

RESILIENT EXECUTION

Modernize the shop floor with Manufacturing Operations Management for efficient and resilient manufacturing execution

RESILIENCY RELIES ON RADICAL TRANSFORMATION

TRANSFORMATION DRIVERS IN MANUFACTURING

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With the rapidly increasing pace of innovation and change, manufacturing companies need to be more resilient than ever in their operations. Digital innovation is essential as global disruptions and instabilities impose the need and opportunity for growth amid shifts in supply, demand and customer expectations for digital-first experiences¹.

“**Disruption isn’t about what happens to you, it’s about how you respond to what happens to you.**”

Jay Samit, Serial Disruptor, Bestselling Author and Keynote Speaker


The goal of manufacturing resiliency, driven through digital transformation, is based on agility, flexibility and sustainability. Agility in responsiveness to the unexpected and the flexibility to pivot are essential to enable growth and innovation when opportunities are presented by disruptions. These require a forward-looking mindset and scalable digital infrastructure that supports business goals. Lastly, sustainability refers to resource preservation throughout operations and decreasing global carbon footprint. These elements are the foundation for new innovation and operational improvements to create sustainable, profitable growth.

¹ Betti, Francisco; de Boer, Enno and Giraud, Yves. McKinsey & Company. “Operations Practice: The manufacturers lighting a path to sustainable growth” (March 2021)

This can be achieved through digital transformation. Many manufacturers are starting transformation initiatives in different areas of industrial engineering or the supply chain domain. However, few have addressed the transformation of their shop floors with a modern manufacturing operations management (MOM) solution for their factory of the future. MOM goes beyond traditional manufacturing execution systems (MES) as it involves automating, executing and managing the performance of all business processes relevant to manufacturing execution, which includes manufacturing production (MES), quality, warehousing, the workforce and maintenance.

While it is well recognized that investment in these systems is necessary to stay competitive, the challenge is to determine the right fit that can help you simultaneously maintain high levels of throughput, quality and customer service—while creating opportunities for sustainable innovation.

This eBook illustrates:

-  **Key trends and challenges in manufacturing and operations today, across various industries**
-  **The value of manufacturing operations management (MOM) in addressing these challenges and trends, and in building operational resiliency**
-  **The advantages of a well-formed MOM strategy and critical considerations on the path to transformation**

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Key trends in manufacturing and operations

Modern disruptions in the technology sphere are amplifying the challenges for manufacturers across various industries. This, in turn, raises the urgency for companies to pay close attention to and act on these growing trends to ensure resiliency and business continuity:

Current Business Trends



Re-alignment of operations

Industrial companies are now exploring ways to reduce the risk of supply chain disruptions without sacrificing efficiency by focusing on positioning production facilities where demand is strong. Smaller, flexible plants could be on-shored in different geographies around the world and companies will complement their supply chain initiatives with advanced digital technologies and other actions that drive resiliency, like dual sourcing, revising inventory policies and reducing complexity².



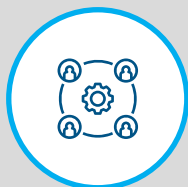
Embracing new business models

From disruptions to evolving regulatory systems, changes will drive manufacturers to restructure operations and infrastructure and adopt new manufacturing models in order to support new products, services and business processes. Key to this are data democratization and the lowering of artificial silos to allow unfiltered access to data that can be mined for new insights³.



Enterprise digitalization

“Digitalization” and “digitization” have often been used interchangeably but are not synonymous. Digitization refers to the process of shifting from analog to digital, whereas digitalization is the use of digital technologies to change a business model and provide new value-generating opportunities. In this context, we are referring to enterprise digitalization. Businesses are transforming every facet of their operations around speed and opportunity response, leveraging a digital-based global economy—leaving behind unresponsive and costly legacy manufacturing environments.



Re-imagining and re-skilling the workforce

Large portions of the manufacturing workforce will need to be re-trained in response to increasing digitization and automation of repeatable tasks. At a higher level, new workers who are digital natives will expect to use smart devices in their roles. Companies that tread water with traditional systems and limited data access will be less attractive to the tech-savvy talent required for future manufacturing success. In fact, IDC anticipates that by 2030, 60% of G2000 manufacturers will address growing industry talent shortages by making significant investments in intelligent robotic process automation⁴.

