



DoD Wide Cold Spray Technology Roadmap

24 June 2020

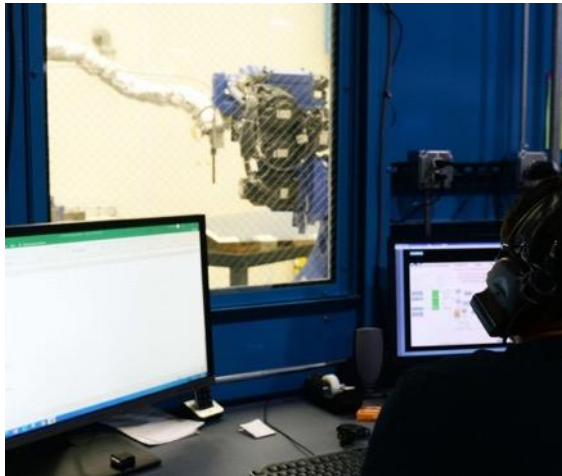


Commissioned by the
Office of the Secretary of Defense
Manufacturing Technology Program



AGENDA

- **Background and Purpose**
- **Approach**
- **Findings**
- **Conclusions and Recommendations**



All images this slide from www.dvidshub.net



Roadmap Project Team



Driven by



**THE BARNES GROUP
ADVISORS**



BACKGROUND AND PURPOSE

Background

- DoD and partners have developed and implemented Cold Spray technology for more than 15 years
- Cold Spray technology improves operational readiness and sustainment
- Awareness, communication, and knowledge sharing across the DoD is based on ad-hoc relationships

Purpose - Develop a DoD Wide Cold Spray Technology Roadmap to...

- Understand current state activities and drive awareness
- Identify common needs
- Project future state activities
- Prioritize collaboration areas

Why a DoD Wide Cold Spray Technology Roadmap?

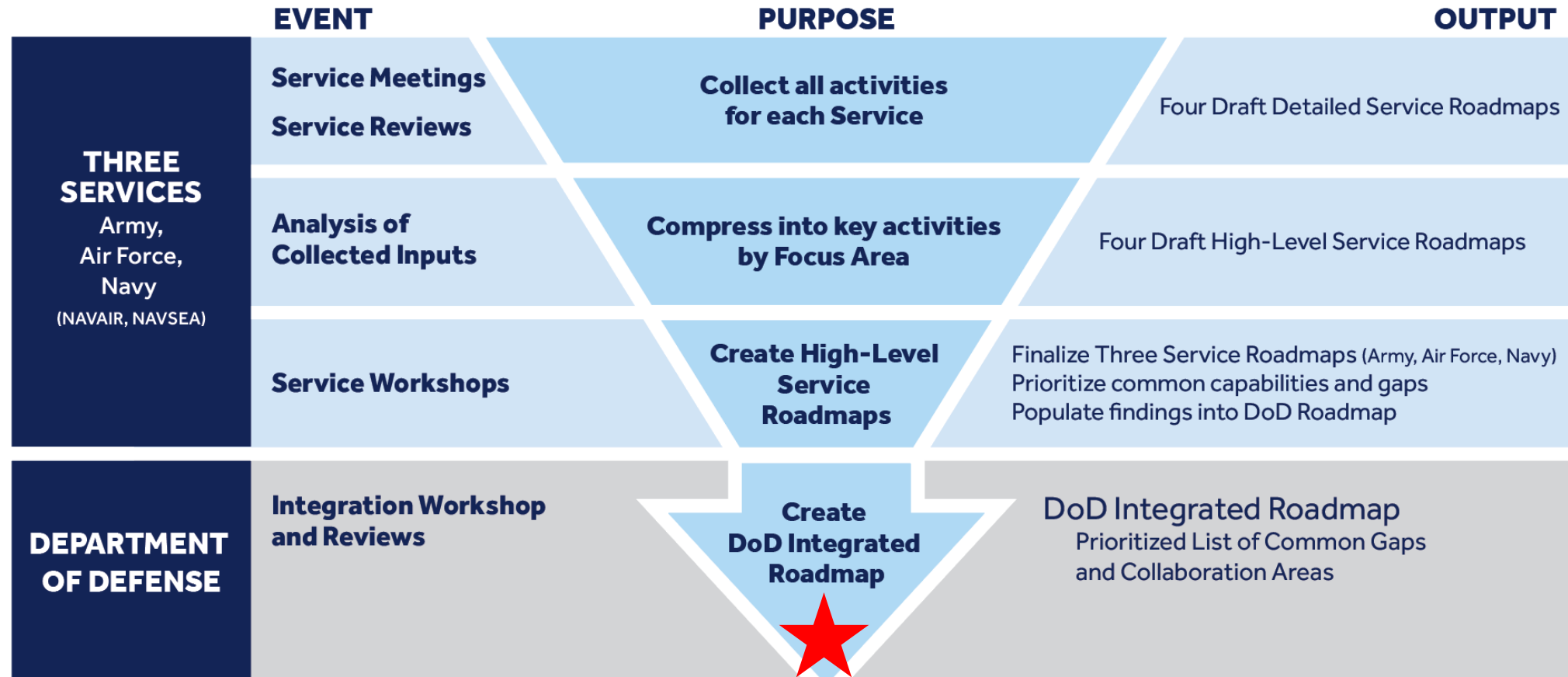
- Enhance current activities and accelerate adoption
- Avoid duplication of efforts



