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BEST PRACTICES

AWARDS

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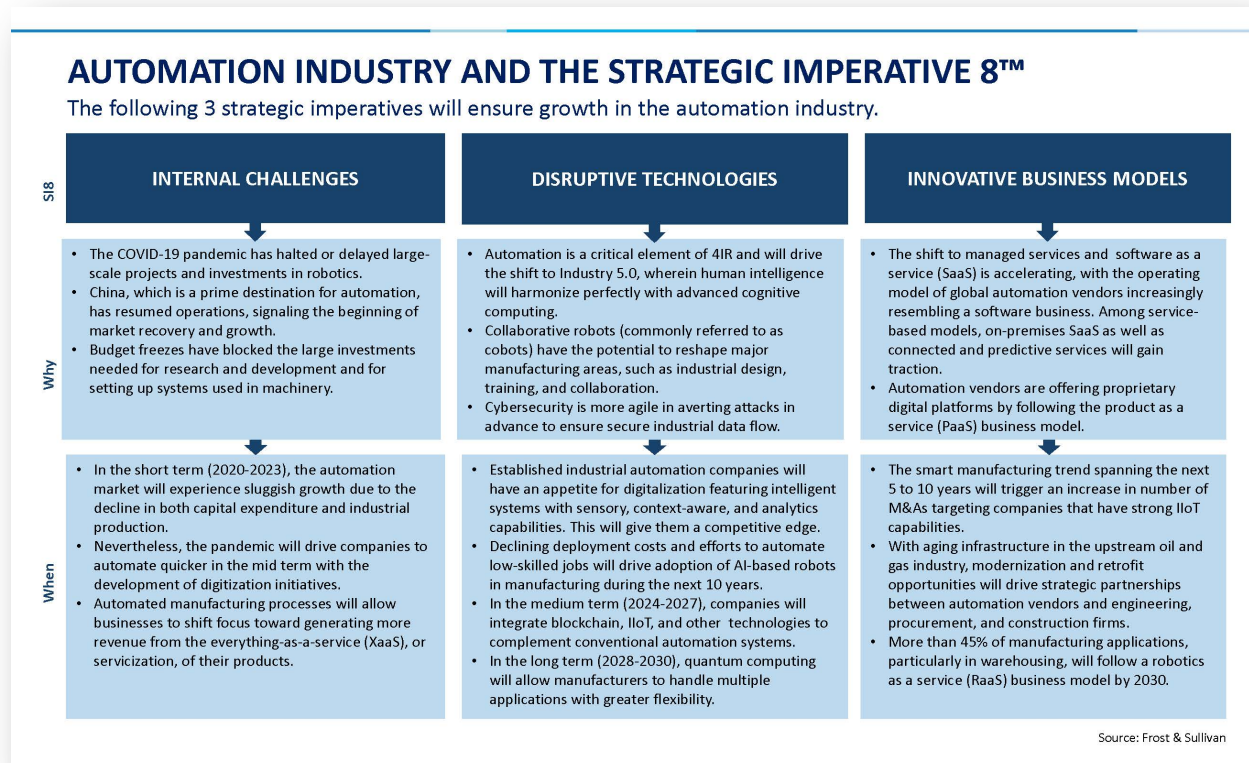
2020 BEST PRACTICES AWARD

\Orchestrating a brighter world

NEC

2020 GLOBAL HIGH-PERFORMANCE COMPUTING PRODUCT LEADERSHIP AWARD

Strategic Imperatives

Frost & Sullivan identifies three key strategic imperatives that impact the automation industry: internal challenges, disruptive technologies, and innovative business models. Every company that is competing in the automation space is obligated to address these imperatives proactively; failing to do so will almost certainly lead to stagnation or decline. Successful companies overcome the challenges posed by these imperatives and leverage them to drive innovation and growth. Frost & Sullivan's recognition of NEC is a reflection of how well it is performing against the backdrop of these imperatives.

AUTOMATION INDUSTRY AND THE STRATEGIC IMPERATIVE 8™
The following 3 strategic imperatives will ensure growth in the automation industry.

