West Virginia University
Benjamin M. Statler College of Engineering and Mineral Resources
Department of Industrial and Management Systems Engineering

Smart Manufacturing for SMM
Opportunities and Challenges

Small to Medium Manufacturing (SMM) Needs and Case Studies

- Presentations & Panel Session -

NIST Industry Forum

May 8, 2018
Gaithersburg, USA

Dr. Thorsten Wuest
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Agenda

1. Smart Manufacturing
2. SmartMfg Survey of SMEs in West Virginia
3. Projects & Case Studies
4. Recommendations

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You may have heard of

Smart Manufacturing

Intelligent Manufacturing

Industrial Internet

IMS

Industrie 4.0

Cyper-Physical (Production) Systems

Industry 4.0

Factory of the Future

Smart Factory

Manufacturing Intelligence

Cloud Manufacturing

… and many more!

All these terms describe a similar development!

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SMART MANUFACTURING PRINCIPLES
/ CONNECTIVITY
/ VIRTUALIZATION
/ DATA UTILIZATION
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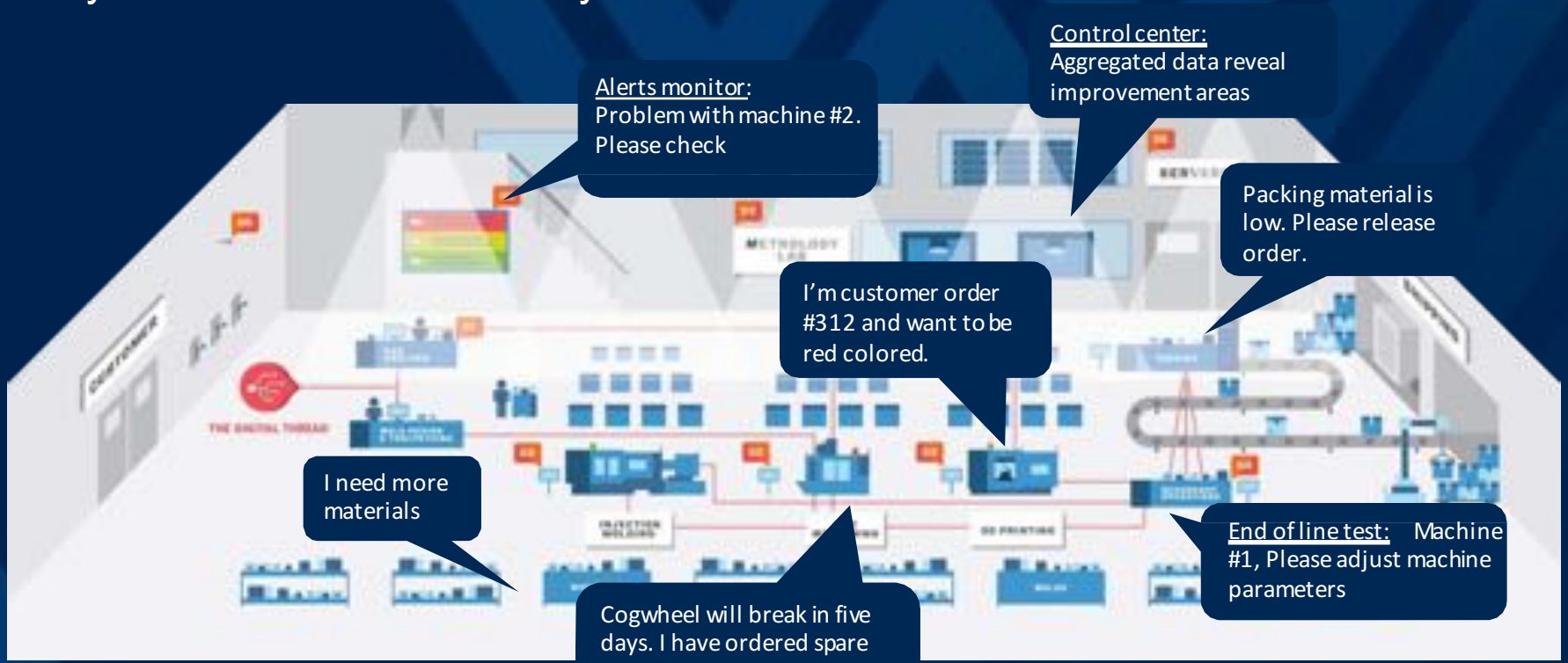
Schmid & Wuest, 2017

