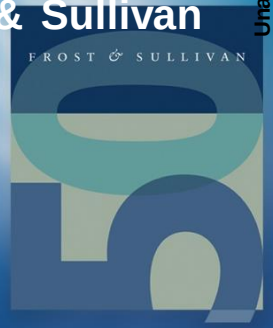
Global Modular Data Centers Market, Forecast to 2029

Data Centre Advancements Drive Market Penetration Team at Frost & Sullivan



Dec 2024

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Executive Summary

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Key Findings

- The global modular data centers market was worth $2.41 billion in 2023 ($2.06 billion 2022), and is in its growth stage.
- The market is expected to grow at a fast pace during the forecast period, with growth rates expected to accelerate further post 2023. The market is estimated to grow at a compound annual growth rate (CAGR) of 22.1% from 2024 to 2029.
- In 2023, North America and APAC accounted for a big majority of the total market revenues, at 71.33%. Asia-Pacific (APAC) will act as the key growth engine over the forecast period.
- Emerging markets are expected to grow at a faster rate than developed markets. APAC will be the fastest-growing region, at a CAGR of 23.7% from 2024 to 2029, followed by Rest of the World (ROW), at a CAGR of 17.9%.
- Government and BFSI remain the primary demand drivers among end-user verticals, accounting for 62% of the market in 2023. Demand from transportation and education scenarios is expected to grow at a CAGR of over 26% in the coming years.

Source: Frost & Sullivan

Market Engineering Measurements

Total Modular Data Centers Market: Market Engineering Measurements, Global, 2023

Market Overview

Note: All figures are rounded. The base year is 2023. Source: Frost & Sullivan

Market Scope, Definitions, and Segmentation

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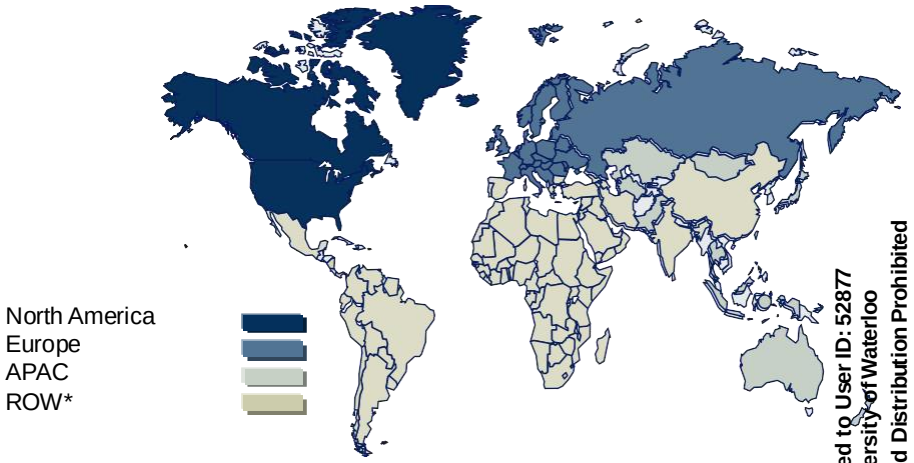
Market Scope

Scope	
Geographic Coverage	Global
Study Period	2020– 2029
Base Year	2023
Forecast Period	2024– 2029
Monetary Unit	US Dollars

Segmentation by Region



A modular data center is a modular solution that fully integrates core functionalities such as power supply (e.g., UPS), and cooling into one or multiple racks. It is designed for efficient deployment and independent operation, making it suitable for edge computing, small-scale data centers, or rapid expansion scenarios.

*ROW includes LATAM and the Middle East and Africa.

Source: Frost & Sullivan

Market Definitions

Modular Data Center Market

- In the modular data center landscape, the industry generally recognizes two main categories: prefabricated modular data center and micro modular data center. Prefabricated modular data centers are often applied to large-scale projects, where modules are manufactured off-site and assembled on-site. By contrast, micro modular data center are more suitable for smaller-scale or edge computing scenarios, offering flexibility and rapid deployment in indoor environments, such as server rooms.
- This report focuses on Micro Modular Data Center, which integrate essential infrastructure—such as power supply, cooling, and monitoring—into single or multiple racks. This high level of integration enables quick installation, flexible scalability, and simplified operations and maintenance.