SI8	INTERNAL CHALLENGES	DISRUPTIVE TECHNOLOGIES	INNOVATIVE BUSINESS MODELS
Why	• The COVID-19 pandemic has halted or delayed large-scale projects and investments in robotics. • China, which is a prime destination for automation, has resumed operations, signaling the beginning of market recovery and growth. • Budget freezes have blocked the large investments needed for research and development and for setting up systems used in machinery.	• Automation is a critical element of 4IR and will drive the shift to Industry 5.0, wherein human intelligence will harmonize perfectly with advanced cognitive computing. • Collaborative robots (commonly referred to as cobots) have the potential to reshape major manufacturing areas, such as industrial design, training, and collaboration. • Cybersecurity is more agile in averting attacks in advance to ensure secure industrial data flow.	• The shift to managed services and software as a service (SaaS) is accelerating, with the operating model of global automation vendors increasingly resembling a software business. Among service-based models, on-premises SaaS as well as connected and predictive services will gain traction. • Automation vendors are offering proprietary digital platforms by following the product as a service (PaaS) business model.
When	• In the short term (2020-2023), the automation market will experience sluggish growth due to the decline in both capital expenditure and industrial production. • Nevertheless, the pandemic will drive companies to automate quicker in the mid term with the development of digitization initiatives. • Automated manufacturing processes will allow businesses to shift focus toward generating more revenue from the everything-as-a-service (XaaS), or servicization, of their products.	• Established industrial automation companies will have an appetite for digitalization featuring intelligent systems with sensory, context-aware, and analytics capabilities. This will give them a competitive edge. • Declining deployment costs and efforts to automate low-skilled jobs will drive adoption of AI-based robots in manufacturing during the next 10 years. • In the medium term (2024-2027), companies will integrate blockchain, IIoT, and other technologies to complement conventional automation systems. • In the long term (2028-2030), quantum computing will allow manufacturers to handle multiple applications with greater flexibility.	• The smart manufacturing trend spanning the next 5 to 10 years will trigger an increase in number of M&As targeting companies that have strong IIoT capabilities. • With aging infrastructure in the upstream oil and gas industry, modernization and retrofit opportunities will drive strategic partnerships between automation vendors and engineering, procurement, and construction firms. • More than 45% of manufacturing applications, particularly in warehousing, will follow a robotics as a service (RaaS) business model by 2030.

Source: Frost & Sullivan

Best Practices Criteria for World-Class Performance

Frost & Sullivan applies a rigorous analytical process to evaluate multiple nominees for each award category before determining the final award recipient. The process involves a detailed evaluation of best practices criteria across two dimensions for each nominated company. NEC excels in many of the criteria in the high-performance computing (HPC) space.

About NEC

Established in 1899, NEC is a global IT, network, and infrastructure solution provider with a comprehensive product portfolio across computing, data storage, embedded systems, integrated IT infrastructure, network products, software, and unified communications. Headquartered in Tokyo, Japan, NEC has been at the forefront of accelerating the industrial revolution of the 20th and 21st

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centuries by leveraging its technical knowhow and product expertise across thirteen different industries[1] in industrial and energy markets. Deeply committed to the vision of orchestrating a better world. NEC envisions a future that embodies the values of safety, security, fairness, and efficiency, thus creating long-lasting social value. NEC's solutions, therefore, have been carefully planned and designed to address the seven themes of social value creation, which includes Sustainable Earth, Safer Cities and Public Services, Lifeline Infrastructure, Communication, Industry Eco-System, Workstyle and Quality of Life. In Frost & Sullivan's Digital Industrial and Energy Guidebook assessment, NEC stands out for its range of high-performance computing solutions, the SX series. Enriching end-users with its 30 years of supercomputing product management experience, NEC has leveraged its thirst for knowhow and product expertise to invent its next-generation vector computing platform SX-Aurora TSUBASA in 2018. Frost & Sullivan notes that NEC's SX series have been utilized in the third generation of Japan's Earth Simulator, owned by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), thus making it stand out among elite high performance computing processors used for weather forecasting, disaster analysis, management, and prediction. Further enriching its partnership with JAMSTEC, NEC will be providing its next generation of SX-Aurora TSUBASA vector supercomputer which is expected to become operational by 2021. This new addition is expected to further boost JAMSTEC's research and development efforts in the field of marine and earth sciences.

