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Policy Options to Promote DoD-Defense Industry Collaboration in STEM Education and Workforce Development Programs, Activities, and Outreach

WRT-1077

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About this Study

- FY2020 NDAA: House Report 116-333
- Conferees note the importance of developing a world class cadre of technical talent for STEM job functions, including a number which require security clearances
- Conferees believe that a strong partnership between the defense industry and DoD can stimulate efforts to increase that pool
- Conferees direct Secretary of Defense to commission study to develop policy options and recommendations to **promote DoD-defense industry collaborations**
 - Create clearable technical workforce to meet defense missions
 - Support educational opportunities for defense sector personnel
 - Increase educational opportunities for veterans and military dependents
 - Emphasize activities based on metrics and education best practices

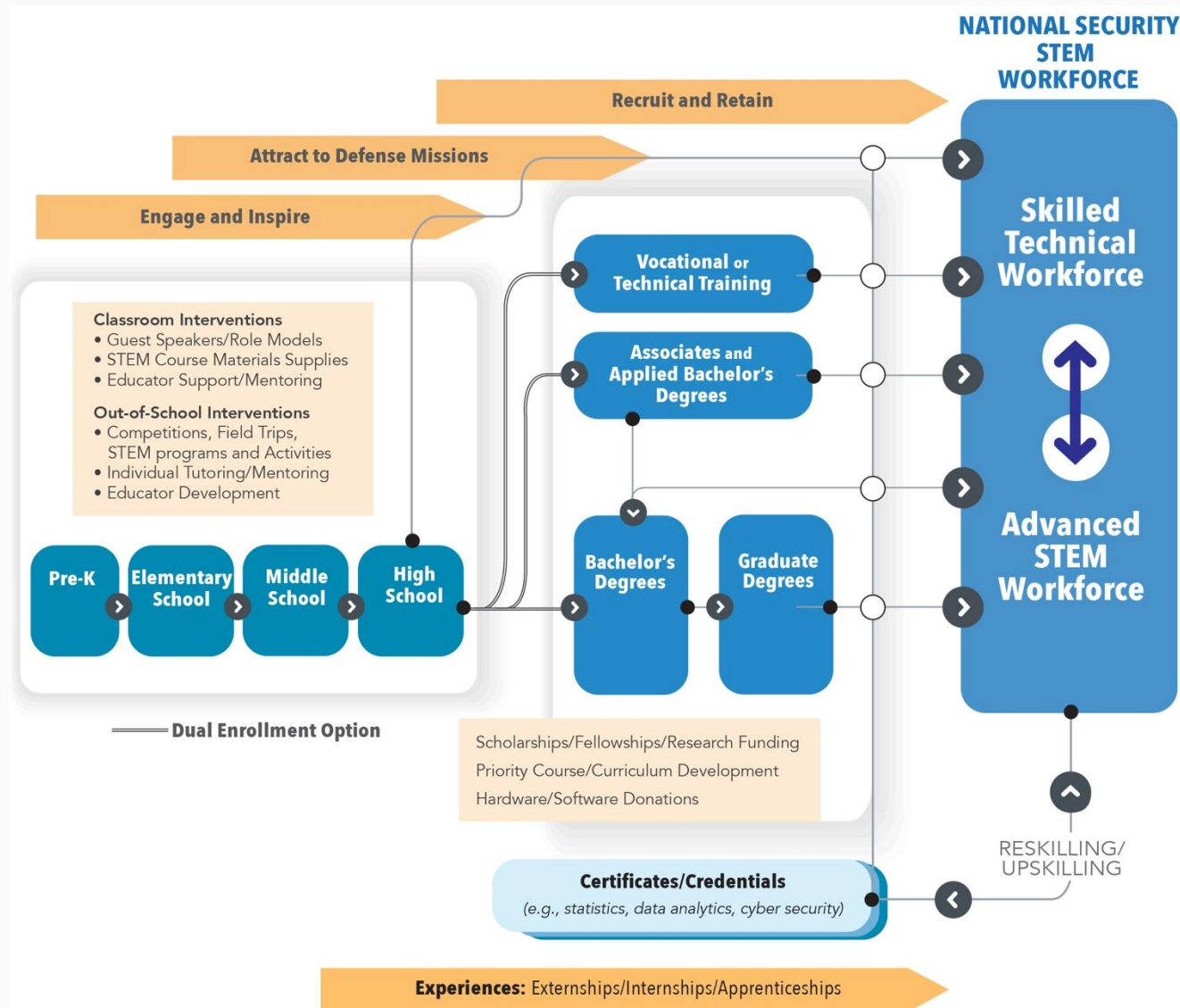
Study Approach and Reports

- Phase 1 – Interim Report
 - Understanding the landscape of STEM-related activities supported by DoD and the DIB
 - Discussions with selected external organizations engaged in relevant STEM activities
 - Literature reviews to better understand the importance of a STEM-competent workforce for defense missions and STEM ecosystem models
- Phase 2 – Final Report
 - Targeted discussions with DoD leadership and program managers
 - Discussions with DIB leadership
 - Outreach to defense-related professional organizations
 - Discussions with subject matter experts in areas including evaluation and assessment of STEM activities
 - In-depth literature review augmented by a workshop focused on the Skilled Technical Workforce
- ✓ *Reports (all cleared for open publication)*
 - *Interim (February 2022) – Preliminary recommendations responding to legislative language*
 - *Final (July 2022) – Greater emphasis on clearable workforce, incentives for DoD-DIB collaboration, STEM Ecosystems*
 - *No cost extension (October 2022) – Preliminary Reference Architecture for STEM Ecosystems*
 - *Follow-on project (underway): Case Studies of selected STEM Ecosystems*

A Case for Action

- A ***skilled STEM workforce is especially critical*** in a defense-focused industrial strategy, which requires innovative and bold solutions and production and integration of complex systems
- DoD and the DIB have a ***common mission*** and ***shared strategic risks*** stemming from projected shortfalls in the workforce needed to support defense missions
- DoD and DIB technical personnel are uniquely qualified to ***engage***, ***inspire***, and ***attract*** future generations of talent to pursue careers in support of defense missions
- DoD and the DIB, working together, can create the ***educational pathways*** needed to develop the technical skills needed to support ***evolving defense mission needs***
- DoD and the DIB, working together, can establish a ***sustainable system*** that ***improves outcomes, amplifies impacts***, and ***enables ongoing assessment*** of their collective efforts toward developing the clearable STEM workforce for defense missions

Pathways to Develop the Technical Workforce for Defense Missions



Critical Roles for DoD/DIB

- **Engage and Inspire**
 - Military-connected
 - Other Priority Populations
- **Attract to Defense Missions**