Scope of the report

Micro Modular Data Center

Prefabricated Modular Data Center

Source: Frost & Sullivan

Market Definitions (continued)

Segmentation by End-user Vertical

- **Government:** Includes e-government cloud, tax systems, as well as government operations and service centers supporting policy implementation and administrative management.
- **Transportation:** Includes traffic management platforms, signaling systems, and rail transit management, enabling intelligent transportation management and monitoring.
- **Banking, financial services, and insurance (BFSI)** comprises finance management, banks, mortgage brokers, and investment services.
- **Education**: Includes research institutions and educational infrastructure, supporting digital education and scientific research operations.
- **Other end-user verticals**：Includes power systems, small businesses, part of IT and telecommunication, and healthcare, such as hospitals and emergency centers, supporting foundational capabilities and social services.

Source: Frost & Sullivan

Drivers and Restraints—Total Modular Data Centers Market

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Market Drivers

Total Modular Data Centers Market: Key Market Drivers, Global, 2024– 2029

Drivers	1–2 Years	3–4 Years	5–6 Years
Highly attractive features, functionalities, and benefits of modular data centers will attract revenues.	H	H	H
The increasing demand for on-premises data processing, security, and speed will drive Micro Modular Data Centers' expansion.	H	H	H
The growing adoption of AI training and inference in small and medium-sized enterprises creates new market opportunities for Micro Modular Data Centers.	H	H	H
The advent of 5G and edge computing will further boost Micro Modular Data Centers' deployment.	M	H	H
Overall increase in global data center investments will drive market penetration.	M	M	M

Impact Ratings: H = High, **M** = Medium, **L** = Low

Source: Frost & Sullivan

Drivers Explained

Highly Attractive Features, Functionalities, and Benefits of Modular Data Centers

- While there are multiple market drivers—including the growing adoption of AI-based applications, surging demand for data storage, overall expansion in global data center investments, and the boom in the Internet of Things (IoT) and Big Data—the most pivotal factor remains the advanced design of modular data centers.

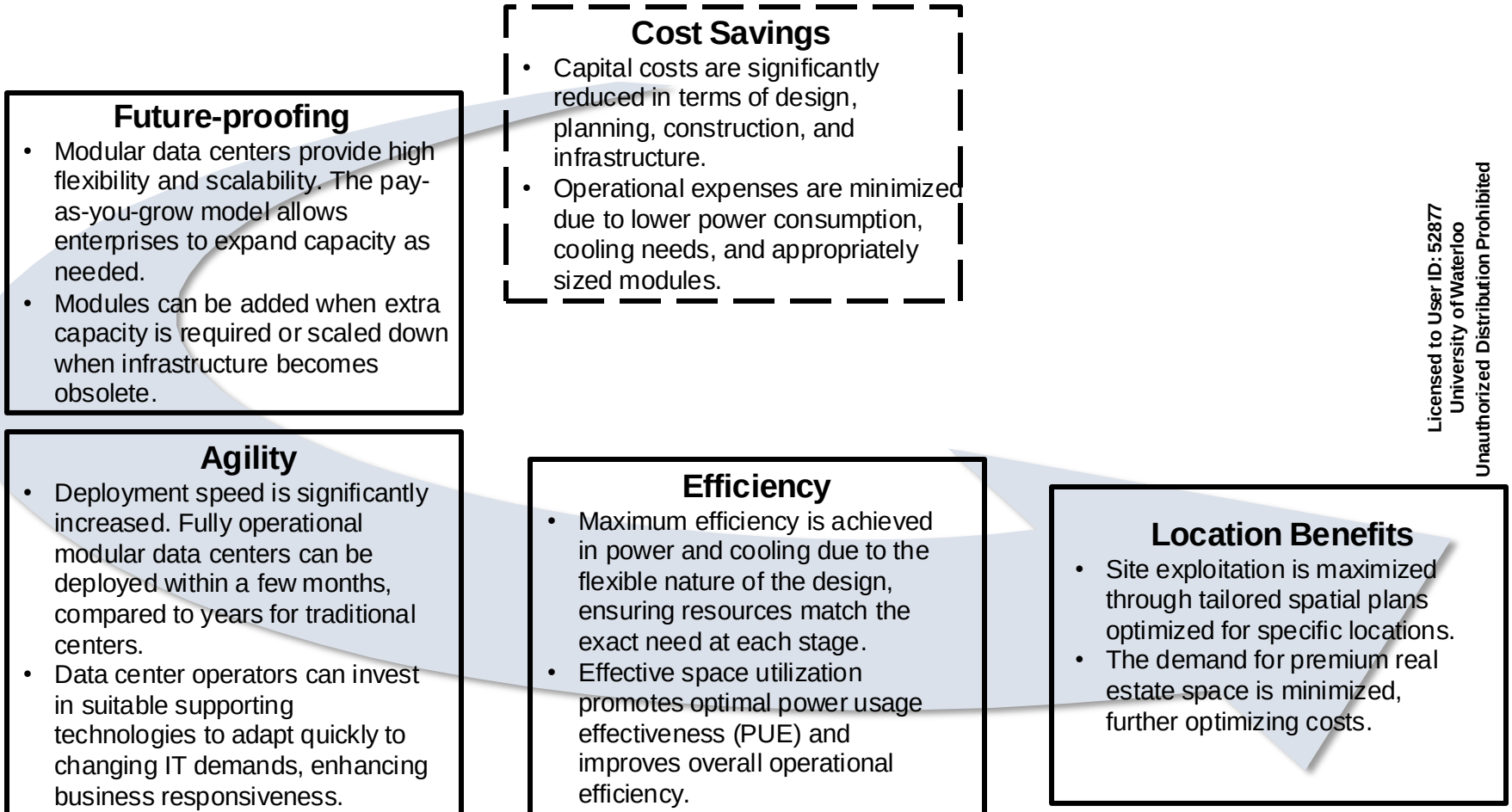
- Backed by value-added functionalities and benefits, modular data centers deliver significant advantages to end users, enabling them to focus on their core businesses. As the IT and data center landscape evolves rapidly, forward-thinking chief information officers (CIOs) consistently seek solutions that minimize capital expenditures and adapt to fast-changing business and technology requirements.