AWARD CRITERIA

Product Portfolio Attributes	Business Impact
Match to Needs	Financial Performance
Reliability and Quality	Customer Acquisition
Product/Service Value	Operational Efficiency
Positioning	Growth Potential
Design	Human Capital

Addressing Unmet Market Needs

According to Frost & Sullivan's assessment, industrial and energy markets face four major long-term challenges: the shift toward de-centralization, digitalization, de-carbonization, and the implementation of new business models. In this critical juncture, when industries are at a crossroads, staring at an extraordinary shift, the role of HPC is vital to tackle the most pressing technical challenges related to computational information processing. HPC can accelerate the extraction of meaningful intelligence that pave the way for optimal digital outcomes, but certain requirements must be in place, specifically:

[1] https://www.nec.com/en/global/about/profile.html

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The need for a reliable and robust HPC solution for real-time computations of large volume and bandwidth.

> *"NEC's SX-Aurora TSUBASA stands out in the market for its modularity and superior vector-based architecture. The product enables robust high-performance computing capability, thus providing end users a sense of assurance when tackling their respective industry's frontline computational challenges."*
>
> *- Vasanth Krishnan, Senior Analyst*

The need for a proven HPC solution that excels in next-generation areas of artificial intelligence, machine learning, image analysis, plant control, and cybersecurity.

The need for compatibility with open environment platforms such as Linux OS for ease of programming.

The ability to support different types of deployments (i.e., a container-based system, rack-based system, or a tower mount-based model)

To meet the aforementioned needs, NEC released the SX-Aurora TSUBASA, its next-generation HPC solution in line with its strategic high-performance computing vision (see Exhibit 1), in 2018. The SX-Aurora TSUBASA is based on vector engine technology and addresses the industrial and energy market by providing accelerated computing. The product has been carefully designed so that the application is allocated to the entire vector engine for processing. Operating system (OS)-based tasks are performed by the vector host (i.e., an x86 server). Furthermore, NEC has ensured that the vector technology is compatible with Linux OS, thus providing end users with an open-environment for programming.

Exhibit 1: NEC's High-Performance Computing Vision
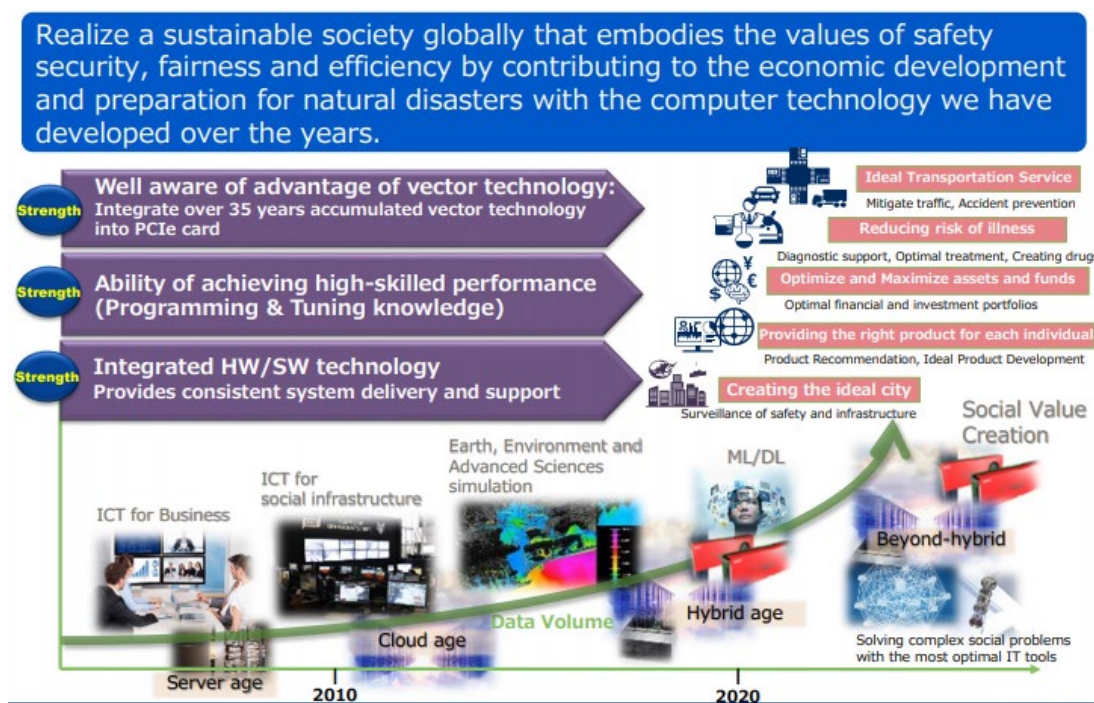
Best Practices Example

