High-Performance Computing: Game Changer in the Manufacturing Industry

Increase Agility and Innovation in Process and Product Development with Simulation, Modeling, and Data Analytics

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Navigating this White Paper

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Introduction

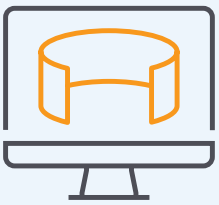
Industrial enterprises are currently caught between the challenging poles of geopolitical uncertainties, rising energy prices, raw material shortages, supply chain disruptions, skilled labor shortfalls, and the growing importance of sustainability. At the same time, digitalization is wreaking a fast-paced, fundamental change in the value creation process of manufacturing enterprises and is driving business, productivity, and long-term competitiveness.

So it is all the more important to have a holistic, consistent and reliable information and data base to speed up innovative industrial product development and manufacturing processes, and above all, to develop new (digital) products, services, and business models that save resources. The main enabler in this instance is the adaptation of modern technologies as part of industrial transformation and effective digitization measures. Based on modern IT technologies and analysis methods, IT-based simulation, modeling and analysis count as key solution approaches. They optimize current industrial processes and create scope for innovation. Thanks to its efficiency and new usage models, in combination with cloud solutions for example, high-performance computing (HPC) unlocks additional opportunities for industrial enterprises to promote agility and digital transformation.

This IDC White Paper examines the goals and challenges relating to the use of industrial simulation, modeling, and data analysis, as well as the use of HPC infrastructures for their calculation. The paper also describes specific usage scenarios and success factors. In December 2021, IDC conducted a telephone survey of 200 IT and departmental decision makers from enterprises in the discrete and process manufacturing industries with more than 500 employees in Germany, Austria, and Switzerland. All respondents make or influence decisions in their enterprises relating to the use of IT-based simulation, modeling, and data analysis.

Simulation and modeling

Simulation and modeling include techniques, methods and processes for the data-based mapping or replication of real processes and scenarios. Simulations and models can be used to explore the influence of different variables and external influences on processes and scenarios.



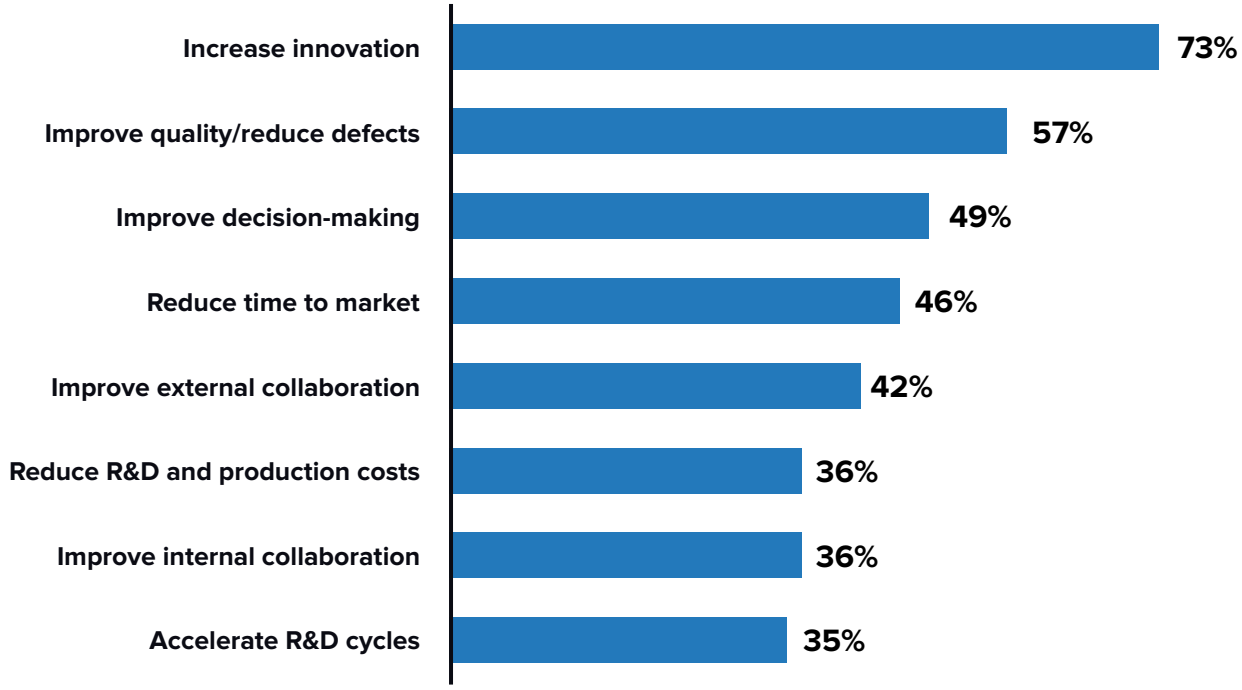
Using simulation, modeling, and analysis to increase industrial innovation

Both the industrial products and the value creation processes and supply chains underpinning them are complex, intricate systems with an infinite number of parts, modules, and groups that have to interact perfectly. Customer expectations with regard to quality and service, cost and competitive pressures have also increased. Over the years, calculations, prototypes, and tests have become all the more important to ensure in advance that products and production processes function as expected and are cost-effective. A world without industrial simulation and modeling is hard to imagine, and digital support with CAD, CAM, and CAE (computer-aided design, engineering, and manufacturing) software has long been an established fixture of value creation in manufacturing. For several years, this has also included software support with 3D displays, which are already used by almost two-thirds of the industrial enterprises surveyed to assist product development and manufacturing processes and which almost all enterprises surveyed aim to use in the next two years.

Manufacturing enterprises closely link simulation, modeling and analysis to the fulfillment of key business goals. The potential to increase innovation is particularly significant and is deemed most important by three-quarters of respondents. Calculations of this nature are aimed at speeding up product development and time to market, at reducing costs and firming up the basis for decision making in response to rising competitive pressure.

FIGURE 1

Business objectives of simulation, modeling, and data analytics



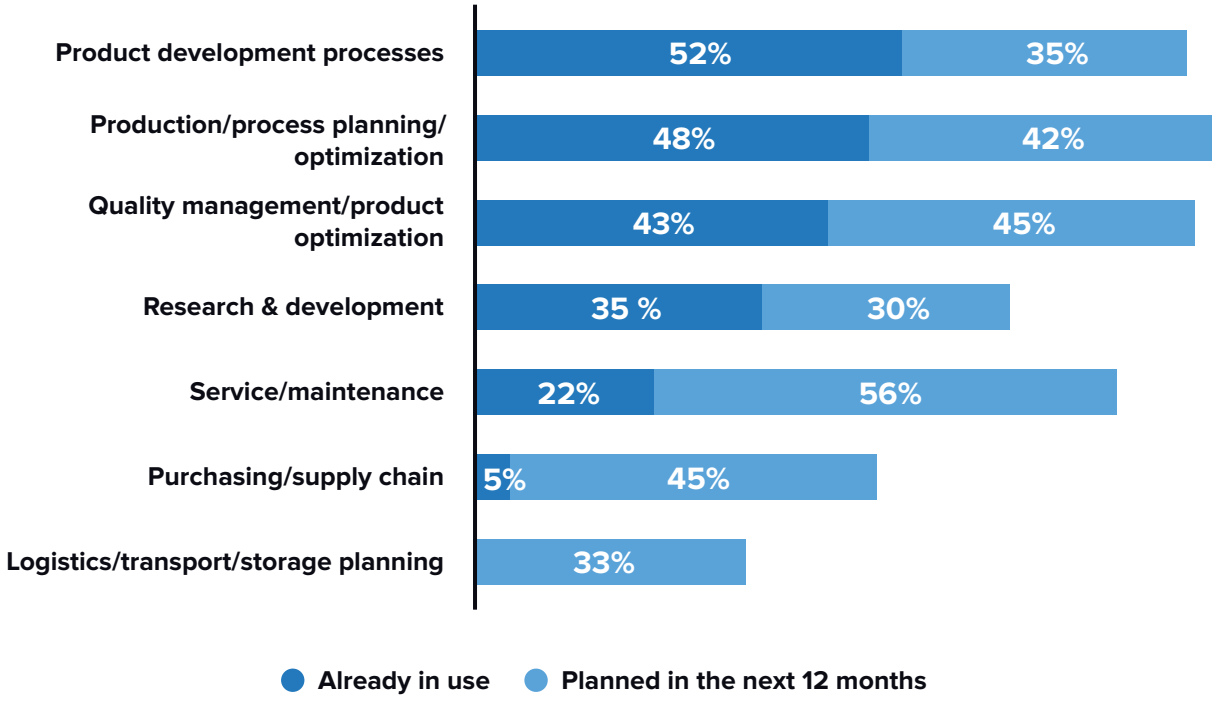
N=200 enterprises; multiple answers possible; source: IDC, 2022