All images this slide from www.davidshub.net



APPROACH



**Guiding future investments in Cold Spray technology
aligning to OSD ManTech Priorities**



APPROACH

Participants provided input during telecons, meetings and workshops

R&D Organizations

Army Research Laboratory, Office of Naval Research,
Air Force Research Laboratory

Central and Program Engineering Organizations

Program Engineering Offices, NAVAIR, NAVSEA, System Support

Sustainment Organizations

Depots, Fleet Readiness Centers, Shipyards,
Aviation Logistics Centers, Metals Technology Office

Service Leads

Identified Service participants, coordinated meetings and workshops, and reviewed roadmaps and reports



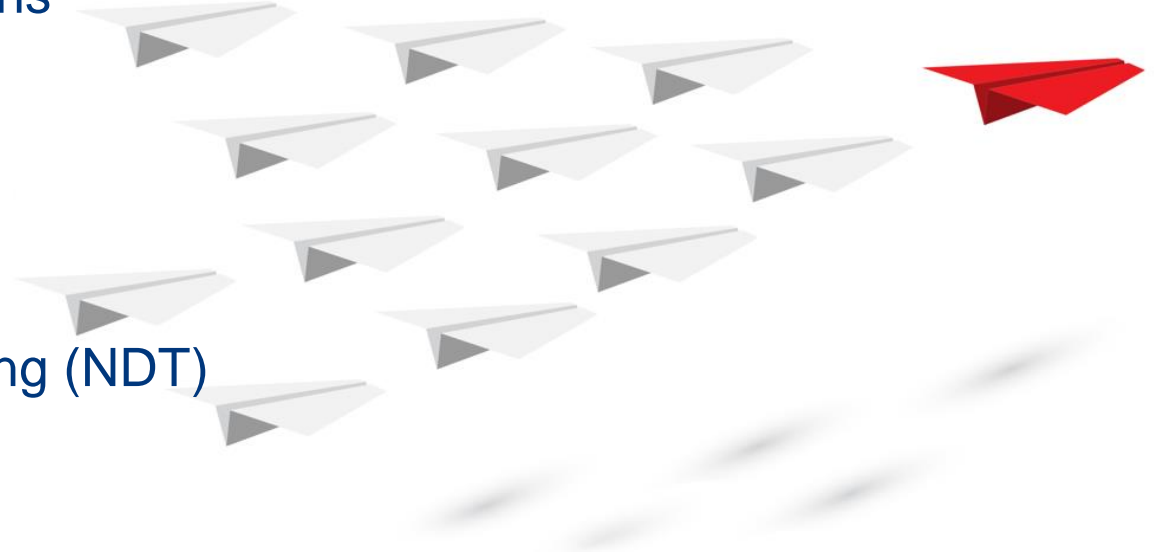
All images this slide: NCDMM



FINDINGS

Common Across Three Roadmap Levels

1. **Non-Structural Repair** (Aluminum and Magnesium; Carbon Steel; Other Alloy)
2. **Capability Stand-Up** (Powder Supply Chain; Facility/Engineer/Technician Training; Facility Support)
3. **Non-Booth Cold Spray**
4. **Engineering for Non-Structural Applications**
5. **Enhanced Cold Spray**
6. **Engineering for Structural Applications**
7. **Corrosion, Wear, and Specialty Coatings**
8. **Environmental and Safety**
9. **Structural Repair / Non-Destructive Testing (NDT)**
10. **Part Manufacture**
11. **Unique Materials and Parts**