- By incorporating all the merits of traditional data centers while eliminating their shortcomings, modular data centers present a purpose-built infrastructure. When compared to conventional brick-and-mortar facilities, they offer five key advantages: cost savings, future-proofing, agility, efficiency, and location benefits.

Source: Cisco; Frost & Sullivan

Drivers Explained (continued)

Total Modular Data Centers Market: Key Advantages, Global, 2023



Source: Frost & Sullivan

Drivers Explained (continued)

Increasing Demand for Data Storage, Security, and Speed

- The exponential growth of data generation and processing has driven the need for highly efficient storage solutions. The widespread adoption of artificial intelligence and big data analytics has made low-latency, high-capacity storage systems a key driver for the development of modular data centers.
- The rising frequency of cyber threats and data breaches has made data security a top priority for businesses. modular data centers offer modular isolation and multi-layer encryption technologies to meet the demand for sensitive data protection and compliance.
- The surge in remote work, streaming services, and IoT devices has amplified the need for high-speed data transmission. modular data centers enhance data transfer efficiency by optimizing network connectivity and edge computing capabilities, enabling real-time applications and low-latency scenarios.

Source: Frost & Sullivan

Drivers Explained (continued)

The Growing Adoption of AI Training and Inference in SMEs

- Small and medium-sized enterprises (SMEs) are rapidly embracing AI solutions to enhance their business processes, streamline operations, and gain competitive advantages. AI-driven applications—ranging from predictive analytics to intelligent customer service—necessitate robust computing resources and prompt data processing.
- AI training typically involves running complex machine learning models on substantial datasets, while inference requires low-latency environments to deliver real-time or near-real-time insights. The pursuit of high-performance computing at an affordable scale fuels the demand for on-premise or near-edge infrastructure.
- Micro Modular Data Centers address these requirements by providing SMEs with cost-effective, scalable, and energy-efficient solutions that support AI workloads. Through compact, modular designs integrating power, cooling, and monitoring, these data centers enable swift deployment and easy expansion. This allows SMEs to fully harness AI's potential without incurring the prohibitive expenses and complexities associated with larger-scale data center facilities.

