Advanced Robotics for Manufacturing Innovation Institute

Office of the Deputy Assistant Secretary of Defense
Manufacturing and Industrial Base Policy

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June 15, 2017

Manufacturing USA Program Significance

- Recognized objective: Shore-up the domestic industrial base's:
  - Advanced manufacturing innovative capacity/capability
  - Global competitiveness
- Provides key, direct benefits for *defense* industrial base and DoD's mission
- Whole-of-government response: Manufacturing USA Program
  - Administration-led, 5+ year endeavor with bi-partisan Legislative Branch support
  - 14 -15 institutes programmed; 14 established or announced
  - Nearly $700 million in programmed federal investment, $1.4 billion in committed industry cost share for the established DoD institutes
  - Network of institutes taking shape, momentum is building—more than 1,300 industry/academic and other members.
  - Almost every state is represented.
- USG and DoD are *fully committed* to Manufacturing USA and its long-term success
- DoD's essential sub-focus: Long-term viability/success of the family of DoD-established institutes
- DoD must continue to ensure its enabling role(s) and responsibilities—which will change over time—are clearly *defined*, *understood* and *carried out*

Institute Technical Topic Selection Process

DoD Stakeholders

- The DoD stakeholders provide input for initial topic selection through suggestion for topics which meet their specific needs.
- JDMTP, Science and technology community through Science and technology deputies committee provide input.

Interagency stakeholders

- A government interagency team is formed for each topic area to assess and advice on all matters for that topic area.

Industry academics and other stakeholders

- After receiving the recommendations the DOD ManTech team conducts due diligence through as a joint service effort.
- Stake holders are involved through the Request for Information (RFI) process, work shops and interviews to assess a number of attributes which would satisfy conditions for a successful institute.

MIBP responsibility but whole of DoD and stakeholder approach

Topic selection – Key considerations

Defense Relevance

- Technical area must address key defense manufacturing needs.

Manufacturing Ecosystem

- Whether there is an adequate manufacturing ecosystem to work towards bridging the gap between basic research and product development.
- Whether the available manufacturing ecosystem would benefit from an Institute level of effort by a public private partnership addressing precompetitive challenges.

Industry and other stakeholders

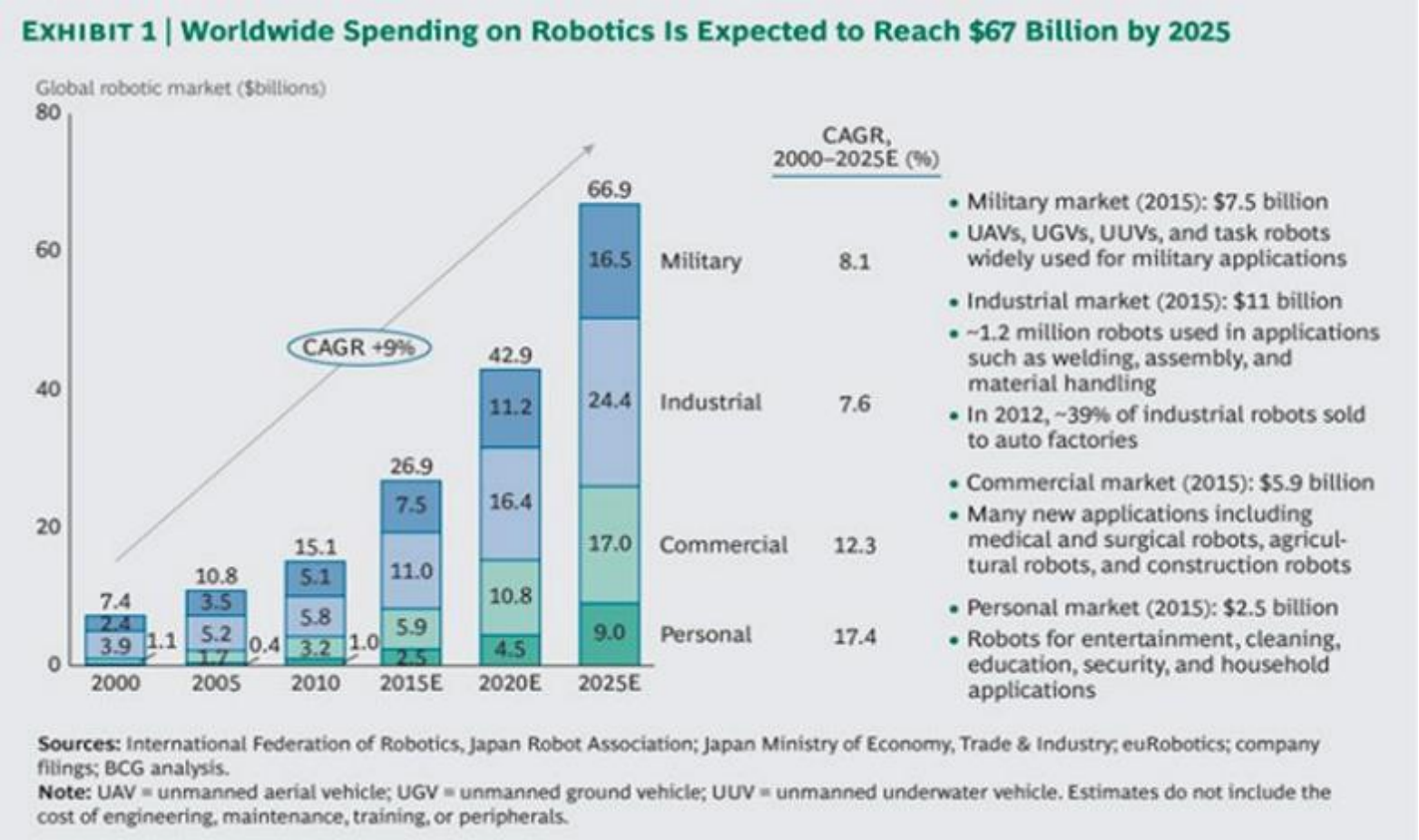
- Industry leaders would be willing to actively engage in a government industry partnership, including cost sharing and working to create a highly collaborative, dynamic environment that spurs manufacturing technology innovation and technology transfer to meet these challenges.