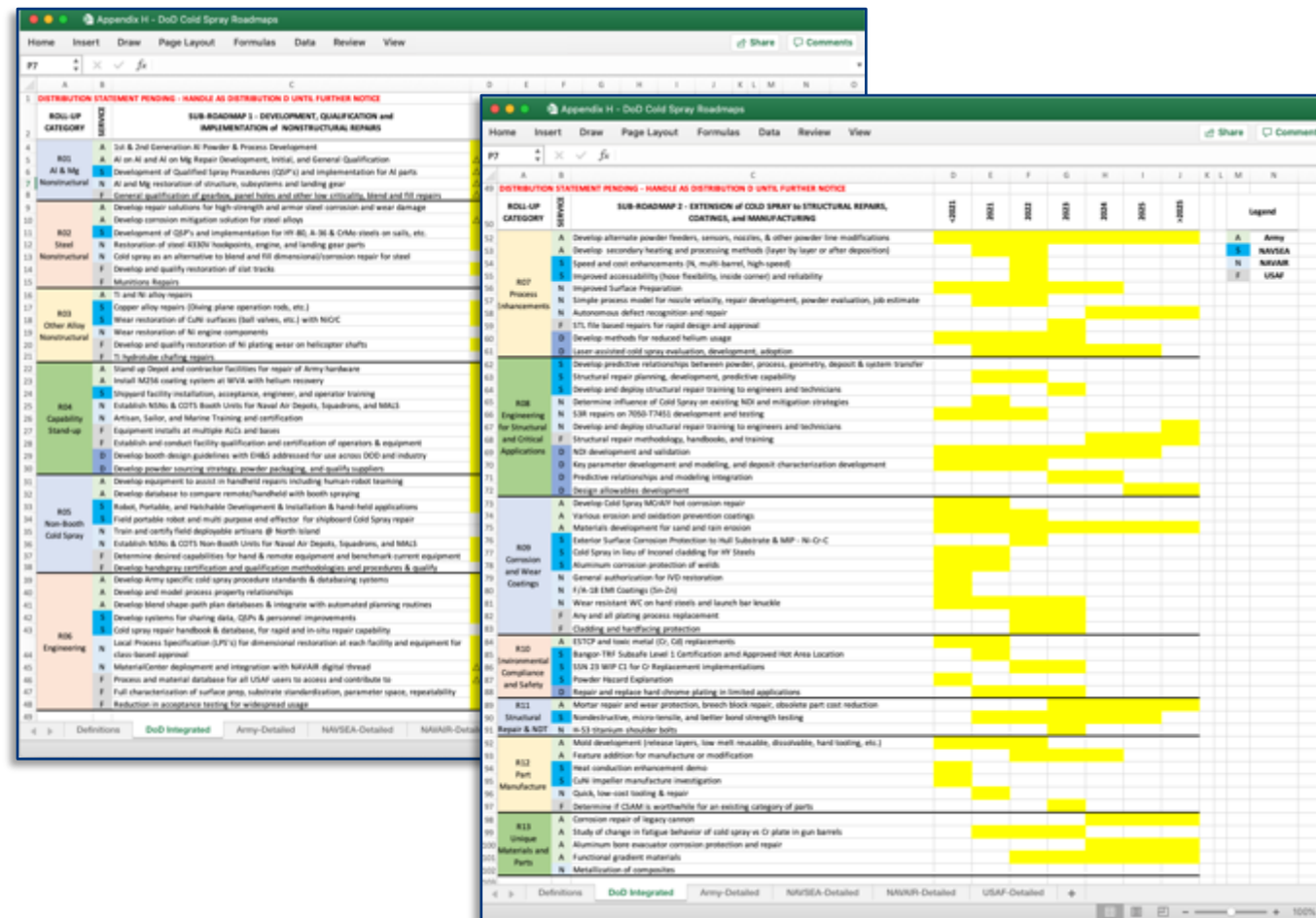


FINDINGS

DoD Integrated Roadmap

- Qualification and Implementation of Nonstructural Repairs
- Extension of Cold Spray to Structural Repairs, Coatings, and Manufacturing

Roadmaps of varying detail levels have been developed.





DoD Wide Cold Spray Technology Roadmap

Guiding Future Investment



Gap		Recommendation			
Name	Description	Priority	Benefits	ROM (\$M)	Anticipated Period of Performance
A DOD-wide culture of collaboration and data sharing to drive Cold Spray adoption (W01)	Activity to encourage (possibly incentivize) collaboration across DoD including enhanced communication, technical exchanges, joint-service roadmapping and technical committees, working groups, etc. and IT support for data sharing.	Establish a Cold Spray Integration Working Group (CSIWG)	Harmonize activities, improve communication and drive collaboration between services	<\$1M per year	ONGOING
Common Database Approach and Taxonomy for Data (103)	Property (physical, mechanical, metallurgical, corrosion) dataset covering coupons to parts and taxonomy, to support structural and non-structural repairs Fixturing, QSP, unique solutions, lessons learned	Database and Taxonomy Short-term project	Ensure coordination and cross-pollination of knowledge for efficient expansion of Cold Spray	<\$1M	12 months
Safety Planning and Approval Data (102)	Data package to support facility safety planning and approvals	Safety Short-term project	Ensure ability of services to use Cold Spray when and where needed	<\$1M	18 months
Training and Certification Standards (101)	Standards and certifications for engineer and technician training	Training Short-term project (launch)		\$1-10M	Phase 1: 6 months
		Training Long term project (continued)			Phase 2: 18 months
Evolving Cold Spray Supply Chain (119)	Development of robust supply chain. DoD or Industry Controlled equipment and powder specifications that are insensitive to supply chain changes.	Supply Chain Short-term project (launch)		\$1-10M	Phase 1: 6 months
