



Dell EMC Ready Solution for HPC Digital Manufacturing

Tap into the power of AI and high performance computing to speed design workloads

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93% of manufacturers

classify AI as “highly important” or “absolutely critical to success” over the next five years¹

Get to market faster

Technology has long been a major driver of competitiveness in manufacturing. For decades, manufacturers have been using technologies such as high-performance computing (HPC) to power the engineering and design that helps create innovative products and grow revenue while cutting costs. Now, the manufacturing industry is undergoing a “fourth industrial revolution,” powered by the rapid advancement of technologies that promise to reshape the industry.

Sensors and devices that make up the industrial internet of things (IIoT) can provide manufacturers with important new data points that, when combined with other unstructured business data, create a clearer picture of the entire product lifecycle. Data analytics and artificial intelligence (AI), underpinned by powerful HPC clusters, will be the key to unlocking the value of your data. And when harnessed, this intelligence can inform and drive decisions that impact success.

The manufacturing sector is already leading the way in the application of advanced computing. In particular, HPC-powered analytics and AI will revolutionize engineering to help manufacturers speed time to market with more innovative and higher quality products. And Dell EMC is helping push the boundaries of performance with scalable, flexible solutions designed to help bring products to market faster.

Dell EMC has what you need

Expertise and guidance

The technology around data analytics, HPC and AI is emerging quickly, so your team may not have had time to develop the skills required to design, deploy and manage solution stacks optimized for new workloads. While AI might seem like the latest IT trend, Dell EMC has been a leader in the advanced computing space for over a decade, with proven products, solutions and expertise. Dell EMC has a team of data analytics, HPC and AI experts dedicated to staying on the cutting edge, testing new technologies and tuning solutions to your applications to help you keep pace with this constantly evolving landscape.

Dell EMC Ready Solutions for HPC

The advantage in today’s marketplace goes to the data-driven enterprise. For many organizations, high performance computing is — or is becoming — an important source of competitive advantage. An optimized HPC solution delivers the compute, throughput and capacity needed to manage the rapid data growth and increased workload demands presented by advanced data analytics and other enterprise workloads. Dell EMC Ready Solutions for HPC simplify design, speed configuration and ordering of clusters with standardized building blocks tested for digital manufacturing, engineering and design applications.

Solutions customized for your environment

Dell EMC uniquely provides an extensive portfolio of technologies to deliver the advanced computing solutions that underpin successful data analytics and AI implementations. With an extensive portfolio, years of experience and an ecosystem of curated technology and service partners, Dell EMC provides innovative solutions, workstations, servers, networking, storage and services that reduce complexity and enable you to capitalize on the promise of the data analytics, HPC and AI.

¹Forbes, “[How AI Builds a Better Manufacturing Process](#),” July 2018.

4.4PB

of data generated by autonomous driving software developers³

10M

data points per modeling run involved in automotive crash testing⁴

Do any of these challenges sound familiar?

“Workstations don’t provide sufficient performance for digital manufacturing workloads.”

Many struggle with insufficient scalability/performance of installed workstations to get the job done. These platforms are often running at maximum capacity and don’t have the ability to handle today’s peak computational workloads. A balanced and integrated HPC system can deliver the throughput and capacity needed to manage rapid data growth and increased workload demands. Dell EMC makes it easy to customize an HPC solution to meet performance requirements with a range of available options.

“We need to be able to build out digital manufacturing infrastructure more easily, with a shorter learning curve.”

Advancements in digital manufacturing software capabilities continue to push the limits of existing systems. To keep up, you need the power to scale quickly and easily. The modular, building-block design of Dell EMC Ready Solutions for HPC Digital Manufacturing makes it easy to manage and extend compute power, storage and networking on-premises so you can grow as needed to keep pace with the competition.

“It’s important for us to reduce risks for HPC investments.”