Source: Frost & Sullivan

Drivers Explained (continued)

Advent of 5G and the Emergence of Edge Computing

- With the next era of digitalization, a silent revolution is expected to change the location where data is processed, as well as the speed in which it is done, owing to edge computing and 5G.
- Edge computing is giving rise to a new wave of data centers that are smaller in terms of footprint and located close to the source. Modular data centers are well positioned to address edge computing needs.
- The need for edge-based data centers arises from 3 factors: latency, growing data volume, and reduction in data processing in large data centers.
- This rapid growth is being driven by a combination of factors including an increase in the number of connected and IoT devices, growth in the number of connected and autonomous cars, increase in content streaming, and a rise in the number of users playing massive multi-player games and games that require streaming. Most of these require close-to-zero latency data transfer, paving the way for edge data centers.

Source: Frost & Sullivan

Drivers Explained (continued)

Overall Increase in Global Data Center Investments

- Global data center budgets and investments have been steadily increasing over the past few years, and this trend is expected to remain robust during the forecast period. The primary driving force behind this growth is the exponential rise in IP traffic, driven by demand for content-heavy applications such as bandwidth-intensive video and media services.

- Moreover, there is a significant increase in demand for flexible and scalable IT infrastructure to support evolving business needs and digital transformation. This demand has driven investments in efficient and easily scalable data center solutions, particularly in the rapidly growing Asia-Pacific region, which has become a key focus for global data center investment growth. Meanwhile, North America and Europe continue to strengthen their positions in data center investments by focusing on enhancing data management and modernizing infrastructure.

Source: Frost & Sullivan

Market Restraints

Total Modular Data Centers Market: Key Market Restraints, Global, 2024– 2029

Restraints	1–2 Years	3–4 Years	5–6 Years
Skepticism toward implementing new technologies or unfamiliar solutions restrains market growth.	M	M/L	L
Lack of awareness about modular products and lack of product knowledge have a negative impact on market revenues.	M	M/L	L

Impact Ratings: H = High, **H/M** = High to Medium, **M** = Medium, **L** = Low

Source: Frost & Sullivan

Restraints Explained

SKepticism Toward Implementing New Technologies or Unfamiliar Solutions

- For small and medium-sized enterprises (SMEs), adopting modular data centers still faces skepticism toward new technologies or unfamiliar solutions. This skepticism primarily stems from limited technology budgets and concerns about the potential risks and complexity of technology migration. Additionally, SMEs often prefer to continue using existing on-premise solutions or traditional small-scale IT infrastructures to avoid the risks of failed technology investments.

- However, some SMEs, under the pressure of business growth and digital transformation, have started piloting modular data center solutions. These early adopters have demonstrated the benefits of rapid deployment, cost savings, and flexible scalability, providing confidence for other businesses to follow suit.

- As market awareness of modular data centers grows and vendors offer more tailored and supportive services, this skepticism is expected to gradually diminish, driving further adoption in the market.

Source: Frost & Sullivan

Restraints Explained (continued)

Lack of Awareness About Modular Products and Lack of Product Knowledge

- Although awareness of modular data centers has significantly improved in 2023, some challenges remain. A portion of end users, particularly in emerging markets, still lacks a deep understanding of the specific functionalities and application scenarios of modular solutions. This gap is most evident in their limited appreciation of the flexibility and cost-effectiveness of modular designs, leading to hesitation in product adoption.

- Moreover, varying degrees of modularity among available solutions in the market may contribute to user misconceptions. For instance, some products labeled as modular lack true flexibility, further challenging user trust in modular technology. However, with vendors increasing their promotional efforts, showcasing successful case studies, and providing tailored technical support, end-user confidence is steadily growing.

- Over the next 1-2 years, as modular data center technology becomes more widespread and user education advances, the impact of this restraint is expected to diminish further.

