Manufacturing Transformed with SAP S/4HANA
SAP Manufacturing Solutions running on the SUSE Operating System with Intel-based Dell EMC infrastructure

ABSTRACT
Historically, manufacturing processes have continually evolved to take advantage of new and emerging technologies. This is the case today as manufacturers are capitalizing on the latest technologies — innovations such as 3-D printing, artificial intelligence, biotechnology, Internet of Things and robotics — to harness the value of mass data, improve processes, cut costs and drive revenue growth, shaping a new industrial revolution known as Industry 4.0.

To be successful in this new industrial revolution, manufacturers need to generate insights in real time and gain transparency over all aspect of their operations. In this white paper, learn the keys to enabling this new level of innovation, and the benefits of running manufacturing software from SAP on Dell EMC infrastructure with the SUSE operating system and the latest Intel® Xeon® processors, enabling organizations of any size to accelerate innovation, manufacture high-quality products at increased profit margins, and lower the effort and expenditures of compliance.

This white paper explores:
• A glance at manufacturing history and the Smart Manufacturing opportunity
• Challenges on the road to transforming manufacturing
• Solutions to enable Industry 4.0
• Tips for getting started on your journey
A GLANCE AT MANUFACTURING HISTORY

When James Wood Johnson set foot in New Brunswick, New Jersey, on a cold January day in 1886, he had as much understanding of the future growth of his new company as a babe on his mother's lap. The typewriter had been invented eight years earlier and was used by Johnson & Johnson (J&J). Edison had invented the lightbulb the following year, in 1879. It was a great time to start a company.

The newly founded J&J company was close to the communication and shipping channels of its time, the Pennsylvania Railroad and the Raritan River and Delaware-Raritan Canal. Also, close to the new J&J 1886 office was a fruit-jar manufacturer and a box manufacturer, both of which would become closely knit to the J&J packaging supply chain. From then until today, manufacturing processes have changed dramatically to align with new communication and shipping channels, improving efficiency yet adding complexity to management decision making.

Like many other manufacturers, Johnson & Johnson, the face of America’s baby products for more than 130 years, has evolved and transformed itself over time. Although, J&J’s baby product line is small in comparison with the greater J&J revenue, it represents products that have built consumer loyalty and trust due in part to quality manufacturing processes. Today, J&J is building on this rich heritage as it evolves its strategies and processes to achieve success in the new digitally driven economy, which is increasingly driven by online marketing and sales activities. This is an evolution that all companies now face, even the most venerable companies like J&J.

Managing a manufacturing organization in today’s technological climate is much more complex than it was 132 years ago. This complexity raises new questions for your enterprise. Do your organization’s “proven” business models to monitor and govern digital business interactions among suppliers, global markets, competitors and customers work to drive deeper customer insights, enable more efficient supply chains and optimize processes? Is there complexity in untapped and growing data lakes that makes you concerned whether you are steering your organization in the right direction? The list of potential questions goes on and on.

Many manufacturers find there is room for improvement in these areas, and they may consider new technologies like machine learning, artificial intelligence (AI) and blockchain, to name a few. AI-based systems can consume large amounts of data — including data related to customer transactions and broader market activity — enabling the “systems to respond quickly and effectively to changes at every step, from changes in tariffs and the subsequent potential implications on supply chain, to a shift in buyer preferences and behavior,” in the perspective of author Geoff Webb. He adds, “This helps manufacturers more clearly understand the true costs, and value, of their products, so that they can set the right price at the right time for each customer.”

Emerging technology breakthroughs in mass data-producing technologies have long supported manufacturing companies in their efforts to increase revenue and lower cost. Today, these innovations include 3-D printing, artificial intelligence, deep learning, machine learning, nanotechnology, biotechnology, materials science, energy storage, quantum computing, robotics, the Internet of Things and autonomous vehicles. These innovations are shaping the new fourth industrial revolution.

