BOSTON ENGINEERING™

Imagine the Impact™

2025 TECHNOLOGY OVERVIEW

Industry Insights I Capabilities I Trends



March 2025

How to Use This Guide

The 2025 Technology Overview from Boston Engineering offers an insightful glimpse into trends and innovations on the horizon. Spanning artificial intelligence, robotics, additive manufacturing, and more, this collection of articles provides key takeaways for those looking to stay ahead of the technology curve.

Through the diverse perspectives of Boston Engineering's Principals, Directors, and Subject Matter Experts you will gain valuable foresight into the breakthroughs shaping industries from medical technology to defense. Whether you're an engineering professional, business leader, or technology enthusiast, the 2025 Overview delivers not only excitement about what's next but also strategic advice on leveraging emerging capabilities.

Key highlights provide a compass for navigating the landscape in the years ahead. Learn how re-shoring can provide opportunities to adopt innovative technologies. Continued software innovation in embedded computing point to growing performance and expanded applications. The adoption of digital modeling and simulation promises to accelerate and transform design and development across sectors.

Equally important, this overview offers wisdom on aligning innovation investments with long-term business strategy. As new technologies captivate imaginations, the collection grounds us in objective assessments that consider return on investment along with the organizational change management required.

At a time of rapid digital disruption, the 2025 Technology Overview equips readers with an informative advantage. Gain the knowledge to anticipate challenges, leverage opportunities, and strategically hone capabilities for the future. Both rational and inspirational, this glimpse ahead provokes one to imagine the impacts on our work, our industries and our world.

We hope you enjoy.

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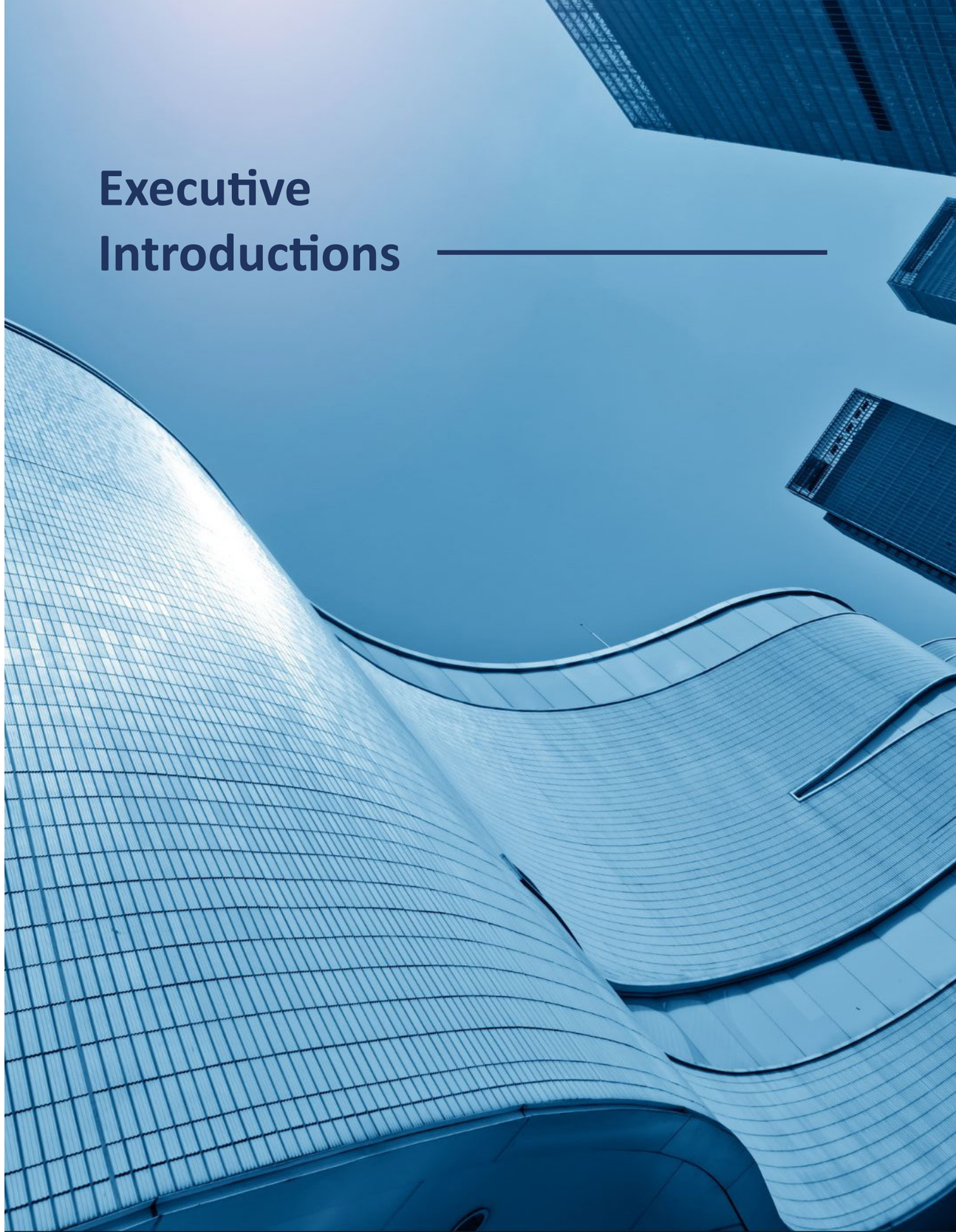
About Boston Engineering

