Response to the Request for Information (RFI) by the State of Colorado, Office of Economic Development and International Trade (OEDIT)
National Institute for Standards and Technology (NIST)
Advanced Manufacturing National Program Office (AMNPO)
Federal Register Docket Number 120418419-2419-01

Technologies With Broad Impact

1. *What criteria should be used to select technology focus areas?*

First and foremost, the technology of focus should have broad relevance to small and medium enterprises (SMEs), specifically as it relates to becoming part of a strong and agile supply and value chain for OEMs in a particular region, while also serving the needs of the global market. It should also be asset-based and build on existing regional strengths in industry, labor, academia and government, including organizing existing programs to be more aligned and focused.

The criteria should focus on a specific keystone technology related to a persistent problem encountered by manufacturing companies in Colorado, across the Rocky Mountain region and ultimately across the nation. For example, OEDIT, NASA and various other state agencies, with input from industry, have recently identified several overarching issues that cut across several advanced industries prevalent within the Rocky Mountain region, including aerospace and clean energy:

- ***Modeling & Simulation:** modeling tools for simulating complex man-made systems such to help identify cost-cutting improvements*
- ***Composite Materials & Coatings:** incorporating conductive materials directly into a composite offers weight advantages, labor savings, fabrication time reduction*
- ***Energy Storage/Conservation:** technologies applicable to both space exploration and clean and renewable energy such as fuel cells and electrolyzers, advanced photovoltaics, and battery performance improvements*
- ***Sensors:** smart, lightweight, low-volume/power, micro and miniaturized and stand-alone ruggedized sensor system*

2. *What technology focus areas that meet these criteria would you be willing to co-invest in?*

The constant keystone technologies that are prevalent across each of the four areas outlined above that OEDIT would be willing to invest in would be wide-band gap semi-conductor materials and carbon fiber components. Such keystone technologies would strongly affect the organization and diversity of technologies in the industrial base relative to other technologies, demonstrate sustained, market-driven adoption once performance and price targets are achieved and both are transformative across multiple production systems and supply chains, in each case as further described below.

Wide-band gap materials:

Organization	• ***Increase energy efficiency of devices and systems such as switches and solar cells*** • ***Enhance an existing U.S. based industry***
Diversity	• ***Expand the market applicability of GaN, SiC, Diamond based devices*** • ***Complicated manufacturing process and requires high level of quality control*** • ***Requires an advanced workforce***
Sustained, market-driven	• ***Existing market for Si based devices that have reached their performance limitations, there is a demonstrated market***

adoption	***need for the technology*** • ***Market adoption is limited by cost and quality***
Transformative and/or cross-cutting	• ***Would create a step change in performance of devices based on the enhanced material properties over current state of the art*** • ***Applicable to many systems and supply chains*** • ***Expanded role within several large industries: aerospace and clean energy***

<u>Carbon fiber components:</u>

Organization	• ***Create lower energy intensive production methods (Out of the Autoclave), lower GHG, lower cost*** • ***Early industries for use of these low cost CF composites are U.S. manufacturing strengths (aerospace and clean energy)*** • ***Sustained, market-driven adoption***
Diversity	• ***Applicable to a current range of industries but has really an unlimited potential*** • ***Complicated manufacturing process, requires high level of quality control***
Sustained, market-driven adoption	• ***Existing market for products by traditional manufacturing routes, replacement potential is high*** • ***Market adoption is limited by cost and time to develop, high quality control needs, automation needs***
Transformative and/or cross-cutting	• ***Create completely new methods for production, transformative*** • ***Applicable to many systems and supply chains*** • ***Expanded role within several large industries: aerospace and clean energy***

3. *What measures could demonstrate that Institute technology activities assist U.S. manufacturing?*

OEDIT suggests the following measures that could be used to demonstrate that Institute technology is assisting US Manufacturing:

1) ***Economic development metrics for all companies working with or connected to the Institute:***
    a. ***Net new jobs in American manufacturing,g***
    b. ***New American manufacturing products or services and associated revenues' contribution to GDP, and***
    c. ***New Exports of Advanced Technology Products, returning the USA to a trade surplus in that category.***
2) ***Number of small and medium companies engaging with the Institute as their "first ever" contact with a research institute or university (i.e. serving a new market)***
3) ***Sustainability of the institute, suggesting sufficient on-going investment into the Institute by industry members deriving value***
4) ***Number of institute patents or IP adopted and used by industry***
5) ***Number of companies using institute owned / licensed IP***
6) ***Number of industry participants actively working with / for the institute***

4. *What measures could assess the performance and impact of Institutes?*

OEDIT suggests the following as measures that could be used toward institute performance:

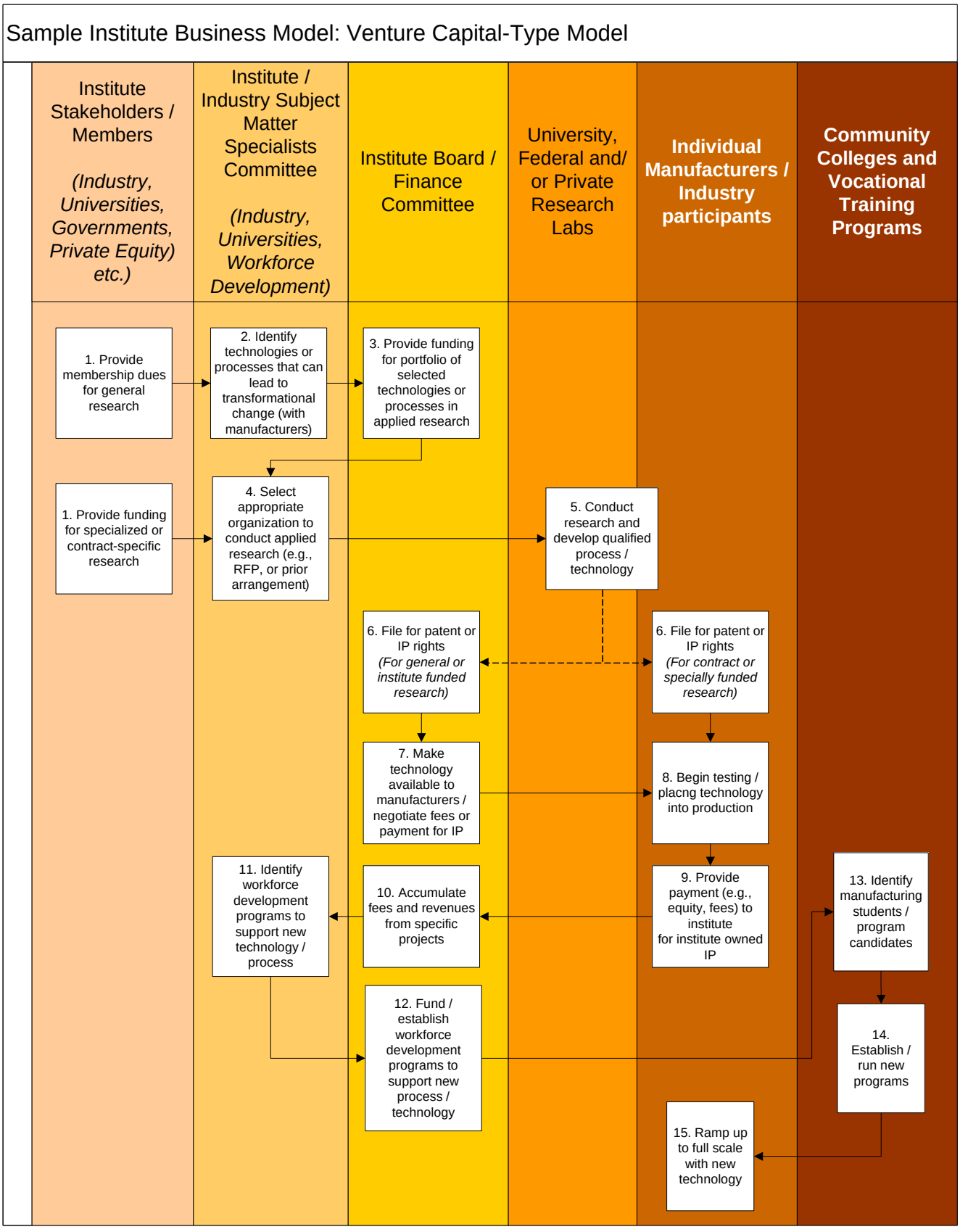
1) ***Attraction and retention of high-caliber industry members and top researchers***
2) ***Creation of new markets or the disruption of existing markets***
3) ***Sustainability of the institute, suggesting sufficient on-going investment into the Institute by industry members deriving value***
4) ***Institute revenues from non-governmental sources (e.g., industry membership fees, license fees)***
5) ***Number of manufacturers engaged in institute related projects, either participating in directed or collaborative research, licensing technologies, or taking advantage of workforce training programs***
6) ***Number of individuals newly hired into industry and incumbent workers upgraded within their company from Institute-related training programs***

