Seven Key Scenarios Demonstrate AMCPR Strength

SCENARIO A: Veterans Health Administration (VHA) to the Rescue
Leveraging the VHA’s additive manufacturing capability to provide additively manufactured medical swabs when facing a national shortage

SCENARIO B: Community Crushes COVID-19
Convening and coordinating a broad community of designers, reviewers, and suppliers to manufacture a previously unreleased polymer facemask

SCENARIO C: Earthquakes Earn Enmity
Responding to infrastructure impact by rapidly supplying three couplings with approved designs to repair a potential water main break

SCENARIO D: Blackhawk Down
Addressing mission readiness for a downed UH-60 Blackhawk by additively manufacturing a fuel elbow component lacking an existing production supply chain

SCENARIO E: Gas Turbine Vane Inserts
Demonstrating rapid response to an unplanned shutdown of a key power plant by providing a critical vane insert required to bring the gas turbine back online

SCENARIO F: Tooling Takes Too Much Time
Producing a sand mold for a t-joint that would have been made using traditional manufacturing methods to decrease tooling time and increase supply chain flexibility

SCENARIO G: Taking a Shot at Shots (Syringes)
Responding to limited syringe availability. Due to stakeholder safety concerns, scenario was not completed, necessary steps to enable scenario execution were documented.
SCENARIO A: VHA to the Rescue!

PROBLEM
Medical Device Shortages

The Veteran’s Health Administration (VHA) operates the largest healthcare network in the world, providing care at 1,255 health care facilities and serving 9 million enrolled Veterans each year. The VHA has invested in the capability to additively manufacture personal protective equipment, medical devices, and other community and clinical needs components. During a medical crisis, self-sustaining, organizations like the VHA can demonstrate vital leadership in responding to widespread supply shortages.

SOLUTION
VHA Leverages In-House AM Capability

In this scenario, a selected VHA Innovation site (VHA Seattle) downloaded a single technical data package (TDP) for a 3D printable, clinically-reviewed swab. The VHA Seattle innovation site printed the part and shipped to the requesting VHA Clinic (VHA Cleveland). 3D Systems also served as a secondary source of supply for the requesting VHA clinic.

IMPACT
Meeting Medical Community Needs

This scenario demonstrated how simple, regulated medical parts can quickly be downloaded, printed, and supplied using the AMCPRE Exchange. As the nasal swabs required specific additive manufacturing technology, the dual sources to manufacture and supply the swabs ensured medical device needs of the community were met. The AMCPRE Exchange provided a platform for connecting large, matrixed organizations with time-sensitive part needs.

Scenario Participants

3D Systems

VHA

U.S. Department of Veterans Affairs
SCENARIO B: Community Crushes COVID-19!

PROBLEM
New Facemask Needed from a Variety of Suppliers

The COVID-19 response demonstrated that the US economy hosts tremendous latent capacity that can be mobilized to respond to crises. This scenario tested the potential of a broad community of professional, capable producers to respond to an immediate crisis requiring the 3D printing of a facemask. America Makes leveraged various communication channels (e.g., America Makes webinar, direct outreach) to simulate an immediate request.

SOLUTION
Leveraging a Broad Community of Additive Producers

For this scenario, the US Navy leveraged the AMCP Exchange to provide the design and the technical data package for a community facemask. The design was reviewed and approved for use on the AMCP Exchange. After initial outreach, three suppliers with the necessary additive manufacturing equipment were engaged to download and print the facemasks. The VHA test lab reviewed and tested the facemask per the "community" test protocol.

IMPACT
Quick Mobilization through the AMCP Process

This scenario successfully demonstrated the ability to convene and coordinate a broad community of designer, reviewers, and suppliers after an immediate call to the ecosystem. A novel, previously unreleased polymer facemask was able to be printed to specification and provided to America Makes within four weeks.

Scenario Participants

U.S. Department of Veterans Affairs
FORECAST 3D
TRONIX3D

AMCPR SCENARIO EXECUTION
Mfg. Process: Multi Jet Fusion
Material: Polyamide (Nylon) 12
SCENARIO C: Earthquakes Earn Enmity!

PROBLEM
Water Main Break Caused by Earthquake

While seismic activity is not common in all large US cities, a major earthquake could have catastrophic impacts on grey infrastructure in a major metropolitan area and cut off services to millions of citizens. Testing the response capabilities of a statewide or regional manufacturing community in an earthquake is an important effort to increase resiliency and preparedness given the lack of forewarning associated with seismic crises.

SOLUTION
Additive Manufacturing Pipe Couplings

This scenario simulated a response to a major earthquake and its potential impact on the water delivery system by printing and qualifying a stop-gap pipe coupling deployable to temporarily restore service in a crisis. Using the AMCPR Exchange, an emergency request was sent to five capable suppliers across the country to produce three couplings of varying sizes in polymer material. The pipe couplings were printed and shipped to five identified end-users on time and without defect.

IMPACT
Restoration of Service During Crisis

This scenario successfully demonstrated the ability of a diverse set of manufacturers to rapidly supply qualified parts to multiple end users simultaneously. Swift production and delivery of stop-gap parts can reduce the severity of the impact of an earthquake. The AMCPR Exchange provided an effective platform to connect requesters and suppliers and ensured that the part was qualified prior to supplying it to requesters.

Scenario Participants

AMCPR SCENARIO EXECUTION
Mfg. Process: Fused Deposition Modeling
Material: Acrylonitrile Butadiene Styrene
SCENARIO D: Blackhawk Down!