In IDC's view, especially for industrial enterprises in Germany, Austria and Switzerland, in addition to innovative power, quality is a significant competitive factor in view of the competition from the many toll-manufacturing countries, which are catching up strongly with new and modern products. 57% of decision makers regard simulations, models, and data analysis to be an important means of improving product and service quality and avoiding defects, and more importantly, the resultant negative user experiences.

In around half of the manufacturing enterprises surveyed, simulation, modeling, and analytics are already used in product development and production and process planning, closely followed by quality management. Within the next two years, the degree of deployment in each of these areas is set to rise to as high as 90%, with almost two-thirds of the respondents planning relevant investments.

FIGURE 2

Degree of deployment of IT-based simulation, modeling, or data analytics at the various value creation stages



N=200 enterprises; multiple answers possible; source: IDC, 2022

"At Bridgestone, we use simulation and data-driven models to further optimize our whole manufacturing process. This means improving the efficiencies, reducing the defects, and increasing the quality and sustainability of our production."

Wolfgang De Salvador, R&D Coordinator for R&D Virtualization, Bridgestone EMIA

Despite the increasing support of industrial processes with efficient software enabling ever better calculations, the potential has not yet been exhausted. In most industrial enterprises, deployment at all value creation stages, from development and production to logistics and service, can be further promoted. However, this alone will not suffice to achieve optimum digital support of value creation, because in many enterprises data silos frequently arise due to the absence of a holistic data strategy. It may even result in every department in the same process chain using different information and data or their "own truth" as the basis for simulation, modeling, and analysis. An important task in IDC's opinion is therefore to integrate data sources and create a unified information base as a "single source of the truth" for all concerned. This is the only way digitalization can realize its full potential to enable seamless integration, increased efficiency, and an acceleration of value creation chain through end-to-end, cross-departmental process chains and to increase innovative power.

In addition to internal information flows, in-house collaboration and the integration of value creation processes, IT-based simulation, modeling, and analysis can also support data communication with external partners in the value chain, and with innovation alliances and industrial ecosystems. The latter, in particular, will play a key role in the future. Data and application sharing, as well as collaboration with other enterprises in the same and other industries, such as healthcare, finance, or insurance, has major potential for new innovative products, services, and business models.

64% of the industrial enterprises surveyed plan to invest in modern simulation, modeling, and high-performance data analytics.

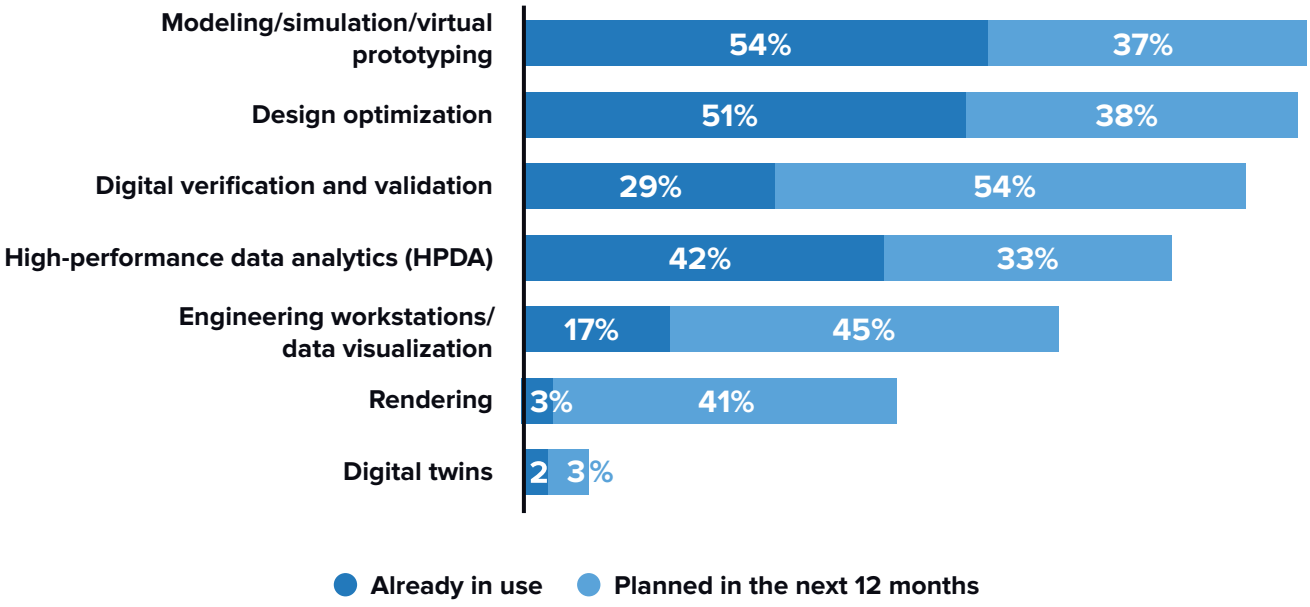
IT technologies as an enabler of new usage scenarios

The huge advances in the development of information technologies have also significantly expanded the usage scenarios for IT-based calculations on the production front. Meanwhile, it is now possible to improve the entire industrial development and manufacturing process with IT applications.

- More than half of the industrial decision makers surveyed already use simulation, modeling, and virtual prototyping to virtually test the feasibility and envisaged functionality of products as early as possible. Development processes can be speeded up significantly since building prototypes and physical tests have been largely eliminated. Simulation-based digital twins of products or processes are set to further reduce the gap between physical product performance and digital product development. The use of IoT and sensor data from ongoing product operation and digital twins enables a digital feedback loop, which provides developers with additional information for product development.
- Similarly, in the case of IT-based design optimization, the ratio of material deployment to technical benefit is maximized with the help of mathematical optimization.
- IDC identifies an important addition in the shape of digital verification and validation. It is just as easy for a process-focused manufacturer to test a virtual car tire in various terrains and weather at high mileage as it is for a discrete manufacturer in the aircraft construction industry to test the impact of air pollution on the longevity of wings and engines.
- Holistic analysis is required for many applications in which the data volumes or computing operations are very extensive, for example when learning AI/ML algorithms. 42% of the enterprise surveyed already use high-performance data analytics (HDPA) to ensure fast calculations for use in business decision-making processes.

FIGURE 3

IT technologies in product development and production planning



N=200 enterprises; multiple answers possible; source: IDC, 2022

"Establishing data integrity from design to manufacturing is the key challenge in the manufacturing world today. In our vision, we want to create the complete product life cycle connecting the different parts of the physical and virtual world together into one, fusing virtual simulation data with real world metrology and quality data."

Jessica Zheng, Head of Virtual Manufacturing and Costing CoE, Design & Engineering Business Unit, Hexagon Manufacturing Intelligence

"Digitization and data are key to our corporate strategy. To govern processes end to end, to retrieve clean and connected data, and to centralize all the data across all processes will provide extra value, extra capabilities, and a good level of flexibility. In turn, this will enable new scenarios, products, and business models that are not possible if data is handled in different and isolated silos."

