

Is Industry Ready for Digital Manufacturing?

for the

Digital Enterprise Symposium

Digital Enterprise Center

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By

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Purdue University



Collins Aerospace



The Digital Manufacturing Institute

Raytheon

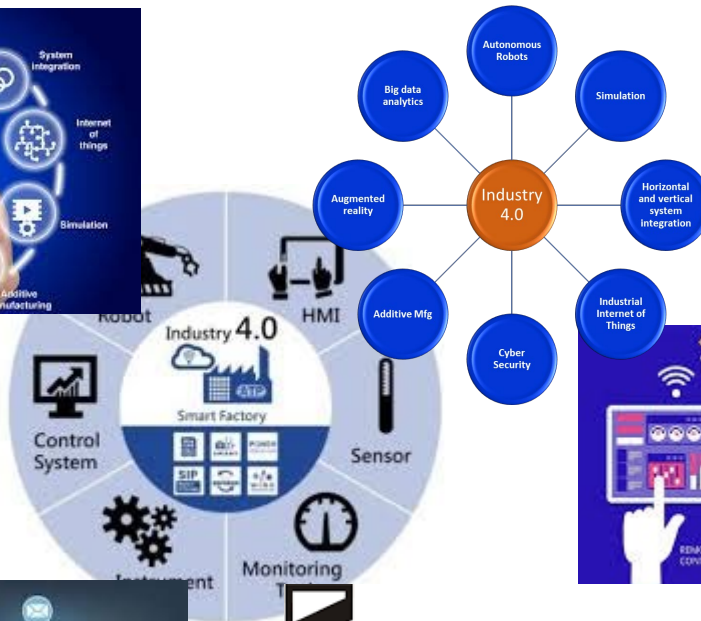


NIST
National Institute of
Standards and Technology
U.S. Department of Commerce



14.0/Smart Mfg./Smart Factory

- Digitally enabled manufacturing is discussed using many terms that all mean something specific, but are quite often used interchangeably by manufacturers, government and academics.





- The cyber and physical worlds are becoming increasingly integrated creating the Industrial Internet of Things (IIoT).
- Integration of connected devices, digital design, data analytics, and augmented reality are blending the physical and virtual worlds of manufacturing.
- Data has to be processed with advanced tools to generate meaningful information.
- Advanced manufacturing in the form of additive manufacturing, advanced materials, smart automated machines, flexible robotics and other connected technologies are creating a new manufacturing platform.

The Problem

- Significant communications inefficiencies continue to increase costs and time while stymying innovation.
- This is a hidden cost to manufacturers who see it as the way business has to be handled.
- Most collaborative exchanges around technical data are executed via unstructured communications and do not easily allow for capture, analysis and re-use.



Are We There Yet?



Research Methodology

The purpose of this survey was to determine the state of Industry 4.0 technology adoption. In March, Informa Engage emailed invitations to participate in an online survey to subscribers of *IndustryWeek* and/or *New Equipment Digest*.

Subscribers representing the following job titles and industries were specifically targeted:

- C-Level, IT Management, Operations Management and Plant Management
- Manufacturing, Automotive, High Tech, Retail, Chemicals, Life Sciences, Aerospace and Defense, and Engineering and Construction

The primary objectives that respondents say drive their organization's Industry 4.0 implementation are not very different than goals that drive any business strategy. Enhancing workforce productivity and improving customer experience top the list, with a majority of the respondents citing them as their primary objective for implementing Industry 4.0 technologies. However, it's important to note that no single objective dominates, which suggests that respondents understand their companies can't compete only with a single strategy.

The survey results indicate that company leaders are aware that ensuring connected business processes is the ultimate goal.