A Fortune 200 manufacturing client was on the lookout for an ideal computing solution to resolve the complicated and unstructured processing of large data volumes originating from the company's global manufacturing facilities. The client was facing long lead times of more than two days from the point of

data generation. After a careful selection process, the client chose NEC SX-Aurora TSUBASA's innovative, proven, and efficient platform due to the product's HPC expertise and low-latency processing prowess compared to its peers. The company noted that the vector engine was able to process large datasets fifty-seven times faster than its nearest competitor, thus accelerating its software maintenance cycle. Such performance is a testament to the product's superior design quality. Frost & Sullivan notes NEC's capabilities to deliver HPC solutions amid a wave of industrial transformation is exceptional.

Unmatched Product Quality and Reliability

NEC is a pioneer in HPC technology. The company's history dates back to 1983, when it released its first SX vector supercomputer (i.e., the SX-2). The product had a central processing unit (CPU) frequency of 166 megahertz (MHz), CPU performance of 1.3 giga FLOPS (GFLOPS), and a CPU memory bandwidth of 10.7 gigabytes (GB)/second. NEC has continuously upgraded the SX-Series in both form factor and performance, relentlessly pursuing unmatchable product quality and reliable performance.

Exhibit 2: NEC's High-Performance Computing Product Lines

Series	Release Year	Technology	CPU Frequency (MHz)	CPU Performance (GFLOPS)	CPU Memory Bandwidth (GB/sec)
SX-2	1983	Bipolar	166	1.3	10.7
SX-3	1989	Bipolar	340	5.5	12.8
SX-4	1994	350nm	125	2	16.0
SX-5	1998	250nm	250	8	64.0
SX-6	2001	150nm	500	8	32.0
SX-7	2002	150nm	552	8.8	35.3
SX-8	2004	90nm	1000	16	64.0
SX-9	2007	65nm	3200	102.4	256.0
SX-ACE	2013	28nm	1000	256.0	256.0

This highlights the company's thirst to succeed by accelerating the mainstream adoption of high-performance computing. In line with this trait, NEC's SX-Aurora TSUBASA comprises three key features that add tangible value to end users. Specifically:

1. **High-Performance Delivery:** Engineered with vector technology, the SX-Aurora TSUBASA can process information ten times faster (10X) than its nearest competition. In specific use cases, it can deliver higher levels of processing speeds.

2. **Product Flexibility:** Due to its modular form factor, the SX-Aurora TSUBASA can fit with four different and commonly used server topologies (e.g., tower-based, rack mount, water-cooled, and supercomputer model), thus providing customers the flexibility to choose appropriate server architecture based on their needs (see Exhibit 2).

3. **Ease-of-Use:** SX-Aurora TSUBASA supports C,C++, and Fortran, thus supporting parallelization and speeding up analysis processing in decentralized processing environments such as APACHE SPARK.

