Smart Manufacturing & the Industrial Internet of Things (IIOT)

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NUMBER OF DEVICES ON THE INTERNET BY 2020

SAFE & COLLABORATIVE ROBOTS

AI & MACHINE LEARNING CPS, PREDICT FAILURES AND REDUCE DOWNTIME

WEARABLES & MOBILE DEVICES TRANSFORM WORK FLOWS
OPPORTUNITY

- Reduction in Capital Expenditures
- Improved Time to Market
- Reduction in Inventory
- Improved Productivity
Macro Trends and PRESSESURES

Market
Global Competitiveness

Workforce
Talent Shortages & Skills Gap

Risks
Changing Risk Patterns

Technology
Industrial Internet of Things

Opportunities and challenges in changing global landscape

Global challenge hiring and retaining

Highly publicized and expensive incidents worldwide

IoT value at stake and growth of internet enabled assets

220,000 New engineers every year until 2022 to connect the unconnected
The World Bank Studies

70% Suffered a security breach in the last year
2014 Ponemon Institute survey

11% Of worlds economy in 2025 will be provided by IoT
McKinsey & Co 2015
84% of Executives believe Internet of Things (IoT) will create new income streams for their operations.

IoT will deliver:
- 87% long-term JOB growth
- 57% long-term REVENUE growth

46% saw improving productivity as the key benefit of IoT

Leaders understand IoT?
- 38% fully understand it
- 57% some understanding
- 4% little at all

ONLY 7% have developed a comprehensive strategy

Executives cited digital initiatives as a tool for growth, compared to 31% in 2014.

SOURCE: Accenture CEO Briefing and The Economist Intelligent Unit
Industrial IoT Opportunity

$4.6T Economic Impact of Industrial IoT by 2025

35% MANUFACTURERS at early adopter stage of IoT use case development

Asset Utilization | Employee Productivity | Supply Chain Logistics | Customer Experience | Innovation

LNS Research
Business Risks & Drivers

Realizing Smart Manufacturing has become a *business imperative*

- **$65B** Automation systems reaching end of life
- **~75%** U.S. plants are more than 20 years old
- **$20B** cost of unscheduled downtime
- **2 Exabytes** Big data generated in manufacturing
- **<14 %** US Plants completely integrated
- **21%** Suffered a loss of IP in the past year

*SOURCE: ARC*
*SOURCE: Industry Week*
*SOURCE: ARC*
*SOURCE: McKinsey*
*SOURCE: Industry Week*
*SOURCE: Kapersky*
SMART MANUFACTURING

- Highly Responsive to Consumers
- Less Supply Chain Risk & Variability
- Disaster Forecasting & Recovery
- Inventory Reductions
- Production Efficiencies
The Connected Enterprise Delivers:

- Faster Time to Market
- Improved Asset Utilization
- Enterprise Risk Management
- Lower Total Cost of Ownership

INDUSTRY CONSORTIA

- Smart Manufacturing Leadership Coalition, NNMI
- Innovate UK
- Industrie du Futur
- Industrie 4.0
- Produktion 2030
- China Manufacturing 2025
- Manufacturing Innovation 3.0
- Make in India
- Industrial Value Chain Initiative (IVI)
The Digital Thread
Design – Operate – Maintain – Innovate
Is Your Company Ready?

ONLY 11%

Strategy in place – implemented

No plans to develop strategy
34

IoT technologies into processes

Strategy in place – not yet implemented
23

Plan to develop strategy
33

ONLY 12%

Strategy in place – implemented

No plans to develop strategy
37

IoT technologies into products

Strategy in place – not yet implemented
20

Plan to develop strategy
30

Source: MPI Internet of Things Study, The MPI Group, December 2015
## DIGITAL OPPORTUNITIES
That Reduce Cost within Operations

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs for Quality</td>
<td>10-20%</td>
</tr>
<tr>
<td>Design &amp; Engineering Costs</td>
<td>10-30%</td>
</tr>
<tr>
<td>Time-to-Market</td>
<td>20-50%</td>
</tr>
<tr>
<td>Costs for Holding Inventory</td>
<td>20-50%</td>
</tr>
<tr>
<td>Total Machine Downtime</td>
<td>30-50%</td>
</tr>
<tr>
<td>Forecasting Accuracy</td>
<td>85%+</td>
</tr>
<tr>
<td>Productivity of Labor</td>
<td>44-55%</td>
</tr>
<tr>
<td>Resource Process Productivity</td>
<td>3-5%</td>
</tr>
</tbody>
</table>

**Source:** McKinsey
The Connected Enterprise

CREATING HIGH-QUALITY PRODUCTS, BETTER, FASTER, AND MORE ECONOMICALLY THAN EVER BEFORE

Improving processes, products, and business performance
The Connected Enterprise
Highly Connected knowledge-enabled operations

Management
I can see my production status and recommend adjustments to better manage my global operations and maximize profits.

