

II. PRODUCTION

Digitally mature production processes enable automation of operations and real-time management of manufacturing.

Examples of technologies that enable digitally mature production include:

- Smart devices embedded in equipment and processes to capture and share production data in real time (e.g., quality, productivity, stoppages, equipment wear)
- Robotics, automation, and advanced human-machine interfaces to automate dangerous tasks and lower variability for repetitive work
- Computerized maintenance management systems (CMMS) to manage and optimize assets
- Machine learning to reduce process variability
- Manufacturing execution systems (MES) to monitor data from embedded devices and sensors in real time and identify improvement opportunities

Digital best practices include empowered frontline staff; daily huddles; and visual management systems that enable production employees to respond in real-time and autonomously solve problems.

Digitally enhanced outcomes include world-class safety, quality, speed, productivity, energy-consumption, and environmental performances.

24. What best describes the application of smart devices/embedded intelligence to production processes at your company?

- No plans to apply smart devices/embedded intelligence
- Production processes evaluated for potential application of — and benefits from — smart devices/embedded intelligence
- Legacy devices and technologies replaced with smart devices/embedded intelligence for some production processes
- Legacy devices and technologies replaced with smart devices/embedded intelligence for most production processes
- Smart devices/embedded intelligence have been applied where necessary and local data-sharing and analytics (i.e., with plant systems) occur
- Smart devices/embedded intelligence have been applied where necessary and widespread data-sharing and analytics (i.e., with plant and business systems, suppliers, customers) occur
- Don't know

25. What percentage of production equipment and processes incorporate smart devices/embedded intelligence?

- 0%
- 1-10%
- 11-25%
- 26-50%
- 51-75%
- More than 75%
- Don't know

26. Has the application of smart devices/embedded intelligence enhanced the capabilities of your company's operations technologies (OT)?

- No application of smart devices/embedded intelligence
- Planning to connect smart devices/embedded intelligence to operations technologies (OT)
- Connection of smart devices/embedded intelligence to applicable OT systems is underway
- Some applicable OT systems improved by the application of smart devices/embedded intelligence
- Most applicable OT systems improved by the application of smart devices/embedded intelligence
- All applicable OT systems improved by the application of smart devices/embedded intelligence
- Don't know

27. To what extent has the application of smart devices/embedded intelligence in plants helped to improve environmental, health, and safety (EHS) performances.

- No smart devices/embedded intelligence
- No improvements yet to EHS performance
- Some improvements to EHS performance
- Many improvements to EHS performance
- Extensive improvements to EHS performance
- Extensive improvements to EHS — industry leader
- Don't know

28. By approximately what percentage has the plant's energy usage (kilowatt-hours) per unit of production changed over the past three years?

- Increased
- Stayed the same
- Decreased 1-5%
- Decreased 6-10%
- Decreased 11-15%
- Decreased more than 15%
- Don't know

29. What method best describes how quality problems are typically identified and resolved?

- No method per se
- Quality control inspection at end of production
- Frontline associates alert management when they see a quality problem
- Frontline associates use process data to identify in-process poor quality and stop production (e.g., and/or) until problem can be resolved
- Smart devices/embedded intelligence identify in-process poor quality and automatically stop production until problem can be resolved
- Smart devices/embedded intelligence identify in-process poor quality and digitally recalibrate process/equipment to prevent problem recurrence
- Don't know

30. What is your company's finished-product first-pass quality yield?

- Less than 80%
- 80-84%
- 85-89%
- 90-94%
- 95-98%
- 99-100%
- Don't know

31. How does maintenance typically respond to equipment problems?

- No maintenance department per se
- Management contacts maintenance when equipment breaks down
- Frontline associates contact maintenance when equipment breaks down
- Frontline associates contact maintenance when equipment data indicates a potential problem
- Smart devices/embedded intelligence alert maintenance in real time to a potential problem
- Smart devices/embedded intelligence alert maintenance in real time to a potential problem as well as schedule preventive maintenance when equipment-performance variations exist
- Don't know

32. What percentage of maintenance work is reactive?

- More than 50%
- 31-50%
- 21-30%
- 11-20%
- 5-10%
- Less than 5%
- Don't know

33. What is company-wide machine availability as a percentage of scheduled uptime?

- Less than 75%
- 76-85%
- 86-90%
- 91-95%
- 96-99%
- 100%
- Don't know

34. How are finished-goods inventory levels within plants determined?

- No process to establish inventory levels
- Management reacts to depleted inventories
- Manual counts of inventory establish inventory levels (periodically)
- Automated counts of inventory establish inventory levels (periodically)
- Automated counts of inventory combined with consumption data and forecasts establish inventory levels (periodically)
- Automated counts of inventory and dynamic consumption data and forecasts establish inventory levels (real time)
- Don't know

35. How has the total inventory turn rate (raw material, work-in-process, and finished goods) changed over the past three years?

