



US Defense Research and Development Growth Opportunities

Reduced Budgets Challenge New Product Development

Global Aerospace & Defense Research Team at Frost & Sullivan

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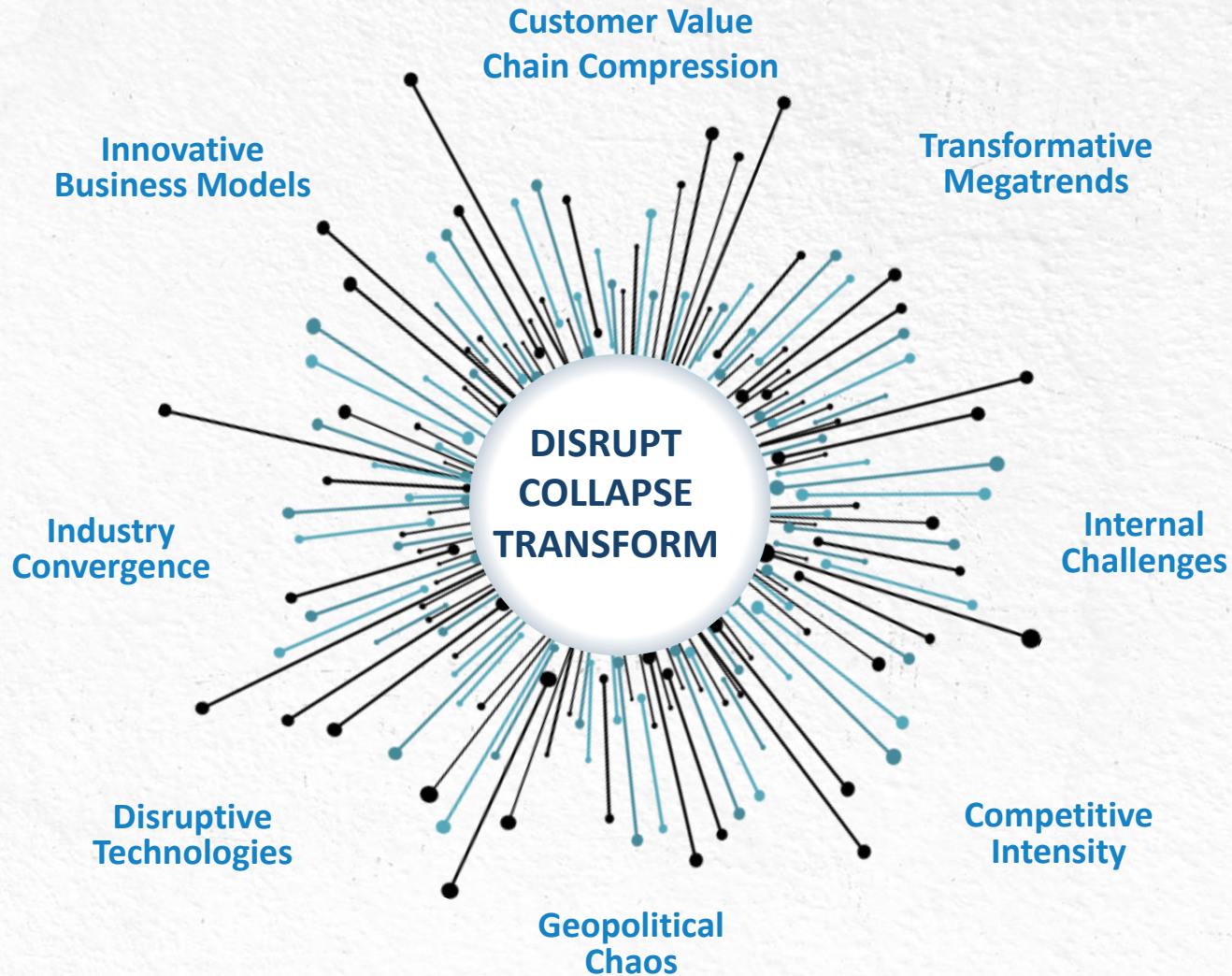
Transformation in the US Defense Research and Development Industry

Is your company prepared to Survive and Thrive through the coming Transformation?

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Why Is It Increasingly Difficult to Grow?

The Strategic Imperative 8™: Factors Creating Pressure on Growth



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The Strategic Imperative 8™

Innovative Business Models

A new revenue model that defines how a company creates and capitalizes economic value, typically impacting its value proposition, product offering, operational strategies, and brand positioning

Customer Value Chain Compression

Customer value chain compression as a result of advanced technologies, internet platforms, and other direct-to-consumer models that enables reduction in friction and the number of steps in customer journeys

Transformative Megatrends

Global forces that define the future world with their far-reaching impact on business, societies, economies, cultures, and personal lives

Internal Challenges

The internal organizational behaviors that prevent a company from making required changes

Competitive Intensity

A new wave of competition from start-ups and digital business models that challenge the standing conventions of the past, compelling established industries to re-think their competitive stance

Geopolitical Chaos

Chaos and disorder arising from political discord, natural calamities, pandemics, and social unrest that impact global trade, collaboration, and business security