Smart Manufacturing Vision

Fully Connected Smart Factory



Source: http://smartamerica.org/teams/smart-manufacturing/

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SMART MANUFACTURING MARRIES TECHNOLOGY, DATA AND HUMAN INGENUITY

Schmid & Wuest, 2017

Smart Manufacturing in
Small- and Medium-sized Enterprises (SMEs)

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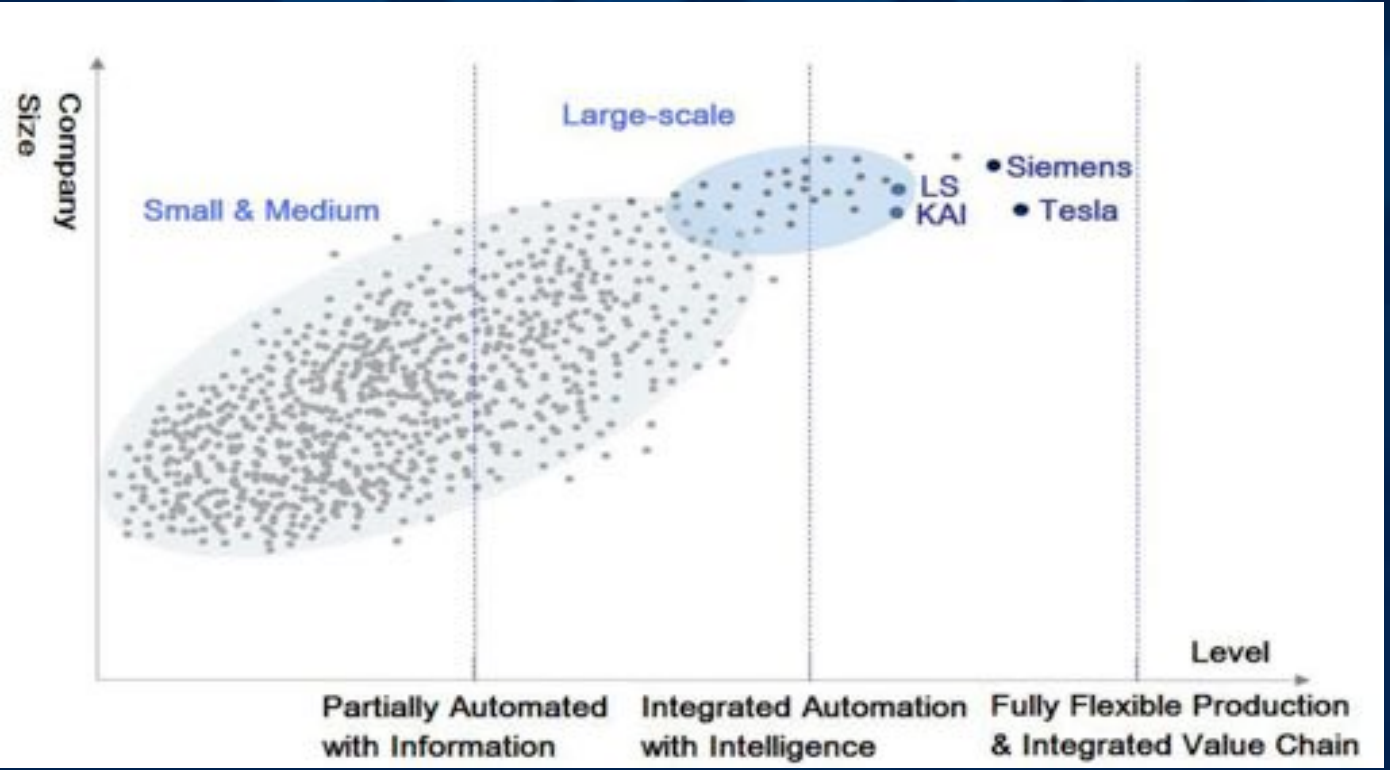
Status of Industry