Institute Structure and Governance

5. *What business models would be effective for the Institutes to manage business decisions?*

OEDIT suggests the following models for consideration:

- ***Venture capital-type model where technologies / processes are developed and tested with Universities / Laboratories/ Manufacturers and subsequently provided to small and medium enterprises (SMEs) with a return of equity or license fees for use. OEDIT has developed a suggested / draft model for consideration with the Colorado Advanced Manufacturing Alliance:***



- ***CCAM Model. Other models include the Commonwealth Center for Advanced Manufacturing (CCAM).***

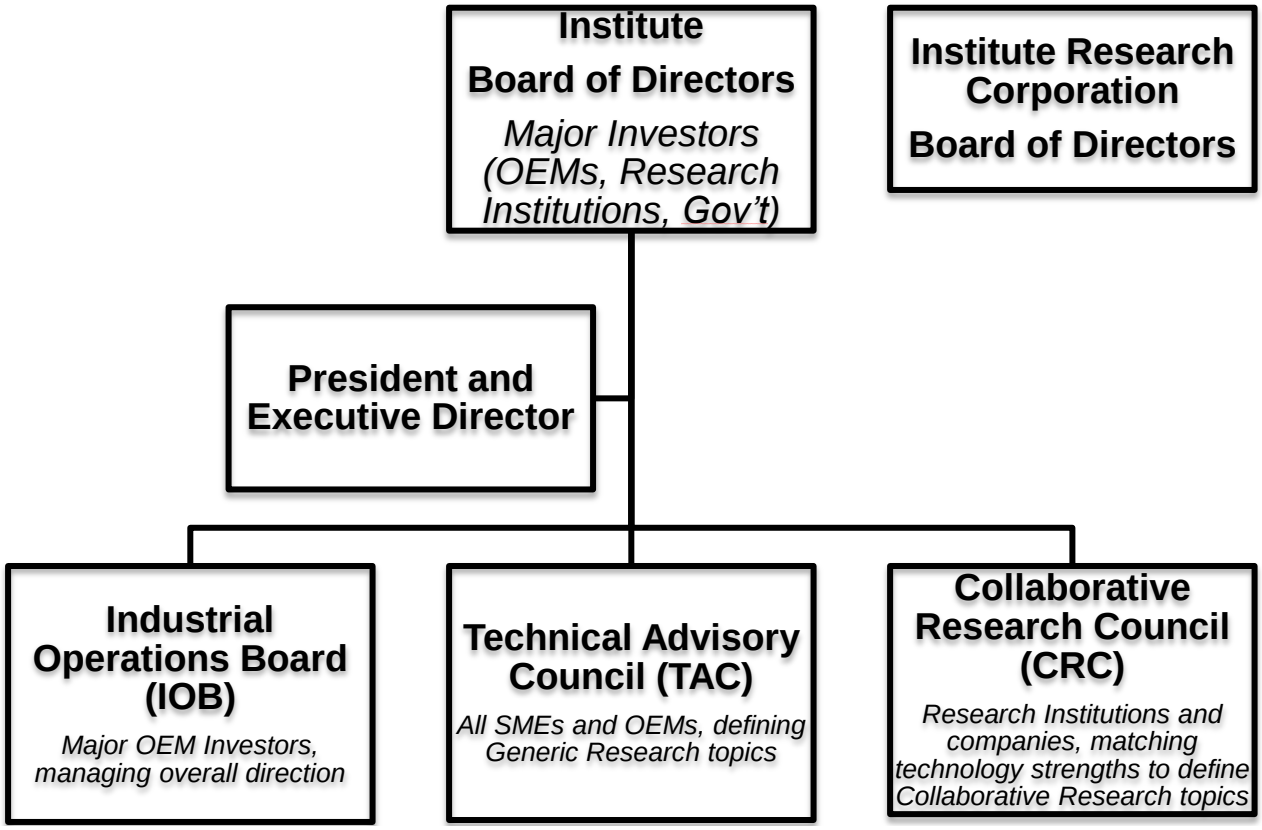
6. *What governance models would be effective for the Institutes to manage governance decisions?*

