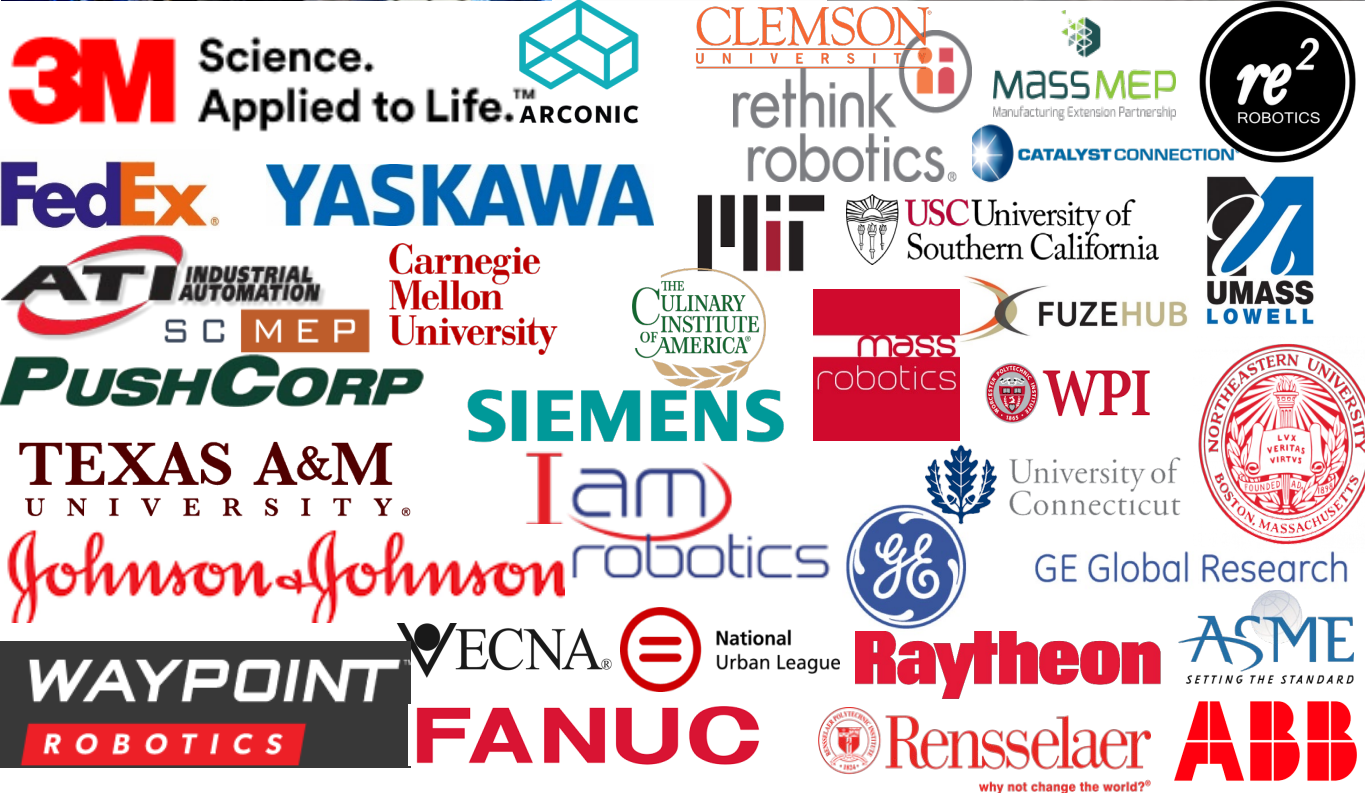# ARM Advanced Robotics for Manufacturing Institute
## Cobots for sustainment and maintenance applications

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# 300 strong consortium of the leading Robotic OEM's, Manufacturers, Integrators, Tier 1 research Universities innovators, GOV departments and the DOD



**We**
Accelerate the development and adoption of innovative robotics technologies …

**We**
Make robotics, autonomy and Ai more accessible to U.S. mgs.

**We**
Nurture an ecosystem
- Introduce DOD/OEMs to new suppliers
- Create relationship thru project teaming

**We**
Convene Workshops and TIMS to ID understand and prioritize tech gaps

**We**
Develop technology to Improve the performance efficiency and/or proficiency of robots used in manufacturing

**To us**
Maintenance and Sustainment and manufacturing share a lot of common processes.
- Fabricate, finish, assemble, inspect
- Scan/map/model/repair and maintain
- Handle material, tend machines, fetch, kit, store, pack / unpack, load /un-load

**We**
Developing education & workforce development frameworks and tools to alleviate the challenges of training and staffing a future American workforce that uses ROBOTs as a tools.

**Maintaining US access to latest robotic mfg. and supply chain tech**

# ARM DEVELOPED ROBOTIC TECHNOLOGY SERVES THE FULL MANUFACTURING CYCLE (FABRICATE, FINISH, ASSEMBLE, INSPECT, HANDLE)

1. **Pliant & rigid component fabrication**
   - Lay up / manipulate 3D multi-ply composites
   - Wet(resin and catalyst) or Dry (Prepreg)process
   - Cut, thread wires, drape, manipulate, align, bond

2. **Aerospace/Maritime/Space/Auto/Heavy Equip manufacturing**
   - Sand, grind, and polish composite or metal parts
   - Coating, cold sprays, paint, apply resins & slurries
   - Cold work, roll and other surface treatments