Source: Jinwoo Park, 2015

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Siemens Digital factory

- Siemens' plant in Amberg, Germany
- ***Products communicate*** with manufacturing machines
- IT systems control and optimize all processes
- Production quality is at ***99.99885 %***

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SMEs vs MNEs – Different requirements

#	Features	SMEs	MNEs
1	Use of Advance Manufacturing Technologies	Low	Very High
2	Financial Resources	Limited	Comparatively more
3	Organization Culture/ Leadership	Conservative	Flexible
4	Company Strategy	Dictated by Gut Feeling of the Leader (Owner)	Market Research and Accurate Analyses
5	Decision Making	Restricted to Leader/ Few Knowledge Carriers	Board of Advisory
6	Human Resources	Engaged in Multiple Domains	Have Own Area of Specialization
7	Human Resource Development	Exposure	Training, Mentors, Workshops
8	Alliances with Universities/ Research Institutions	Not so Strong	Strong
9	Important Activities	Outsourced	Internal to the Organization
10	Nature of Product	Highly Specialized	Little Specialized
11	Collaborative Network	High Dependence	Not so much Dependent
12	Customer/Supplier Relations (Partner Dependence)	Very Strong	Not so Strong
13	Standards	Not so Strictly	Strictly Obeyed
14	Organizational Structure	Less Complex and Informal	Complex and Formal
15	Software	Provides Tailored Solutions to Problems	Standardized Solutions
16	Use of Resources/ Research & Development	Low	High
17	Knowledge and Experience	Focused in a Specific Area	Spread Around Different Areas

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Upgrade existing systems

- Bosch upgraded ***Lathe from 1887*** to be Smart Manufacturing ready
- ***New capabilities***:
  - process monitoring for constant quality assurance
  - another is condition monitoring in order to prevent unplanned downtimes
- Extreme example but ***showcases the potential***

http://ww

http://www.bosch-presse.de/pressportal/en/69632.html

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Project Scope

Background

- Internet of Things is **changing** the industrial landscape
- Manufacturing is undergoing a major **transition**
- **Large** corporations are dealing with this topic intensively

⇒ **But how to apply Smart Manufacturing in small companies?**

⇒ **How can small manufacturers take advantage of it?**

Objectives

- Examine the **current state** of manufacturing with a **survey**
- Understand the manufacturing landscape and its specific **challenges** and **concerns** by conducting **interviews** and plant visits
- Support **small** manufacturers in adopting Smart Manufacturing technologies by setting up a training **workshop**

Work Packages

1. Online survey
2. Interviews & plant visits
3. Analysis of results & report
4. Training workshop

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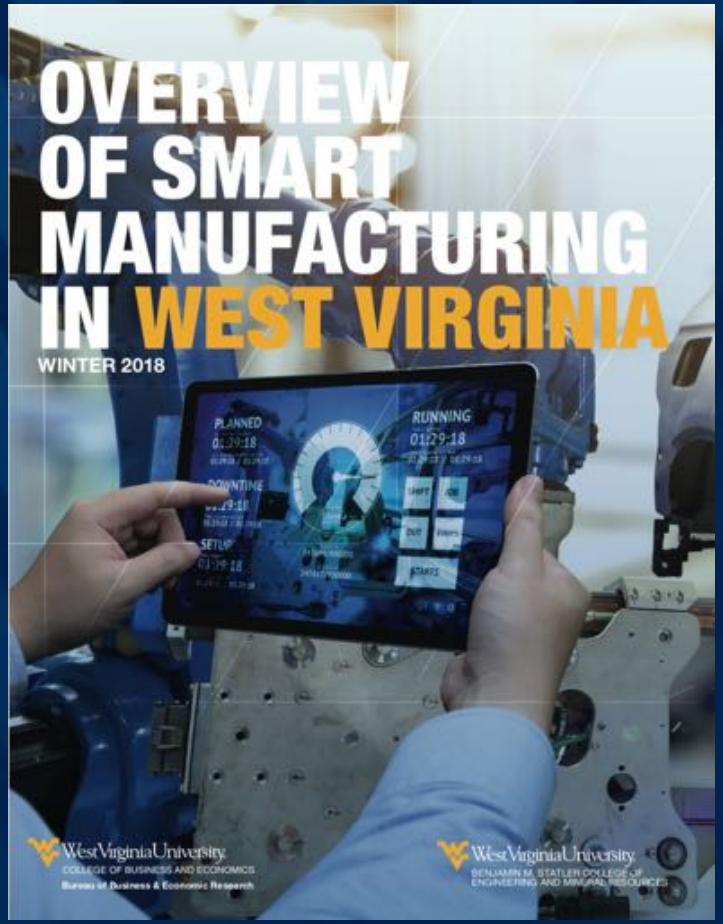
Survey Report