HPC is an important source of competitive advantage, but deploying HPC systems for specific or multiple workloads requires significant investments of time and resources — and increases the chance for errors. Tested and validated Dell EMC Ready Solutions for HPC reduce deployment risks, increase system reliability and provide a single point of contact for services and support.

Dell EMC Ready Solutions for HPC Digital Manufacturing

Dell EMC Ready Solutions have been designed to simplify the configuration, deployment and management of HPC solutions. They provide trusted designs that have been optimized, tuned and tested for a variety of key use cases. These modular designs include the servers, storage, networking, software and services that have been proven in our labs and in customer deployments to meet workload requirements and customer outcomes. The modular designs provide a customized, yet validated approach, for customers deploying new clusters or upgrading their existing environments. Ready Solutions for HPC Digital Manufacturing are designed to deliver faster performance with purpose-built solutions and easier scaling with modular building blocks while reducing risk.

Faster performance

Dell EMC is committed to helping more people make more innovations and discoveries than any other HPC solutions vendor in the world. To that end, Dell EMC engineers and industry experts have worked in collaboration with Dell EMC customers and partners to design these solutions specifically for digital manufacturing workloads. The Dell EMC HPC and AI Innovation Lab works closely with customers and partners to optimize these solutions, with a focus on performance, efficiency and reliability.

³ Dell EMC case study, [“Safer Driving.”](#) June 2018.

⁴ HPCwire, [“HPC for Everyone Comes to Manufacturing.”](#) July 2018.

Faster performance

Easier scaling

Reduced risk

Easier scaling

Dell EMC Ready Solutions for HPC help customers get the optimal IT infrastructure for today — and tomorrow. That means creating solutions with scalable building blocks to meet evolving needs over time. Dell EMC Ready Solutions for HPC are built with modular building blocks that enable you to scale easily to meet new capacity and performance demands. Dell EMC’s extensive track record with servers, storage, networking and services means we can implement holistic solutions that work from day one, with an eye toward the future.

Reduced risk

Dell EMC engineering architects and tests Ready Solutions for HPC Digital Manufacturing to reduce risk while it making it easier to take advantage of high performance computing for workloads such as structural analysis, computational fluid dynamics, noise, vibration and harshness (NVH); engineering, analysis and design. Dell EMC Services — ranging from consulting and education to deployment and support — are available when and where you need them. With proven success in thousands of implementations worldwide, you can be confident that you can rely on Dell EMC.

Customer success stories

Mikuni®: automobile engine components

20% improvement in software performance

~40% more capacity than previous workstations

Several minutes → seconds for boot up

“We laid out our requirements and the people at Dell EMC took those requirements and developed exactly what we needed.”⁵

—Thomas McCauley,
engineering manager,
Caterpillar autonomous
mining program

See [Connected Cars](#).

Nissan® Motor Company

73% reduction in backup times

20X more capacity with 40TB available storage

30 hours → 8 hours to back up data

Read [Gearing up for data driven automobile manufacturing](#).

Nakashima Propeller: maritime components

70–80X more parallel calculations through better server performance

2 weeks → 2 days for analysis

Read [Helping make maritime shipping faster and greener](#).

- Dell EMC is helping transform the [auto industry](#).
- [Zenuity](#) is accelerating the advent of driver assistance and autonomous driving technologies.
- [Cat®](#) trucks rev up their autonomous mining program.
- [Brembo](#) boosts its design capabilities with an upgraded HPC environment.

⁵ Dell EMC case study, “[Autonomous Mining](#),” August 2017.

Dell EMC Ready Solutions for HPC Digital Manufacturing Specifications

The base configuration shown in the following table serves as a starting point for your solution. Your sales specialist can assist you with designing an HPC solution for your specific needs.



