ARM INSTITUTE

YEARS

ARM Institute Overview

1 December 2022

Agenda

1. Introduction to Mill 19 and Pittsburgh
2. Robotics Industry Background
3. Highlights of First Five Years
4. Consortium
5. Technology
6. Education and Workforce Development
7. Physical Commons

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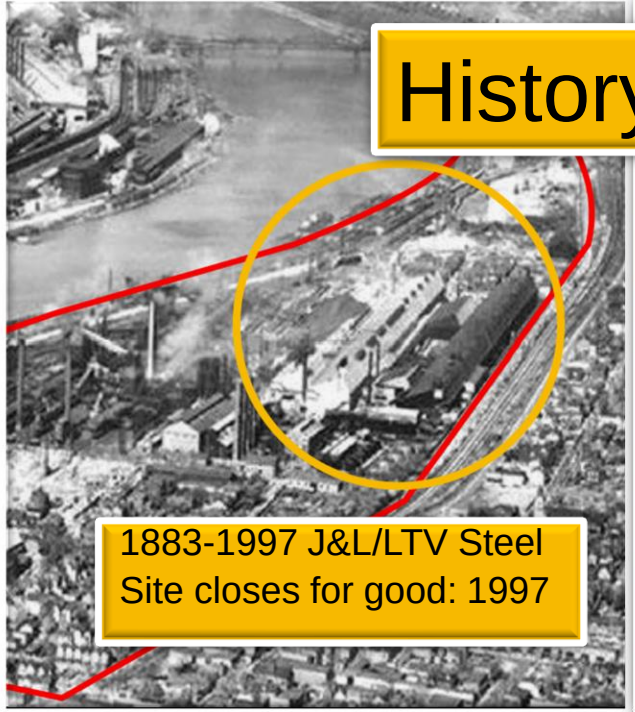
History of Mill 19 – ARM Institute Headquarters



1883-1997 J&L/LTV Steel
Site closes for good: 1997

2002-2015
Site remediation and Cleanup

Outer Steel Skeleton Retained

2016-2019
Construction and Ribbon Cutting

From an Industrial Steel-Making Past to a Sustainable Advanced Manufacturing Future

[[File:Pittsburgh skyline panorama at night.jpg|Pittsburgh_skyline_panorama_at_night]]

Advantages of the Pittsburgh Location for the ARM MII Headquarters

- >100 Robotics Companies; >$3.4B in Investments; > 7000 employees
- World's largest center for autonomous robots: Capital investment ~$13.5B:
  - MOTIONAL, AURORA, WAYMO
  - $3.3B invested by VC & PE in robotics companies since 2012
- Anchored by Carnegie Mellon University: ranked No. 1 in six different technology areas including AI, computer science, and cybersecurity
  - Top 5 in 9 other areas
- >20 other academic and research organizations working in robotics
- National Robotics Engineering Center (NREC), Army AI2C
- Amazon, Uber, Facebook, Apple, Bosch, GE, etc. Are here

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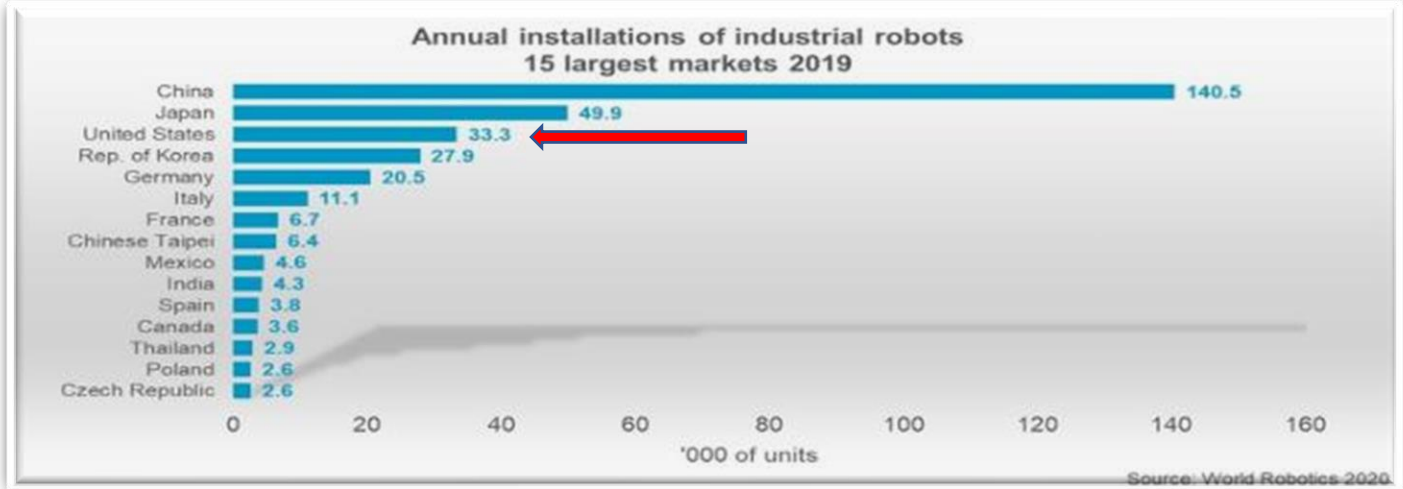
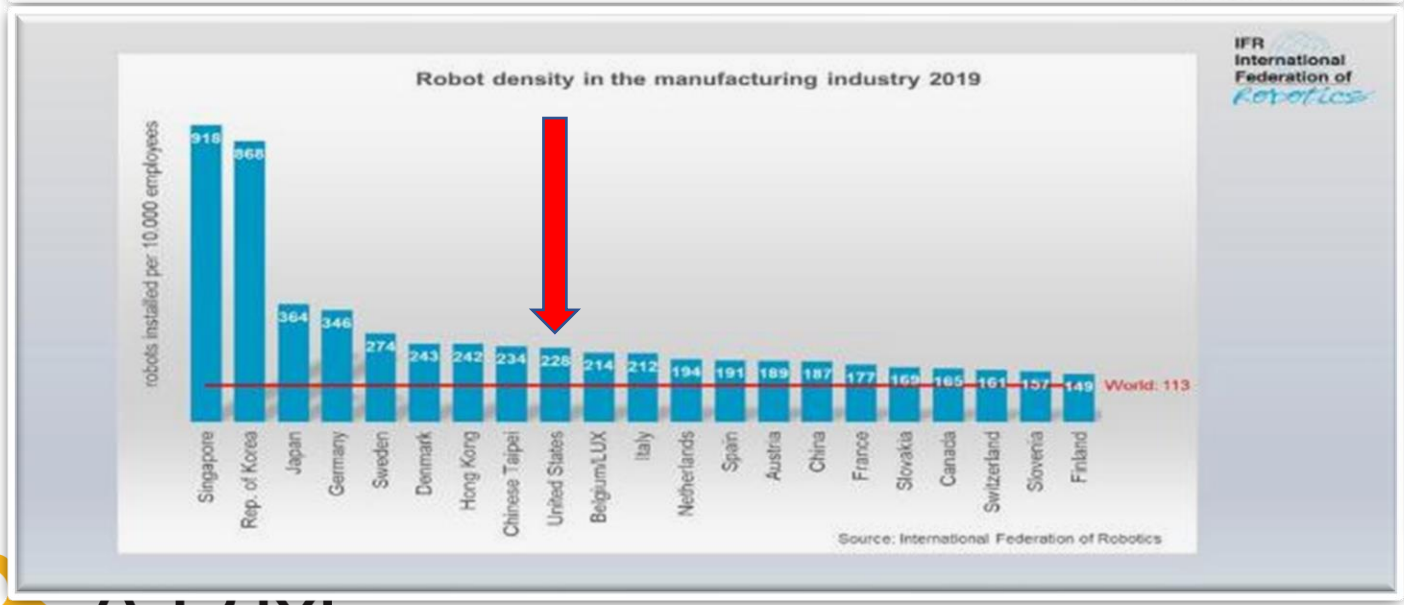
Robotics Industry Background

Global 2.7M Industrial Robots in Factories





The US is in 3rd place, trailing China by > 4:1 in total installations. Asia overall has 2/3 of all global installations.

US is far behind Asia and Germany in robots/10,000 employees

None of the largest Industrial Robot Vendors are US-Owned Companies

The US is trailing. We cannot be a large producer of industrial robots but we can lead the world in *advanced*, intelligent, collaborative robotic development and deployment. This is ARM's focus.

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Largest Vendors of Industrial Robots are not US Companies

Industrial robots

- Manufacturing
- Construction

- Examples of Key Players
  - Fanuc Robotics (Japan)
  - Yaskawa Electric (Japan)
  - Stabuli (Swiss)
  - Comau (Italy)
  - Universal Robots (Denmark/Teradyne)
  - Kuka (China)

Enterprise Robots

- Warehousing, logistics
- Retail, consumer, agricult
- Flexible cobots

- Examples of Key Players
  - ABB (Germany)
  - Baylo (US)
  - GEA Group (Germany)
  - Kuka (China)
  - Amazon (US)
  - Zebra (US)

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2019 Data: Global Robotics Projected to grow from $70B to $275B by 2026 (26% Annual Growth Rate)

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Needs for Robotics

- **Advance robotics in manufacturing & sustainment environment for commercial & defense manufacturing**
  - High mix / low volume
    - Human Robot Interaction (HRI)
    - Interoperability
    - Intelligent Robotic Systems
    - Reconfigurable, Agile, & Flexible Robotic Systems
    - Autonomy & mobility
    - **Defense unique tolerances & materials**
- **DoD Environment 2022+**
  - Small lot sizes
  - Will require flexible and reconfigurable robotic systems working in close proximity with and augmenting the human workforce.
- These attributes are consistent with robotics growth areas and US's world-leading competencies

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The Advanced Robotics for Manufacturing (ARM) Institute Established to Meet These Needs

- Established 2017 by Carnegie Mellon University
- One of 16 national Manufacturing Innovation Institutes (MIIs)
  - 1 of 9 MIIs funded by the US Department of Defense
- A Public-Private Partnership: > 370 members across industry, academia and government representing the entire robotics ecosystem
- >125 projects funded to date in both technology and workforce development
- Managed >$100 Million of Government Investments to date, matched by cost share investments from members

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The ARM Institute Mission

The ARM Institute accelerates the development and adoption of innovative robotics technologies that are the foundation of every advanced manufacturing activity today and in the future.

