PRIVATE EQUITY PERFORMANCE IMPROVEMENT

Factory of the Future: Technology Early Wins

This is Part 2 of a series on manufacturing in a new economic and digital landscape. **Read Part 1 here.**

In our previous article, "Factory of the Future: Paving the Way to Industry 4.0," we highlighted the need for a practical approach to Factory of the Future (FoF) initiatives. Defining a strategy that identifies low-cost, high-impact opportunities in the value stream is essential for securing quick wins and establishing a foundation for long-term goals.

Across industries, factories early in their FoF journey face common challenges, including:

1. Lack of accessibility to ***trustworthy production data***, which hinders management's effectiveness at increasing production and lowering costs;
2. Challenges with ***defect detection*** and subjectivity in quality acceptance decisions, creating excess waste and in some cases allowing defective product to escape downstream; and
3. Reactive approaches to ***critical asset maintenance***, resulting in lost production time and high operating costs.

These issues often disrupt daily operations but can be addressed with simple, cost-effective and low-risk technologies. Implementing low-effort, high-return technologies builds early momentum and stakeholder confidence, enabling bolder, long-term investments that can accelerate the early FoF journey.

How Can Companies Use Technology to Address Common Challenges?

Simple FoF technologies can help solve each of the primary challenges faced by factories early in their journeys. Though there are a variety of hardware and service providers that can support FoF efforts and mitigate the challenges factories face, each factory will experience individual pitfalls and opportunities. As such, some approaches and technologies may be a helpful starting point to uncover low-cost FoF solutions that fit the specific needs of each factory.

1. Accessing Trustworthy Production Data

The Problem:

When production lines miss targets, leaders need clear insights into the causes. Outdated equipment, limited technical expertise or overstretched management can make it nearly impossible to gather actionable data. However, relying on anecdotal operator feedback often leads to misguided assumptions or investments in ineffective solutions. Without objective data, efforts to improve performance may result in costly measures like overtime, unnecessary capital expenditures or outsourcing.

The Solution:

Thanks to the advancement of FoF technology, extracting real-time production data no longer requires extensive programmable logic controller (PLC) programming, IT network support or original equipment manufacturer (OEM) service technicians. For a few thousand dollars, standalone hardware can be deployed in a matter of hours that tracks production counts, captures operator input on root causes and analyzes the data to allow managers to act quickly and effectively.

Case Study: Output Tracking Tools

A Midwest client struggled with on-time delivery for a key customer due to frequent stoppages across multiple liquid-filling production lines. Output was only tallied at shift end, which left managers unaware of downtime causes. A cost-effective solution — $50,000 total and less than $5,000 per line — used photo eyes, barcode scanners and a standalone data hub to track output. When bottlenecks occurred, operators scanned predefined downtime reasons, including maintenance, quality or material issues, and managers received instant alerts. This visibility enabled root-cause analysis and preventive measures, improving on-time delivery by 78% within five months.

2. Standardizing Quality Inspections

The Problem:

Many factories depend on manual quality inspections, creating challenges like labor dependency, subjective pass/fail decisions and delayed defect detection. Post-process inspections lead to costly rework while training and documentation struggle to keep pace in high-turnover or low-experience environments. This increases scrap rates, late defect detection and the risk of defective products escaping to customers.

The Solution:

If quality checks — including machining fixture fit checks, first-piece inspections and tooling calibrations — can be performed prior to processing, defects can be prevented. Process control sensors can be a low-cost solution to proactively detect leading indicators of quality issues. As an example, processes particularly sensitive to environmental factors, like temperature or humidity, can have sensors installed that trigger warning lights or messages to notify operators when the plant is approaching a critical threshold. As another example, computer numerical controls (CNCs) can be equipped with tool-life detection monitors that calculate whether a cutting tool is nearing its end-of-life before it catastrophically fails and damages a production part.