Our mission is to improve the way people work and live through innovative product design and novel engineering.

Founded in 1995 and headquartered in Waltham, Massachusetts, Boston Engineering boasts over 30 years of transformative expertise at the intersection of engineering and technology. Positioned in the thriving tech hub of Greater Boston, the company has become a trusted partner in guiding clients through the entire product development lifecycle. Specializing in Robotics, Embedded Systems, Digital Solutions, Control Systems, and Design for X (DFX), Boston Engineering's multidisciplinary team collaborates to deliver tailored solutions with a commitment to excellence.

Adapting to evolving technological landscapes, the company's success is marked by the continuous innovation and integration of cutting-edge technologies. Beyond technology development, Boston Engineering fosters a culture of collaboration, knowledge-sharing, and community engagement, contributing to the growth of the Greater Boston tech ecosystem. The company is defined by a passion for problem-solving and a customer-centric approach, solidifying its position as a trailblazer in engineering consultancy. As Boston Engineering continues to shape the future of technology, its commitment to excellence and client success remains unwavering, making it a key player in driving innovation.

Executive Introductions



Leveraging Technology to Overcome Current Commercial Challenges

"At Boston Engineering, I've seen how technology has transformed product development and manufacturing over the last 30 years. In this time, we've worked with companies across industries—from defense to medical devices to commercial manufacturing—helping them adapt to and excel in shifting market conditions."

Robert Treiber II
President



Over the last few years, reshoring— bringing manufacturing back to the U.S.—has gained momentum, and not just due to tariffs or trade policies. Economic shifts, rising wages abroad, the pandemic's supply chain disruptions, and national security concerns have created a perfect storm for executives to rethink their strategies. For companies considering reshoring in the coming year, the challenges are real: redesigning products, rebuilding supply chains, and addressing workforce shortages.

Modern technologies – such as digital twins, automation, and artificial Intelligence/ machine learning – offer powerful tools to not only overcome these hurdles but to make the transition a competitive advantage.

Addressing Product Redesign for Domestic Manufacturing

One of the first challenges of reshoring is that products originally designed for overseas manufacturing often aren't optimized for the higher wages and automation requirements of U.S. production. By investing in technologies like AI and automation, companies can streamline production processes to reduce dependency on manual labor while improving precision and quality.

Virtual modeling tools such as digital twins allow companies to simulate production changes, identify inefficiencies, and validate improvements before implementing physical changes. This reduces risk, speeds up development, and positions companies to compete more effectively in high-cost environments.



Building a Resilient Supply Chain with Digital Twins

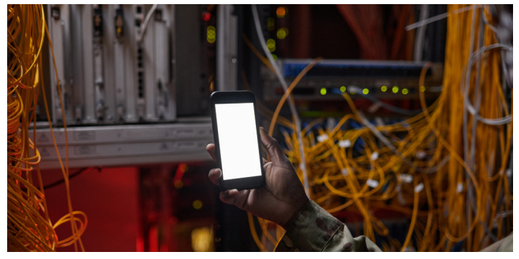
Another major hurdle when reshoring is rebuilding a supply chain that was previously dependent on overseas suppliers. Companies must source components domestically or integrate new suppliers, often while revalidating compatibility and quality standards. This is where technologies like digital twins become indispensable.

Digital twins provide a virtual representation of a company's manufacturing or supply chain processes, enabling real-time testing and analysis.