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² Baumgartner, Thomas; Dhawan, Rajat and Padhi, Asutosh. McKinsey & Company “Advanced Industries Practice: The CEO agenda for companies in advanced industries” (February 2021)

³ Dassault Systèmes, DELMIA. “Transformation Journey Research Note Series: The 7 components to transforming operations” (2020)

⁴ Prouty, Kevin; Slowik, Maggie and Paquin, Reid. IDC. “IDC FutureScape: Worldwide Manufacturing 2020 Predictions” (7 November 2019)

Cross-industry manufacturing challenges

The general sentiment across businesses of all disciplines is that disruption will be part of the “next” normal. In response, manufacturing leaders must consider concerns from an enterprise perspective, the challenges of which revolve around the lessons learned in 2020. As many manufacturers discovered, the disparate, siloed manufacturing systems that permeate their shop floors lack the digital agility to meet today’s business needs, which result in these challenges:

A lack of digital ability to scale and change within and across plants

Inability to remotely visualize or manage plant processes

Relying on multiple vendor solutions for product design and engineering

MES projects can be expensive and time-consuming

Inability to quickly pivot operations based on external events

Difficult and time-consuming re-shoring of operations

Limited capabilities to monitor assets and operations performance



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At the plant level, the tactical challenges are no less important but are equally frustrating, with several conflicting goals to balance for a smooth and efficient production process. Figure 1 highlights some of the questions asked daily on the shop floor of a manufacturer that has not transformed its business in terms of digitalization or manufacturing processes.

Manufacturing Challenges



Figure 1: Plant-level manufacturing challenges

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Increasingly, companies are looking for and realizing the value of more dynamic environments that can change quickly and enable agile operations. In manufacturing, products must now be developed and delivered faster than ever with **greater personalization** and **complex specifications**. To remain competitive and to stay in business, both design and execution systems must be seamless to compress time to market and be 'change-ready'.

According to IDC, the growing trends and challenges are driving significant opportunities in the digital operations space and require new approaches and capabilities:

TEN SIGNIFICANT DIGITAL OPERATIONS OPPORTUNITIES

OPPORTUNITY DRIVERS

- Modernize remote work capabilities
- Remote monitoring and diagnostics of operations and assets
- Heavy investment in process automation
- Remote product services as a key part of product innovation
- Resilient supply chain

OPPORTUNITIES

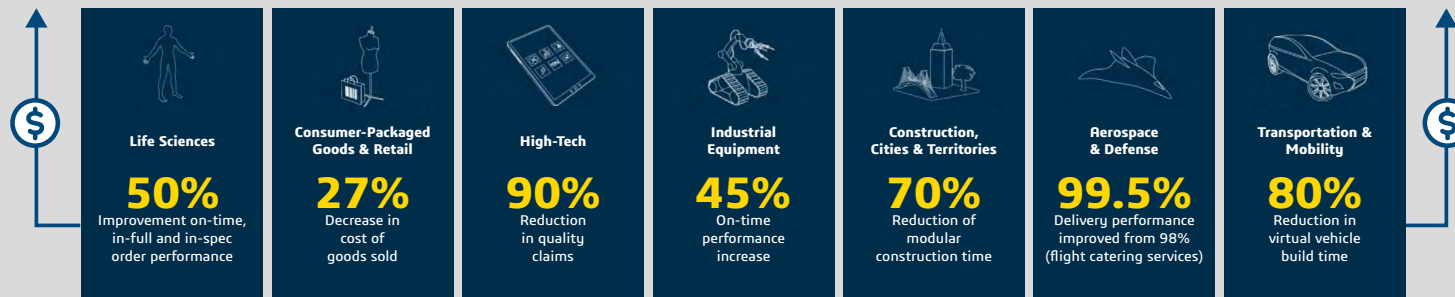
- Collaboration platform
- Connected assets
- AI for decision support
- Remote product performance
- Warehouse robotics
- AI-driven inspections
- IT/OT convergence
- RPA for manual operations
- Service robotics
- Ecosystems and networks

While Industry 4.0 brought automation and incremental change, the vision of a smart, connected factory or Factory of the Future extends previous concepts and creates an opportunity for step change. According to Deloitte Insights, a true smart factory can integrate data from system-wide physical, operational and human assets to drive manufacturing, maintenance, inventory tracking, digitization of operations through the digital twin and other types of activities across the entire manufacturing network⁵.