OEDIT suggests the following governance structures for consideration:

- ***A membership managed professional organization (501(c)(6) or other not-for profit structure with a board that includes key institute stakeholders (e.g., industry anchor companies, state governments and universities) such as the Colorado Advanced Manufacturing Alliance (Alliance).***

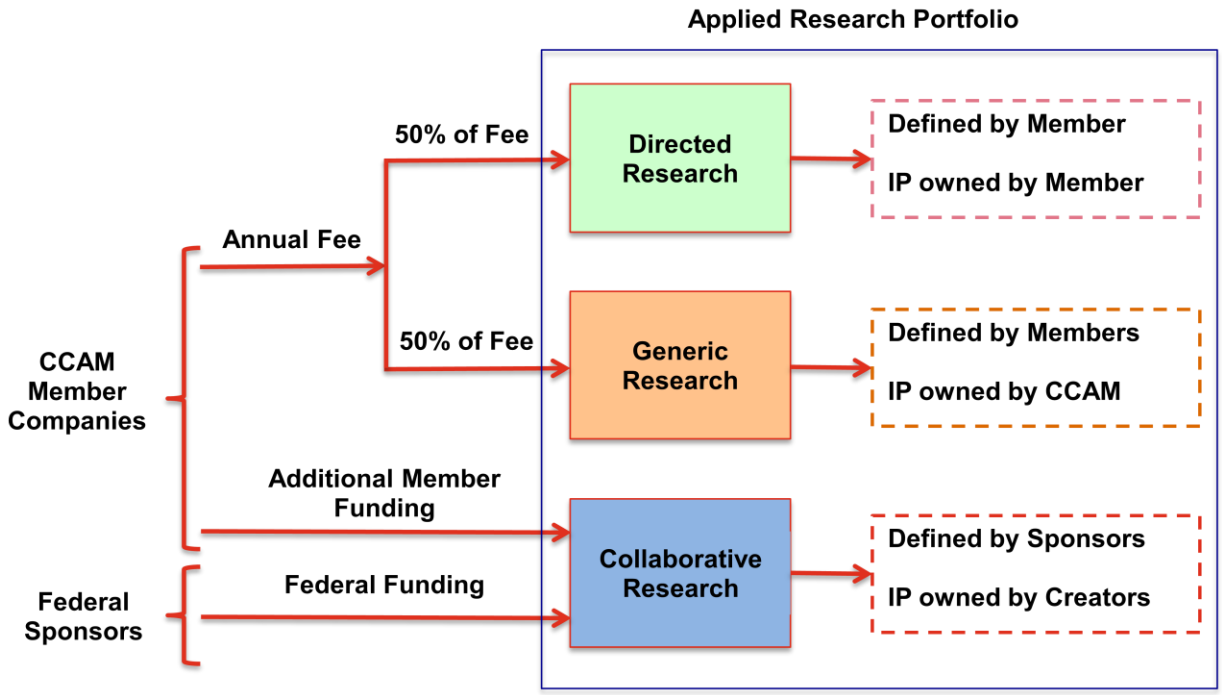
This will allow the Institutes to be driven by SMEs as customers and OEMs as clients, advisors, collaborators and solution-providers. The Alliance will manage a Technology Advisory Council, together with applicable industry leaders, to identify top technologies or technology gaps that will have the greatest impact on the retention and future growth of manufacturing in Colorado and the USA, enabling differentiation and competitiveness for the U.S manufacturing supply chain. Such technologies must be well-defined with broad application and focus on applied research, commercialization and manufacturability. Such keystone technologies must demonstrate sustained, market-driven adoption once performance and price targets are achieved, and be transformative or broadly-applicable across multiple production systems and supply chains.

