

Design for Manufacture and Assembly Leads to Cost-effective, Mass Production



Client
You First Services, Inc.

Industry
Medical-device technologies

Challenge
Translate prototype specifications into a manufacturing-ready design.

Outcome
DFMA guidance cleared the path for putting YFS's innovative product into cost-effective, scaled production.

Company

You First Services Inc. (YFS) is a seven-year-old company based in Buffalo, New York. It specializes in the development of medical-device technologies for the healthcare industry with high commercialization potential. YFS's engineered-system products address the containment and control of infectious diseases and other environmental safety concerns within healthcare.

YFS recently entered into an exclusive reseller agreement with a global healthcare equipment retailer that will see its patented technology, SteriSpace™, installed into temporary patient-isolation shelters. The portable chambers will be used throughout the world by emergency field medics treating patients with deadly infections like COVID-19. In addition to its use in short-term environments like field hospitals, the product can be permanently installed in hospitals, pharmaceutical production locations, and industrial spaces to improve air quality.

“Overall, the design process was invaluable, accurate and effective. It helped us create the production unit quickly and with greater accuracy. It was the single most impactful thing that stood out the most.”

John Lordi

Situation

SteriSpace™ is a novel device that was developed to remove biological contaminants from air using compressive (adiabatic) heating of a continuous air stream. Independent testing confirmed that the initial prototypes successfully deactivated biological, airborne diseases, including coronavirus.

In order to begin mass production of SteriSpace™, YFS had to translate its prototype specifications into a manufacturing-ready design. John Lordi, Ph.D., executive vice president of engineered systems at YFS, sought assistance for this critical design activity and turned to the Center of Excellence in Advanced and Sustainable Manufacturing (COE-ASM) at Rochester Institute of Technology (RIT).

After meeting with Dr. Lordi and the SteriSpace™ team, COE-ASM suggested a design for manufacture and assembly (DFMA) assessment as the best next step to reduce product cost and complexity.



Pictured: SteriSpace™ unit with engineering team after successfully passing a validation test.

Deliverables

DFMA is a methodology for identifying process and cost efficiencies for a product during the design phase before manufacturing begins. It's a proven method for streamlining the design and planning for manufacturing in order to minimize the need for changes late in the development cycle, which can be costly, push out timelines, and drain resources.

The goals of the DFMA performed on the SteriSpace™ product were to simplify the manufacturing and assembly process, reduce production time, decrease the overall product cost, and extend the product's useful life in the field.

Results

The COE-ASM team first revised the original product's bill of materials (BOM) to create a multi-layered, indented BOM (IBOM). An IBOM displays a product's assemblies, components, and parts in a hierarchical, ordered fashion that eases the structural interpretation of a design. The revised IBOM informed the DFMA because it allowed the COE-ASM engineers to better visualize opportunities for improving the prototype design. After completion of the DFMA, an updated IBOM as well as computer-aided design models were created to capture the new design concepts. These were sent to YFS's manufacturing partners so they could update their production quotes.

A general principle guided the COE-ASM team's analysis: The best design uses the fewest parts. With this in mind, they carefully looked for part functions that could be eliminated or integrated. This led to a reduction in both the number of components and fasteners required in the final product and the time needed for assembly. The COE-ASM team also looked for further opportunities to accelerate the manufacturing cycle time in order to get units to customers quicker, a priority driven by the product's value during the ongoing COVID-19 pandemic. To do this, they shifted the assembly process to a module-based approach that allows for more subassembly outsourcing and reduced production lead time. The module-based approach also facilitates a more streamlined operation with lower work-in-process volumes and a shortened production cycle time.

The DFMA suggested a number of changes to reduce overall design complexity including the number of parts. The following are some specific recommendations from the DFMA:

- The number of insulation panels needed was reduced from 18 to six.
- A five-piece weldment was converted into a one-piece, formed metal design with four unique mounting flanges where the original prototype had 18.
- The heat-exchanger assembly was also simplified, requiring only two parts with two fasteners instead of eight parts with 24 fasteners.
- The need for welding throughout was greatly diminished, resulting in significantly reduced manufacturing costs.





The analysis also pointed out design changes to improve the product's performance and reliability. Parts and components were made easier to remove or replace, simplifying maintenance and supporting extended service life. Three new product features were also suggested. The first saw changes to the piping components to increase volumetric flow to the blower. The second redirected the motor fan's inlet flow through the electrical enclosure to better cool the electronics. The third reimaged supports for the blower-motor assembly to improve critical component alignment. Improved alignment also enabled a lower cost motor coupling.

COE-ASM's design guidance cleared the path for putting YFS's innovative product into cost-effective, scaled production. The assessment proactively addressed potential manufacturing challenges that are often difficult for small companies to successfully navigate.

Results continued

On July 30, 2020, New York State's Empire State Development announced that YFS was among 12 companies to receive a total of nearly seven million dollars to advance innovations that will safeguard the state against COVID-19 infections. YFS was awarded \$250,000 to fund its production scale-up of SteriSpace™. At a cost starting at \$50,000 per location, units will be installed in public facilities across the state, like hospitals, universities, schools, restaurants, border entry and security spaces, and medical offices. The company plans to invest more than \$1 million into installation costs, adding up to 20 employees to its current staff of 40.



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