Luigi Lobello, IT Digital Innovation Leader, Bridgestone EMIA

39 % of respondents try to virtually simulate and model as many physical processes as possible.

“Manufacturing is getting ever more intelligent and there is a need to couple feed-forward CAE data loops with feedback manufacturing and life-cycle data loops that are fully integrated. Traditionally, if there is a difference in production quality, the process would be stopped, analyzed, and fixed. With manufacturing data intelligence integrated into the process, for example based on reduced order engineering simulation models instead, adjustments can be made during the manufacturing process and to the process workflow itself without the costs of maintenance and downtime.”

Mahesh Kailasam, General Manager, Design & Engineering Business Unit, Hexagon Manufacturing Intelligence

"The digital twin of a tire provides significant benefits in efficiency and sustainability — cutting development time, raw materials use, and CO2 emissions — along with offering greater accuracy and flexibility. Tire development can be cut by up to 50% using a virtual environment and thereby reducing a vehicle's time to market."

Wolfgang De Salvador, R&D Coordinator for R&D Virtualization, Bridgestone EMIA

Technology trends for industrial development and manufacturing

Data Visualization and Engineering Workstations as a Service

Visualizing data and information is an essential component promoting sharing between different development teams and improving its efficiency, when engaging in collaborative design, for instance. Every team in the development and production process has to have constant access to the latest information for its own work steps. Modern engineering workstations provided "as a Service" by datacenters drawing on a common data pool and based on visualization and cloud technologies can help with this. Combined with modern forms of data presentation such as augmented and virtual reality (AR/VR), development processes can be reimagined.

Detailed insights and digital products and services with digital twins

One technological development with major potential in IDC's view is digital twins. Using data, processes, production plants, and products can be mapped digitally down to the last detail. This digital image can be permanently monitored and analyzed to detect problems on the real object or better still avoid them without having to disrupt the process. It can also be used to simulate hypothetical scenarios – to test changes in processes or to simulate the long-term operation of a product in terms of quality management. The benefits of digital twins do not stop there. They can be used as virtual platforms that combine data from producers, operators, customers, and other ecosystem partners for new products and services. IDC is therefore confident that digital twins will prompt a wave of new, innovative business models as they mature. This includes services such as data-based usage optimization for products and new sales models in which the product's benefits are sold instead, in the form of a "Product as a Service" or "Outcome-based Service".

Infinite usage scenarios through combination and integration

Further added value can be achieved by combining various IT solutions that utilize IT-based simulation, modeling, and data analysis, thus enabling the support of specific usage scenarios and many different kinds of workloads. From finding new substances (drug discovery) with the help of established machine learning in pharmacy to developing and simulating rubber products in tread profiles during tire production to testing planned functions by simulating systems in mechanical engineering – the possibilities are infinite.

Top 5 application scenarios in manufacturing sectors

Pharmaceutical products		Chemical products, rubber and plastic products, and other process manufacturing		Automotive, mechanical engineering, electrical, electronic, and optical products and other discrete manufacturing	
Machine learning, deep learning	100%	Simulations of reactivity, stability of products/ additives	41%	Simulations of machines or plants	58%
Simulation of products for quality management	60%	Simulations of adhesion and absorption	35%	Collaborative design	53%
Active pharmaceutical ingredient (API) formulation and physiochemical characterization	48%	Chemistry, drug or material discovery	33%	Simulation of products for quality management	38%
Bioinformatics and genomics	36%	Modeling of new molecules, substances or reagents	29%	Virtual prototyping	31%
Simulations of machines or plants	36%	Simulations of machines or plants	21%	Modeling of design plans and machine parks	24%

N=200 enterprises; multiple answers possible; source: IDC, 2022

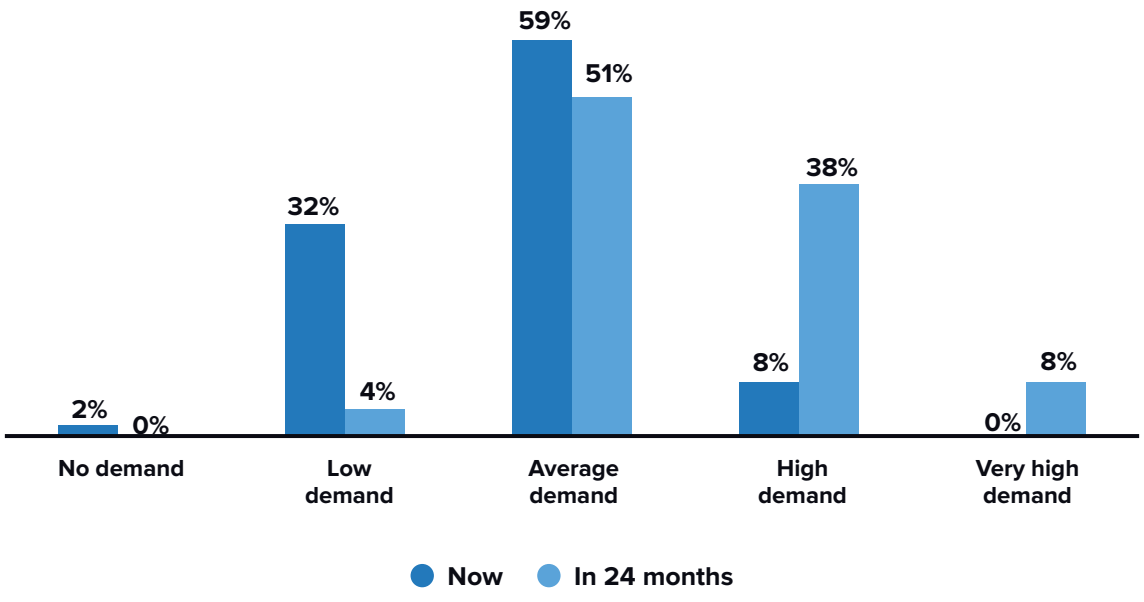
High-performance calculations to keep enterprises ahead of the curve

Industrial simulation, modeling, and analysis is based almost exclusively on complex computing operations. The underlying calculation methods and algorithms are improving all the time, which is both a blessing and a curse. While on the one hand, the quality and reliability of results are greatly improving, on the other, calculations are taking longer, with increasing complexity, when the available hardware is limited. For this reason, industrial enterprises are frequently faced with a trade-off in their calculations between time and quality or accuracy. They have to simplify simulations and modeling to the extent that they do not hamper development processes, rather than accelerate them, but, if necessary, with corresponding consequences for the validity of the results. Many face the additional difficulty of modern calculation methods meeting old or conventional IT infrastructures and possibly generating high costs for the delivery of computing power. The simulations used by 42% of respondents are already outdated or inaccurate.

The ability to perform high-performance calculations is therefore becoming a significant competitive factor. It enables usage scenarios based on modern simulation and modeling techniques and has a major impact on the speed of calculations. IDC anticipates a significant increase in demand for high-performance calculations, which is also confirmed by the manufacturing enterprise decision makers interviewed. Currently, only 8% identify a high demand for such calculations, which require high performance, yet in two years' time, almost half of all respondents are expected to do so. Half of the respondents already admit that iterations and calculations take too long. Developers therefore have to wait for their simulations and analysis due to a lack of computing capacity, further delaying the development process.

FIGURE 4

Development of demand for high-performance calculations



N=200 enterprises; source: IDC, 2022

HPC as game changer for product and process innovation in industry

Enterprises in the discrete manufacturing and process industries that project high or very high demand for high-performance calculations,can benefit significantly from the use of high-performance computing (HPC). HPC comprises technologies and methods to efficiently perform complex calculations. Aggregated high-performance computing facilities are generally used for this purpose, with work orders being processed in parallel on multiple connected systems.

Indeed, four out of five industry decision makers surveyed agree that HPC is a game changer for product and process innovation. Various reasons support this premise.