Create critical infrastructure:

- Whether there is evidence that success in meeting these challenges could create the critical infrastructure necessary to provide sustainable domestic production scale up and commercialization.

The topic should positively impact the manufacturing ecosystem

Why Robots in Manufacturing Environments



Industrial robotics has an explosive growth (49%) compared to the wider robotic industry

Why Robots in Manufacturing Environments

- The U.S. currently leads in such areas as robot navigation in outdoor environments, robot architectures (the integration of control, structure and computation), and in applications to space, defense, underwater systems and some aspects of service and personal robots.
- Japan and Korea lead in technology for robot mobility, humanoid robots, and some aspects of service and personal robots (including entertainment).
- Europe leads in mobility for structured environments, including urban transportation. Europe also has significant programs in eldercare and home service robotics.
- Australia leads in commercial applications of field robotics, particularly in such areas as cargo handling and mining, as well as in the theory and application of localization and navigation

Institute would help the robotic ecosystem to preserve US lead and help us compete better in the manufacturing context

Why Robots in Manufacturing Environments Notable quote from a RFI respondents

"Service robots are the next great industrial tool; a tool that won't eliminate people from work, rather they will amplify our capabilities; allowing us to safely operate at rates never seen, in places we could never go, and with cognitive and physical capabilities we could never imagine."

"Product assembly remains as the last frontier to benefit from process automation with many companies assembling their products in low labor wage countries due to the complexity required and lack of automated systems to grasp and manipulate unique parts. Overcoming these challenges will bring back many manufacturers to assemble their products in the United States."

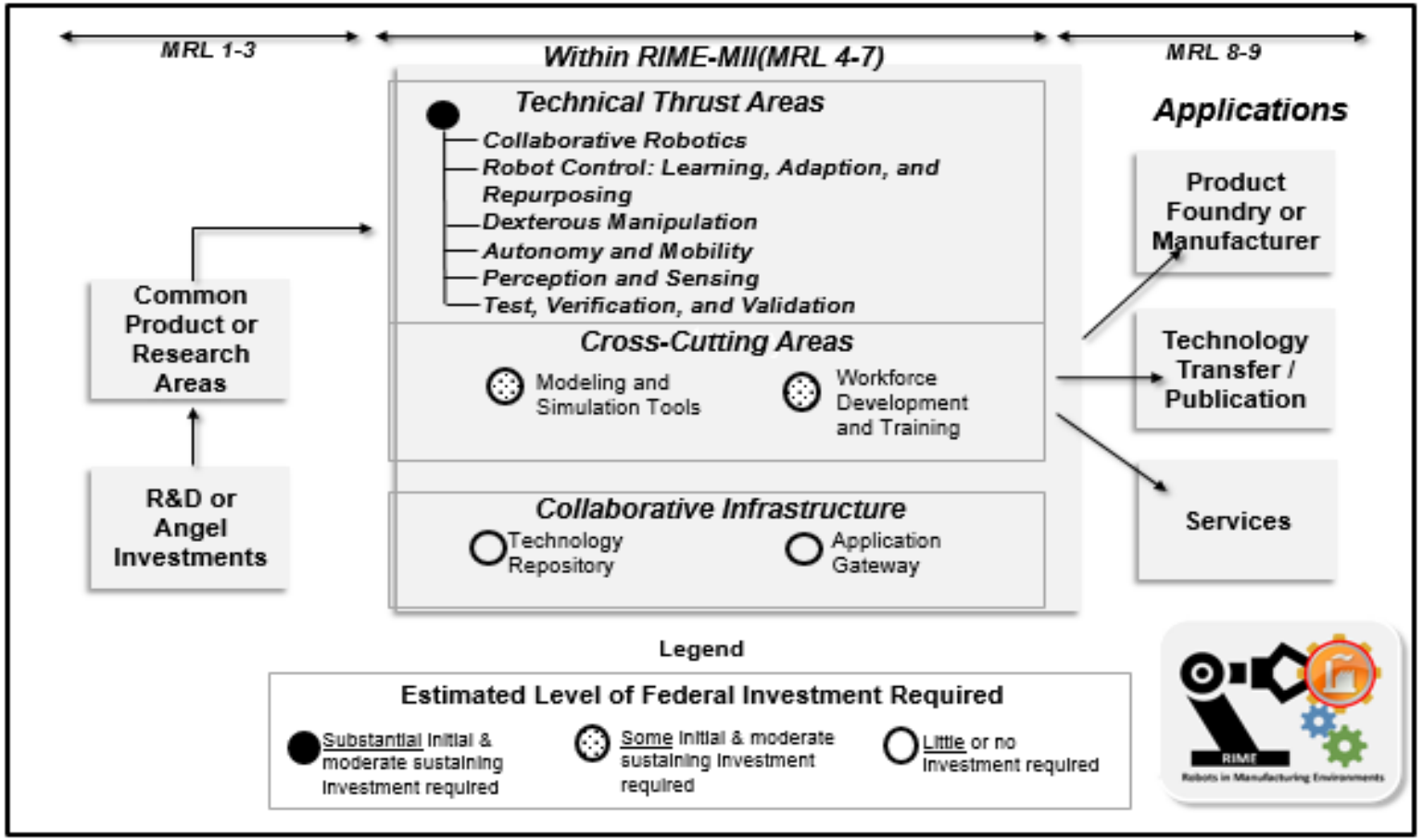
Institute would help the robotic ecosystem to help US industries to compete domestically and internationally