Exhibit 3: NEC's SX-Aurora TSUBASA Deployment Platforms
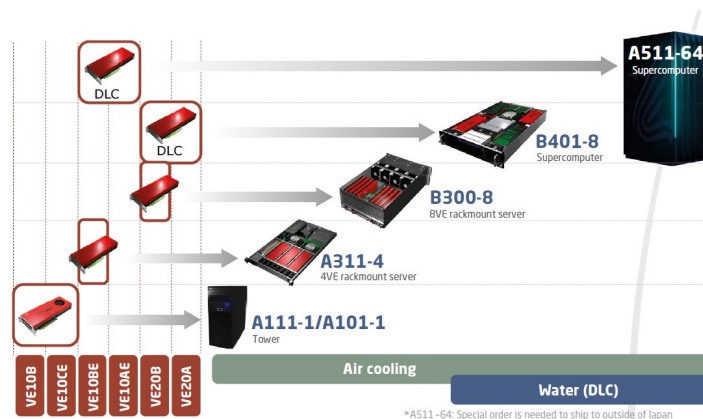
Future-Proof Product Design

NEC has staunchly differentiated itself in the HPC industry by launching innovative products such as the SX-Aurora TSUBASA. For example, the SX-Aurora TSUBASA is based on vector-based processing compared to CPU or graphical processing unit (GPU)-based processing. SX-Aurora TSUBASA's vector processing unit (VPU) carries a single-thread per core processing architecture, wherein one thread is allocated per core as compared to hyper-threading, where multiple threads are allocated per core. Moreover, the VPU interfaces with a 256 x 64 element vector register, 16 megabytes (MB) cache, and a memory of 48 GB for process execution. The holistic architecture allows for the execution of instructions in a single sequence, enabling a super-speed memory bandwidth and much faster processing speeds even with low latency. The SX-Aurora TSUBASA's CPU is derived from NEC's experience of spearheading the supercomputing industry and was developed in collaboration with Taiwan Semiconductor Manufacturing Company. The computer's six, three-dimensional stacked memory architecture is based on the second generation of high-memory bandwidth (HBM) technology.

Exhibit 4: NEC's SX-Aurora TSUBASA Core Architecture
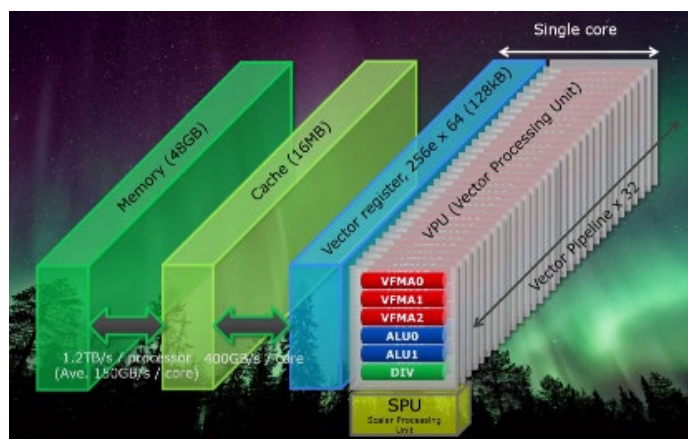
Moreover, SX-Aurora TSUBASA supports implementation via a Peripheral Component Interconnect (PCI-e) slot, thus supporting the faster deployment of compute power. Keeping different end-user needs in mind, NEC offers six distinct types of vector engines with an eight or ten-core architecture:

1. **Type 20A:** The fastest SX-Aurora TSUBASA range, operating at a frequency of 1.6GHz, with core performance of 307 GFLOPS, processor performance of 3.07 TF, and a memory bandwidth of 1.53 TB/sec with a 48GB memory.

2. **Type 20B:** The second fastest SX-Aurora TSUBASA range, operating at a frequency of 1.6GHz, with core performance of 307 GFLOPS, processor performance of 2.45 TF, and a memory bandwidth of 1.53 TB/sec with a 48GB memory.

3. **Type 10AE:** The third fastest SX-Aurora TSUBASA range, operating at a frequency of 1.5GHz, with core performance of 304 GFLOPS, processor performance of 2.43 TF, and a memory bandwidth of 1.35 Terra Bytes per second (TB/sec) with a 48GB memory.

