Manufacturers
ALLIANCE
FOUNDATION

Legacy Systems & Digital Transformation

A Guide for Faster Evolution

SEPTEMBER 2024

Introduction

U.S. manufacturers are staying the course on digitalization. Despite concerns about economic volatility, they continue to invest. According to Manufacturers Alliance's **June 2024 CEO survey**, 45% of CEOs expect spending on infrastructure and facilities to increase by more than 10% over the next 12 months. When it comes to technology and automation, more than a third (34%) expect more than a 10% increase in investment.

There are brand new factories being built, but the bulk of the focus is on existing facilities, which have been successfully pushing out quality products for years and still contain valuable equipment and machinery. That legacy gear, amounting to some **$2.65 trillion in assets** according to the National Institutes of Standards and Technology, is still functional and remains at the heart of day-to-day production in the United States.

In many cases, the adage, "If it ain't broke, don't fix it," is apt, especially when uptime is paramount and the appetite for experimentation is minimal. As one consumer packaged goods manufacturing executive told us, "We have equipment that is rather old. I mean, mechanically these machines go back to the 1960s and 70s. The control systems have been upgraded a few times over the decades, but some of those are still quite old." While this equipment still works, the benefits of digitalization are getting harder to deny, especially as best practices accumulate from early adopters. In addition, the triple pressures to do more with less, gain more insights from data, and avoid being blindsided by disruption all point to the need to bring legacy operations into the digital age.

To gain a better understanding of how manufacturers are tackling this widespread challenge, Manufacturers Alliance partnered with **Siemens** to

tease out the toughest aspects and identify successful strategies that manufacturers are using on the ground right now to achieve faster results. Our research included a survey of almost 200 U.S.-based mid-cap to large-cap manufacturing companies representing a variety of company sizes and industries. We also spoke one-on-one with manufacturing leaders about successful strategies for legacy operations.

Adopting more advanced technology brings its own set of hurdles to people, production, and processes. This is especially true in today's environment of rapid technological change. When we asked manufacturers to rank the challenges of managing technology upgrades as advances continue, concerns about budgets, security, talent, interoperability, and complexity topped the list.

These challenges are often interconnected. "When it comes to legacy equipment, it's never a one-topic conversation," Philip Vita, Technical Director at **Procter & Gamble** explained. "What is the cost to upgrade, and does

it make sense to spend money on a control system that is this old? Is it time to do a refresh because of obsolescence or are there safety improvements and

> "No matter what the pilot is, it's always important to start it knowing what success looks like and when you have reached it. That way, it is clear when to move forward or not."
>
> **– Heavy equipment manufacturer**

other operational benefits? It quickly becomes a larger conversation about how you're managing the lifecycle of your equipment. That digital capability is just another factor in the overall decision," Vita continued.

Top 5 Concerns About Technology Upgrades

#1
Budget constraints hindering timely upgrades

#2
Balancing security concerns with the need for technological advancements

#3
Limited availability of skilled workforce for emerging technologies

#4
Concerns about the compatibility of existing systems with new technologies

#5
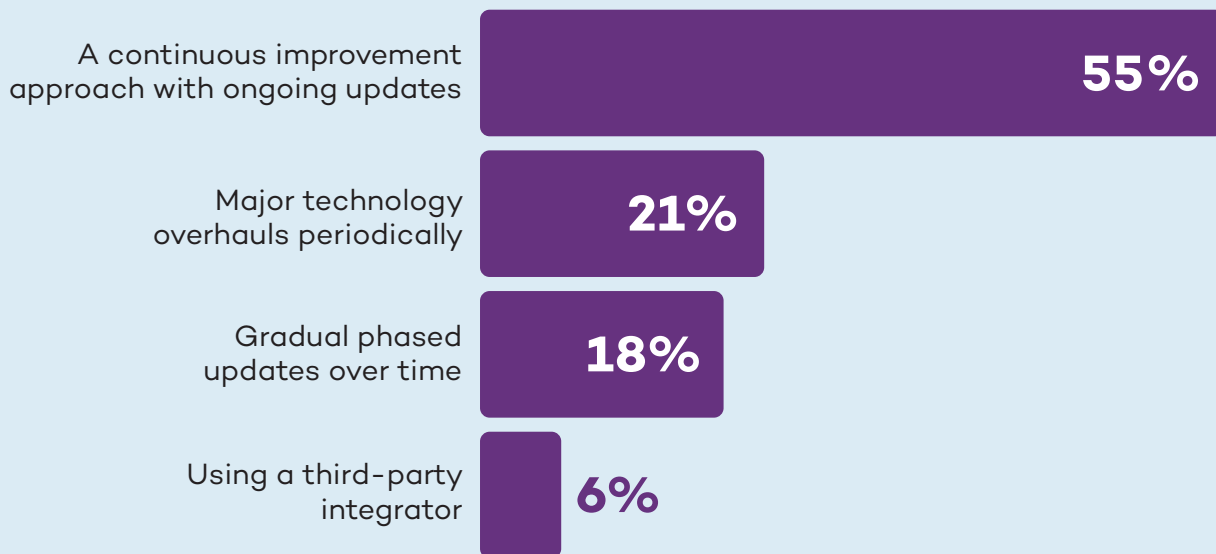Managing the complexity of integrating diverse technologies

