A Case for Paperless Manufacturing

Why the time is now and how to plan accordingly

EXECUTIVE SUMMARY

Today's manufacturing environment requires an enterprise that can adapt quickly to opportunities and threats while continuing to operate with great precision within compliance and quality metrics. Many factories are still hobbled by paper-based processes that make it difficult to respond quickly and accurately to change. The volatility that exists across global marketplaces has intensified to new levels not expected to go away – even after the passing of COVID-19. Supply chain disruption is widespread and increasingly common. The time for gaining efficiency and responsiveness is now, and most importantly, it must be implemented effectively to achieve the desired results.

The best paperless strategies are only useful when they provide the right data, at the right time, to support front-line connected workers with accurate work processes and executives with real-time results and metrics. Given that technology projects must deliver results rapidly and cost-effectively, timely implementation is critical. Pre-configured solutions should be sought after that are easy to use, scalable, incur minimal technical debt, and operate as part of a natively digital, open ecosystem to successfully become a paperless, digitally transformed manufacturer.

This paper presents several reasons why it is now critical to start or accelerate your investment in paperless manufacturing, including the benefits manufacturers can achieve, and suggestions on how to make this business transformation both smooth and successful.

Table of Contents

1   WHY PAPERLESS MANUFACTURING NOW?

Paperless manufacturing technology is not new. The benefits are well proven. Yet many enterprises still use manual systems, or manually key in data to spreadsheets, paper forms, whiteboards, and emails to manage their plant processes and operations. There are many reasons for this reluctance to change. The cost to convert, the potential for disruption, and the concern that a paperless project could fail to deliver its intended results.

These are valid considerations. But recent developments have now tipped the scales in favor of now going digital. One factor is that manufacturers have been experiencing a growing disruption in their factories and supply chains in recent years. The trend has only been accelerating. This stress has strained outdated, fragmented, and paper-based management systems to the breaking point. This disruption has only been intensified by the COVID-19 pandemic. The problem, however, has been building for quite some time due to everything from natural disasters to political instabilities. Further, the "new normal" that evolves out of the pandemic will forever change the way business is done. Expectations have adapted, and manufacturing operations management systems must follow suit.

These challenges are especially acute for complex discrete manufacturers that assemble products containing hundreds or even thousands of parts. Typically, these production processes use model-based designs that frequently change driving a need for effectivity far and wide across the value chain, with customers that have zero tolerance for any out-of-specification material, assembly, or product quality metric. This is particularly the case for those operating in highly regulated industries such as aerospace, defense, or medical device manufacturing.

Another factor influencing the decision is the maturity of the technology involved. Paperless manufacturing, implemented with what is typically referred to as a Manufacturing Execution System (MES), is well past the early adopter stage and is proven in many of the world's largest enterprises. It has reached the point where some MES vendors now tout plug-and-play solutions that don't require modifications to work seamlessly with other enterprise applications such as Enterprise Resource Planning (ERP) systems. This can have a profound impact on usability and ROI without overloading IT resources.

For the most part, the technical barriers to paperless manufacturing have been removed. Innovative vendors have created solutions that empower and augment the performance and efficiency of employees who use them. This strategy provides the necessary visibility and control to improve performance while improving the organization's ability to provide more robust decision support across functions, on a global scale.

Finally, the ability to support a remote workforce and workflows today is entirely dependent upon a paperless work environment.

2 A COMPELLING CASE – TODAY MORE THAN EVER

Given that the ability to move to paperless manufacturing is more proven and practical than ever before, and the pressure to improve operational agility has never been higher, the question is not so much why to digitalize now, but why not?

Beyond the pandemic, several other factors have come into play that has further accelerated this transition. Manufacturers are now devoting substantial resources, time, and effort into fueling paperless manufacturing and other digital transformation projects, recognizing that now is the time to act. What many manufacturers have now come to realize is that it is very difficult to work remotely when paper plays a role in how production and quality assurance processes are executed and managed

> **Lockheed Martin Skunk Works is implementing a paperless strategy with an iBase-t MES that went live during the COVID-19 in record time.**
>
> *Read the news announcement here*

What follows is a summary of several factors that have become far greater of a challenge for those manufacturers still clinging on to paper as part of their internal procedures.