4. **Type 10BE:** The fourth fastest SX-Aurora TSUBASA range, operating at a frequency of 1.4GHz, with core performance of 270 GFLOPS, processor performance of 2.16 TF, and a memory bandwidth of 1.35 TB/sec with a 48GB memory.

5. **Type 10B:** The fifth fastest SX-Aurora TSUBASA range, operating at a frequency of 1.4GHz, with core performance of 268 GFLOPS, processor performance of 2.15 TF, and a memory bandwidth of 1.22 TB/sec with a 48GB memory.

6. **Type 10CE:** The sixth fastest SX-Aurora TSUBASA range, operating at a frequency of 1.4GHz, with core performance of 268 GFLOPS, processor performance of 2.15 TF, and a memory bandwidth of 1 TB/sec with a 24GB memory.

Based on the above-outlined factors, product differentiations, and the platform's design excellence, Frost & Sullivan rates NEC's capability to deliver computational outcomes much faster than its nearest competition. Moreover, support for licensed and open-source programming environments allow NEC SX-Aurora TSUBASA's future-proof design to be leveraged by a broad end-user base across industrial and energy markets for faster computational processing.

Accelerating Time to Business Value

NEC's products are known for efficiency and performance durability. The rich HPC history that the company is part of elucidates this statement. Starting from the remarkable earth simulator created for JAMSTEC in 2002-04 to the TSUBAME 2.0 used at the Tokyo Institute of Technology's Center in 2011, and the recent application in the German Aerospace Center (CARA), NEC's range of HPC solutions are at the forefront of accelerating time to business value in advanced scientific and geographical applications. NEC aims to break traditional computing barriers by accelerating HPC's adoption in industrial and energy market applications. For example, Frost & Sullivan finds that NEC's SX-Aurora TSUBASA can expedite new oil and gas reservoir discoveries by leveraging full-wave inversion and reverse time migration for seismic processing much faster than its peers. This is a result of SX-Aurora TSUBASA's high bits per flop processing capability. Similarly, for supply chain analysis, circular industrial transformation, space

automation, and semiconductor performance testing, Frost & Sullivan notes NEC's capability to accelerate computational outcomes amid shifting industry dynamics. In line with its vision, NEC endeavors to carry the mantle of HPC into present-day digitalization breakthroughs such as artificial intelligence, image analysis, chemical analysis, plant control, and malware detection. NEC plans to achieve this task by combining traditional HPC with AI and Machine Learning technology, positioning it uniquely to accelerate faster computational processing which continues to pivot every year. The company is uniquely positioned to accelerate faster computational processing, which continues to pivot positively every year.

Customer Onboarding Pathways

NEC offers a distinct customer onboarding pathway for end users across industrial and energy markets. Known as the SX-Aurora TSUBASA WING Trial program, NEC provides a remote cloud experience in which end users can experience SX-Aurora TSUBASA's processing capability. NEC also offers an on-premise entry model trial machine for up to sixty days for customers devoid of cloud access.

Since the program's announcement, customers from Japan, the United States, Brazil, Russia, and other prominent countries have applied for the WING program. Frost & Sullivan notes that this success is attributed to the company's product differentiation and high-performance capability, thus appealing to a wide end-user base across industrial and energy markets.

Offering Strong Growth Potential

Building on its legacy as a provider of super computing solutions, NEC is committed to the modern imperative of promoting digitalization and decentralization while supporting societal transformation. To that end, the company has partnered with Colfax to provide the A100 series of desk-side vector-based CPUs, which will provide supercomputing prowess on a compact personal desktop. Frost & Sullivan finds NEC to be an industry visionary and pioneer due to its unique ability to enable HPC and accelerate the digital transformation of industrial and energy markets. Moreover, Frost & Sullivan is keeping close tabs regarding the pathways with which NEC is leveraging its AI and Machine Learning technology in tandem with its high-performance computing legacy.