The Factory of the Future works to enhance the virtual world with operational experience, capturing all data in operations management to be fed into a digital twin. At DELMIA, we go beyond the digital twin with the Virtual Twin Experience— it captures implicit knowledge, know-how and best practices in the plant and shop floor for the current as well as future workforce. This accumulation of information allows the Factory of the Future to be optimized over time as workers grow, change, move into new positions and learn new capabilities.

WHY INDUSTRY 4.0 OR FACTORY OF THE FUTURE?

More efficient and agile system with less production downtime. Greater ability to predict changes in the facility or broader network, leading to better positioning in the competitive marketplace.



Digitalizing your operations not only enables more agile and efficient production, but can also lead to major cost savings. IDC highlights an example of **expected savings** from operational technology investment over a period of three years for a large process manufacturing company:

\$750
million in operational analytics

\$890
million in operational optimization

\$2.7
billion in asset reliability and resiliency

⁵ Burke, Rick; Laaper, Stephen; Mussomeli, Adam; Hartigan, Martin and Sinderman, Brenna. Deloit Insights. "The Smart Factory: Responsive, adaptive, connected manufacturing" (31 August 2017)

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Why Manufacturing Operations Management (MOM) matters

The hunger for transformation among industry players is at an all-time high. But at the same time, organizations want options that include a lower risk approach to digitalizing the shop floor. Currently, manufacturing leaders are seeking new operational directions as they evaluate their organizational crisis performance, planning a strategic course to support re-shoring activities and acquisitions.

The use of isolated, inflexible solutions tied to physical assets and siloed applications that are local and transactional will diminish. Manufacturers who want to seize opportunities created by disruptions should seek a **connected, scalable** and **sustainable platform** approach—one that is collaborative on a global scale, model based and bound only by the imagination and creativity of their employees. That is the definition of the **3DEXPERIENCE** platform and the DELMIA Manufacturing Operations Management (MOM) solution.

Powered by the **3DEXPERIENCE** platform, **DELMIA MOM** creates a foundation for digital transformation that is unified, flexible, scalable, secure and provides real-time availability to critical manufacturing data for responsive decision-making. A strong MOM environment on the shop floor is at the heart of digital transformation as this is where the product, business and operational functions of the enterprise intersect and is, arguably, where a solid digital platform is needed most.



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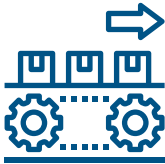

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Though MES and MOM have been used synonymously, the ISA-95 standard has long dropped the MES term, favoring the broader scope of MOM, which, as described earlier, goes beyond traditional MES to include capabilities in Quality, Warehousing and Logistics, Time & Labor and equipment maintenance.

The DELMIA MOM suite offers a solution for global manufacturing operations management. By digitalizing the entire manufacturing process—from design to build to support—our comprehensive MOM solutions enable manufacturers to control and synchronize their operations as a global, best-in-class enterprise. With an emphasis on business process management, unique global management capabilities and robust data collection from any IIoT device, our solution supports multiple manufacturing models from discrete to process and is scalable from the largest of factories to small, niche manufacturers.

DELMIA functional coverage	Capabilities	Advantages
 <p>Production</p>	<p>DELMIA Production offers the functionality needed to support today’s extended manufacturing environments. As an enterprise solution, it easily adapts to simple or complex manufacturing environments. It allows manufacturers to define, control and optimize operations across multiple sites and functions, while still accommodating site-specific requirements. When combined with DELMIA Manufacturing Process Intelligence, DELMIA Production offers unprecedented levels of visibility and control, including Machine Time Analysis, OEE and many other role-based KPI, report and analytics views.</p>	<ul style="list-style-type: none"> • Provides global manufacturing visibility • Boosts operational efficiency • Accelerates New Product Introduction (NPI) • Ability to adapt and shift production to demand across geos, while ensuring process standardization
 <p>Quality</p>	<p>DELMIA Quality brings a unified approach to managing quality assurance and control across all phases of manufacturing operations—and your entire enterprise. It provides powerful tools for managing quality processes and product characteristics against specifications. Standardizing quality processes across your organization and into your product supply network with DELMIA Quality provides enterprise-wide visibility and control over your entire quality management program.</p>	<ul style="list-style-type: none"> • Provides global visibility and control • Enhances genealogy, traceability and containment • Facilitates continuous improvement management