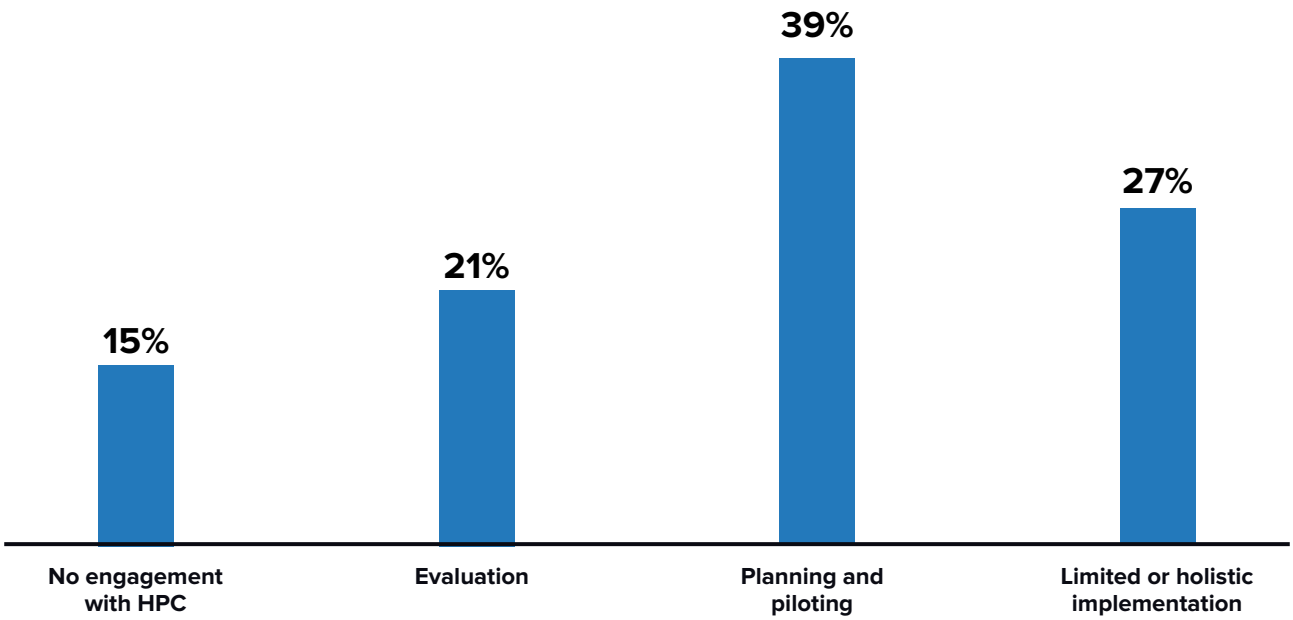
- **HPC enables completion of complex calculations.** Many statistical analysis methods and mathematical optimizations that could be used in production were hardly viable even for the supercomputers of recent decades. Thanks to advances in HPC, such as the increasingly efficient parallel performance of computing operations, optimized processor architectures for special computing operations, faster memory cards and improved connectivity, it is now possible to carry out highly complex simulations, modeling, and data analysis.
- **HPC increases the quality and intensity of use.** The high computing power enables high-quality simulations, modeling, and analysis to be carried out more quickly. This acceleration enables more iterations to be performed, increasing the quality of findings and intensity of usage when freed-up computing time can be used to perform new alternative calculations.
- **HPC unlocks new usage scenarios.** By expanding technological options, industrial enterprises can implement usage scenarios that were previously confined to scientific institutions with supercomputers at their disposal. In addition, it enables developers to create new, individual application possibilities that are tailored to their enterprises.
- **HPC increases innovation and agility.** Thanks to multiple deployment options and a higher number of analyses in a shorter space of time, all departments in the value creation process can integrate complex calculations into their development, planning, and production processes, and so on, to speed them up and make them more agile. So not only can more new ideas be developed, tested, and implemented faster, but new digital products, services, and ultimately even business models can be realized on the basis of the new data.

IDC therefore anticipates that established multicore workstations will be replaced by HPC environments for many high-performance workloads. More than a quarter of the enterprises surveyed already use professional HPC infrastructures for their high-performance calculations, and another 39% plan and are piloting deployment. Only 15% of the enterprises surveyed are not currently engaging with HPC, ascribing the fact to high investment costs, scant appreciation of deployment opportunities, and the newness of the topic.

Due to the high relevance and the additional innovative power that HPC offers industrial enterprises, IDC believes that using HPC-based simulations, modeling, and data analysis will be routine in many enterprises within a few years.

FIGURE 5

Degree of HPC deployment in industrial enterprises



N=200 enterprises, source: IDC, 2022

81% of respondents view HPC as a game changer for product and process innovation, with the figure rising to 96% for enterprises that have already implemented HPC.

"In addition to speed and agility, digitization, simulations, and CAE modeling drives quality, which is the main value of Hexagon's manufacturing intelligence division."

Mahesh Kailasam, General Manager, Design & Engineering Business Unit, Hexagon Manufacturing Intelligence

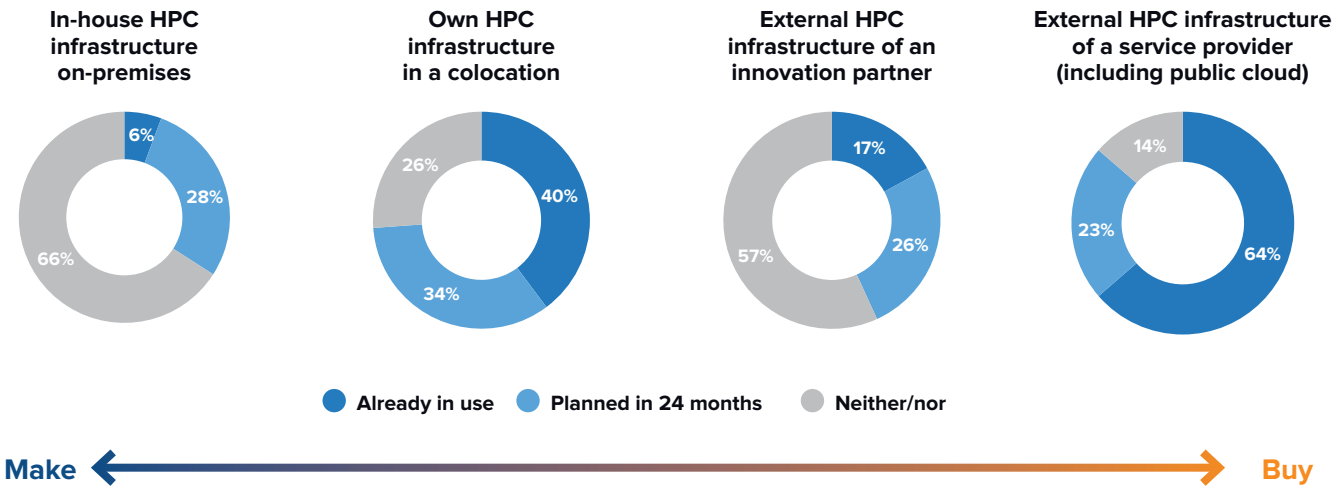
Limitations and challenges in current HPC usage

Performing HPC calculations hinges on the availability of suitable IT infrastructures that is specialized in carrying out complex calculations. Basic options include the setting up and use of in-house HPC environments or the use of external HPC infrastructure. A variety of options are used to carry out HPC workloads

- The majority of enterprises surveyed are currently focusing on outsourcing as much of the workload as possible and not running the HPC environment themselves. Consequently, 87% of HPC users prefer external HPC infrastructures for their existing HPC workloads from cloud providers, for instance, or are planning to use them.
- Another possibility is to run the explicit HPC infrastructure themselves, while outsourcing datacenter support infrastructure such as a reliable power supply or cooling system — colocation. In fact, 74% operate or are planning their own HPC infrastructure in external colocation datacenters.
- Innovation partners such as scientific research institutions with an HPC infrastructure are also being used or planned by 43% of the industrial enterprises surveyed. In the light of the preference given to scientific projects and the long waiting times, they are only suitable to a certain extent for time-sensitive, commercial HPC deployment.
- Only 6% of current HPC users have their own HPC infrastructure in an on-premises datacenter and 28% plan their use in the next two years. Of the surveyed manufacturing enterprises that only plan to use HPC in the future, only seven intend to set up their own on-premises infrastructure. And most of them would like to use external infrastructure to benefit from the agility a service provider can offer compared to their own enterprise.

