The journey to smart manufacturing and beyond

A step-by-step guide

Executive summary

As manufacturers continue to invest in transformative technology, the decisions they make today will affect their ability to continue to adapt and thrive.

In late 2023, we surveyed manufacturing leaders, asking **“If a manufacturer had an extra $1 million (or $10 million or $100 million) to invest, how would they utilize those dollars?”** The results of the research uncovered this: Whether respondent answers were to split marginal dollars between present challenges and future big bets or to go all in on current challenges, most executives felt that marginal dollars would be best spent at an intersection of strategy, people and technology.

Our interview respondents understood that the nature of work is changing. Employees and employers alike want human work to be focused on strategic, business (and personal) growth initiatives. Repetitive and sometimes dangerous work is where technology can best aid manufacturers, both now and in the future. Autonomous factories aren’t about removing humans from manufacturing, they are about putting both people and machines where they can make the most impact.

But as with any major change, the execution is as critical as the strategy. In this ebook, we will share a step-by-step guide to thinking through smart manufacturing (and beyond).

Lowering costs and increasing productivity as well as building a stronger, more resilient workforce should not be considered as competing interests, but rather as interdependent strategies.

—"How Firms Would Invest a Marginal Dollar with Their Company” Cognizant and NAM Research Study

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The core of smart manufacturing

Smart manufacturing integrates and harmonizes supply chain and manufacturing data and processes with analytics with the goals of delighting customers and enabling higher margin products and services, while streamlining manufacturing and cutting inventory, rework and maintenance costs.

To enable a smart manufacturing facility, organizations should look to three key areas:

- Operational excellence
- Asset excellence
- Resource excellence

More than half of those interviewed cited automation investment as key component of their marginal dollar spend and a driver for future growth.

—"How Firms Would Invest a Marginal Dollar with Their Company" Cognizant and NAM Research Study

Three primary use cases for smart manufacturing

87% of those surveyed in the “Fictiv Sustainability in Manufacturing Report” shared that sustainability is growing in importance.

However, 30% of surveyed manufacturers are struggling to form effective strategies to improve the sustainability of their operations. And, of course, quality is always paramount in manufacturing. Both require meaningful, accurate data.

Below are three primary use cases to make the case for smart manufacturing:
Business use cases

Operational excellence

- Improved throughput and efficiency
- Remove operational bottlenecks
- Enhanced worker experience and safety

Asset excellence

- Improved asset health and uptime
- Reduced spares and inventory
- Reduced equipment investment

Resource excellence

- Optimal resource usage
- Improved environmental resilience and compliance
- Improved product quality and reduce wastage

Enablers

Modernized plant OT networks

Cloud and edge computing

Cyber security

Robotics

Analytics and generative AI

Wireless and wired connectivity

AR/VR wearables

IT/OT integration

Defining five key challenges

Manual, missing or complex processes

- Different sites operating with different models
- Multiple systems of record in use
- Current digitization leverages heavy customization
- Significant breaks in the process needing manual intervention

Scattered technology

- Missing integration layers
- Replacement of technology and systems are slow compared to the speed of business
- Stopgap solutions proliferate as technology harmonization is slow

Fragmented OT landscape

- Heavy on integration, too many vendors, “shop floor to top floor”
- MES must be as reliable, secure and real-time as process control/automation
- Data, application functionality and infrastructure need streamlining

IT/OT convergence and data acquisition

- Unconstrained redesign of key business and work processes for high performance and output
- Standardize master data and data collection functionality
- Leverage communication standards
- Consolidate across sites (ex. private cloud)

Disruptive digital technologies adoption

- New operations model to fully leverage AI, IoT, 5G
- Integration between planning, scheduling and daily execution systems

Getting ahead of roadblocks for smart manufacturing

There are five key areas manufacturers must consider as they chart a path forward.