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Warehouse management

DELMIA Warehouse tightly unifies manufacturing operations with warehouse processes. This unique material synchronization between the warehouse and shop floor enables unprecedented coordination. It directs people and equipment to perform warehouse processes, such as put-aways and cross-docking materials directly to and from production based on real-time status, alerts and replenishment policies. Efficiency and operations performance can be improved while removing idle inventory. Monitoring and reporting is provided on activities ranging from the receipt of raw materials to the shipment of finished goods.

- Synchronizes material flows to production in real time
- Improves operations performance and reduces inventory
- Enables a demand-driven enterprise



Maintenance

DELMIA Maintenance provides essential capabilities for maintenance management, including the ability to schedule preventive maintenance, manage maintenance calendars, respond quickly to unplanned downtime and manage parts and spares. It directs maintenance tasks while tracking actual time and labor per maintenance work order and enables supervisors to track workloads while monitoring KPIs such as MTBF and MTTR.

- Synchronizes maintenance across all operations
- Increases equipment uptime
- Improves manufacturing productivity and quality
- Reduces maintenance costs
- Expands maintenance productivity and effectiveness to offline locations



Time & Labor

DELMIA Time & Labor gathers, manages and validates real-time employee time and labor data as collected and processed during the course of daily activities in all operational areas running DELMIA. It makes this data available to easily review, approve and export into enterprise ERP or Payroll systems.

- Optimizes time and attendance tracking
- Enables lean analysis to improve operations by capturing value add and non-value add times
- Eliminates paper tracking and manual data entry

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“ DELMIA is a highly configurable MES/MOM solution that is well suited to discrete manufacturers with multiple factories and manufacturing models distributed around the world.”

Gartner, Magic Quadrant for Manufacturing Execution Systems 2019

On a broader scale, the DELMIA MOM solution is very mature. It goes beyond traditional business process accelerators and functions as a comprehensive and core platform for manufacturing excellence, offering these competitive advantages:

Build on a business process foundation

A key approach to heightening responsiveness while maintaining process consistency and quality standards is establishing a Center of Excellence (CoE) team to configure and distribute process improvements. Together with a global platform for MOM that embeds Business Process Management (BPM), manufacturing leaders can simplify process distribution, governance and monitoring, resulting in greater standardization with less effort.

DELMIA MOM, Global Process Manager, embedded with BPM, helps establish and maintain a CoE, ensuring the greatest operational flexibility to global change. Used in conjunction with a CoE and Global Process Manager, it enables you to effectively manage the complete lifecycle of a process. With real-time visibility and control, you can monitor process governance at every facility—for all manufacturing operations. Beyond improving agility, it enables you to reduce IT costs, ensure brand integrity, ease process governance and accelerate time to value to support shifts in production in response to demand changes.



Democratize your data

Many industry-leaders use operational intelligence to identify opportunities for improvement and cost reduction. Enterprise Manufacturing Intelligence (EMI) helps improve visibility across global operations, making the right information available quickly, with sufficient granularity and context to empower managers to make better decisions, faster.

DELMIA Manufacturing Process Intelligence (MPI) delivers broad visibility and decision support to achieve and sustain manufacturing excellence. MPI offers consistent, unified views into specific areas of manufacturing operations to facilitate performance comparisons across locations, eliminating data silos for faster insight into problem resolution and performance improvement. Gathering and aggregating clean data quickly is simplified, resulting in valuable analytics and reporting delivered in near real-time. Additionally, MPI lets you modify existing KPIs, measures and analytics and complements your existing enterprise IT landscape, enabling efficient and accurate data collection from almost any third-party solution.

