



We Are GE

The world's premier digital industrial company.

We transform industry by connecting people, data, and machines. Living in perpetual motion, we are sensing, predicting, and responding to make the world work better.

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What My Mom Does at GE - video



<https://www.youtube.com/watch?v=Co0qkWRqTdM>



GE's Brilliant Factory

How to combine Lean and Digital capabilities to be Brilliant

Laszlo Magyar & Bryce Poland

October 27, 2016

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Agenda

1. Intro / GE/GET, Key terms, WHY/WHAT/HOW (10 min.)

2. GE's Brilliant Factory in Action / Lean + Digital = Brilliant (35 min)

3. Key learning / Take away & call for Action (5 min.)

4. Q & A / (5 min.)



We are GE Transportation. We move the world.

Established over 100 years ago, we're proud to be one of the original GE businesses.

With over 65 sites worldwide, there's a good chance you can call us neighbor.

Our multi-national team is 10,000 strong.

We're proud to call Chicago, IL, home.

Our global leadership team is hands-on wherever we are.

In 2015, our partnerships yielded a revenue of \$5.9B USD.

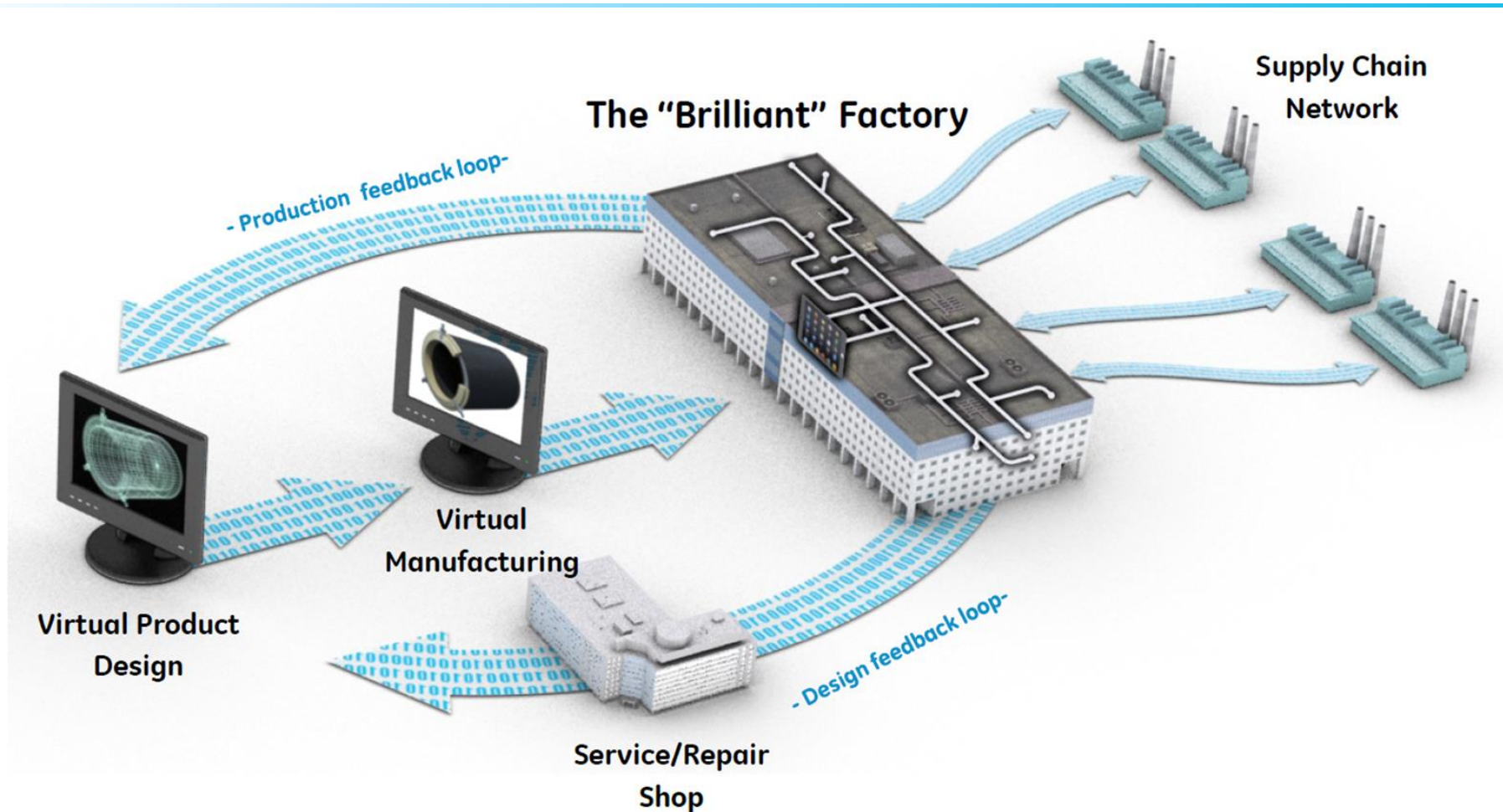


Key terms



What is Digital Thread

FLOW of Value
from concept to end of useful life



What is Digital Twin

MODEL of a physical asset
... no unplanned downtime

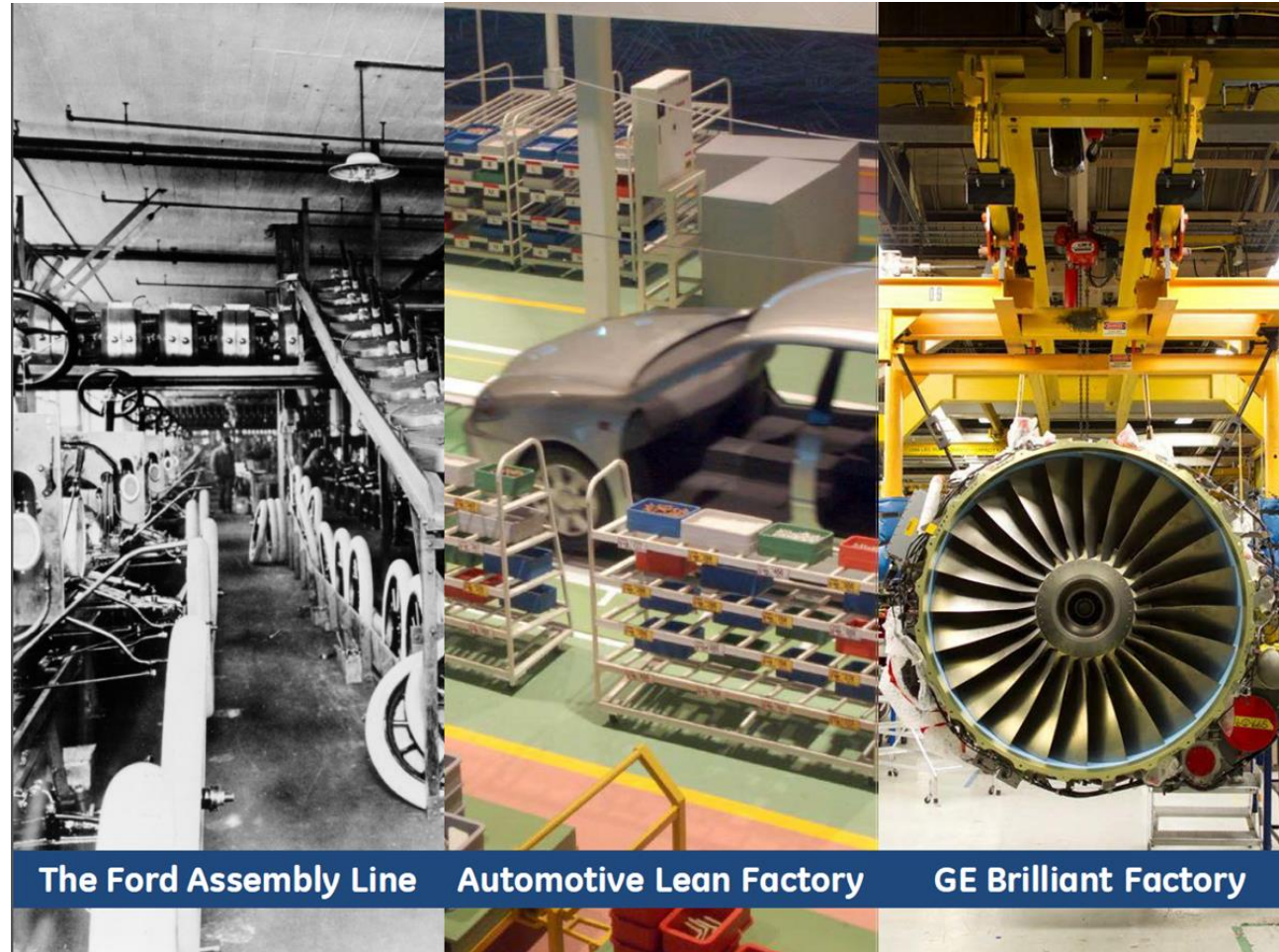


2hrs saved/wk * 4 yrs = **12** days back