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1 Margaret Gurowitz, "130 Years Ago: James Wood Johnson Arrives in New Brunswick!" November 6, 2018.
Let’s look at how we reached this point:

• The first and most famous Industrial Revolution — the one that gave the concept a name — was inspired by machinery leveraging energy from water and steam.
• The second benefited from electrical-powered machinery.
• The third leveraged innovation from information technology and electronics to drive machinery automation.
• And now the fourth industrial revolution is building on the third but on a much greater scale and at significantly faster speeds.

To stay relevant in this new era, manufacturers must partner with software and infrastructure providers to innovate, to produce at mass scale, to combine robotics with human resources and to deliver goods in an ever-so-demanding world. This new world, where the omnichannel supply chain is balanced with new global tariffs, is causing macroeconomics to be a political element of manufacturing complexity.

These new imperatives for manufacturers build the case for a new, transformative approach to manufacturing processes. That’s Smart Manufacturing.

THE SMART MANUFACTURING OPPORTUNITY

Smart Manufacturing is where human resources are joined with connected factory automation to drive higher levels of efficiency. It connects and leverages digital and social 3-D product definitions, additive manufacturing, robotics, mobile, cloud, artificial intelligence, deep learning algorithms and machine learning to optimize what machines do best with what humans excel at.

The Internet of Things (IoT) has been discussed much in the press since the phrase was introduced by RFID founder Kevin Ashton while giving a presentation to Procter & Gamble in 1999. The IoT industry is forecasted to reach $457 billion by 2020 at 28.5 percent CAGR. Of the $457 billion industry revenue, manufacturers are set to invest $267 billion in IoT by 2020.

IoT technologies include devices from smart shelves to sensor-embedded automation controls connecting and automating new areas of the factory, enabling the Industrial Internet of Things (IIoT). As reported by MESA International, the Manufacturing Enterprise Solutions Association, “the new generation of IIoT-enabled smart machines for manufacturing will have onboard computers that directly support Internet protocols and allow direct communication with enterprise applications.”

When combined with other emerging technologies, the evolving IIoT will dramatically change the management of manufacturing operations, according to MESA. “We are not just dusting off old automation plans and putting new labels on them,” the association notes. “Smart Manufacturing is the convergence of multiple technologies into a new generation of business processes and business models for manufacturing.”

CHALLENGES ON THE ROAD TO TRANSFORMING MANUFACTURING

For manufacturers, the road to transformation is not easy and will take time. Some of the major challenges include:

• Reducing IT complexity and information silos that lead to errors, inefficiencies and high costs
• Making planning and processes more accurate and timely

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• Reducing equipment and management overhead
• Making the supply chain more responsive and cost-effective
• Optimizing order processing, production, customization, inventory, fulfillment and logistics
• Predicting customer demand more accurately to optimize materials and reduce stock-outs and overruns
• Improving product quality
• Keeping machinery working at full capacity
• Ensuring data quality — having consistent, valid, clean data is often ignored due to lack of understanding and quantification.
• Enabling data integration — connecting varied sources to ingest pipelines to do specialty tasks presents unique challenges many teams are ill suited to handle.
• Dealing with huge amounts of data — the volume of data, sprawl of sources and increasing depth of telemetry continue to grow and inundate infrastructure solutions.
• Adapting IoT devices in legacy machinery, infrastructure and software
• Using supply chain to gain competitive advantage — more than 1,500 industrial companies will have digitized their supply chains by 2020, taking advantage of digital procurement, inventory, business intelligence, product lifecycle management, sales and operations planning, logistics and manufacturing optimization.8
• Replacing legacy spreadsheet-producing systems with interconnected enterprise resource planning (ERP) systems — these software solutions can automate all business operations and produce real-time reports for quick insights with predictive capabilities.
• Managing cost with big data technologies like Hadoop — gaining insights into all sorts of data, structured and unstructured, requires the use of cost-saving technologies like Hadoop where data can be stored and accessed.
• Maintaining skilled employees to increase productivity in the face of the retirement of large numbers of workers

USE CASES

The challenges summarized above can’t be overcome with status-quo approaches to manufacturing. Manufacturers need new, smarter approaches that support new business-driven use cases. While these use cases will vary by company and industry, typical manufacturing use cases involve some or all of the following:

• Improving visibility into manufacturing processes — assessing and resolving quality and productivity issues quickly and reducing warranty and liability risks through better, more transparent production management
• Adapting to meet individualization requirements — accommodating “market of one” demand and extreme product variability while maintaining productivity, margin and quality levels, and improving customer satisfaction
• Using assets effectively — improving asset and equipment effectiveness, facilitating predictive maintenance, minimizing downtime and keeping manufacturing operations running smoothly
• Enhancing logistics/fleet — using connected trucks and route optimization technologies to shave costs and time from logistics processes and enable more profitable and timely product deliveries

8 PWC, “Industry 4.0 How digitalization makes the supply chain more efficient, agile, and customer-focused,” November 7, 2018.
SOLUTIONS TO ENABLE INDUSTRY 4.0

For organizations that are on the road to Industry 4.0 and Smart Manufacturing, a significant transformation lies ahead. It’s important to begin this journey with a broad understanding of the software, hardware and services that enable transformation, as well as the benefits and implications of leveraging new applications and technology.

If your organization is on this path to the future, Dell EMC, Intel, SUSE and SAP are your ideal partners. Together, this team of world-class companies brings together the hardware, operating system and application software, services and expertise you need to design and deploy a comprehensive solution for your manufacturing environment.

In this section, we walk through some of the key components that come together to create a robust Smart Manufacturing solution built around products from SAP, Dell EMC, Intel and SUSE.

SOFTWARE

There are many software packages available to provide accounting systems, resource planning, execution, scheduling and inventory, among other use cases. With those in mind, manufacturers should carefully review their short- and long-term needs and operational requirements balanced with financial plans. Of the many software providers, SAP stands out as a viable platform that supports many industries. SAP has been in the business for many years and offers a wide range of Industry 4.0-enabling software solutions.

In particular, SAP offers a variety of applications designed to give manufacturers the information they need, when they need it. Some examples include SAP Manufacturing One, SAP Manufacturing Execution, SAP Maintenance Repair and Overhaul (MRO), and SAP S/4HANA® Supply Chain. SAP has designed SAP S/4HANA to be the digital core of a manufacturer’s IT landscape, encompassing enterprise resource planning (ERP), manufacturing execution and service.

SAP S/4HANA harmonizes planning and execution processes. It provides the capacity to connect with IoT devices to automatically respond to fluctuating signals, as well as to provide predictive indicators for preventative maintenance and product service, with deep insight into the cost implications and tradeoffs of different scenarios.

SAP S/4HANA enables manufacturers to react quickly to variable market demand, predict operational issues and improve manufacturing performance by streamlining and integrating the entire lifecycle — from planning and scheduling, to sequencing and execution, to analysis. With SAP S/4HANA providing the most current information on demand, manufacturing processes, resources and capacity are tightly aligned to market demands for optimal production efficiency and profitable and timely delivery of products.

SAP Leonardo, SAP’s digital innovation system, enables rapid innovation to help manufacturers reimagine their businesses. With its portfolio of capabilities — including SAP Leonardo IoT, SAP Leonardo Machine Learning, SAP Leonardo Analytics, SAP Leonardo Big Data and SAP Leonardo Blockchain — Leonardo powers a digital approach to manufacturing using the SAP HANA platform.

Leonardo ties together a connected network of people, processes and things, and applies business context to the real-time insight generated from this network. And Dell EMC is the first to have an SAP-certified Leonardo gateway device that allows for processing at the edge and data streaming back to the core.
SAP is an in-memory data platform that enables organizations to accelerate business processes, deliver more customer and business insights and intelligence, and simplify IT environments with analytics and predictive insights. SAP Streaming Analytics adds real-time streaming analytics to the SAP HANA platform. This makes it easy for developers to incorporate smart stream capture and active event monitoring, alerting and event-driven response capabilities to their SAP HANA applications.