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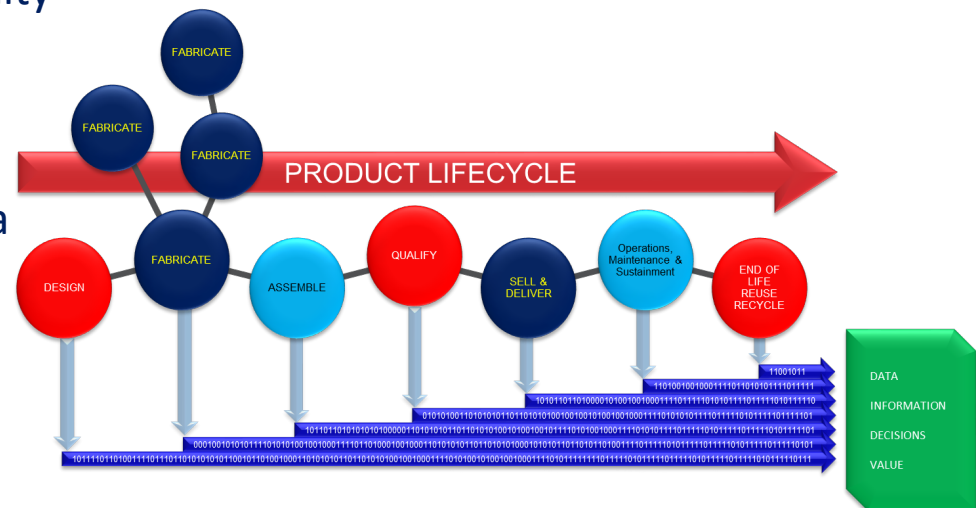
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QUALIFYING CRITERIA

Between March 1 and March 18, 2019, Informa Engage received 945 completed surveys, of which 172 respondents represented companies that met the qualifying criteria. This report is based on those respondents.



- Industry interviews revealed a significant gap in the believed readiness or capability of suppliers to adopt digital manufacturing processes and participate fully in a digitally enabled supply chain.
- ✓ Little understanding of what is “Digital Manufacturing”
- ✓ Most interviewees translate or recreate CAD files, even STEP, without validation or notifying the customer
- ✓ 91% use email to exchange tech data, 23% still use fax, with both methods leading to loss of data fidelity
- ✓ Very little design collaboration
- ✓ Limited exchange of production data





- Significant adoption barriers
 - Lack of understanding/misperception
 - Lack of a business case
 - Interoperability issues
 - Cost/effort
 - Lack of resources
 - Lack of infrastructure and skills



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- Tech data issues
 - Received by portal, email, fax and paper
 - Most translate CAD/STEP files to their own preferred format
 - Translations **typically** aren't validated
 - Conflicts between drawings and models
 - Little collaboration during design phase
 - Additional data/clarification often needed
- Very limited exchange of production data
- Findings validated by secondary research
 - ITIF Report
 - WVU Paper
 - **European study**
 - **Australian article**



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- Report on Korean and U.S. industries found “... that, for all manufacturing digitalization’s promise, U.S. manufacturers – especially small- to medium-sized enterprises (SMEs) ... have been particularly slow to adopt digital manufacturing practices, with most companies remaining just at the initial stages of smart manufacturing technology adoption”
- Wuest et al. found that “Overall, there is little awareness of Smart Manufacturing and related topics among manufacturing SMEs in WV”
- A DoD study in 2016 provided insight into a number of issues with organizations, albeit government, adopting digital manufacturing/model-based enterprise (MBE) capabilities.
- Mittal, et al., found similar issues with European manufacturers with adoption of Industry 4.0 digital capabilities.



GENERAL MANUFACTURING

Finding the confidence to embrace new technologies as an early adopter

Addressing five common concerns CFOs have over
digital technologies

www.infor.com

- Digital Technologies are disruptive, leading to chaos and confusion
- Digital technologies are only for large enterprise-size companies with huge budgets
- Digitalization is all about machines, robotics and the IoT
- Digitalization is unproven, highly risky, and invites security breaches
- If we don't have a digital plan already then it's already too late