 - Role Models
 - Mission-related Interventions
 - Scholarships/Fellowships
- **Recruit and Retain**
 - Mission-related Experiences
 - Mission-relevant Curriculum
 - Reskilling and Upskilling

Key Take-aways *(From Year-1 Study Period)*

- **DoD-DIB Collaboration on STEM education-related activities is rare**, although the scope and scale of STEM interventions by both DoD and DIB organizations is vast
 - Collaborations *do exist* in the area of manufacturing/industrial workforce development
 - Incentives must be aligned to create an environment conducive to meaningful collaboration
- The **Skilled Technical Workforce (STW) is of growing importance** but not well understood
 - Nascent efforts are underway to characterize the manufacturing-related STW
 - Needs extend beyond that domain
- **Few STEM initiatives directly target building a clearable technical workforce**
 - Although both DoD and DIB organizations do emphasize engagement with military-connected families
- Opportunities exist to **leverage ongoing activities within existing STEM ecosystems**
 - But DoD and DIB organizations have a *differentiated role that cannot be ceded* to those efforts
- **Evaluation/assessment methodologies currently in use are inadequate** for understanding long-term impacts

Setting the Conditions for Success

THE FIVE CONDITIONS OF COLLECTIVE IMPACT	
Common Agenda	All participants have a shared vision for change including a common understanding of the problem and a joint approach to solving it through agreed upon actions.
Shared Measurement	Collecting data and measuring results consistently across all participants ensures efforts remain aligned and participants hold each other accountable.
Mutually Reinforcing Activities	Participant activities must be differentiated while still being coordinated through a mutually reinforcing plan of action.
Continuous Communication	Consistent and open communications is needed across the many players to build trust, assure mutual objectives, and create common motivation.
Backbone Support	Creating and managing collective impact requires a separate organization(s) with staff and a specific set of skills to serve as the backbone for the entire initiative and coordinate participating organizations and agencies.

Source: Stanford Social Innovation Review (2011)

Three Preconditions

- 1) Influential champion (or a small group of champions)
- 2) Adequate financial resources
- 3) Sense of urgency for change

Isolated Impact vs. Collective impact: As-Is vs. To-Be

Isolated Impact vs. Collective Impact	
Isolated Impact	Collective Impact
▪ Funders select individual grantees that offer the most promising solutions ▪ Nonprofits work separately and compete to produce the greatest independent impact ▪ Evaluation attempts to isolate a particular organization’s impact ▪ Large scale change is assumed to depend on scaling a single organization ▪ Corporate and government sectors are often disconnected from the efforts of foundations and nonprofits	• Funders and implementers understand that social problems, and their solutions, arise from the interaction of many organizations within a larger system • Progress depends on working toward the same goal and measuring the same things • Large scale impact depends on increasing cross-sector alignment and learning among many organizations • Corporate and government sectors are essential partners • Organizations actively coordinate their action and share lessons learned