Source: Manufacturers Alliance Foundation study 2024

Companies are choosing their battles in terms of the timing and type of technology to deploy. Most (55%) take a continuous improvement approach with ongoing upgrades, according to our survey. A great example is the work of mining leader, **Freeport-McMoRan**. To increase its copper production, the company had the choice of opening a new mine—an expensive and decade-long undertaking—or improving output at its mature mines with their aging technology. Freeport opted for the latter approach using a combination of AI and advanced analytics. They quickly achieved a 5-10% production improvement building on their existing data. As Cory Stevens, President of Mining Services put it, "...[I]f we do the implementation at all seven of our sites right, it's almost **like having a brand-new plant** without having to go through the permitting process and disturbing a new area. It's in the billions of dollars that we're offsetting by going through the transformation."

Only a minority (21%) of companies we surveyed take on the daunting task of major overhauls periodically. The rest are following a gradual, phased approach, sometimes working with a systems integrator. Change can sometimes be perceived as the enemy, especially in plants where employee pay is directly related to uptime. "Don't experiment with me," is the sentiment, one manufacturing CIO told us. "Our plant people are compensated on a pay-for-performance rate. So from their perspective, anytime anything is down, they're not getting paid."

Organizational Tactics for Managing Technology Upgrades

Tactic	Percentage
A continuous improvement approach with ongoing updates	55%
Major technology overhauls periodically	21%
Gradual phased updates over time	18%
Using a third-party integrator	6%

Source: Manufacturers Alliance Foundation study 2024

Strategies for Funding

Timely and sufficient funding depends on the ability of the manufacturer to see the value that investments will bring in the near and long term. As one quality leader in durable goods manufacturing told us, the pace of technological change is just too rapid for his company's investment approval cycle. "By the time you figure out the software you want and get it through the system to start utilizing it, it is no longer valid."

How to measure a return on investment (ROI) can be a challenge in itself. Many operations professionals lack experience in measuring the business value of their technology investments because their focus has been on solving engineering problems rather than business problems. Manufacturers told us that measuring ROI is the top issue they face when determining the right approach to digital transformation. (See our companion research, "**Digitalization Gains: Manufacturers Forge Ahead with Digital Transformation**" for more information on ROI challenges.)

Another facet of the funding challenge results from the splintering of investments across too many parts of the organization. When companies spread resources too thinly across multiple, disconnected activities, the result can be "a lot of activity, but not much value," which **McKinsey identifies** as a common problem among companies. This is especially true in organizations that roll out pilots without clear definitions of success and failure.

It can be tricky to find the right balance between huge investments that may create waves of disruption and small investments that generate activity but no value. A Goldilocks scenario is emerging in the form of software-

as-a-service (SaaS) which combines edge and cloud computing with SaaS. Rather than deploying enterprise-scale integrations and unnecessarily broad licensing agreements, manufacturers can expand in small segments as needed. With this approach, companies can leverage a new economic paradigm for their technology investments, get more life out of their existing machinery and automation, and move forward with digitalization at a pace that is relevant to their business.