FIGURE 6

HPC environments for performing HPC workloads



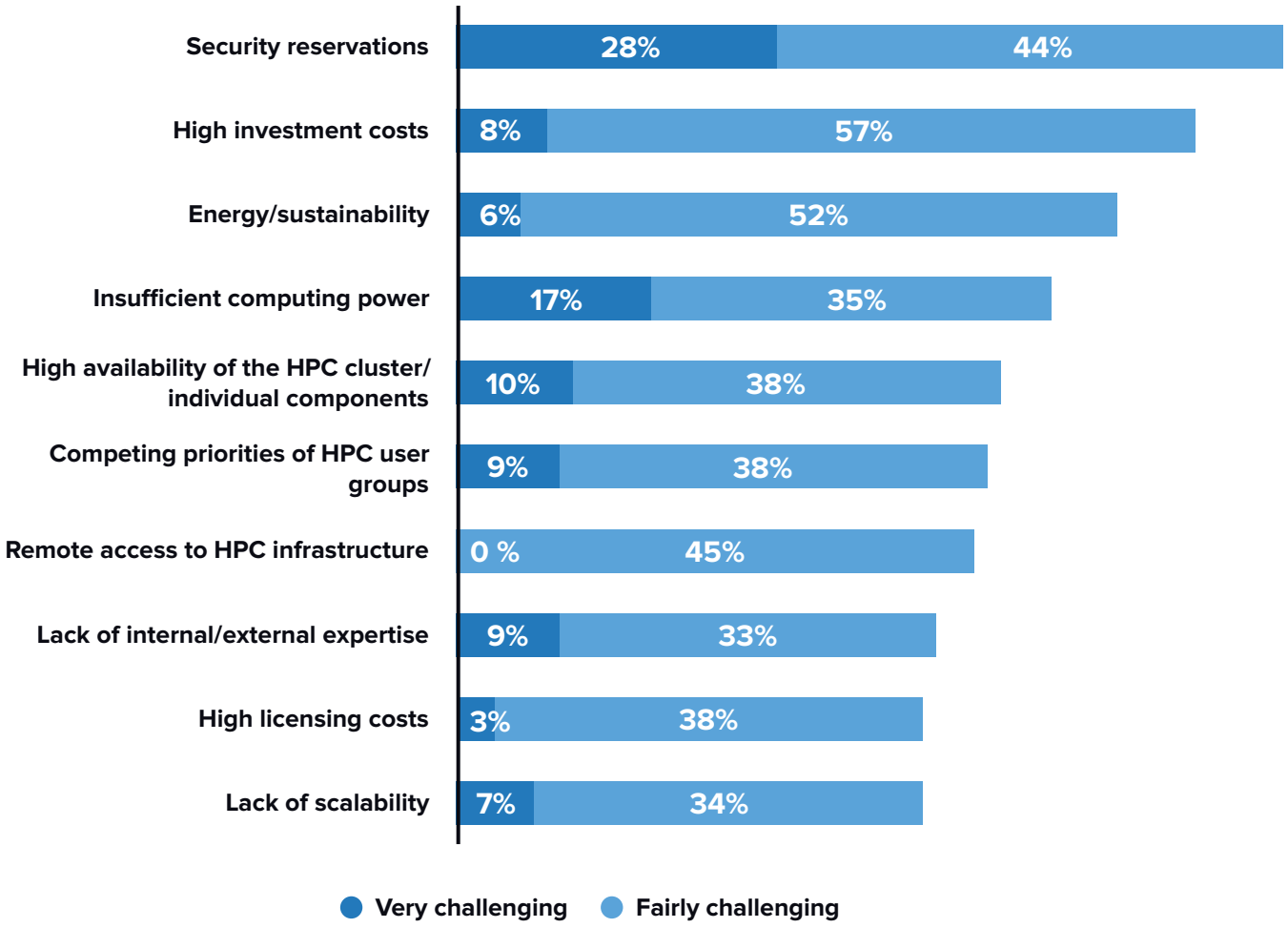
N = 88; only enterprises that already use HPC; source: IDC, 2022

The different scenarios for using HPC come with many challenges that need to be resolved. Mounting cyber criminality and spying activities are increasing pressure on industry to protect intellectual property. For this reason, security concerns top the agenda for 72% of respondents. When using external HPC infrastructures or colocation datacenters, for instance, sensitive data has to leave the company, potentially exposing it to risk. Yet in-house data processing is also vulnerable to dangers such as espionage and ransomware.

Building their own HPC infrastructure requires major investment and operating costs as well as regular updates to guarantee continued flexibility and agility when performing simulations, modeling, and data analysis. In addition to operating costs for hardware, licensing costs especially can be formidable because in the case of many vendors, they frequently depend on the number of CPUs in HPC workstations or clusters, even if the former are not used all the time or to full capacity. This goes some way to explaining why on-premises HPC operation tends not to be used or planned. Ultimately, the expense involved in delivering HPC and the actual use of analysis must be balanced. So for those that use their HPC infrastructure intensively all the time, running their own may actually be more advantageous.

FIGURE 7

Challenges involved in the use of HPC



N = 88; only enterprises that already use HPC; multiple answers possible; source: IDC, 2022

Another key issue for 58% of respondents is the high energy consumption and sustainability of HPC. Rising energy prices and growing calls for the quantification of CO2 emissions have a major influence on energy-intensive HPC. In industry, both are fundamentally important and hotly debated factors. Thanks to the modernization of HPC infrastructures and new architectures that have a positive effect on energy consumption and the amount of hardware required through improved energy and computing efficiency, at least the impact on sustainability can be reduced.

There are also many technical requirements. Many of the respondents identify computing power as an inhibiting factor. Inadequate computing performance and short-term load peaks that cannot be satisfied have negative effects on the duration, frequency, and accuracy of calculations. Ensuring high availability of the HPC infrastructure is also testing for many industrial enterprises. Furthermore, HPC infrastructures need to be optimized or updated regularly and cause problems due to their complexity. In fact, it is not an infrequent occurrence for HPC infrastructure to be unavailable for calculations for several weeks or even months every year. These and other issues such as remote access, the scalability of the HPC cluster, or costs can be resolved and optimized by expanding, adapting, or combining HPC operating models.

39% of respondents think that sooner or later they will need external support to implement their HPC plans. The lack of internal and external expertise is another challenge of the day for 42% of HPC users.

"Today's main engineering simulation challenges are throughput and the ability to run larger models more quickly — user productivity. For instance, we are finding that customers want to run ten times larger models in half the time without losing accuracy. Product development and R&D teams need to investigate baselines and figure out what is needed to reach these targets. Cloud access therefore becomes very important to achieve these goals."

