

High Value Computer-Aided Engineering Solutions from Hewlett Packard Enterprise (HPE) – a Quantitative Assessment

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Executive Summary

As manufacturers struggle to overcome competitive and cost pressures, they are increasingly using Computer-Aided Engineering (CAE) and Analytics to deliver higher quality products faster at lower costs and risks. The use of CAE is growing and can deliver very high Return on Investment (ROI).

As data volume/variety and virtual model complexity/fidelity continue to grow, the ROI from CAE could be greater especially as CAE is being integrated with Artificial Intelligence (AI). This could accelerate innovation and further improve a manufacturer's competitive position and the quality of its products, operations and customer engagement.

But this is also driving up compute and storage requirements and manufacturers are still facing numerous deployment challenges to scale CAE across their enterprises. To overcome these obstacles, they rely on High Performance Computing (HPC).

As a market leader in CAE, HPE HPC solutions have several novel features to reduce complexity and bring high-performance and scalability to run multiple complex CAE workloads. The integration of a wide choice of processors, accelerators, networks, storage and software including performance-optimized CAE applications lead to quicker deployments and faster time to value. These solutions also require minimal ongoing administration or tuning, allowing manufacturers to maximize their **Total Value of Ownership (TVO)**, which is (Total Benefits – Total Costs).

The comprehensive TVO analysis presented in this paper compares HPE CAE solutions with a corresponding white box cluster (proxy for commodity clusters) for three configurations – small, medium and large. This cost-benefit analysis framework considers cost/benefit drivers in a 2 by 2 continuum: Direct vs. Derived and Technology vs. Business mapped into four quantified quadrants: Costs, Productivity/Quality, Revenues/Profits and Risks.

Compared to using a white box cluster, HPE clients deploying CAE workflows **can improve the three-year ROI for all configurations** despite modestly higher acquisition costs. Likewise, the Payback Period (PP) for HPE solutions is shorter than white box clusters; providing manufacturers faster time to value. In fact, these ROI/PP improvements grow with configuration size; offering clients better investment protection as data volumes and CAE model complexities continue to grow.

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Growing Value of CAE in Manufacturing

Manufacturers continue to invest in Computer-Aided Engineering (CAE) and Analytics. CAE helps slash production time, optimize designs, enhance productivity of engineers and suppliers, improve product quality, prevent expensive rework and spur innovation. In fact, the global CAE (Structures, Fluids, Electromagnetics, etc.) software market size was valued at \$7.3 billion in 2019 and is expected to grow 9.3% annually through 2027.¹ The ROI from CAE can be in the 100s of percent.²

As data gathering techniques improve and volumes grow, CAE has evolved from simulating simple physics at a component/part level to large-scale, coupled, multidisciplinary, iterative modeling of complex systems. CAE is also being integrated with Artificial Intelligence (AI) – see Appendix B for details. All this can further improve the ROI from CAE.

However, this is driving up computing and storage requirements for CAE. Highly reliable High Performance Computing (HPC) infrastructures that scale and perform consistently are needed to generate time-critical insights and maximize the Total Value of Ownership (TVO) for manufacturers.

This paper uses a TVO model that quantifies some of the key interrelated cost and benefit drivers and differentiators of Hewlett Packard Enterprise (HPE) systems over white box (proxy for commodity) systems. These cost and value drivers were identified using over a dozen in-depth interviews representing HPE customers and HPC/CAE experts across multiple industries and company sizes, HPE input and other research. This holistic cost-benefit analysis examines various configuration sizes (small, medium and large) for high-value HPE solutions over white box choices.

High Value CAE Solutions from Hewlett Packard Enterprise (HPE)

As the market leader in HPC systems with about 37.8 percent market share³, HPE delivers the industry's most comprehensive CAE solutions across compute, interconnect, software, storage and services, delivered on premises, hybrid or as-a-Service. These solutions simplify system and data management, reduce costs and complexity, and scale to deliver excellent performance for CAE and AI.

These solutions have three pillars – partnerships, platforms and services that **improve TVO for CAE**:

Partnerships: Deep technical collaborations with all major CAE applications providers (many have AI capabilities) produce reliable and optimized CAE applications to deliver excellent performance.

Platforms: High-performance hardware and software improve efficiency, reliability and scalability of CAE workflows with remote visualization capabilities. HPE provides a continuum and choice of servers ([HPE Apollo and Cray Supercomputer family](#)) with processors and accelerators (Intel, AMD and NVIDIA GPUs), and tailored software, interconnect and storage that deliver the best performance for CAE and AI.

The [HPE Apollo 2000 Gen10 Plus System](#) is the fourth generation of HPE's density-optimized, multi-server, shared-infrastructure design with shared power and cooling resources, enabling the system to drive higher levels of efficiency, compute density, and system scaling. It has up to four HPE ProLiant XL225n Gen10 Plus servers installed in the 2U chassis and each server supports up to two 2nd Generation AMD EYPC processors. The Apollo 2000 Gen10 Plus System delivers storage and compute flexibility, increased power capability and support for 200+W processors.