Disruptive Technologies

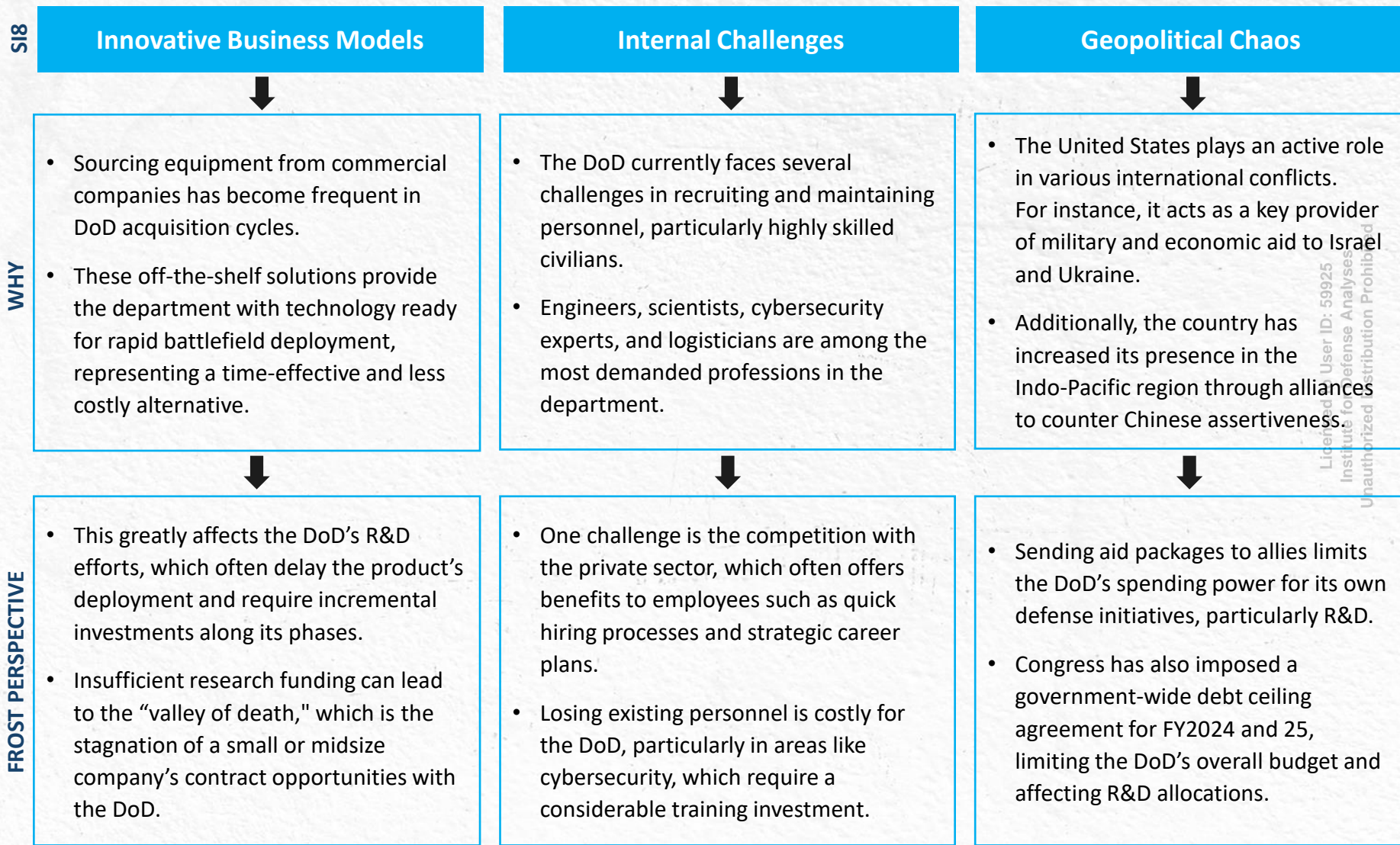
New, disruptive technologies that are displacing the old, and significantly altering the way consumers, industries, or businesses operate

Industry Convergence

Collaboration between previously disparate industries to deliver on whitespace cross-industry growth opportunities

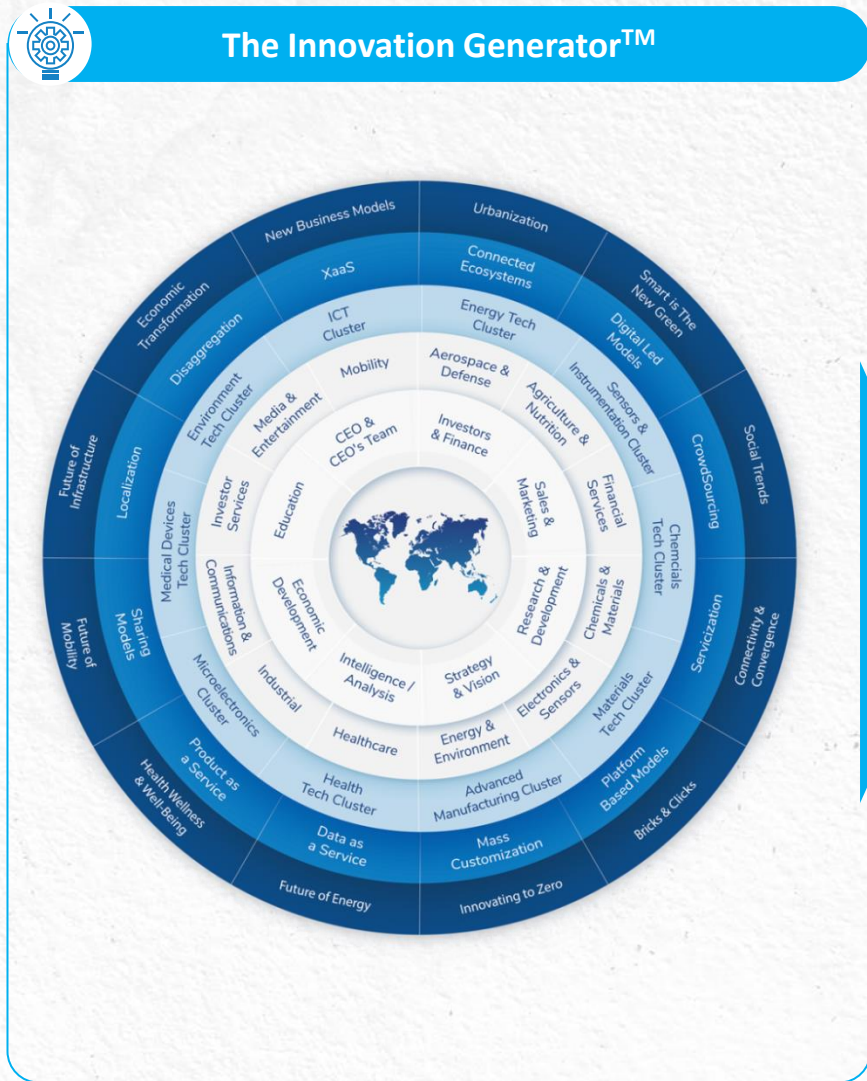
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The Impact of the Top 3 Strategic Imperatives on the US Defense R&D Industry



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Growth Opportunities Fuel the Growth Pipeline Engine™