PROBLEM
Mission Readiness of a Blackhawk Compromised

The UH-60 Blackhawk Helicopter is a multi-purpose tactical helicopter that was put into service in 1979. In this scenario, mission readiness of a UH-60 Blackhawk will be diminished due to unavailability of a component, the "UH-60 AM Fuel Elbow". It is assumed that the supply chain for this component has dissipated over the years and no current source exists.

SOLUTION
Using AM to Supplement the Supply Chain

To address the problem, the fuel elbow was rapidly redesigned and manufactured out of a new material – 316L stainless steel. Zverse leveraged a legacy 2D print from the US Army to provide a converted 3D model. The suppliers, 3D Systems and EOS, 3D printed the new fuel elbow component and shipped to the US Army for testing. Due to the restricted nature of the design, the scenario was initially executed offline and later when the AMCPR Exchange was ready, the design was uploaded and requested through the Exchange.

IMPACT
Restoration of Mission Readiness

This scenario demonstrated how additive manufacturing can provide a rapid response when there is no existing supply chain to provide a part. The AMCPR Exchange provided a complex, mission critical component through digitally distributed manufacturing, improving mission readiness. The platform proved effective at restricting access and supplying the part to the entity in need.

Scenario Participants
SCENARIO E: Veritable Vane Inserts!

PROBLEM

Natural Disaster Causes Unplanned Shutdown

Recent events in Texas have demonstrated the need for rapid restoration of power during an extreme natural disaster. For this scenario, a key power plant in the Southwestern United States faced an unplanned shutdown due to a catastrophic natural disaster. To bring the gas turbine back online, a legacy vane insert component needed to be rapidly designed, tested, and supplied.

SOLUTION

Additive Manufacturing of a Legacy Component

This scenario simulated a response to a major natural disaster and the potential impact on the power grid by additively manufacturing and supplying a critical gas turbine vane insert. For this scenario, Siemens Energy provided and reviewed the vane insert design. The AMCPR Exchange then connected a requester with two capable suppliers to provide the vane insert part. Siemens Energy and Stratasys printed and heat-treated the vane insert before supplying to the requester.

IMPACT

Gas Turbine Back Online

This scenario successfully demonstrated how the AMCPR Exchange database of parts can be leveraged for rapidly responding to a crisis. Swift production and part delivery can help restore power during any future unplanned shutdowns. The AMCPR Exchange successfully mobilized experts from the energy industry to produce and validate a highly complex additively manufactured part.

Scenario Participants

- Siemens Energy
- Stratasys
- NIAR
SCENARIO F: Tooling Takes Too Much Time!

**Problem**

*Winter Storm Creates Crack in Plumbing*

In this scenario, a polar vortex causing extreme winter storms created a dangerous crack in a plumbing t-joint that supports the core cooling system for a reactor. Initial inquiries indicated no readily available supply for the t-joint which could prove catastrophic to the surrounding power grid if not addressed. The quoted lead time through traditional manufacturing methods is estimated to be six months due to the need for tooling creation.

**Solution**

*AM Replaces Traditional Manufacturing*

This scenario simulated a response to a major winter storm by not only designing and 3D printing the t-joint tooling, but also pouring and machining the t-joint for full product testing. Using the AMCPR Exchange, an emergency request was sent to a supplier with demonstrated capability in sand casting using additive manufacturing. The highly complex t-joint required casting and machining, resulting in multiple post-processing steps.

**Impact**

*Decreased Tooling Time & Increased Supply Chain Flexibility*

The goal of this scenario was to test a weather-based crisis scenario in which additive manufacturing is used to produce tooling that would typically have been made using traditional manufacturing methods. Successful tooling and part production is necessary for flex supply chain capacity. The AMCPR Exchange proved successful in sourcing parts with highly complex manufacturing processes (e.g., sand casting).

**Scenario Participants**
SCENARIO G: Taking a Shot at Shots (Syringes)!

PROBLEM

Limited Syringe Availability in Rural Areas

Reopening the economy requires wide-spread vaccine deployment, for which syringe availability is critical to success. Consumption of syringe production capacity by vaccine manufacturers is expected to put tremendous pressure on syringe supplies for other uses (i.e., routine vaccination or anesthetics). In this scenario, local and regional leaders think that additive manufacturing might support them when syringe availability runs short.

SOLUTION

Additive Manufacturing Syringe Components

In the original scenario narrative, a syringe device was to be designed by a community of designers then tested and validated through the FDA, NIH, and VHA for production. However, due to stakeholder safety concerns with material compatibility, sterilization, reproducibility, and quality assurance, the scenario was not fully executed. Rather, strategic interviews were held with key stakeholders to understand the approach, regulatory barriers, and necessary steps to enable scenario execution in the future.

IMPACT

Increased Availability of Syringes

While the targeted solution was not completed, this scenario gathered key takeaways from two government bodies – the VHA and the FDA – as well as private medical device manufacturer, Fresenius Kabi.

Lessons Learned:

- Development is costly. The timeline for development for 3D printing medical devices is time consuming and expensive
- Guidance is necessary. Medical regulations and guidance can be challenging to understand, find, and track updates on for the additive community
- The time to act is now. Engaging the public private partnership for strategic project calls will help address key barriers for additively manufacturing products where the development timeline is too long/complicated (e.g., medical devices)

Scenario Participants

- U.S. Department of Veterans Affairs
- FDA
- Fresenius Kabi