What is Brilliant Factory

Driving digital maturity
built on lean foundation
with continuous improvement



The Ford Assembly Line

Automotive Lean Factory

GE Brilliant Factory

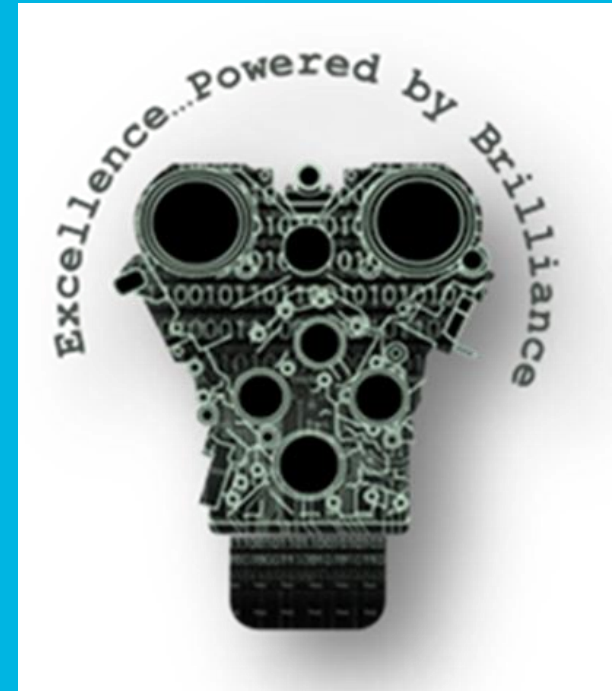
- ✓ Lean and Efficient
- ✓ Smart and Digital
- ✓ Real Time Visibility and Optimized
- ✓ Culture of Continuous Improvement



Our Brilliant Factory Story

Diesel Engine Reman. Grove City, PA

AME Short BF Video



Brilliant Factory

Competitiveness, Efficiency, Productivity

1) WHY

*corporate level

GE's pivot to be the **best Digital Industrial company**, writing the next chapter in the Industrial Evolution
WHY clarity and constancy of Purpose

LEADING THE MANUFACTURING REVOLUTION



GE Brilliant Factory:

Driving digital maturity built on lean foundation with continuous improvement

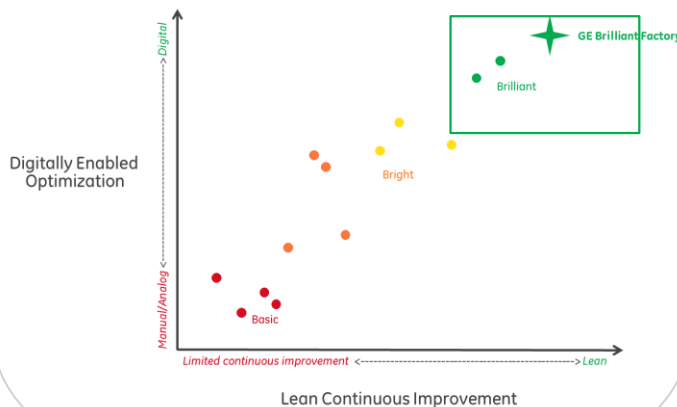
2) WHAT

*corporate level

Lean + Digital = Brilliant Factory

showcase digital industrial capabilities & impact expectations and high level std. framework on

WHAT to achieve



3) HOW

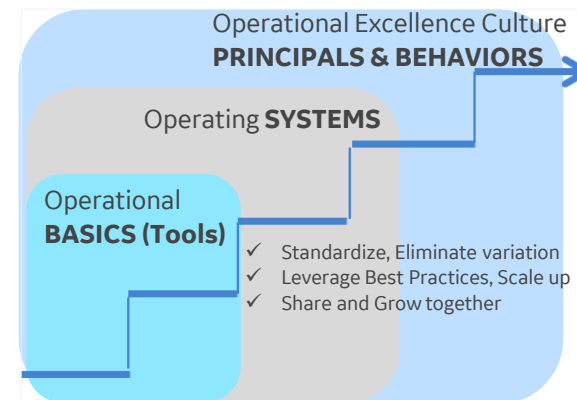
*business level (initially)

GET Excel our stairway to Brilliance

our Business Excellence System to drive consistent progress on OPEX evolution

HOW to get there

Detailed progression model towards Excellence



our path to Brilliance

Tools



Systems



Culture

Lean Model Lines

Extremely Visual &
Extremely Efficient Factory

Lean Management System

Enterprise

Excellence
model

Sustainable Transformation to Brilliance



Key tenants of GET Excel

Operational BASICS

Level 1-2

- ✓ Visual leadership support and engagement on lean/CI
- ✓ Std. work established (including hazard and risk awareness/compliance)
- ✓ Visual Workplace/5S in place (easy to spot Abnormal)
- ✓ Point of Use material presentation (kitting, SM/Pull)
- ✓ Takt Time established, line balanced to meet Takt
- ✓ Machine efficiency initial TPM/SMED
- ✓ Single Piece Flow operation (no batching)
- ✓ Visual Metrics
- ✓ Andon escalation system in place to resolve abnormality quickly
- ✓ Turning leadership support to drive, leader led lean transformation

Operating SYSTEMS

Level 3-4

- ✓ True North / Strategy Deployment System in place (Vision-Breakthrough Objectives-Execution plan aligned)
- ✓ Visual Process Adherence/Visual Process Performance System in place - Extremely Visual Workplace
- ✓ Leader Std. work/Std. Gemba Operating System
- ✓ Structured Problem Solving System (PDCA cycles)
- ✓ Q4 leadership, feedback reach, high level of trust, leader as well as a coach
- ✓ Improvement System / Idea Generation and Implementation System
- ✓ Lean Management System in place

Operational Excellence CULTURE

Level 5

- ✓ GE Beliefs personalized. Values, Guiding Principles & Beliefs aligned
- ✓ Ideal Behaviors defined, modeled and coached through the organization
- ✓ Daily CI/Kaizen culture (I want to be better today than I was yesterday...)
- ✓ The entire organization embraces lean as a Time Based Growth Strategy





Real Example #1 => Strategy Deployment Wall

Constancy of Purpose
True North



Vision...
to provide World Class Remanufactured Engines and Components to Power Locomotives Safely & Reliably Enabling Customer Success through a Culture of Operational Excellence and Digital Brilliance.