Why Robots in Manufacturing Environments: Other Roadmaps – NASA 2015 to 2035

4.0 Robotics and Autonomous Systems	Goals:	Extend our reach into space, expand our planetary access capability and our ability to manipulate assets and resources, prepare planetary bodies for human arrival, support our crews in their space operations, support the assets they leave behind, and enhance the efficacy of our operations.
4.1 Sensing and Perception	Sub-Goals:	Provide situational awareness for exploration robots, human-assistive robots, and autonomous spacecraft; and improve drones and piloted aircraft.
4.2 Mobility	Sub-Goals:	Reach and operate at sites of scientific interest in extreme surface terrain or free-space environments.
4.3 Manipulation	Sub-Goals:	Increase manipulator dexterity and reactivity to external forces and conditions while reducing overall mass and launch volume and increasing power efficiency.
4.4 Human-System Interaction	Sub-Goals:	Enable a human to rapidly understand the state of the system under control and effectively direct its actions towards a new desired state.
4.5 System-Level Autonomy	Sub-Goals:	Enable extended-duration operations without human intervention to improve overall performance of human exploration, robotic missions, and aeronautics applications.
4.6 Autonomous Rendezvous and Docking	Sub-Goals:	Provide a robust and safe autonomous rendezvous and docking capability for human and robotic systems.
4.7 Systems Engineering	Sub-Goals:	Provides a framework for understanding and coordinating the complex interactions of robotic systems and achieving the desired system requirements.

Align with other roadmaps

RIME functional Ecosystem concept



Concept developed for maximum impact

RIME functional range of operations

	TRL 1:	Basic principles observed and reported	MRL 1:	Manufacturing feasibility assessed
	TRL 2:	Technology concept and/or application formulated	MRL 2:	Manufacturing concepts defined
	TRL 3:	Analytical and experimental critical function and/or characteristic proof of concept	MRL 3:	Manufacturing concepts developed
NNMI Target	TRL 4:	Component and/or breadboard validation in a laboratory environment	MRL 4:	Capability to produce the technology in a laboratory environment
NNMI Target	TRL 5:	Component or breadboard validation in a relevant environment	MRL 5:	Capability to produce prototype components in a production relevant environment
NNMI Target	TRL 6:	System/subsystem model or prototype demonstration in a relevant environment	MRL 6:	Capability to produce prototype system or subsystem in a production relevant environment
NNMI Target	TRL 7:	System prototype demonstration in an operational environment	MRL 7:	Capability to produce systems, subsystems or components in a production relevant environment
	TRL 8:	Actual system completed and qualified through test and demonstrated	MRL 8:	Pilot line capability demonstrated; Ready to begin Low Rate Initial Production
	TRL 9:	Actual system proven through successful mission operations	MRL 9:	Low rate production demonstrated; Capability in place to begin Full Rate Production

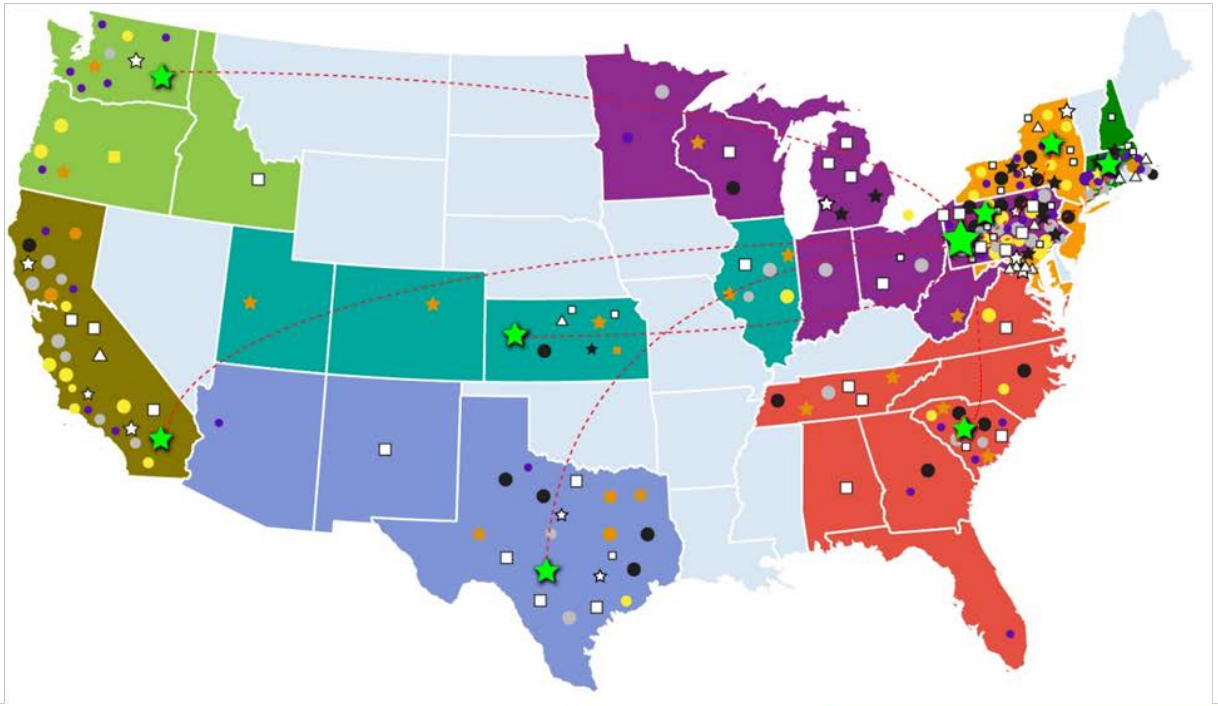
Scope of operations

Transform U.S. manufacturing through innovations and education in robotics and related automation technologies

ARM's Mission

- Assert U.S. leadership in advanced manufacturing
- Lower the technical, operational, and economic barriers for companies to adopt robotics technologies
- Empower American workers to be cost-competitive with low-wage workers abroad