Panasonic Corporation is using SaaS as a way to enhance what the company calls PX (short for Panasonic Transformation), its group-wide digital transformation strategy. The goal is to accelerate digitalization in product development and design. Using the SaaS nature of the Siemens Xcelerator platform, Panasonic is migrating legacy IT assets and traditional on-premises data management to the cloud. As a result, Panasonic expects to reduce IT infrastructure maintenance hours and total cost of ownership while also accelerating secure access from a variety of device types across its locations around the world. Panasonic CIO Hideyuki Miyazaki views the expansion of its digital transformation as a way to "enhance our market competitiveness and increase our enterprise value."

Funding Strategy Tips

>> **Create a formal business case for the project.**

>> **For pilot projects, define success before the pilot starts and include provisions for additional budget when the pilot is successful.**

>> **Consider SaaS options to get more value out of your legacy machines.**

Strategies for Security

Cybersecurity concerns remain a key obstacle to embracing advanced technologies. As the **2024 report from IBM Security X-Force** reveals, manufacturing is the number one target industry for hackers for the third year running. Its share of attacks has grown for five straight years culminating in 26% of attacks in 2023.

Outdated technology can be more vulnerable to attack, especially if software patches are no longer available or not feasible to install. At the same time digitalization brings its own set of concerns since the manufacturer's attack surface increases as connections proliferate.

Manufacturers have made significant progress in terms of prioritizing cybersecurity as a business risk. As we reported in our November 2023 **cybersecurity report**, the vast majority of companies are implementing new

> **"In some cases, our devices are 20 or 25 years old, and the manufacturer no longer supports the product."**
>
> **– Global Cybersecurity Director in the Off-Highway Vehicle Industry**

solutions to address the cybersecurity risks to their operational technology (OT). Security audits are a regular part of the OT purchasing process for most companies as are monthly or quarterly assessments of existing equipment.

Ensuring that legacy systems remain secure as digitalization increases requires special attention to segmentation, including hyper-segmentation of legacy machines. One manufacturing IT executive summed it up nicely: "You can't say you're secure if you've secured everything except for those two machines in the corner that have never been patched."

Maintaining a solid grasp of changing regulatory requirements is essential, especially since new Securities and Exchange Commission cybersecurity regulations came online in 2023 and 2024. Useful guides and templates are also available within **The National Institute of Standards and Technology's Cybersecurity Framework**.

Security Strategy Tips

>> **Perform IT and security audits as part of the OT purchasing process and audit existing equipment on a monthly or quarterly basis.**

>> **Consider a hyper-segmentation approach for legacy machines.**

>> **Monitor reporting regulations and consult the NIST Cybersecurity Framework for best practices.**

Strategies for Talent

The skilled talent shortage inevitably comes into play in the digital transformation journey. The good news is that advances in innovation are starting to help companies fill the skills and experience gap. A great example is the use of industrial-grade generative artificial intelligence (AI) chatbots. As detailed in our recent **AI report**, most manufacturers have already deployed virtual assistants for their teams to make up for lack of training or experience. **Andreas Schick**, Chief Operating Officer of Schaeffler AG, said "artificial intelligence can already be used in production today. With [Siemens Industrial] Copilot, we are providing our experts on the shop floor with an innovative digital tool, which simplifies their work and significantly increases their efficiency."

Software-defined automation is another way to address the talent shortage. Virtual programmable logic controllers (vPLCs) that remove the manual process of deploying hardware, setting parameters, and maintaining assets are changing the game for manufacturers. By downloading a virtual PLC, they can manage their controllers remotely.

Through this type of architecture, if a technician is unavailable at a particular plant, it is possible to manage a controller needing attention, such as running improperly or not running at all. Through a virtual controller, the technician at a central location can get the machine running again. This approach effectively brings the IT model to the OT environment by using the IT delivery model.

Adding more digital technology to the existing equipment on the plant floor raises the question of where to find and how to pay for the talent for integration and support. As Greg Geihsler, Technical Director at Procter & Gamble, put it, "The equipment cost itself is sometimes not that significant, but the integration and support required for hundreds of pieces of machinery significantly impacts operating costs and complexity."

Talent Strategy Tips

>> Stay current on the latest AI use cases, such as virtual assistants, to bridge the skills gap.

>> Consider a virtual control architecture to manage equipment remotely.

>> Think through the talent implications of integrating digital upgrades at the machine level, especially if multiple lines and locations are involved.