Analytical Perspectives



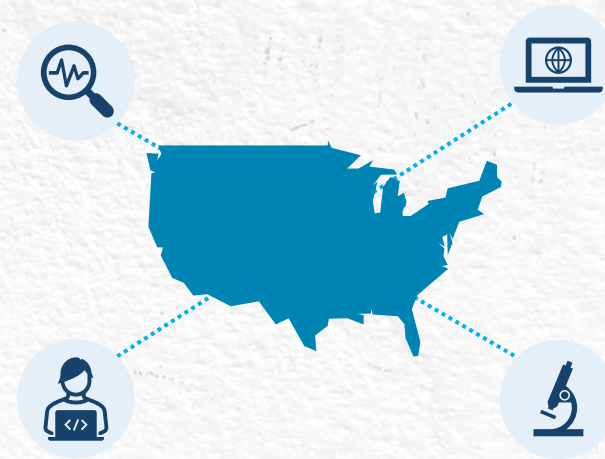
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Growth Opportunity Analysis



Scope of Analysis

Scope	
Base Year	FY2023
Study Period	FY2023–FY2029
Forecast Period	FY2024–FY2029
Geographic Coverage	United States
Monetary Unit	US Dollars (USD)

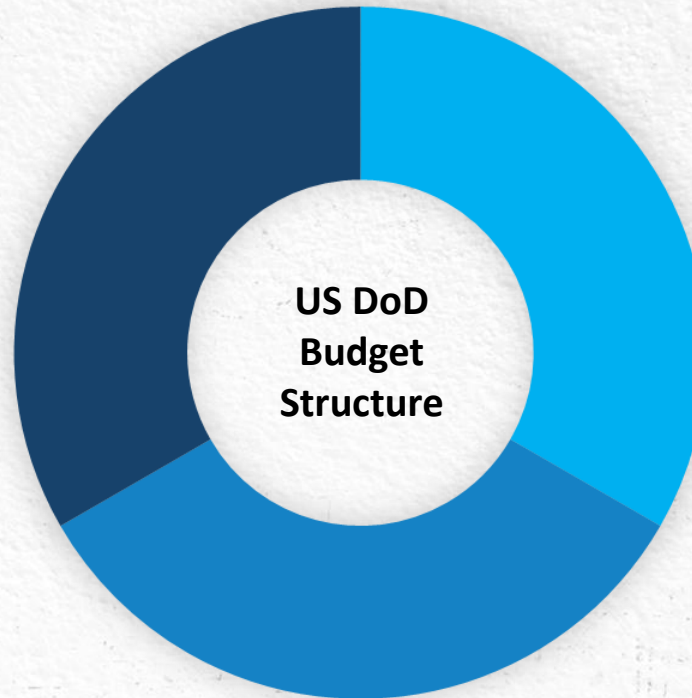


- This study analyzes the US DoD's R&D budget between FY2023 and FY2029.
- The study outlines the DoD's budget activities and funding distribution amongst military branches and provides a forecast with spending estimates.
- Additionally, the study highlights the trends, challenges, drivers, and restraints the DoD and industry partners may encounter.
- Finally, the study points out some short- and long-term growth opportunities for defense research initiatives.

Definitions

Operations and Maintenance (O&M)

O&M includes appropriations allocated toward expenses such as maintenance services, base operations support, civilian salaries, minor construction work, administrative services, supplies, materials, and training initiatives. It is usually the biggest portion of the US DoD budget.



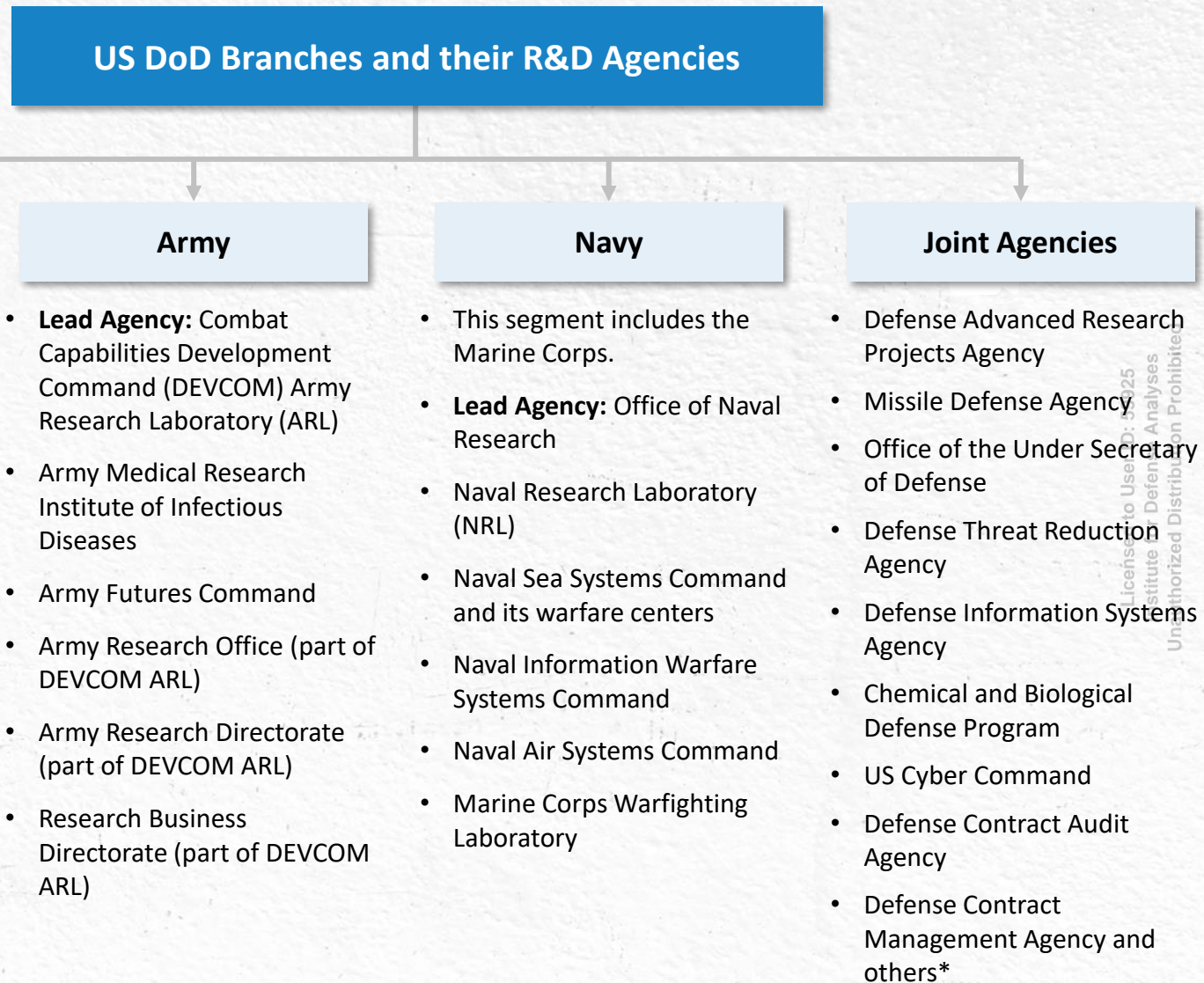
Procurement

Procurement includes appropriations allocated toward equipment and system acquisition, modification, major service life extension programs, initial spares and repair parts, support elements, and non-construction-related investment items.