3. **Material handling**
   - Fetch, hold, inspect, machine/ workcell tending

4. **Service robot**
   - Dis-infect empty and occupied facilities
   - Erection/construction of temporary facilities
   - Biohazard material handling and dexterous manipulation roots

| | | |
|---|---|---|
| 3 Cobotic arms helping to lay-up 3m$^2$, 18 -ply composite shape | Robot ARM picks maneuvers and aligns large delicate composites | Robot selects threads pulls and cuts wires to build a harness |
| Robot sands & polishes the interior wields of a turbine duct | Robot grinds interior splines into a gear train hub | Articulated snake robot inspects, and extracts refuse from a confined space |
| fetch and help AMR. Retrieves parts from the stores to the cell, Aligns and holds them for assembly | 3d part map, 3d conform, and defect inspect Cobot | Meandering AMR that visually "fingerprints" parts in factories and later searches and locates them when misplaced. |
| AMR that maps, plans, & disinfects occupied depots Identifies specific areas for spray | AGV that stretches out fabric for bonding of mobile facilities | AMR using "SAFE" tech to traverse chaotic factory floors |

# ARM HAS DEVELOPED 13 COBOTS APPLICABLE TO THE SUSTAINMENT COMMUNITY VIA CALLS, IN PARTNERSHIP WITH JROBOT AND OUR DOD PARTNERS VIA DIRECTED CALLS

**Fabrication Cobots**

Cobot that helps a coworker carry a large sheet of composite to a mold, align and drape it so the human can smooth it.

Composites

Multi ARM Cobot that performs bubble and wrinkle free pre-preg composite sheet layup over a curvilinear mold

**Re Finishing Cobots**

Cobot that automatically figure out how to sand aircraft skins and panels alongside a human coworker while inspecting for defect to rework

**Disassembly and re-assembly Cobots**

Wire harness install Cobot -

Wire harness tool kit (build, pin, install)

Autonomously assemble Wire harness Cobot

Wire harness assembly Cobot that tell installer here to install which line and pot error.-

**Part Scan, defect Inspection, and conformation of new and existing parts to drawings**

*Advisor inspection robot* , Polarized & Multiband fine detail inspection of brightly and dimly lit highly reflective curvilinear 3d object Automated Defect Inspection of Complex Metallic Parts

Cobot that Scans and conforms 3d parts

**robotic material handling fetch /transport COBOT**

Autonomous mobile Cobot that collect waste and Safely transport it through occupied factories for disposal.

Occupied Facility disinfectant AMR

Software module that seamlessly integrates multiple robots from multiple venders.

AMR COBOT for fetching part from the store back to the workcell, positioning and holding them in place for attachment by a coworker.

OEM agnostic AMR /AGV fleet Manager

*2017 -2018*

*2018 -2019*

*2019 -2020*

*2020 -2021*

ARM

# BACKUP

# ARM HAS DEVELOPED **13** COBOT CAPABILITIES THAT ARE APPLICABLE TO THE SUSTAINMENT COMMUNITY VIA INSTITUTE CALLS, JROBOT AND DIRECTED PROJECTS

## Fabrication Cobots
### robotic material handling
### fetch /transport COBOT

*Cobot that helps a coworker carry a large sheet of composite to a mold, align and drape it so the human can smooth it.* Cobot technology to observe a human, predict and understand their intended movement, and aid a coworker to drape and smooth a large composite sheet ARM-TEC-18-01-F-13-

*Cobot that performs bubble and wrinkle free prepreg composite sheet layup over a curvilinear mold* Multiple ARM Cobots that work that pick collate align and place small composite sheets into trays and lays up those sheets onto a mold with human assistance ARM-TEC-19-01-F-12,

## ARM Finishing Cobots

*Cobot that automatically figure out ho to sand aircraft skins and panels alongside a human coworker while inspecting for defect to rework* Cobotic work cell, sand, visually inspect & automated path plan/ replan ARM-TEC-18-01-F-08,

## Assembly Cobots

*Wire harness install Cobot -Robot-Assisted Wire-Harness Installation* ARM-TEC-17-01-F-31

*Wire harness assemble Cobot* Automated Wire Harness Assembly:ARM-TEC-17-01-F-05

*Wire harness assemble Cobot -Perception-Aided Collaborative Robotic Wire Harness Assembly*, iWIRED ARM-TEC-17-QS-F-04

## Inspection

*Advisor inspection robot* , Polarized & Multiband fine detail inspection of brightly and dimly lit highly reflective curvilinear 3d object Automated Defect Inspection of Complex Metallic Parts ARM-TEC-19-01-F-07-,

*Cobot that Scans and conforms 3d parts* Human-Robot Collaboration in Quality Inspection to Empower Workforce to Easily Program and Operate Automated 3D Scanning ARM-TEC-19-02-F-03

## robotic material handling
## fetch /transport COBOT

*Software module that seamlessly integrates multiple robots from multiple venders.* Seamless Multi-Robot, Multi-Machine Interoperability ARM-TEC-18-01-F-25

*Autonomous mobile Cobot that disposes waste.* map, & navigate an AMR using audio & visual triggers for safety, Safe Autonomy Features in the Edge (SAFE) ARM-TEC-19-02-F-05-

*AMR COBOT for fetching part from the store sback to the workcell, positioning and holding them in place for attachment by a coworker*. AMR fetch, place assemble COBOTs ; ARM-TEC-17-QS-F-02:

*OEM agnostic AMR /AGV fleet Manager* Interoperability & Orchestration of Autonomous Mobile Robots (IO-AMRs) ARM-TEC-20-01-F-17

*Occupied Facility disinfectant AMR*. Autonomous Robotic Spraying & Disinfection in Un occupied space of Warehouses & Shipyards using a dexterous arm ARM-TEC-20-02-F-02,

| *2017 -2018* | *2018 -2019* | *2019 -2020* | *2020 -2021* |

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