The [HPE Apollo 2000 Gen10 System](#) is a 2U density optimized system built on 2nd generation Intel Xeon Scalable Processors. Each system will support up to four HPE ProLiant XL170r trays for compute density and up to two HPE ProLiant XL190r trays with GPU support. Both Gen10 and Gen10 Plus

¹ <https://www.grandviewresearch.com/industry-analysis/computer-aided-engineering-cae-market>

² <https://www.hpe.com/us/en/resources/solutions/hyperion-hpc-value.html>

³ Hyperion Research HPC Qview Q3 2019

ROI from CAE in
100s of percent

CAE needs
reliable HPC
solutions that
scale and
perform
consistently

HPE is the market
leader in HPC and
offers
considerable
choice and
flexibility for CAE

HPE partnerships,
platforms and
services improve
TVO for CAE

systems have individually serviceable nodes, include high-speed fabric and are ideal for small to medium size CAE installations.

[HPE Cray Supercomputing servers](#) (air- and liquid-cooled) are good for medium to large CAE configurations. Air-cooled systems consist of traditional rack systems with Cray software and Slingshot interconnect. The liquid cooled Cray servers are scalable with liquid-cooled rack infrastructure (up to 64 blades and 512 processors per rack) with dual socket AMD EPYC Rome nodes.

In addition, HPE offers the [Cray ClusterStor E1000](#) – a storage solution to address unique data management, throughput and archiving challenges associated with extremely large datasets. It significantly reduces the need for additional storage drives through intelligent data management and delivers the best filesystem performance for all flash, all disk or hybrid configurations. Pre-integrated and tested in the factory, it is easy to implement and can scale from small to very large configurations.

[HPE Performance Cluster Management](#) software provides complete provisioning, management, and monitoring for very large clusters. It enables fast system setup from bare-metal, comprehensive hardware monitoring and management, image/power management, and software updates.

Services: Purpose-built CAE solutions and advisory services deliver faster time to value. HPE Centers of Excellence (COE) and 24/7 support ensure efficient operations with minimal disruptions. Consultants have deep expertise in CAE applications and algorithms to help clients optimize their workloads.

These three pillars of differentiation of HPE solutions are included in the TVO Framework for CAE.

High Level TVO Framework with Key Cost and Value Drivers for CAE

The TVO framework (Figure 1) categorizes the interrelated cost/value drivers (circles) for CAE solutions by each quadrant: Costs, Productivity/Quality, Revenue/Profits and Risks. Along the horizontal axis, the drivers are arranged based on whether they are primarily **Technology** or **Business** drivers. Along the vertical axis, drivers are arranged based on ease of measurability: **Direct** or **Derived**.

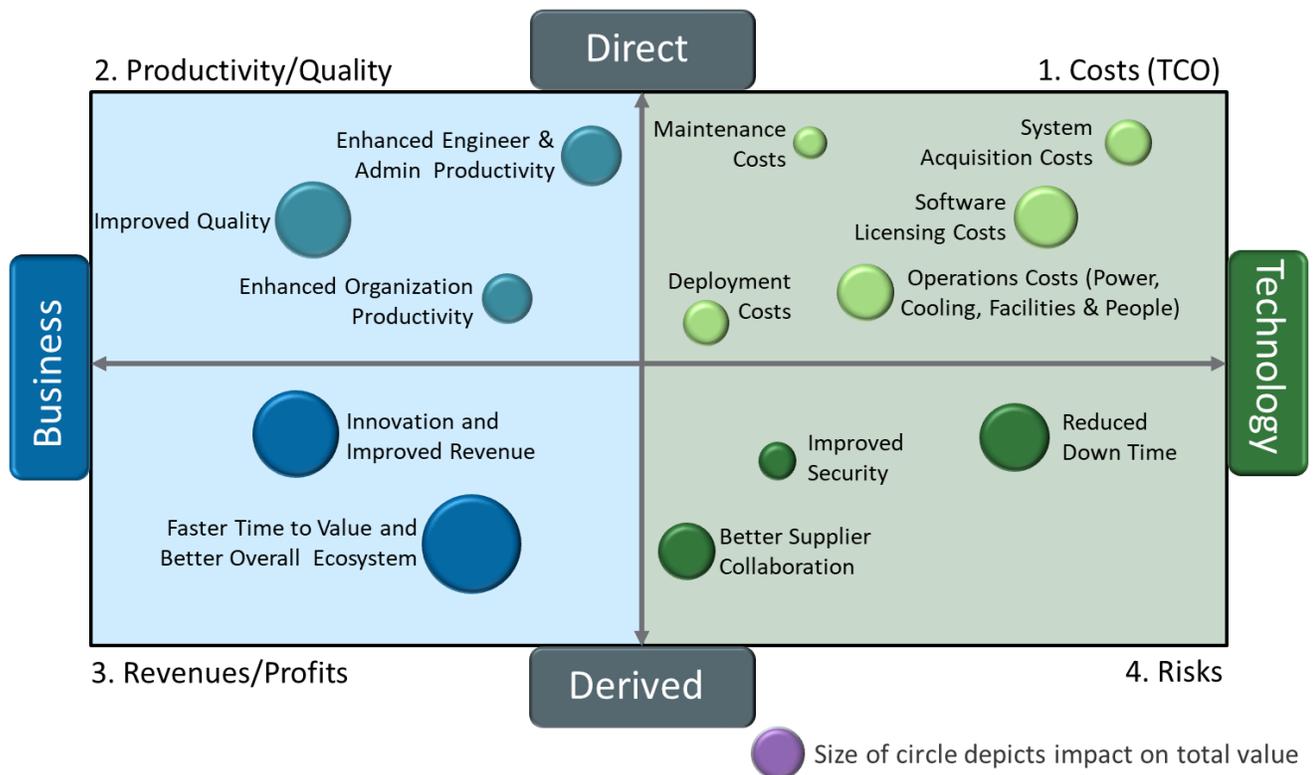


Figure 1: TVO Framework for CAE with Cost/Value Drivers

HPE servers, storage and software provide additional differentiation and value for CAE