Research, Development, Test, and Evaluation (RDT&E)

RDT&E includes appropriations allocated toward developing a new capability or improving an existing one. This segment includes services, equipment, components, software, materials, and end items. The work can be performed by contractors and US DoD employees.

Segmentation

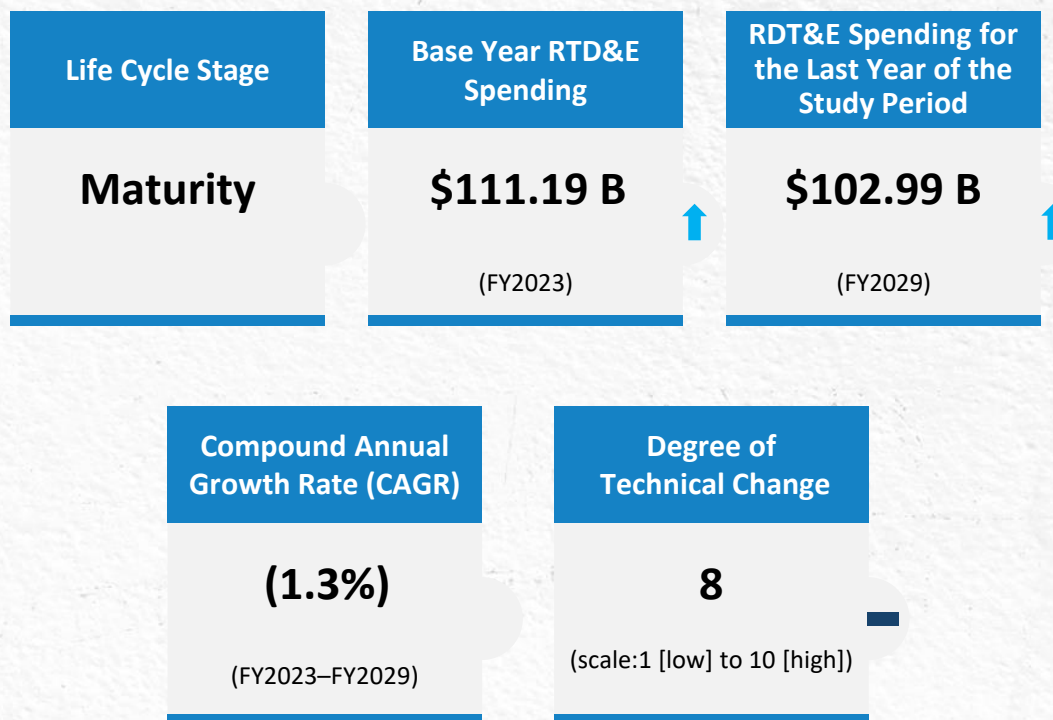


*Defense Counterintelligence and Security Agency, Defense Health Agency, DoD Human Resources Agency, Defense Logistics Agency, Defense Security Cooperation Agency, Defense Technical Information Center, DoD Inspector General, Operational Test & Evaluation, US Special Operations Command, and the Joint Staff.

Note: The Air Force, Army, and Navy lists are non-exhaustive.

Growth Metrics

Defense R&D: Growth Metrics, United States, FY2023



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Growth Drivers

Defense R&D: Growth Drivers, United States, FY2024–FY2029

Driver	1–2 Years	3–4 Years	5–6 Years
The DoD is currently carrying out defense-wide and force-specific major modernization programs that ensure long-term R&D opportunities for companies of all sizes. Examples include CJADC2, the Army’s Army Integrated Air and Missile Defense program, the Navy’s Pilot Fish project, and the Air Force’s Next Generation Air Dominance (NGAD) program.	High	High	High
Innovation from the commercial sector is hitting unprecedented rates, with fast-paced product launches and updates in sectors such as cybersecurity and artificial intelligence. The DoD has established several partnerships with commercial companies that provide the organization with tailor-made, mission-ready solutions.	High	High	High
The US aims to maintain its competitive edge over its global political adversaries by staying at the forefront of military technological innovation. To do so, the DoD will continue to promote in-house product development and collaboration with industry participants through R&D budget activities.	High	High	Medium

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Growth Restraints

Defense R&D: Growth Restraints, United States, FY2024–FY2029

Restraint	1–2 Years	3–4 Years	5–6 Years
<p>Most of the DoD's budget is allocated toward O&M, thus restricting spending on R&D projects and new technologies. For reference, the FY2025 DoD budget request allocates around \$337.92 billion to O&M while assigning \$143.12 billion for R&D (including classified projects).</p>	High	High	High
<p>The DoD heavily relies on private capital to support its R&D efforts. Despite its detailed budget, the department's R&D funding does not rapidly translate into available capital for start-ups, delaying product scalability. This makes the private market more attractive for these companies.</p>	High	High	Medium
<p>The incoming Trump administration is expected to ramp up the US defense budget, but future spending priorities are still unclear. This causes uncertainty to industry participants, potentially dissuading them from working with the DoD in the short term. Once in office, the government will provide more insight into its defense policy.</p>	High	Medium	Medium

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Global Conflict Analysis

Europe

- The Russia-Ukraine conflict encouraged spending increases and military modernization efforts across the region.
- Despite Europe's consolidated defense industry, US imports and investments still play a huge role in the continent's military readiness.
- In 2023, the DoD signed a cooperation agreement with the European Defense Agency, a local organization that carries out defense research projects.

Middle East

- The Israel and Palestine conflict has led to attacks on commercial vessels in the Red Sea by Yemen's Houthi group.
- The United States has intervened in both conflicts through retaliations and military aid packages for Israel worth around \$12.50 billion.
- The DoD and Israel's Directorate of Defense Research and Development have collaborated on multiple research projects.

