

# GAGE

National Science Foundation's  
Geodetic Facility for the  
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# Implementation of Lean Manufacturing Tools in Assembly of Scientific Instrumentation

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## INTRODUCTION

Droplet Measurement Technologies (DMT) is a company that manufactures instruments used for measuring water droplets, ice crystals, black carbon, single particles, and aerosols in the atmosphere.

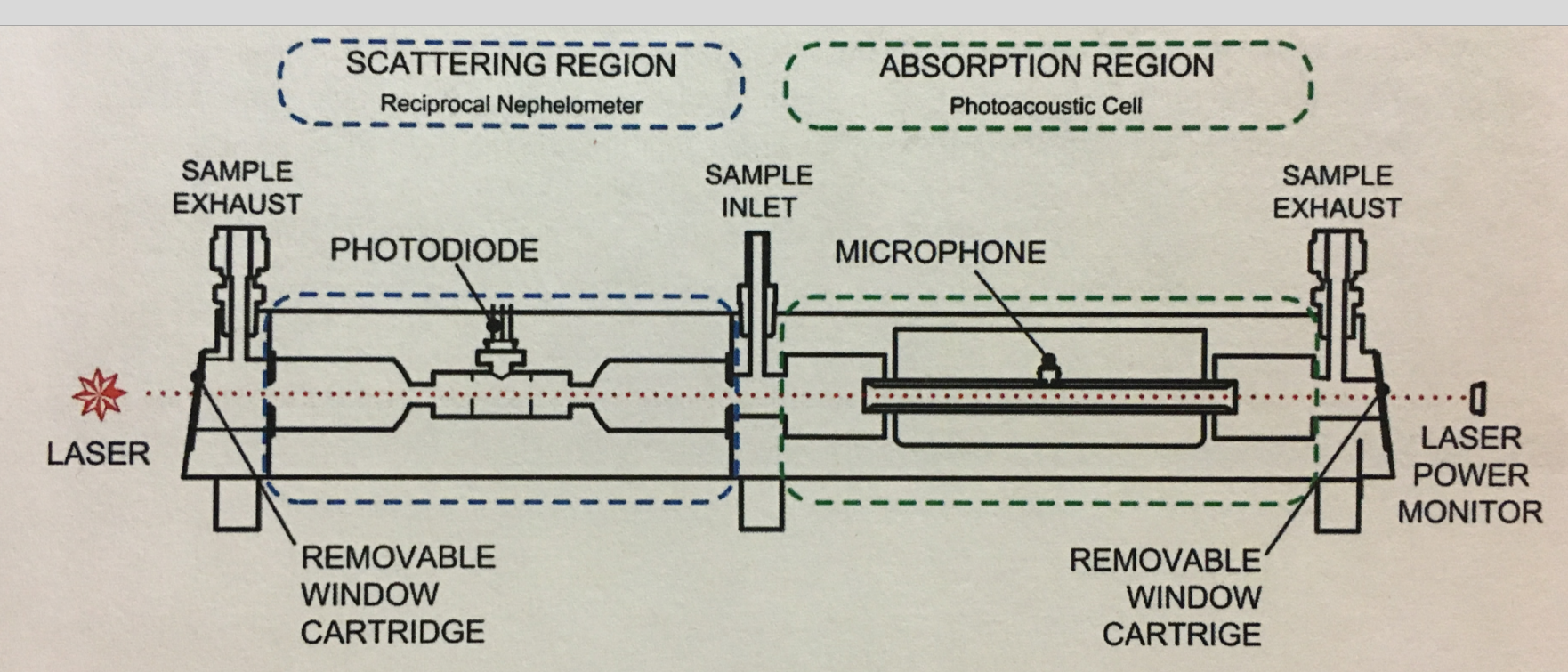
Our project was to create lean manufacturing work instructions by utilizing PowerPoint for building the PAX 870 instrument. We also created pick lists and presentation kits for enhancing efficient productivity of the PAX 870 building process.

## PAX INSTRUMENT



Figure 1. Research station (left photo); the PAX inside the research station (right photo). Photos courtesy of DMT.

