



This image is representative and not an actual product.

Optimizing Autonomous Robotics Design for Manufacturability and Serviceability

About the Customer

Our customer specialized in autonomous robotic transportation and delivery devices for the medical industry and was expanding into the hospitality sector. By introducing the robot to the hospitality industry, they aimed to help hotels optimize operations and automate secure delivery to guest rooms. This advanced technology addressed ongoing staffing shortages and rising labor costs, making it an ideal solution for businesses seeking operational optimization.

To expand into a new market and handle increased demand, the customer sought a partner to redesign elements of its robot to address technical challenges that limited production scaling and address known field operational issues. The objective of the redesign was to

reduce production cost and improve operational uptime to win market share.

The Challenges

Amid growing adoption of automated logistics, the customer experienced strong demand for its existing robotic solutions. The customer was building many of its products in-house, and as demand for their solution strengthened, they needed a partner with deep robotics manufacturing experience to scale production efficiently. They sought to redesign their products' subsystems for easier, quicker repairs and to let their products remain in operation longer, generating service subscription revenue. Their objective was to find a trusted engineering and manufacturing partner

that could help them redesign the internals for better manufacturability—making the robots easier and more cost-effective to produce—and for improved serviceability, ensuring the robots could be repaired and maintained efficiently in the field, all while meeting industry requirements for durability and longevity. The design changes would also allow the customer to reduce their environmental footprint in manufacturing and service activities. They turned to Benchmark as their partner of choice.

Enhancing Manufacturability

Seeking to enhance their design and manufacturing processes to ensure consistent product quality, the customer collaborated with Benchmark to conduct a comprehensive product design analysis. This collaboration focused on design changes to optimize manufacturability. Ensuring the design was thoroughly and thoughtfully laid out did more than make manufacturing easier and more efficient; it also improved yields and reduced production costs.

The customer recognized the importance of strengthening their supply chain to ensure continuous and seamless operations. Although occasional disruptions—such as delays and shortages—are to be expected in a global supply chain, the customer sought opportunities to improve resiliency and reduce risk. By prioritizing supply chain optimization with Benchmark, the customer demonstrated their proactive approach to meeting the evolving demands of their valued customers.

Scaling Production to Meet Growing Service Demand

Scaling production was another critical challenge that the customer encountered. Although they had been manufacturing their robots for many years, their in-house manufacturing approach was stretched thin, making it difficult to keep pace with growing demand. Recognizing the need for agility and expansion, they collaborated with Benchmark to outsource

manufacturing. This proactive step optimized processes, enabling the customer to continue scaling rapidly and grow revenue.

Improving Maintenance and Serviceability

The maintenance and serviceability of their robots was yet another challenge the customer faced. Because they were an early leader in the autonomous robotics space, they relied on rapid design, deployment, and iteration to deliver a robot that could safely operate in a crowded hospital. However, they reached a point in their flagship product's lifecycle that demanded refinement to align with additional design standards.

Variations between deployed designs led to elevated support costs and inefficiencies in maintenance and repairs. Some of the parts most likely to experience failures were inaccessible in the design, hidden behind cables and other assemblies. They needed a sustainable solution that minimized environmental impact while optimizing support processes to keep robots deployed in the field. This challenge led to working with Benchmark to transition to a more modular, simplified design.

The Solution

During Benchmark's initial customer visit, the customer and Benchmark identified product and process improvement opportunities, aligning the customer's manufacturability, repairability, and scalability goals with manufacturing readiness. This kickstarted a series of Benchmark Creative Workshops focused on design for excellence (DFX), leveraging industry best practices to refine the original design and optimize manufacturing processes.

The first workshop focused on Agile Design for Manufacturability (ADFM) principles. The team assessed the existing design, identifying areas that required immediate attention to ensure efficient manufacturing. This collaborative process allowed both teams to understand each other's perspectives,

aligning expectations and goals. Subsequent workshops involved discussions on commercialization, test strategy, and redesigning key elements, such as schematics and printed circuit boards (PCBs). Through these workshops, both engineering teams focused on enhancing overall manufacturing efficiency while keeping the customer's goals at the forefront.

Improved Serviceability and Design for Manufacturing (DFM) Implementation

Together, both the customer's and Benchmark's teams established a comprehensive design process to ensure that only thoroughly vetted designs would be released to production. This collaborative approach helped to minimize design flaws and enhance product reliability from the outset. Further, Benchmark's electrical and mechanical engineering design teams worked closely together to deliver a comprehensive overhaul of the customer's flagship product, particularly the wiring, lid, chassis, and internal layout.

The original wiring system was transformed into an organized, efficient network, significantly reducing the number of cables required. With the deep expertise of the electrical engineering team and the use of advanced software simulation tools, the designers were able to rewire the electrical system between PCBs, power, and control systems. They also identified unseen ground loops in the original system and corrected for this in the new wiring design, preventing reliability problems that are notoriously difficult to detect in the field. The team also rerouted the communication lines in the system harnesses to remove potential noise generators that would interfere with electrical performance. By combining their expertise with advanced tools, the team designed new cable harnesses, predicting cable lengths with over 95% accuracy before prototyping, enabling a very high first-design success rate. This helped Benchmark deliver a satisfactory solution to the customer quickly.

Benchmark's mechanical engineering team redesigned the lid and chassis to enhance serviceability and simplify the physical design. To make the electronics easier to access, they moved many of the PCBs to a single location within the product. The team designed a pull-out tray to house all the PCBs and added an automatic lift to the access lid for easy opening. This created a solution that delivered fast, easy access to most of the electrical system. The team also maintained the enhanced aesthetic appeal and optimized production processes, ensuring a consistent brand image and streamlining and improving the manufacturing pipeline. The team successfully improved the device's serviceability and production efficiency by prioritizing access and simplifying manufacturing.

The redesign included another critical improvement — a new, enhanced battery. As the team integrated this feature, they developed an upgraded chassis to accommodate the larger battery while maintaining the device's structural integrity. This comprehensive approach ensured that the design improvements did not exist in isolation but were implemented holistically, transforming the device for optimal functionality and longevity.

The Results

Benchmark's expertise in design for excellence, supply chain, and robotics was instrumental in transforming the customer's advanced systems into functional and serviceable products. By leveraging Benchmark's design for manufacturing (DFM) capabilities, the customer was able to lower manufacturing costs and optimize production efficiency. Simultaneously, improvements in serviceability reduced maintenance complexity, making it easier to keep these large, complex robots in the field longer. This dual approach enhanced supply chain efficiency, reduced the carbon footprint of producing new units, and provided customers with an ongoing

revenue stream through subscriptions and repair services.

By prioritizing supportability and ease of manufacturing, Benchmark helped the customer create a product built to last and easy to maintain, ultimately enhancing the customer experience and driving long-term success. In short, this unique partnership helped to create stability and efficiency throughout the product's lifecycle.

About Benchmark

Benchmark provides comprehensive solutions across the entire product lifecycle, leading through its innovative technology and engineering design services, leveraging its optimized global supply chain, and delivering world-class manufacturing services. The industries we serve include commercial aerospace, defense, advanced computing, next-generation communications, industrial, medical technologies, and semiconductor capital equipment.

Benchmark

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