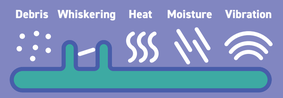
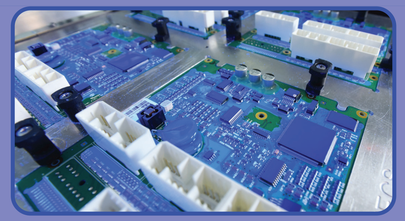
CNC CONFORMAL COATING MACHINE

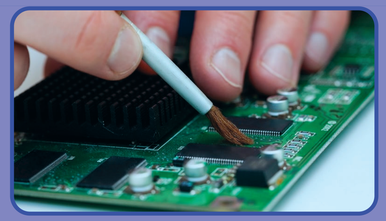
01 BACKGROUND

Conformal Coating
During printed circuit board (PCB) fabrication, a protective polymer layer is applied to shield the board from harsh environmental conditions, such as those present at the launch pad and in outer space.



PCB Rework
During new hardware development, engineers often need to remove the conformal coat in certain areas to perform modifications to the board. After the fixes are implemented, the board needs to have the coating re-applied prior to qualification testing.





Blue Origin's Current Process: Out-source or In-house
There are two options for reapplying the conformal coat. Sending boards back to the fabrication facility for recoating is time consuming and can block development for weeks. Performing in-house coating by hand using a brush is labor intensive and makes it hard to achieve a consistent coating. This makes rework a slow and expensive process.

Value Landscape
Existing coating machines are designed for mass production, lacking the ease-of-use required for ad hoc rework and bloated with unneeded functionality.

02 SOLUTION

Integrated Fume Extraction
allows the machine to run safely in any lab space, without additional air filtration infrastructure

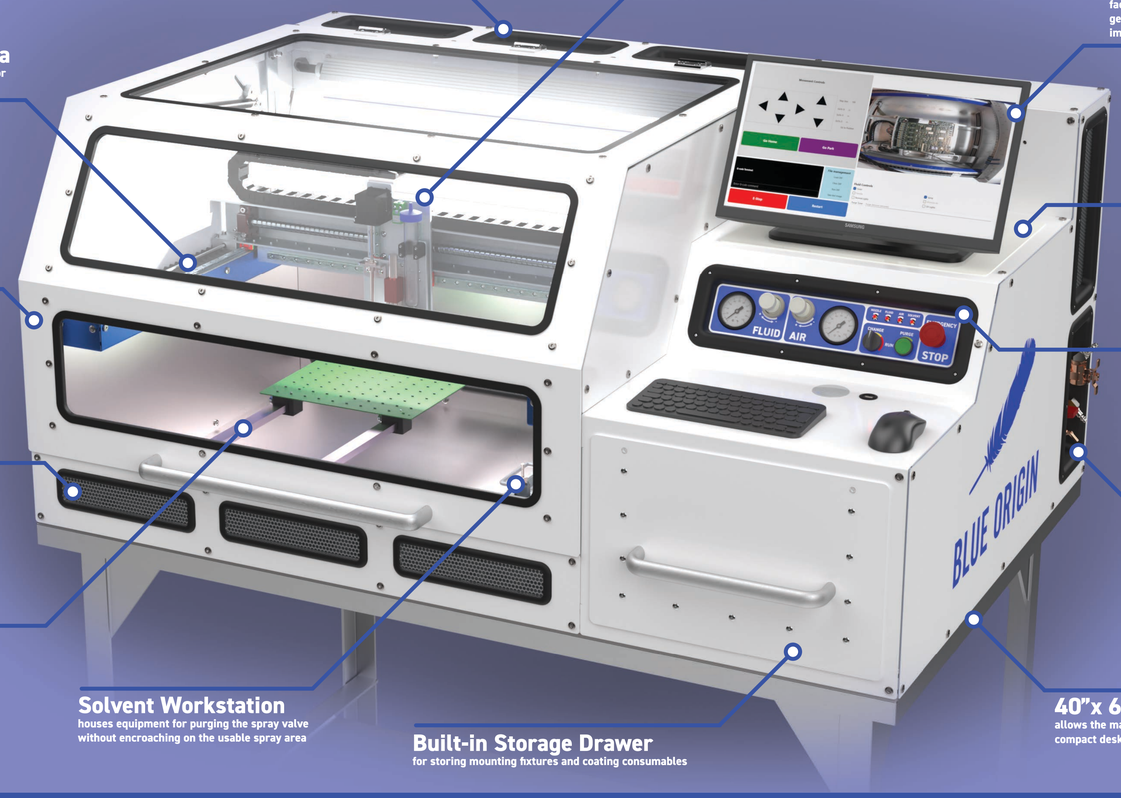
Quick-change Toolhead
enables rapid cartridge swapping, with dedicated solvent hookup for semi-automatic purge routines

Spray Mapping Software
facilitates quick and intuitive path planning and generation using augmented reality with a UV image of the board

24" x 24" Spray Area
gives capacity to coat the largest PCBs or multiple small boards at the same time

Access Covers
allow for quick service and testing of the critical hardware systems

Ergonomic Door
uses a gas spring for low-force action and an adjustable stay for operator comfort



Analog Control
creates a direct connection with the spray and motion system hardware, giving the operator greater machine awareness and control

Quick-Swap Filters
simplify machine maintenance

Interface Panel
consolidates power, air, and fluid hookups, simplifying machine setup

Modular PCB Fixturing
accelerates the setup process for boards of all shapes and sizes

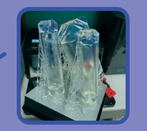
Solvent Workstation
houses equipment for purging the spray valve without encroaching on the usable spray area

Built-in Storage Drawer
for storing mounting fixtures and coating consumables

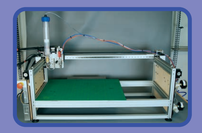
40"x 60" Footprint
allows the machine to operate as a compact desktop device

03 PROCESS

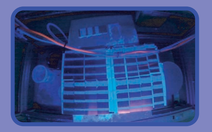
Architecture Trade Studies
Through several cycles of requirement capture and trade studies, the team narrowed in on a high-level architecture for the machine.



Testbed Gantry
We built an MVP gantry as soon as possible to validate the motion and spray system hardware. This provided us with a platform for software development and integration testing.



Spray Characterization
Using the testbed gantry, we developed routines to characterize the spray valve, coating over 300 test coupons. By the end of the first semester, we were able to successfully coat our first board.



Final Machine
We designed the final machine using learnings from the prototype, and incorporating the full list of desired functionality.

UI Development
Using a pre-made CNC control software as a starting point, we began to develop a fully customized solution that combines machine control and spray mapping in one program.

04 VALUE

"This is the most valuable senior capstone project at Blue to date."

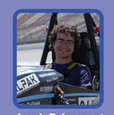
i Faster & Cheaper
Our machine reduces rework costs by 50% and reduces rework time by 15%.

ii Consistent Coating
Our spray characterization data promotes repeatable and consistent operation.

iii Streamlined UX
Our machine interface accelerates spray planning and machine operation, enabling spraying in as little as 15 minutes after machine power-up.

05 TEAM

Danny Burns
MechE '25



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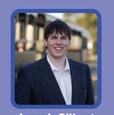

Joseph Gilbert
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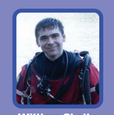

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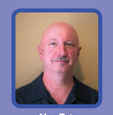
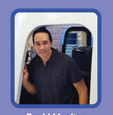


Alan Tate
Liason



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BLUE ORIGIN