Dell EMC Ready Solutions for HPC Digital Manufacturing technical specifications — Bright Cluster Manager

Servers/ processors	Head node	PowerEdge R640
	Compute nodes	Choice of: PowerEdge C6420 PowerEdge R640 PowerEdge R840
	Processors	Intel® Xeon® 8200, 8100, 6200, 6100, 5200, 5100, 4200, 4100, 3200 and 3100 series Intel Xeon SKL-F only on C6420 Intel Xeon E7-4800 v3, E7-8800 v4
Operating systems	Head nodes	Red Hat® Enterprise Linux® (RHEL) (2- or 4-socket)
	Compute nodes	RHEL for HPC Compute Node (2- or 4-socket)
Software		Bright Cluster Manager® Mellanox® OFED NVIDIA® CUDA® Intel XPPSL IFS
Networking		
Omni-Path (OPA)	OPA Host Fabric Interface (HFI)	Intel Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe x16
	OPA switches	Dell EMC Networking H1000 Edge series: H1048 and H1024 Dell EMC Networking H9100 series
	OPA IFS driver	10.9
InfiniBand® (IB)	IB host channel adapters	Rack: Mellanox ConnectX®-5 EDR single port or Mellanox ConnectX-3 FDR dual port Blade: Mellanox ConnectX-3 small form factor (SFF): FDR or FDR10 mezzanine cards
	IB switches: FDR and EDR	Rack: Mellanox SwitchX® 6xxx series Mellanox SB 77xx and 78xx series Mellanox MSB 78xx series Blade: Mellanox M4001F with M640
	Drivers	Mellanox OFED 4.5
	Ethernet	
Ethernet	NICs	1, 10, 40GbE (full and low profile)
	Dell EMC Networking switches	Z and S series, 1, 10, 40GbE
Storage	NFS	Dell EMC Ready Solutions for HPC NFS Storage
	Lustre®	Dell EMC Ready Solutions for HPC Lustre Storage
	Isilon	Dell EMC Isilon Scale-out NAS Storage
	SAS RAID Controller	PERC 10
Systems management		Dell EMC Deployment Toolkit (DTK) Dell EMC OpenManage (OM)

Dell EMC Ready Solutions for HPC Digital Manufacturing technical specifications — Open source option

Servers/ processors	Head node	PowerEdge R640	
	Compute nodes	Choice of: PowerEdge R640 PowerEdge C6420 PowerEdge R840	
	Processors	Intel Xeon 8100, 6100, 5100, 4100, and 3100 series Intel Xeon E5-2600 v4 series	Intel Xeon E5-4600 v4 series Intel Xeon E5-2600 v4 series Intel Xeon E7-4800 v3, E7-8800 v4
Operating systems	Head nodes	RHEL (2- or 4-socket)	
	Compute nodes	RHEL for HPC Compute Node (2- or 4-socket)	
Software		OpenHPC Mellanox OFED	IFS
Networking			
OPA	OPA HFI	Intel Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe x16	
	OPA switches	Dell EMC Networking H1000 Edge series: H1048 and H1024 Dell EMC Networking H9100 series	
	OPA IFS driver	10.9	
IB	IB host channel adapters	Rack: Mellanox ConnectX-5 EDR single port or Mellanox ConnectX-3 FDR	Blade: Mellanox ConnectX-3 SFF: FDR dual port or FDR10 mezzanine cards
	IB switches: FDR and EDR	Rack: Mellanox SwitchX 6xxx series Mellanox MSB 78xx series	Blade: Mellanox M4001F (supported on Mellanox SB 77xx and 78xx series M640 blades)
	Drivers	Mellanox OFED 4.5	
Ethernet	NICs	1, 10, 40GbE (full and low profile)	
	Dell EMC Networking	Z and S series, 1, 10, 40GbE	
Storage	NFS	Dell EMC Ready Solutions for HPC NFS Storage	
	Lustre	Dell EMC Ready Solutions for HPC Lustre Storage	
	SAS RAID controller	PERC 10	
Systems management		Dell EMC Deployment Toolkit (DTK) Dell EMC OpenManage (OM)	

Solution highlights

- [Dell EMC PowerEdge Servers](#) enhance performance across the widest range of applications with highly scalable architectures and flexible internal storage.
- [Dell EMC Ready Solutions for HPC NFS Storage](#) are reliable, easy to administer and have very good performance within certain boundaries.
- [Dell EMC Ready Solutions for HPC Lustre Storage](#) allow customers to tap into the power and scalability of Lustre with simplified installation, configuration and management features.
- [Bright Cluster Manager for HPC](#) enables the deployment of clusters over bare metal with a management view that spans the hardware, operating system, software and users.