We leverage a unique, robust and diverse ecosystem of partners across industry, academia and government to:

- **Make robotics, autonomy and artificial intelligence more accessible to U.S. manufacturers large and small**
- **Train and empower the manufacturing workforce**
- **Strengthen our economy and global competitiveness**
- **Elevate our national security and resilience**

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Ira Moskowitz
Chief Executive Officer

Suzy Teele
Chief Strategy Officer

Jay Douglass
Chief Operating Officer

Arnie Kravitz
Chief Innovation Officer

Louisa Michaels
Chief Financial Officer

Lisa Masciantonio
Chief Workforce Officer

Chuck Brandt
Chief Technology Officer

Cassandra Stahl
Executive Assistant

ARM Institute's Leadership Team

How Far We Have Come

2017
- 14th Manuf. USA Institute
- First 3 Project Calls
- 1st Member Meeting
- 100 Members (December)

2018
- 2 Project Calls
- Website/Branding Launch
- Member Community Launch
- 140 Members (June)

2019
- 4 Project Calls + JROBOT
- EWD Solutions Summit
- Mill 19 HQ Opens
- 187 Members (June)

2020
- 6 Project Calls (4 directed)
- CARES Act / COVID
- RoboticsCareer Begins
- 274 Members (June)

2021
- 4 Project Calls
- Robotics Career Launch
- ARM Exchange Webinars
- DoL Funding
- 315 Members (June)

2022
- 21st (TIA) Project Call
- 120+ Projects Funded
- JDMC Review
- RC/Endorsements
- BBB Funding for Mill 19
- Florida Office Opens
- 378 Members

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Highlights and Impact of our First Five Years

- Strengthened the DoD, elevating our national security through 21 Tech Project Calls and 90 projects with dual use to industry
  - Produced over 133 Gigabytes of IP, with over 60% of projects already transitioning, & all available to members and the USG
  - Multiple projects advancing US resiliency against COVID-19
- Attracting & Accelerating the Training of the “new collar” workforce via RoboticsCareer.org
  - >16,000 programs and 35 Endorsements completed or in WIP, against a first-of-its kind standardized framework for robotics technician competencies

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Highlights and Impact of our First Five Years

- Built the largest and most active public-private consortium advancing U.S. robotics manufacturing and workforce
  - >370 members representing the entire US robotics ecosystem
  - Grew membership ~70% during the Pandemic!
- ARM Online Member Community: Discussions, Directories, Projects, Project Calls, ARM Exchange, News and Event
- Represented our consortium's interests widely in the federal government
- Highlighted your accomplishments as our members and partners
- Succeeded in the 5-year JDMC Review by the DoD
  - ARM Institute recommended for follow-on agreement with DoD

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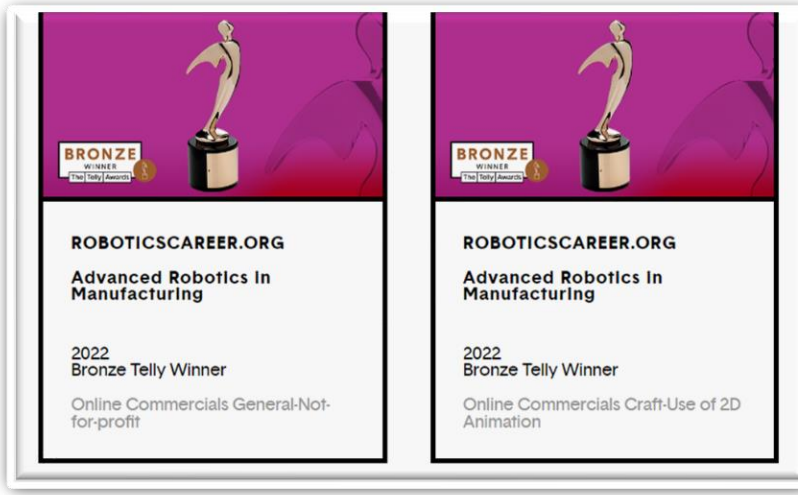
ARM Awards and Recognition

- 4 Times “Best Places to Work” Finalist (Western PA)
- 5 Times Pittsburgh “Tech 50” Finalist (Most successful and innovative companies in Southwestern PA)
- 2 Times Robotics Business Review (RBR) Winner
  - 2021 – Mill 19
  - 2022 – RoboticsCareer.Org
- Lisa Masciantonio Recognized Twice:
  - SME’s List of “Exceptional Women in Robotics”
  - RealLIST Connectors list of the “100 Influential Leaders to Know in Pittsburgh Tech”
- 2 Telly Awards, Roboticscareer.org Video - 2022



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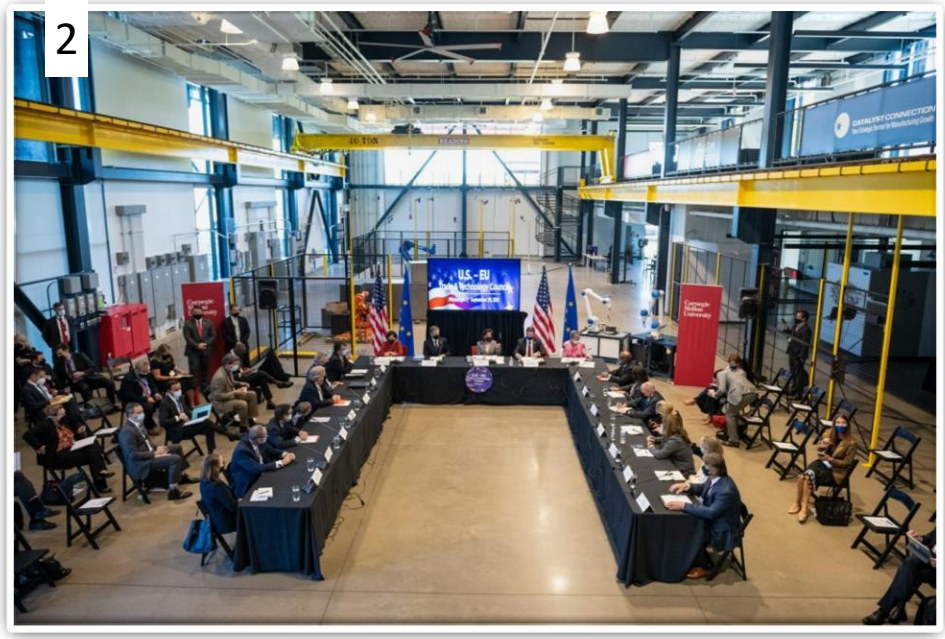
ARM increasingly Recognized by National Leadership

1. Visit by President of United States; ARM & members engaged in discussion on manufacturing & labor policy
2. ARM participated in roundtable with 2 US Cabinet Secretaries & 2 EU Ministers at Inaugural US-EU Trade & Technology Council Meeting in Mill 19
3. ARM joined US Secretary of Labor on panel discussing impact of robots on jobs
4. ARM joined all 16 Institutes in White House meeting with 11 Agency Deputy Secretaries & Under Secretaries



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ARM INSTITUTE HAS GAINED TRACTION AT THE NATIONAL LEVEL

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Consortium

ECOSYSTEM: OVER 370 ARM MEMBERS REPRESENTING THE ENTIRE ROBOTICS ECOSYSTEM

1. **Largest US Defense Contractors, many other large corporations**
2. **Dominant share of industrial robot suppliers to US**
3. **Smalls/Mediums/Start-ups** across a variety of industries (>150)
   - >75 are Robotics, Autonomy, AI, Integrator & Cobot Companies
4. **Top US Research Universities for robotics; multiple FFRDCs**
5. **Community Colleges, VoTech Schools**, **Training Centers** (~55)
6. **Manufacturing Extension Partnerships (**MEPs: 13)
7. **Robotics Industry Associations, Numerous Non-Profits**
8. **US Government:** Army, Air Force, Navy, NIST, NIOSH, DOL…

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What makes this Consortium Unique?

- Enables broad industry roadmapping (Space, Textiles, Logistics, Automotive, etc.)
- Competitors enabled to work together horizontally in pre-competitive space
- New supply chains formed vertically, rapidly; new partnerships (OEM+Startup)
- Introduces Non-traditionals of all sizes leveraging industry expertise to solve Government challenges with dual industry use
- Enables sharing of Consortium Developed IP to accelerate member progress
- Cost share between the Government, Industry and Academia uniquely multiplies efficiency of consortium investments

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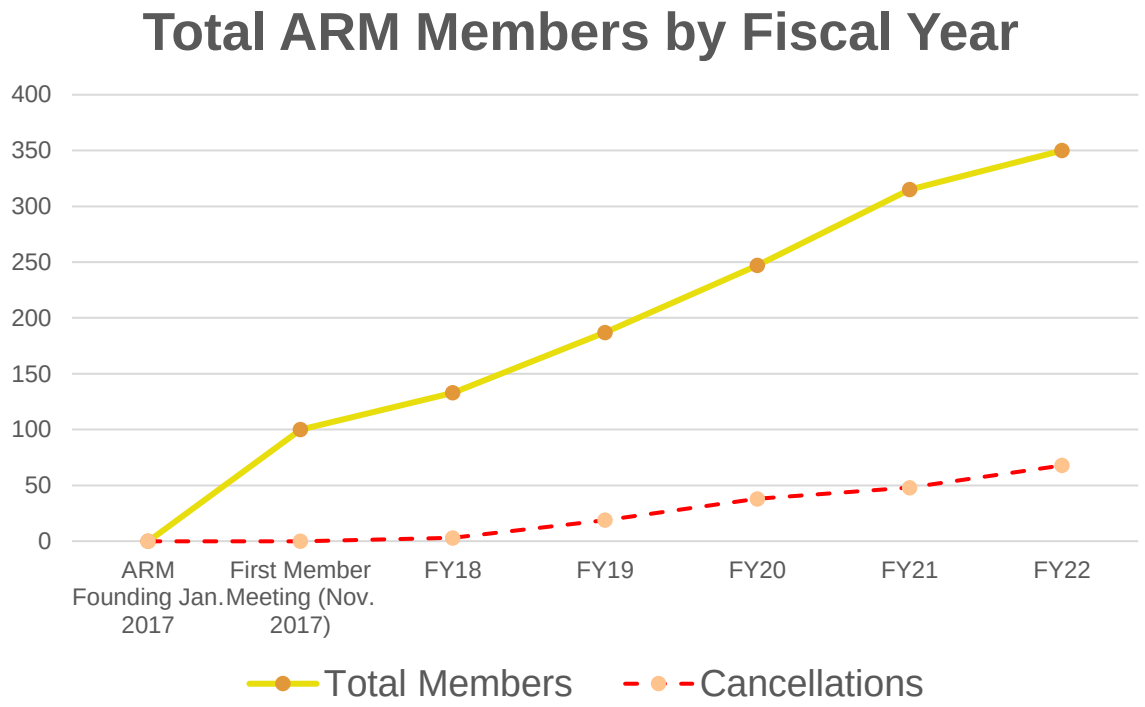
Nearly 1000 people collaborating…a unique diversity of experts from industry, academia and government leveraging industry expertise to advance technology and training with dual industry-DoD requirements

ARM Consortium leverages all of the entities the DoD can access (DoD Labs, FFRDCs, Universities, and DoD Contractors). In fact, we create partnerships between them.