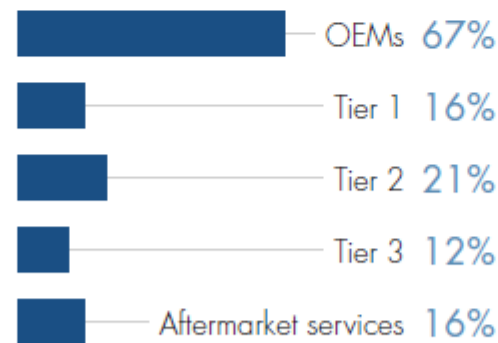
TRENDS IN DIGITAL MANUFACTURING | MARKET SURVEY

Survey highlights//

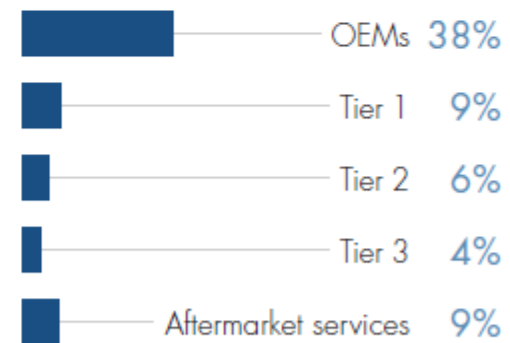
OEM'S PAVE THE WAY TO 4.0

BY IMPLEMENTING
THESE MAIN
INITIATIVES

Digitizing manual processes initiative



Connecting to shop floor sensors initiative



TRENDS IN DIGITAL MANUFACTURING | MARKET SURVEY

HURDLES ON THE ROAD TO DIGITAL TRANSFORMATION

Which hurdles must your company overcome while pursuing your digital transformation?

The survey showed nine common hurdles to digital transformation that are experienced across multiple industries. As with any adoption of new technology, the potential complexity of new system integration seems to be the biggest challenge with implementing 4.0 technologies as it was reported by 44% of respondents, while 29% reported their greatest hurdle being lack of human resources. 21% of respondents said it was too early to implement digital transformation in their organization, while lack of management buy-in was reported by 18%. A lack of ROI data is an issue for 8% and the concern of cyber security threats appears to be an issue for just 8% of the respondents, however this requires further analysis.



* The total responses add up to more than 100% as some respondents marked multiple options.

- Inefficient communication of data and information in engineering-centric manufacturing supply chains increases cost and time while stymying innovation.
- Supplier network complexity is growing exponentially.
- The pressure is on companies to find new opportunities to improve productivity.
- Inaccurate data due to multiple independent databases that do not agree.
- Production jobs below break-even costs are real issues.
- Interoperability of systems contributes to both long lead times and increasing errors in processes.
 - Finding from NIST indicated that inadequacies in supply chain infrastructures to be in excess of \$5 billion for the automotive industry.
 - Air Force Research Lab found similar costs in large DoD programs.
- Unprofitable business practices



So, what does a SMM do?

- Most manufacturers agree that digitally connected systems and machines will determine who survives in the coming decades of data-driven analytics and automation.
- The toughest decision is knowing how to get started.
- With so many options and so many products, it's difficult to know if you're making the right long-term choices, however, waiting is not the answer.
- Understand that this is a large initiative and improvements must take place in phases with the basics fixed first, but a significant return on investment was required for each undertaking
- The path forward: Vision, Fundamentals, Analyze, Choose based on ROI, and Follow Through



Understand Digitization vs. Digitalization

- They are NOT the same!
- Digitalization does not simply mean paperless.
- Digitization is the computerization of a manual activity, taking analog information and encoding it into zeroes and ones so that computers can store, process, and transmit the information.
 - Memorandums to email
 - Inspection forms to Excel
- Converting existing inefficient processes to a digital format is simply digitizing and results in a faster inefficient process
- Digitalization is the replacement of a manual or digital activity and taking advantage of the capabilities of connectivity and application capabilities to remove wasteful actions from the process, resulting in a more efficient, effective and value creating activity.
 - Real time digital work instructions presented electronically on the floor of a mixed model production line
 - Automated First Article Inspection programming directly from the 3D Solid Model



Positives and Negatives

- Upside of digitizing

- It is easy to get started
- Less threatening
- Lower costs

- Downside of digitizing

- Still requires human intervention
- Still disconnected silos
- Little visibility