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Scalability and flexibility: Manage globally, execute locally

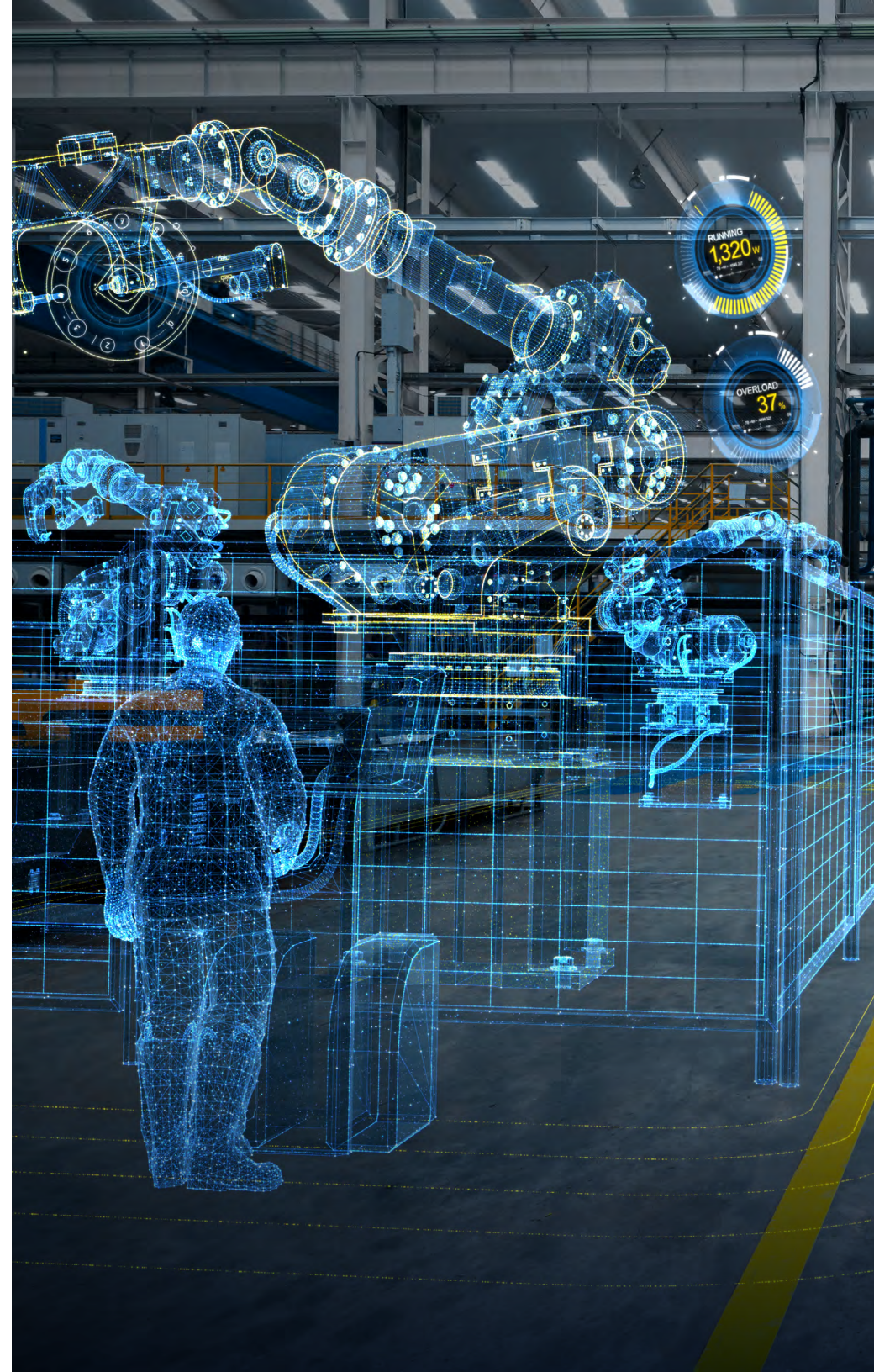
Organizations may have sufficient needs and skills at individual plants to enable innovation at the local level, but also need a strategy that works on a global scale. Most manufacturing IT architectures are too inflexible as a multi-site platform, and too expensive to reconfigure.