ARM Innovation Ecosystem



ARM Headquarters

Regional Robotics Innovation Collaborative (RRIC) Leaders

PLATINUM GOLD SILVER BRONZE START-UP UNIVERSITY EDUCATIONAL PARTNERS

MEMBERSHIP COMMITMENT

INDUSTRY

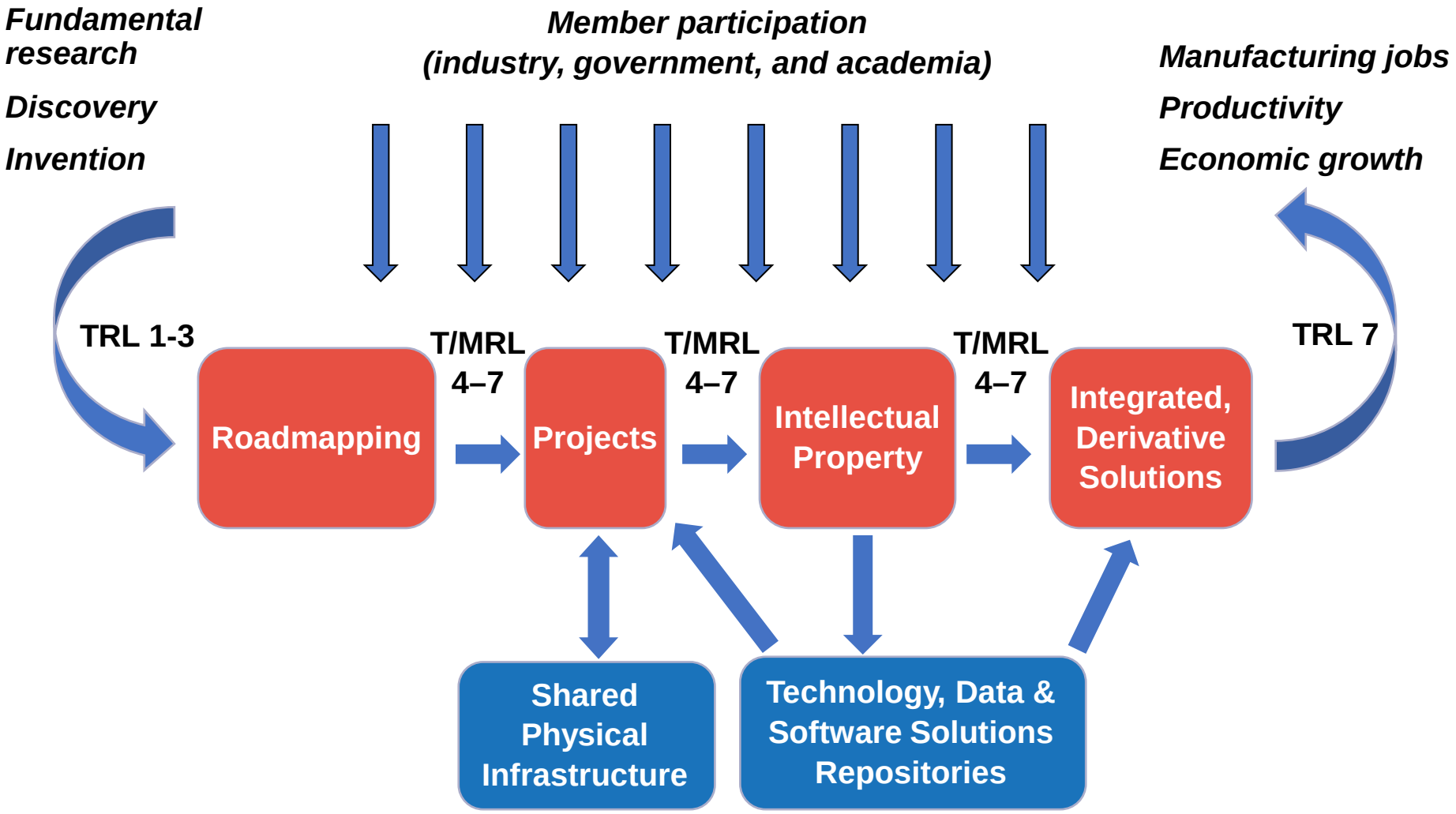
UNIVERSITY

GOVERNMENT

NONPROFIT/COMMUNITY COLLEGES/ MEP/OTHER

ARM Institute Partners

How ARM Works



TRL = “Technology Readiness Level”

MRL = “Manufacturing Readiness Level”