ROI

- Key use cases and KPI drivers identified with users
- Total value of use cases calculated and agreed upon
- Cash flow and financials for both benefits and cost detailed

Funding

- Funding mechanism identified and incorporated in ROI
- Initial implementation often required centralized funding
- Value of scale needs to be included

Segmentation

- Not all plants are the same or need the same capabilities
- Plants often need to be segmented
- Standard designs developed by segment

Change management

- Persona-based use cases to encourage easy adoption
- Criteria and tools for measuring success
- Governance and program management

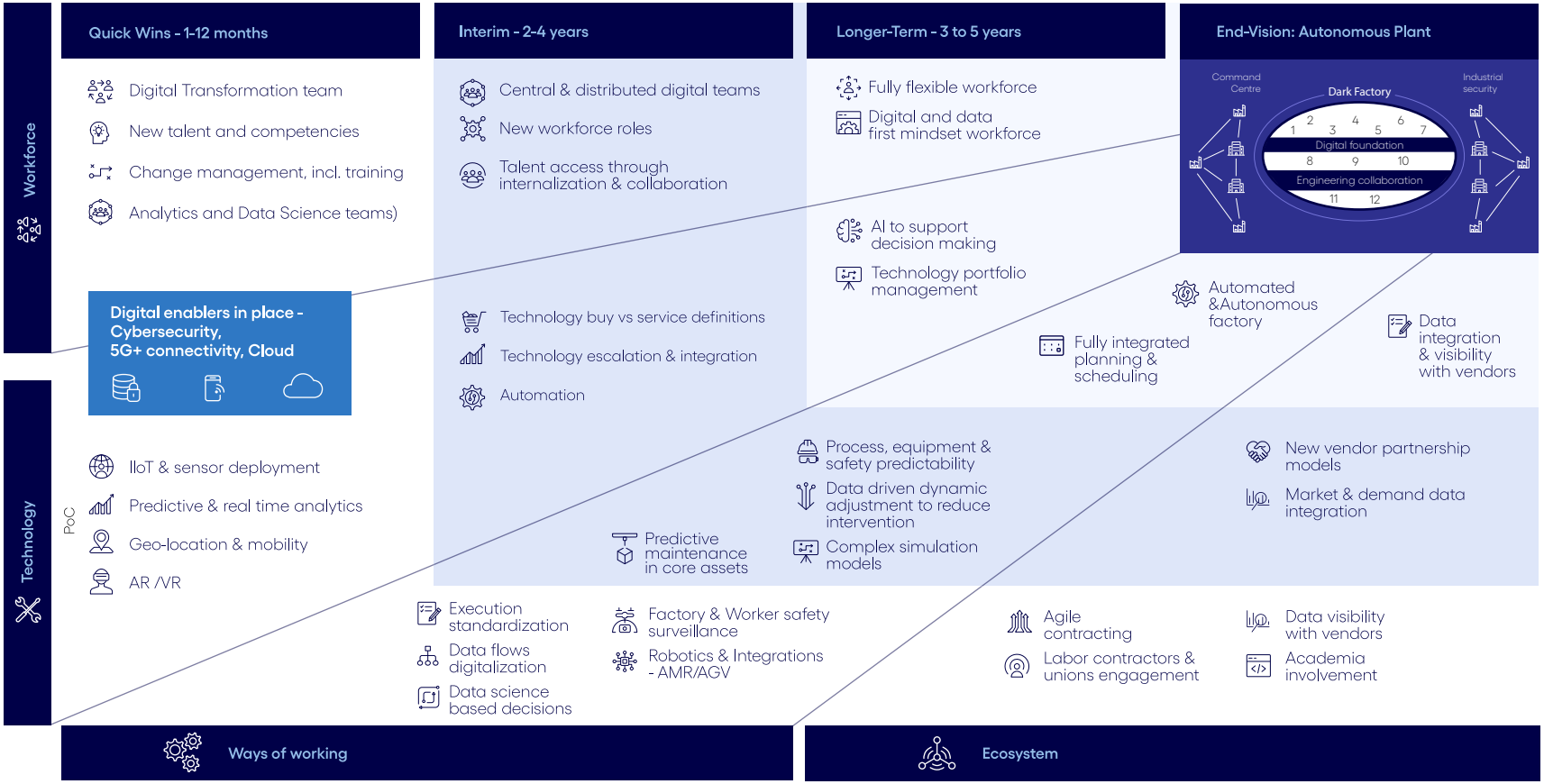
At-scale deployment

- Integrated, scalable architecture with agile dev and deployment model
- Small-scale pilots to develop reusable solutions at scale
- Standardized infrastructure and support processes