Membership Growth



55+

New ARM Institute Members

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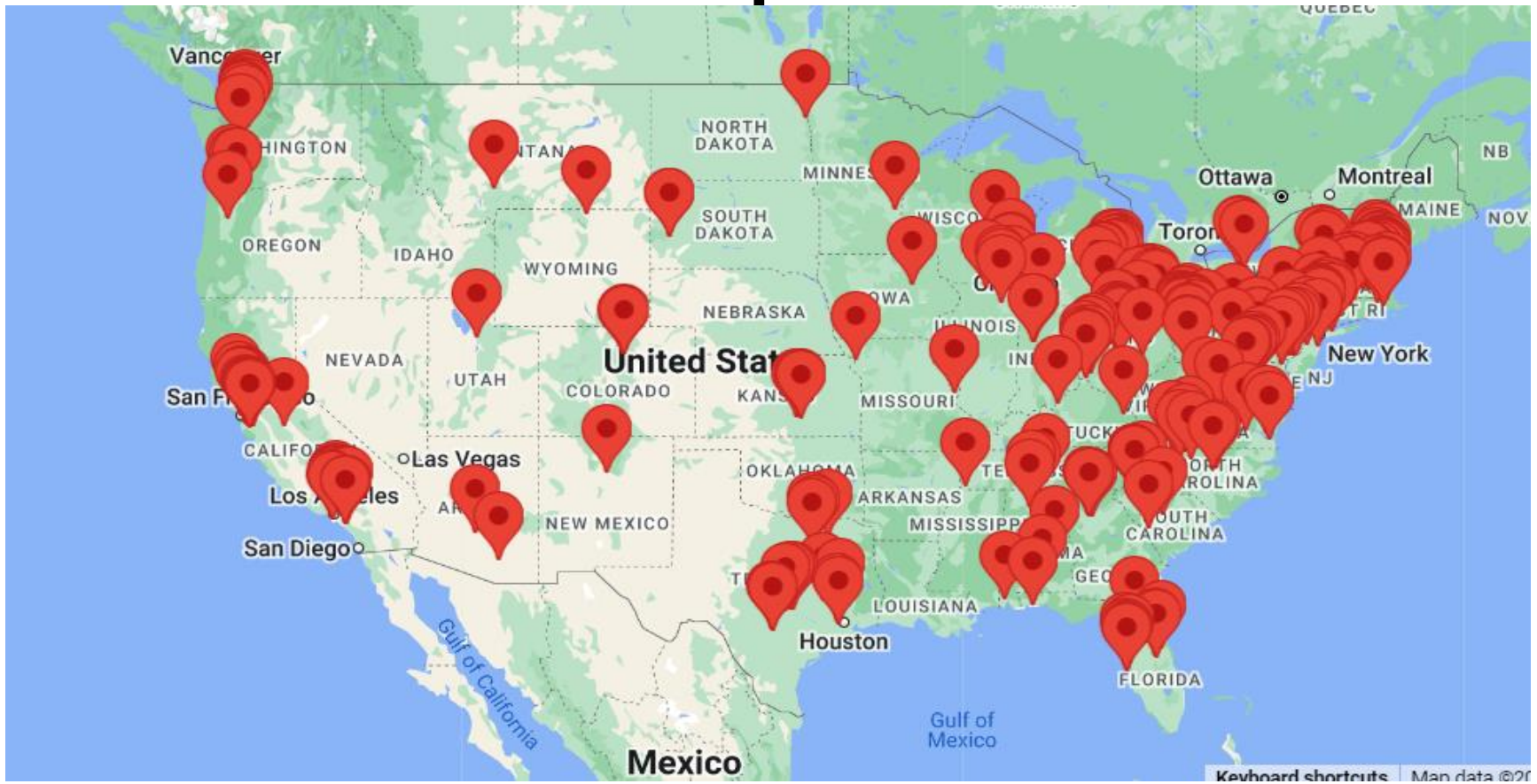
Membership Distribution



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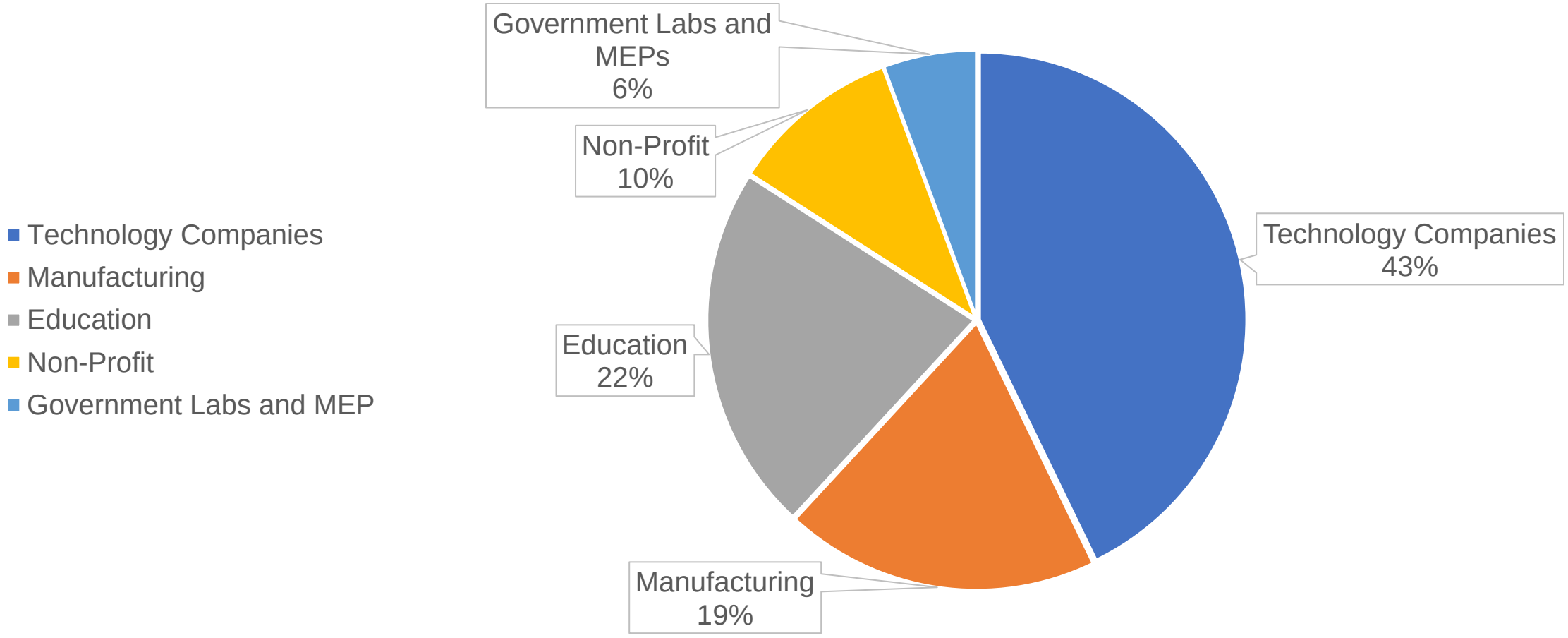
Ecosystem Mix



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Strategy for Retaining Members Key to Sustainability Success

- **ARM Integrative/Derivative IP**: ARM-Funded IP Free to members pre-Commercial, Fair License Fee for Commercial Use
- **Webinars, Community Outreach, Events, Social and Regular Media, ARM Champions, Discovery Workshops**
- **ARM Member Community Interface**: 698 Participants (approx. 2 per member), 80 ARM Exchange Articles, 2,921 Project File Downloads, Over 3000 webinar attendees, etc.
- **The ARM Project Book**: All active & completed projects, indexed; Project teams & funding; Brief project summaries and SOWs
- **The CDIP Repository**: centralized, secure, and accessible digital storage for all IP files and software; tools to upload, re-use and share
- **ARM Strategic Investment Catalogue (ASIC):** Lists projects and technologies funded, their applicability to different markets and uses, TRL/MRL levels, how they relate to previous projects; transition data

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Technology Program

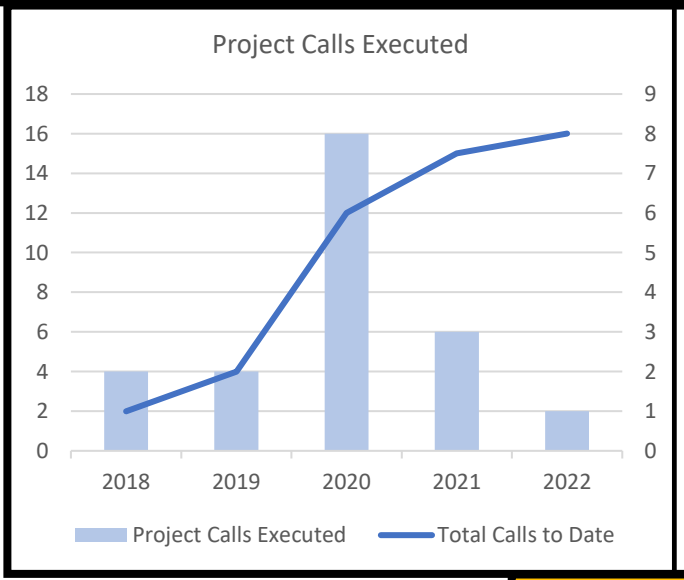
Technology Focus Areas

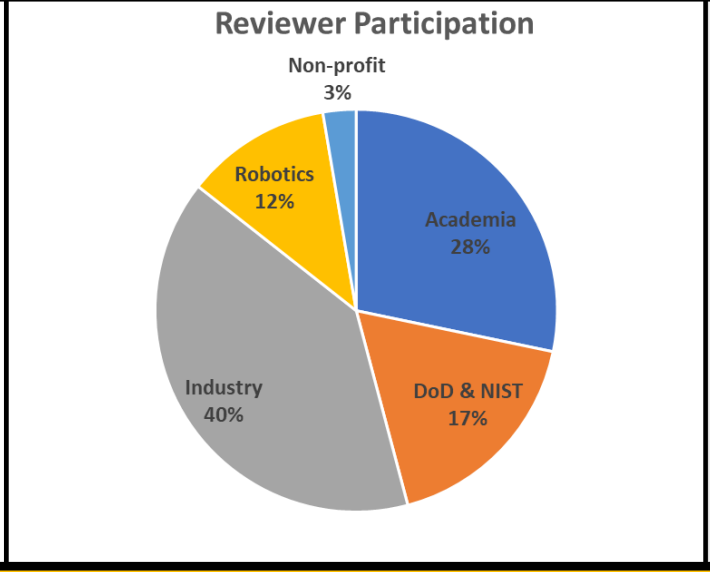
1. Risk Reduction for Transition to the Factory Floor
2. Human-Robot Interaction
3. Interoperability
4. Reconfigurable, Agile, and Flexible Robotic Workcells
5. Intelligent Robotic Systems

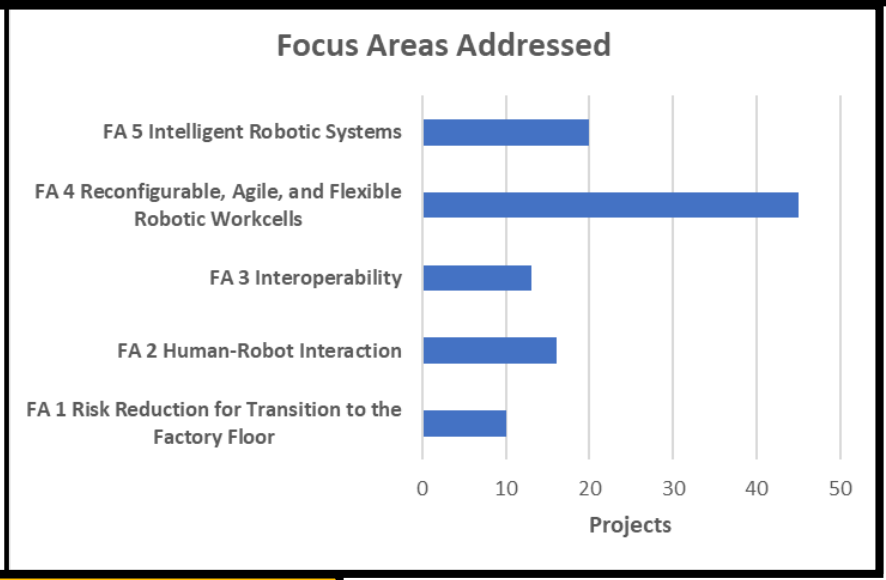
ARM has a Transition Team, Impact Metrics and a Structured Process to Monitor and Manage Transition Success

TECH: Overall Dashboard

Project Calls	Proposals Reviewed	Projects	CDIP-1	CDIP-2	Transitioning
16	364	73 17 Active 56 Complete	(designs, reports, …) • **653** Total Files • **133GB** of Data • **2,721** Downloads	(software; GITHUB) • **38** repositories • **20** access reqs • **1.5GB** SW	62% (35/56 projects)







