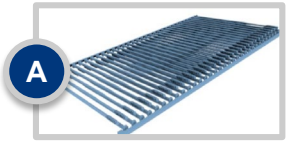
Seven Key Scenarios Demonstrate AMCPR Strength



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

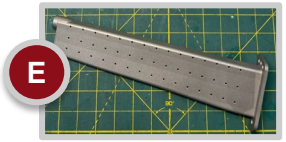
Convening and coordinating a broad community of designers, reviewers, and suppliers to manufacture a previously unreleased polymer facemask

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.

TESTING PARAMETERS

- Process & Task Complexity
- Stakeholder Capability Risk
- Product Complexity
- Ecosystem/ Participant Complexity
- Connectivity Risk

A SPECIAL THANK YOU TO OUR SCENARIO PARTICIPANTS!

U.S. Department of Veterans Affairs
U.S. ARMY
UTEP
ASTM INTERNATIONAL
FDA
ZVERSE
NIAR Wichita State University National Institute for Aviation Research
3D SYSTEMS
Markforged
FRESENIUS KABI
SEA AIR SPACE Machining & Molding
stratasys
eos
SIEMENS energy
ET
res3D
IC3D
RAPID Application Group
Freshmade3D
TechSolve
TRONIX3D
FORECAST3D
Humtown Products

SCENARIO A: VHA to the Rescue!

AMCPR SCENARIO EXECUTION
Mfg. Process: Selective Laser Sintering
Material: Polyamide (Nylon) 12

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

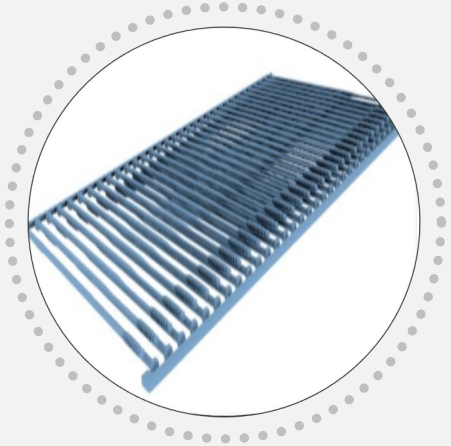
Meeting Medical Community Needs

This scenario **demonstrated how simple, regulated medical parts can quickly be downloaded, printed, and supplied using the AMCPR 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 AMCPR Exchange provided a platform for connecting large, matrixed organizations with time-sensitive part needs.

Scenario Participants

3D SYSTEMS

U.S. Department of Veterans Affairs



SCENARIO B: Community Crushes COVID-19!

AMCPR SCENARIO EXECUTION
Mfg. Process: Multi Jet Fusion
Material: Polyamide (Nylon) 12

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 AMCPR Exchange to provide the design** and the technical data package for a community facemask. The design was reviewed and approved for use on the AMCPR 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 AMCPR 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 · SEA AIR SPACE Machining & Molding · TRONIX3D

SCENARIO C: Earthquakes Earn Enmity!

AMCPR SCENARIO EXECUTION
Mfg. Process: Fused Deposition Modeling
Material: Acrylonitrile Butadiene Styrene

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.

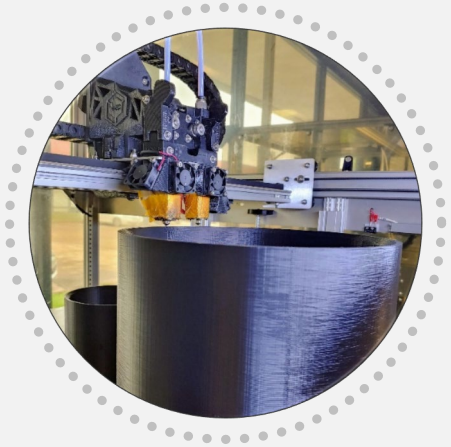
IMPACT

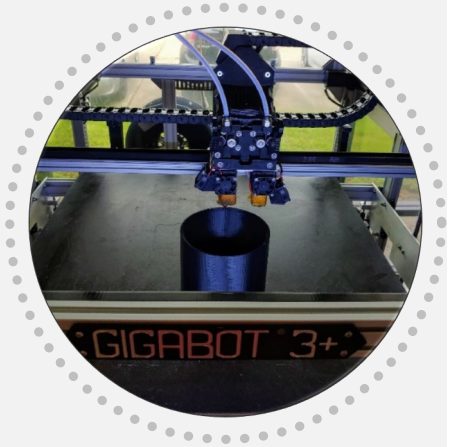
Restoration of Service During Crisis

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

ASTM INTERNATIONAL · UTEP · IC3D · RAPID APPLICATION GROUP · re3D · Markforged · stratasys





SCENARIO D: Blackhawk Down!

AMCPR SCENARIO EXECUTION
Mfg. Process: Laser Powder Bed Fusion
Material: Stainless Steel 316L

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

U.S.ARMY ZVERSE 3D SYSTEMS EOS

SCENARIO E: Veritable Vane Inserts!

AMCPR SCENARIO EXECUTION
Mfg. Process: Selective Laser Melting
Material: Inconel 625

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.

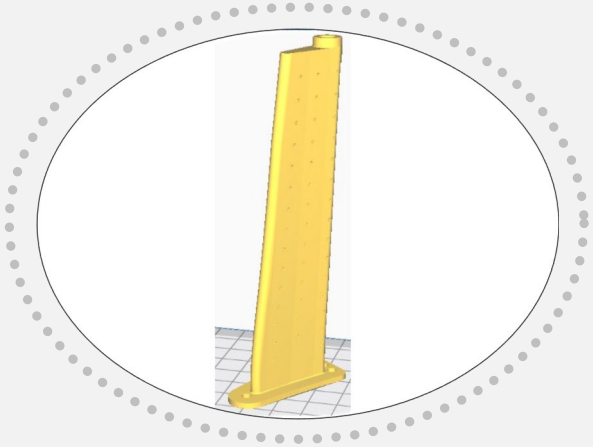
IMPACT

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 Wichita State University National Institute for Aviation Research



SCENARIO F: Tooling Takes Too Much Time!

AMCPR SCENARIO EXECUTION

Mfg. Processes: Sand Binder Jetting S-Max Pro (mold) & Metal Casting (t-joint)

Materials: Silica Sand (mold) & Aluminum (t-joint)

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.

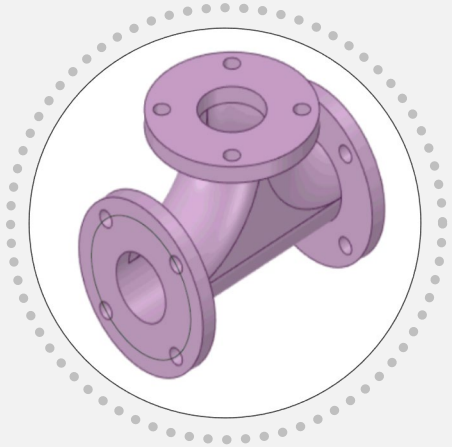
IMPACT

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

TechSolve® Freshmade 3D Humtown® PRODUCTS NIAR® Wichita State University National Institute for Aviation Research



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

AMCPR SCENARIO EXECUTION

Due to stakeholder safety concerns, scenario was not completed.

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