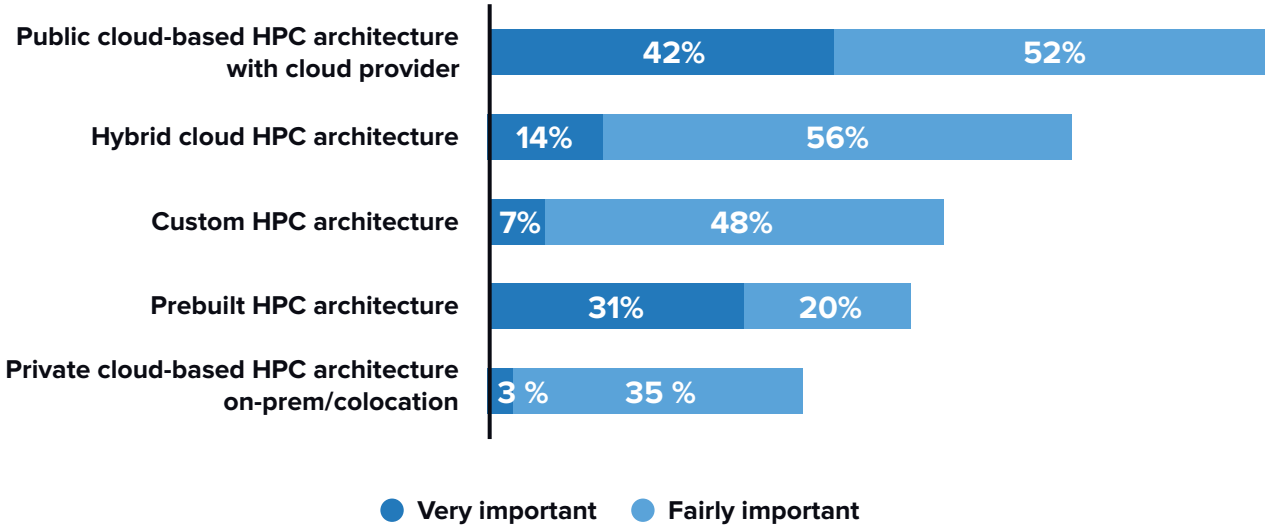
Jessica Zheng, Head of Virtual Manufacturing and Costing CoE, Design & Engineering Business Unit, Hexagon Manufacturing Intelligence

Improving scalability and flexibility with cloud-based HPC architectures

Like the entire IT sector, HPC has developed significantly in recent years. In addition to major advances in hardware, the advent of cloud architecture and the associated program-based improvement in controlling and scaling IT resources has broadened the spectrum of possible HPC architectures. Traditional customized HPC architectures rub shoulders with prebuilt standard HPC systems and a growing number of cloud products. In the future, the public cloud is set to be by far the most important HPC architecture in the manufacturing enterprises that already use HPC or are planning to do so. They are followed by hybrid cloud HPC architectures that enable users to benefit from the scalability of the public cloud when dealing with high numbers of analysis or load peaks without having to outsource all data or workloads to it. In the view of many decision makers, in addition to the public cloud, prebuilt architectures will be in the running as they are easier to set up and less prone to failure due to their integrated components and proven reference architectures.

FIGURE 8

Importance of different HPC architectures in two years' time



N = 130; only enterprises that already use HPC or plan to do so; source: IDC, 2022

When selecting HPC architectures, IDC recommends making a fundamental decision on whether to "make or buy" — whether it is worthwhile setting up an in-house infrastructure or rather buy HPC services. OPEX-based HPC from the public cloud may offer significant advantages in technical and financial terms in relation to the CAPEX of in-house HPC infrastructure. Barring special usage scenarios, in-house HPC architectures, like any other IT infrastructure, reach their limitations. Three-quarters of the industrial HPC users cited increasing overall HPC cluster performance as one of the main HPC optimization measures and around half of the respondents judged it very important. Although in HPC infrastructures run in-house performance can be increased to a certain extent via software, ultimately it comes down to regularly renewing hardware or expanding the HPC cluster horizontally. This

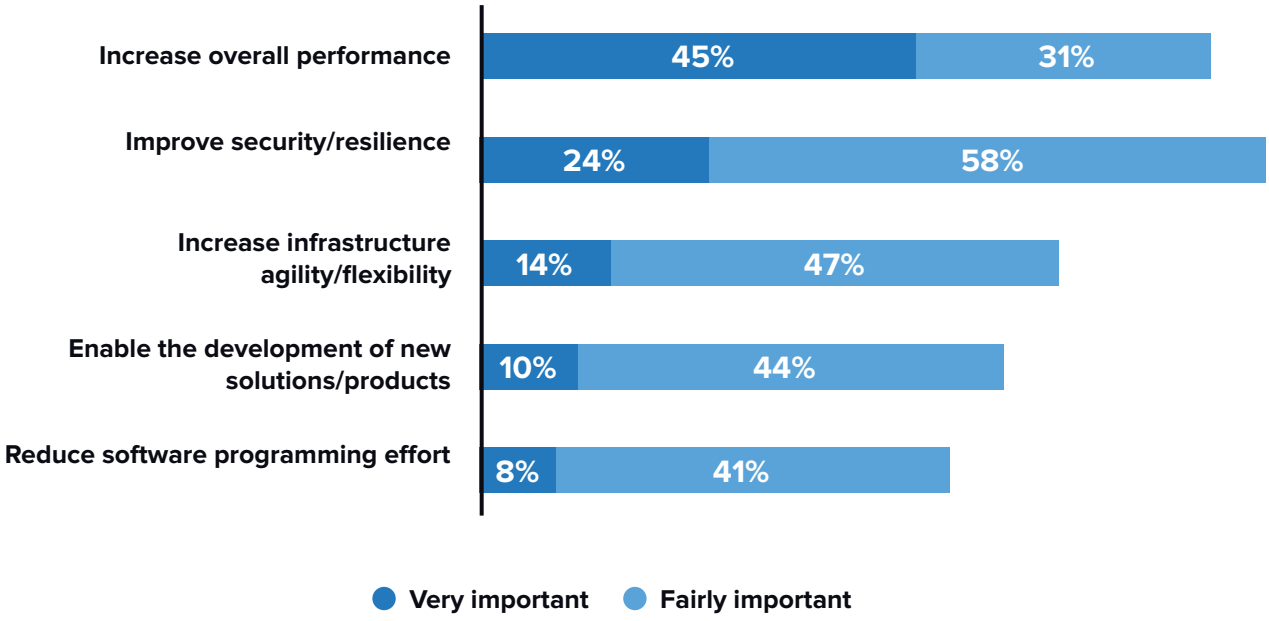
entails higher maintenance and operating costs, regardless of the fact that the potential overall performance is rarely used to its full extent other than during peak periods. Furthermore, due to their hardware almost all custom HPC environments are limited in terms of expansion, so expansion or modernization is only possible through the purchase of a completely new, larger HPC cluster. Many industrial enterprises therefore deem it easier to increase overall performance via the public cloud.

This also applies to optimizing agility and flexibility. HPC infrastructure operated on-premises or in a colocation is usually set up to meet a specific requirement and needs to be operated continuously. The scope for short-term adjustments to other usage scenarios as well as on-demand increases or decreases in performance is severely restricted as a result. The lack of flexibility in adapting to new usage scenarios in particular greatly hampers agility in process and product development. It limits the possibilities of unlocking the full potential of internal data through the use of as many different analysis approaches as possible.

This mainly has consequences for the setting up of new data-based products, services, and business models, such as digital twins, for new insights into product usage, which can be sold as a new consulting service or used to create predictive maintenance services. More than half of the respondents that already use HPC therefore appreciate how important, and in the eyes of 10% of HPC users how very important, it is to optimize HPC now to enable the development of new solutions and products.