A step-by-step evolution to the future

Evolution to autonomous plants

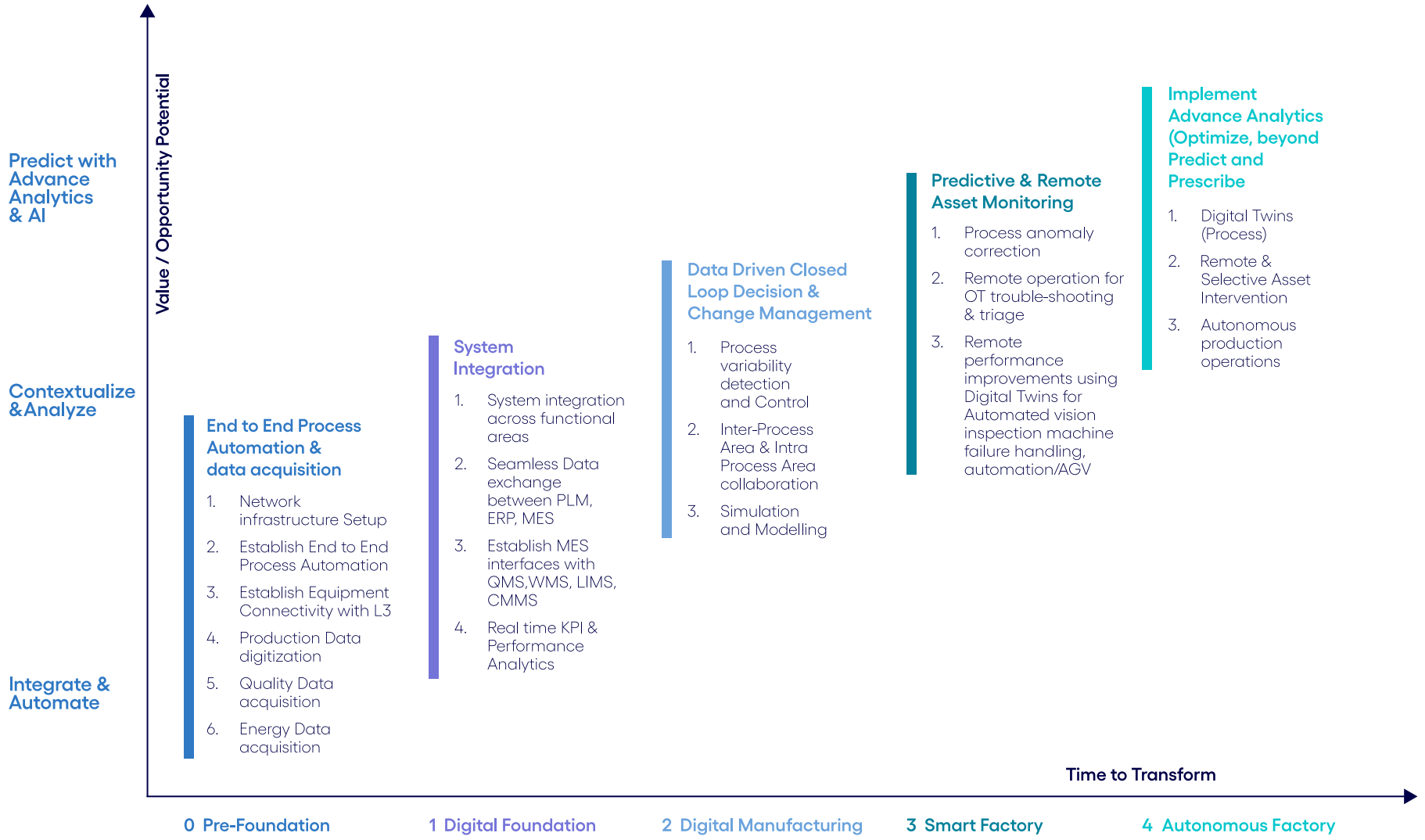
Autonomous factories make safe and secured decisions in real-time through automating the operations using advanced technologies like artificial intelligence, internet of things, and robotics.