2.1 Remote Working

The number of remote workers has been growing over the past few years. This rate of growth spiked dramatically once the global pandemic began spreading. There are many indications these workers will continue to work remotely in the future. According to the U.S. Census Bureau, over the last 5 years, there has been a 44% increase in remote employees[1], defined as those who work from home at least half of the time. Gartner predicts that by 2024 half of factory work will be done remotely.[2] This is not an insignificant trend that can be ignored.

This is happening across industries, including manufacturing. In the wake of the U.S. economic shutdown, many corporations are having employees continue to work from home permanently. They found it can save money and add flexibility. As more workers seek remote employment, businesses must adapt to the demand. Of course, factories will always need workers on the plant floor, but a growing number of managers and decision-makers are working remotely. Continued investment in automation technologies will only further accentuate this trend.

All of this is in addition to the extensive remote communications that are already part of any manufacturing enterprise, both within the four walls of the company and beyond, to external partners and suppliers.

---

[1] *Global Workplace Analytics, according to data from the US Census Bureau*
[2] *Factory Innovation Post-COVID-19, Gartner*

2.2 Climate Change

Call it global warming, climate change, or increasing environmental disruptions, the bottom line is that the weather is now playing a greater role on a wide range of dependent variables impacting production efficiency and timeframes at a whole new level. These disruptions range from electricity availability to supply chain disruptions, among other issues. Even the most severe predictions are falling short of reality. The United States alone could face $2 trillion worth of workplace disruption by 2030[3]. These kinds of disruptions are often sudden, severe, and hard to predict. They're guaranteed to worsen in the years ahead. A digitalized factory with modern paperless systems has the resilience to navigate this threat far better, with less of an impact on business operations or the bottom line.

2.3 Competitive Necessity

With so many forces at work, one would expect manufacturers to embrace paperless operations as a competitive necessity. According to IDC, by 2023 worldwide spending on digital transformation will reach $2.3 Trillion, or half of global IT spending[4]. Manufacturers that use digital technology to transform their factories and enterprises will be able to operate at an elevated level of resiliency, able to predict and survive stress that could bring down manufacturers of the past.

2.4 Worker Productivity

With heightened competitive pressure, employee productivity has never been more important. Paperless manufacturing empowers people to do their jobs better. Frontline workers and supervisors get a motivation boost by having insight into their impact on the enterprise, and the ability to communicate their needs and areas of opportunity to management. This improves performance at all levels of the business. Instead of viewing information from last week or month, top executives can use real-time information to make more educated decisions.

2.5 The Next Generation of Connected Workers

Millennials are 50 percent of the American workforce and by 2025, 75 percent of the global workforce.[5] These workers can be defined as "digitally native," which comes with a set of expectations on how they work and what kinds of leaders they will become. As Baby Boomers continue to retire, these digital natives will fill key management roles. Those businesses that lack a digital infrastructure now expected by digital natives will struggle to attract new workers and leaders.

2.6 Reduction of Errors

Mistakes can happen from duplicate entries, data input errors, using outdated materials, or from an unauthorized action. Regardless the source, by removing paper from these processes will force a stricter adherence to a process or policy as it was originally intended. And, with a digital record of how procedures were executed, when it comes time to performing a root cause analysis or audit, a digital trail provides near-perfect accuracy when compared to a manual process based on paper.

---

[3] *Climate Change and Labour: Impacts of Heat and the Workplace, UN Development Programme, 2016*
[4] *2020 IDC Analyst IT spending market report*
[5] *The (Millennial) Workplace of the Future Is Almost Here -- These 3 Things Are About to Change Big Time, Inc.,*

3 WHAT CAN YOU DO WITH A PAPERLESS FACTORY?

The goal of "going digital," removing manual processes and paper from operations, is to create a digital enterprise that is resilient, so it can adapt and evolve quickly in response to opportunities or threats.

What does paperless manufacturing look like? What can you do with it?

What is Paperless Manufacturing?

This concept refers to the use of software-based electronic systems to monitor and enforce production processes while capturing all information associated with production records.

Consider everyday factory activities. A paperless Manufacturing Execution System detects and flags inconsistencies or problems on the production line so you can fix them quickly. It increases efficiency by coordinating realistic production schedules using raw materials and inventory information, which eliminates the need to reconfigure schedules while waiting for parts to be delivered. It can improve the accuracy and efficiency of employee scheduling to help avoid unnecessary overtime costs or possible injuries. It streamlines communication, so if your purchasing and shipping departments need to know what is available in each facility, they will be able to consult a digital master inventory record that is constantly being updated as production occurs, in real-time.