Available for free

Download here:

https://t.co/8uTam5lQtl



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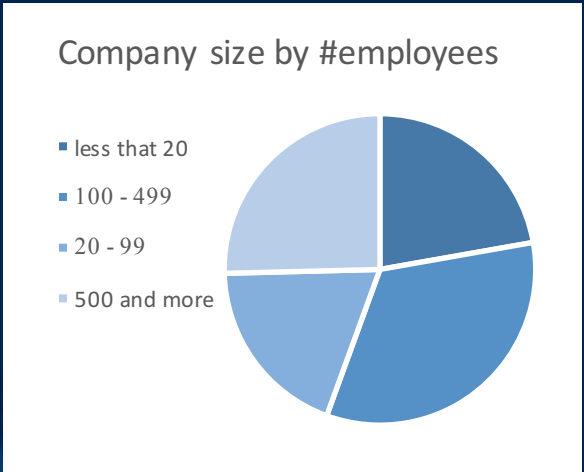
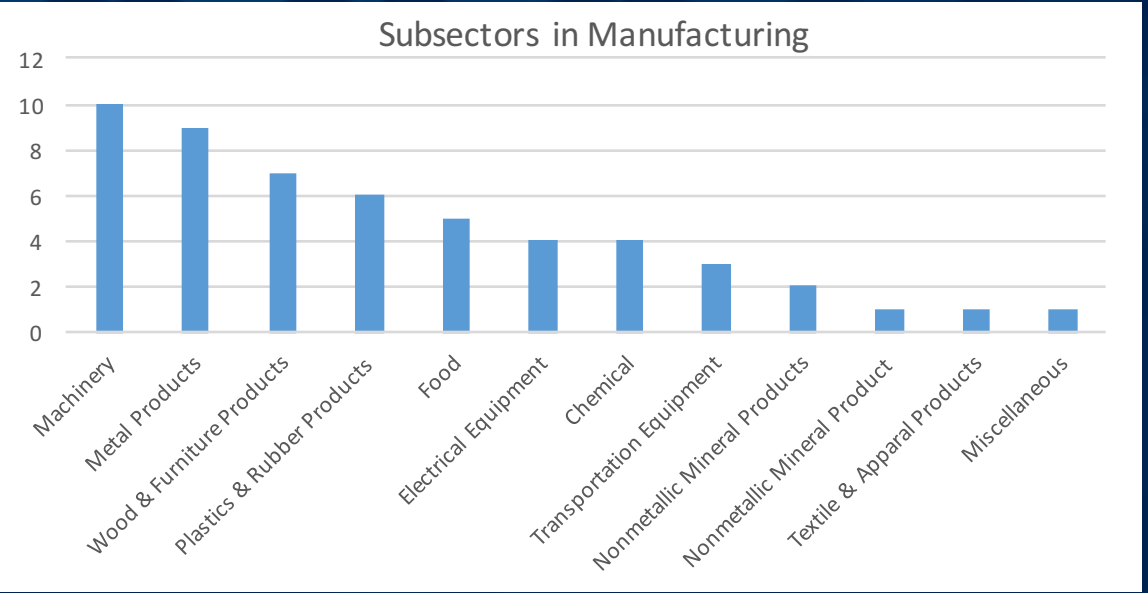
Survey Method

Who participated in the survey?