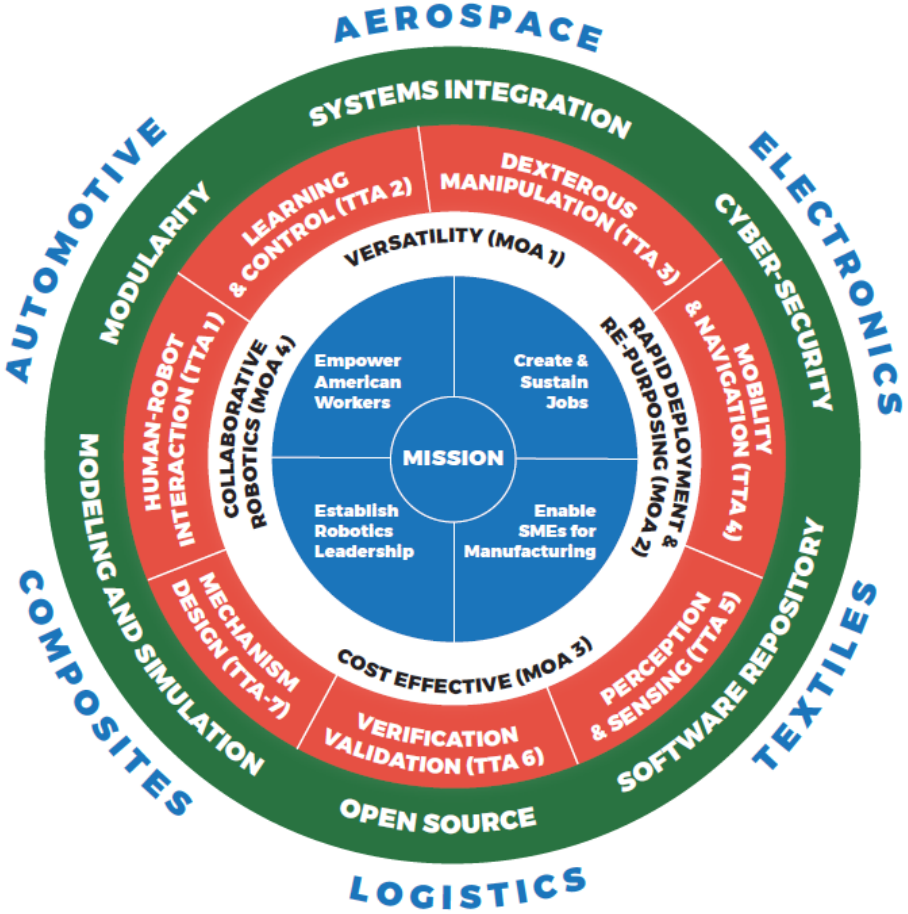
ARM Technology Scope

Key Applications

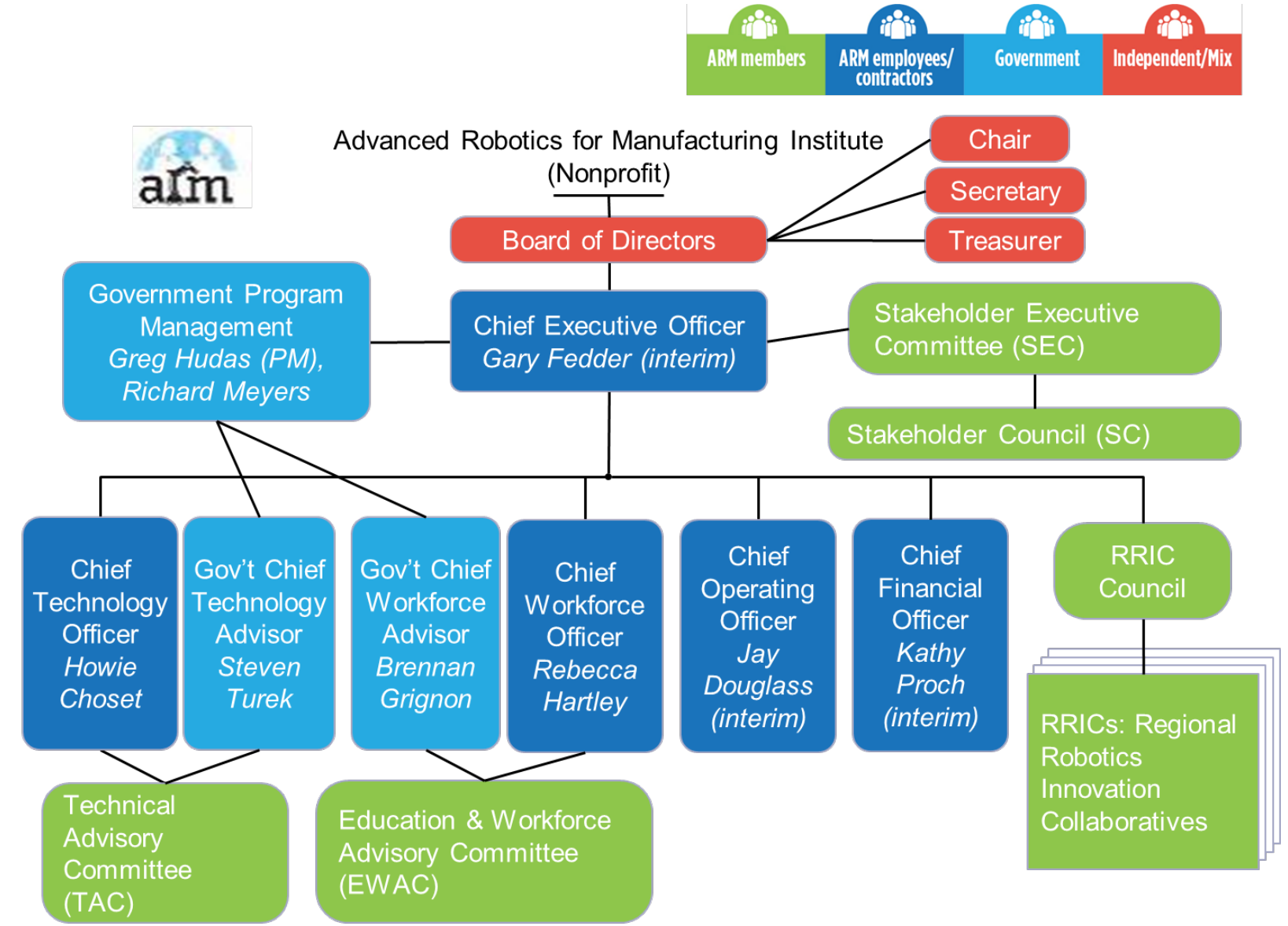
Cross-Cutting Themes

TTA = Technology Thrust Areas

MOA = Manufacturing Operational Aims



ARM Organizational Chart



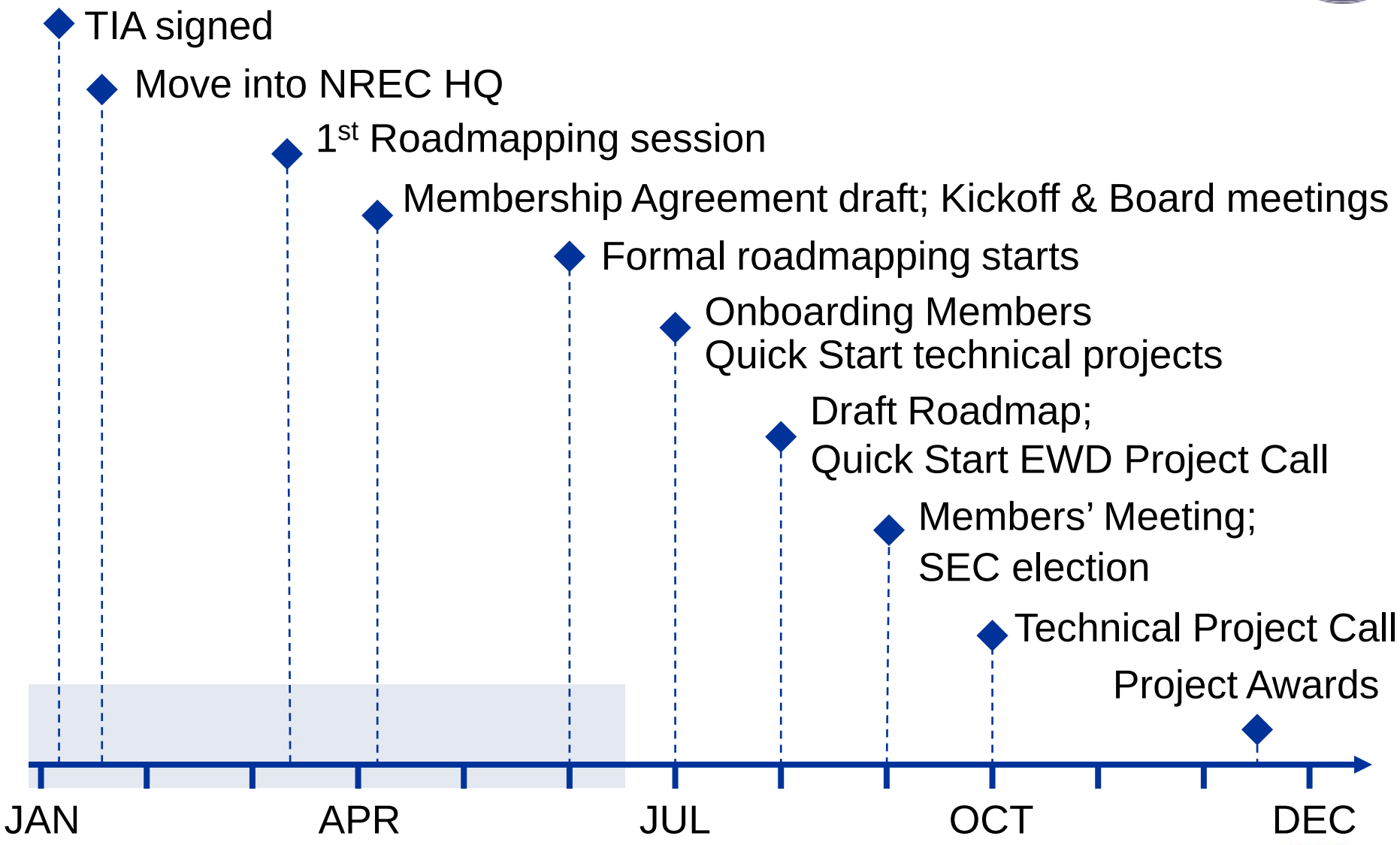
Regional Robotics Innovation Collaboratives (RRICs)

- A collaborative collection of ARM members (companies, universities, nonprofits, and governmental organizations) that associate with a specific region of the country
- RRIC “co-leads”: individuals who serve as liaisons to augment the value of ARM to their region.
- RRICs do *not* create a hierarchy within the Institute