The Photoacoustic Extinctionmeter (PAX) is a device that measures aerosol optical properties relevant for climate change and carbon particle sensing, including black carbon. The instrument is suitable for fixed site, mobile or airbone sampling.



The Heart of the Pax is the cell. The cell uses a modulated diode laser to simultaneously measure light scattering and absorption. The standard infrared, 870-nm wavelength option is highly specific to black carbon particles, since there is relatively little absorption from gases and non-BC aerosol species at this wavelength.

Figure 2. Drawing and description of the PAXs Cell. Courtesy of DMT.

## WORKFLOW

### STEP 1:

With observation and documentation, we assembled step-by-step work instructions per Droplet's templates. At end of the steps we created 600 PowerPoint slides. Each slide contains color coded text for tools (green), parts (blue), and notes (orange).

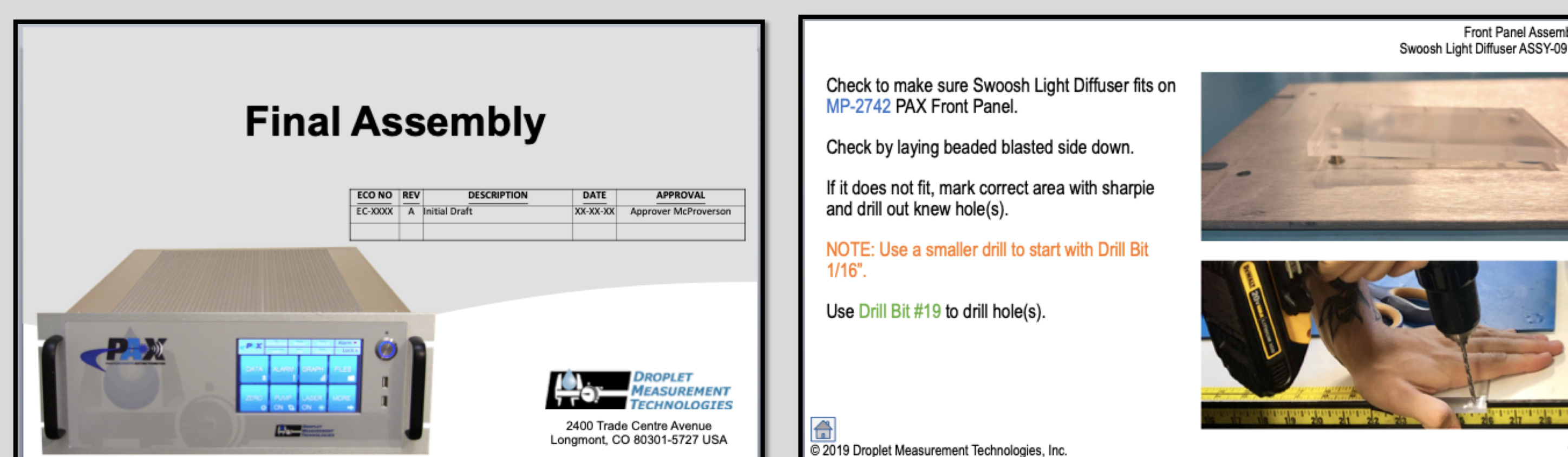


Figure 3. Laser & Final Assembly Instructions using PowerPoint.

### STEP 2:

Using Excel, we created a series of pick lists for each step of the PAX 870 build. These materials included quantities of assembly parts, connectors, cables, hardware, and tools. Color coding was applied to help sort for the Presentation Kit process.