53 Total # of respondents from manufacturing





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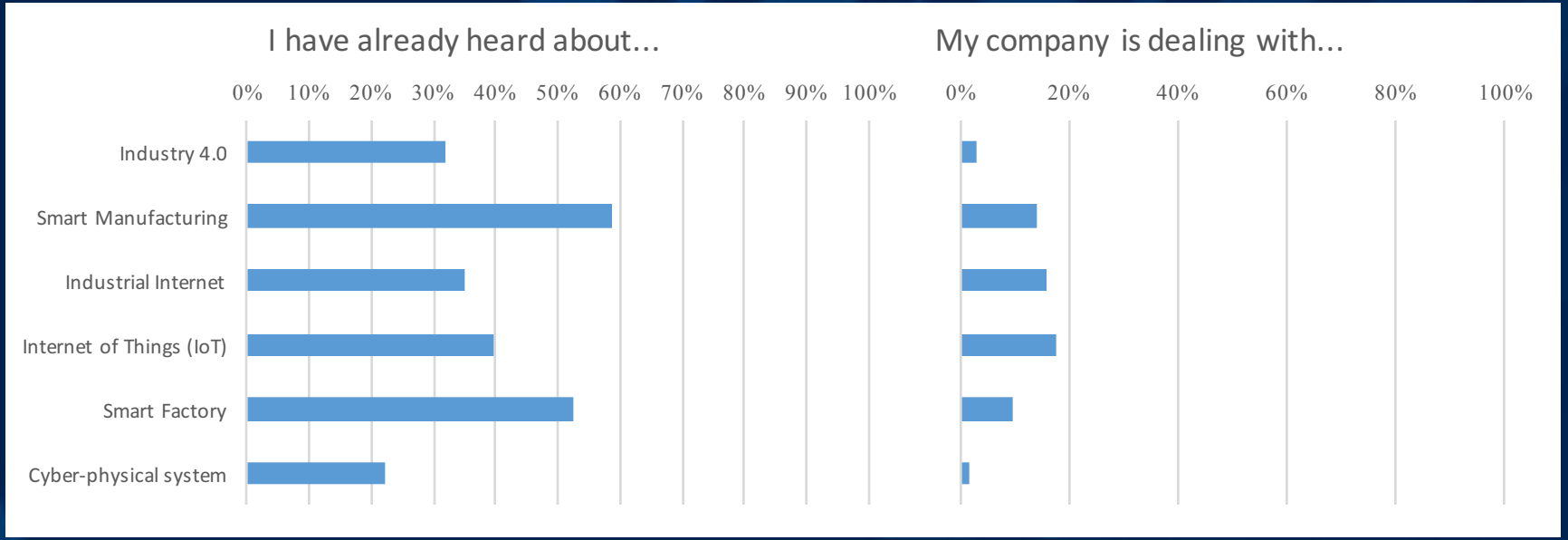
Survey Results

How aware are companies of the transition towards Smart Manufacturing?



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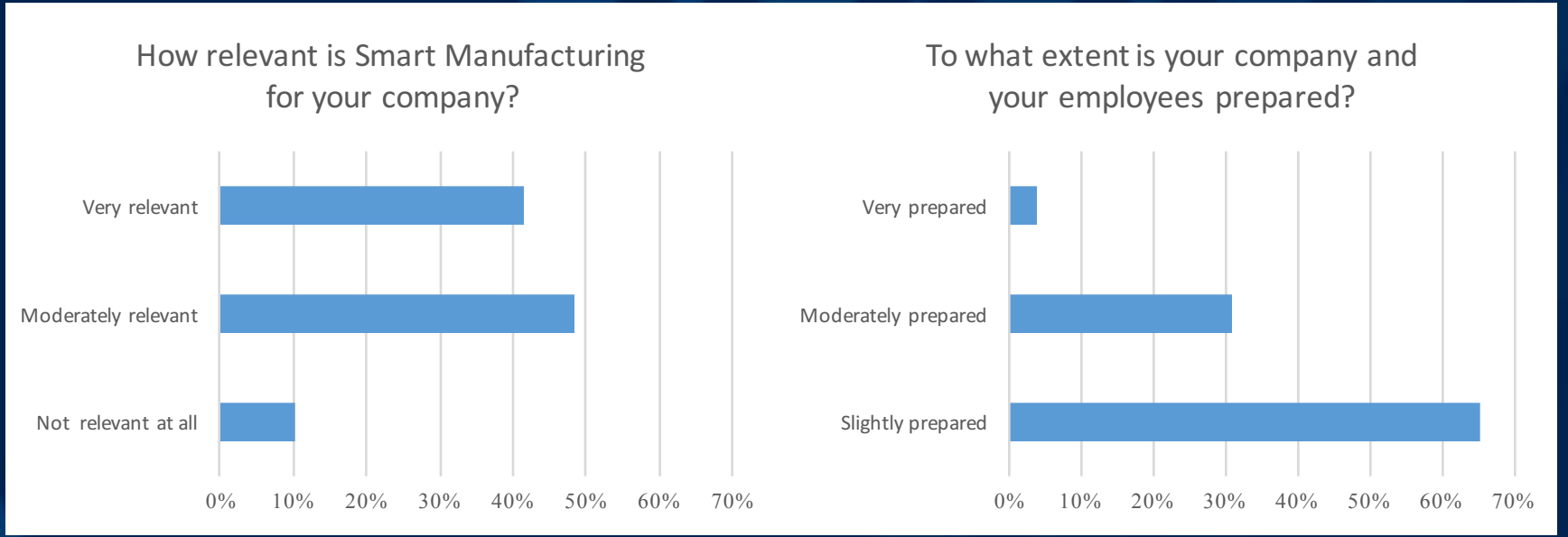
Survey Results