HPE consultants have deep expertise in CAE applications and algorithms

TVO Framework organized by Technology/ Business and Direct/ Derived cost and value drivers

Key cost/value drivers identified and quantified holistically

Value includes lower costs, enhanced productivity/quality, higher revenues/ profits and reduced risks

The cost/value drivers for CAE are depicted as a circle whose size is proportional to the potential impact on a manufacturing client’s Total Value (Benefits – Cost) of Ownership or TVO as follows:

- 1. Total Costs of Ownership (TCO):** Typical costs include one-time acquisition costs for the hardware and deployment, and annual costs for software, maintenance and operations.
- 2. Improved Productivity/Quality:** The TVO model quantifies the value of productivity gains of administrators, engineers and the organization. It also estimates improvements in product quality.
- 3. Revenue and Profits:** Faster time to value with a better optimized and more comprehensive CAE ecosystem. Greater innovation capabilities for manufacturers spur growth, revenues and improve profits.
- 4. Risk Mitigation:** A streamlined process, lower system downtime and better business and IT understanding/collaboration with suppliers minimize cumbersome iterations in rework and delays. Improved security, process consistency and data quality mitigate risks of failed/poor analysis outcomes.

The TVO for both HPE and white box systems typically grow by CAE solution size, with key differentiated features in the HPE solution (detailed in the Appendix A) driving added value over white box alternatives.

Total Value of Ownership (TVO) for CAE – Results

The Cost-Benefit Analysis presented here quantifies the Total Value (Total Benefits – Total Costs) for three years of the HPE CAE Portfolio over corresponding white box clusters. Three configurations (Table 1) are analyzed: small, medium and large. All costs and benefits grow with configuration size for both HPE and white box clusters. HPE hardware acquisition and maintenance costs are assumed to be 10% higher than corresponding white box clusters for all cases.

TVO analysis for three configurations: small, medium and large

CONFIGURATIONS	SMALL		MEDIUM		LARGE	
	White Box	HPE	White Box	HPE	White Box	HPE
Number of Racks	0.20	0.20	1	1	4	4
Number of Servers	16	16	80	80	240	240
Number of Processors	32	32	160	160	480	480
Number of Cores	512	512	2560	2560	7680	7680
RAM (128GB / Server)	2048	2048	10240	10240	30720	30720
Storage (4TB / Server)	64	64	320	320	960	960

Table 1: CAE Configurations - Small, Medium and Large for HPE and White Box Clusters

Results for a Small CAE Configuration: Figure 2 depicts the costs and benefits mapped by each quadrant and value driver. HPE’s (Apollo 2000 Gen10 or Gen10 Plus System) slightly larger acquisition and maintenance costs are more than offset by higher client benefits in enhanced productivity and quality, higher revenues/profits and lower risks.

Small HPE Apollo 2000 Gen10 Plus System provides faster time to value and higher revenue/profits