Building blocks

Easily grow capabilities and scale your environment with these building blocks. They are designed and tested for a variety of digital manufacturing workloads, with recommendations below based on application needs.

Basic building block	Typical use	Windows-based customers looking for a modest cluster to improve single job capacity and overall volume of jobs Stepping stone from Windows workstation usage to full Linux-based HPC cluster environment
	Typical simulation types	Crash, stamping, safety, impact analysis, fluid flow, pump design, combustion, aerodynamics, acoustics
	Typical run environment	SMP parallel jobs on a single node and MPI parallel jobs run across two-node 10GE switchless “couplet”
	Recommended	PowerEdge R840 Intel Xeon 6242 (64 cores/server, 128 cores/couplet) 384GB DDR4 memory 4x 480GB mixed-use SATA SSDs
Visual building block	Typical use	Pre/post processing software on data in HPC environment for remote desktop use
	Typical software	VNC®, NICE®, VMware® Horizon®
	Recommended	PowerEdge R740 Intel Xeon 6242 384GB DDR4 memory 2x 240GB multi-use SSD (OS in RAID-1) 1.6TB NVMe for local data NVIDIA® Tesla® P40 24GB GPU
Storage building block	Typical use	Customers looking for a cost-effective solution to maintain HPC storage near HPC cluster
	Characteristics	Up to 10TB of raw storage (RAID-6) >1.3GB/s read/write performance Suitable for using IP over IB on existing EDR HPC network
	Recommended	PowerEdge R740xd Dual Intel Xeon 4110 Silver (20 total cores) 96GB DDR4 memory 2x 240GB multi-use SSD (OS in RAID-1) 12TB (12x) nearline SAS HDDs in RAID-6 PERC H740P RAID controller

Solver building blocks for digital manufacturing workloads

Solver building blocks are designed and tested for a variety of computer-aided engineering workloads. Options are available to mix and match server processor, memory and storage, with recommendations below.

Solver building block	Base simulation compute resource
Form factor	PowerEdge R640 (1U) or C6420 (4 in 2U) based on rack density requirements
Processor	Intel Xeon 6242 (16-core) or Intel 6252 (24-core) based on overall workload
Memory	192GB memory or 384GB memory based on problem size
Storage	800GB NVMe scratch or 1600GB NVMe scratch based on problem size
Network	EDR