Funds Committed: $27.2M Core/$39.2M Cost Share/$8.4M Sponsored

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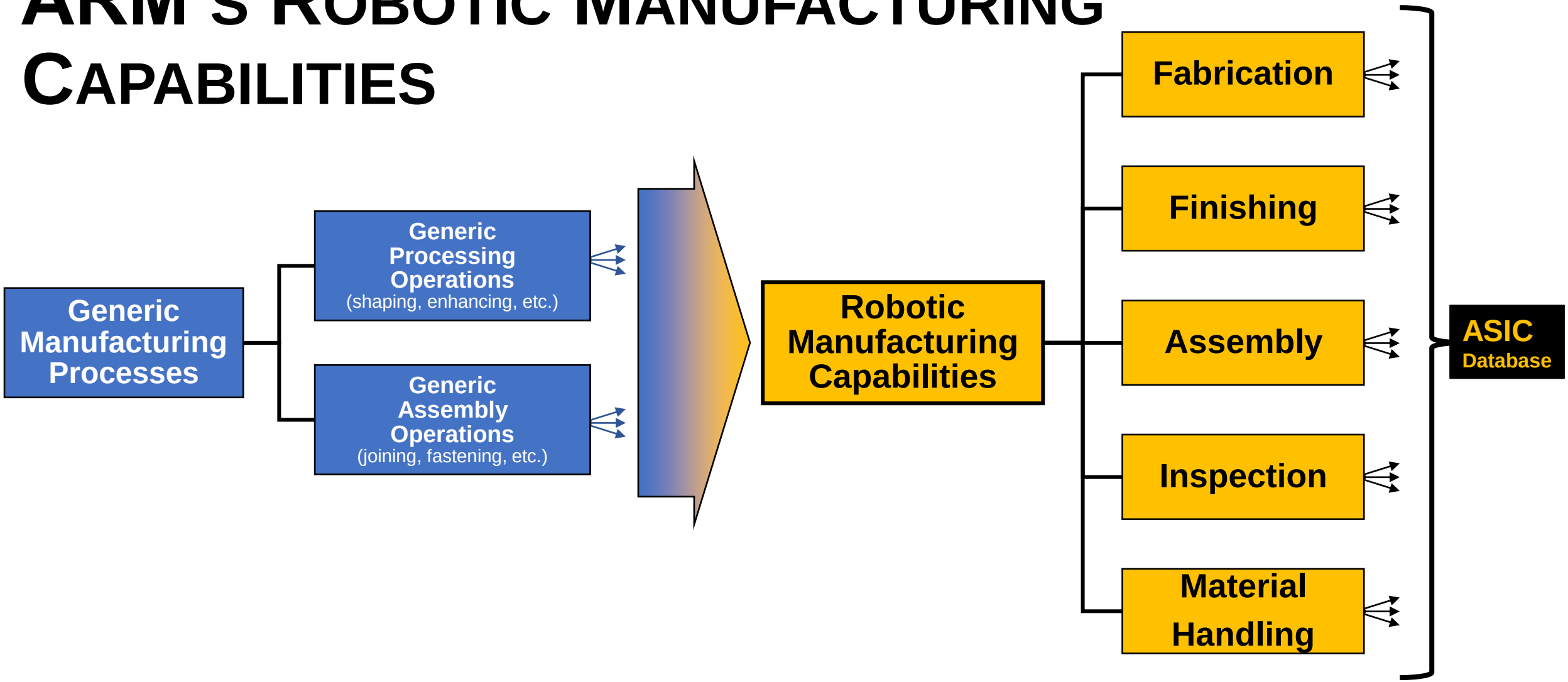
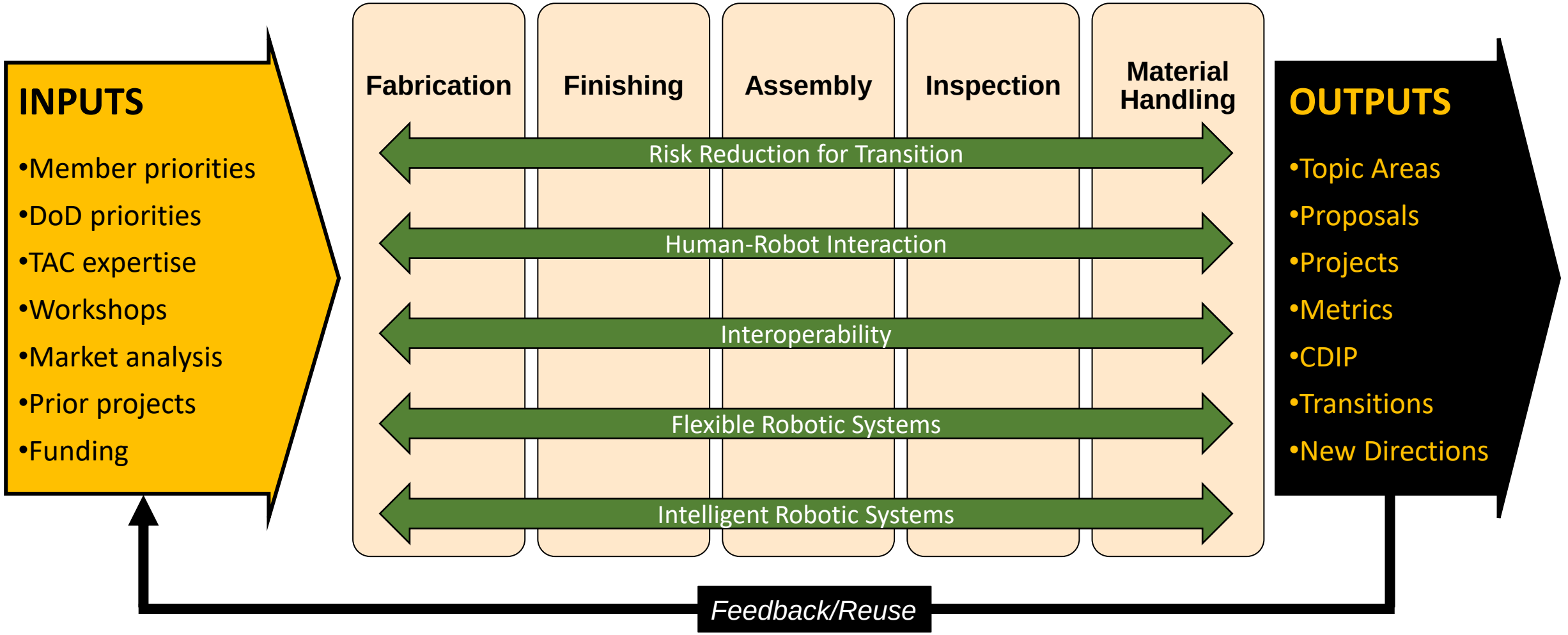
ARM's Robotic Manufacturing Capabilities



ARM's Robotic Technologies for Manufacturing Matrix



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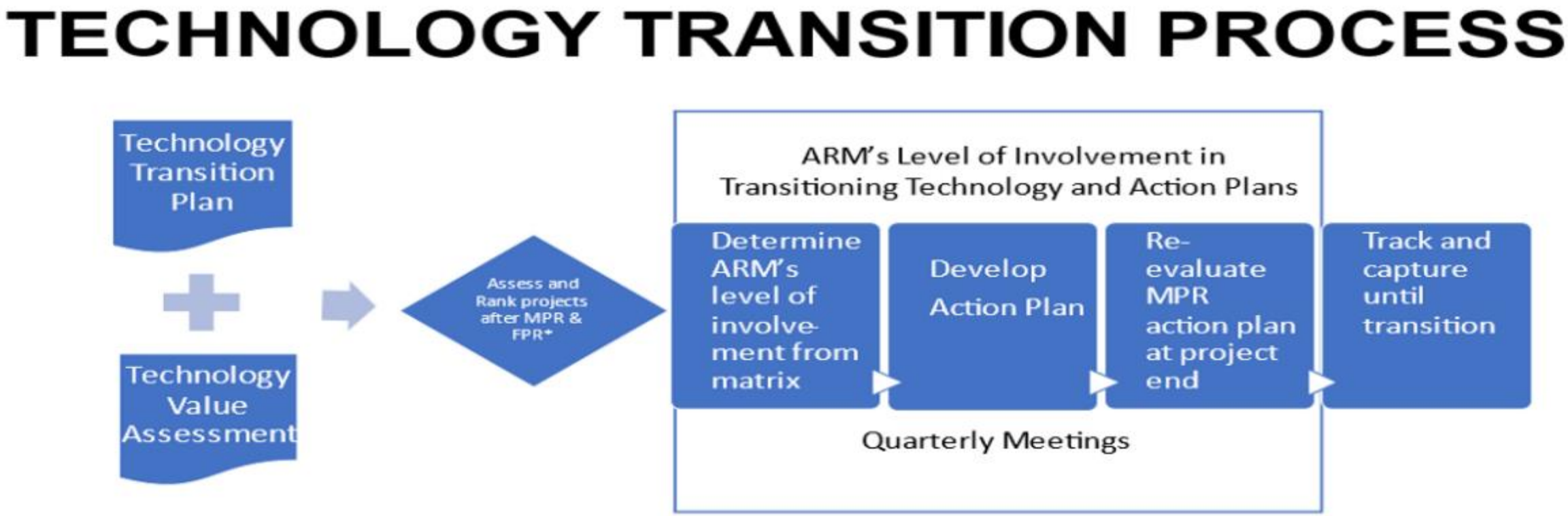
New Tech Transition Process Supporting the Business Plan (See Weakness in SWOT Analysis)



Goal is to prioritize projects and effectively utilize ARM resources to transition technologies

*MPR –Mid-Program review; FPR- Final-Program Review

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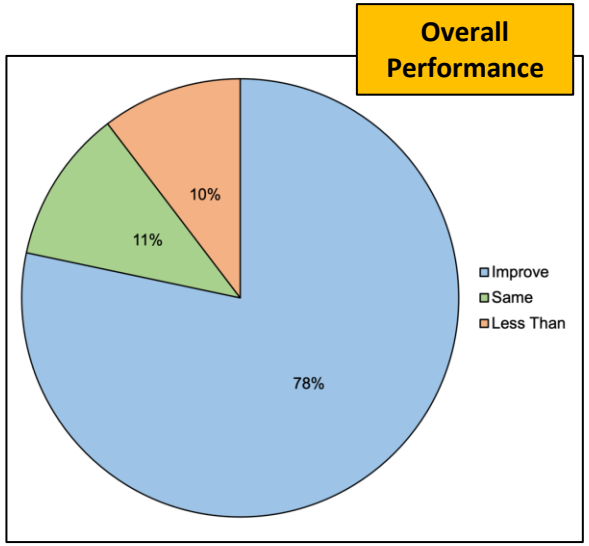
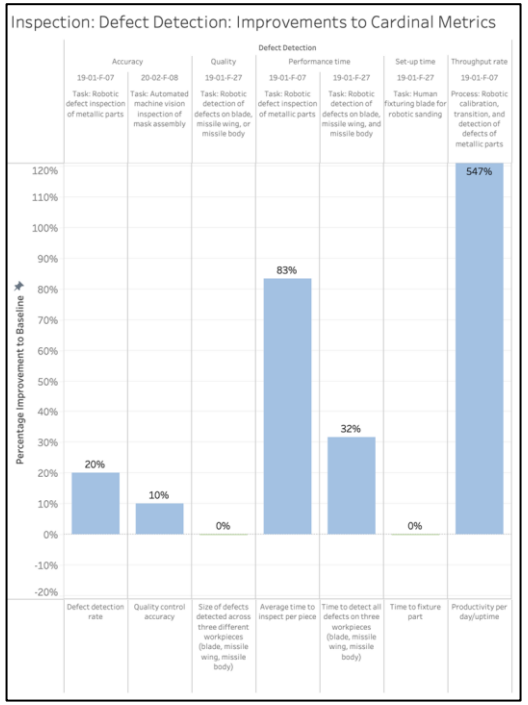
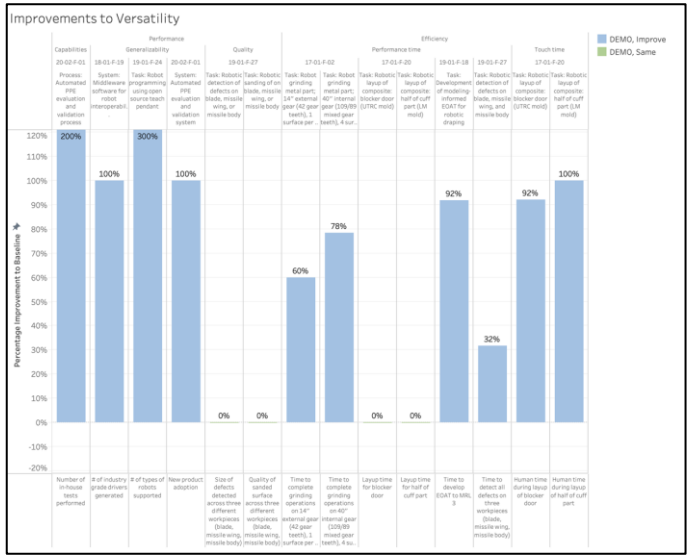
TECH: Project Metrics