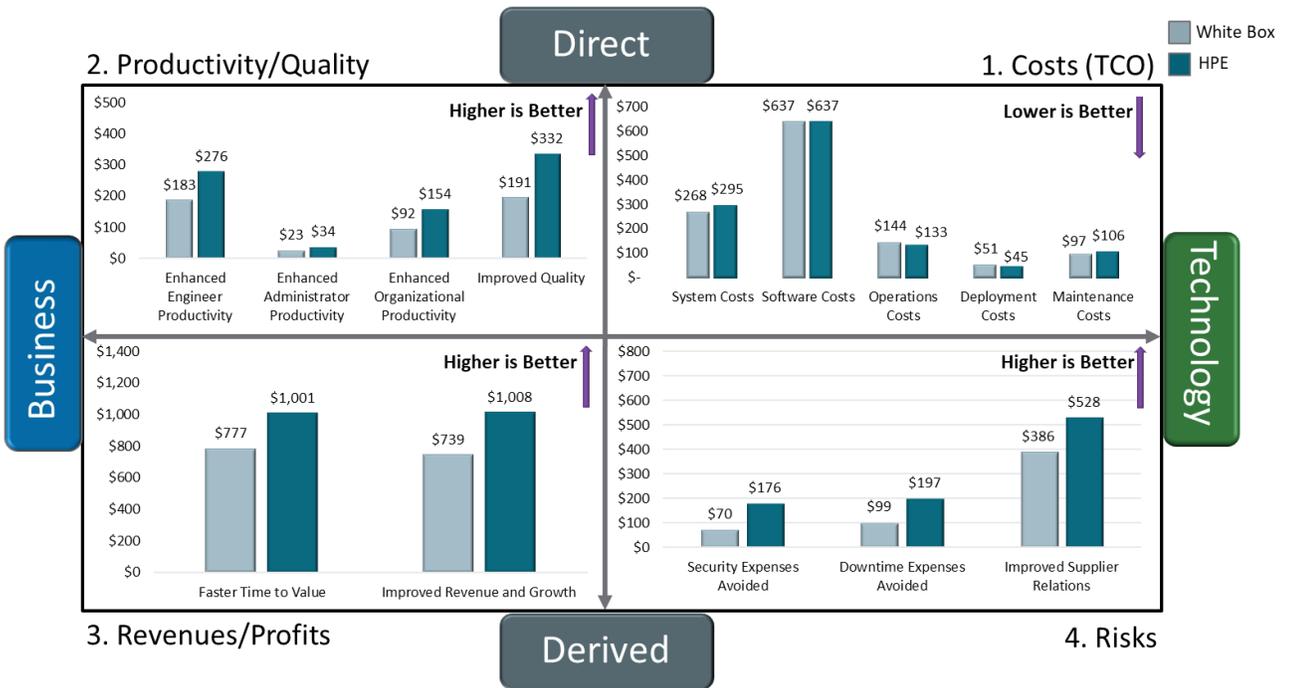


Figure 2: Costs and Benefits (\$K) by Driver for HPE Systems versus White Box Clusters (Small)

Results for a Medium CAE Configuration: Figure 3 depicts the costs and benefits mapped by each quadrant and value driver. Again, HPE's (Apollo Gen10 or Gen10 Plus System) slightly larger acquisition and maintenance costs are more than offset by even greater client benefits in enhanced productivity and quality, higher revenues/profits and lower risks.

Medium HPE systems deliver even more value

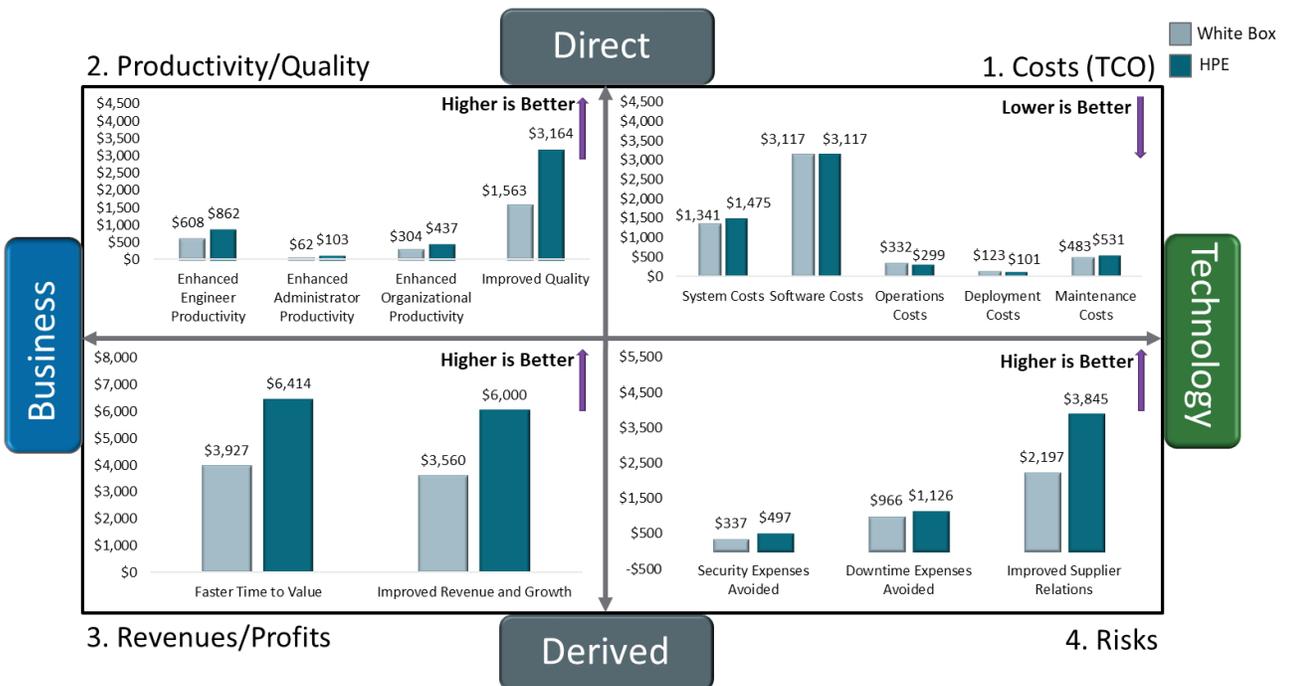


Figure 3: Costs and Benefits (\$K) by Driver for HPE Systems versus White Box Clusters (Medium)

Better productivity/quality, faster time to value, improved revenues/profits with HPE Apollo 2000 Gen10 Plus systems and Cray Air-cooled supercomputers

Results for a Large CAE Configuration: Figure 4 depicts the costs and benefits mapped by each quadrant and value driver. Again, the HPE Cray supercomputer's slightly larger acquisition and maintenance costs, including for liquid cooling, are considerably more than offset by even greater client benefits in enhanced productivity and quality, higher revenues/profits and lower risks. Manufacturers can get significant returns because of unique CAE capabilities that help drive radical innovation and have the potential of creating entirely new product categories.