Post-processing can also be automated and improved with low-cost solutions. For example, the combination of high-resolution cameras and AI software has allowed manufacturers to visually detect in-process defects beyond the capabilities of a human inspector. These cameras can be mounted within the machine itself and detect defects at line rates far beyond the human eye's capabilities. AI software, when properly trained, can then provide objective analysis and defect detection, minimizing the subjectivity that can result from variations between each inspector's experience and training.

Case Study: Climate Control Sensors

A musical instruments manufacturer was seeking improvements to boost financial profitability within its guitar manufacturing division. The plant had been plagued by scrap within its paint process since the aesthetic importance of the product required the reworking in the presence of even small imperfections. The true root cause of paint defects was considered elusive, though it was loosely understood that environmental factors played a large role in paint quality concerns.

By implementing low-cost sensors to determine temperature, humidity and air quality throughout the plant, the team was able to quickly correlate a trend between poor environmental conditions and an increased volume of paint defects. The plant team invested in infrastructure to better control the climate and air quality, resulting in a 22% increase in output and a 56% improvement in the paint process' first pass yield. This generated over $2 million in annual contribution margin to the plant, with the upfront investment only costing a fraction of the savings.

3. Detecting Critical Asset Failures Proactively

The Problem:

A shrinking pool of skilled maintenance workers has left teams understaffed and focused on break-fix cycles, with little capacity for preventive or predictive maintenance. This is especially costly for asset-intensive or continuous-flow operations, where unplanned failures lead to lost production, reduced labor efficiency and expensive recovery efforts. Despite the costs of unplanned maintenance downtimes, shifting to proactive maintenance often feels daunting without a clear strategy.

The Solution:

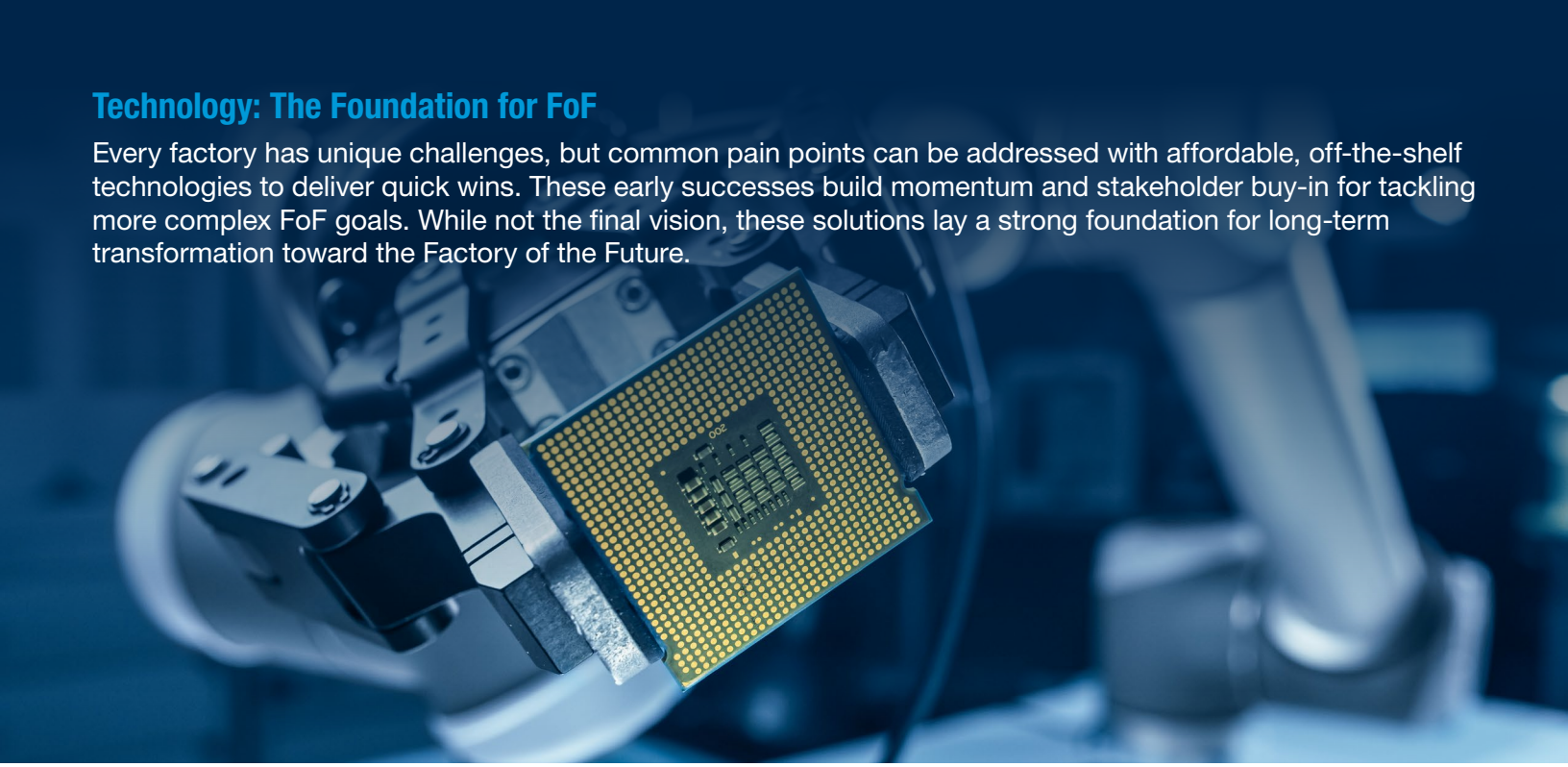
The key to 'climbing out of the trench' is reducing the maintenance team's overall workload and de-escalating the production urgency behind their activities. Small battery-operated sensors can be magnetically mounted to critical equipment to help predictively detect component failures. These sensors can track leading failure indicators, such as temperature, vibration and fluid pressure, and are often mounted on an asset's component equipment, which can include pumps, motors and gearboxes. With even minimal technical knowledge, an operator can be alerted when a reading spikes from its historical baseline. These sensor setups are often predictive enough to allow an operator to notify maintenance, procure replacement components and schedule planned downtime for repair before a catastrophic or unplanned failure occurs. This can help keep production running consistently and maximize efficient planning and scheduling for the maintenance team — making the greatest use of their hours and lowering costs for the plant as a whole.