- **DoD and DIB organizations are today largely operating in the ‘Isolated Impact’ mode**
- **This study recommends transition toward ‘Collective Impact’**

STEM Learning Ecosystems

- “A *STEM learning ecosystem* provides the architecture for cross-sector learning, offering young people access to *STEM-rich learning environments* so they can develop important skills and engagement in science, technology, engineering and math throughout preK-16”*
- STEM ecosystems act as ***force multipliers*** to amplify the reach, visibility, and outcomes of individual initiatives
- STEM ecosystems harness the unique contributions of member organizations to provide ***mutually reinforcing programs*** that assist with learning
- Well-designed ecosystems enable a ***continuum of STEM exposure*** via interventions through childhood into adolescence and early adulthood
- Systems of ecosystems provide fertile ground for ***cross-pollination of ideas***
- Robust STEM ecosystems tend to include a ***diverse set of stakeholders and partners that have a vested interest*** in increasing the STEM competency within the local community

*<https://stemecosystems.org/what-are-stem-ecosystems/>

STEM Learning Ecosystems – Typical Partners and Stakeholders

MANAGEMENT/GOVERNANCE

- Lead organization
- Advisory board(s)
- Committees

EDUCATION SYSTEMS

- Local schools and school districts
- Community colleges
- Technical institutes
- 4-year higher education institutions

GOVERNMENT

- Local agencies
- Federal agencies
- Military facilities
- National laboratories

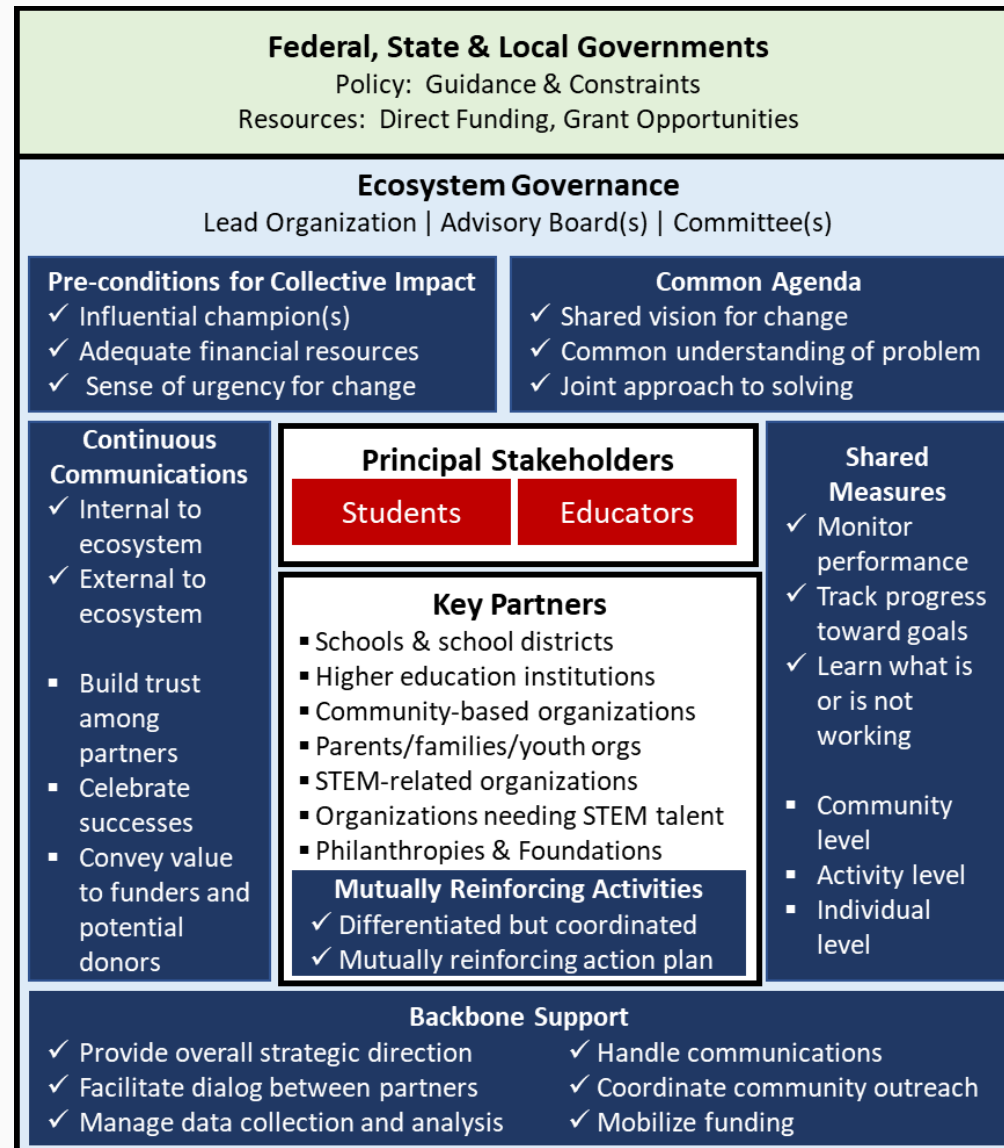
INDUSTRY

- STEM-related companies
- Businesses that recognize the need for STEM competencies

