Brilliant Manufacturing Suite

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Industrial Internet Drivers

- PHYSICAL AND ANALYTICAL
- BRILLIANT MACHINES
- INDUSTRIAL BIG DATA
- PEOPLE & WORK

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The Industrial Internet Journey

**GET CONNECTED**
- Gain visibility across the plant and enterprise
- Identify issues with cause analysis
- Take fast action to minimize production impact

**GET INSIGHTS**
- Predict when issues are about to impact quality, delivery or performance
- Take proactive action toward no unplanned downtime
- Boost production output with longer period of continuous operation

**GET OPTIMIZED**
- Maximize production performance across the enterprise
- Create more efficient operating processes for production and equipment maintenance
- Leverage history of plant performance to create best capital investment decisions

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Our Brilliant Manufacturing Software Suite, powered by Predix, enables you to predict, adapt, and react more quickly and effectively than ever before. Link design, engineering, manufacturing, supply chain, distribution and services into one globally scalable intelligent system.

Simple to use data analytics is the key to unlocking unprecedented efficiency and optimizing factory operations.

### Get Connected

Empower decision makers with real-time visibility and deep operational intelligence.

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<thead>
<tr>
<th>GET CONNECTED</th>
<th>GET INSIGHTS</th>
<th>GET OPTIMIZED</th>
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<tr>
<td><strong>Efficiency Analyzer</strong></td>
<td><strong>WIP Manager</strong></td>
<td><strong>Production Manager</strong></td>
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<tr>
<td>• Machine Visibility</td>
<td>• WIP Visibility</td>
<td>• Labor Tracking</td>
</tr>
<tr>
<td>• Downtime Causes</td>
<td>• Order Tracking</td>
<td>• Work Instructions</td>
</tr>
<tr>
<td>• Machine/Line OEE</td>
<td>• Material Movement Management</td>
<td>• Document Mgmt</td>
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<tr>
<td>• Performance</td>
<td>• Qualification Management</td>
<td>• Order Scheduling</td>
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<tr>
<td>• Yield</td>
<td></td>
<td>• Qualification Management</td>
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<tr>
<td><strong>Quality Manager</strong></td>
<td><strong>Genealogy Manager</strong></td>
<td><strong>Routing Optimizer</strong></td>
</tr>
<tr>
<td>• Quality Data</td>
<td>• Genealogy and Traceability</td>
<td>• Dynamic Re-Routing</td>
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<tr>
<td>• SPC &amp; SQC</td>
<td>• Tool Genealogy</td>
<td>• Dynamic Re-Scheduling</td>
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<td>• Specifications</td>
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<td>• Routing Control Rules</td>
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<tr>
<td>• Non-Conformance Management</td>
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<td>• Supplier Collaboration</td>
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<tr>
<td></td>
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<td>• Receiving Inspection</td>
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<tr>
<td><strong>Shared Functionality</strong></td>
<td><strong>Plant Pulse Optimizer</strong></td>
<td><strong>Asset Optimizer</strong></td>
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<td></td>
<td><strong>Plant Pulse Optimizer</strong> - Broad visibility &amp; real time status updates</td>
<td>• Asset Performance Mgmt</td>
</tr>
<tr>
<td>• Product Management including BOM &amp; Recipes</td>
<td><strong>Enterprise Pulse Optimizer</strong> - Live snapshot of top-line KPIs for all plants</td>
<td>• Condition Based Maintenance</td>
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<td>• Plant Calendar</td>
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<td>• Maintenance Integration</td>
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### Simple to use data analytics is the key to unlocking unprecedented efficiency and optimizing factory operations.
Creating Unprecedented Outcomes

DESIGN
MANUFACTURING
QUALITY
OPERATIONS
EQUIPMENT
SUPPLY CHAIN

Data

PREDIX™

Insights & Analytics

Manufacturer

CUSTOMER BENEFIT
Maximize Productivity
Ensure Product Quality
Limit Sustainability Costs
Optimized Operations

GE Brilliant Factories
10,000+ MANUFACTURING ENGINEERS

GE DIGITAL
1,000+ SOFTWARE ENGINEERS
“By connecting and listening to machines we’re able to recognize they’re going to fail and move to fix them faster -- resulting in higher availability, lower costs, and improved quality as we can see critical machine data and make proactive adjustments.”