- Decreased
- Stayed the same
- Increase 1-5%
- Increase 6-10%
- Increase 11-15%
- Increase more than 15%
- Don't know

36. What is the production output of your company's plants as a percentage of designed production capacity?

- Less than 70%
- 71-80%
- 81-90%
- 91-95%
- 96-100%
- More than 100%
- Don't know

37. Which of the following constraints impair or preclude your company's ability to digitize production processes? (choose all that apply)

- Human resources/talent
- Improvement-process knowledge
- Access to enabling technologies
- Leadership/guidance
- Funding
- Infrastructure
- Lack of external support (e.g., system integrators)
- Other (please specify):
- No constraints
- Don't know

38. Please include comments/notes for the Production category that can help in planning digital improvements for your company.

III. WAREHOUSES/DISTRIBUTION CENTERS

Digitally mature warehouse/distribution processes enable automation of goods storage and real-time management of warehouse activities.

Examples of technologies that enable digitally mature warehouses and distribution centers include:

- Smart devices embedded in warehouse processes to capture and share inventory data in real time
- Warehouse management systems (WMS) to optimize resources and space in moving and storing materials and goods
- Robotics, automation, and advanced human-machine interfaces to automate dangerous tasks and lower variability for repetitive work
- Radio frequency identification (RFID) to track goods

Digital best practices include empowered frontline staff; daily huddles; and visual management systems that enable warehouse employees to respond in real-time and autonomously solve storage and warehouse problems.

Digitally enhanced outcomes include world-class warehouse metrics (e.g., pick times, inventory accuracy, backorder rates).

39. What best describes the application of smart devices/embedded intelligence to warehouse/distribution-center processes at your company?

- No plans to apply smart devices/embedded intelligence
- Warehouse processes evaluated for potential application of — and benefits from — smart devices/embedded intelligence
- Legacy devices and technologies replaced with smart devices/embedded intelligence for some warehouse processes
- Legacy devices and technologies replaced with smart devices/embedded intelligence for most warehouse processes
- Smart devices/embedded intelligence have been applied where necessary and local data-sharing and analytics (i.e., with warehouse systems) occur
- Smart devices/embedded intelligence have been applied where necessary and widespread data-sharing and analytics (i.e., with warehouse, plant, and business systems and with suppliers and customers) occur
- Don't know

40. What percentage of warehouse equipment and processes incorporate smart devices/embedded intelligence?

- 0%
- 1-10%
- 11-25%
- 26-50%
- 51-75%
- More than 75%
- Don't know

41. To what extent have smart devices/embedded intelligence (e.g., sensors) been applied to monitor the conditions (e.g., temperature, moisture, movement) of goods?

- No use of sensors
- Evaluating sensor technologies and potential areas of application
- Trialing the application of sensors
- Sensors in use for some applicable goods
- Sensors in use for many applicable goods
- Sensors in use for all applicable goods
- Don't know

42. To what extent have smart devices/embedded intelligence (e.g., sensors) been applied to improve material handling (e.g., locating, picking, and moving goods)?

- No use of sensors
- Evaluating sensor technologies and potential areas of application
- Trialing the application of sensors
- Sensors in use for some applicable goods
- Sensors in use for many applicable goods
- Sensors in use for all applicable goods
- Don't know

43. What is the inventory accuracy in your company's warehouses/distribution centers?

- Less than 80%
- 80-85%
- 86-90%
- 91-95%
- 96-99%
- 100%
- Don't know

44. Which of the following constraints impair or preclude your company's ability to digitize warehouse/distribution-center processes? (choose all that apply)

- Human resources/talent
- Improvement-process knowledge
- Access to enabling technologies
- Leadership/guidance
- Funding
- Infrastructure
- Lack of external support (e.g., system integrators)
- Other (please specify):
- No constraints
- Don't know

45. Please include comments/notes for the Warehouses/Distribution Centers category that can help in planning digital improvements for your company.

V. SUPPLY CHAIN

Digitally mature supply-chain processes enable a company to digitally connect and coordinate its operations with suppliers.

Examples of technologies that enable digitally mature supply chains include:

- Smart devices throughout supply-chain processes to capture and share in real time information critical to supplier performances
- Supply-chain management (SCM) systems to integrate and manage the flow of goods and services across the supply chain
- Supplier-network optimization tools to improve efficiency and performance of the supply base while ensuring reliability of goods and services, and reducing supply-chain costs
- Predictive analytics to monitor, manage, and proactively react to changing supply-chain conditions

Digital best practices include digital sharing of real-time production data, schedules, and sales forecasts; and real-time monitoring of operations and shipments at primary suppliers.