- **Metrics & Evaluation Work Group (MEWG)**
- **72 technology projects currently tracking**
  - 30 projects introducing robotics to a process/application (42%)
  - 42 projects improving robotics for a process/application (58%)
- **Six cardinal metrics –**
  - Performance(9), Efficiency(3), Productivity(3)
  - Acquisition cost(2), Sustaining cost(6), Investment prudency(2)
- **Align cardinal metrics with ARM technical focus areas (TFAs) and targets to improve (TTIs)**
- **Metrics analysis across & within –**
  - Industries (e.g., aerospace); Applications (e.g., composites); Processes (e.g., inspection)
  - Projects; Project Calls; Time
- **Trend & conclusion analysis at multiple levels underway**

UMASS LOWELL NERVE CENTER







Analysis of project metrics shows improvements across projects, focus areas, & processes

- **Metrics Database:** catalogs all metrics proposed and demonstrated.
- **Metrics & Evaluation Handbook:** definition of cardinal metrics, metrics framework, and evaluation guidelines.

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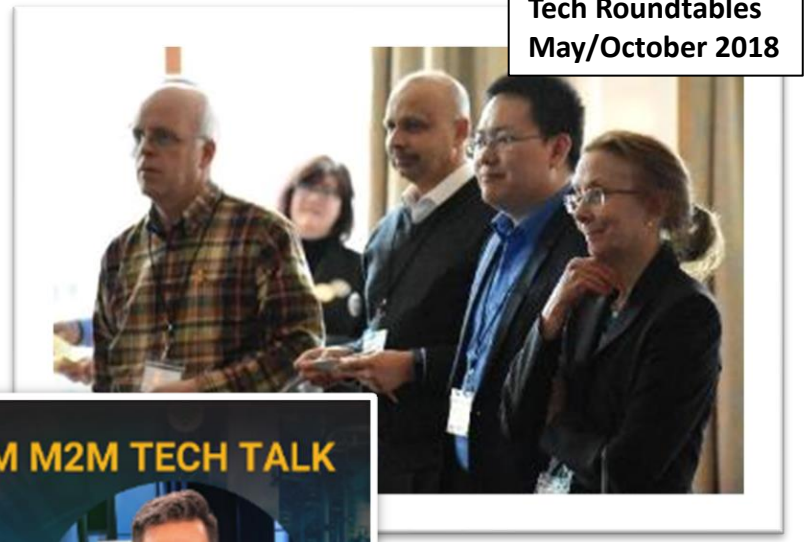
Gathering Technology Requirements to Sustain the Business Plan

1. Direct engagement with Warner Robins AFB, AFRL, AFWERX, Army DEVCOM, AI2C, NNRL, DLA, NAVSEA, OCEA/AF, etc.
2. Tech Roundtables, Deep Dives, Webinars, Focus Groups
3. Project Call Tech Days
4. Tech deep dives
5. Face to face meetings; Facility tours
6. Surveys
7. Annual Member Meetings
8. Webinars
9. Focus groups: Aero, Ground, Textiles, Logistics
10. Member to Member Tech Talks
11. Discovery Workshops
12. National Defense Strategy of the US
13. DoD Modernization Priorities
14. DAF 2030 Science & Technology Strategy
15. Army Priorities: AFC, DEVCOM, etc.
16. JROBOT



Tech Roundtables
May/October 2018

Annual Member
Meeting 2019

Example of How ARM Gathers Requirements

Joint Robotics Organization for Building Organic Technologies (JROBOT)

- ARM asked to commission solutions for high priority sustainment challenges in Tech and EWD
- **EWD**: Developed systems to bridge Organic & Defense Industrial base need for job skills
- **Tech**: 27 proposals submitted, 5 awards by JROBOT, 1 by Navy – idea to award in 120 days, 149 days to contract – All all with AI content
  - Cited as a “best practice” by National Academies of Science Phase 2 report on MIIs & DoD

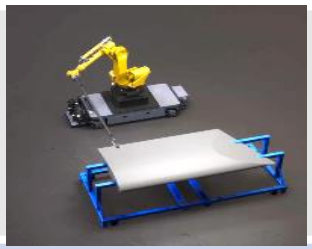
JROBOT
JOINT ROBOTICS ORGANIZATION FOR BUILDING ORGANIC TECHNOLOGIES

MR-Guided Path Planning with Robotically Generated Digital Twin

Hardened Underwater Modular Robot Snake

Autonomous Multi-Tool Head Robotic Solution for Surface Preparation

Autonomous Coating with Realtime Control and Inspection



Mobile Autonomous Coating for Aircraft Sustainment ($4M plus-up from AF ManTech)

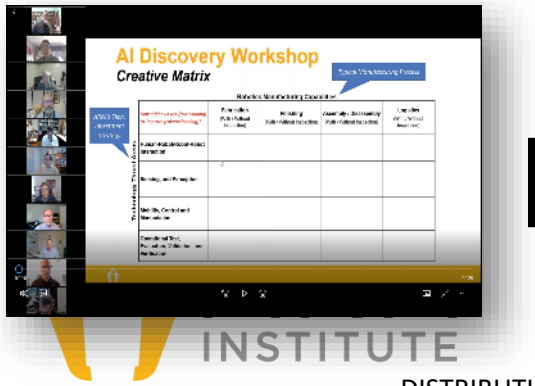
Autonomous Swarm Inspection & Interactive 3D Modelling with Orchestrated Visualization (ASIMOV)

Defining Element of Area #2 of Business Plan:
Rapid Project Cycles to Solve Sustainment Challenges with Cross-Service and Industry Utility

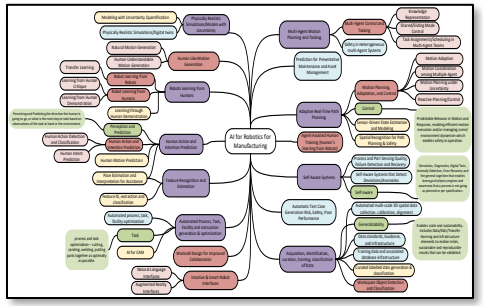
Example Of How ARM Gathers Requirements: Discovery Workshop Process

- **Background:**
  - At least half of ARM Tech Projects deployed AI solutions
  - Strategic alignment with DoD Modernization Priorities
  - AI Discovery Workshop with >20 AI Subject Matter Experts (SMEs): Robotics vendors, defense OEMs, Army, Air Force, Navy, Universities, FFRDCs, NIST, and NIOSH
  - Purpose: Define the ARM technology strategy for AI in Robotics for Manufacturing
- **Results:**
  - Identified, Prioritized, & Road-mapped 8 AI Technologies in depth
  - Prioritized Data (enabler) for all AI solutions for robotics for manufacturing
  - Developed 263-page report and detailed $100M action plan
    1. Initiated a member driven Data for AI Working Group (“DAWG”)
    2. Initiated funding strategy for first step, the AI Data Foundry & Learning Lab

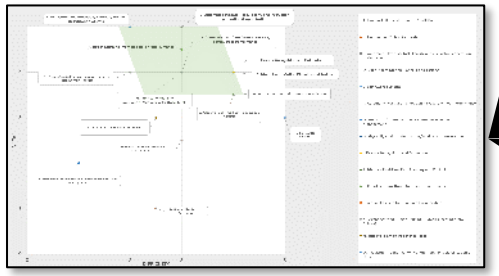
Ideas (~300) by 50+ contributors



Clustered 15 AI Tech. Groups



Prioritized



AI Tech Needs in RfM:

- Robot Learning
- Human Intention Prediction
- Automated Process & Task Generation
- Feature Recognition
- Automatic Test Case Generation
- Multi-Agent Motion Planning
- Adaptive Real Time Path Planning
- Physically Realistic Models/Simulations

Data Acquisition AI
Acquisition, identification, curation, training, classification

22-01 Project Call: Special Topics Areas

Robotics for Manufacturing

ARM is soliciting Concepts in **Artificial Intelligence** that address the needs of the manufacturing industry **and** the Department of Defense Modernization Priorities.

Special Topic Areas (STA)

- **Adaptive Real-time Path Planning & Control (STA1)**
- **Human Action & Intention Prediction (STA2)**
- **Robot Learning (STA3)**
- **Feature & Pose Recognition and Estimation (STA4)**
- **Virtual Commissioning of Adv. Robotic Systems (STA5)**
- **AI+Data for Adv. Manufacturing Robotic Systems (STA6)**
- **Multi-Agent Motion Planning and Tasking (STA7)**
- **Virtual Masking for Adv. Coating Applications (STA8)**

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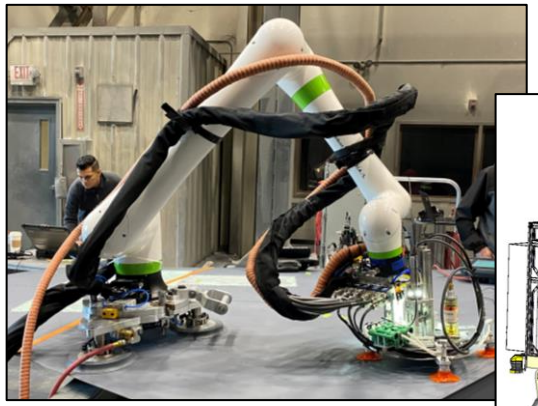
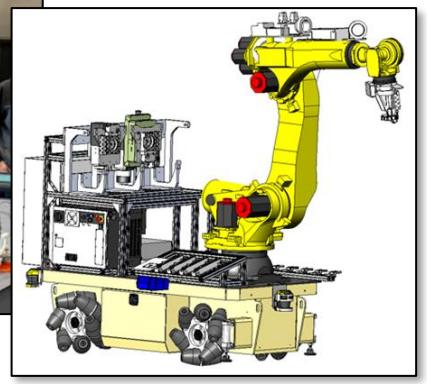
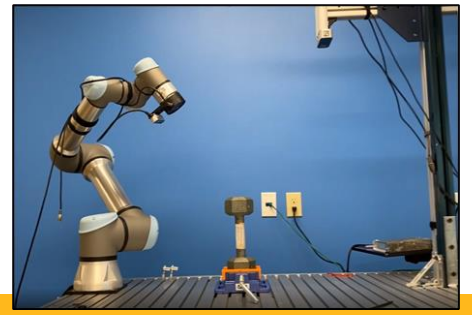
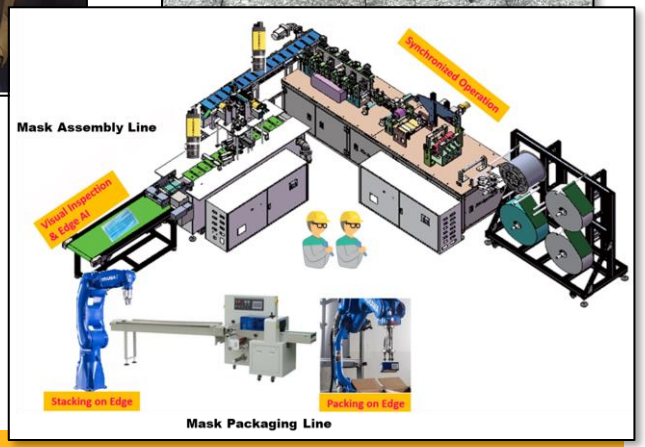
Directed/Sponsored Project Overview