Source: Frost & Sullivan

Forecasts and Trends—Total Modular Data Centers Market

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Market Engineering Measurements

Total Modular Data Centers Market: Market Engineering Measurements, Global, 2023

Market Overview

Measurement Name	Measurement	Trend
Market stage	Growth	–
Market revenue (2023)	$2414.3M	▲
Market size for last year of study period (2029)	$9695.7M	▲
Base year market growth rate	17%	▲
Compound annual growth rate (CAGR, 2024– 2029)	22.1%	–
Customer price sensitivity (scale of 1 to 10, Low to High)	6	●
Degree of technical change (scale of 1 to 10, Low to High)	7	▲
Market concentration (% of base year market controlled by top 3 competitors)	31.3%	▲

Trend	Decreasing	Stable	Increasing
	▼	●	▲

Note: All figures are rounded. The base year is 2023. Source: Frost & Sullivan

Forecast Assumptions

Forecasts are based on the factors listed below:

- Impact of global gross domestic product (GDP) growth
- Macroeconomic trends, such as resource availability, government regulations, and political stability
- Mega Trend analysis and impact assessment
- Technology evolution and its impact
- Impact of market drivers and restraints during the forecast period
- Data center expansion/new build trends
- Data center investment trends
- Data center application trends
- End-user vertical trends

Source: Frost & Sullivan

Revenue Forecast Discussion

- The ever-increasing demand for data centers will drive modular data centers' growth, fueled by the evolving needs in data storage, security, and speed. This demand, combined with the surging adoption of AI-driven workloads, is expected to be the primary driver for this market.

- Data center investments have surged in the last few years, which is expected to continue during the forecast period. In addition, IoT and Big Data have had tremendous activities and will play a crucialrole in increasing the penetration rate of the modular data centers market during the forecast period.

- The global modular data centers market is expected to grow at a CAGR of 22.1% from 2024 to 2029. Emerging markets such as APAC are expected to drive this high growth.

- Key application types driving revenue growth will be starter data centers and HPC/edge computing. Growth drivers from the end-user vertical perspective are expected to be education, transpiration and BFSI.

Source: Frost & Sullivan

Revenue Forecast Discussion by Region

- Demand for modular data centers in North America is primarily driven by SMEs' focus on efficient IT solutions. These businesses aim to reduce construction costs and deployment times while lowering latency to support localized critical operations. Additionally, the continued growth of IoT and Big Data activities is increasing the demand for flexible and scalable solutions in the region.
- The European modular data center market will be led by growth in the United Kingdom, Germany, France, and Benelux, which are the largest revenue contributors. Southern Europe, the Nordic countries, and Eastern Europe are also expected to contribute significantly to market growth. Among the Nordic countries, Sweden stands out as the largest market, supported by its focus on sustainability and energy-efficient data centers.
- APAC is expected to be the fastest-growing region in terms of modular data center revenues, with a projected CAGR of 23.7% from 2024 to 2029. One key trend in APAC is the increased focus on advanced, energy-efficient data centers. Government policies and incentives are driving large investments aimed at supporting green data center development.
- China is expected to be a key growth market driving modular data center revenues in APAC. The Chinese data center market is experiencing rapid expansion and is one of the fastest-growing markets worldwide. Demand from SMEs for flexible and rapidly deployable solutions, combined with government support for digitalization and green energy initiatives, is a major driver of market growth.

Source: Frost & Sullivan

Revenue Forecast Discussion by Vertical Segment

- Government The government sector is a major end-user vertical for modular data centers, contributing significantly to the revenue in 2023 and expected to maintain a strong market share in the coming years. The primary drivers in this segment include e-government clouds, tax systems, and digital transformation of critical infrastructure, fueling the adoption of efficient and scalable modular solutions.
- Banking, Financial Services, and Insurance (BFSI) BFSI is one of the key growth segments for modular data centers, with a substantial revenue share in 2023. Banking outlets and financial institutions increasingly rely on secure and flexible data management solutions to meet data protection regulations and ensure business continuity. The BFSI sector's share is expected to grow steadily as digital transformation accelerates in the industry.
- Education The education segment is one of the fastest-growing verticals, with a projected CAGR of 27.3% from 2024 to 2029. Universities and research institutions drive this growth through increasing demand for high-performance computing and data storage. Particularly in the rapidly developing Asia-Pacific region, demand in the education segment is growing significantly.
- Transportation The transportation sector is experiencing rapid demand growth, with a projected CAGR of 26.3% from 2024 to 2029. Intelligent transportation management platforms, rail transit signaling systems, and other digital projects are the primary growth drivers. The flexible deployment and rapid response capabilities of modular data centers meet the efficiency needs of this industry.
- Others Other industries, including healthcare, retail, and energy, are steadily increasing their adoption of modular data centers. In healthcare, the demand for data storage and real-time analysis from hospitals and emergency facilities is a key driver. The Asia-Pacific region and emerging markets are seen as critical growth opportunities for this segment.