Digitally enhanced outcomes include partner relationships with key suppliers (e.g., sharing of intellectual property and resources) and world-class supplier metrics (e.g., quality, timeliness, cost containment).

46. What best describes the application of smart devices/embedded intelligence to the supply-chain processes at your company?

- No plans to apply smart devices/embedded intelligence
- Supply-chain processes evaluated for potential application of — and benefits from — smart devices/embedded intelligence
- Legacy devices and technologies replaced with smart devices/embedded intelligence for some supply-chain processes
- Legacy devices and technologies replaced with smart devices/embedded intelligence for most supply-chain processes
- Smart devices/embedded intelligence have been applied where necessary and local data-sharing and analytics (i.e., with supplier systems) occur
- Smart devices/embedded intelligence have been applied where necessary and widespread data-sharing and analytics (i.e., with supplier systems and downstream plant and business systems) occur
- Don't know

47. How well do primary suppliers' networks and systems communicate with those of your company?

- No communications attempted
- No communication currently available
- Minimal communication available
- Some communication available
- Significant communication available
- All necessary networks and systems communicate seamlessly
- Don't know

48. Does your company digitally track supplies and integrate that information into its enterprise systems such as ERP?

- No digital tracking of supplies
- Planning to digitally track supplies and integrate information into enterprise systems
- Trialing tracking and integration of supplies information
- Tracking some supplies and integrating digital information into some applicable enterprise systems
- Tracking a majority of supplies and integrating information into many applicable enterprise systems
- Tracking most or all supplies and integrating information into all applicable enterprise systems
- Don't know

49. With what percentage of primary suppliers are your company's production schedules automatically shared?

- 0%
- 1-25%
- 26-50%
- 51-75%
- 76-99%
- 100%
- Don't know

50. With what percentage of primary suppliers are your company's demand plans/sales forecasts automatically shared?

- 0%
- 1-25%
- 26-50%
- 51-75%
- 76-99%
- 100%
- Don't know

51. For what percentage of primary suppliers is your company able to monitor their operations (e.g., goods in production, throughput, quality) in real time?

- 0%
- 1-25%
- 26-50%
- 51-75%
- 76-99%
- 100%
- Don't know

52. What is your primary suppliers' on-time delivery performance to your company's operations?

- Less than 80%
- 80-85%
- 86-90%
- 91-95%
- 96-99%
- 100%
- Don't know

53. What is the defect rate on components and materials received from primary suppliers?

- More than 15%
- 11-15%
- 6-10%
- 3-5%
- 1-2%
- 0%
- Don't know

54. Which of the following constraints impair or preclude your company's ability to digitize supply-chain processes? (choose all that apply)

- Human resources/talent
- Improvement-process knowledge
- Enabling technologies
- Leadership/guidance
- Funding
- Infrastructure
- Lack of external support (e.g., system integrators)
- Other (please specify):
- No constraints
- Don't know

55. Please include comments/notes for the Supply Chain category that can help in planning digital improvements for your company.

V. LOGISTICS/TRANSPORTATION

Digitally mature logistics/transportation processes enable a company to digitally connect and coordinate its operations with transportation and logistics providers.

Examples of technologies that enable digitally mature logistics include:

- Smart devices and radio frequency identification (RFID) within logistics/transportation processes for tracking shipments en route in real time
- Transportation management systems (TMS) to monitor and manage carriers, optimize routes, deliver alerts, reduce costs, and improve customer satisfaction
- Automated carrier invoicing and payment processes

Digital best practices include consolidated shipments; "milk runs;" and real-time monitoring and alerts for abnormal driver and vehicle conditions.

Digitally enhanced outcomes include world-class logistics and transportation metrics, including delivery times and delays, damaged/missing shipments, transportation costs, fuel efficiency, and accuracy of freight payments.

56. For what percentage of inbound shipments can your company identify the approximate location in real time?

- 0%
- 1-50%
- 51-75%
- 76-90%
- 91-99%
- 100%
- Don't know

57. For what percentage of outbound shipments can your company identify the approximate location in real time?

- 0%
- 1-50%
- 51-75%
- 76-90%
- 91-99%
- 100%
- Don't know

58. To what extent can your company monitor in real time the conditions of inbound shipments?

- No plans to monitor shipment conditions
- Evaluating the use of shipment monitoring
- Trialing the monitoring of applicable shipments
- Monitoring some applicable shipments
- Monitoring many applicable shipments
- Monitoring all applicable shipments
- Don't know