Operations
I gain insight into usage patterns from operators, materials, equipment, enabling me to improve the process for better performance.

Maintenance
I know when to deploy the right resources for predictive maintenance to minimize equipment failures and eliminate unscheduled downtime.

IoT TECHNOLOGY | OPEN ARCHITECTURE | REAL TIME ETHERNET | SECURITY | SMART ASSETS

GLOBAL OPERATIONS
GLOBAL MANUFACTURING SITES | GLOBAL SUPPLY CHAIN | GLOBAL CUSTOMERS | LOGISTICS
Smarter Machines & Equipment

Real-time Data
Voltage, Kwh, Running Time, Temperature

Information
CONTEXTUALIZATION
Energy/Product, OEE

Knowledge
ANALYTICS
Predict bearing will fail in 10 hours

Wisdom
OPTIMIZE
More efficient process workflows
Smarter
Plants & Operations

Yield will meet today’s production needs

7100KWh of energy used today

Time to reach temperature is longer than normal

ALERT Maintenance Line #1
VISIBILITY
See deeper into operations and logistics, with new ways to link processes and facilities to suppliers and customers.

COLLABORATION
Between people, between teams and departments, and even between the machines themselves.

EFFICIENCY
Transform information into insight. Increase ROI, get to market faster, and dramatically reduce waste.
MOBILITY AND VISUALIZATION

INFORMATION MANAGEMENT & ANALYTICS

SCALABLE COMPUTING

MULTI-DISCIPLINE CONTROL AND INFORMATION

SECURE NETWORK INFRASTRUCTURE
Business Systems – Transactional

Operations - Real-time

CONVERGENCE

IT

OT

ERP - MRP FINANCIALS HR LOGISTICS QUALITY CRM

SENSORS, ACTUATORS

CONTROLLERS

MATERIALS & TRANSPORT

MACHINES & EQUIPMENT
Concerned about network security: 76%
Concerned about data privacy: 74%

Sources: IndustryWeek Manufacturing Connectivity and Data Integration report 2015 MPI Internet of Things Study, The MPI Group, December 2015
Business Drivers

END USER

- Faster Time to Market
- Improved Asset Utilization
- Enterprise Risk Management
- Lower Total Cost of Ownership
- Exceed Productivity & Efficiency Goals

OEM

- Flexibility
- Integration & Standardization
- Performance/OEE
- After Market Service & Support
- Total Cost to Design, Develop & Deliver

Innovation to Drive Differentiation
GREATEST ROI IMPACT?

SMART ASSETS

PREDICTIVE EQUIPMENT

COMPLIANCE & LABOR/CUSTOMER PROCESSES

OPERATIONS & SUPPLY CHAIN VISIBILITY
<table>
<thead>
<tr>
<th>The Connected Enterprise</th>
<th>Rockwell Automation Transformation</th>
</tr>
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<tbody>
<tr>
<td><strong>Inventory</strong></td>
<td>120 days to 82 days</td>
</tr>
<tr>
<td><strong>CapEx</strong></td>
<td>30% per year in capital avoidance</td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>Mid-80s to 96%</td>
</tr>
<tr>
<td><strong>Lead Times</strong></td>
<td>Reduced 50%</td>
</tr>
<tr>
<td><strong>Time to Want</strong></td>
<td>82% to 98%</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>50% reduction in PPM</td>
</tr>
</tbody>
</table>

**Productivity** ▶ 4% to 5% per year
Real-time Prediction of Potential Failures

Monitor > Analyze > Predict > Optimize

- Pump Fillage Optimization improves well production
- Predicting failure modes minimizes unscheduled downtime