- Upside of digitalizing

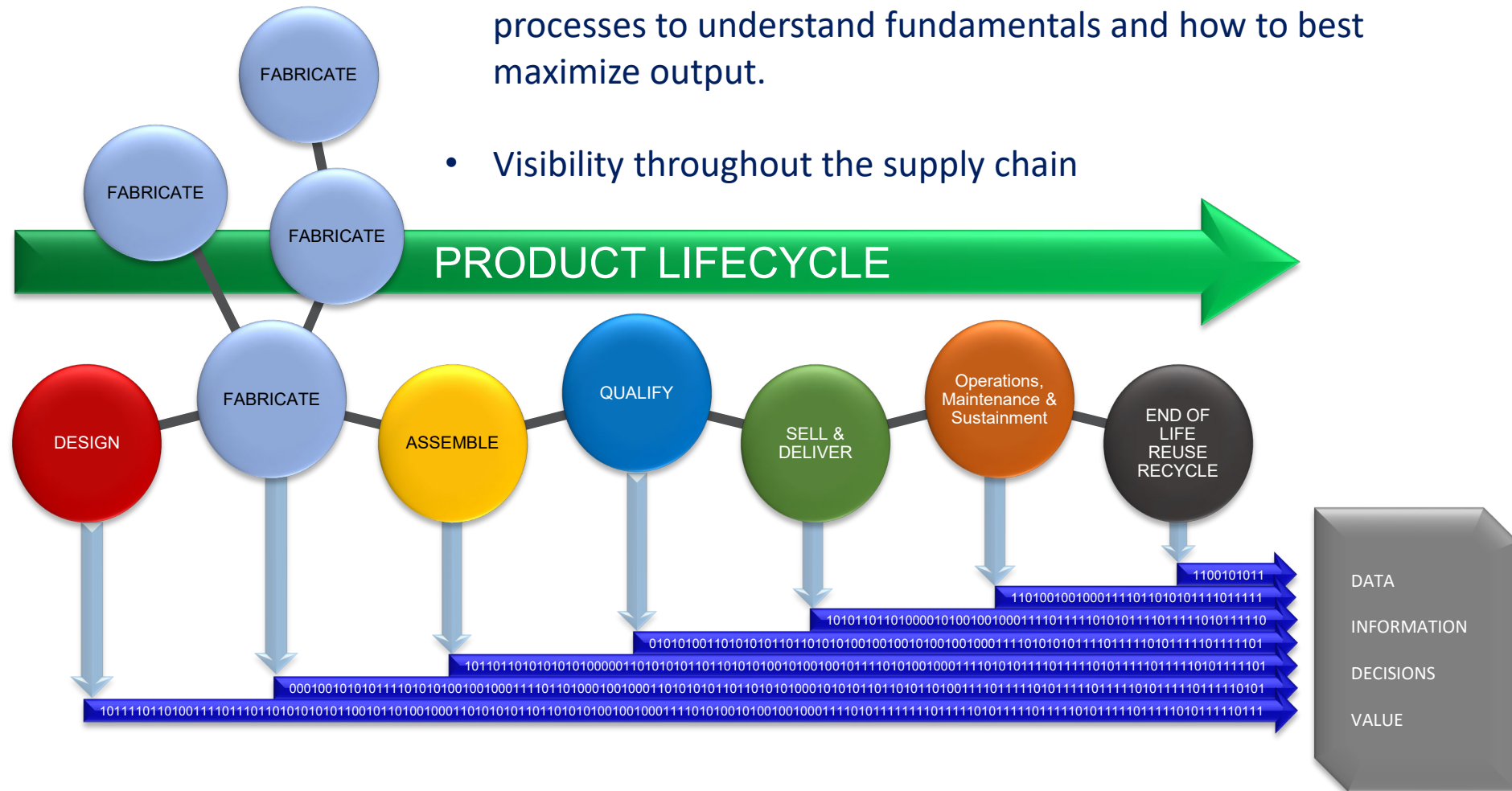
- The payoff is great
- Better understanding of processes
- Improved visibility
- Less human intervention
- Less time, fewer delays

- Downside of digitalizing

- It's not necessarily easy
- Will require investment in all resources
- People basically dislike change