- **Air Force**
  1) ARM-TEC-20-DC-F-01: Sustainment Autonomous Masking
  2) **ARM-TEC-20-DC-F-02: Virtual Part Repair Programming for Robotic Thermal Spray Applications**
  3) ARM-TEC-20-DC-F-04: Automated Manufacturing Study of Flex2 Solar Panels
  4) ARM-TEC-20-DC-F-03: Flexible Drilling System (FDS)
  5) ARM-TEC-21-DC-F-03: Collaborative Robotic Process Planning for Surface Treatment of Complex Components
  6) ARM-TEC-21-03-F-01: Augmented Reality for Manufacturing & Sustainment
  7) **ARM-TEC-21-03-F-02: Depot Factory AI Robotics (Depot-FAIR)**
  8) ARM-TEC-22-DC-F-01: Agile Autonomous Mobile Manipulator (A2M2)
- **Navy**
  1) **ARM-TEC-19-04-F-10: Autonomous Swarm Inspection and Interactive 3D Modelling with Orchestrated Visualization (ASIIMOV)**
- **Army**
  1) **ARM-TEC-22-DC-F-02: Refined Automated Production of Inflatable Devices (RAPID)**
- **Office of the Secretary of Defense** (CARES Act)
  1) ARM-TEC-20-02-F-01: Automation of Characterization and Evaluation (ACE) in PPE Manufacturing Plants
  2) ARM-TEC-20-02-F-02: Autonomous Robotic Spraying and Disinfection in Warehouses & Shipyards
  3) ARM-TEC-20-02-F-03: Built-By-Bot: Customized Mask Assembly using Robots
  4) ARM-TEC-20-02-F-05: Mobile Autonomous Industrial Disinfector (MAID)
  5) ARM-TEC-20-02-F-07: Human-Assisted Autonomous MultiSpace Disinfect Robot (HAAMSDR)
  6) **ARM-TEC-20-02-F-08: RApid PPE Production through Automation & Robotics (RAPPAR)**
  7) ARM-TEC-20-02-F-09: Rapid Robotic Diagnostic kit Discovery (R2D2)
  8) **ARM-TEC-20-02-F-12: Robotic Application of Anti-Microbial Copper Coatings**
  9) ARM-TEC-20-02-F-15: Swarm Robotics for Large Structure Manufacturing









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ARM assisting with:
- **OIB Modernization Assessments**
- **Technology Transition Working Group**

SUCCESS STORY:
Robotic Sanding and Finishing

- **Problem**: **Manual finishing processes** to remove surface irregularities and prepare for additional coating applications, create the following issues:
  - **Ergonomic**: repetitive motion and vibratory tool use
  - **Health**: dust exposure
  - **Quality**: inconsistencies in surface preparation
  - **Cycle time**: differences in the human element.
- **Approach:**
  - **Phase 1**: developed a prototype low cost and flexible system for sanding segments of helicopter blades.
  - Provided sensing of the work item, path planning for both low- and high-resolution scanning, defect detection and cueing to the human as to where to apply filler material, and automated sanding and QC checking.
  - Modular Robot Operating System (ROS) nodes.
  - **Phase 2**: improve the Phase 1 system for products with complex geometries, larger dimensions and a variety of materials for sanding.
- **Benefits:**
  - **Demonstrate** on parts used on helicopters, missiles (**JASSM**) and spacecraft (Orion).
  - Reduce risk of repetitive motion injury to the human operator and increase production throughput of large surface area, contoured parts.

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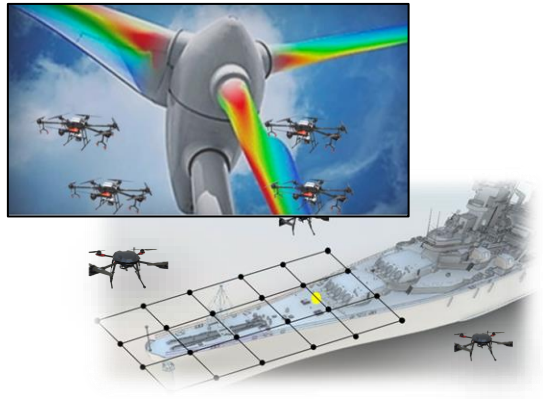
SUCCESS STORY: ASIIMOV

TEAM:Siemens (Prime); Siemens Energy, Allem Business Ventures

Autonomous Swarm Inspection & Interactive 3D Modelling with Orchestrated Visualization

- **Problem**:
  - **Inspection of large structures is a manual process: time, cost, safety concerns**
  - Emerging UAV-based methods need extensive preparation, skilled pilot control and data processing; need days to complete a full task
  - Need “Inspection software stack” that can be used for advanced service capabilities and inspection for: Shipyard operations (e.g., ship hulls), Hangar operations (e.g., automated aircraft inspection), Energy infrastructure (e.g., power plants), and Large field machines.
- **Approach:**
  - An inspection kit for agile deployment in remote / complex environment
  - Autonomous swarm **allow operator to focus on inspection** instead of UAV piloting
  - Mixed reality & HMI provide instant feedback to ensure the quality of work
  - **Automated process for repeatable results to improve productivity and performance**
  - Interoperable open SW/HW design allow fast adaptation and adoption.
- **Benefits**: Fully autonomous, fast operation, agile deployment inspection kit using swarm of autonomous drones and mixed reality-based human-in-the-loop to significantly advance the inspection technology for large structures / DOD sustainment goals.



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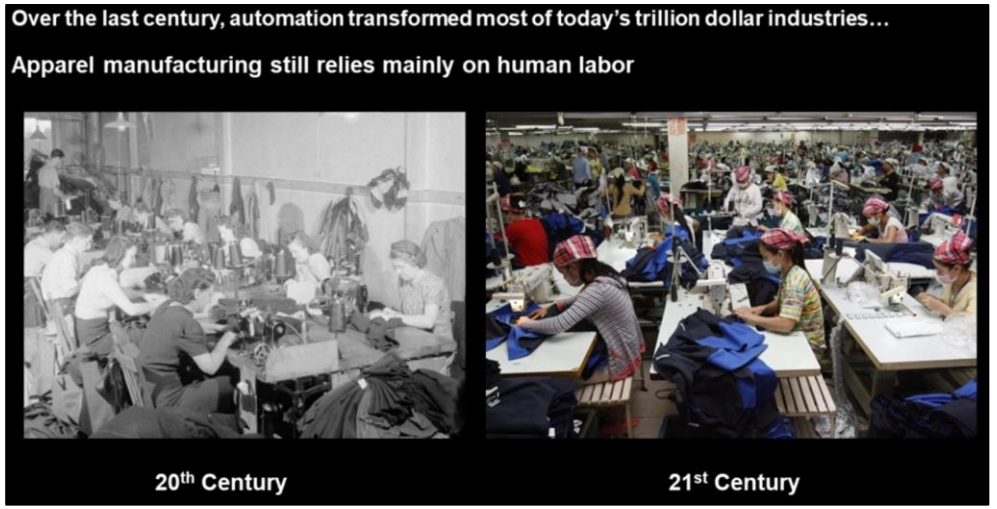
JROBOT JOINT ROBOTICS ORGANIZATION FOR BUILDING ORGANIC TECHNOLOGIES

Success Stories in the Making: Robotic Garment Assembly

TEAMS: Siemens, Sewbo, Blue Water Defense, Henderson Sewing, RPI, Hickey-Freeman, Levi Strauss, Yaskawa, UCBerkeley, DAP America, Interface Technologies, ISAIC, Pvilion, USC, Black Swan Textiles



- **Problem**: **ARM has funded a variety of projects that have significantly advanced the state of the art in robotic sewing, which was previously nonexistent**. Our early work integrated sewing machines with collaborative robot systems and designed an end effector capable of lifting and controlling a single large ply of fabric. Recent projects have focused on more advanced operations like hemming, pocket setting, and curved stitches. Companies like Levi's and sewing machine technology providers are very interested in integrating this capability into their processes and products.
- **Benefit to the Warfighter:**
  - The DoD buys an extraordinary amount of sewn goods – from uniforms, to tents, to parachutes, and more. By using robotic systems to produce these inexpensively in the US, we will secure our supply chain and reduce costs.
  - **The robotic technologies developed in these projects extends beyond the apparel industry to other companies that handle thin sheets (such as metal and plastic sheets, composites).**

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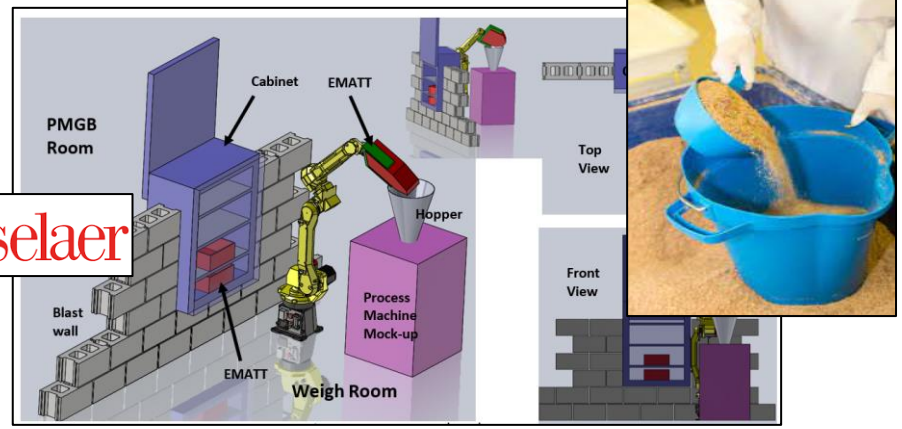
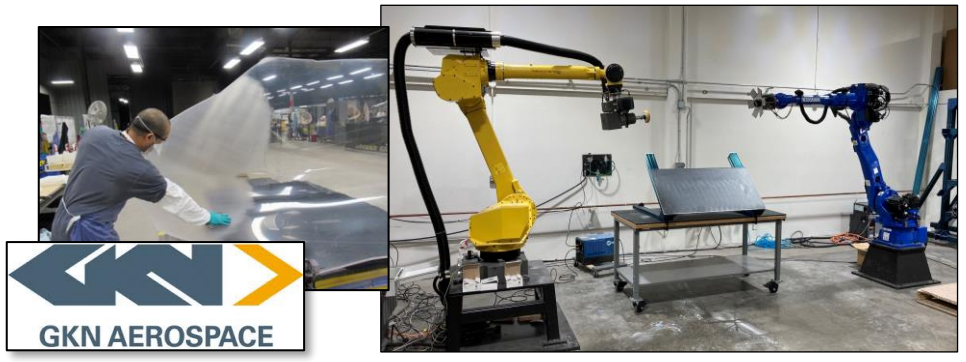
Success Stories in the Making

- **Safe Robotic Handling of Energetic Materials**
  - **Benefits**:
  - ✓ An 'off-the-self' solution for handling energetic materials.
  - ✓ **Safety – human elimination from current operation**
  - ✓ Efficiency – zero production line stoppage by operators
  - ✓ Productivity – a conservative 5 – 10% throughput increase per day.