How prepared are companies for Smart Manufacturing?



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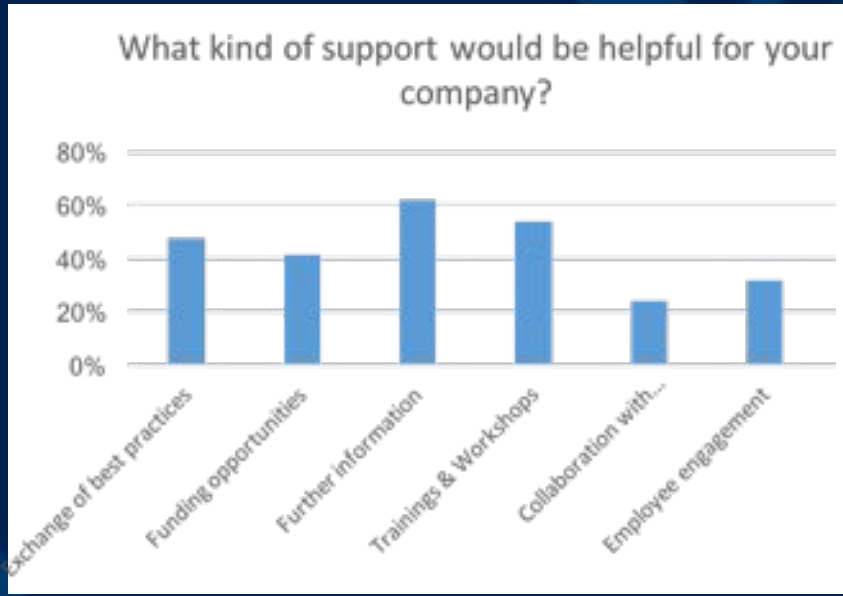
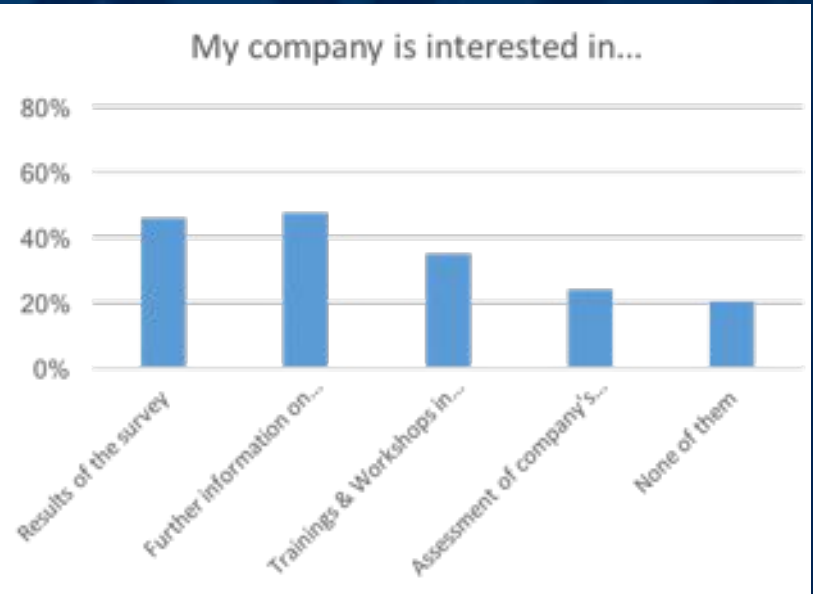
Survey Results