By using these tools, companies can evaluate supplier options, simulate material substitutions, and optimize logistics strategies without interrupting existing operations. This not only helps reduce costly downtime but also ensures continuity and quality as supply chains transition.

Tackling Workforce Shortages with Advanced Tools

The workforce challenge looms large for reshoring efforts. The U.S. manufacturing sector is already facing a skills gap, with millions of jobs going unfilled. For companies reshoring production, finding skilled workers—and upskilling their existing workforce—is critical. Technology again offers a way forward. At Boston Engineering, we've developed tools like **Mixed Reality Expert Guidance (MREG)** to address this issue.



MREG allows fewer experts to guide multiple workers remotely, magnifying their impact. For instance, instead of sending a senior engineer to every facility to troubleshoot issues, companies can use MREG to provide real-time video guidance securely, no matter the location. This not only saves time and cost but also enables companies to operate more efficiently despite workforce constraints.

Reshoring as a Catalyst for Innovation

Reshoring is often viewed as a necessary response to external pressures, but it's also a chance to innovate. By integrating technologies like AI, machine learning, and digital twins, companies can modernize not just their manufacturing processes but their entire approach to product development.

These technologies don't just solve today's problems—they position businesses for future success by building resilience and agility into operations. For example, companies that redesign products for automation and integrate real-time monitoring systems often see improved scalability, reduced costs, and enhanced product quality.

Such investments not only address current challenges but also enable companies to adapt more quickly to future disruptions or shifts in demand.

Looking Ahead

As we move further into 2025, reshoring will continue to be a critical priority for many companies. While the challenges are significant, they are not insurmountable—especially with the right technologies and expertise. At Boston Engineering, we've seen firsthand how tools like digital twins, AI, and automation can transform manufacturing and product development, enabling companies to navigate the complexities of reshoring with confidence.

For executives considering reshoring, my advice is this: Don't just aim to bring production back—use this opportunity to rethink and reinvent. With the right technology and partners, you can build a supply chain and manufacturing process that's not only more resilient but also more competitive in the long term. Reshoring isn't just about reacting to challenges; it's about embracing the future of manufacturing.

The Future of Shipyard Robotics: FOSAR's Vision for 2025

The Family of Shipyard Assisting Robotics (FOSAR) initiative represents a groundbreaking approach to advancing shipyard automation and robotics.

Designed to address the growing complexity of naval sustainment while fostering collaboration across the supply chain, FOSAR is positioned to play a transformative role in shipyard operations in 2025. By leveraging modular, scalable, and flexible technologies, FOSAR promotes innovation while ensuring compatibility across diverse platforms and applications.

Technologies Driving FOSAR in 2025

Key advancements within the FOSAR program in 2025 include the continued development of modular robotics platforms capable of scaling across multiple shipyard applications. A central focus is crawler robotics, where FOSAR's efforts will improve durability and efficiency for tasks associated with hull inspection and maintenance.

These robotics systems will integrate technologies such as advanced sensors, robotic arms, and other modular devices. By designing robots that operate in challenging environments, the initiative will minimize the need for direct human involvement, enhancing both safety and productivity.

Digital tools will also play a critical role, providing operators with intuitive interfaces to oversee operations and maintain consistent quality standards.

The use of AI and machine learning will optimize robotic operations, enabling systems to adapt in real time to changing conditions.

Expanding the Shipyard Supply Chain

FOSAR is not just about robotics technology, it's about reshaping the shipyard supply chain. By introducing a family of interoperable robotic systems, the initiative encourages collaboration between suppliers, contractors, and end-users. This approach simplifies integration, reduces duplication of effort, and accelerates the adoption of advanced solutions. For example, the use of modular "building block" components—electronic, mechanical, and software systems—enables faster customization and broader application across shipyards.

Moreover, the initiative seeks to address workforce challenges by making shipyard jobs more appealing through the adoption of digital tools. By modernizing workflows and introducing robotics that assist rather than replace workers, FOSAR helps bridge the skills gap and ensures that shipyards remain competitive in attracting top talent.

Commercial Applications Beyond Shipyards

FOSAR's technologies have profound implications for commercial industries facing similar challenges. Robotic Crawlers, for example, can be adapted for infrastructure maintenance, such as inspecting and repairing wind turbines, bridges, and high-rise buildings. Similarly, the modular robotics framework can streamline factory automation, enabling rapid adaptation to product changes and reducing the need for extensive retooling. UV light systems, initially designed for underwater biofouling prevention, could be employed in commercial settings like food production and healthcare to ensure hygienic surfaces and contamination control.