  - A member has full rights within the ARM Institute to participate and enjoy the benefits of their membership tier, regardless of their association with one or more RRICs

Purpose of the RRICs

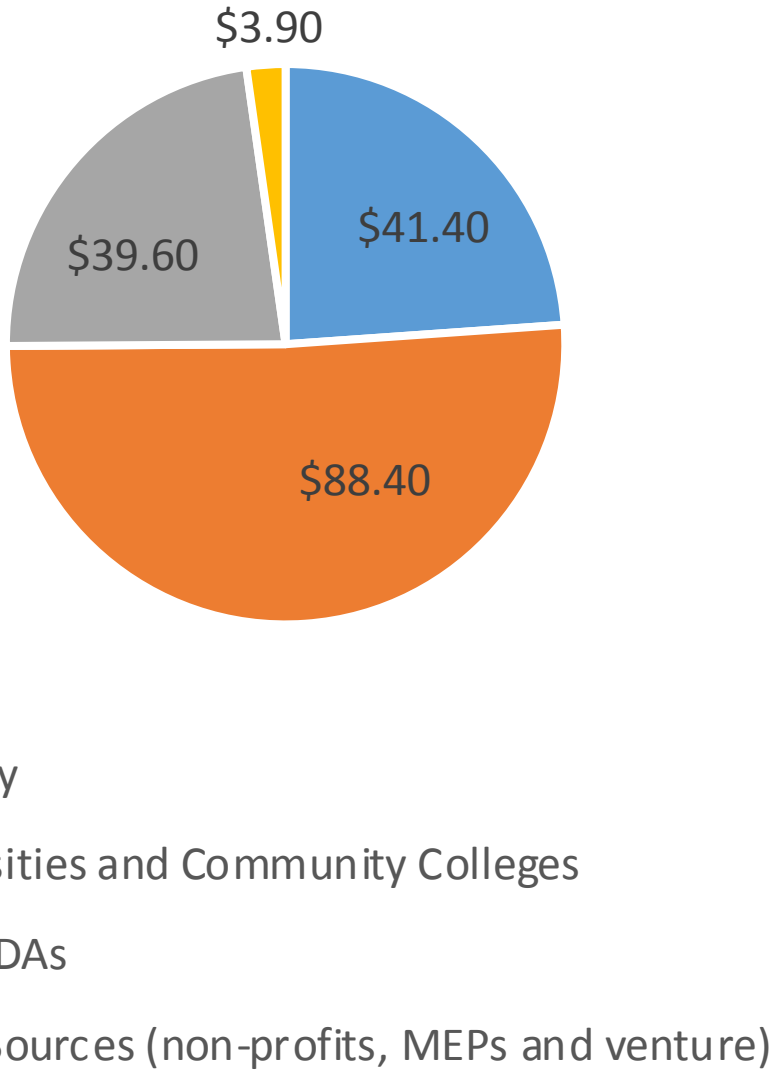
- As the regional partnerships within ARM, RRICs create a scalable national reach for the ARM Institute
- RRICs support the ARM Institute mission by:
  - Facilitating regional networking
  - Leveraging existing shared physical infrastructure and resources
  - Engaging in education and workforce development
  - Connecting to state government
  - Championing the ARM Institute's mission
- The RRIC strategy is currently evolving; more detail will be provided over the summer