Figure 4: Costs and Benefits (\$K) by Driver for HPE Systems versus White Box Clusters (Large)

TVO Model Assumptions and Discussion of Results

Most Total Cost of Ownership (TCO) models only quantify the costs in the top right quadrant. The TVO model outlined here not only considers these costs but also the benefits from the value drivers in the other three quadrants. For each configuration size, these costs and benefits are computed as follows:

- Costs:** HPE hardware acquisition (one-time) and maintenance costs (annual after year 2) are assumed to be 10% greater than the corresponding white box cluster. The licensing costs (annual) for CAE application software are the largest cost component and are assumed to be same for both alternatives. Electricity costs are \$.10/kWh. Same competitive salaries are assumed for personnel.

Compared with white box clusters, HPE systems lower data center facilities, power and cooling costs, and require fewer systems administrators to manage CAE environments; reducing operations costs (annual). Often pre-configured in the factory, HPE systems have easy to use integration templates for commonly deployed CAE applications. This helps lower deployment times (one-time cost) and improve productivity. All these differential savings with HPE systems increase with configuration size.
- Productivity/Quality:** With fewer downtimes and better streamlined/performance-optimized CAE solutions, HPE systems enhance the productivity of engineers. Systems administrator productivity for HPE systems is also enhanced with turnkey HPC cluster solutions and software for comprehensive ongoing node to rack to job management. Organizational productivity is further

HPE Cray supercomputers can drive radical innovation by solving large “intractable” problems

Despite slightly higher acquisition and maintenance costs, HPE systems lower deployment and operating costs for CAE

enhanced with other HPE value-added services tailored for the manufacturing industry. These productivity improvements and differentials grow with configuration size.

Manufacturers can improve the quality of products and the CAE process by easily integrating with other HPE Manufacturing solutions: Edge, IoT, AI (with GPU accelerators), etc., and detecting problems faster to reduce rework and costs. Greater Quality benefits accrue with larger configurations that enable more realistic Multiphysics CAE models.

- Revenues and Profits:** HPE solutions also deliver faster time to value through a better and more comprehensive ecosystem of CAE partners whose applications are optimized for predictable performance, scale, ease of deployment and integration. Value added HPC software from HPE and partners enable manufacturers to optimize complex CAE workflows and automate cluster installation which become very cumbersome for white box clusters as configuration size grows.

Manufacturers can innovate more and generate better new product ideas through deeper insights from more accurate Multiphysics applications which typically require larger configurations. This further improves a manufacturer’s competitive advantage, revenues and profits. Revenues and profits grow considerably with larger configurations consistent with other HPC ROI studies.

- Risks:** Manufacturers must mitigate risks which typically grow with configuration size. Better reliability, availability and serviceability (RAS) and security features in enterprise-grade HPE systems for CAE help manufacturers contain downtime and security expenses. HPE solutions also promote better collaboration with suppliers to further lower risks and drive revenues/profits.

Better ROI/Payback for CAE with HPE Systems Over White Box Systems

Key financial metrics for a 3-year time horizon for all three configurations for HPE and White Box clusters shown in Figure 5 include: Return on Investment (ROI) and Payback Period (PP).

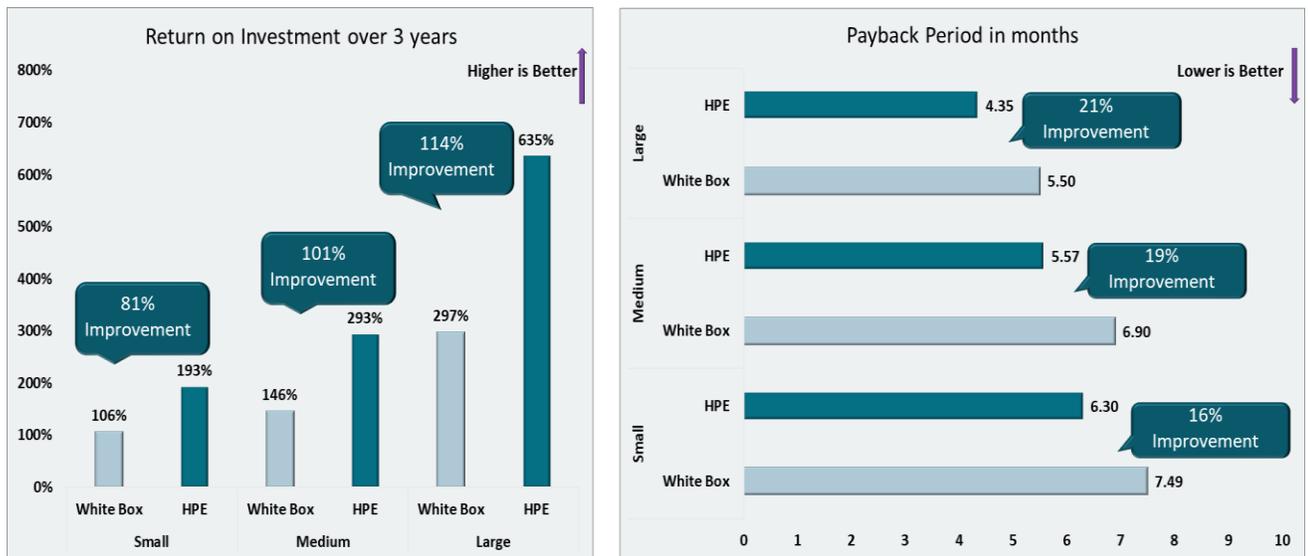


Figure 5: Better ROI and Payback Period with HPE Systems over White Box Systems

For all cases, the ROI and Payback Period improve as configuration sizes grow from small to medium to large. This is expected. As HPC systems scale, the differential value increases because of the very large business benefits for manufacturers driven by innovation and the ability to solve intractable problems; both critical for new product development.