- Jamie Miller, CIO, GE
Get Connected | Visibility

- Start
- Get Connected
- Visibility Across Assets, Material and Labor
- Take Action with Efficiency Analyzer
- Opportunity Uncovered
- Take Action to change the process or machine
- Get Insights
- What would an Opportunity to Improve 1%? 5%? 10%? Mean Across your Enterprise?
- Get Optimized
- Get Results
- Repeat at Scale

Get

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GE Transportation Success Story
Grove City Engine Remanufacturing

240,000 sq. ft.
300+ employees
2,000+ engine repairs annually
250+ machines

20% reduction in unplanned downtime
Get Insights
Best Practices and Results | Industry Leaders

15% improved running efficiency
30% faster new product introductions
12% reduction in energy consumption
30% reduced inventory
90% decreased rework

Leaders ultimately outperform planned margin goals by +9%
- Aberdeen Group
Brilliant Manufacturing Landscape *powered by Predix™*

- **Control Systems**
  - PLC, DCS, SCADA, Scanners, Printers
- **Business Systems**
  - ERP, PLM, LIMS, EAM, HRM,…

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**Predix Field Agent**

- **Manufacturing Micro-Apps**
  - Quality Manager
  - Production Manager
  - WIP Manager

- **Efficiency Analyzer**

- **Visualization**
  - Single Pane Glass
  - Cloud / OnPrem Content
GE Brilliant Manufacturing Sites

Key Businesses
- GE Lighting
- GE Appliances
- GE Healthcare
- GE Power & Water
- GE Transportation
  - Battery
  - Locomotive Services
- GE Motors

Showcase Sites
- Hino, JP (GE HC)
- Florence, IT (GE OG)
- Jenbach, AT (GE Power)
- Haiphong, VT (GE Renewables)
- Pune, IN (Multi-Modal)
- Grove City, US (GET)
- Muskegon, US (GEA)
**Dynamic Router**

- **Oil & Gas**
  - Builds short term route and order schedule from ERP plan; “What-if” analysis
  - Predix back-end
  - Implemented on 6 lines so far
  - Savings in first 6 weeks – labor, WIP and uptime; does not include OTD, added capacity, scrap

**WIP Manager**

- **Aviation Repair Shops**
  - Visibility to working capital on shop floor
  - Predix back-end
  - Predix compute power to perform advanced metrics on Work in Progress
  - Projected Savings in 1st year in inventory reduction

**Efficiency Analyzer**

- **Across GE**
  - 86 Connected Machines
  - 5 Sites
  - Cloud hosted backend
  - Field Agent provides secure connectivity to cloud through Predix Machine
  - 1.5 days up and running

**Plant Pulse Optimizer**

- **Healthcare**
  - Real time visibility to shop floor activity, lead time, TAKT time, yield, orders complete to plan.
  - Gained 35 hours/week in productivity to the product and line leaders, plus inventory reduction savings
  - Rolling out to 36 sites in 2016
GE Health Care Success Story
Visualization & Dashboards

<table>
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<tr>
<th>Complete</th>
<th>Yield</th>
<th>WIP</th>
<th>Lead Time</th>
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<tbody>
<tr>
<td>93%</td>
<td>100%</td>
<td>28%</td>
<td>72%</td>
</tr>
<tr>
<td>76/82 Units</td>
<td>76 Units Produced</td>
<td>398/512 Goal</td>
<td>16M Lead Time</td>
</tr>
<tr>
<td>0% - 100%</td>
<td>28% - 72%</td>
<td>7m - 9m</td>
<td>7m Aug. Idle Time - 9m Aug. Cycle Time</td>
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Brilliant Factory Reference Architecture
It is about a Digital Thread

Outcomes

- Downtime 10-15%
- Labor costs 14%
- Inventory 30%
- Lead time 60%
- Quality
- On time delivery 58%
- Throughput
Industrial Internet platform requirements

- Cloud for efficiency and agility
- Going mobile: anytime/anywhere Access
- End-to-end Security
- Predictive insights from Big Data
- Consistent and meaningful User Experience
- Cloud based Integrated Asset Management
- Transition to “Brilliant Factories”
PREDIX™ PLATFORM IS THE ENABLER

Cloud-based platform for Industrial Internet

- Connected assets
- Industrial data management
- Industrial data science
- Cloud & mobile

Capabilities for Industrial companies

- Enterprise visibility
- Manufacturing intelligence
- Predictive maintenance
- Operations & execution

- 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
GE Digital collaboration projects

**WHAT IS IT** Working together to solve tough problems and drive better business outcomes.

**WHAT DO I GET** An app powered by Predix that delivers insights to solve your tough problems.

**HOW WE’LL SOLVE IT** We’ll use the Predix platform along with data and analytics to drive new innovation.

**HERE’S HOW IT WORKS**

**DISCOVER**
- Observation
- Problem Framing
- Plan the Pilot

**DEVELOP**
- Design Prototypes
- Iterate & Refine
- Proof of Concept

**LEARN**
- Value Created
- Go or No Go Develop
- Scale/Pivot/Next