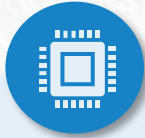
Latin America

- The United States, China, and Russia are some of the main extra-continental defense suppliers and exert their influence in this region through arms sales.
- Most Latin American countries currently prioritize long-term modernization plans and the refurbishment of obsolete equipment.
- The United States involves itself in the region more through procurement opportunities than through research ones.

Asia-Pacific

- Tensions with China, especially near Taiwan, boosted the US' defense collaboration with Indo-Pacific nations, such as Australia, India, and Japan.
- Partnerships such as the Quad Security Dialogue and the AUKUS alliance act as crucial frameworks for technology sharing and joint projects.
- The US highlights joint defense research projects as a priority in its Indo-Pacific strategy.

Market Trends Analysis



Semiconductors

Local semiconductor production is a top priority for the DoD to counter China's presence in this market. Smart weapon systems increasingly rely on chips to work, so the United States encourages their in-house development through the CHIPS Act.



Quantum Technology

Quantum computing offers exponential speedups that can enable machine learning (ML) and artificial intelligence (AI) capabilities. Meanwhile, quantum sensing is often used in GPS-denied environments to enable continued navigation.



Artificial Intelligence

The DoD has created special research projects and offices to promote its use across the military. AI presents benefits such as greater autonomy and less workload yet has faced criticism for its potential use in lethal weapon systems.



Unmanned Systems

Unmanned systems provide the military with a cost-effective, autonomous solution that can replace humans in complex tasks. The DoD aims to quickly scale and dispatch multiple units, with the help of the commercial sector, through the Replicator project.



Space Technology

The DoD is keen on integrating scalable commercial technology into its space arsenal. GPS resiliency and security are some of the department's immediate operational requirements to counter electronic warfare efforts from adversaries.



Training and Simulation

The department is moving away from live-only training methodologies and instead resorting to constructive or virtual training environments. This has created demand for AR/VR devices with advanced features such as biometrics and motion capture.

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CHIPS: Creating Helpful Incentives to Produce Semiconductors; GPS: Global Positioning System;
AR/VR: Augmented Reality / Virtual Reality.

Forecast Considerations

Spending data for this forecast was obtained from official and publicly available DoD budget documents managed by the Undersecretary of Defense/Comptroller.

**Spending
Data
Sources**

**Not
Included
Data**

The next slides do not include data related to classified programs, as well as from continuing resolution programs and financing for cancelled account adjustments.

The budget considers inflation when calculating future spending. Frost & Sullivan estimates that the inflation rate for the United States in FY2025 will be around 2.0%.

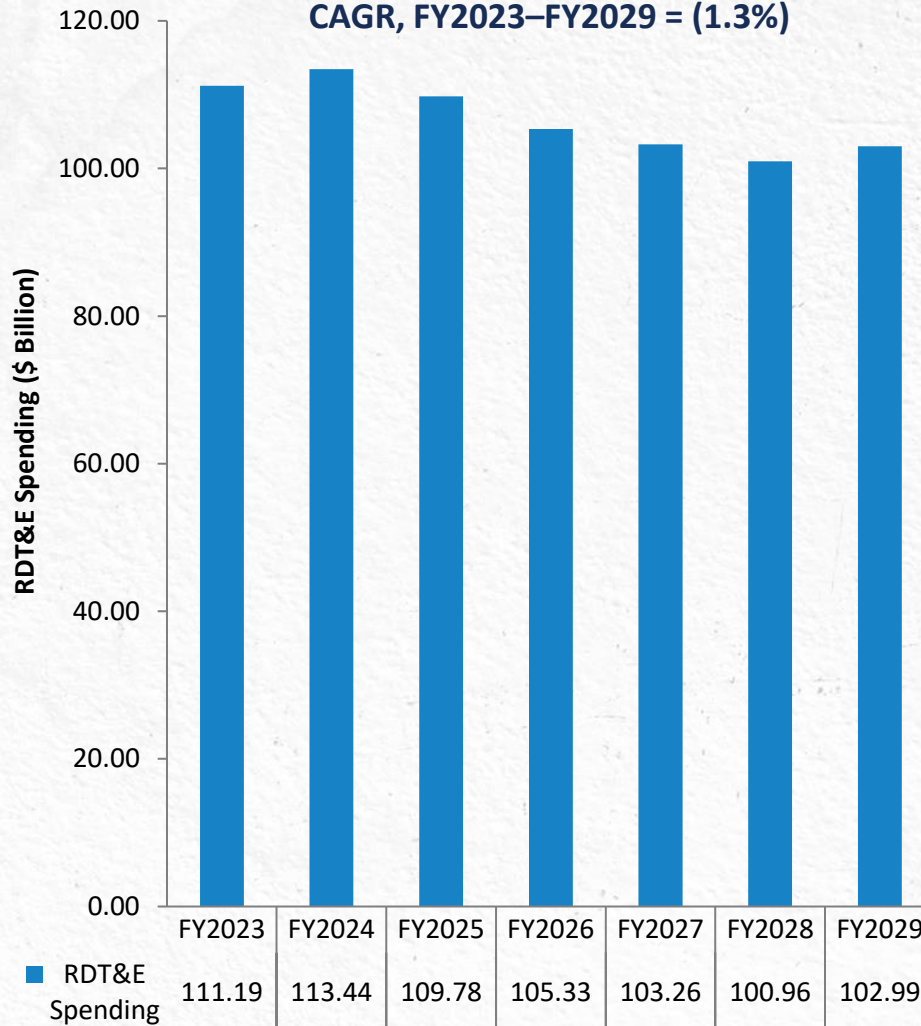
Inflation

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Spending Forecast and Analysis

Defense R&D: RDT&E Spending Forecast, United States, FY2023–FY2029

CAGR, FY2023–FY2029 = (1.3%)