Part No.	Description	Qty	Unit
AAA-0128	PAX 870 - Step 1 - Test Bed		
AAA-0000	PAX POWER DISTRIBUTION BOARD	1	
AAA-0001	PAX CONTROL BOARD	1	
AAA-0002	PAX SCATTERING BOARD	1	
AAA-0003	PAX LASER POWER DETECTOR BOARD	1	
AAA-0004	PAX MICROPHONE AMP	1	
AAA-0005	PAX Rev. A TEMPERATURE BOARD	1	
AAA-0006	PAX Rev. A PHOTOACoustic BOARD	1	
AAA-0007	PAX PHOTOACoustic BOARD ASSEMBLY	1	
AAA-0008	PAX Cable Scattering Det. Pwr.	1	
AAA-0009	PAX Cable Microphone Pwr.	1	
AAA-0010	PAX Cable Laser Power Pwr.	1	
AAA-0011	Dual USB A Panel 1 to 2x20, E	1	
AAA-0012	MicroSD Memory Card 16GB	1	
AAA-0013	MicroSD Memory Card 32GB	1	
AAA-0014	MicroSD Memory Card 64GB	1	
AAA-0015	MicroSD Memory Card 128GB	1	
AAA-0016	MicroSD Memory Card 256GB	1	
AAA-0017	MicroSD Memory Card 512GB	1	
AAA-0018	MicroSD Memory Card 1TB	1	
AAA-0019	MicroSD Memory Card 2TB	1	
AAA-0020	MicroSD Memory Card 4TB	1	
AAA-0021	MicroSD Memory Card 8TB	1	
AAA-0022	MicroSD Memory Card 16TB	1	
AAA-0023	MicroSD Memory Card 32TB	1	
AAA-0024	MicroSD Memory Card 64TB	1	
AAA-0025	MicroSD Memory Card 128TB	1	
AAA-0026	MicroSD Memory Card 256TB	1	
AAA-0027	MicroSD Memory Card 512TB	1	
AAA-0028	MicroSD Memory Card 1PB	1	
AAA-0029	MicroSD Memory Card 2PB	1	
AAA-0030	MicroSD Memory Card 4PB	1	
AAA-0031	MicroSD Memory Card 8PB	1	
AAA-0032	MicroSD Memory Card 16PB	1	
AAA-0033	MicroSD Memory Card 32PB	1	
AAA-0034	MicroSD Memory Card 64PB	1	
AAA-0035	MicroSD Memory Card 128PB	1	
AAA-0036	MicroSD Memory Card 256PB	1	
AAA-0037	MicroSD Memory Card 512PB	1	
AAA-0038	MicroSD Memory Card 1EB	1	
AAA-0039	MicroSD Memory Card 2EB	1	
AAA-0040	MicroSD Memory Card 4EB	1	
AAA-0041	MicroSD Memory Card 8EB	1	
AAA-0042	MicroSD Memory Card 16EB	1	
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AAA-0059	MicroSD Memory Card 2EB	1	
AAA-0060	MicroSD Memory Card 4EB	1	
AAA-0061	MicroSD Memory Card 8EB	1	
AAA-0062	MicroSD Memory Card 16EB	1	
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AAA-0095	MicroSD Memory Card 128PB	1	
AAA-0096	MicroSD Memory Card 256PB	1	
AAA-0097	MicroSD Memory Card 512PB	1	
AAA-0098	MicroSD Memory Card 1EB	1	
AAA-0099	MicroSD Memory Card 2EB	1	
AAA-0100	MicroSD Memory Card 4EB	1	

Figure 4. PAX 870 Pick List, created using Excel.

### STEP 3:

By cutting out Presentation Kits, we designed and built tools in order to increase flow in the lean manufacturing process. With materials placed into the foam kits, it makes them fast to build and efficient.



Figure 5. PAX 870 Presentation Kits. Photo before (left) and after (right).