Furthermore, by going paperless on the manufacturing floor today, enterprises lay the foundation for a fully digital enterprise network of smart factories that operate together across an open, digital ecosystem to connect workers and workflows at all levels across the world.

There are numerous mature, yet innovative applications ready to be deployed on the factory floor. Here are some of the capabilities made possible by paperless manufacturing and, more broadly, digital transformation.[6]

3.1 Supply Chain Management

Manufacturers can use the digital data captured by production and other related systems to better manage a complex supply chain. Those capable of digitizing their supply chain operate at a much higher level by connecting key partners at every tier of the supply chain with a digital ecosystem of collaboration.

3.2 AI & Machine Learning

An MES can provide valuable data about equipment and processes. This data can then be leveraged by Artificial Intelligence (AI) and machine learning technology. Product failure can often be caused by issues not seen by traditional testing. Digital technologies can spot product imperfections that would otherwise get past inspectors. AI can draw from a vast data archive to identify areas that need more testing.

---

[6] *Sources: Analyst and research industry discussion, IBM, MIT Technology Review*

One highly effective use of this technology is predictive maintenance. Taking the guesswork out of machine maintenance and replacing the process with an AI-based system can dramatically reduce downtime. This often involves embedding sensors directly into the factory's machinery to detect irregularities. The benefits of AI & machine learning span from physical aspects, like smart sensors, to complex data-driven computer decision making.

3.3 Data Mining & Analytics

Everyone is familiar with data analytics, but data mining takes the process to an elevated level. Effective data mining is executed by analysis from many dimensions and perspectives; the speed and level of detail provided by modern analytics are unparalleled. An especially important capability in today's volatile marketplace is predictive analytics, where AI can recommend to executives a specific future course of action based on intelligence gained by data mining and analytics.

3.4 Regulations & Governance

Government and environmental regulations can call for intensely detailed investigations into production. When factory operations are no longer paper-based and digitalized, it enables executives to precisely isolate and resolve issues that can arise from varying regulations and compliance issues without needing to shut down large swathes of production lines. It also simplifies and improves the accuracy of reporting, with data available on-demand instead of next week or next month.

3.5 Synchronized BOM Management

Complex products have detailed Bills of Material (BOMs) prone to inconsistencies that can negatively affect product launches, customer satisfaction, and product support costs. Cloud-native synchronization of different BOMs across engineering, manufacturing, sales, and service provides visibility to executives and front-line workers while still allowing each BOM to be labeled and structured differently. A modular approach based on features, instead of individual SKUs, can reduce the complexity of data management. These are streamlined to have the fewest levels possible and can link second- and third-tier suppliers to original equipment manufacturers.

3.6 Digital Thread

A digital thread is the connection framework that allows for data flow and a traceable view of a product's lifecycle, where traditionally the information has been siloed. This can improve product quality by avoiding mistakes in manual translations of engineering specifications along the value chain and improve new product introductions by allowing for communication of engineering changes. By leveraging digital data now available on the product, manufacturers can deliver new services to customers along with the physical product. This could include improvements in preventive maintenance, service contracts, timely product upgrades, and product support.

4 WHAT'S THE NEXT STEP?

Most manufacturers have already computerized and standardized key operations such as purchasing, scheduling, product design, process planning, and production line robotics. The key component that is missing in most enterprises is a standard, automated approach to managing the overall activities of each factory including all the supporting regulatory compliance procedures. Legacy plant systems are widespread in the typical global enterprise, simply because production processes that worked in the past are difficult to give up, including those processes that depend on clipboards and spreadsheets.

Digitalizing the plant floor with a Manufacturing Execution System (MES) connects operations and performance within the factory, as well as with the rest of the company, partners, and suppliers. It's the central nervous system of the digital manufacturing enterprise, and it must be able to integrate seamlessly with all the other systems of a global organization.

Embracing a paperless strategy with an MES is an essential component of becoming a digital enterprise, but not the only one. Many other technologies can be part of a digitally transformed enterprise. Artificial Intelligence, immersive virtual experiences, Internet of Things, digital supply chain strategy, and descriptive analytics can all play a greater role in driving operational excellence across paperless operations as part of a digital transformation.[7] There is no single technology that transforms an enterprise by itself. It is the synergy of systems and the resulting visibility into, and control over, all operations that makes a smart factory part of a transformed enterprise.

