ENABLING SMALL AND MEDIUM MANUFACTURERS TO ADOPT SMART MANUFACTURING

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WHAT IS SMART MANUFACTURING?

The term “smart manufacturing” has been used to mean many things. When answering the following questions, please consider this definition:

Smart manufacturing integrates technologies to communicate data between people and machines where it’s useful, when it’s useful, and in the form that’s useful.
WHICH SMART SOLUTIONS ARE SMART FOR SMM?

- Small and medium manufacturers (SMMs) face higher barriers
- More research needed on the experiences of US SMMs
- UCI Smart Manufacturing in SMMs survey
  - Funded by the office of Energy Efficiency & Renewable Energy of the US Department of Energy as part of the Smart Connected Workers in Advanced Manufacturing project
  - With CESMII and NIST’s Manufacturing Extension Partner Centers
  - Subsample: 54 owners and employees of SMMs (< 500 employees)
  - Readiness, drivers, and barriers
  - Plus: focus on specific tasks and technologies

Do you agree or disagree that the following statements are true for your company?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Somewhat agree</th>
<th>Neither</th>
<th>Somewhat disagree</th>
<th>Strongly disagree</th>
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</thead>
<tbody>
<tr>
<td>Readiness Index</td>
<td>3.8</td>
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<tr>
<td>Management has clear concept of technology</td>
<td>3.8</td>
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<tr>
<td>Management has clear concept of potential</td>
<td>4.0</td>
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<tr>
<td>Management willing to implement near future</td>
<td>4.0</td>
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<tr>
<td>Management pressured to work with SM</td>
<td>3.7</td>
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<td>Management willing to take risks to experiment</td>
<td>3.9</td>
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<tr>
<td>Management has nec knowledge about SM</td>
<td>3.9</td>
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<tr>
<td>Company has support from top management</td>
<td>4.0</td>
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<td>Employees have right competencies</td>
<td>3.8</td>
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<tr>
<td>Employees have right motivation</td>
<td>3.7</td>
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<tr>
<td>Company has economic freedom</td>
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<tr>
<td>Company already using SM</td>
<td>3.6</td>
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</table>
How prepared is your company to introduce new technologies for smart manufacturing?

- Full concept in implementation: 16%
- Implemented first measures: 20%
- Developed clear business case: 36%
- Developed first concepts: 16%
- Not prepared: 12%

What best describes the skill level of the workers in your company?

- Existing employees have enough skills to adapt to new technology: 11%
- Existing employees could adapt to new technology with a little training: 63%
- Existing employees would find it significantly difficult to adapt to new technology; need to hire new people: 26%

In some situations, it’s easier to use traditional, lower-tech solutions, such as paperwork on clipboards, or manually checking readouts to make decisions. In other situations, these solutions are slow or unwieldy compared to newer technologies.

Do you think your company would benefit from adopting smart manufacturing solutions for any of the following tasks?

- Assigning jobs/tasks: 43%
- Communicating with third parties: 41%
- Internal communication: 35%
- Managing stock: 30%
- Completing timesheets: 26%
- Accessing data: 24%
- Accessing job/task information: 22%
- Analyzing data: 21%
- Inputting information into forms: 21%
How often does your company face significant productivity issues due to the following problems? (always, often, sometimes, rarely, never)

- Having to do tasks manually (e.g., on paper): 36% Often or more, 69% Sometimes or more
- Having to wait for job/task information: 33% Often or more, 78% Sometimes or more
- Not having correct tools or equipment: 29% Often or more, 56% Sometimes or more
- Problems with technology: 25% Often or more, 59% Sometimes or more
- Lack of training to do the job or task: 23% Often or more, 64% Sometimes or more
- Shifts or tasks not appropriately scheduled: 22% Often or more, 62% Sometimes or more
- Getting incorrect or insufficient information: 18% Often or more, 59% Sometimes or more
- Delays in getting to the job or task: 18% Often or more, 49% Sometimes or more

What do you think are the most critical factors driving your company to implement smart technologies? (up to three; prompted for ‘topmost’)

- To reduce costs: 24% TOPMOST, 41% ANY
- Conscientious strategy on smart manufacturing: 15% TOPMOST, 33% ANY
- Customer requirements: 11% TOPMOST, 24% ANY
- Competitors practice smart manufacturing: 9% TOPMOST, 28% ANY
- Work initiated with input from public advisors: 9% TOPMOST, 19% ANY
- Seen what and how others have done: 7% TOPMOST, 17% ANY
- Lack of qualified employees: 7% TOPMOST, 15% ANY
- To improve time-to-market: 4% TOPMOST, 17% ANY
- Work initiated on requests from consultants: 4% TOPMOST, 13% ANY
- Due to legal requirements/changed legislation: 4% TOPMOST, 19% ANY
- Don’t know: 2% TOPMOST, 2% ANY
- None: 2% TOPMOST, 2% ANY
What are the most critical barriers involving implementing smart technology and smart production processes in your company? (up to three; prompted for ‘topmost’)

- Additional investment of time: 26%, 30%, 43%
- Additional investment of funds: 22%, 24%
- Concerns regarding data security: 9%
- Missing standards for interconnection: 11%, 7%
- Insufficient management commitment: 7%, 6%
- Uncertainty about implications on profits: 6%
- Reluctance to innovate: 4%
- Availability of equipment or software: 4%
- Employee pushback: 4%
- Lack of qualified employees: 2%
- Insufficient network bandwidth: 2%
- Other: 2%

- Tablets
- Mobile phones
- Handheld scanners
- Wearable scanners
- Wearable mobile phones/computers
- Smart glasses
- Headsets
- Virtual reality (VR) headsets
- Augmented reality (AR) for training
- Augmented reality (AR), purposes other than training
- Internet of Things / sensors / M2M (machine to machine) communication
- Cloud computing
- Cybersecurity
- Big data and analytics
- Simulation
- Artificial intelligence (AI)
- Autonomous robots
- Radio-frequency identification (RFID) and/or real-time locating system (RTLS)
- Additive manufacturing (e.g., 3D printing)
- Horizontal and vertical system integration
Does company use as part of a smart manufacturing solution... OR implemented but later discontinued use because you experienced problems... OR seriously considered implementing but decided not to because you expected problems?

Based on your experiences, what is the most significant "pro" of the following technologies?

- Increased task completion speed
- Better ergonomics
- Reduced task complexity
- Easier implementation
- Reduced "management by walking around"
**Cons of Technology Types**

**Worker Reactions to Technology Types**

Based on your experiences, what is the most significant "con" of the following technologies?

Overall reaction of workers in your company to implementing the following types of smart technology?

- Mobile phones
- Tablets
- Smart glasses
- Cyber-security
- Artificial intelligence
- Cloud computing
- Big data and analytics
- Handheld scanners
- Horizontal and vertical system integration
- AR other than training
- Additive manufacturing
- Headsets
- Autonomous robots
- Simulation
- AR for training
- Wearable mobile phones/computers
- IoT/sensors/M2M
- Wearable scanners

- Strongly positive
- Somewhat positive
- Mixed or neutral
- Somewhat negative
- Strongly negative
TAKE-AWAYS

• SMMs face challenges with adopting smart manufacturing solutions
  • Negotiating cost and time
  • Limited readiness
  • Worker response

• Focus on tailored solutions
  • Address the problems they most need to solve
  • Pros and cons vary across specific technologies
  • Inroads with accessible options: tablets, mobile phones, cybersecurity, data analysis, IoT

QUESTIONS AND COMMENTS WELCOME

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