SAP S/4HANA is a real-time enterprise resource planning suite built to take advantage of the SAP HANA in-memory computing platform. SAP S/4HANA removes common obstacles associated with legacy ERP applications, such as batch latency, complex landscapes and manually driven processes. The result is incredible flexibility and speed enabled by a dramatically simplified data model.

SAP HANA DATA ACCESS, INTEGRATION AND VIRTUALIZATION
SAP enables manufacturing organizations to get data from any source without sacrificing performance with built-in SAP HANA data access, integration and virtualization capabilities. SAP HANA supports federated queries, data replication, remote data sync and processes to improve data quality. These capabilities allow staff to access data from inside and outside the organization for full visibility in a simplified IT landscape.
SAP ANALYTICS CLOUD AND SAP DIGITAL BOARDROOM
SAP Analytics Cloud combines all analytics capabilities — including planning, predictive analytics and business intelligence (BI) — in a single solution delivered under a software-as-a-service (SaaS) model. IT staff can take advantage of a modern, intuitive user experience — and save time by planning, analyzing, predicting and collaborating in context.

SAP Digital Boardroom, in turn, equips enterprise leaders with real-time contextual information, ad hoc reporting and what-if analysis for better planning and decision making.

SAP HANA ENABLES REAL-TIME SUPPLY CHAIN INSIGHTS
Using the SAP HANA in-memory database technologies, data from supply chain resources like machine learning, artificial intelligence and other data-gathering systems can be quickly turned to actionable insights. These insights can help increase manufacturing insights and reduce supply chain issue response time, bringing costs down and increasing company profits and customer satisfaction.

With SAP HANA, the enterprise data hub becomes the repository for all data, including structured and unstructured data sets, big data and streaming data from sensors and IoT devices. SAP HANA is designed to handle this type of data by processing transactions and analytics at significant speeds in-memory. In the process, SAP HANA transforms these types of data to deliver real-time analytical insights.

ARCHITECTING SAP INFRASTRUCTURE FOR MANUFACTURING

The first SAP-certified IoT edge device
In July 2017, Dell EMC introduced the first SAP-certified Dell EMC Leonardo IoT Gateway edge device. By combining the Leonardo-certified Dell IoT Gateway with SAP solutions, organizations can integrate IoT edge devices in minutes, not hours or days. Learn more.

Figure 2. SAP MES, MII and Plant Connectivity for Industry 4.0 organizations.9

9 SAP Road Maps
**INFRASTRUCTURE**

Dell EMC infrastructure components for manufacturers include the compute power of Dell EMC PowerEdge™ servers with the latest Intel® Xeon® processors, in combination with Dell EMC software, storage and networking products. Dell EMC offers a portfolio of infrastructure options that include quick-to-deploy Ready Nodes and Ready Systems. To make it easier for manufacturing technology leaders to decide on a deployment model that is best for them, Dell EMC offers these certified SAP HANA Ready Solutions optimized for SAP analytics workloads.

Dell’s SAP solution portfolio includes support for any cloud operating model, from on-premises to hybrid to public cloud. The cloud solutions include hyper-converged and converged platforms that are virtualized with VMware software. Moreover, data protection for business-critical SAP systems is available to address business SLAs. Also available from Dell Technologies is Virtustream cloud solutions.

**DELL EMC TRANSFORMING MANUFACTURING IT**

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**Figure 3.** Dell EMC Ready Solutions are SAP Certified and provide choice and flexibility for manufacturers.

- **Ready Nodes** are built on Dell EMC™ PowerEdge™ servers with Intel Xeon processors, available as ready-built appliances and delivered with SAP HANA software pre-loaded or provided as a Tailored Data Center Integration (TDI) where the HANA database is installed on-premises.

- **Ready Systems** are ready-built systems with the convenience of an appliance and the flexibility of TDI, including options that incorporate Dell EMC V[x]Block, VxRail and VxRack.
DELL EMC CONVERGED AND HYPER-CONVERGED SYSTEMS

The Dell EMC converged and hyper-converged portfolio, including VxRail, VxRack and VxBlock, provides the ease of deployment and hybrid cloud deployment power to harness even the largest data analysis challenges. In addition, Dell EMC Isilon scale-out storage solutions provide native HDFS (Hadoop Distributed File System) storage for big data that enables the Hadoop data lake. All of these components of the modern data center are powered by Intel processors and technologies.