Case Study: Total Productive Maintenance

A global pharmaceutical contract development and manufacturing organization (CDMO) faced equipment reliability issues across its five-plant network. Lacking maintenance expertise, the client needed to transition from reactive to predictive strategies. A centralized total productive maintenance (TPM) approach, supported by a computerized maintenance management system (CMMS), enabled best-practice deployment and internet-of-things (IoT) sensor installation for critical equipment. Early pilots projected $3 million to $5 million in annual savings by reducing downtime and improving maintenance efficiency.

Technology: The Foundation for FoF

Every factory has unique challenges, but common pain points can be addressed with affordable, off-the-shelf technologies to deliver quick wins. These early successes build momentum and stakeholder buy-in for tackling more complex FoF goals. While not the final vision, these solutions lay a strong foundation for long-term transformation toward the Factory of the Future.



How Can A&M Help?

Alvarez & Marsal's PEPI team evaluates hundreds of manufacturing facilities annually, identifying opportunities for improvement. Our experience positions us to determine the right technologies and solutions to meet the unique needs of your business and position you for the future. Our supply chain and manufacturing services team specializes in identifying and deploying performance improvement initiatives, such as improving equipment capacity, increasing overall equipment effectiveness, reducing scrap, consolidating footprint and enhancing direct labor productivity, among others. The technologies and use cases above are an extract of some of these experiences.

AUTHORS

Jim Guyette
Managing Director
Dallas, TX

jguyette@alvarezandmarsal.com

Mack Brown
Director
Charlotte, NC

mack.brown@alvarezandmarsal.com

Kelly Flack
Manager
Tampa, FL

kflack@alvarezandmarsal.com

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