## LEAN MANUFACTURING

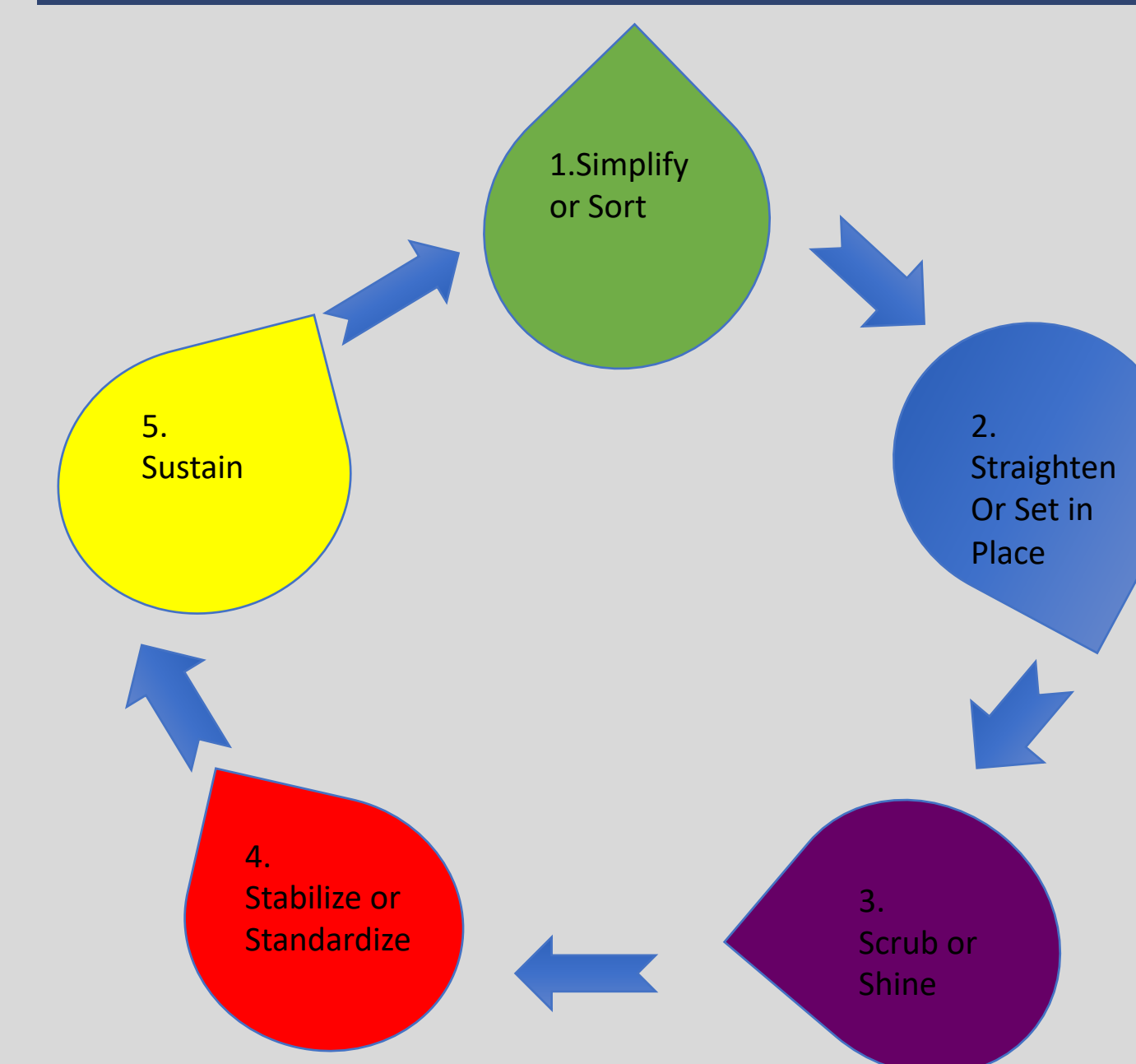


Figure 6. The 5 S's of lean manufacturing

By practicing lean manufacturing for creating work instructions, DMT can make scientific devices at a faster and efficient pace. Scientists can purchase devices and start collecting data more timely.

## FUTURE WORK



Now that the PAX 870 work instructions, pick lists, and presentation kits are completed, DMT will continue creating lean manufacturing instructions for all of their scientific devices. DMT builds around 27 other devices and by employing these lean build instructions, devices can be built with quality.

These instrument can help study:

- Clouds microphysics
- Aircraft icing tests.
- Icing on wind turbines.
- Atmospheric ozone.
- Black carbon which contributes to effects of global warming.

## ACKNOWLEDGMENT

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