HPE systems enhance productivity/quality, increase revenues/ profits and lower risks

ROI and Payback Period improve as configuration sizes grow

HPE consistently delivers better ROI and Payback compared to white box clusters

The percent improvements in ROI and Payback Period for HPE systems over white box systems also grow (Figure 5) with configuration size. This means as manufacturers grow their CAE footprint to drive more innovation and deploy AI, HPE systems will deliver better differential value compared to white box systems. HPE systems are also simpler to manage and operate on premises or in hybrid clouds.

Hybrid HPC Cloud:⁴ Public clouds can be attractive for some CAE workloads by providing flexibility, scalability, pay-per-use, and lower costs. However, they are either lower performing, expensive or hard to customize for the increasing diversity and complexity of many CAE workloads.

A hybrid HPC cloud combines or augments traditional CAE infrastructure with a private or public cloud to potentially offer a better solution for manufacturers to improve end-user experience, agility, economics and TVO. The [HPE GreenLake](#) consumption-based offering allows a manufacturer's engineering IT department to experience the same cloud-like benefits of fast deployment, scalability, and pay-per-use economics — all within the control of their own on-premises environment.

CAE and AI Integration: The use of AI is growing rapidly in manufacturing across the entire value chain and product lifecycle: from design, development to production and service operations (see Appendix B for more details). Major CAE application providers are adding AI capabilities to augment traditional physics-based simulation and help manufacturers accelerate innovation and improve operations.

Conclusions and Recommendations

Even with fierce cost pressures, manufacturers continue to grow investments in CAE, Analytics and AI to improve productivity and quality, grow revenues and profits, and mitigate risks. The ROI from CAE investments can be 100s of percent.

However, as data volumes, engineering model complexities and AI deployments grow, manufacturers need enterprise-grade HPC solutions to produce more realistic, reliable, actionable and time-critical analyses. As a market leader in CAE, HPE provides these HPC infrastructure solutions across compute, interconnect, software, storage and services, delivered on premises, hybrid or as-a-Service.

Compared with white box clusters, HPE delivers a more comprehensive portfolio of HPC systems and software, high-value services and the best ecosystem of CAE partners to help manufacturing customers maximize their Total Value of Ownership (TVO). Some key features/benefits of HPE solutions for CAE include:

- Faster time to value with factory pre-configured CAE and other software installed before shipping the system.
- Greater productivity with lower job completion times, higher throughput and less downtime.
- More new product ideas and innovation from deeper insights gleaned from solving very complex CAE problems with greater accuracy.
- Better employee and supplier collaboration with enhanced data quality, consistency, and security by keeping data within the data center and with remote visualization capabilities.

For manufacturers, these features/benefits (and the longer list in Appendix A) collectively reduce costs, enhance productivity and quality, drive revenues/profits, and mitigate risks.

The 3-year TVO analysis presented here quantifies all these cost/value drivers holistically for three configurations: small, medium and large. The ROI for an HPE solution ranges from 193% (small) to

⁴ <https://www.hpe.com/us/en/resources/solutions/hybrid-hpc-cloud.html?parentPage=/us/en/solutions/hpc-high-performance-computing>

Hybrid HPC Cloud
can improve ROI

CAE and AI
integration can
accelerate
innovation and
improve
operations

Manufacturers
continue to
invest in CAE,
Analytics and AI
despite cost
pressures

HPE delivers a
more
comprehensive
portfolio of HPC
systems and
software, high-
value services
and the best
ecosystem of CAE
partners

635% (large) while an equivalent white box cluster delivers an ROI of 106% (small) to 297% (large). This implies that HPE systems deliver a considerable ROI improvement of 81% (small) to 114% (large) over corresponding white box clusters.

Likewise, the Payback Period (PP) in months for an HPE solution ranges from 4.35 (large) to 6.30 (small) while the corresponding white box cluster delivers a PP in months of 5.50 (large) to 7.49 (small). This implies that HPE systems also deliver better Payback improvements from 21% (large) to 19% (small) over corresponding white box clusters.

Despite the small acquisition cost differential over commodity white box clusters, manufacturing clients deploying CAE and AI solutions should seriously consider HPE solutions for the following reasons:

1. The cost-benefit analysis and business case are compelling for all configurations.
2. The business value and ROI/Payback Period differential improve as configurations get larger.
3. This investment is protected and can continue to deliver even greater value for more complex analytics including the rapidly growing use of AI – all areas where HPE continues to invest heavily.
4. HPE is the market leader in HPC and is a reliable partner for manufacturers worldwide and provides unprecedented choice and flexibility for CAE.