With a common platform approach to all operations, you can scale resources, enable centralized management of the system and standardize processes and best practices across sites. This eliminates custom systems and enables scalable continuous improvement initiatives on a global scale. DELMIA MOM helps manufacturers extend their best practices and application footprint without upgrades or integration—increasing flexibility to meet unique process or plant requirements, lowering IT costs and providing a “future proof” model. DELMIA MOM’s winning architecture supports multiple manufacturing models and enterprise manufacturing, from large to small manufacturers.

Deployments that make sense

The complexities and costs of maintaining a distributed IT system traditionally increase with more locations, process changes and affected IT systems.

DELMIA supports manufacturers in this process by offering the ability to centrally manage business processes and deploy them to the field—without coding or taking down the system to install new software at each site. This critical capability, combined with the BPM-based global manufacturing platform, facilitates continuous improvement initiatives while enforcing process standardization across sites and supporting site-specific extensions.



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MOM will continue to drive operations for several years, but will have to evolve and adapt as edge technology and IIoT continue to advance. For a more comprehensive and forward-thinking approach to transformation, you may want to consider these aspects, which are fully supported by DELMIA via the 3DEXPERIENCE platform.

Cloud and On-Premise

There is a growing movement to put applications in a cloud environment instead of on-premise, and for good reason: lower hardware and architecture costs, less need for on-site technical staff and reduced large capital expenditures for new systems. However, most companies are still hesitant to consider cloud solutions for MOM for a number of, again, very good reasons:

Internet latency:

There is still a degree of inherent latency when working over the Web, which is manageable in many (near) real-time applications like ERP and PLM. However, on shop floors where communication with multiple types of equipment is critical, and the speed of which may need to be measured

in micro-seconds, internet latency can be prohibitive to successful shop floor operations. The advent and expanded availability of 5G communications may change this, but in today's environment, internet latency is a significant hurdle.

Communication risks:

Loss of communications with host systems is common. However, shop floor solutions like MOM are mission critical, and losing these systems can be catastrophic to a manufacturing entity. For example, if a Tier 1 automotive supplier providing major sub-assemblies to an OEM on a Just-In-Sequence basis has a system failure that causes the OEM to have to shut down an assembly line, the supplier can be charged tens of thousands of dollars per minute for every minute the assembly line is down. This risk can be reduced by running mission-critical applications on-premise.

DELMIA provides high-availability on-premise applications to alleviate this risk. Some of our customers, namely automotive suppliers, have run on a JIS environment for over 10 years and have not experienced any unplanned losses of their DELMIA applications.



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Collaborative Operations

Every manufacturing organization runs on teams and every leader, whether a CEO or department head, wants to be able to make full use of their teams in order to drive improved outcomes for the business. However, traditional team interactions are not truly collaborative, resulting in missed opportunities for problem-solving and follow-up, and could lead to the creation of more operational problems.

DELMIA 3DLean helps manufacturing and operations teams solve those problems by facilitating structured and effective teamwork. A modern, customizable and interactive solution powered by the **3DEXPERIENCE** platform, 3DLean gives managers the ability to capture, monitor and track operational meetings on the shop floor by providing visibility across operations, accountability from all team members as well as improved collaboration. The solution brings Lean practices to the shop floor as an integral part of operations by providing a digitalized solution that empowers managers and teams to communicate, organize and solve problems more effectively. 3DLean breaks down organizational barriers as well as geographic barriers in today's distributed manufacturers, and allows each team to take the right actions, cascade decisions to stakeholders and collaborate seamlessly regardless of their role or location.

IloT

The Industrial Internet of Things (IIoT) is maturing and brings with it a major realignment of how and where IT is used throughout manufacturing operations and decision-making. As devices become more intelligent, a new data and system architecture will emerge that will flatten existing hierarchies, provide the capabilities to send data from anywhere to automation to anywhere and enable next-generation business applications. The advent of digital transformation has boosted interest in MOM as a starting point for integrating factories into IIoT platforms. IIoT initiatives encourage manufacturing leaders to examine their current state of automation and MOM deployment to plan for digital transformation⁶.

