Fostering advanced manufacturing technologies and processes to bolster supply chain resilience and encourage continuous improvement

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Abstract

Background: As part of this mission, FDA must prepare to review and inspect new and innovative technologies used in the production, testing, and monitoring of regulated products. The FDA leverages the scientific expertise of its personnel to develop and assess advanced manufacturing technologies and analytic tools. Advanced Manufacturing has risen to the forefront as a way to build long term capacity for pandemic response and resilience.

Purpose: The Advanced Manufacturing (Adv Mfg) program in the Office of Counterterrorism and Emerging Threats (OCET) is focused on fostering the use of Adv Mfg to:

- improve supply chain resilience to disruption
- increase domestic production of critical medical products
- build flexible capacity to respond to spikes in demand

Expected benefits for Agency include:

- Internal and external grants and projects directed toward Agency priorities
- Increase cross-center cooperation and communication
- Supplement Center innovation and emerging technology efforts
- Assist FDA in development of evaluation metrics and protocols for new/emerging technologies

Discussion: Many methods have been identified as potential avenues to respond to the public health gaps exposed by the pandemic. Adv Mfg is an area where pandemic response and general improvements to the quality of medical products intersect. The OCET Adv Mfg program will:

- help sustain interdisciplinary support for FDA research
- increase FDA engagement with public-private partnerships focused on the development/transition of innovative new tools, technologies, and platforms for Adv Mfg
- enhance internal FDA-wide cross-scientific, multi-disciplinary, exchange of information to inform cross-cutting decisions

Introduction

Innovation of FDA-regulated products has been historically difficult to incentivize given the traditional economic drivers and regulatory environment. However, since the COVID-19 pandemic, there is a renewed focus in industry, legislation, and academia to improve U.S. self-sufficiency and resilience through innovation and especially Advanced Manufacturing (AM).

As part of this mission, OCET must prepare to review and inspect new and innovative technologies used in the production, testing, and monitoring of regulated products. The OCET leverages the scientific expertise of FDA personnel, interagency partners, academic collaborators, and grantees to help inform and prepare the FDA for emergency and pandemic response.

OCET is analyzing the impact of advanced manufacturing used in response to COVID, the potential for advanced manufacturing to assist in long term response, recovery, and prevention efforts, and its ability to increase supply chain resilience.

Goals

Many emerging innovations are disruptive or transformative to old thought processes, ways of doing business, and supply systems. The successful transition to these 21st century technologies will require new standards, and measurement tools, enhanced methods for data analysis and cybersecurity, and even modernized regulatory structures in order to encourage domestic production, increase efficiency, and build a resilient supply chain.

OCET's advanced manufacturing program intends to facilitate industry adoption of advanced manufacturing and to promote regulatory science for innovative, disruptive technologies that can help meet Office and Agency objectives.

Needs Addressed

- Identify regulatory science gaps and solutions for advanced manufacturing
By enabling FDA to identify questions and metrics to assess product quality and safety with disruptive or emerging manufacturing technologies. (e.g. continuous and digital manufacturing, biofabrication)

- Identify processes, technologies, and resources that can increase the resilience and decrease the vulnerability of U.S. supply chains to disruption by natural disasters or pandemics
    - After the 2017 Hurricane season, large portions of the U.S. sterile saline manufacturing capacity was destroyed along with damage to many medical device and pharmaceutical production facilities
    - During the COVID-19 pandemic, huge global demand and export restrictions caused or threatened shortages in key products such as personal protective equipment (PPE) and critical pharmaceuticals

- Create a microcosm of the industry's technology landscape in partnership with other stakeholders to help develop impactful, innovative approaches to improve public health

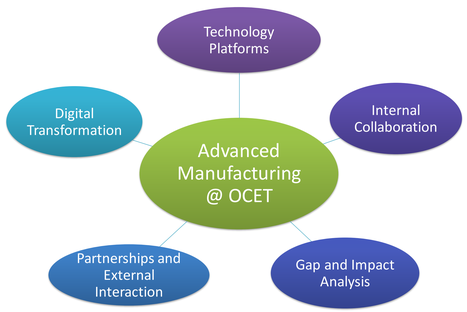

Figure 1. The OCET Advanced Manufacturing program aims to capitalize on internal FDA expertise and external interactions to identify technology platforms, digital and smart technologies, and other innovative processes that will meet the changing needs of industry, domestic manufacturing, and public health.