---

[7] **Hype Cycle for Manufacturing Operations Strategy, 2020; Gartner**

5   HOW TO DO IT RIGHT

Paperless manufacturing is a significant undertaking, but there are several things you can do to stay on a productive path and ensure a successful outcome.

It's important to look for MES solutions that communicate and integrate easily with business planning, engineering, and each of the other systems already in place. Some vendors will give you a toolkit to build your custom application. While this may initially appear to be desirable, significant amounts of technical debt will result, leading to higher future costs and an inability to effectively add new capabilities down the road.

What is Technical Debt?

Technical debt (aka design debt or code debt) is a concept in software development that reflects the implied cost of additional rework or support caused by not choosing the right technology solution.

A better option is to use a pre-configured solution that can be put to work quickly, helping to avoid placing too much demand on IT resources[8]. This not only provides fast ROI, but it also reduces the potential for technical debt, or not investing in the right technology with your initial solution.[9]

Support and consultation services are also critical. Even pre-configured solutions depend on the resources available at each site across your enterprise. Every situation is unique, and you should expect your vendors to collaborate with you to develop a phased, individualized approach.

Successful productivity improvement projects like paperless manufacturing are not implemented all at once. One way to start by deploying an MES at a single factory, or even a single line within a factory, and then expanding locations and capabilities as your experience and successes grow. Some MES vendors have designed solutions specifically to make them highly modular and resilient. This means that upgrades, local adaptations, and alternative configurations are easy to deploy and manage.

Paperless manufacturing is not a one-and-done project. It is a dynamic process of continuous learning and improvement – and one you will need to work with the right vendors and partners that have the right experience and knowledge while sharing your vision.

---

[8] **Toolkits vs Out-of-the-Box for an MES, by Darrell Sabourin, 2020**

[9] *Why Now is the Time to Cut Technical Debt, Evan Sloss*

6 CONCLUSION

In a volatile market that requires extreme resilience, manufacturers are increasingly turning to paperless manufacturing and other digital projects to optimize operations performance while promoting innovation. Cost optimization, production output, value chain management, product quality, and overall manufacturability require a new level of visibility and control to succeed – now more than ever. Paperless manufacturing provides a means to achieve these capabilities while opening the door to using advanced technologies such as Artificial Intelligence and machine learning to empower intelligent decision support.

The good news is that the technologies to go paperless are mature, proven, and practical for most manufacturers. The bad news is that if you are not well on your way to digitalizing your operations, then you are already well behind the curve.

Today, paperless manufacturing is no longer just a possibility. It is now a necessity. As we see companies fail due to the coronavirus pandemic, it is quickly becoming clear that the value of operational agility, resilience, and intelligent decision support made possible by digital transformation, is about much more than achieving an ROI from investment. It is about economic survival in today's digital age.

About **iBase·t**

iBase-t is the global leader in cloud software for the aerospace and defense industry. Committed to innovation, customer success, and product excellence, iBase-t ensures digital continuity across manufacturing, quality, and maintenance, repair, and overhaul (MRO) operations on a global scale. iBase-t's Solumina Manufacturing Operations Platform is a cloud-native solution that establishes a digital ecosystem to drive innovation and improve operational performance for the most critically complex manufacturers. iBase-t customers include Lockheed Martin, Northrop Grumman, GE Aerospace, Rolls Royce, Pratt & Whitney, and Textron.

The Solumina Manufacturing Operations Platform by iBase-t consists of an integrated suite of MES, SQM, and MRO solutions. Designed for complex, highly regulated discrete manufacturers who seek to digitally transform their operations, Solumina connects manufacturing operations, quality, and sustainment management in a seamless flow of data across the value chain and product lifecycle.

The Solumina Manufacturing Operations Platform creates the technology infrastructure manufacturers need to harness advances in model-based functionality like PMI continuity, Assisted Engineering Changes and augmented reality guidance for the workforce, IIoT connectivity for equipment, new levels of intelligence for decision making, and higher levels of customer and supply chain collaboration.

Learn more at ibaset.com.

Phone:	Fax:	Email:	Website:	Address:
949.598.5200	949.598.2600	inquiry@ibaset.com	www.ibaset.com	26812 Vista Terrace Lake Forest, CA 92630 USA