However, implementing IIoT comes with its own shortcomings, with 75% of IIoT projects facing challenges in terms of digital acceleration⁷, due to these obstacles:

- The use of older equipment with little to no connectivity
- Big data challenges around capturing, storing, analyzing and contextualizing data
- IT and OT, developed separately, need to securely integrate without data loss
- Constant need for uninterrupted connectivity
- Challenges in identifying achievable KPIs
- Retirement of experienced workers, which is expected to create a skills gap

⁶ LNS Research. "Jumpstart Digital Transformation with MES: The Road to Manufacturing Operations Maturity in the IIoT Age" (15 March 2019)

⁷ Klubnikin, Andrei. SoftEQ. "75% of IIoT Projects Fail. Here's What You Could Do to Avoid This Scenario" (11 March 2020)



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A key issue contributing to these shortcomings is that IIoT and MES/MOM projects are often siloed, run by separate teams with little or no interaction. IIoT achieves maximum benefit when the data collected is contextualized in a business process and actionable. DELMIA's MOM both contextualizes collected or traced data and initiates actions in response to issues identified by IIoT and other data sources. In essence, **MOM delivers the promise that IIoT promotes**. To run the projects separately at best sub-optimizes the results, and at worst leads to project failure.

Additionally, a key consideration is determining the long-term vision for IIoT in manufacturing. LNS Research breaks this down as the **“seven lives of MOM”**, which are:

- Life 1** No MOM
- Life 2** Traditional monolithic MOM
- Life 3** Cloud-based MOM
- Life 4** Distributed modular MOM
- Life 5** The “transitory life of MOM” – IIoT platform with some MOM applications
- Life 6** MOM applications on IIoT
- Life 7** No MOM, but efficient, flexible factories run by people and systems that are continually learning and improving⁸

⁸ Hughes, Andrew. LNS Research. “The Seven Lives of Manufacturing Operations Management (MOM)” 16 March 2017

⁹ Hughes, Andrew. LNS Research. “Can MES Jumpstart Transformation for Industrial Organizations? Seventh Life of MOM – Refined” 30 March 2021

The long-term future calls for a scenario where “the functionality previously implemented in MOM systems would be distributed as apps across an IIoT platform.”⁹ This would seem to discount the importance of MOM, however, it has been acknowledged as an unrealistic near-term goal for most organizations. In fact, approximately 80% of organizations are still at Life 1, while the rest are mostly at Life 2.

A more viable path suggested by LNS Research is to select an MES system that can be installed with a few functions but solid data connectivity, which is a good strategy for smaller companies. For larger organizations, the most optimal solution is to **invest in a MOM platform that is flexible, modular, scalable and provides strong data connectivity**. This enables companies of any size to start small with a few modular functions, integrated with IIoT from the start. They can expand modularly to grow capabilities that meet near-term needs and transition to the subsequent “lives of MOM” while receiving value at every step without discarding the modular solutions that have developed over time. This approach provides both short-term benefits and a “future proof” long-term solution—which is precisely what DELMIA MOM and the **3DEXPERIENCE** platform from Dassault Systèmes provide.



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Autoliv, a Fortune 500 Tier 1 supplier of airbags and safety systems to all major automotive OEMs worldwide, wanted to improve quality, material flows and traceability across all of its manufacturing plants.

CHALLENGE

- Autoliv needed to better manage quality and material flows, achieve greater traceability and drive consistent, lean continuous improvement across all its manufacturing plants.
- The company also wanted to improve and harmonize its operational and commercial business processes into one integrated platform.

STRATEGY

- Autoliv deployed its ERP and MES together in a deployment system internally known as ACE (Autoliv Consolidated ERP) to help standardize and share best practices across its multiple plants.
- The company's operational and commercial business processes were improved and unified in a single system with its ACE rollout deployed together with DELMIA.

RESULTS

- Thanks to DELMIA, Autoliv now has better visibility into materials, workflows and processes, helping to **improve productivity, enhance global traceability and standardize global process improvement.**
- Based on the initial success of pilot deployments, Autoliv is now **rolling out its ACE solution to 30 manufacturing plants** globally.