Strategies for Interoperability

Interoperability becomes a key concern because so much of the digital transformation involves threading together an Industrial Internet of Things (IIoT) that previously operated relatively independently. In some organizations, each line or plant manager can independently decide on technology for their line. "It used to be pretty random based on whatever the local manager decided," one executive told us, adding "I don't think there was a strategy, and technology investments were completely decentralized. Obviously, this made it hard to have a holistic digital strategy."

Even at companies that have adopted more centralized control over technology purchases, older systems present interoperability challenges because many were not designed for that purpose. What's more, machines may run on proprietary protocols and outdated software that make integration difficult. The problem is compounded in environments where equipment from multiple vendors is present. Greg Geihsler of Procter & Gamble explained the challenges of centralizing data across machines, factories, and global locations. "How do you get all that data from very dissimilar equipment within the same site? We're trying to think about not just my equipment but all equipment which could be from Rockwell, Siemens, or even really old TI (Texas Instruments) stuff. They all use their own special protocols, some of them very old."

Many manufacturers are solving the interoperability problem by adding an edge device on the machine layer and sending encrypted machine data to a public, private, or hybrid cloud. In the cloud, data from multiple machines and locations can be analyzed, delivered to dashboards, and benchmarked against historical in-house data or industry standards. "The edge device gives you that flexibility. You have a small PC that can talk to that PLC system, aggregate the data and then serve it up to whatever system we're using," Geihsler added.

Edge devices require a minimal level of digitalization. "Where the data is coming from plays an important role," Geihsler pointed out. "In the case of old-style, analog pressure gauges or flow meters with a little ball floating in a tube, you would have to replace those devices with new modern digital sensors and add wiring at the machine level. There may not be room for these in the cabinet, the machine, on the existing IO rack, or in the PLC memory. You can have a snowball effect, so you really need to look at everything on a case-by-case basis to understand the true scope of rolling something out." Geihsler explained.

Tackling legacy systems is not a hardware and software matter alone. Processes play a huge role in the way machinery is utilized in production. Moving into the digital world means digitalizing processes, and in many cases, simplifying them. Manufacturers must decide whether they update their processes as a first step in the digitalization journey or take the opposite approach

Interoperability Strategy Tips

>> Create dashboards for a holistic view of machine health, energy use, and overall productivity.

>> Eliminate artificial barriers between legacy machines with a cloud-based solution. Consider a lift and shift approach.

>> Make collaboration among teams a priority by eliminating organizational barriers to inhibit interoperability between functions. Build a compelling story around why, what, and how.

– the so-called "lift and shift" – and bring existing processes and applications into the cloud as a first step.

Lift and shift has been the approach taken by **MSA Safety** as part of its multiyear digitalization journey. As Dr. Heiko Will, Chief Digital Officer at MSA Safety, explained it, "You can start with all of your processes first and think about how to digitalize them, but this can take a very long time. Or you can do it the other way around – lift and shift existing processes and software without even touching them. Just put them in the cloud, so that you achieve a certain digital level and start creating value on the gathered process data. After they are in the cloud, this is where you can work on changing them. It might seem counterintuitive, but in our case the goal was to start improving as quickly as possible. We increased access to data, broke down silos, and definitely lowered our operational costs. We have a culture of continuous improvement, and for us, the lift and shift approach works well."

Any discussion of interoperability would be incomplete without addressing the role of collaboration across a set of functions that have historically been quite separate. As Jeff Kent, Vice President of Smart Platforms Technology and Innovation at Procter & Gamble put it, "You're dealing with technology but you're also dealing with people and capabilities, human psychology, and our acceptance and resistance to change." He also emphasized the importance for how leaders communicate the transformation: "When we think of smart manufacturing and smart platforms, you have to get to the 'golden circle' of why, what, and how. Our collective job is to build a compelling story around each of these so everyone in the business understands how the technologies and the transformation will contribute to our goals and vision in a more effective way."

Sustainability Goals

BorgWarner was able to meet sustainability goals for reducing energy intensity at its plants. The goal was to "analyze and implement energy efficiency projects at the plant level by understanding current energy consumption, calculating reduction potential, and costs." After making public commitments to reduce energy consumption, they ran into challenges pulling shop floor data from more than 70 manufacturing facilities. BorgWarner originally expected to need a few years to gather data from the machines at these plants. Working together with an ecosystem of partners, BorgWarner was able to shorten this time frame to fewer than six months. The results speak for themselves: BorgWarner posted its third consecutive year of reduced energy intensity in 2023.