Initial Stage

OCET is leveraging its experience with disruptive technologies and public private partnerships to initiate two studies:

1. Investigating the impact of interagency 3D printing efforts on COVID-19 pandemic response, which will
    - Quantify the number and type of medical devices, and response-related accessories, used for COVID-19 response, that were manufactured with alternative methods by stakeholders that typically did not produce those items
    - Analyze the geographic distribution of these alternative manufacturing efforts and impact relative to demand
    - Describe difficulties that stakeholders and responders had in producing or procuring parts through this emergency system

2. Analyzing the advantages and barriers to adopting SMART manufacturing for medical products
    - Identify technical, business, and logistical barriers to adopting smart and advanced manufacturing technologies;
    - Identify and develop best practices for stakeholders wishing to transition to those technologies in a regulated environment, leveraging successful industry use cases to accelerate adoption, and;
    - Provide data for FDA research and regulatory policy partners to analyze for solutions the FDA can provide that would foster adoption of these technologies

Outcomes of these studies will inform development of regulatory science metrics, procedures, and best practices. It will also inform FDA's collaboration on Advanced Manufacturing with the National Institute of Standards and Testing (NIST). The FDA has unique insight into the broad landscape of medical manufacturing and the regulatory science opportunities presented by emerging technologies. NIST is a globally recognized source of world-class measurement and testing facilities, many of which focus on the processes, controls, and modeling used in modern manufacturing.

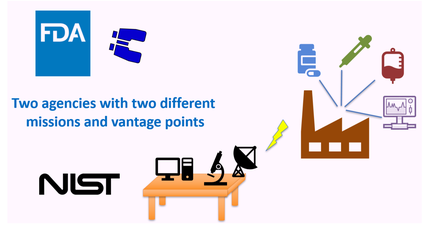

Figure 2. We envision that the NIST / FDA partnership will leverage the complementary skills of the FDA's regulatory expertise and NIST's precision characterization and standards.

Activities Summary

A centralized connector

- Aggregate and share knowledge internally
- Communicate externally to increase visibility

Advanced manufacturing demonstrator

- Provide platforms for internal research
- Experience can research priorities policy and review
- Amplify Center work of identifying emerging technologies

Funding cross-cutting projects

- Internal and external research projects
- Surveys and data mining for industry and technology trends

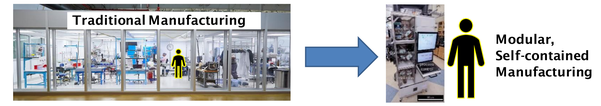

Figure 3. One approach to reduce the U.S. supply chain vulnerability and advance rapid response capabilities is to develop distributed and mobile manufacturing units.

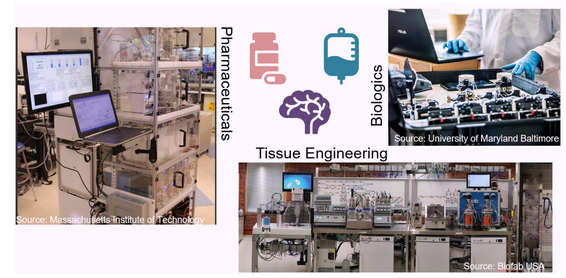

Figure 4. Several technologies have been identified and are being assessed for their potential impact on supply chain resilience and future pandemic readiness. These include on-demand production of pharmaceuticals (left), automated manufacturing of tissue engineered products (middle), and portable production of biologics (right)

Conclusion

Advanced manufacturing is a high priority for the FDA because it will greatly help address a number of significant challenges or issues related to medical product development, quality, manufacturing, and availability that the United States is currently facing, including: (1) Rapidly scale manufacturing capabilities for vaccines and other medical countermeasures (MCMs) to respond faster to emerging threats and public health emergencies, notably the novel coronavirus causing COVID-19. (2) Increase supply chain resilience to disruption by emerging threats or public health emergencies by creating a distributed network of small manufacturing sites that can provide reserve capacity. OCET's advanced manufacturing program aims to meet these needs and facilitate FDA and industry adoption of advanced manufacturing for medical products.