Excellence... powered by Brilliance

Customer Outcomes

- Life Cycle Cost Excellence
- Superior Product Reliability
- On-Time Delivery

Strategy ← → **Execution**

LEVEL 1

- Brilliant Factory

LEVEL 2

- Digital Thread
- Simplify
- Bring Work In
- Product Cost Out
- Culture of Excellence

LEVEL 3

GE Logo





Real Example #2 => Extremely Visual Workplace

Visual Process Adherence (VPA)

Making the Work
Visual



Manual
Pulse Point example
from the shop
(YES we use digitals too..)

Name Ron Date/Time: 9/22 10:15 am

1. Health of the Employee; 2. Safety/SS; 3. Quality; 4. Delivery; 5. Cost
GET EVO Power- Pulse Point Arrow Checklist

Area	Description	Welder	Via Mill	Sagin Cutter	Weld and Test	Head Arm	Stronghold Arm	Overall
Safety/SS	SS maintained?	X	X					
PM/Machines	PM's completed, machine operation normal							
Material	Available, Correct amount of full/empty kit carts?							
Production	On track to meet goal?							
Quality	Torque Marks, No Defects, passing test							
Visual Process	Board updated, Ideas submitted, Accountability actions							

Instructions:
GO - Item is normal, process flowing as expected. Leave box blank
NO GO - Abnormality from the standard. Place "X" in box above.

Actions: 1) Relay out Supermarket material
2) Move oil Barrel
3) Remove Scrap Heads
4) ~~Keep~~ Annabelle Book for clean on
5) Square off Pallet for overproducing

Visual Process Performance (VPP)



Manual
Visual Board
example
from the shop
(YES we use digitals too..)

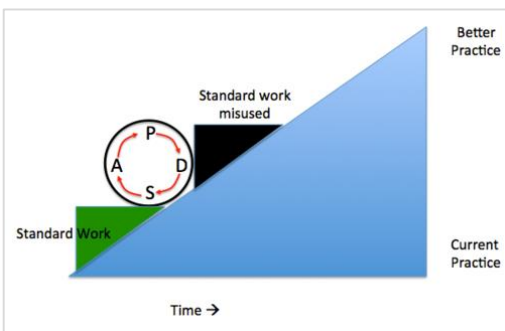




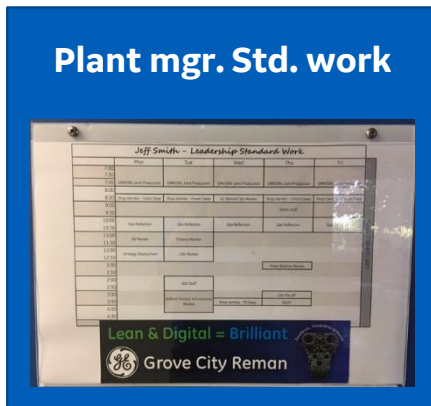
Real Example #3 => Leader Std. Work & Behaviors

Visual and Timely
Driving Action and Learning

Leader Std. Work



Coaching,
Leading by example
Model and drive
ideal behaviors



Discovery
learning & coaching



Guided
Analysis

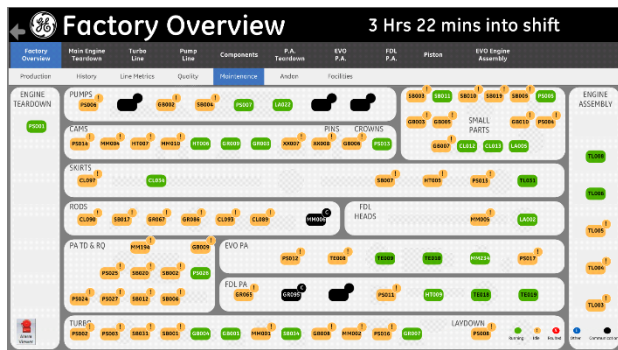


Process Monitoring
& Communication
Problem Solving



Plant Overview (Real Time)