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HPE systems produce a considerable ROI improvement of 81% (small) to 114% (large) over corresponding white box clusters

HPE provides market-leading CAE and AI solutions for manufacturers with considerable choice and flexibility

Appendix A: How HPE CAE Solution Portfolio Features Improve TVO

As a market leader in CAE infrastructure and with the inclusion of the Cray portfolio, HPE solutions provide the following features and client benefits that improve a manufacturer's product development ROI and reduce the payback period over white box systems:

1. **Lower TCO:** Even with slightly larger initial acquisition costs over corresponding white box systems, HPE CAE-enabled platforms improve operating costs by:
 - Enhancing CAE solution performance with the same or smaller data center footprint; potentially lowering CAE software licensing costs.
 - Reducing process and operations variability with more reliable and optimized CAE solutions.
 - Lowering data center facilities, power and cooling costs.
 - Requiring fewer systems administrators to manage CAE environments particularly large systems using HPE Cluster Management Tools.
 - Providing resilient and secure systems that are designed for ease of use for the Enterprise, and easy to service/upgrade.
2. **Improved Productivity/Quality:** HPE's unified compute, storage, networking and software solutions simplify system and data management to enhance productivity of engineers, administrators and the manufacturer:
 - Improved system performance
 - Optimized for CAE/AI application performance and performance at scale.
 - Designed to support a variety of high-performance CPUs and GPUs.
 - Optimized for large scale deployments – better density, reliability, and TCO (less cabling and less optical cabling required for larger clusters).
 - Comprehensive modular software portfolio for any CAE/AI customer workload.
 - Fully integrated system management software for deployment of any scale.
 - Slingshot interconnect and Cray Software enable cloudlike user experience on Cray systems.
 - Twice the density of traditional rack mount systems with a flexible scale-out architecture for CAE workloads
 - Comprehensive system management with HPE Performance Cluster Manager
 - Enhanced productivity of engineers by:
 - Improving the efficiency and effectiveness of users by streamlining the process, automating critical bottlenecks, minimizing downtime and system outages.
 - Delivering purpose-built, secure platforms for extreme performance, scale and efficiency for time-critical actionable product development insights.
 - Decreasing job completion times and increasing throughput for CAE solvers.
 - Performing larger, more detailed simulations and potentially solving the “unsolvable”.
 - Evaluating more design variations before expensive real physical prototyping.
 - Enhanced productivity of administrators by providing:
 - Integrated turnkey HPC cluster solutions with compute, storage, networking and software.
 - Simplified setup, deployment and built-in diagnostics.
 - Easy integration (often in the factory) with existing IT infrastructure and policies.
 - Extensive set of tools for comprehensive ongoing node to rack to job management.
 - Organizational productivity is further enhanced with other HPE value-added services that deliver:
 - Expertise to advise, deploy, integrate and support throughout the design and analysis process.
 - Easy to use integration templates for commonly deployed CAE applications.

Lower TCO with reduced operating and deployment costs

Better system performance

Improved productivity of engineers, administrators and organizations

Higher product/process quality

- Pre-configured, customized and optimized CAE solutions pre-built at the HPE factory.
- Global 24 x 7 x 52 Support to expedite problem resolution.

HPE solutions also allow manufacturers to improve the quality of products and the CAE process by:

- Integrating easily with other HPE Manufacturing solutions i.e. Edge, IoT, Machine Learning, etc.
- Better interpreting technical requirements and eliminating ambiguity in original requirements.
- Detecting problems much faster, deploy and monitor fixes, and reduce rework and costs.

3. Higher Revenue and Profits: In addition to enhancing productivity and quality, HPE solutions also deliver faster time to value through a better and more comprehensive ecosystem of CAE partners:

- Faster time to value with:
 - Preconfigured CAE and other software before shipping the system lower deployment and runtimes for design prototyping.
 - Streamlined and automated processes across compute, storage and fabrics.
 - Increased scaling and performance on latest x86 processors from Intel and AMD.
 - Reduced cluster installation times with simple, automated installation process provided in various HPE cluster software solutions:
 - Installing a cluster from scratch, or using open-source toolkits, can be time-consuming.
 - May require specialized, scarce and often expensive skills.
- More comprehensive and better-optimized CAE (and Manufacturing) ecosystem:
 - HPE is the market leader in HPC and a top technology partner for CAE application providers.
 - HPE systems deliver twice the density of traditional rack mount systems and firmware-level server security with a flexible scale-out architecture for Analytics and HPC workloads.

In addition, manufacturers can drive innovation, revenues and profits with HPE systems.

- Drive more innovation and develop smarter products by:
 - Spurring new product ideas from deeper insights gleaned from solving more complex Multiphysics problems with greater accuracy.
 - Addressing intractable problems through supercomputing.
- Improved revenues and profits with:
 - Faster applications performance which allows more CAE simulations and virtual prototyping; translating to better products than competition and first-mover advantage for manufacturers.
 - Optimized, ready to deploy configurations.

4. Risk Mitigation: Better reliability, availability and serviceability (RAS) and security features in enterprise-grade HPE systems for CAE help manufacturers contain downtime and security expenses. HPE solutions also promote better collaboration with suppliers to lower risks and drive revenues/profits.

- Reduced downtime with:
 - Highly reliable system with very stringent Service Level Agreements (SLAs). HPE systems have more than 99.99% availability – larger than standard white box rack systems.
 - Deep HPC expertise and enterprise-level support allow manufacturers to resolve issues faster than with a typical white box solution provider.
 - Global 24 x 7 x 52 help desk availability and HPC Center of Competency.