The Digital Thread Vision

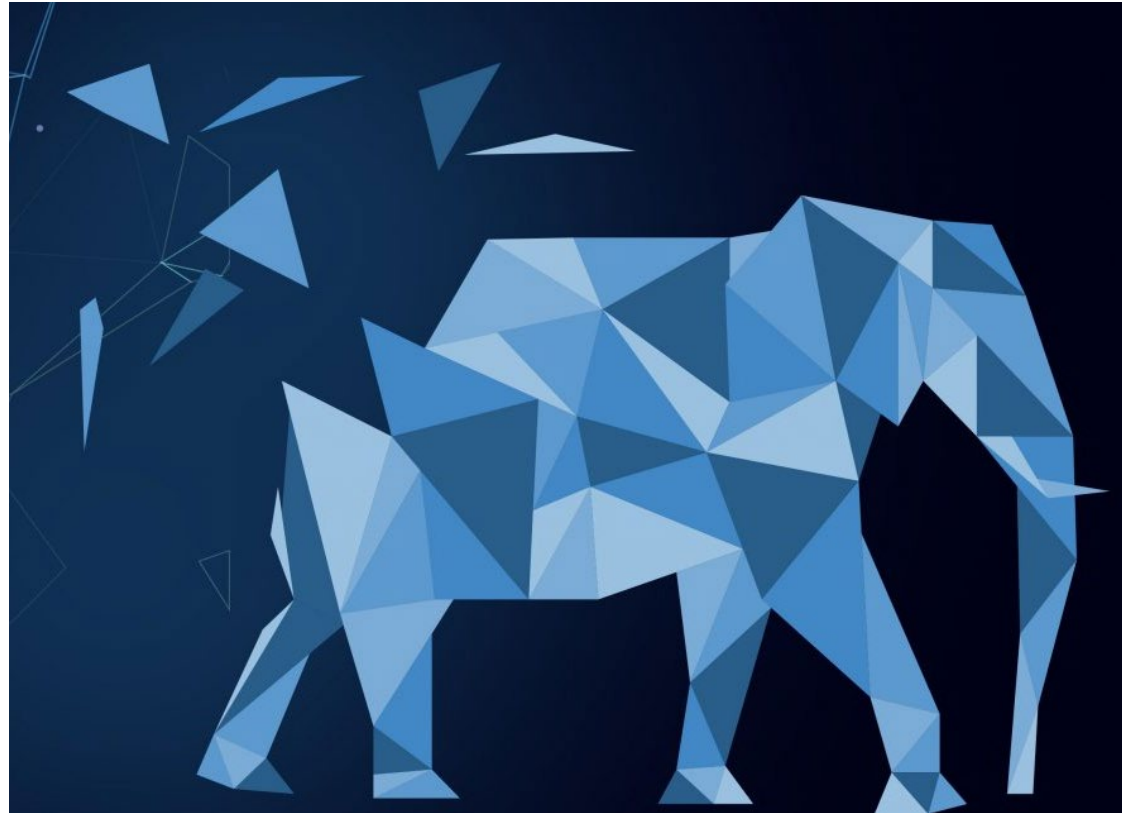
- The Digital Thread connects all processes.
- Use data analytics on all current business and manufacturing processes to understand fundamentals and how to best maximize output.
- Visibility throughout the supply chain



- Standardized processes
- Collect and use data on the processes to make a systems-level view
- Improve processes using known techniques and applying digital capabilities
- Map the processes, and then implement digital tools to increase speed, accuracy, and efficiency
- Financial data assurance
 - This is the start of the Digital Thread journey
 - Without a solid foundation of accounting and business processes visible and accurate there will be no journey

- Apply Data Analytics to internal processes
- Pareto the processes based upon the needs of the business
 - Business growth
 - Highest costs
 - Defects
 - Lead time improvement
- Hit the problems that cost the most
 - Resources
 - Funding
 - Reputation
 - Lead Time
 - Responsiveness
 - Agility

- What is your ROI measure?
- Small bites, chew well!
- Determine the highest Return Investment project and DO IT!
- Standardize the solution
- Train users to modify behaviors
- Remove the opportunity to backslide



<https://logisym.org/digitalisation-eating-the-elephant-april-2018/>



Cortez Method of Change Management





Systematic follow through

- Re-analyze the list of issues and repeat
- Take a Systems View
- Remaining up-to-date with technology and innovations is key to gaining and maintaining competitive advantage
- Each improvement is another stitch in the Digital Thread



Understand what you are up against...

“There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one.”

Machiavelli (1513)



Questions?

Thank You!

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