What are the needs of manufacturers when it comes to Smart Manufacturing?





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Interview Method

Who participated in the interview sessions?

Manufacturers

10

Interviewees in manufacturing companies

Manufacturing Experts

8

Experts in academia, associations & state agencies

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Smart Manufacturing in SMEs

Lack of opportunity

Resources & cost

Knowledge & awareness

Skilled workforce

Missing ‘success stories’

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'Capability creates Opportunity'

Craig Hartzell, Azimuth Inc., 2017

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Opportunities for entrepreneurs

Brave new world

'Low' initial investment

Dedicated 'Apps' (Platform solution)

Scalable solutions (interoperable & extensible)

Fast deployment

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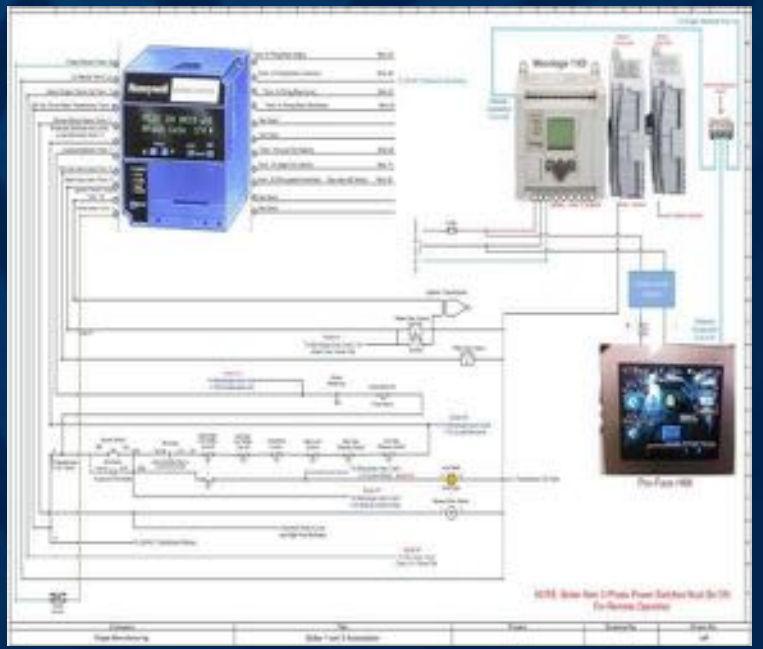
Boiler Revision Project (1/2)

at Eagle Manufacturing

Concept to revise boiler controls

Plant maintenance can control and monitor the steam boilers from outside of the plant instead of coming to the plant to schedule and check on them physically

Before



Provided by : Eagle Manufacturing, jmcknight@eagle-mfg.com

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Boiler Revision Project (2/2)

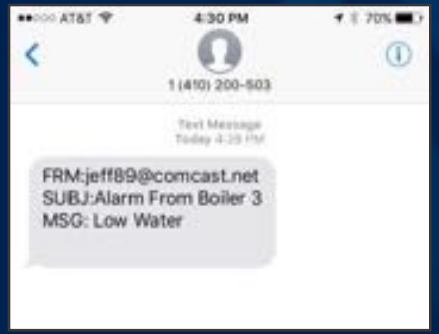
at Eagle Manufacturing

Solution

- Using newer technology
- **PLCs** with integrated **Ethernet** and SMTP (**email**) protocol
- along with advanced HMI and **smart hub network** functionality

Benefits

- **Better control** & scheduling of system
- **Real-time alarm** monitoring (through mobile devices)