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Laboratoires M&L, the manufacturing division of the L'Occitane Group, implemented DELMIA to improve production planning flexibility and quality consistency of its products.



CHALLENGE

- Laboratoires M&L needed to enhance the flexibility of its production planning to deal with the fluctuations in natural raw materials and to deliver products on time to support the company's sustained growth.
- Traceability and security were also a concern—from raw material procurement to delivery of finished products to its boutiques.
- It also required internal process improvements and employee training to enhance the company's industrial performance.

STRATEGY

- Laboratoires M&L implemented DELMIA to help optimize its global production and logistics operations, including raw material reception, weighing, production, packaging and storage, and to anticipate early issues that can adversely affect the quality and delivery of its products.
- Before switching to DELMIA, Laboratoires M&L created test scenarios with "Go/No Go" decisions along the way, which were executed in two months before the final "Go Live", followed by the training of all staff on DELMIA and its new ERP solution.

RESULTS

- With **real-time availability of information**, the company has more foresight thanks to better planning and the availability of information in real time, which also **improve decision-making**, while **reducing the rate of non-quality, waste by 50% and production interruptions for inventory purposes**.
- **Employees are offered new career opportunities** thanks to improvements in their day-to-day productivity.
- Laboratoires M&L has now enabled **100% paperless operations** with all reports, daily KPIs and operator updates going through the DELMIA system.

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By now, it is clear that MOM is key to manufacturing excellence. Starting with a MOM implementation can prove to be a low-risk, high-value entry point for digital transformation and to modernize the shop floor environment for improved performance, a competitive edge and to better manage disruptions. Leveraging DELMIA MOM on the **3DEXPERIENCE** platform, you can unlock the potential for greater levels of manufacturing efficiency, productivity and profitability.

Implementing MOM with DELMIA and the **3DEXPERIENCE** platform allows manufacturers to:

- Build on a business process foundation to increase responsiveness to change to support new manufacturing strategies such as on-shoring
- Maintain process consistency and quality standards
- Democratize data to improve visibility and enhance performance
- Centrally manage business processes and flexibly deploy them on a global scale
- Incorporate critical complementary technologies to further enhance manufacturing execution

The result is improved agility and expanded continuous improvement across the enterprise and extended global supply chain, bringing your organization closer to manufacturing and operational resilience.



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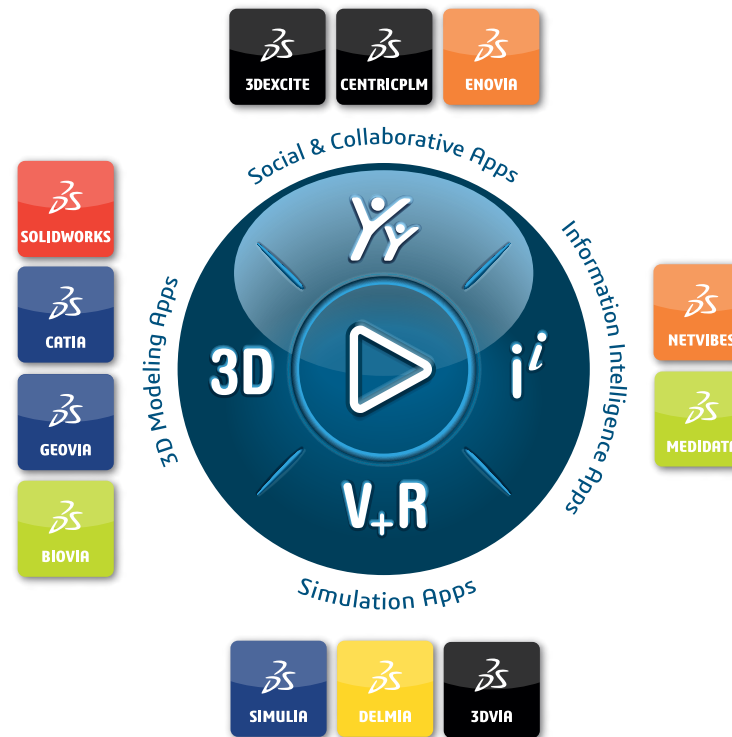
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