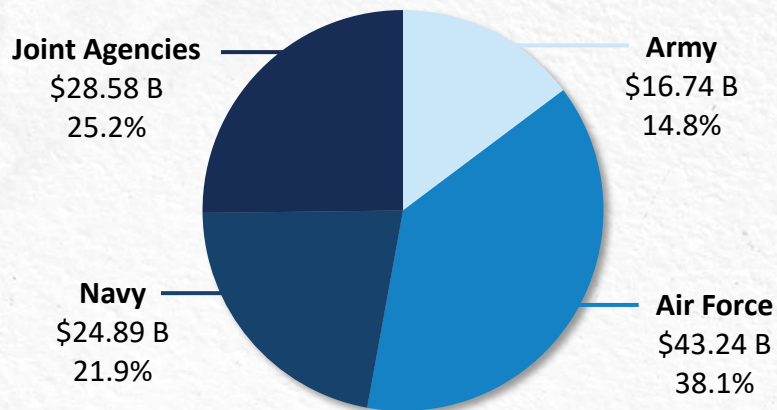
Forecast Period Insights

- The US DoD's RDT&E unclassified budget will experience a nearly \$10.45 billion decrease during the forecast period.
- A possible reason is that the US government's debt ceiling agreement will affect the DoD's RDT&E spending from FY2025 onwards, limiting the department's overall budget to \$895.0 billion.
- Additionally, the DoD has followed a pattern of assigning more funding to the procurement and O&M accounts over RDT&E for at least 5 years. This trend is expected to continue during the forecast period.
- The bulk of the budget will go towards the Advanced Component Development and Prototype budget activity during the forecast period, holding an average share of 34.1% of the total RDT&E budget.
- This spending category includes programs such as NGAD and Space Technology Development and Prototyping.

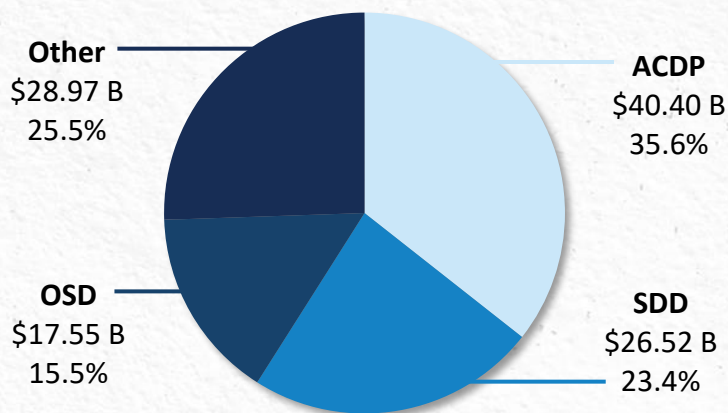
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Spending Forecast and Analysis (continued)

Defense R&D: RTD&E Spending Request by Force, United States, FY2024



Defense R&D: RTD&E Spending Request by Budget Activity Title, United States, FY2024



FY2024 Insights

- The Air Force is the largest spender in RDT&E in FY2024. The service’s largest program element is the development of the Ground Based Strategic Deterrent, an intercontinental ballistic missile system. Other relevant budget line items include the enhancement of space capabilities, such as missile tracking through low Earth orbit (LEO) satellites.
- Joint agencies occupy the second place due to the DoD’s goal to promote collaboration among forces and enhance the readiness of the joint force.
- The ACDP category received the most funding in FY2024 and the rest of the forecast period. The leading program within this category during FY2024 was the Air Force's allocation for the long-range strike bomber (\$3.04 billion).
- SDD is the second-largest spending category. This segment includes nearly \$615.0 million for the Chief Digital and Artificial Intelligence Officer’s development activities.

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ACDP: Advanced Components and System Development; SDD: System Development and Demonstration; OSD: Operational Systems Development
 Other: Advanced Technology Development, Management Support, Applied Research, Basic Research, RDT&E, and Software and Digital Technology Pilot Programs

Notable Programs

- The FLRAA program is the Army's contribution to the cross-force Future Vertical Lift modernization initiative, aiming to develop a replacement for the UH-60 Black Hawk.
- The program focuses on developing virtual prototypes using advanced technologies and a modular open systems approach to ensure affordability.
- In December 2022, the Army awarded Bell Textron with the weapon system development contract, launching a rapid prototyping phase.

Future Long Range Assault Aircraft Development (FLRAA)

\$1.25 B
Est. FY2025 Funding

Army Integrated Air and Missile Defense (AIAMD)

\$602.0 M
Est. FY2025 Funding

- The AIAMD program enhances the Army's capabilities through agile software development and a network-centric system-of-systems architecture.
- This integrates air and missile defense sensors and weapons, enabling extended range and non-line-of-sight engagements, including joint kill chain operations.
- The program will allow users to train on a unified command and control system, leading to cost savings in training.

- This program's goal is to advance the development of advanced components and prototypes for the Navy.
- Pilot Fish's budget justification details are classified.
- However, it is worth noting that the program's funding will receive a substantial increase from FY2022 to FY2025, nearly quintupling its budget, which shows the force's interest in conducting research on state-of-the-art capabilities.

Pilot Fish

\$1.01 B
Est. FY2025 Funding

Notable Programs (continued)

- The CPS program will oversee the building of a multi-platform, common hypersonic missile that will provide precise and rapid strike capabilities in contested environments.
- The Navy and Army are collaborating on the missile's development, and each service will develop its own weapon control systems and launchers for sea or land deployment.
- The Navy will first deploy the missiles on its Zumwalt-class missile destroyer vessels and Virginia-class attack submarines.

CPS

\$903.9 M
Est. FY2025 Funding

Ground Based Strategic Deterrent EMD

\$3.72 B
Est. FY2025 Funding

- This program will oversee the development of the LGM-35A Sentinel intercontinental ballistic missile.
- Key activities include systems engineering, IT, data management, and delivering a critical weapon system design.
- The program will modernize and expand its analytic environment and labs to support EMD, ensuring the program can manage the technical baseline throughout its lifecycle.

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- The NGAD family of systems will be designed to provide air superiority in complex operational environments for the Joint Force.
- This program focuses on digital acquisitions, agile software development, open systems architectures, and full weapon systems design and testing.
- Though mainly developed by the Air Force, NGAD technologies will be available for integration with other DoD systems.

NGAD

\$3.31 B
Est. FY2025 Funding

Notable Programs (continued)

- The Missile Defense Agency is developing the Next Generation Interceptor (NGI), which aims to address emerging threats (such as North Korea and Iran) with a more advanced system with improved survivability and better performance.
- The program's budget will fund further development, testing, and risk reduction of the selected NGI design, including its booster, payload, and sensors.
- Lockheed Martin is the prime contractor for the program.

Improved Homeland Defense Interceptors

\$1.70 B
Est. FY2025 Funding

Industrial Base Analysis and Sustainment (IBAS)

\$1.10 B
Est. FY2025 Funding

- The IBAS program element from the Office of the Secretary of Defense invests in primary and secondary suppliers to address supply chain risks and resolve production capacity limitations.
- Part of the initiative addresses the DoD and the defense industrial base's critical workforce development issues.
- Some key sectors that the program focuses on include microelectronics and missiles.