After

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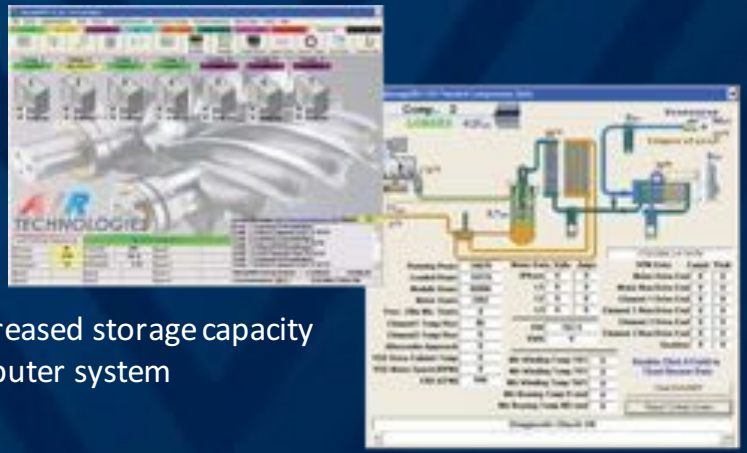
Compressed Air System Monitoring (1/2)

at Homer Laughlin China Company

Problem

- Compressed Air System was experiencing unacceptable **pressure variations** during peak demand hours
- Current system inefficient consuming 80% of full load energy while producing 20% capacity



Solution

- Balance system (compressor relocation, piping improvements, and increased storage capacity
- Change control method to a load – no load system managed by a computer system

System operation

- Compressors are monitored & system is monitored for pressure
- Compressors are started and stopped with systematic method based on demand
- Operating sequence is determined to maintain pressure and equal compressor run-time

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Compressed Air System Monitoring (2/2)

at Homer Laughlin China Company

System benefits

- Annual **energy savings** over $100,000
- Real time information allows personnel to quickly **identify problems**
- Run time of compressors is reduced extending their **operating life**
- **Preventative Maintenance** tracking and scheduling
- Consistent system operating pressure

Next steps

- Vibration and air end temperature monitoring to improve predictive maintenance of system
- Investigating use of Bosch CISS (**Connected Industrial Sensor Solution** multi-sensor device)

Further benefits

- One device type can be used in a variety of applications
- CISS connects existing machines without intervening to the machine control
- Visualize live and historic data
- CISS integrates easily to various platforms

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Smart Services Project

at Conair Group (IPEG Inc.)

Problem

- How to provide the best possible service for manufacturing equipment to customers?

Approach

- Collaborate & Innovate

Solution

- I4.0 Platfrom that provides interface and cloud access to machine data incl. visualization
- Allows monitoring all equipment set points and actuals incl. feedback on performance
- Uptime Guaranteed™ with Smart Services

Source & more information:
https://www.conairgroup.com/product/smart-services/

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Recommendations (1/2)

for Smart Manufacturing in SMEs

- Provide **educational resources** on Smart Manufacturing and Industry 4.0 ('spread the word' in an accessible way) for industrial partners.
- Jointly develop **curriculum for 1) professionals** to equip them with required knowledge to innovate and operate within a Smart Manufacturing environment, and 2) include Smart Manufacturing in **existing engineering curricula** across institutions ('high school to masters/Ph.D.'), departments and majors.
- **Communicate successes** broadly and encourage peer-to-peer exchange (across industries) of best practices and lessons learned.

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Recommendations (2/2)

for Smart Manufacturing in SMEs

- Build **strong and sustainable partnerships** between companies, academia and industry associations. For example, leverage (local) technology start-ups to team-up with established manufacturers and academia.
- Start with small **'lighthouse' projects** targeting specific pain points to learn and achieve quick wins.
- **Leverage state and federal funding** to complement the limited recourses available to manufacturing SMEs.

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My take on this issue:

- Solutions must be ***tailored to SMEs'*** (real!) needs & requirements!
- Create ***real value*** (short AND long term)!
- Fit the strategy / vision!

To do so **SMEs need** to:

- ***Assess*** their current processes critically
- ***Identify*** their core competencies
- ***Build*** on those and
- Develop a roadmap with specific milestones / objectives
- (keep ***80/20 rule*** in mind!)

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Thank You!

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