Source: Frost & Sullivan

Growth Opportunities and Companies to Action

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Growth Opportunity—Edge Computing

Applicable Regions: Global

- Vision Transformation
- Mega Trends' Impact
- Disruptive Applications
- Business Models
- Offerings
- New Capabilities
- Value-add Services
- Vertical Markets
- Geographic Expansion
- Partnerships
- Investment/M&A

Context and Opportunity

- Growth in edge computing is primarily driven by latency-sensitive applications such as IoT devices, smart homes, Artificial Intelligence (AI), gaming and video streaming, autonomous vehicles, and virtual/augmented reality. These use cases increasingly require real-time data processing, significantly accelerating the adoption of modular data centers.
- Modular data centers are emerging as key technological solutions to support edge computing needs due to their rapid deployment, flexible scalability, and high energy efficiency.

Call to Action

- Modular data center manufacturers should capitalize on the growth opportunities presented by the edge-focused diversified ecosystem.
- Focus on technological innovation and optimizing modular data center designs to meet the specific requirements of real-time data processing and low-latency applications.
- Data center manufacturers should build an open ecosystem and collaborate with technology partners to advance edge computing development.

Source: Frost & Sullivan

Strategic Imperatives for Success and Growth

Expanding into Emerging Markets: Companies need to focus on high-growth emerging markets where data creation is still nascent, and data center construction is in its infancy. modular data centers, with rapid deployment and scalability, can help solution providers quickly penetrate these markets.

Catering to Edge Computing: modular data center manufacturers should prioritize smaller-capacity products to address the growing demand for edge computing. These solutions are well-suited for distributed computing and low-latency applications, such as IoT devices, 5G networks, and real-time data processing.

Intelligent operation : Such technologies enable modular data centers to achieve efficient operations and automation, driving the evolution toward intelligent management. Advanced on-demand cooling solutions can effectively reduce PUE, significantly enhancing energy efficiency.

Green and Sustainable Solutions: Green energy has become a critical focus for data center development. modular data centers should adopt efficient energy management and integrate renewable energy to minimize carbon emissions while maintaining operational efficiency.

Innovative Modular Designs: Given the high demand and competitive intensity in the modular data center market, manufacturers must innovate modular designs to deliver more flexible and cost-effective solutions, meeting diverse end-user needs.

Source: Frost & Sullivan

The Last Word

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The Last Word—3 Big Predictions

1. Data center construction is experiencing rapid growth, transitioning toward high-performance, energy-efficient, green, and intelligent data centers. Development trends indicate that large-scale traditional data centers are evolving into modular, small-to-medium-sized centers to meet the demand for flexibility, rapid deployment, and high energy efficiency. modular data centers, with their scalability and flexibility, are emerging as the core enablers of this transformation.

2. The rapid development of edge computing scenarios has raised higher demands for real-time data processing and low latency. modular data centers, with their distributed deployment and proximity to data sources, are emerging as ideal solutions to support edge computing applications, such as IoT devices, 5G networks, autonomous driving, and AR/VR, driving sustained market expansion.

3. The APAC region, particularly China and Southeast Asian countries, will become the primary growth area for modular data centers. As these regions accelerate their digital transformation, demand for efficient and flexible data center solutions is rapidly increasing. To capture market share, North American and European players are expected to intensify their presence in these markets in the mid-term.

