Pathfinding Innovation for Legacy Munitions

Panel #13 : From Demo to Deterrence: Accelerating Surge Capacity and Fleet Integration

ACQUISITION AND SUSTAINMENT

DOCUMENT RESTRICTIONS

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Research Issue

Problem:

- A range of challenges impede implementing advanced manufacturing in legacy munitions.
  - Many legacy munitions are manufactured using production processes that predate proven commercial approaches

Objective:

The Joint Production Accelerator Cell (JPAC) seeks to identify how advanced manufacturing approaches could be applied to increase the producibility of legacy munitions and adjacent systems. The benefits of transitioning to new production processes include:

- Applying newer processes could enable surging production of major weapons systems
- Newer commercial approaches have the potential to improve the cost-effectiveness and efficiency of munitions production.

Scope and Definitions:

- Legacy munitions refers to munitions that are currently in production and have already been deployed.
- Advanced manufacturing encompasses the innovation of improved methods for manufacturing existing products, such as components and parts. It also includes the production of new products enabled by advanced technologies.
- Advanced manufacturing approaches include:
  - Robotic technologies
  - Digital engineering
  - Sensing
  - Advanced materials
- The present focus on ramping up production provides the government and industry with a reason to consider new solutions to pressing problems.

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Research Methodology

The Approach: To study how and when advanced manufacturing approaches can be efficiently applied to improve production capacity for the legacy munitions enterprise, JPAC conducted 18 interviews with researcher and experts. The guided conversation questions are as follows:

- What advanced manufacturing approaches or commercial technologies are currently being applied to enhance the producibility of legacy munitions?
- What advanced manufacturing approaches or commercial technologies are relevant and mature, but not yet applied to legacy munitions?
- Why are advanced manufacturing approaches not more widely used in the DoD? What could be done to change that?
- What challenges are industrial partners that employ advanced manufacturing approaches facing when working with DoD or legacy munitions?
- What are the limitations for advanced manufacturing approaches in terms of producibility?
    - Is there a need for more testing to mature the technologies?
    - Are the advanced manufacturing approaches difficult to qualify?
    - Is cost a limiting factor?
    - Is there a need to incorporate advanced manufacturing approaches early to avoid the need to modify processes or designs? Is this causing problems with producibility or manufacturing?

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Issues and Obstacles

- Producer Financial Incentives
  - **Demand Signal and Boom and Bust** – Industry lacks robust forecasting or assurances that there will be demand
  - **Limits of Incremental Adoption** – Funding is needed to upgrade infrastructure, implement digital foundations, establish networking, and implement new supply chains
  - **Narrow Time Windows for Economical Adoption** - Advanced manufacturing is easiest to implement when manufacturers commit to it earlier, it is difficult to make the business case later
  - **Barriers to Competition** – It is difficult to bundle contract orders and incentivize becoming a DoW provider
  - **Intellectual Property and Business Models** - Cooperation is not incentivized because companies have proprietary designs
- Departmental Process and Regulations
  - **Qualification and Testing Challenges** – New approaches require qualification, which is expensive and takes time.
  - **Data Challenges** - DoW will often not accept testing data from industry
  - **Safety Concerns** – Advanced manufacturing approaches could provide unknown safety risks and challenge current safety standards
  - **Contract, Requirement, and Design Inertia** – It is difficult to update contracts to allow for new processes or techniques. Engineering change requests take more time than implementing the change.
  - **Appropriations Process** - Funding is subject to strict color of money requirements and advanced manufacturing has high upfront costs and distributed benefits across the government
- Culture
  - **Resistance to Change** – DoW and industry need to be willing to take
  - **The First Mover Disadvantage for Programs** – There is reluctance to disrupt processes to experiment with new technologies
  - **Workforce Requirements and Concerns** – Advanced manufacturing can compound labor shortages by requiring manufacturers with specialized knowledge

Mature Advanced Manufacturing Processes Showing Promise for Legacy Munitions

Type of Advanced Manufacturing	Facility / Location	Government Organizers	Details
Automation	Troy, AL	ARM Institute	Robotic sanding and finishing solution
	Wharton, NJ	US Army DEVCOM AC	Container for handling energetics, robot code, and a supervisory system controller
	Wharton, NJ	US Army DEVCOM AC and ARM Institute	Robot scoops and weighs powder
	Marion, IL, Hampton, AR, and Coachella, CA	DPAP	Robotic stations for production line
	Lincoln, NE	DPAP	Nondestructive inspection of SRM nozzles.
	Wharton, NJ	Army ManTech	Slurry loading
	Camden, AR, Orange, VA, and Huntsville, AL	DPAP	Robots move SRM cases and components
	Xenia, OH	DPAP	Producing SRM cases using additive manufacturing
Digital Engineering and Sensing	Wharton, NJ	MxD and US Army DEVCOM AC	Machine-agnostic sensor kit that gathers data for analysis
	Wharton, NJ	US Army DEVCOM AC and MxD	Digital twin for melt-pour process
Advanced Materials	Detroit, MI	LIFT AMPP	Creating custom alloys and feedstocks for metals

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Potential Reforms and Best Practices

- Producer Financial Incentive Reforms and Best Practices
  - Create a steady demand signal
  - Invest in research lab efforts
  - Derisk and pilot applications
  - Encourage Manufacturing Innovation Institutes, Service Research Lab, and consortium collaboration
  - Use Other Transaction Authorities (OTAs), fixed price contracting, and multi-year contracting

- Departmental Process and Regulation Reforms and Best Practices
  - Share testing data
  - Change the qualification process
  - Accept manufacturer and supplier data
  - Accept sensor data and digital twins
  - Use OTAs to support prototyping, partnerships, and distributed contracting

- Culture and Workforce Constraint Reforms and Best Practices
  - Educate communities
  - Data driven decision-making
  - Training and Workforce Development

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Next Steps

- JPAC will apply lessons from this project to foster proactive failure analysis detection and mitigation.
- JPAC will leverage lessons learned from artificial intelligence to predict and address common production failure modes to better assess failures/defects during processing before they are discovered in the finished product during acceptance testing – saving time and money during production.
- The paper also suggests further opportunities for piloting or scaling the case studies above to better integrate advanced manufacturing into the defense industrial base in hopes of helping to build surge capability and produce legacy munitions faster.
- These potential pathways focus on automation technologies more broadly, digital engineering and sensing, reforming qualification for additive manufacturing, and flexible manufacturing.

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