HYBRID AND CLOUD OPTIONS

Most industries still employ on-premises solutions. However, industrial and manufacturing software deployments — whether for sandbox, testing, quality assurance (QA) or production environments — are progressively moving to a cloud operating model (private, public, and hybrid clouds). To meet customers’ needs, Dell EMC offers a complete selection of fully managed cloud and hybrid cloud solutions for off-premises SAP HANA environments.

- **Hybrid cloud** — Dell EMC offers a mix of on-premises, private cloud and public cloud services from Virtustream, a Dell Technologies company, with orchestration between the platforms. Such configurations enable workloads to move between private and public clouds as computing needs and costs change, giving businesses greater flexibility and more data deployment options. The Dell EMC Enterprise Hybrid Cloud solution brings together hardware, software and services from Dell EMC and VMware into a platform to deliver the foundation for infrastructure as a service. Dell EMC and VMware engineering teams have designed, tested and proven the hybrid cloud solution in multiple workload settings, so organizations can avoid risk and accelerate time to production value.

- **Off-premises managed cloud for SAP** — Virtustream offers private, hybrid and public cloud solutions, along with an unparalleled platform for running SAP and SAP HANA workloads in the cloud. Virtustream cloud solutions are purpose-built to run complex, mission-critical, I/O-intensive applications like SAP with unmatched economics, application-level performance SLAs and integrated security and compliance. Virtustream pre-sales experts and consultants have extensive experience working directly with SAP applications. They have the expertise to seamlessly migrate SAP deployments to the cloud.

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**Running SAP in the Modern Data Center**

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Key Considerations

1. Modern Architecture
   - Consolidate | Simplify IT
   - SAP System Landscapes

2. On-Premises Cloud
   - Run SAP in a “Cloud Operating Model”
   - Applications | Infrastructure Operations Unified
   - Converged | Hyper-Converged

3. Edge-to-Core
   - Data Management
   - Volume | Varying Types | Sources
   - Distributed Data Management
   - Edge On-Premises Cloud

Figure 4. Dell EMC Modern Data Center enables any operating model.
**OPERATING SYSTEM**

SUSE open source software solutions enable a manufacturer’s SAP environment to be set up quickly and to run smoothly and efficiently. As an example, SAP recommends HANA System Replication as the primary way to help ensure high availability and reliable disaster recovery for SAP HANA databases.

SUSE supports SAP HANA System Replication by including its High Availability Extension with its tailored-for-SAP operating environment, called SUSE Linux Enterprise Server for SAP Applications, the leading operating system used worldwide for deploying SAP HANA. SUSE and SAP together have engineered software elements called resource agents in order to enable and streamline the automation of HANA system replication.

In what is known as a “scale-up” SAP HANA scenario, a master node assumes responsibility for the SAP HANA databases running in primary mode, and the slave is responsible for instances that are operated in synchronous (secondary) status.

At a broader level, SUSE is the No. 1 recommended OS for SAP applications, and SAP itself standardizes on SUSE.

Simply put, SAP and SUSE continue to team up to make sure that HANA-powered SAP HANA solutions are up to the task of running your SAP manufacturing workloads.

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**DELL EMC**

Dell EMC, a part of Dell Technologies, services its customers — including 98 percent of the Fortune 500 — with a broad, innovative infrastructure portfolio that spans from edge to core to cloud. A strategic SAP technology and software partner for more than 20 years, Dell EMC is a leader in server and storage performance benchmarks for SAP HANA and SAP applications.

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**SUSE**

SUSE is a global open-source software company that develops and sells Linux and an array of other open source distributions and support services to business customers. The primary distribution from SUSE is SUSE Linux Enterprise Server (SLES), aimed at enterprises seeking robust support for their application and database workloads, whether in physical, virtual or cloud-based environments. Other SUSE offerings include SUSE Manager, SUSE Openstack Cloud, SUSE Enterprise Storage and SUSE Container as a Service Platform, all of which may be implemented as part of a comprehensive SAP system infrastructure strategy.