Source: Frost & Sullivan

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The Frost & Sullivan Story

The Journey to Visionary Innovation

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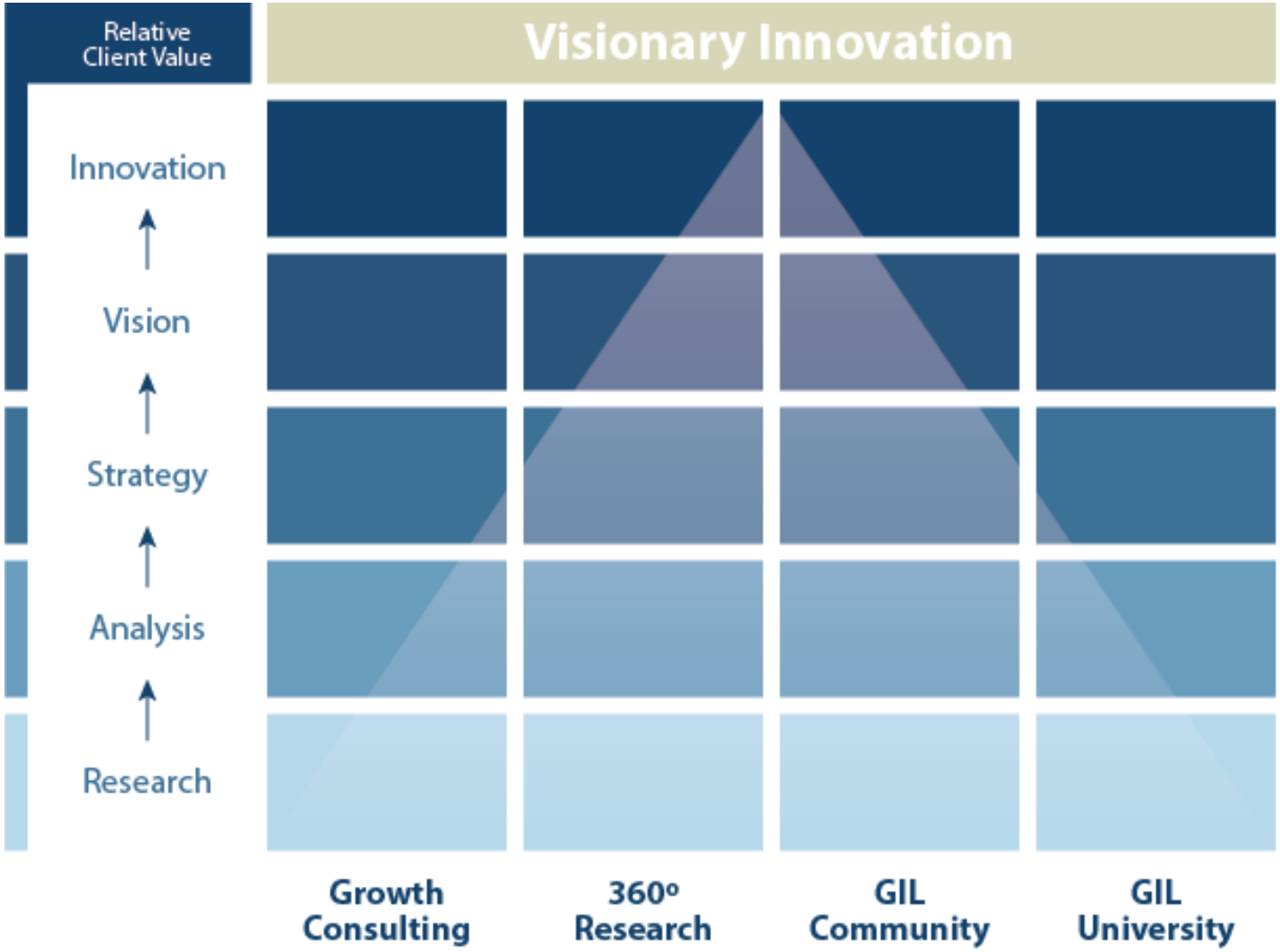
The Frost & Sullivan Story

Value Proposition—Future of Your Company & Career

Our 4 Services Drive Each Level of Relative Client Value



Global Perspective

40+ Offices Monitoring for Opportunities and Challenges

Industry Convergence

Comprehensive Industry Coverage Sparks Innovation Opportunities

Aerospace & Defense

Measurement & Instrumentation

Consumer Technologies

Information & Communication Technologies

Automotive Transportation & Logistics

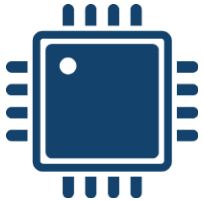
Energy & Power Systems

Environment & Building Technologies

Healthcare

Minerals & Mining

Chemicals, Materials & Food



Electronics & Security

Industrial Automation & Process Control

360º Research Perspective

Integration of 7 Research Methodologies Provides Visionary Perspective

Implementation Excellence

Leveraging Career Best Practices to Maximize Impact

Our Blue Ocean Strategy

Collaboration, Research and Vision Sparks Innovation