FIGURE 9

Top 5 steps for HPC optimization

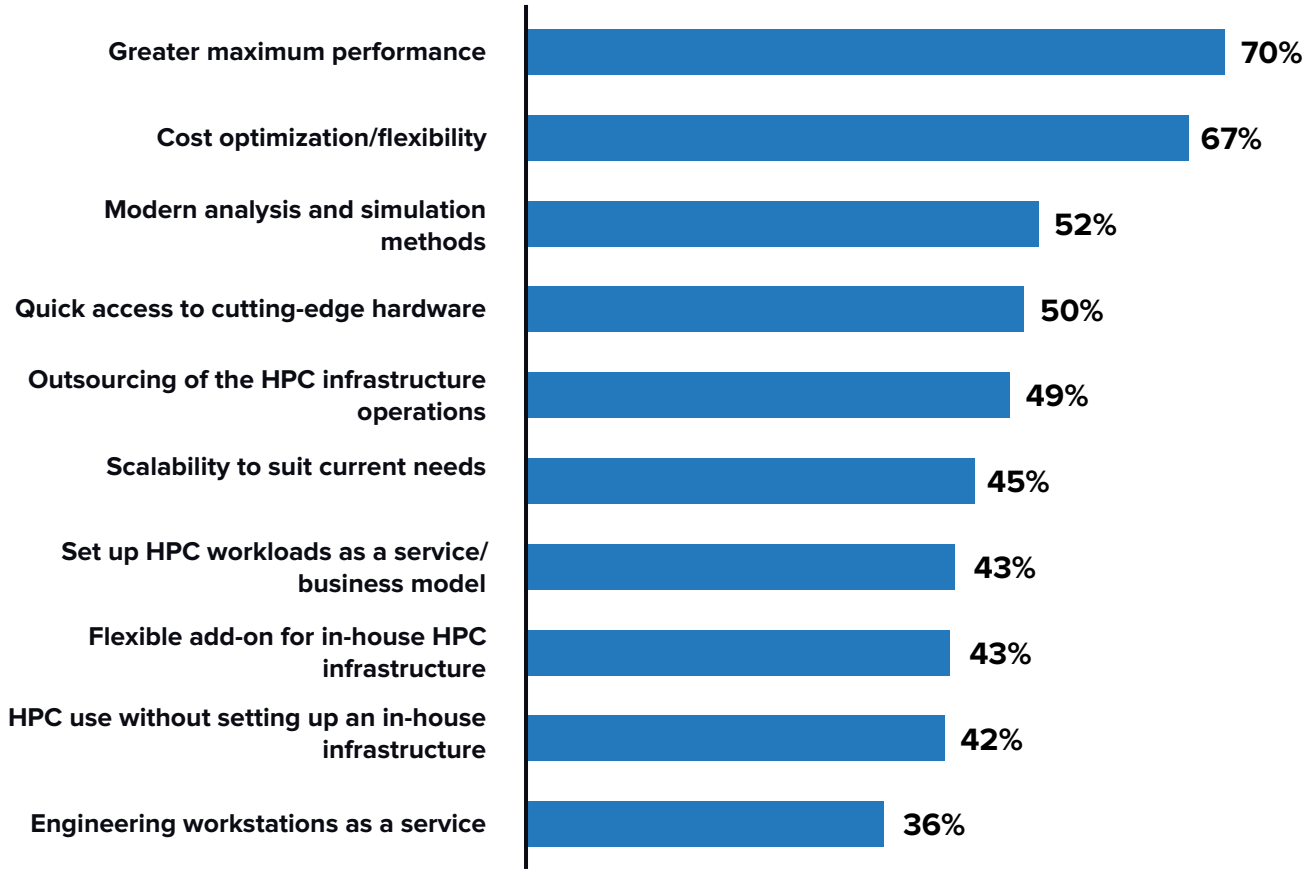


N = 88; only enterprises that already use HPC; multiple answers possible: source: IDC, 2022

Besides innovation and performance, improving security and resilience is deemed important by more than 80% of industrial HPC users, and even a very important role by almost a quarter. Despite intensive maintenance, updates and patches, in-house HPC environments are frequently subject to downtimes — planned and unforeseen. Creating service level agreements can improve resilience to failures of this nature. The necessary security level depends on the sensitivity of the industrial sector or the data processed, possibly requiring the use of on-premises infrastructure. In IDC's view, even in this case it can make sense to opt for hybrid HPC architecture, in which sensitive data can be analyzed within the in-house HPC infrastructure while load peaks or non-critical workloads can be addressed by temporary use of a public cloud.

FIGURE 10

Benefits of HPCaaS vs. in-house HPC infrastructure



N = 200 enterprises; surveyed on a scale of five; sum of citations of "critical" and "major" benefit; source: IDC, 2022

The manufacturing enterprises surveyed identify other factors that speak in favor of purchasing HPC as a Service (HPCaaS) instead of or complementing an in-house cluster.

- In addition to the flexible maximum performance mentioned above, cost optimization and flexibility is considered a major advantage for two-thirds of decision makers. This includes switching from cost-intensive CAPEX to a long-term OPEX spreading or pay-as-you-billing ito select the most cost-efficient option for each usage scenario depending on the required performance, configuration, and frequency of calculations. It is also a good option for occasional users and enterprises just beginning to feel their way into HPC.

- 49% of respondents regard HPCaaS as a way of outsourcing HPC infrastructure operation completely, while 42% see it as a means of using HPC without having to set up their own HPC infrastructure. This takes the pressure off in-house IT capacities and is convenient for occasional users who have no interest in operating and maintaining their own infrastructure all year round. However, it must be borne in mind that HPC run in the cloud does not take care of itself. Trained IT personnel and professionals with analysis and HPC skills are required to configure and operate the virtual clusters, program the calculations, and interpret and analyze the results.
- A major bonus is modernity. As they have to serve customers with different demands and scenarios, cloud providers offer a broad range of technologies and methods. Solutions and innovation are subject to continuous development. In fact, 52% of respondents deem the fast and flexible access to cutting-edge analysis and simulation methods and state-of-the-art hardware a core aspect of HPCaaS with regard to innovation. The higher speed of calculations alone can be a crucial competitive factor, although actually even more potential is offered by the new methods for processing and using data. They not only provide better insights through more in-depth analysis, but also novel possibilities of creating new (digital) products, services, and business models based on data. This is core for the entire industry in the context of digital transformation.

IDC identifies two further aspects offered by HPCaaS that are set to become more important in the future. The first has to do with global cooperation, especially in times of skilled labor shortages. Hybrid work flows, involving employees in offices and working from home around the world, are on the rise, and the growing digitalization of industrial value creation as well as of the entire value creation chain including customer and partner ecosystems poses manufacturing enterprises with new challenges when collaboration extends between all stakeholders. Cross-team/department software from 3D CAD to modern HPC simulations and a common database already play an important role. However, if solutions are to be used efficiently, it is essential that process and product development be integrated and data based, and based on this, innovative products, services, and business models created. More important still is the creation of a single source of truth, a common foundation on the basis of which all concerned can work. Employee workstations must become more efficient to be able to use software productively. Upgrading conventional engineering workstations to such an extent is, however, expensive. Individually configurable and scalable engineering workstations “as a Service” in the cloud, with access to a common database, can significantly improve productivity, collaboration, and thus innovation at a reasonable cost.

The second aspect has to do with the scalability of HPCaaS as the basis for new business models based on HPC. HPC algorithms and simulations developed to optimize an enterprise’s materials, products, and processes can be offered as a service to other enterprises, or enterprises can sell insights gained from HPC analysis of the digital twins used by customers. 81% of respondents that have already implemented HPC intend to implement HPC-based business models. HPCaaS enables them to gradually build up a customer base and intensify collaboration as they go without having to make cost-intensive investments upfront for their own HPC environments. In IDC’s view, the use of HPCaaS has great potential.

81% of respondents who already use HPC intend to implement new HPC-based business models.

"Modern computing models like cloud-based HPC datacenters help to drive energy efficiency of computations and contribute to sustainability targets at the host manufacturing company."

Mahesh Kailasam, General Manager, Design & Engineering Business Unit, Hexagon Manufacturing Intelligence

"Bridgestone decided to explore the agility and cost effectiveness of the cloud for high-performance computing to overcome technical limitations. For example, those limitations include peak capacity limits or hardware freshness, as well as the financial challenges of an on-premises HPC infrastructure such as cost structure, upfront investment, upgrade, and maintenance costs.

Regarding cloud, we are taking a step-by-step approach because it is important for us to be confident around the cloud in our own environment. We need to manage the change and want to make this cloud transition as seamless as possible."

Luigi Lobello, IT Digital Innovation Leader, Bridgestone EMIA

Conclusion

Industrial enterprises are currently facing a variety of disruptive changes. IDC regards IT-based simulations, modeling, and data analytics as a key enabler in addressing these challenges and in responding proactively with increased agility and innovation to strong international competitive pressure. Virtual process steps streamline and speed up product development and manufacturing, and also create new industry-specific usage scenarios. They support the analysis of alternative raw materials and processes, the optimization of supply chains, energy consumption and sustainability, as well as the development of new and, above all, digital products, services, and business models.