Based on adaptation of CCAM model:



7. *What membership and participation structure would be effective for the Institutes, such as financial and intellectual property obligations, access and licensing?*

OEDIT suggests the Federal government consider variations on the CCCAM model for managing financial and intellectual property (IP) obligations. Each institute will need to adjust this model for the industry / technology / region, however their IP and financial framework provides a basis for discussion and evaluation.



8. *How should a network of Institutes optimally operate?*

   Institutes should be connected to a robust virtual shared space such that the diverse manufacturing firms and research institutes of Colorado, the Rocky Mountain Region and the nation can regularly and easily access knowledge, existing and emerging technologies, equipment and facilities, suppliers and new markets, and technical assistance. As an initial foundation for shared physical and virtual facilities and ideas, use a region's strong research capacity, such as that which exists in Colorado and the Rocky Mountain Region, to identify existing technologies that is connected to an industry base focused on advanced manufacturing, such as in Aerospace and Clean Energy.

   OEDIT suggests that the network of Institutes operate to industry facing entities as a "single organization" with separate focuses, similar to the National Institutes of Health (but privately funded). Perhaps each institute is a subsidiary or contractually bound to a single, central institute that provides general policy guidelines to the individual, specialized institutes. Perhaps the central institute is persistently funded at a guaranteed level to ensure the longevity of the network. Additionally, institute revenues could be pooled at a certain percentage (e.g., 20%) to support a central institute. This central institute could operate the administrative (e.g., IT, accounting, contracting) functions, as well as serve as the unified 'gateway' to all institutes.

9. *What measures could assess effectiveness of Network structure and governance?*

   To assess the network structure and governance, OEDIT suggests the following measures:

   - ***Number of institutes complying with centralized governance***
   - ***Number of cross-Institute projects***

Strategies for Sustainable Institute Operations

10. *How should initial funding co-investments of the Federal government and others be organized by types and proportions*

    Initial funding should be provided such that the institutes have an incentive to grow industry-based revenues. For example, funding should shift from a heavy Federal cost share of 80% to 20% over a five year period.

11. *What arrangements for co-investment proportions and types could help an Institute become self-sustaining?*

    OEDIT suggests that initial investment proportions be higher from governmental sources, but that this proportion will shift as the institutes prove their value – if institutes do not meet mandated performance targets, their governmental funding should be removed.

12. *What measures could assess progress of an Institute towards being self-sustaining?*

OEDIT suggests that Institute revenues come from industry participants in a fee for services model, and repeat membership or participation be used as the primary measures for self-sustainment.

13. *What actions or conditions could improve how Institute operations support domestic manufacturing facilities while maintaining consistency with our international obligations?*
    Using the business model provided above, Institutes could be required to provide new technologies to domestic manufacturers for 'generally funded' technologies. Contract-specific (i.e., research paid primarily by companies directly) should not be restricted or have limited restrictions.