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- This program targets high-value opportunities to quickly mature critical technologies and systems for modern network-centric warfare strategies, particularly in joint operations such as strategic planning and tactical and urban missions.
- Such initiatives aim to use existing and emerging networks, robotics, and information technologies to equip next-generation US forces with enhanced capabilities, increased lethality, and faster responsiveness.

Network-centric Warfare Technology

\$886.5 M
Est. FY2025 Funding

Highlighted Industry Participants

Large Defense Companies

Lockheed Martin

- The company is ranked as the largest defense company in the world and is the lead contractor in multiple US DoD research initiatives, such as the NGI program and DARPA's Artificial Intelligence Reinforcements initiatives.
- Lockheed's in-company R&D budget reached \$1.50 billion in 2023, and its main areas of interest include cyber, electronic warfare, and data analytics.

Northrop Grumman

- Northrop Grumman was appointed by the AFRL in late 2023 to build a satellite constellation and integrate commercial space internet into airborne platforms in support of the CJADC2 strategy.
- The company is also collaborating with DARPA in the development of the SHEPARD vehicle, an uncrewed air system with hybrid electric propulsion, also dubbed X-plane.

L3 Harris Technologies

- L3 Harris will collaborate on a research project with the Army's DEVCOM about the open systems approach for future ground vehicles.
- Additionally, the company partnered with startup Zapata AI and DARPA in early 2023 to research quantum computing use cases for defense and other areas, such as chemistry, finance, machine learning, and more.

Highlighted Industry Participants (continued)

Mid-sized and Small Companies

SimX

- The company provides medical training and simulation products and services, such as an exclusive training curriculum for the Air Force through a nearly \$20.0 million DoD R&D contract vehicle.
- The Virtual Advancement of Learning and Operational Readiness (VALOR) program, where SimX was involved, integrated virtual reality to achieve a more immersive training experience.

Rescale

- Rescale delivers a high-performance computing platform that can be accessed and hosted on the cloud and used for various use cases, including aerospace and defense.
- The company, along with Parallel Works, partnered with the Defense Innovation Unit to research cloud-based supercomputing services and their potential use in the DoD.

Aloft Sensing

- The company provides self-contained navigation technologies through distributed sensors with pinpoint accuracy, even in GPS-denied environments.
- Aloft obtained a Small Business Innovation Research (SBIR) Phase 2 contract from the Army in 2022, valued at nearly \$2.0 million.

Conclusions and Future Outlook

- 1 The DoD's unclassified RDT&E budget will decrease by around 7.4% between FY2023 and FY2029 due to government spending limitations and a greater focus on procurement.
- 2 Ongoing global conflicts will drive the DoD to increasingly prioritize the in-house development of advanced defense technologies to maintain a competitive edge.
- 3 The DoD must accelerate its investment in cutting-edge technologies to keep up with the private sector's fast-paced innovation cycles.
- 4 The DoD will continue collaborating with industry partners, particularly academia and research centers, to leverage external expertise for its R&D programs.
- 5 The outcome of the upcoming presidential election will potentially solidify the DoD's R&D key priorities and funding directions for the coming years.

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Growth Opportunity Universe

What Growth Strategies have you embraced to maximize your Growth Potential?

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Growth Opportunity 1: Human-Machine Interfaces

Opp. Size in 5 Years USD 100 M – USD 500 M	Relevant End-User Industries for this Growth Opportunity			Applicable Regions Central & East Europe South Asia Western Europe CIS North America Latin America Africa Middle East Asia-Pacific
	Manufacturing	Mobility	Metal & Mining	
Timeline for Action 1 to 3 Years	Energy & Environment	Chemicals & Materials	Information & Communications Technologies	
	Electronics & Semiconductors	Agriculture, Food & Nutrition	Govt and Public Sector	
	Construction	Education	Healthcare & Lifesciences	
GO Base Year 2024	Consumer	Aerospace	Hospitality	
	Retail	Defense	Banking & Financial Services	

Frost & Sullivan has identified 10 Growth Processes that serve as levers for determining and evaluating new Growth Opportunities.



Growth Opportunity 1: Human-Machine Interfaces (continued)



Context and Definition

- Human-machine interfaces (HMIs) are technologies, mainly used for training and simulation, that combine human interaction with augmented and virtual reality.
- HMIs can provide highly immersive and realistic training environments, recreating complex geographies by processing real geospatial imagery.
- Often, HMIs are combined with AI, adding dynamism and unpredictability to training exercises.
- This technology can incorporate multiple combat variables and create autonomous agents (such as enemies and allies) and scenarios.
- The US DoD is making significant investments in AI (around \$1.80 billion for FY2025) and creating specific organizations, like Task Force Lima, to research and implement its defense use cases.
- Combining HMIs and AI enhances service members' performance and mission readiness by representing potential battlefields more accurately.



Call to Action

- Companies that provide HMIs to the DoD should invest in adaptive learning technologies to allow greater customization and evaluation of its users.
- Data analytics software can be leveraged to gather insights about warfighters' performance, which can provide commanders with the big picture of their division's readiness.
- These companies must ensure their HMIs are easily integrated with existing DoD training systems.
- Such compatibility will quicken new technology deployment in military training ranges.
- HMI providers must consider the importance of including multi-domain joint operations in their models.
- Solutions that incorporate this concept are in high demand for the DoD, especially in the context of its CJADC2 strategy.

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Growth Opportunity 2: Alternative Navigation Technologies

Opp. Size in 5 Years USD 100 M – USD 500 M	Relevant End-User Industries for this Growth Opportunity			Applicable Regions
	Manufacturing	Mobility	Metal & Mining	Central & East Europe South Asia
Timeline for Action Over 3 to 5 Years	Energy & Environment	Chemicals & Materials	Information & Communications Technologies	Western Europe
	Electronics & Semiconductors	Agriculture, Food & Nutrition	Govt and Public Sector	CIS
	Construction	Education	Healthcare & Lifesciences	North America Latin America
GO Base Year 2024	Consumer	Aerospace	Hospitality	Africa Middle East
	Retail	Defense	Banking & Financial Services	Asia-Pacific

Frost & Sullivan has identified 10 Growth Processes that serve as levers for determining and evaluating new Growth Opportunities.