- Unanchored
- Static Scallop
- Target Valve Leaky
- Gas Locked
- Turnup
- Turndown
- Worn Pump
- Hole Drilled

Windows Azure

Pump Fillage Optimization Improves Well Production
Real-Time Plant & Equipment Monitoring

Cloud storage of machine data for compliance and R&D
Brewing Capacity \( \uparrow 25\% \)

Time of Each Brew Cycle was \textbf{CUT IN HALF} \( \text{\textbullet} \)

Cut Raw Material Costs \textbf{by 5\%} Annually

\textbf{One Million Gallons of Water Saved} (predicted)

\textbf{Optimize Brews Real-time}

\textbf{20 VARIETIES}

\textbf{VISIBILITY & INSIGHT}
OT Infrastructure as a Service (IaaS)

A subscription for plant network, virtual server instance and 24x7x365 infrastructure monitoring

Virtually Eliminating Network & Server Issues

24x7 Proactive Support led to 90% Reduction in Troubleshooting Time

Virtually Eliminating Network & Server Issues

ELIMINATED 100% OF CAPEX

with Redundant Expandable Architecture and a Fully Managed Support Contract
Iron Pipe Manufacturer—Improved OEE

RESULTS

- **ALL OPERATORS**, shifts and production modes can now be analyzed for Improvements in OEE
- **TIME** in state reporting is in place to identify process delays
- **DOWNTIME** events are tracked and reported (top 5 stop reasons), including drill-down capability for further analysis

Steel Producer – Energy Management

RESULTS

- **PROVIDES** role-based, unified access to business and operations systems data
- **SYSTEM PULLS** in over 3,000 points of energy data, allowing operators to adjust energy supply parameters based on production goals
- **MANAGEMENT HAS ABILITY** to review trends across the enterprise to optimize energy use for larger-scale savings
ASSESS & PLAN
SECURE & UPGRADE
DATA & ANALYTICS
OPTIMIZE & COLLABORATE
Assess and Plan
Develop the blueprint for success

75%
Plants in the US are over 20 years old
Sources: Industry Week

>14%
US Manufacturers have completely integrated plant floor information to the enterprise
Source: IndustryWeek

24%
have NEVER performed an ICS vulnerability assessment
Source: Control Engineering 2014 Cyber Security report
Secure and Upgrade
Technology & threats are evolving

Smart, Secure & Safe Assets

IoT enabled Infrastructure

Defense-in-Depth approach

$65B
Automation systems reaching end of life
Source: ARC

70%
of companies have suffered a security breach in 2014, yet only 28% rank security as a top 5 strategic priority.
Source: 2014 Ponemon Institute survey
Data and Analytics
Information driving business improvements

24%
Average annual improvement in Total Cost per Unit
Source: MESA

40%
Reduction in maintenance costs & unplanned downtime cut in HALF
Sources: McKinsey & Co.
SCALABLE ANALYTICS

DEVICE
- Information from smart assets
- Third party device integration
- Machine/fleet management for remote assets

SYSTEM
- Real-time optimization of machines, processes & plants
- Predictive maintenance
- Abnormal system awareness & action

ENTERPRISE
- Site to site benchmarking
- Operational analytics
- Integration to/from business systems
- Data visualization & discovery

DATA
- DESCRIPTIVE
  - What happened?
- DIAGNOSTIC
  - Why did it happen?
- PREDICTIVE
  - What will happen?
- PRESCRIPTIVE
  - What should I do?

SYSTEM HUMAN INPUT

DECISION
Decision Support

ACTION
Decision Automation

FEEDBACK
Optimize and Collaborate
Innovation creating insights to your operations

- Mobility
- Scalable Compute & Cloud
- Remote Monitoring & Support

80% Top Performers OEE
10% higher than average

Source: MESA

1% Data used from 30,000 sensors on a typical oil rig to drive process improvements

Source: McKinsey & Co

$20B Cost of unscheduled downtime

Source: ARC
TAKEAWAYS

- Senior Management Sponsorship
- Don’t Underestimate the Culture Change
- Create a “Win” - Others Will Follow
- Must be Tied to Business Strategy
  - Not a Stand Alone Initiative
- Focus on Critical KPI’s vs Data
- Never Ending Journey
The Connected Enterprise delivers transformational value in productivity and global competitiveness.
Where are you innovating?

How are you gaining value for your customers?