Boston Engineering's ability to develop these technologies and foster collaboration across partners is a powerful testament to its problem-solving capabilities.

By uniting suppliers, contractors, and developers under a shared vision, Boston Engineering has built a family of robotics that serves as a model for cross-industry innovation. This approach directly addresses the concerns of executives outside the military and shipyard sectors, especially those grappling with a shrinking workforce and disrupted supply chains.

For product development leaders, FOSAR exemplifies how Boston Engineering's expertise can help design solutions that are not only cutting-edge but also practical and scalable. The emphasis on modular, flexible systems ensures that commercial enterprises can adapt quickly to market shifts, technological advancements, and workforce limitations. By adopting a similar strategy, industries like manufacturing, logistics, and energy can achieve greater resilience and efficiency, ensuring they remain competitive in an unpredictable world.





"Throughout 2025, Boston Engineering will demonstrate that it is more than simply a military and shipyard innovator—it is a trusted partner capable of solving the most complex challenges across industries."

Mark Smithers
Vice President and CTO

Engineering



The Technologies Shaping 2025: A Mechanical Engineering Vision for Impact

As we look to 2025, the rapid evolution of key technologies is set to drive significant changes across industries. Here's how these innovations will empower organizations to improve efficiency, reduce costs, and enhance decision-making:

Simulation Data and Regulatory Collaboration

The integration of simulation data into regulatory processes could transform how products gain approval. By combining advanced modeling with empirical data, organizations can accelerate design validation and streamline compliance. This approach not only reduces development time but also improves regulatory confidence, ensuring safer and more reliable products reach the market.

Digital Twins

Digital twin technology is redefining how businesses optimize production and design. By creating physics-based models of unstructured parts, organizations can eliminate the need to divert costly components from production. These virtual replicas allow teams to generate data for AI training, optimize processes like path planning, and deliver significant savings in both time and resources.

IoT-Enhanced Legacy Systems

The Internet of Things (IoT) is breathing new life into legacy components. By incorporating sensors, control systems, and network communications into decades-old systems, organizations are enhancing performance, improving safety, and enabling predictive maintenance. This upgrade minimizes downtime, increases operational efficiency, and provides actionable insights for facilities managers.

Advanced Simulation: CFD and FEA

Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) remain critical in design. These tools allow teams to target high-risk areas, evaluate trade-offs between prototyping and simulation, and make informed design decisions. However, their success hinges on skilled analysts who can ensure simulation results are both accurate and actionable.

In 2025, these technologies will enable organizations to reduce risk, boost innovation, and deliver lasting value for customers. Decision-makers who invest in these advancements now will position their companies as leaders in the year ahead.



Matt Ebbs
Director, Mechanical Engineering

Matt Ebbs works collaboratively with cross-disciplinary teams on projects in the medical, commercial, and defense industries. As a former mechanical engineer, now project manager, his experience includes new product developement, mechanical and electromechanical systems, test design/DOE, design for high-volume manufacturing, and more.

Advancing Robotics in 2025: Boston Engineering's Vision

In 2025, Boston Engineering is focused on enhancing robotics systems with advanced data collection and analysis capabilities.

Our systems leverage a wide range of sensors deployed by robots or operators to provide real-time and post-operation data analysis.

This setup ensures that subject matter experts can interpret critical data efficiently, enabling improved decision-making in applications such as medical diagnostics, hazardous material handling, and battlefield operations.

Our internal robotics stack continues to evolve, with the recent integration of high-sensitivity sensors arrays and motor control updates. These advancements are critical for enabling robots to operate effectively in high-risk environments, such as hazardous facilities or security and defense scenarios. The addition of increasingly sophisticated sensors enhances the robot's ability to detect and respond to these environmental hazards.



Our architecture is designed with flexibility at its core. Our sensor systems can operate in standalone configurations or integrate seamlessly with a host computer.

This dual-mode capability addresses power, communication availability, and size, weight, and power (SWaP) constraints. Users of these systems have options/ choices on how to integrate these sensor components into their solutions.



Gerard Sequeira
Robotics Software Engineer

Gerard Sequeira has over 15 years of experience designing and developing innovative robotic systems for commercial and defense spaces. His work involves designing, developing and implementing navigation systems, drive control, sensor fusion and engine control for surface, air and underwater robots.

For example, a user could use the system for quick reading without the need for analytics, whereas the same system connected to a host platform could use the sensor system data for additional analytics/storage/ processing.