- “Heartbeat of the plant”
- Real time alerts for excessive down time
- Drill down capability

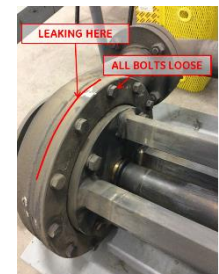
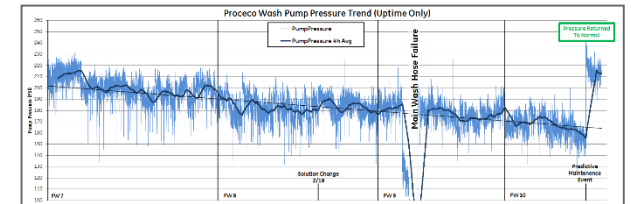
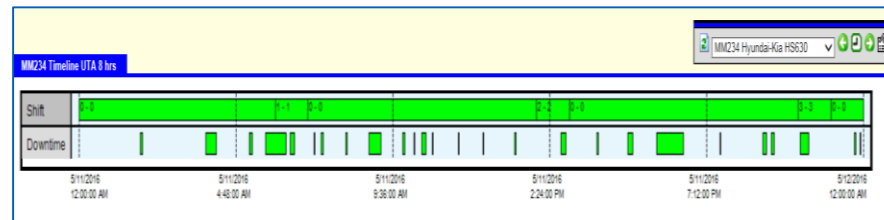


Machine health information (Predictive)

- Customizable screens by machine by attribute
- Alerting capability for out of spec variables
- Preventive maintenance and rapid triage of issues

Historical Running / Not Running

- Identify areas of waste
- Investigate and improve
- Sustain



Similar Proceco Pump From Skirt Washer



Smart Parts... auto-data capture

**Data
Matrix**



**Bluetooth
Gauges**



**Radio
Frequency
IDentification**



**Visual
Recognition**



Benefits

- **Part Traceability**... accurately maintain genealogy
- **Populating the Digital Thread**... integrated with pillar applications
- **Increased analytics yield**... accuracy & repeatability
- **Efficiency**... to offset increased data capture requirements





Real Example #6 => Connected Systems

DIGITAL THREAD



DIGITAL TWIN



BRILLIANT FACTORY

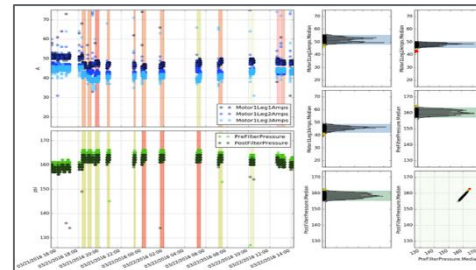
Connected Systems

- ERP
- MES
- Maintenance
- Reliability
- Operations Data

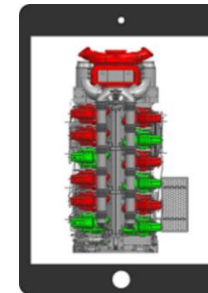
WSN		FEM	
Main Power	E468		
PreMain	E466		
Cam & Flywheel	E471		
Crank	E473		

SHIFT	WEEK
11	161
15	225
2	42
3	225
0	4
3	45

Customer Based Decision Making on the shop floor



RM&D...
Smart Signal, continuous monitoring and alerting



Conditional Process Routing

Item	Part Name	Qty	Location	Bin	Bin Type	Bin	Bin Type	Bin	Bin Type	Bin	Bin Type
2014-01-01	2014-01-01	1	1	1	1	1	1	1	1	1	1
2014-01-02	2014-01-02	1	1	1	1	1	1	1	1	1	1
2014-01-03	2014-01-03	1	1	1	1	1	1	1	1	1	1
2014-01-04	2014-01-04	1	1	1	1	1	1	1	1	1	1
2014-01-05	2014-01-05	1	1	1	1	1	1	1	1	1	1
2014-01-06	2014-01-06	1	1	1	1	1	1	1	1	1	1
2014-01-07	2014-01-07	1	1	1	1	1	1	1	1	1	1
2014-01-08	2014-01-08	1	1	1	1	1	1	1	1	1	1
2014-01-09	2014-01-09	1	1	1	1	1	1	1	1	1	1
2014-01-10	2014-01-10	1	1	1	1	1	1	1	1	1	1
2014-01-11	2014-01-11	1	1	1	1	1	1	1	1	1	1
2014-01-12	2014-01-12	1	1	1	1	1	1	1	1	1	1