14. *How should Institutes engage other manufacturing related programs and networks?*
    OEDIT suggests that Institutes identify programs that address each Institute's core value proposition / core mission and make them active partners in the institute operations. The overall goal and guiding mission should be to coordinate with and align with what is already going on in the ecosystem.

15. *How should Institutes interact with state and local economic development authorities?*
    OEDIT suggests that Institutes be encouraged to approach State and Local governments as partners, especially with regard to economic development, the identification of institute corporate partners, and with regard to identifying community college and vocational providers.

16. *What measures could assess Institute contributions to long term national security and competitiveness?*
    Returning to a trade surplus in exports of Advanced Technology Products is cited by the AMP as an indicator of declining American competitiveness, so that may be one critical measure.

Education and Workforce Development

17. *How could Institutes support advanced manufacturing workforce development at all educational levels?*
    Using the business model provided, advanced manufacturing would be supported at both the University / design level and the vocational level by providing avenues for funding both initiatives.

18. *How could Institutes ensure that advanced manufacturing workforce development activities address industry needs?*
    Coordinate and expand the multiple existing and emerging education and workforce training programs that serve the manufacturing industry, including expanding opportunities for young and re-careering individuals to move into manufacturing; providing opportunities for on-the-job experience for jobseekers and entry-level workers; better connecting programs into logical career pathway systems that better serve jobseekers and that provide manufacturers with accurately skilled workers; and finding ways to train new and incumbent workers for new technologies.

19. *How could Institutes and the NNMI leverage and complement other education and workforce development programs?*
    In coordination with the activities of the Institute, existing workforce development best practices and resources could be leveraged with the private sector through the Colorado Advanced Manufacturing Alliance.

    Current workforce development efforts to be leveraged in Colorado and the Rocky Mountain Region:
    - ***The Colorado Workforce Development System, including current Regional Manufacturing Sector Initiatives***
    - ***The Colorado STEM Network***
    - ***Development of flexible, industry co-sponsored Mobile Learning Labs***
        - ***Pueblo Community College's Gorsich Advanced Technology Center, example***
    - ***Career Pathways & Industry Recognized Credentials***
    - ***Career & Technical Education (CTE) industry partnerships***
        - ***Colorado has a dynamic network of CTE programs meeting the training needs of industry. Through the Alliance this resource can be leveraged to provide a state-wide network of training resources for new and existing workers.***
    - ***Apprenticeships/pre-apprenticeships***
        - ***Colorado has a history of effective partnerships with labor and industry in the development of apprenticeship and pre-apprenticeship programs; however efforts***

lack a specific focus on manufacturing needs. Through the Alliance we will be able to leverage resources to develop an effective advanced manufacturing apprenticeship program to provide the appropriate workplace learning. A national best practice that will inform this development is the Aerospace Joint Apprenticeship Committee (AJAC) Program in Washington State.

20. *What measures could assess Institute performance and impact on education and workforce development?*

OEDIT suggests the following measures:

- **Number of graduates hired into industry from institute-affiliated vocational programs**
- **Number of engineers graduated in institute-affiliated programs**

21. *How might institutes integrate R&D activities and education to best prepare the current and future workforce*

Workplace learning is critically important to the successful training of incumbent and new members of the advanced manufacturing workforce. Allowing for the Institute to serve as a classroom and give access to trainings on the equipment and processes in the facility will be critically important.

Additionally, there is an emerging model and opportunity defined through the "Maker Movement" to allow for more passive, self-directed workforce training and development. Through some type of individual membership model, it may be possible to give access to the Institute's facilities, equipment and trainings to individual entrepreneurs, tinkerers and innovators, who are motivated, self-starters and quick learners. By allowing for more open access—with appropriate oversight—to equipment and R&D in the Institute facilities, more passive education and innovation may be enabled.