Industrial and energy market end users who have partnered with NEC to leverage SX-Aurora TSUBASA for their computational processing needs have exhibited an exceptional performance record, resulting in substantial efficiency improvements and operational profitability. With its proven ability to support digital agility and truly deliver on its capabilities, NEC sets a high industry benchmark. Moreover, the company's offerings provide a significant value-add, helping address the long-term needs of digitalization.

According to Frost & Sullivan analysis, industrial and energy market incumbents with computational processing needs should partner with NEC to leverage the company's SX-Aurora TSUBASA. Overall, Frost & Sullivan rates NEC's capability to deliver optimal digitalization outcomes and high-touch customer support far higher than competitors and finds NEC's SX-Aurora TSUBASA a best-in-class HPC solution for the industrial and energy markets.

Conclusion

As industrial and energy markets continue the shift away from steady profit-driven operations to demand-driven, outcome-based operations, the need for dynamic and enterprise-wide digital agility is essential.

While many high-performance computing solutions serve the industrial and energy markets, NEC's SX-Aurora TSUBASA is truly differentiated due to its vector-based approach. SX-Aurora TSUBASA's pioneering architecture, reliable performance guarantee, and low latency processing have the potential to deliver long-lasting digitalization outcomes that far exceed customer expectations. Moreover, the company builds value into its solution through high bandwidth, superior processing capacity, advancing AI and Machine Learning technologies in tandem with high performance computing.

For its iron-clad value proposition, holistic platform with best-in-class features, close client relationships, and strong overall position, NEC is recognized with Frost & Sullivan's 2020 global Product Leadership Award for high-performance computing solutions.

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What You Need to Know about the Product Leadership Recognition

Frost & Sullivan's Product Leadership Award recognizes the company that offers a product or solution with attributes that deliver the best quality, reliability, and performance in the industry.

Best Practices Award Analysis

For the Product Leadership Award, Frost & Sullivan analysts independently evaluated the criteria listed below.

Product Portfolio Attributes

Match to Needs: Customer needs directly influence and inspire the product portfolio's design and positioning

Reliability and Quality: Products consistently meet or exceed customer expectations for performance and length of service

Product/Service Value: Products or services offer the best value for the price compared to similar market offerings

Positioning: Products serve a unique, unmet need that competitors cannot easily replicate

Design: Products feature innovative designs, enhancing both visual appeal and ease of use

Business Impact

Financial Performance: Strong overall financial performance is achieved in terms of revenues, revenue growth, operating margin, and other key financial metrics

Customer Acquisition: Customer-facing processes support efficient and consistent new customer acquisition while enhancing customer retention

Operational Efficiency: Company staff performs assigned tasks productively, quickly, and to a high-quality standard

Growth Potential: Growth is fostered by a strong customer focus that strengthens the brand and reinforces customer loyalty

Human Capital: Commitment to quality and to customers characterize the company culture, which in turn enhances employee morale and retention

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About Frost & Sullivan

Frost & Sullivan is the Growth Pipeline Company™. We power our clients to a future shaped by growth. Our Growth Pipeline as a Service™ provides the CEO and the CEO's growth team with a continuous and rigorous platform of growth opportunities, ensuring long-term success. To achieve positive outcomes, our team leverages over 60 years of experience, coaching organizations of all types and sizes across 6 continents with our proven best practices. To power your Growth Pipeline future, visit Frost & Sullivan at http://www.frost.com.

The Growth Pipeline Engine™

Frost & Sullivan's proprietary model to systematically create on-going growth opportunities and strategies for our clients is fuelled by the Innovation Generator™.

Key Impacts:

- **Growth Pipeline:** *Continuous flow of Growth opportunities*
- **Growth Strategies:** *Proven Best Practices*
- **Innovation Culture:** *Optimized Customer Experience*
- **ROI & Margin:** *Implementation Excellence*
- **Transformational Growth:** *Industry Leadership*

The Innovation Generator™

Our six analytical perspectives are crucial in capturing the broadest range of innovative growth opportunities, most of which occur at the points of these perspectives.

Analytical Perspectives:

- Mega Trend (MT)
- Business Model (BM)
- Technology (TE)
- Industries (IN)
- Customer (CU)
- Geographies (GE)