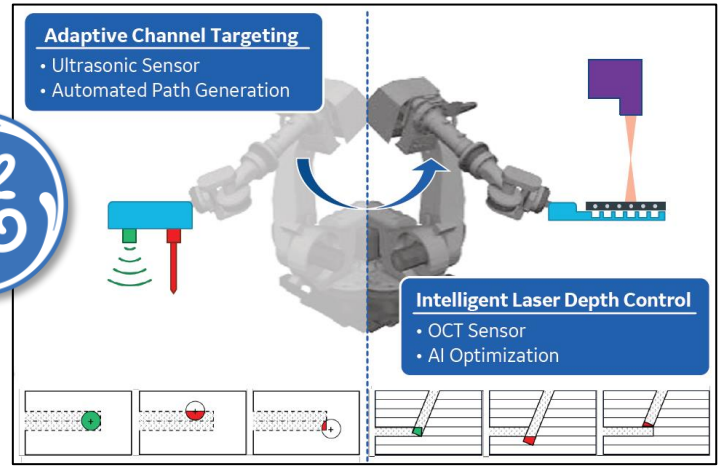
Rensselaer

- **Uniform Work Robotic Sanding with Intrastage Inspection**
  - **Benefits**:
  - ✓ Process performance: material removal with an **80% improvement in first pass optical distortion acceptance**
  - ✓ Efficiency: accurate sanding intra-step inspection will **eliminate 80% of polish stage defects and rework**
  - ✓ Productivity: effective system creation would **reduce canopy production time by 30% and scrap by 50%**.



GKN AEROSPACE

- **High Precision Adaptive Machining for High Temperature Materials**
  - **Benefits**:
  - ✓ **Enables advanced cooling architectures**
  - ✓ **25% reduction in scrap rate** over "fixed" machining approach
  - ✓ Time and NRE costs to MRL5 reduced by an estimated 9 months and $1.5MM when applied to similar processes
  - ✓ Enable higher levels of automated processing for CMC material systems (e.g., C/C, SiC/SiC)
  - ✓ **CMCs, with improved cooling architectures, expected to enable reduced fuel burn of 10% in next generation engines**



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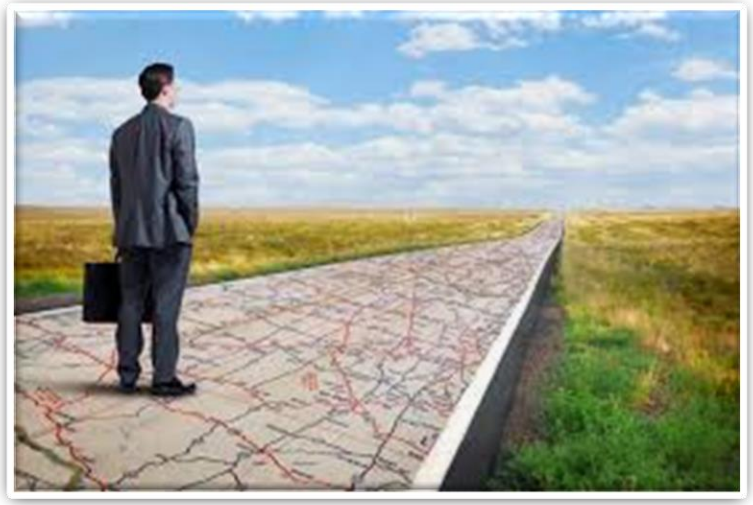
Education and Workforce Development

Needs Identified by Government, Unions, Industry, and Academia …Via Workshops, Councils, Solution Summit

- ✓ No single resource promoting **robotics careers** in manufacturing
- ✓ No definitive source to **define and communicate** these competencies
- ✓ No consistency among **job titles** and **jobs descriptions**
- ✓ No single resource to **recognize programs** that teach these competencies and skills
- ✓ No easy way to identify which programs are best suited to help education seekers **prepare for a robotics career** in manufacturing
- ✓ No easy way for **employers** and **education providers** to identify and respond to each other's needs



Solution: RoboticsCareer

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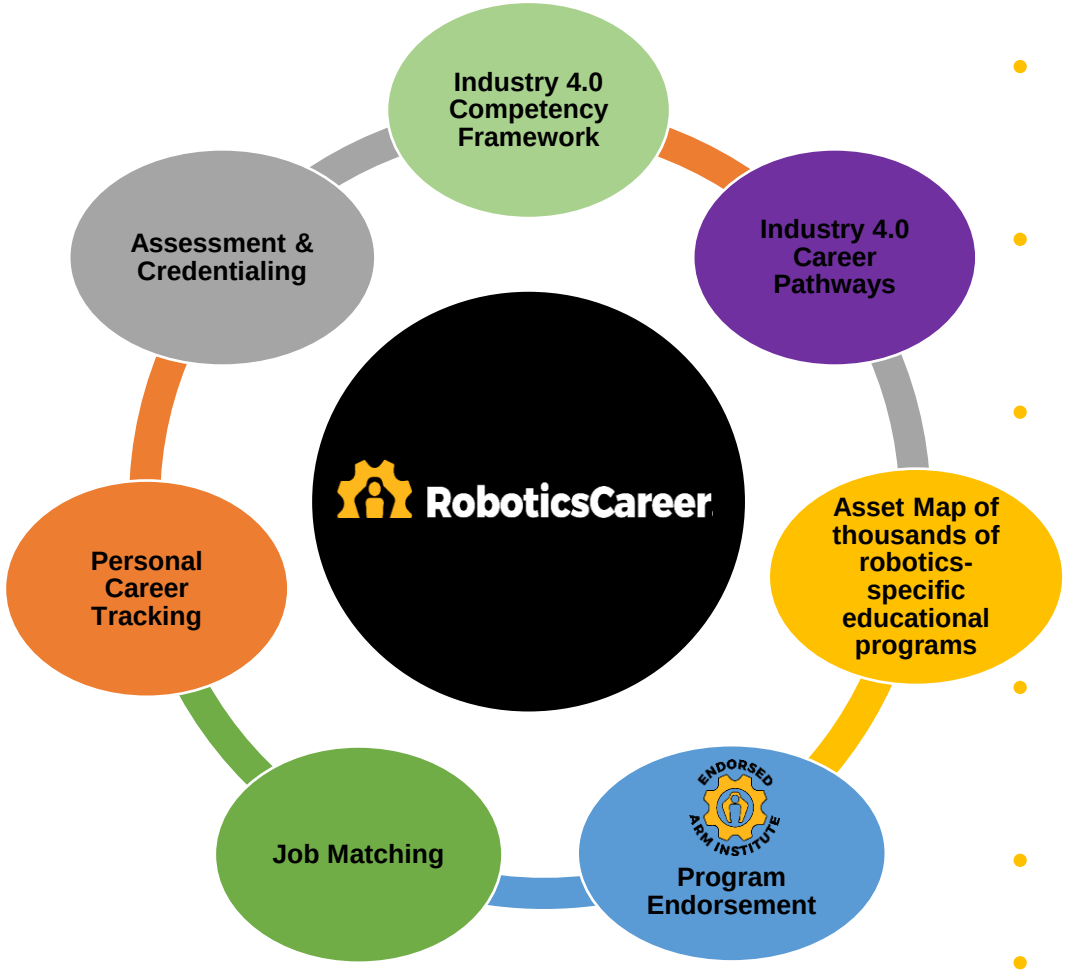
RoboticsCareer: A national Program with regional Impact



- Defined technician job classes and 26 robotics competencies, determined by our consortium
- Compiled robotics education training programs across the country <u>in that framework</u> (over 15,000 to date)
- Audit training programs on the framework vs. Best-in-Class, provide feedback & ARM Institute Endorsement
  - <u>Transfers national knowledge to underserved regions</u>
- Help employers find staff and training with the right competencies
- Help students find the best-fit program in their region
- Features under development: Job-to-Skills Matching, Career Tracking, Virtual AR/VR skill credentialing

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***"RoboticsCareer.org is the best site I've seen, and all students ought to be using it"*…Rodney Petersen: Director of the National Initiative for Cybersecurity Education (NICE) at the National Institute of Standards and Technology (NIST)**

https://www.roboticscareer.org

RoboticsCareer.org
POWERED BY ARM INSTITUTE

https://www.roboticscareer.org

Find Education | For Organizations

Gain the robotics skills you need for a career in manufacturing

Search for robotics career training programs that match the competencies manufacturers need

Keywords | State: All | City: All | Search

Find programs close to me

Find YOUR pathway to industry approved robotics career training

Roboticscareer.org is the only national resource that highlights training that has been vetted by industry experts and is proven to give you the skills you need for a career in robotics for manufacturing. Whether you are looking to advance your skills, those of your employees, or have a program to offer – your journey starts here.

Education Seekers

Many exciting robotics career opportunities in manufacturing exist, but finding the right training program can be difficult. Our national resource connects you to vetted training and education programs to start or advance your career in robotics. Search based on location, delivery method (on-site, virtual or both), and other criteria. Scroll down to learn more about career pathways in

Employers

Upskilling your workforce is critical to strengthening your manufacturing operations. Our database can help you find an industry-proven program to upskill or retrain your workforce. The ARM Institute competencies and careers pathways can also help you understand what robotics positions are right for your organization.

Education Providers

Get your program in front of a national audience of organizations and individuals actively exploring educational opportunities and robotics career paths. Adding your program to our broad, but comprehensive and vetted database will help you connect with potential students. Submitting your program for inclusion is free with the option to apply for ARM Endorsement.

RoboticsCareer.org – Training Programs Near DoD Sustainment Centers

Army's Organic Industrial Base includes 22 manufacturing arsenals, maintenance depots and ammunition plants

➔ **190 education organizations with 1102 programs**

Air Force Sustainment Center provides integrated logistics and sustainment through depot maintenance, supply chain management and installation support.

➔ **49 education organizations with 310 programs**

Navy maintains four public shipyards which perform maintenance on submarines and aircraft carriers to provide combat-ready ships to the fleet

➔**45 education organizations with 333 programs**

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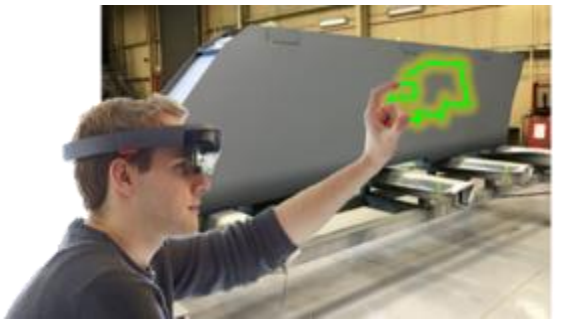
Our Business Plan Post-TIA includes Driving more of these analytics for the DoD

Manufacturing Sector 2032
What Will the Workforce Look Like?

Keeping RoboticsCareer In the Lead for Skills of the Future



- Robotics, automation, and artificial intelligence will be the biggest influencers on the worker of the future
- ARM is working with leaders on this topic across the United States
- What is the impact of robotics and automation on the manufacturing worker 10 years from now?
- Formation of a joint working group from Government, Industry, Academia, Unions, Workforce Investment Boards to explore and guide ARM about:

The Workforce of the Future

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Industrial Commons (Mill 19)

Sustainability Plan for Mill 19

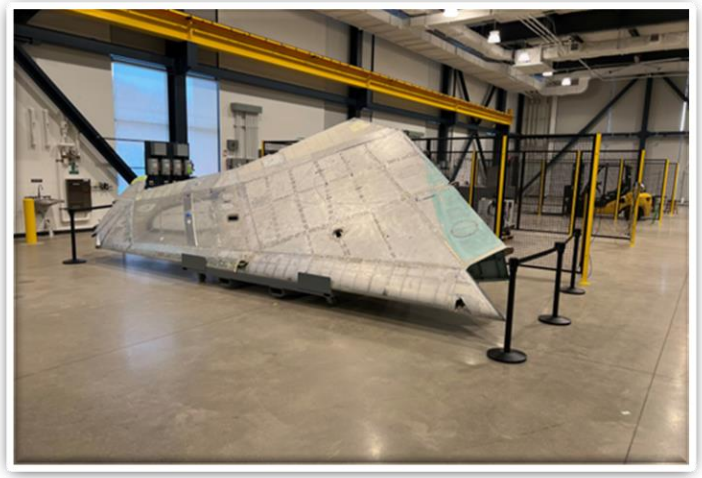
The best use of Mill 19 is a critical element of ARM's sustainability planning and of realizing the vision of Hazelwood Green.