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**INTEL**

Intel is a world leader in the design and manufacturing of essential products and technologies that power the cloud and an increasingly smart, connected world. Intel delivers compute, networking and communications platforms to a broad set of customers, including original equipment manufacturers (OEMs), original design manufacturers (ODMs), and cloud and communications service providers, as well as industrial, communications and automotive equipment manufacturers.
TIPS FOR GETTING STARTED ON YOUR JOURNEY

When you’re ready to begin your Smart Manufacturing journey, the first steps forward involve strategic planning considerations. While there are many ways to get started, many organizations follow a path along these lines:

• Determine the scope of your commitment to SAP solutions.
• Decide whether your enterprise favors a self-managed solution or if a hosting company (like Virtustream) will run the SAP operations for you.
• Decide whether your enterprise favors an on-premises or hosted deployment, or perhaps a deployment of SAP solutions in a public cloud setting.
• Understand the implications of switching to a new database platform and a new or refined set of applications. Consider the impacts on staffing, resource acquisition, third-party contracts, IT staff and end-user training.
• Depending on the answers to the above, engage with a trusted partner or partners to kick off your projects.

BETTER TOGETHER: DELL EMC, INTEL, SUSE AND SAP

The solutions for manufacturers from Dell EMC, Intel, SUSE and SAP bring together all the hardware, operating and application software, services and expertise you need to design and deploy a comprehensive solution that spans a broad environment.

• Dell EMC provides a blueprint for industry-leading solutions that leverage proven infrastructure components and powerful hardware, including Intel Xeon processors, required to drive real-time analytics.
• Intel processors empower Dell EMC edge, core and cloud solutions to run at peak capacity and enable world-leading benchmark performance.
• SUSE enables manufacturers and other large organizations to deploy physical, virtual and cloud SAP workloads leveraging the Linux Enterprise Server (SLES) operating system.
• SAP SE is a multinational software corporation that makes enterprise software to manage business operations and customer relations, including SAP HANA for in-memory, high-speed computing. The company has more than 335,000 customers in over 180 countries. To learn more, visit suse.com/sap.

Ultimately, the combination of powerful hardware components, sophisticated operating and application software, and a leading in-memory database enables your organization to leveraging manufacturing solutions that enhance customers’ lives and lower manufacturing capital and operational costs.

LEARN MORE

To learn more:

• Contact your Dell EMC or SUSE account representative.
• Contact mike.nelson@suse.com or visit https://www.suse.com/products/sles-for-sap/.
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**Mike King** is an accomplished professional with extensive experience in developing database architectures, designs and models for others to reuse. He has dealt with all aspects of database technology and solution architecture, including big data, analytics, data warehousing, metadata, MDM, EA, technology and infrastructure. His experience includes Oracle/Sybase/DB2 DBA, big data, BI/analytics, DW, Certified Sybase Professional DBA, P&T, SQL, database design, shell programming, UNIX/Linux admin, blogger, hacker, disruptor and more.

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**Morten Loderup** is Dell EMC’s Alliance Manager responsible for driving SAP solution revenue with partners and direct sales in North America. Morten is responsible for SAP solutions pipeline growth and development, along with SAP and partner relationship development. His activities include customer target activities and messaging, partner go-to-market events and activities, and joint message development. Morten offers a breadth of experience in this field, having worked at Dell for more than 16 years, with over 11 of those years working on SAP-related projects as an SAP Solution Architect and SAP Services Program Manager for Dell's first SAP HANA launch, and now as an Alliance Manager for SAP. Morten has an Engineering Management degree from the University of Texas, Austin, a Masters of Computer Information Systems degree from University of Phoenix, and an MBA from the University of Phoenix.

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To learn more, visit [DellEMC.com/sap](http://DellEMC.com/sap) or contact your Dell EMC representative for a one-on-one conversation about your needs and goals.