		Supply Chain Long term project (continued)			Phase 2: 30 months
Nondestructive Testing and Quality Assurance (110)	Demonstrated & validated NDT methods for validating quality of deposit, bondline, and integrity of substrate Common requirements/specifications/procedures for when and what nondestructive evaluation method to use	NDT / QA Long term project	Accelerate and align qualification efforts Broaden the application of Cold Spray beyond dimensional restoration	>\$10M	18 months
Material, Process, Property Relationships (115)	Understanding and agreement of the relative impact that feedstock, substrate, equipment, spray, geometry, and post-processing parameters have on deposit density, adhesion, corrosion, and mechanical properties such that a repair can be developed, qualified, locked down, and controlled over an extended period of time.	ICME long term project		>\$10M	Phase 1: 24 months
Identified and Agreed List of Critical Process Parameters (114)	Quantitative understanding of the relationships between feedstock, substrate, equipment, spray, geometry, and post-processing parameters and deposit/substrate density, adhesion, corrosion, residual stress, and mechanical properties such that the properties of the repair or manufacture of a part can be predicted with a level of confidence to enable the repair/part to carry loads.				Phase 2: 24 months
					Phase 3: 36 months



CONCLUSIONS AND RECOMMENDATIONS

COLD SPRAY INTEGRATION WORKING GROUP (CSIWG)

- a. Create communication and information sharing channels to drive a collaborative culture across the DoD
- b. Establish programs across Services to harmonize activities
- c. Develop and maintain a current, living web-based roadmap

SHORT-TERM PROJECTS

- a. Database/Taxonomy
- b. Safety
- c. Training
- d. Supply Chain

LONG-TERM PROJECTS

- a. Training curricula
- b. Supply chain maturation
- c. NDT & QA development
- d. Integrated Computational Materials Engineering (ICME)