A significant focus has also been placed on leveraging **ROS2 (Robot Operating System 2)** in unconventional applications. One notable use case is microfluidics handling, exemplified by an ongoing Life Sciences equipment development project.

By integrating ROS2 into this system, we have achieved precise control over fluid dynamics, enabling high-accuracy handling of minute volumes of liquid. This approach is critical for applications in biotechnology and medical research, where precision is paramount.



By combining advanced sensor feedback, adaptable architectures, and innovative software platforms like ROS2, Boston Engineering will continue to drive robotics capabilities forward in 2025.

The AI Revolution of 2025: Seamless Integration with Digital Technologies

In 2025 technology will transition to a seamless integration of Artificial Intelligence (AI) and Machine Learning (ML) into advanced digital technologies that will redefine value creation across industries.



By embedding AI into tools such as immersive technology (augmented reality (AR), virtual reality (VR), and mixed reality (MR)) and advanced business systems, organizations will begin achieving unprecedented operational efficiency and returns on investment (ROI).

AI-powered AR, VR, and MR solutions are transforming manufacturing, industrial applications, and Department of Defense (DoD) operations. In manufacturing, AR systems provide real-time guidance for complex assembly tasks, reducing errors and downtime.

Predictive maintenance in industrial MR operational environments diagnoses equipment issues remotely, enabling swift resolution and minimizing costly disruptions.

The DoD is leveraging digital technologies for enhanced operational readiness, mission planning and training simulations, offering real-time situational awareness and immersive preparation for varying scenarios.

Visualization solutions, enriched by AI, are unlocking deeper insights from complex datasets.



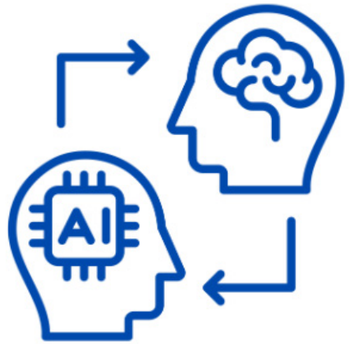
3D modeling and predictive analytics are optimizing supply chains and logistics management.

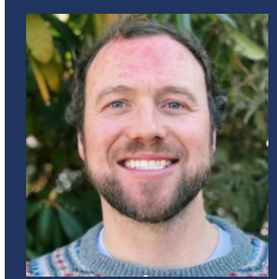
In manufacturing, interactive data visualizations are enabling leaders to optimize workflows and enhance productivity.

Additionally, AI-driven image processing and advanced visualization techniques are driving significant advancements. Image recognition is revolutionizing quality control by detecting defects with unmatched precision. Image processing is providing heightened cybersecurity in an ever-advancing digital world.

Cutting-edge visualization tools such as holographic displays and interactive dashboards are fostering collaboration, refining mission planning, and streamlining industrial processes.

2025 will be a year defined by the seamless synergy of AI/ML with digital technologies. These integrations will drive innovation, increase ROI, and enable industries to achieve transformative growth and efficiency.





Brian Kononchik
VP, Research and Development

With over 15 years of experience, Brian provides a deep expertise in advanced technologies, such as IoT, AR, and ML/ AI, all within industrial environments. He has designed and developed numerous solutions, from proof-of-concept to production, for leading enterprise organizations within the automotive and manufacturing industries, as well as in classified environments for the Department of Defense.



Advancing Embedded Systems and Engineering Efficiency in 2025

In 2025, Boston Engineering will continue to advance embedded systems technology, with a strong emphasis on efficiency, reliability, and adaptability.

Low-power design for battery-operated systems remains a key focus, with new methodologies being developed to further optimize power consumption and extend operational lifespans.

We plan to continue testing processors in ever more extreme conditions, ensuring robust performance in both cold temperatures and ambient temperatures exceeding 70°C.

To enhance engineering efficiency, we are formalizing standardized design methodologies for USB power management and battery charging solutions. This initiative aims to reduce development time, improve design reusability, and protect intellectual property.

On the software side, we are expanding our adoption of Robot Operating System 2 (ROS2) for complex distributed control architectures in robotics and automation. By further refining our in-house expertise, we will maximize ROS2's capabilities while reducing redundant software development efforts.

In 2025, we will accelerate our exploration of Rust, a type-safe programming language, for embedded systems. As more sensor and peripheral drivers supporting SPI, I2C, and traditional serial communications become available, Rust's adoption will improve reliability, security, and efficiency in embedded software development.