In IDC's opinion, HPC technologies are fast becoming a prerequisite for enabling modern simulations and modeling and for staying abreast of their increasing complexity and performance requirements. In addition to conventional custom HPC architectures and prebuilt HPC standard systems, the public cloud and HPCaaS unlock major potential for many manufacturing enterprises. These services can be used, for instance, to expand the agility and scalability of in-house HPC clusters or even dispense with an in-house HPC infrastructure entirely.

The entrepreneurial capacity for innovation, productivity, and competitiveness of the manufacturing industry will largely hinge on the ability of enterprises to create and integrate data and information and to make it accessible internally to all teams and departments across the value creation chain and externally to all partners and customers as a single source of truth. The aim is a seamless, consistent database across the entire product life cycle, from the idea and development to manufacturing, operations, logistics, and service. In the final stage of the cycle especially, the high-quality analysis of data is currently driving innovation to develop new digital products, services, and business models. For these are based on data relating to a wealth of areas including optimizing usage, improving quality, maintenance, and so forth. Combined with HPC, simulations, modeling, and data analytics are vital building blocks paving industry's road to digital transformation.

Recommendations

1 Set up virtual product and manufacturing development as part of your digital transformation and as the basis of new business models

Create transparency across your process and product life cycles to evaluate the potential of modern IT-based simulations, modeling, and analysis to enhance and accelerate them. Do not focus only on ways to support your own digital transformation with wholly virtual and agile development processes, but also view their potential as a basis for developing new new (digital) products, services, and business models.

2 Devise a holistic data strategy and a single source of the truth for seamless integration and collaboration

IT-based simulation, modeling, and analysis requires high-quality data to produce meaningful results, which in turn yield valuable data. IDC recommends a holistic data strategy aimed at a single common database to ensure that all data can be integrated efficiently as the basis for effective feedback loops and end-to-end processes.

3 Evaluate which HPC operating model is best suited to your particular circumstances

When deliberating on the economic benefits of on-premises infrastructure, HPCaaS, or hybrid versions, take into account your particular circumstances such as planned utilization, budget, required maximum performance, and any flexibility needs. Other aspects such as security issues and the availability of IT or analysis skills may be a reason to exclude third parties or any thoughts of running operations in-house.

4 Take into account scalability, security, and energy efficiency when selecting HPC solutions

In view of the spedd at which HPC is developing all the time, IDC recommends you look out for scalable HPC solutions regardless of the operating model. This should be not only with a view to flexibly supporting your employees and processes at any time, but potential HPC-based business models as well. Also focus on modern security features such as encryption during analysis and energy efficiency, given the current context of rising energy costs.

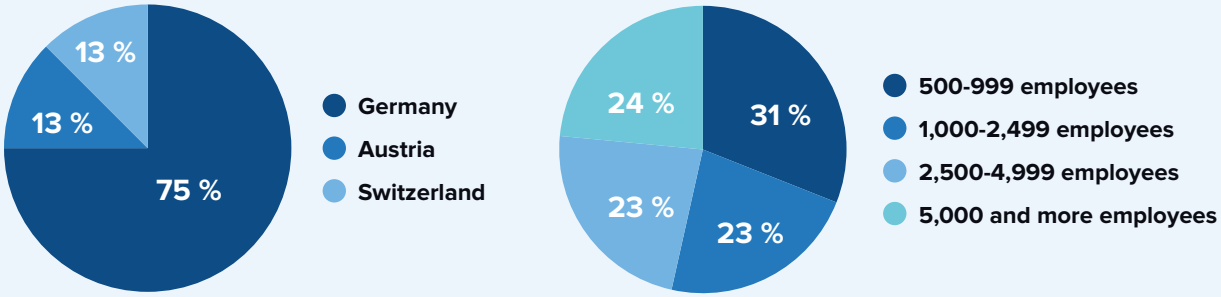
5 Leverage external expertise and ecosystem partners to implement your HPC plans

Setting up, managing, and maintaining HPC infrastructures and performing HPC analysis are difficult tasks due to their versatility and complexity. They require special knowledge that industrial enterprises often lack or are unable to acquire quickly through staff or training. In these cases, third-party expertise from service providers or partners in the enterprise's ecosystem should be sought quickly so as not to fall behind faster competitors.

Methodology

The findings of this IDC white paper are based on a telephone survey conducted in December 2021 of 200 IT and other departmental decision makers from industrial enterprises with more than 500 employees in Germany, Austria, and Switzerland. All the decision makers surveyed have a say in or influence decisions on the use of technology for IT-based simulation, modeling, and data analysis in their enterprises.

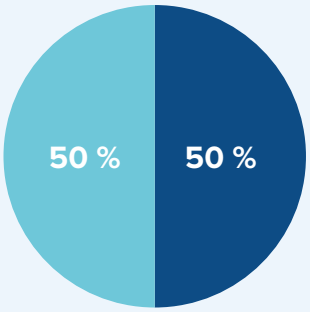
Enterprise headquarters and enterprise size classes



Sectors

Process industry

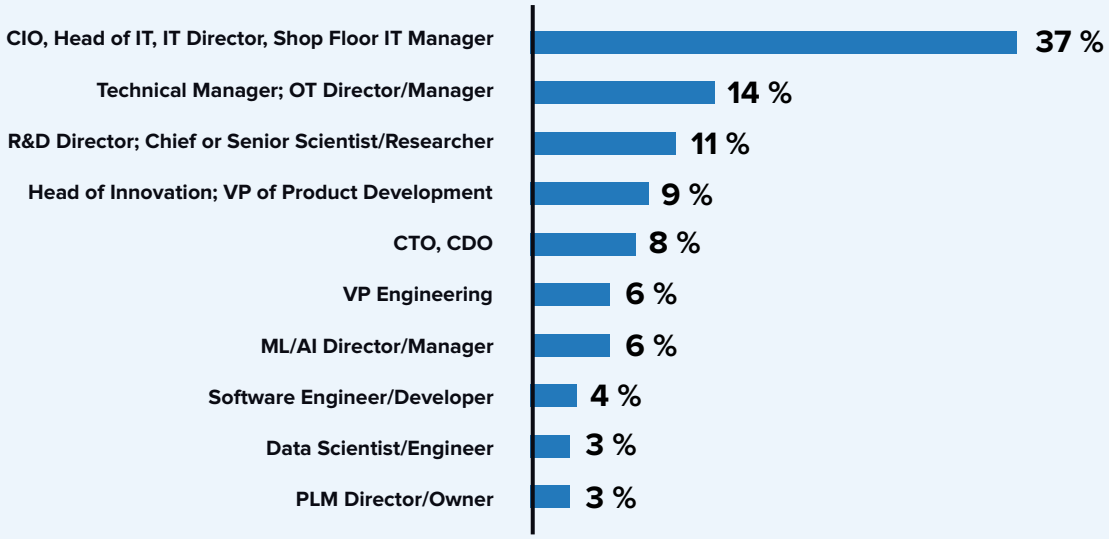
- Chemicals and pharmaceuticals
- Rubber and plastic goods
- Food
- Metal production
- other process-driven manufacturing



Discrete manufacturing

- Automotive and automotive suppliers
- Mechanical engineering
- Electrical goods
- Electronic and optical goods
- Data processing systems
- Clothing
- other discrete manufacturing

Position of the decision makers



ABOUT IDC

IDC is the world's leading provider of market information, consultancy services and events in the information technology and telecommunications field. IDC analyzes and forecasts technological and industry-related trends and potentials, thus providing clients with a basis for judicious planning of the business strategies and IT purchasing. Drawing on its network of more than 1,100 analysts in 110 or so countries with global, regional and local experience, IDC can offer clients comprehensive research findings on various segments of the IT, TC and consumer markets. Business managers and IT professionals have been placing their trust in IDC for decision-making for more than 50 years.

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