Attribute Inspection / Process Data...
CMM, torque, etc.





Building a Culture of Brilliance

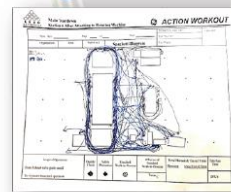
GC REMAN

1 Hearts & Minds



Customer—Cost Position—Communication

2 Waste Reduction



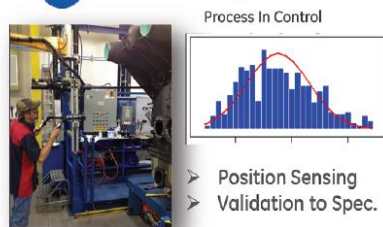
- Elimination of NVA Tasks
- Core 5s
- Highly Visual...Everything has a Place

3 Visualizing Performance & Flow



- RFID Tech tied to SOP's
- Sensor Enabled Machines

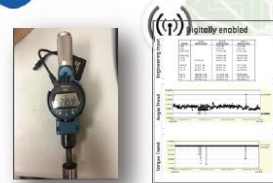
4 Mistake Proofing



Process In Control

- Position Sensing
- Validation to Spec.

5 Auto-Data Capture



"Building the Digital Thread"
Accurate—Accessible—Automatic

6 Transactional Simplification



Paperless
Factory

2D Barcode
Scan



Increased Analytic-
Based Maintenance
Capability & Yield

Significant **IMPACT** to
Customers and Company

Lean + Digital = Brilliance



HOW DOES IT ALL FIT TOGETHER?

Brilliant Factory

A sophisticated factory that combines lean, advanced and additive manufacturing with digital maturity to enhance productivity

Digital maturity

Digital analytics that help improve productivity and connectivity. Powered by GE's Predix platform.

Digital Thread:

- Real-time Visual Management
- Integration

Digital Twin

- Quality
- Machine performance

Brilliant Factory Manufacturing Suite

Lean manufacturing

Systematic method to maximize customer value through the elimination of waste within a manufacturing system.

Lean Principles:

- Elimination of waste
- Continuous improvements
- Levelized production
- Quality Built In
- Standardization

Advanced manufacturing

Cutting-edge technology and new manufacturing processes to lower cost and accelerate the innovation, speed and performance of industrial products

Tools and technologies:

- Robotics
- Advanced fabrication
- Automation
- High precision technologies

Additive manufacturing

A method to build 3D objects by adding layer-upon-layer of material; also known as the industrial version of 3D printing

Technologies:

- Rapid prototyping + tooling
- Modeling, printing, finishing

Significant GE investment:

- CATA R&D - \$39MM
- Acquisitions of Arcam and SLM - \$1.4B

Key learning:

- ✓ Tools, Technology is the “easy” part... it’s all about PEOPLE & CULTURE
- ✓ Lean before Digital
- ✓ Digitize smartly... be aware of the “hangover”
- ✓ Transform Data to Insights then Insights to Outcome
- ✓ Connecting all the dots drives significant benefits
- ✓ Brilliant Factory is a journey not a destination

Q & A



Thank You!

Your opinion is important to us!
Please take a moment to complete the survey using the conference mobile app.

Session: ThP/46

GE's Brilliant Factory

Laszlo Magyar & Bryce Poland

GE Transportation

Laszlo.Magyar@ge.com Bryce.Poland@ge.com

Imagination at work