Explicit finite element analysis (FEA) solver	Typical use	SIMULIA® Abaqus®-explicit, LS-DYNA, PAM-CRASH®, Altair® – RADIOSS™
	Typical simulation types	Crash, stamping, safety, impact analysis
	Typical run environment	Message passing interface (MPI) parallel jobs run across 4-12 server nodes in a cluster with a high-speed EDR network; minimal I/O to local disks during jobs
	Recommended	PowerEdge C6420 (4 in 2U) Intel Xeon 6252 (24-core) 192GB memory 800GB NVMe scratch storage EDR high speed network
Implicit FEA solver	Typical use	ANSYS® Mechanical™, Abaqus-Standard, MSC® Nastran®, NX® Nastran, Altair® OptiStruct®
	Typical simulation types	Noise vibration harshness, structural integrity (linear and non-linear), assembly
	Typical run environment	Most jobs run on a single server node and tend to require large memory to improve overall performance; scratch I/O to array of local disks typically preferred over shared file system
	Recommended	PowerEdge R640 (1U) Intel Xeon 6242 (16-core) 384GB memory 1600GB NVMe scratch storage EDR high speed network
Computational Fluid Dynamics (CFD) solver	Typical use	ANSYS® Fluent®, CFX®, CD-adaptico® STAR-CD®, STAR-CCM+®, OpenFOAM, Exa® PowerFLOW®, AcuSolve
	Typical simulation types	Fluid flow, pump design, combustion, aerodynamics, acoustics
	Typical run environment	MPI parallel jobs run across 4-12 server nodes in a cluster with a high speed EDR network; minimal I/O to local disks during job
	Recommended	PowerEdge C6420 (4 in 2U) Intel Xeon 6252 (24-core) 192GB memory 800GB NVMe scratch storage EDR high speed network
Management	Management software	Bright Cluster Manager (optional) IPMI based cluster management tools Remote Cluster Management Services (optional)
	Management server building blocks	Cluster management: 1 for modest clusters; 2 for larger clusters Cluster administration (queues): 1-2 for each specific task Login: Typically 1 for each 30–100 users
	Recommended	PowerEdge R640 Intel Xeon 3106 (16 cores per server) 192GB 2667MHz DDR4 memory 1x 800GB mixed-use SATA SSDs

Services and financing

Dell EMC is there every step of the way, linking people, processes and technology to accelerate innovation and enable optimal business outcomes.

- [Dell EMC Big Data Vision Workshop](#) focuses on big data for business leaders. We have a unique methodology to identify and prioritize a single use case with a combination of implementation feasibility and business value. It's a three week engagement that applies research, interviews and data science expertise and techniques to the organization — culminating in a one day workshop for your team to identify and agree on a use case and path forward. This approach sets Dell EMC apart from the “bring in a bunch of technology and see what it can do” approach that's pushed by many vendors.
- [Dell EMC Consulting Services](#) are delivered by certified experts to help you get the business value of advanced computing. The services include an assessment, workshop, testing, proofs of concept and production implementation. These experts help determine where advanced computing is a good fit for your organization. They also help you build your own internal team of experts through knowledge transfer at each step.
- [Dell EMC Education Services](#) offers courses and certifications in data science and advanced analytics through self-paced online labs and instructor-led workshops.
- [Dell EMC Deployment](#) experts have the experience, expertise and best practices to enhance your success with data analytics, HPC and AI solutions. With a proven track record of success in thousands of engagements worldwide, you can rely on Dell EMC as your partner.
- [Dell EMC Support](#) experts can provide comprehensive hardware and collaborative software support 24x7 for optimal system performance and minimized downtime. ProSupport includes next-business-day on-site service with four- and eight-hour parts-and-labor response options, and escalation management with customer-defined severity levels. You can also opt for ProSupport Plus to get a technology service manager, who serves as a single point of contact for your support needs.
- Once the HPC cluster is deployed, [Dell EMC Remote HPC Cluster Management](#) services help keep it running smoothly with proactive monitoring and management of the entire HPC solution.
- [Dell Financial Services](#) offers a wealth of leasing and financing options to help you find opportunities when your organization faces decisions regarding capital expenditures, operating expenditures and cash flow.

>30,000

full-time Services and Support employees⁶

>2,200

service centers⁶

Winner of the coveted HPCwire Editors' Choice Award for Best Use of High Performance Data Analytics.⁷

2 days

to perform calculations that used to take 2 weeks⁸

70-80x

more parallel calculations for computational fluid dynamics⁸

2 hours

to run a workload that used to take nine months⁹

Why choose Dell EMC for data analytics, HPC and AI

We're committed to advancing data analytics, HPC and AI, and we've dedicated a great deal of resources toward that goal.