Higher revenues and profits because of faster time to value, better ecosystem and increased innovation

Lower risks with reduced downtime

- Better and unique security down to the silicon on HPE systems to protect your data:
 - Silicon Root of Trust.
 - Secure Recovery.
 - HPE Secure compute lifecycle
 - Better security features in HPE DIMMS memory.
 - Two Factor Authentication through Common Access Card (CAC).
 - Server Configuration Lock.
 - Security Dashboard.
 - Security Hardening Support.
 - CNSA Suite (former NSA Suite B).
 - Prevention of firmware attacks from OS.
 - Detection of Compromised Firmware.
 - Firmware Runtime Verification.
 - Chassis Intrusion Detection on most servers.
 - HPE Rack Cabinet Door Detector.
 - Verified Boot.
 - Trusted Execution Technology.
 - Security Information and Event Management (SIEM) Tool Support.

- Better supplier collaboration by:
 - Enhancing data quality, consistency, and security by: keeping data within the data center and involving suppliers in the quality process, robust reporting and making risk-based decisions.
 - Ensuring business processes are extended to external teams, and across the value chain especially with the pervasive reliance on suppliers and the complexity of products.
 - Establishing secure and efficient processes that exchange design data from Computer Aided Design (CAD) systems and incorporate efficient methods for sourcing new parts from suppliers during product development.
 - Streamlining automation between HPE Performance Cluster Management and other platforms with the Partner Connector Program.

Appendix B: Analytics, CAE and AI Integration

For some time, manufacturers have been aware that they are drowning in data but starving for insight. To get deeper and actionable insights from their massive data volumes, they are investing in Analytics.

Consequently, the global Manufacturing Analytics market is projected to reach \$19.47 billion by 2025, growing at 22.01% annually.⁵ Key growth drivers include several disruptive technologies: Internet of Things (IoT), Augmented/Virtual Reality, 3D Printing, Robotics, and new forms of human-machine interactions – touch, speech and visual processing based on AI.

As data gathering techniques improve and volumes grow, manufacturers are also increasingly using higher value analytics and moving from descriptive (what happened) to predictive (what could happen) to AI (Figure 6).

This is driving an over 40% annual growth in the global AI technologies market for Manufacturing which is projected to be \$16 billion by 2025.⁶

Likewise, CAE has evolved from simulating simple physics at a component/part level to large-scale, coupled multidisciplinary, iterative modeling of complex systems.

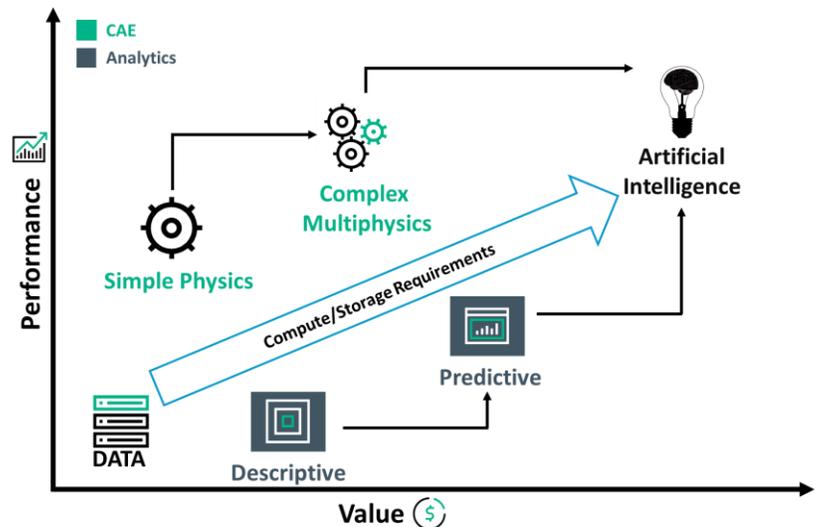


Figure 6: Integration of CAE with Analytics and AI

This stepwise trend is driving up computing and storage requirements for Analytics, CAE and AI particularly as they get integrated. It is also producing many high-value manufacturing AI use cases across the product lifecycle — from design and development to production and service operations.⁷ These include Failure/defect analysis, Predictive maintenance, Supply chain management, Cost/quality management, Facilities/asset management, Price/service optimization, and more.

As an example, by combining and complementing physics-based CAE models with AI-enabled image processing, it is possible to detect and predict product anomalies and failures during manufacturing or when the product is in operation. This predictive capability helps manufacturers take optimal corrective actions during design and development to further improve product quality and accelerate the new product development process.

These manufacturing AI use cases require a High Performance Computing (HPC) solution. So, HPC-based AI revenues are expected to grow 29.5% annually⁸ as more companies integrate AI to enhance productivity, innovation, operations and customer engagement.

⁵ <https://www.marketwatch.com/press-release/manufacturing-analytics-market-key-facts-and-forecast-predictions-presented-until-2025-2019-12-17>

⁶ <https://www.marketwatch.com/press-release/ai-in-the-manufacturing-sector-market-analysis-to-2025-new-technologies-transforming-the-global-industry-2020-02-18>

⁷ <https://www.hpe.com/us/en/pdfViewer.html?resource=/content/hpe/country/us/en/resources/servers/nvidia-galvanize-manufacturing&parentPage=/us/en/solutions/hpc-high-performance-computing/deep-learning×tamp=1584211998143&isGated=true>

⁸ <https://www.enterpriseai.news/2019/11/21/hyperion-ai-driven-hpc-industry-continues-to-push-growth-projections/>

Manufacturing Analytics market is growing 22.01% annually

AI technologies market for Manufacturing growing 40% annually and producing many high-value use cases

CAE and AI integration can further improve quality and accelerate product development

HPC-based AI expected to grow 29.5% annually