Aaron Pailes
Director, Electrical Engineering



Aaron Pailes combines systems engineering and design engineering to developed products, solve problems and improve processes. His experience includes systems engineering, architectural design, electronics design, and embedded firmware. Like many proud Boston Engineering innovators, Aaron has multiple patents that improve the way people live and work each day.

Innovative Software Technologies and Cybersecurity Advancements

There are a number of exciting software technologies found in products and projects that Boston Engineering will be delivering in 2025.

Cybersecurity continues to be a key consideration for any connected system. Processes, systems, and technologies continue to evolve to reduce exposure to cybersecurity threats while continuing to provide rich connectivity features. A number of regulatory requirements and guidelines will affect products from 2025 and beyond, from the FDA's 'Cybersecurity in Medical Devices' to the European Cyber Resilience Act (CRA).

Beyond keeping abreast of these regulations and best practices, Boston Engineering is applying a range of newer technologies. With systems, making use of best practices for encryption and authentication approaches provide tamper resistance and data integrity. For devices, leveraging the Rust programming language helps provide intrinsic security through memory safety.



Boston Engineering Long Range Wide Area Network (LoRaWAN) IP will be shipping in customer projects starting Q2 of 2025. LoRaWAN is a long-range networking technology (~10km).

Low bandwidth IoT applications can leverage LoRaWAN's long range to provide connectivity in environments where WiFi is unavailable, or in where WiFi's range is impacted due to materials, such as building sub-levels.



Chris Morgan
Director, Software Engineering

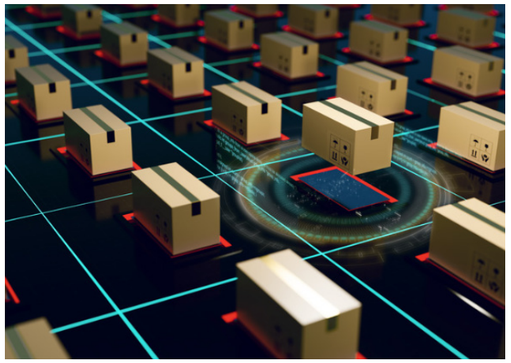
Chris Morgan brings a wide range of software and hardware development experience to commercialize products and solutions. His experience includes industrial communications and IoT technologies, as well as consumer products such as computer disk drives and cardio fitness equipment.



Revolutionizing Product Development: Leveraging DFM & DFA Technologies

In 2025, achieving competitive advantage in new product development requires more than innovative ideas; it demands precision and efficiency in execution.

Design for Manufacturability (DFM) and **Design for Assembly (DFA)** are critical methodologies that streamline production processes, reduce costs, and extend product lifecycles. For executives deciding where to allocate development capital, integrating the latest DFM and DFA technologies offers significant ROI potential.





EJ Miller
Senior Mechanical Engineer

EJ Miller has over 10 years experience providing mechanical engineering solutions for a wide range of products, including focused expertise in consumer products, robotics, defense, and human centered design.

Advanced Simulation Tools

Modern simulation software enables engineers to evaluate manufacturability and assembly processes virtually, reducing costly physical prototypes. Tools like finite element analysis (FEA) and digital twins allow for design adjustments, ensuring products meet production constraints and performance standards.



Additive Manufacturing (AM)

3D printing has evolved into a cornerstone of modern product design. Companies can now prototype complex geometries quickly and affordably, validate assembly processes, and even produce low-volume, highly customized parts—enhancing both speed to market and product differentiation.

AI-Driven Design Optimization

Artificial intelligence is transforming DFM/DFA by analyzing complex datasets to identify optimal designs. AI-powered platforms such as generative design can optimize material choices, and geometric adjustments to maximize performance and manufacturability while minimizing costs.



Collaborative Design Platforms

Cloud-based tools facilitate seamless collaboration between engineering teams, suppliers, and manufacturers. Real-time feedback on manufacturability and assembly feasibility reduces iterations and ensures alignment across stakeholders.

For executives seeking the highest ROI in 2025, investing in DFM and DFA technologies is a strategic move. These tools not only accelerate time to market but also create more cost-efficient, durable, and customer-centric products—unlocking long-term value and sustained competitive edge.

Market Insights

Enhancing the US Navy in 2025: Unmanned Systems, Maritime Sensing, and Digital Transformation

Boston Engineering remains focused on supporting the broader Department of Defense, and particularly the US Navy's 2025 strategic priorities and investments. These priorities are expected to include modernizing its fleet and enhancing technological capabilities to address evolving threats. Our research and development strategic goals are intended to address these priorities.