- Come in for an [executive briefing](#) and collaborate on ways to reach your business goals.
- Dell [Customer Solution Centers](#) are staffed with computer scientists, engineers and Ph.D.s who are subject matter experts in a variety of disciplines.
- We are committed to [providing you with choice](#). We want you to get what you need and have a great experience working with us. If we don't have what you need, we'll tell you who does. We believe in being open, and we publish our performance results.
- Dell EMC is the only company in the world with a portfolio that spans from workstations to supercomputers, including servers, networking, storage, software and services.
- Because Dell EMC offers such a wide selection of solutions, we can act as your trusted advisor without trying to sell you a one-size-fits-all approach to your problem. That range of solutions has also given us the expertise to understand a broad spectrum of challenges and how to address them.
- To protect, detect and recover from cyberattacks, [security is built into the Dell EMC PowerEdge server design](#), not bolted on after the fact.

Dell Customer Solution Centers

Our global network of 21 dedicated Dell Customer Solution Centers are trusted environments where world-class IT experts collaborate with you to share best practices, facilitate in-depth discussions of effective business strategies and help your business become more successful and competitive. Dell Customer Solution Centers reduce the risks associated with new technology investments and can help improve speed of implementation.

Dell EMC HPC and AI Centers of Excellence

As data analytics, HPC and AI converge and the technology evolves, Dell EMC's worldwide HPC and AI Centers of Excellence provide thought leadership, test new technologies and share best practices. They maintain local industry partnerships, and have direct access to Dell EMC and other technology creators to incorporate your feedback and needs into their roadmaps. Through collaboration, Dell EMC HPC and AI Centers of Excellence provide a network of resources based on the wide-ranging know-how and experience in the community.

Dell EMC AI Experience Zones

Curious about AI and what it can do for your business? Run demos, try proofs of concept and pilot software in Singapore, Seoul, Sydney, and Bangalore. Dell EMC experts are available to collaborate and share best practices as you can explore the latest technology, and get the information and hands-on experience you need for your advanced computing workloads.

⁷ HPCwire, "2018 HPCwire Awards – Readers' & Editors' Choice," November 2018.

⁸ Dell EMC case study, "Helping Make Maritime Shipping Faster and Greener," November 2016.

⁹ Dell EMC case study, "Autonomous Mining," August 2017.

Dell EMC HPC and AI Innovation Lab

The Dell EMC HPC and AI Innovation Lab in Austin, Texas, is the flagship innovation center. Housed in a 13,000-square-foot data center, it gives you access to thousands of Dell EMC servers, two powerful HPC clusters, and sophisticated storage and network systems. It's staffed by a dedicated group of computer scientists, engineers and Ph.D. subject matter experts who actively partner and collaborate with customers and other members of the HPC community. The team engineers HPC and AI solutions, tests new and emerging technologies, and shares expertise including performance results and best practices.

Proven results

Dell EMC holds leadership positions in some of the biggest and largest-growth categories in the IT infrastructure business, and that means you can confidently source your IT needs from Dell EMC.

- #1 in servers¹⁰
- #1 in converged and hyper converged infrastructure (HCI)¹¹
- #1 in storage¹²
- #1 cloud IT infrastructure¹³

See [Dell Technologies Key Facts](#).

¹⁰ IDC [WW Quarterly Server Tracker](#), Vendor Revenue, March 2019.

¹¹ IDC [WW Quarterly Converged Systems Tracker](#), Vendor Revenue, September 2018.

¹² IDC [WW Quarterly Enterprise Storage Systems Tracker](#), Vendor Revenue, March 2019.

¹³ IDC [WW Quarterly Cloud IT Infrastructure Tracker](#), Vendor Revenue, January 2019.

Take the next step, today

Don't wait to find out how Dell EMC can simplify design, configuration and ordering — so you can leverage the advantages of HPC sooner and with less risk. Contact your Dell EMC or authorized channel partner representative for more details right away.

Contact us

To learn more, visit dell EMC.com/hpc or [contact](#) your local representative or authorized reseller.