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Growth Opportunity 2: Alternative Navigation Technologies (continued)



Context and Definition

- The DoD is interested in developing navigation alternatives to its Global Positioning System (GPS), the most widespread satellite constellation that transmits positioning, navigation, and timing (PNT) information.
- GPS signals are constantly vulnerable to jamming and spoofing attacks from enemy forces. Therefore, the DoD aims to diversify its PNT sources to avoid the complete shutdown of its navigation systems.
- Some examples of alternative navigation technologies of interest to the DoD are as follows:
 - Magnetic navigation: Uses variations in the Earth's magnetic field to determine an object's position.
 - Celestial navigation: Uses the observation of the stars and planets to determine position.
 - Inertial navigation: Uses motion and rotation sensors to calculate an object's position.
 - Radiofrequency (RF) positioning: Uses non-GPS radiofrequency signals to determine position.



Call to Action

- Providers of alternative navigation technologies are advised to invest in multi-sensor fusion, combining data from multiple sources to decrease reliance on GPS. Multi-PNT receivers are examples of technologies that can integrate data from multiple sources, such as M-Code (part of GPS) and commercial space-based systems.
- Companies must develop solutions that can ensure global operability, that is, that can function in different types of terrain and operational theaters, such as urban environments.
- The DoD demands products with high-security robustness, and businesses must comply with those standards to achieve market success.
- Alternative navigation technologies should be resilient against electromagnetic warfare threats, as well as jamming and spoofing attacks.

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Growth Opportunity 3: Advanced Materials and Manufacturing

Opp. Size in 5 Years USD 100 M – USD 500 M	Relevant End-User Industries for this Growth Opportunity			Applicable Regions
	Manufacturing	Mobility	Metal & Mining	Central & East Europe South Asia Western Europe
Timeline for Action 1 to 3 Years	Energy & Environment	Chemicals & Materials	Information & Communications Technologies	CIS
	Electronics & Semiconductors	Agriculture, Food & Nutrition	Govt and Public Sector	North America
	Construction	Education	Healthcare & Lifesciences	Latin America Africa
GO Base Year 2024	Consumer	Aerospace	Hospitality	Middle East
	Retail	Defense	Banking & Financial Services	Asia-Pacific

Frost & Sullivan has identified 10 Growth Processes that serve as levers for determining and evaluating new Growth Opportunities.



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Growth Opportunity 3: Advanced Materials and Manufacturing (continued)



Context and Definition

- Advanced materials are one of the key science and technology priorities for the DoD, as their use can bring multiple benefits.
- Lightweight yet strong materials that can endure high temperatures are in demand to develop new defense equipment.
- These materials, such as polymers, can be a cost-effective alternative to traditional ones, such as metal and iron.
- The DoD is also prioritizing quick manufacturing techniques, such as 3D printing, to rapidly scale equipment components and certain assets, such as unmanned vehicles. This method uses digital models to print the end product layer by layer. For instance, the Replicator project aims to use additive manufacturing to mass-produce drones quickly.



Call to Action

- Companies should stay up to date with military specifications about the performance, durability, and safety of their equipment.
- When showcasing their innovative products to the DoD, they should abide by these standards to achieve business opportunities.
- Market participants should integrate eco-friendly materials in their manufacturing processes to comply with the DoD's goal to reduce its carbon footprint. Each branch of the military has its own climate change strategy that contributes to this goal. The plan includes actions such as collecting climate intelligence and building climate-resilient infrastructure.
- Businesses should adopt a decentralized production model to enhance their product's scalability and reduce their go-to-market timelines.

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Appendix & Next Steps

How does your organization identify and prioritize Growth Opportunities?

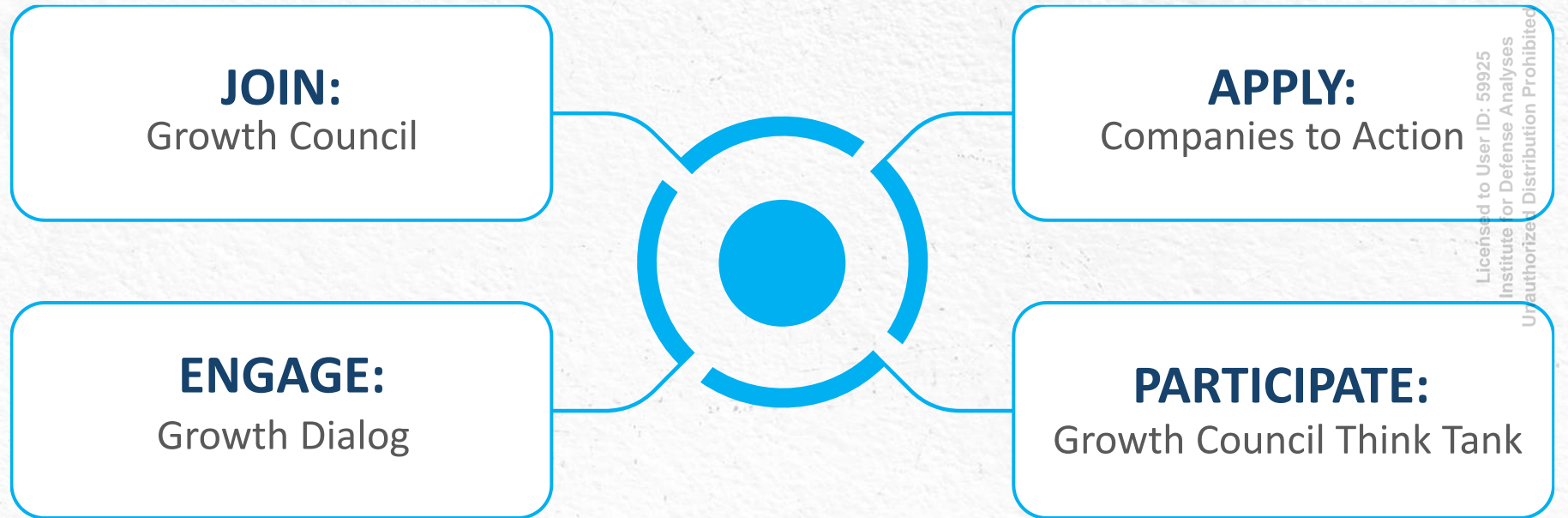
Benefits and Impacts of Growth Opportunities



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Which of these benefits would be most important to your Investor-Customer-Employee?

Next Steps



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Does your current system support rapid adaptation to emerging opportunities?

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