Boston Engineering is addressing the Great Power Competition by attacking challenges related to deterrence and power projection in contested regions, particularly the Indo-Pacific. Our technology development process is aimed at providing capabilities to be agile and responsive to regional conflicts as well as countering emerging technologies such as unmanned systems use by various adversaries.

Our continued development of novel and highly maneuverable unmanned vehicles addresses the Navy's expanding use of autonomous vehicles for reconnaissance and logistics challenges. Leveraging the latest motion control and actuation techniques provides our vehicles with advantages over conventional, commoditized options.

Our maritime sensing systems including profiling buoys and related equipment is directly aligned to support next-generation intelligence collection and warfare systems. Integrating the latest communications technologies and marrying them with our unique payload integration techniques provides advantages for a variety of missions and users. Recent direct collaboration with warfighters has proven our technology but also allowed us to refine the details and ensure tactical relevance.

Our sensing technologies also provide the opportunity for better understanding of the environment as climate change threatens to impact naval operations both in general and in specific scenarios as disaster relief missions and extreme weather events become more common.

Boston Engineering's robotics and digital transformation developments directly support sustainability initiatives that aim to ensure naval readiness and superiority in a rapidly changing global security landscape. From digital warehousing to virtual shipyards to novel shipboard maintenance robotics to AI-based visualization, Boston Engineering R&D is at the cutting edge of naval sustainability advances.



Mike Rufo
General Manager, Maritime Intelligence

"Boston Engineering R&D is at the cutting edge of next generation maritime capability and naval sustainability through our innovative and proven technologies that address high priority strategic areas for the US Navy and other important customers."

Digital-First: Paving the Road to Digital Transformation

To stay relevant and competitive in today's world, a digital-first mindset is a critical imperative for companies across all industries. While a majority of organizations have initiated their digital transformation strategy, the path to full implementation remains challenging for many.

This gap highlights the complexity involved in executing a successful enterprise-wide digital transformation targeting core business aspects. It also underscores the significant untapped potential for companies to pursue a digital-first strategy for more incremental product innovations and operational gains along the way.

Foundational technologies for digital transformation include **cloud computing, artificial intelligence (AI), and internet of things (IoT)**, which enable greater agility, efficiency, and data-driven decision-making.

Many of our clients are also exploring digital twins, augmented reality, machine learning, and computer vision, sometimes in combination. Many of these technologies can be explored and adopted as part of focused product or process development initiatives conceived with a digital-first mindset.

These initiatives play to our solution development strengths as the integration of cyber and physical systems often requires advanced systems engineering capabilities and integrated electrical, mechanical, and software expertise.

Likewise, the application of advanced digital technologies, such as AI, machine learning, augmented/virtual/mixed reality, and other tools requires unique technical talent and skills; thus, Boston Engineering often serves as an extension of our clients' R&D teams.



Implementing a Digital-First Approach in Product Development Builds Foundational Capabilities for Digital Transformation

1. **Prioritize User Experience:** A focus on user-centric design across devices, services, and training establishes a framework for the digital thread.
2. **Design for Connectivity:** IoT devices benefit from extended product lifecycles with the built-in ability to update and add features over time to meet evolving customer needs.
3. **Invest in Platform Solutions:** Software and hardware modules/platforms can be used across multiple product lines and enable scalability.
4. **Embrace Data-Driven Business Models:** As the digital thread grows, consider business models that leverage data access and analytics.
5. **Leverage Advanced Simulation:** Digital twins, machine learning, and AI are powerful tools for virtual testing, exploration of edge cases, and design optimization.



Heather Moyer
Director, Commercial Development

"In 2025, Boston Engineering will continue to collaborate with companies on innovation initiatives that align with their digital transformation strategy."

Digital transformation is fundamentally reshaping how businesses conceive, develop, deliver, and support their products and services. The digital thread enables innovation, enhances customer experiences, and opens up new data-driven revenue streams.

The journey may be challenging, but forward-thinking organizations should consider adopting a digital-first approach as they look to transform their offerings and operations aligned with evolving customer needs and market demands.

Capabilities in Additive and Subtractive Fabrication for the U.S. Navy

Shipboard Advanced Metal Manufacturing

Metal Additive Manufacturing (MAM) technology enhances naval capabilities by replacing unwieldy metal bars of various sizes with a single spool of material that can be shaped into different metal parts. This innovation enables greater system uptime, fewer parts in shipboard inventory, and on-demand repair.