The Lift and Shift Approach

The conventional wisdom is that processes and applications should be optimized before they are digitalized. The opposite approach is to lift and shift by rehosting an application and its data in an as-is condition to a public or private cloud. Immediate benefits include faster migration, more flexible storage options, and a shift of budget from capital expense to operational expense. The IBM website offers more information about lift and shift benefits.

Strategies to Address Complexity

Many manufacturers are concerned about managing the sheer complexity of the digital transformation. When done right, it represents no less than a fundamental reinvention of the business involving the rethinking of supply chains, products, production, processes, talent strategies, distribution, logistics, customer experiences, and more.

Determining where to start can be daunting. This is why so many companies get stuck in the phase of solving isolated problems and an endless series of pilots. This phenomenon is well known in the world of digital transformation, and it is reappearing as companies explore new use cases in AI. Once again, the focus is on singular pain points and individual AI applications versus fleets of AI applications that are orchestrated to perform collections of tasks. Pockets of brilliance may emerge in one location or department, but they will remain isolated unless organizations can find ways to scale up and deploy that brilliance across the enterprise.

Overcoming this complexity may require collaboration beyond the walls of the company, but many manufacturers struggle in developing these types of connections. As we detailed in our companion research, "**Digitalization Gains**," manufacturing lags other industries in terms of creating ecosystems due to difficulty in finding the right collaborators, integration challenges, and lack of awareness of ecosystem benefits.

> "**We need an ecosystem approach to narrowing the growing divide between those that can harness the value of smart manufacturing (large manufacturers) and those for whom the current cost and complexity have rendered it largely inaccessible (most small and medium manufacturers.)**"
>
> **– CESMII Website**

Getting started with an ecosystem might be as simple as visiting a testbed at one of the Manufacturing USA institutes, such as **CESMII** or **MxD**, which convene manufacturers, solution providers, academic institutions, and government agencies to further the mission of advanced manufacturing. There is a special emphasis on democratizing smart manufacturing knowledge and making advanced digitalization and AI approaches available to companies of all sizes so that the United States becomes a more competitive manufacturing location globally.

Procter & Gamble recognizes the importance of ecosystems and works with organizations such as CESMII, the **OPC Foundation**, and technology partners such as Siemens and Microsoft. As Jeff Kent of Procter & Gamble mentioned during a **recent panel discussion**, "P&G's mission is to create superior products in the market. To do that we need a superior supply chain that does that in the most progressive way possible."

Addressing Complexity Tips

>> **Find ways to expand pockets of brilliance beyond a single line or factory.**

>> **Make legacy assets more valuable by adding intelligence at the control level.**

>> **Take advantage of the strength of ecosystem to reduce complexity and make progress at scale.**

Kent reflected on the choice to work in an ecosystem versus relying on strictly internal resources. "When we started the smart platforms journey, we certainly had the internal technology and capabilities, but these products, services, and technologies need to have longevity and be healthy in the long term. Our objective is to do this at scale to unlock significant value, and to do so we have to combine the best of our knowhow and understanding of the problems we want to solve with the very best technology partners."

Conclusion

Manufacturing is moving forward to modernize its legacy infrastructure and bring it into the digital age. Rather than a rip-and-replace approach, companies are increasingly finding ways to do more with their existing assets. The virtual PLC, AI chatbots, more intelligence at the control level, and cloud-based analytics are just a few examples of advances helping manufacturers address funding, security, talent, interoperability, and complexity concerns.

Manufacturers will never adopt technology just because it is new, especially considering the value of legacy assets that may have years or decades of life in them. Innovations must be relevant to real-world manufacturing needs. Increasingly, those needs require a holistic view of the entire manufacturing value stream.

Convergence between IT and OT is a prerequisite for this holistic view, but the blurring of lines will not stop there. Ecosystems that include suppliers increasingly deliver a competitive advantage for manufacturers. Even more powerful are ecosystems that tap into the customer experience, especially in industries tightly coupled with consumer trends, such as automotive, food and beverage, and consumer packaged goods.

Whether they are building new factories full of cutting-edge machinery or revamping existing plants with bridging technology, it is clear that manufacturers are working toward digitalization. The pace of change will vary, and each installation will require a different approach, but the trend lines point toward progress making the sector more productive, technology-relevant, and attractive as a place to work.

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