Timeline


TIA signed
Move into NREC HQ
1st Roadmapping session
Membership Agreement draft; Kickoff & Board meetings
Formal roadmapping starts
Onboarding Members
Quick Start technical projects
Draft Roadmap;
Quick Start EWD Project Call
Members' Meeting;
SEC election
Technical Project Call
Project Awards
JAN
APR
JUL
OCT
DEC

Projected Cost Share Plan – Composition

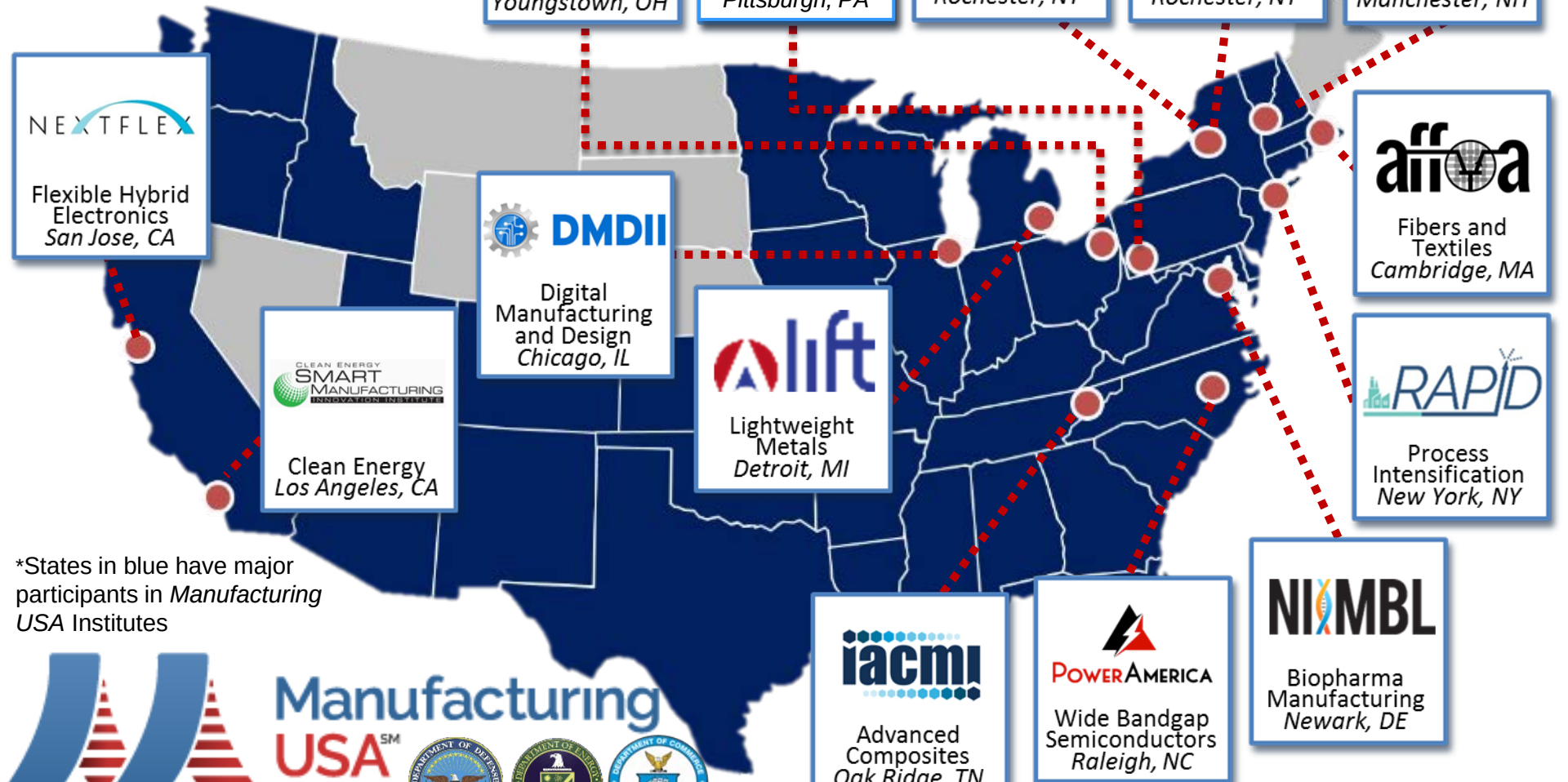
- 164 commitments
- $173M total cost share
- $11.2M cash
- $162M “in kind”



Manufacturing USA

Since launching in 2012:

- $700M+ Fed funding matched by $1.4B+ non-Fed funding
- 1,300+ companies, universities, and non-profits involved
- 40+ states participating



America Makes
Additive Manufacturing
Youngstown, OH

aim
Robotics for Manufacturing
Pittsburgh, PA

AIM photonics
Integrated Photonics
Rochester, NY

Recycling Materials
Rochester, NY

ADVANCED TISSUE BIOFABRICATION
Tissue Biofabrication
Manchester, NH

NEXTFLEX
Flexible Hybrid Electronics
San Jose, CA

DMDII
Digital Manufacturing and Design
Chicago, IL

CLEAN ENERGY SMART MANUFACTURING INNOVATION INSTITUTE
Clean Energy
Los Angeles, CA

lift
Lightweight Metals
Detroit, MI

fiber
Fibers and Textiles
Cambridge, MA

RAPID
Process Intensification
New York, NY

iacmi
Advanced Composites
Oak Ridge, TN

PowerAmerica
Wide Bandgap Semiconductors
Raleigh, NC

NIMBL
Biopharma Manufacturing
Newark, DE

*States in blue have major participants in *Manufacturing USA* Institutes

Manufacturing USA℠

https://www.manufacturing.gov/

Member Value Proposition

- Network with broad membership from industry, academia and government
- Influence roadmapping for robotics in manufacturing environments
- Scale-up of existing manufacturing operations while reducing risk
- Lead and participate in project proposals
- Access to Consortium-Developed Intellectual Property
- Access to Institute expertise
- Access to shared R&D infrastructure
- Access to trained workforce and opportunities for periodic training