Warfighter readiness is enhanced through decreased downtime and shipboard space to store the parts which allows warfighters additional space for operational systems.

Boston Engineering is leading a project that will deliver to the U.S. Navy a shipboard additive and subtractive metal manufacturing (ASMM) system for further testing.

This system incorporates recent advances in size, simplicity, sensing, and ruggedization. The backbone of this system will be a deposition head and engine that incorporates a multiple wire-based additive functionality and is fully controllable with construction parameters monitored throughout the process.

This robotic deposition system will be coupled with subtractive capability of the size and locality needed to operate with the same robotic arm used in the additive process. This provides capability for subtractive removal during the build process and separate processing within the same space without part movement.





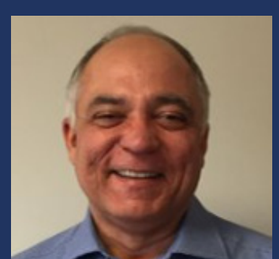
A gantry system will facilitate the transfer of the part for deposition and subtractive operations. Given the challenging shipboard environment, the design will prioritize stability and robustness against shock and vibration and will be isolated as required. Sensing technology will allow for operation only during appropriate levels of shock and vibration, with override to operate on command at critical times.

Inert Gas Reclamation for Metal Additive Manufacturing

Atmospheric control enhancements minimize the use of Argon (Ar) to save space, simplify logistics and extend the operational utility of the system.

Boston Engineering is leveraging knowledge of Naval shipboard implementation as the basis for developing shipboard Ar gas reclamation technology. The reclamation of Ar requires gas to be collected at the build point, water & oxygen removed, and the recycling of remaining Ar, minus losses. Desiccants will be used for water removal, and oxygen getters—devices used to absorb oxygen and other impurities—further improve the efficiency of gas reclamation.

This highly equipment-intensive effort is slated to last three years and will culminate in the delivery of the ASMM system in 2028.



Jose Vazquez
Director, Defense and Security

“Development activities in 2025 will focus on resolving capture efficiency and melt tolerance to gaseous species, two of the most critical aspects of the technology prior to tackling system design.”

Driving Innovation in Life Sciences: Harnessing Cutting-Edge Technologies for 2025

The life sciences industry stands at the forefront of technological innovation, with advances in automation, artificial intelligence (AI), and microfluidics revolutionizing research and development. For executives navigating investment decisions in 2025, these technologies are key to achieving breakthroughs, accelerating timelines, and maximizing ROI.

Automation and AI in Experiments

Automation has become indispensable in modern laboratories, enabling high-throughput experiments and minimizing human error. Coupled with AI and machine learning (ML), automated systems can analyze vast datasets, identify trends, and predict outcomes with unprecedented accuracy. These technologies empower researchers to streamline workflows, reduce costs, and focus on high-value tasks such as hypothesis generation and strategic decision-making.

Machine Learning's Impact on Medicine

ML algorithms are transforming drug discovery, personalized medicine, and diagnostics. Predictive modeling identifies promising drug candidates faster, while advanced analytics uncover patient-specific treatment regimens. This accelerates the path to market for life-saving therapies and improves patient outcomes, offering a tangible competitive advantage.





Smarter Sensors and Feedback Systems

Innovations in sensor technology are providing real-time data on experimental conditions, equipment performance, and biological responses. These smarter sensors, combined with robust feedback loops, enable project managers to proactively address issues, optimize processes, and ensure consistent results.

The Role of Dedicated Project Managers

The complexity of life sciences automation demands focused leadership. Dedicated project managers play a critical role in coordinating multidisciplinary teams, managing timelines, and ensuring seamless integration of new technologies. Their expertise mitigates risks, enhances communication, and drives projects to successful completion.

Microfluidics

Transforming R&D: Microfluidics technology allows researchers to manipulate small volumes of fluids with extraordinary precision, enabling breakthroughs in diagnostics, drug delivery, and organ-on-a-chip systems. This technology reduces reagent costs, speeds up experimentation, and facilitates novel applications in areas like personalized medicine.

By leveraging automation, AI, smarter sensors, and microfluidics—and empowering project managers to lead—companies can drive meaningful progress in healthcare and deliver solutions that redefine the future of medicine.





Harry Martins
Senior Medical Project Manager

"Investing in these transformative technologies ensures that life sciences organizations remain agile, innovative, and competitive."

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