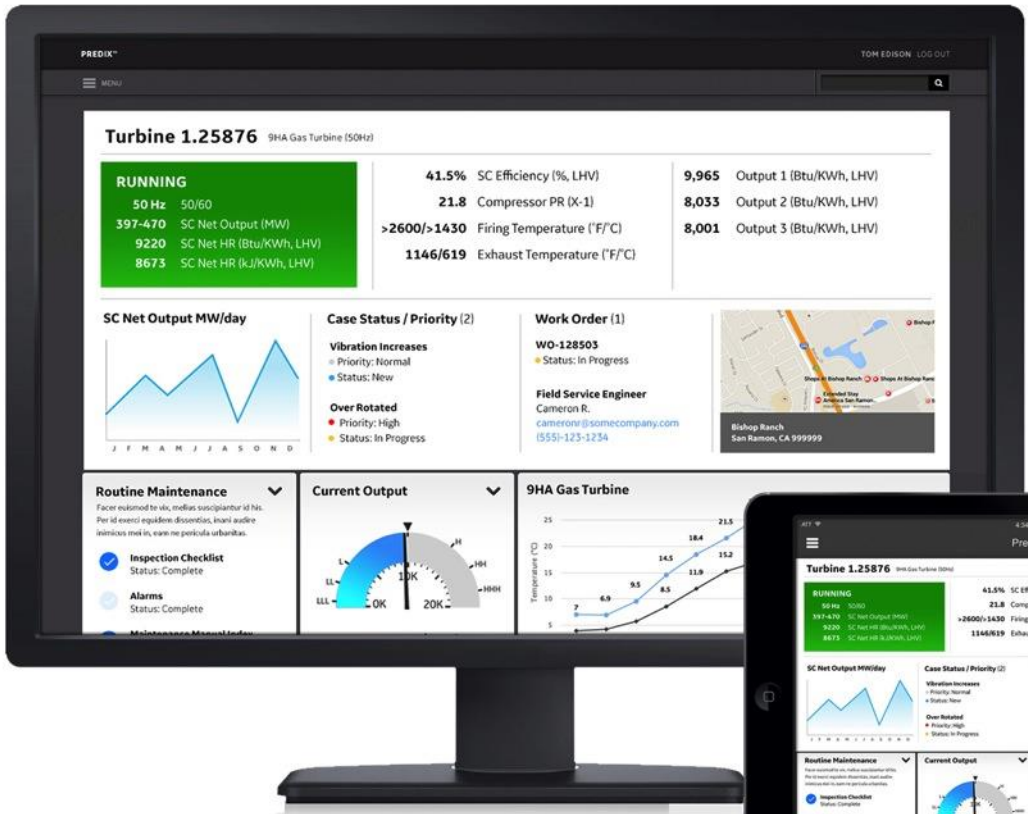
8,033 BTU/KWh
Ideal Heat Rate: 5,000



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

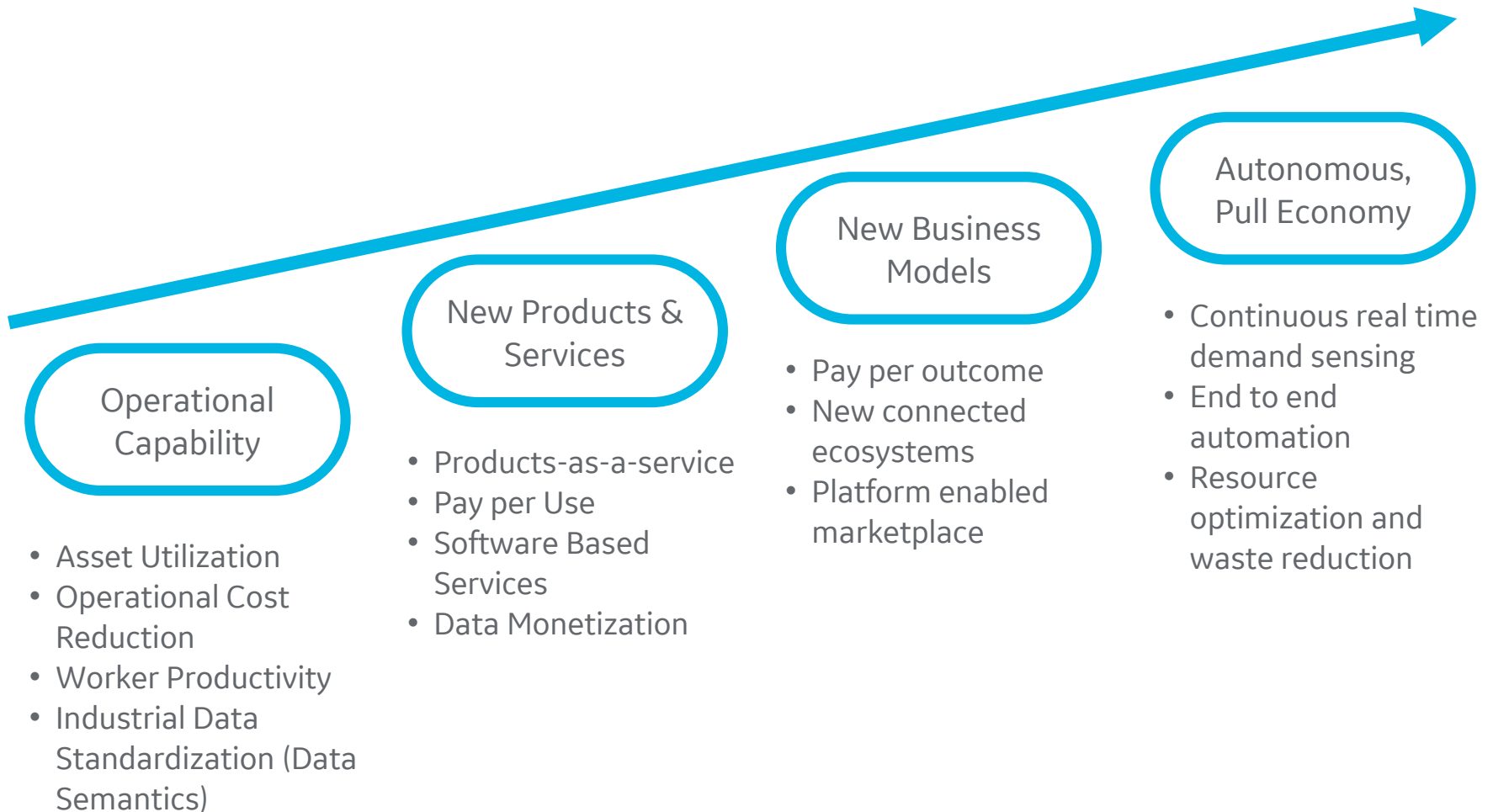
How we
measure
our
success

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

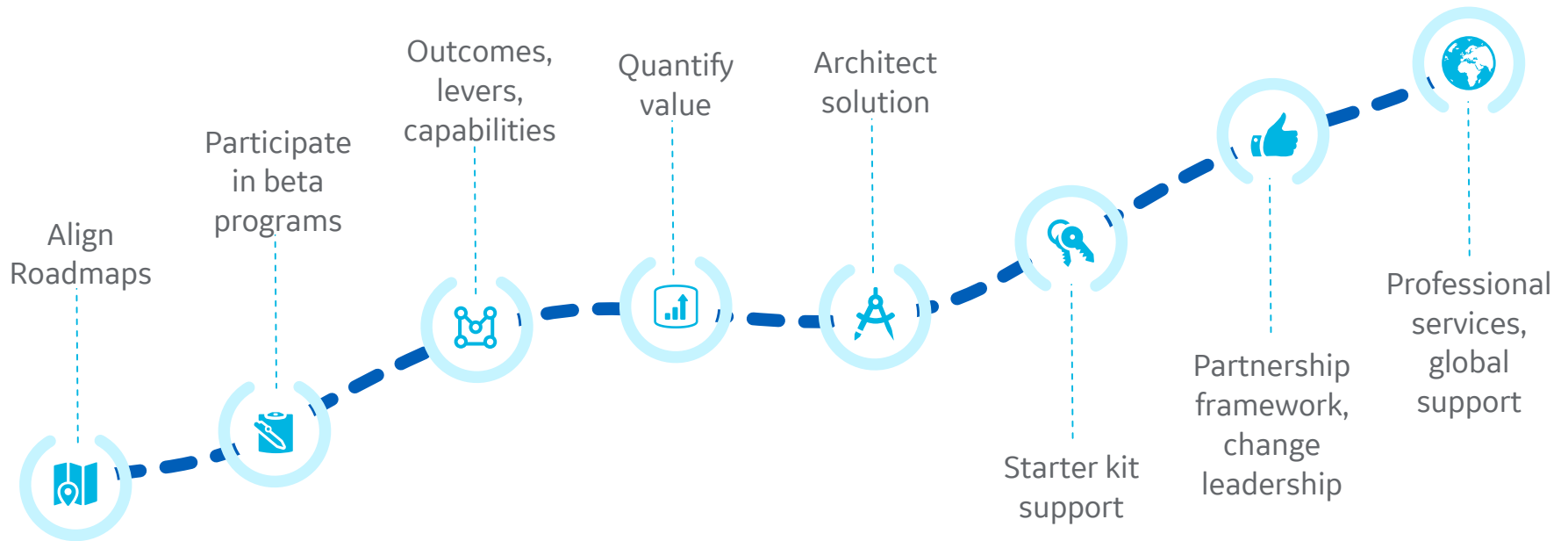
- Maximize Production
- Efficient Operations
- Safe Operations
- Predictive Maintenance

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



Getting Started—How we can work with you

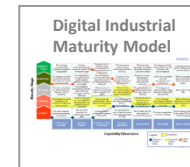
Trusted Partner for your industrial digital transformation journey



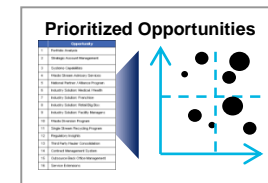
Getting Started—How we can work with you

3 Steps to Get Started

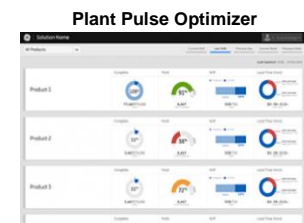
1 Baseline Current Digital Industrial Capabilities



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