AFTER-SCHOOL/OUT-OF-SCHOOL ENTITIES

- Out-of-school time (OST) systems/programs
- STEM-expert museums and science centers
- Libraries
- Community-based organizations
- Philanthropies
- Families and parent organizations
- Youth organizations

STEM Learning Ecosystems – Preliminary Reference Architecture



Follow-on Work Currently Underway

- Conducting deep dive studies of collective STEM initiatives:
 - Case studies on 5 regional STEM ecosystems
 - Statewide STEM initiatives
 - Selected international STEM initiatives
- Identifying promising practices from STEM ecosystems
- Developing potential pilot programs for DoD-DIB collaborative partnerships within existing STEM ecosystems

Vision for DoD-DIB Collaboration

(From WRT-1055 Final Report, July 2022)

...a DoD-DIB collaboratively-operated system of local DoD-DIB nonprofit organizations, each of which is a fully-participating partner within an existing STEM ecosystem.

The DoD-DIB partnership will emphasize:

- *outreach to priority populations;*
- *engaging, inspiring and attracting students to defense missions;*
- *introduction of high-priority STW pathways;*
- *other jointly-established strategic priorities.*

Initial Observations from 5 STEM Ecosystem Case Studies

- **STEM ecosystems vary widely** in terms of maturity, partnerships, activities, and evaluation approaches
- **Full-time leadership and strong backbone support** is vital
 - Diversified fund-raising strategy is necessary to ensure funding, stability, and sustainability
- Interest in **leveraging digital platforms to achieve multiple goals**
 - Communicate, fundraise, improve access to rural populations, evaluate outcomes and impact (e.g., digital badging)
- Some ecosystems emphasize collective impact – but **little to no evidence of measurable impact**
- **Minimal engagement with DoD and DIB** on STEM activities
 - Ecosystems have limited awareness of opportunities to partner with both entities

Initial Observations from State-wide Initiatives

- **Every state in the US** has identifiable STEM education initiatives underway
 - Robustness is highly variable
- Two **motivating factors** are most often cited:
 - STEM competencies required for workforce to enable **economic growth**
 - Concerns relating to **low scores for math and science proficiency** among elementary and secondary school students
- More than half of the states have established **government-driven statewide STEM initiatives**
 - Of those, more than half have convened **public-private advisory bodies** that include industry representation
- All states leverage STEM-related **after-school activities** to augment classroom education
 - State-level **4-H programs** cite STEM-related activities in 90% of states
- **Outcome/impact measures** for STEM initiatives are rare
 - A number of states use math/science proficiency scores as a proxy

Initial Observations from Selected International Efforts

- TIES-led STEM Learning Ecosystem Community of Practice has **expanded internationally**
 - **Kenya, Israel, Mexico, Iceland, Canada**
- Explored STEM landscape in other nations as well
 - **Netherlands, Estonia, South Korea, Malaysia**
- International STEM initiatives appear motivated by the need for **economic growth**
 - Partnerships exist between developed and developing nations
- Multinational STEM initiatives are also underway
 - Some are **global** (e.g. Global Partnership for Education, which focuses on lower-income countries)
 - Some are **regional** (e.g. European Union STEM Coalition)
 - Some are **virtual** (e.g. Science Bits, a digital science curriculum created by the International Science Teaching Foundation)

DoD's STEM Engagement – An Illustrative Example

On 23 October 2018, one of the US Air Force's B-2 bombers made an emergency landing in Colorado Springs, CO, while enroute to its home base at the Whiteman Air Force Base in Missouri.

The nuclear-capable aircraft was forced to make the unscheduled landing due to the inadvertent flip of a switch combined with several rare malfunctions.

To **avoid such unintended and potentially catastrophic events**, the leadership at Whiteman Air Force Base (AFB) turned to a different kind of expert for a solution – **a student robotics team**.

The Stealth Panthers robotics team at Knob Noster High School near the base worked with pilots and engineers to create and test a 3D-printed switch cover prototype. This **\$1.25 cover now is used in all operational B-2s at Whiteman, as well as the aircraft's simulators**.

"I was really happy to know I would have a hand in something that would affect something much larger than me and my town"

~ a Knob Noster high school student on the robotics team



<https://www.thedrive.com/the-war-zone/b-2-flies-mock-strike-mission-from-iceland-to-alaska>



<https://www.stripes.com/news/students-design-1-25-piece-to-help-prevent-b-2-stealth-bomber-emergencies-1.566742>

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