Participation in Projects

- Participating in technical project proposal teams (all tiers except educational partners)
- Leading technical project proposal teams (Pt, Au, Core)
- Participating in EWD project proposal teams
- Leading EWD project proposal teams (Pt, Au, Non-Profits)
- Contributing at least 1:1 cost share relative to U.S. Government funding to the Member as a sub-award on Consortium projects
- Contributing Consortium Developed IP when part of a team performing Consortium Activities
- Proprietary projects with the ARM Institute, when appropriate, leveraging the CDIP repository and ARM Institute technical expertise

Participation in Governance

- Nominating candidates for the Stakeholder Executive Committee (“SEC”) (Pt, Au, Core, Gov’t)
- Voting for SEC candidates
  (voting weighted according to tier)
- Nominating candidates for the Technical Advisory Council (“TAC”) (Pt, Au, Core, Gov’t)
- Nominating candidates for Education and Workforce Development Advisory Council (“EWAC”)
  (Pt, Au, Ag, Non-Profits, Gov’t)
- Voting for co-leads for their RRIC(s), if affiliated with one or more RRICs
- Providing input and feedback to tier representatives on the SEC, TAC, and EWAC

Participation in Meetings

- Project Review and Member Meetings
- Stakeholder Committee meetings
- Platinum Stakeholder Committee (Pt)
- Technical Exchange Meetings
- Technical Roadmapping Workshops (Pt, Au, Core, Gov’t)
- Education and Workforce Development Roadmapping Workshops (Pt, Au, Non-profit, Gov’t)
- RRIC events

Other Participatory Benefits

- Access to Roadmaps
- Access to Technology, Data, and Software Solutions Repositories
- Access to shared infrastructure
- Ability to embed an employee at the Institute HQ (Pt)
- Assign free membership for one SME supplier to Bronze tier or one community college to Educational Partner tier (Pt)

Membership Program Status

- Membership agreement will be finalized in June 2017
- Member outreach has begin in June 2017
- First membership meeting will be held in late September/early October 2017
- To become a member please contact Jay Douglass, COO, ARM Institute at jay.douglass@arminstitute.org.

Visit us at: www.arminstitute.org

Government Contacts

- Dr. Greg Hudas PM

  gregory.r.hudas.civ@mail.mil

- Rick Meyers, Dy. PM

  richard.meyers.3@us.af.mil

- Steve Turek CTA

  steven.turek.1@us.af.mil

Thank You

Questions??

ARM Membership – Benefits and Responsibilities

ARM–A Cooperative Institute with National Reach

The ARM Institute as a whole is greater than the sum of its parts

- Through Institute projects, a base of Consortium-Developed Intellectual Property (CDIP) and know-how will grow
- ARM will have a central repository for CDIP and know-how
    - Technical CDIP and
    - Education & Workforce Development CDIP
- ARM will provide services to provide integrated solutions to members, drawing from the growing foundation of CDIP and know-how
- Dissemination of the methodologies, knowledge, and services to the RRIC-served regions, particularly to SMEs and in workforce training, will achieve national reach of ARM's advances

Membership Agreement

ARM HQ is responsible for onboarding of all members to the Institute and for handling membership dues and financial and technical reporting

ARM members can be affiliated with one or more RRICs according to their membership or, if they choose, not be affiliated at all

Membership Level

- ☐ Platinum (pick up to three affiliated RRICs)
- ☐ Gold (pick up to two affiliated RRICs)
- ☐ Silver
- ☐ Bronze
- ☑ Startup
- ☐ Non-Profit/Univ. Core
- ☐ Non-Profit/Univ. Supporting
- ☐ Educational Partner

RRIC Affiliation(s):

- ☐ Central
- ☐ Midatlantic
- ☐ Midwest
- ☑ Northeast
- ☐ Northwest
- ☐ South Central
- ☐ Southeast
- ☐ West

Unless noted above, pick up to one affiliated RRIC

Membership Information at a Glance

	Membership Level	Annual Dues		R&D Projects	CDIP**
		Cash	In-Kind*		
Industry	**Platinum Member**	$100K	$250K	Lead and participate	50% off C-NERB
Industry	**Gold Member**	$50K	$100K	Lead and participate	C-NERB
Industry	**Silver Member**	$25K	NA	Participate	C-NERB
Industry	**Bronze Member** (< 500 employees)	$5K	$10K	Participate	C-NERB
Industry	**Startup** (pre-revenue; < 15 employees)	-	$2.5K	Participate	C-NERB
Universities & Non-Profit	**Core Member**	$15K	$200K	Lead and participate	N/A
Universities & Non-Profit	**Supporting Member**	$5K	$15K	Participate	N/A
Universities & Non-Profit	**Educational Partner**	-	$15K	Access to Workforce & STEM programs	N/A

***** Commitment must qualify as Cost Share for purposes of meeting Cost Share obligations under the Technology Investment Agreement; In-kind Cost Share on shared consortium projects counts toward the in-kind portion of the membership fee

** CDIP = Consortium Developed Intellectual Property: IP created within a Institute Project funded in part by the Technology Investment Agreement funds and owned by the inventing organizations;

All members are granted NERF for internal purposes, except educational partners granted NERF for internal educational/workforce purposes.

C-NERF = Commercial (external-use) Non-Exclusive Royalty-Free license;

C-NERB = Commercial Non-Exclusive Royalty-Bearing license negotiated with IP owners

Cost Share

Reasonable, allowable, and verifiable
labor, travel, materials, equipment charges
as a meaningful and necessary part of ARM programs
and met with approval by the Government
(DODGARs 32 CFR §37.530)

Cost share is important!

For you: It counts toward your membership dues

For ARM: It counts toward the commitment to the federal government award

Visit us at: www.arminstitute.org