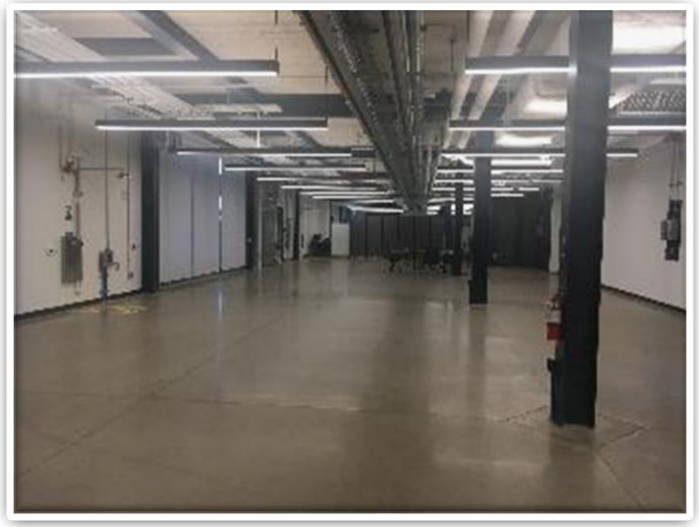
After many discussions, we concluded best uses of the facility consistent with the Mission that did not compete with the Consortium were:

1. **Regional Robotics Manufacturing Hub,** leveraging the Consortium, and feeder spaces in outlying areas, to de-risk the adoption of advanced robotics and automation technology for small and medium manufacturers. (Just funded by DoC EDA, $14.2M over 4 years)

2. **AI Data Foundry for Robotics**, leveraging our co-tenants CMU, the local MEP Catalyst Connection, and the Consortium. The Data Foundry will define, collect, organize, validate, secure and deploy data for machine learning of robots (Funding is in Current Federal Budget)

3. Regional **AI Learning Lab for Robotics** and Experience Center (Funding is in Current Federal Budget)





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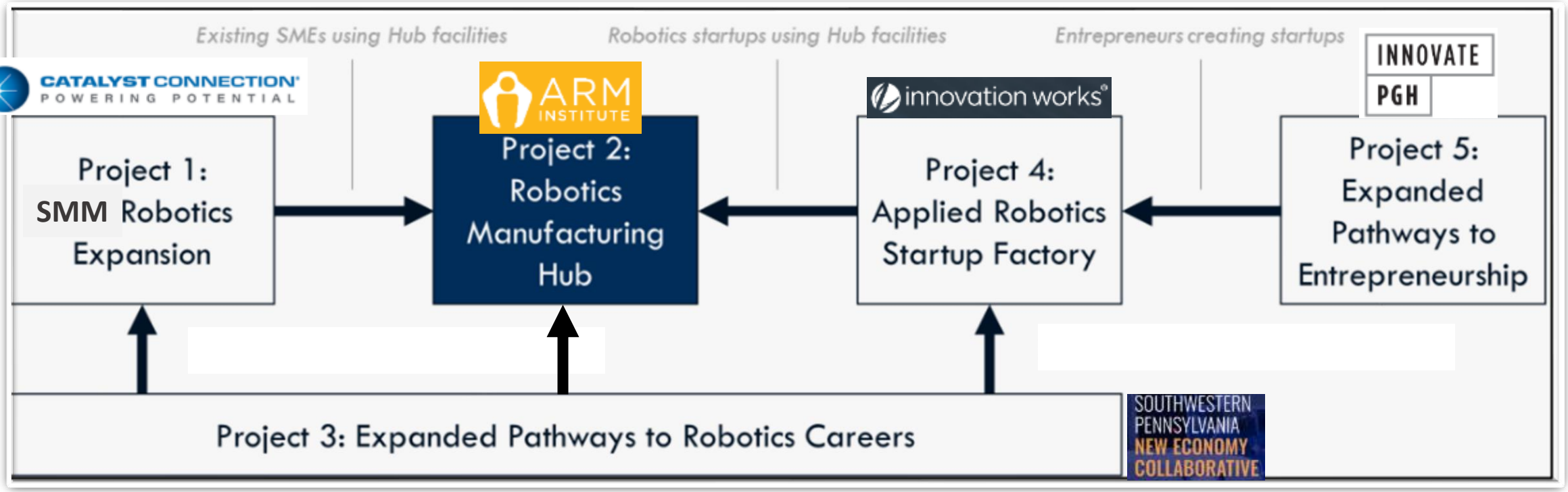
1. Robotics Manufacturing Hub in Mill 19:

Part of a $62.7M Build Back Better EDA Regional Challenge Just Awarded Sept. 2022 to the Southwestern PA New Economy Coalition



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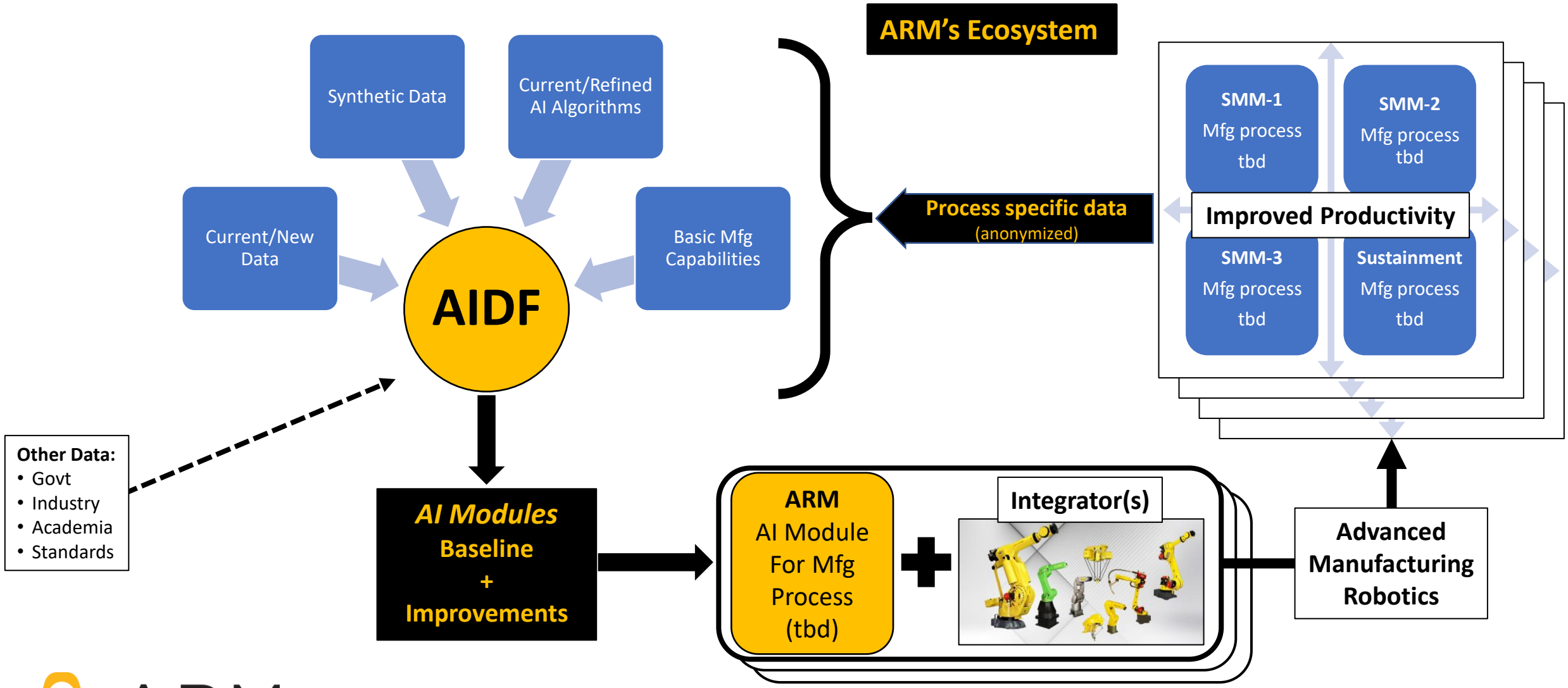
<u>Project 2 Awarded $14.2M Over 4 years</u>

Creates a regional Robotics Manufacturing Hub in Mill 19 and 4 Entrepreneurial Makerspaces in outlying areas to de-risk the adoption of advanced robotics and automation technology for regional small and medium manufacturers.

2. Mill 19 AI Data Foundry for Robotics in Manufacturing



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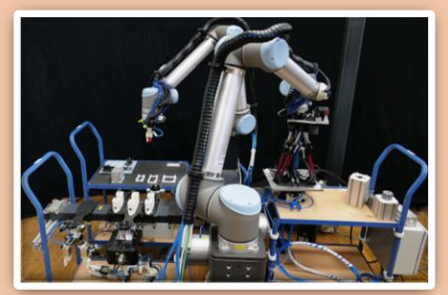
3. Mill 19 AI Learning Lab and Experience Center

LL-A. The Manufacturing Hub Introduction to Robots

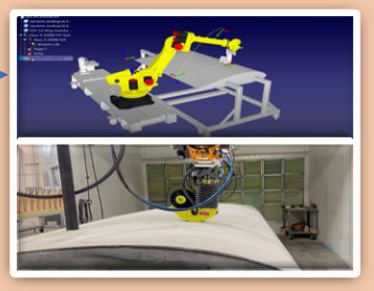
MILL 19
AI Learning
Lab &
Experience
Center



LL-B. Assembly Work Cell
- How robots are programmed

LL-F. Existing ARM EWD Assets to bring in, for DEIA youth programs

LL-C. AI Data Foundry
- Intro to AI & ML in Robotics



Future Mill 19 Lab Cells, CMU And ARM

LL-E. Mill 19 Digital Backbone
- What is a Digital Enterprise?

LL-D. Additive Lab
- Example of How Robotics is used in other systems

Possible Sequence: A → B → C → D → E → F

…Interfacing with External Partners…

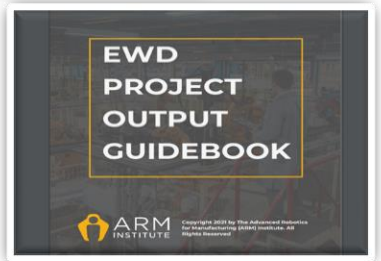
Small and Medium Size Manufacturers (SMMs)
- Factory Workers
- Factory Managers

Classroom Training
- Community Colleges
- Vocational Programs
- Catalyst Connection
- CMU

BBB Project 2 Makerspace Hubs
- Robotic & Automation Start-Ups
- Hub & Spoke Model

Community Outreach
- DEIA Focus on K-12 Programs
- Upskilling & Retraining

Existing ARM EWD Programs
- RoboticsCareer.org
- Cobots for Kids
- RECF
- SMART



Vision of the ARM Institute

Leading the way to a future where people and robots work together to respond to our nation's greatest challenges and to develop and produce the world's most desired products.