1. Digital Safety Energy Management
2. Mobility & Pervasive Wireless
3. Digital Production System
4. Operations Analytics & Process Monitoring
5. Sustainability
6. Advanced Technologies
7. Intelligent Automation & Control
8. **ISA-95 Level 1** Device 1/0 & Controls
9. **ISA-95 Level 2** Automation Systems
10. **ISA-95 Level 3/4** Mfg. Ops & Execution & ERP
8. Talent Develop & Learning
9. Data management

Dark Factory
Contract MFG

Finding your organization on the maturity curve



From digital foundation to digital manufacturing

The goal at this stage is to move beyond connect, integrate and automate, to begin contextualizing information to minimize cycle times, eliminate paper and manual tasks, and improve speed to decision.

System Integration

1. System integration across functional areas
2. Seamless Data exchange between PLM, ERP, MES
3. Establish MES interfaces with QMS,WMS, LIMS, CMMS
4. Real time KPI & Performance Analytics

Data Driven Closed Loop Decision & Change Management

1. Process variability detection and Control
2. Inter-Process Area & Intra Process Area collaboration
3. Simulation and Modelling

1 Digital Foundation

2 Digital Manufacturing

From digital manufacturing to smart factory

The goal at this stage is to continue to leverage technology for speed, efficiency, quality and safety. Harmonized processes exist across the organization, and advanced technology is leveraged to its fullest extent.

Data Driven Closed Loop Decision & Change Management

1. Process variability detection and Control
2. Inter-Process Area & Intra Process Area collaboration
3. Simulation and Modelling

Predictive & Remote Asset Monitoring

1. Process anomaly correction
2. Remote operation for OT trouble-shooting & triage
3. Remote performance improvements using Digital Twins for Automated vision inspection machine failure handling, automation/AGV

2 Digital Manufacturing

3 Smart Factory

From smart to autonomous

In this phase, organizations benefit from extended supply chain integration, remote operational capabilities and predictive/autonomous decision-making.

Predictive & Remote Asset Monitoring

1. Process anomaly correction
2. Remote operation for OT trouble-shooting & triage
3. Remote performance improvements using Digital Twins for Automated vision inspection machine failure handling, automation/AGV

Implement Advance Analytics (Optimize, beyond Predict and Prescribe

1. Digital Twins (Process)
2. Remote & Selective Asset Intervention
3. Autonomous production operations

3 Smart Factory

4 Autonomous Factory

The future in action

While autonomous plants are years away for most manufacturing organizations, circumstances have pushed some organizations there today. Such was the case for a global network of greenfield cold chain warehouses.

The challenge:

With 8% of the US food supply chain passing through our client's cold chain warehouses, speed and efficiency were paramount. The organization was leveraging seventeen different warehouse management systems, WES and WCS systems amongst many different equipment providers. Plus, they had acquired 45 warehouses in the last few years. This led to a labor-intensive operation in sub-zero temperatures creating employee retention challenges.

The solution:

Cognizant provided system design, architecture and development across edge, cloud and enterprise.

- "Automation-OS" was developed as the foundation for integration of all automation
- Computer vision now scans every pallet to monitor all incoming inventory
- Machine learning determines the best location to store pallets—limiting excess moves
- AMRs and AGVs are increasing productivity
- Digital twins are used for modeling layout design and dynamic routing
- The solution is integrated with logistics and fleet management solution

The results:

Our autonomous plant solution enabled a **97%** automated product movement for the **48** inbound-outbound lanes of **225** trucks handling **5,000** pallets in-out per day. The average idle time per truck driver? **<60** min per day. Additionally, **18** overhead cranes move **50** pallets per hour to maximize storage capacity within a **62,000**-pallet position capacity. And we optimized energy consumption estimated to be a **23%** reduction in **2** years.

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