



Big Data for Big Problems: Democratizing STEM Skills

**New England SENCER Center for Innovation
Fall 2014 Meeting**

Massachusetts College of Liberal Arts

Creating Solutions. Inspiring Action.™

Overview

The session will explore:

- BHEF's work to increase STEM degrees
- Develop new modeling tools to sharpen conversations about philanthropy, policy and practice
- BHEF's work in the application of emerging fields in undergraduate STEM education
- Implications for liberal arts and "work-readiness"

BHEF Summary

The Business-Higher Education Forum (BHEF) is a membership organization of Fortune 500 CEOs, college and university presidents, and other leaders who collaborate to promote innovation and enhance U.S. global competitiveness.

BHEF Mission

- BHEF members collaborate to increase baccalaureate attainment and improve alignment between higher education and the workforce by creating undergraduate pathways to produce a diverse, highly-skilled talent pool to meet demand in emerging fields.
- BHEF convenes business and academic leaders, and promotes effective undergraduate program design and development to create workforce solutions, and scaling guidance to increase the impact on baccalaureate outcomes.
- BHEF facilitates peer-to-peer engagement by its members and inspires peer leaders to act.

Shape the National Agenda for Business & Education Collaboration through Convenings

- Through member meetings and convenings, BHEF members influence the national agenda on higher education and workforce.
- BHEF educates and fosters dialogue through access to its networks and peer-to-peer learning convenings.
- BHEF partners with industry associations to advance BHEF's sector scaling strategy.

Influence Practice & Policy through Research & Thought Leadership

- BHEF promotes innovative higher education solutions and analyzes workforce needs and trends to inform policy and practice.
- BHEF builds evidence through research and tools such as the BHEF U.S. STEM Undergraduate Model™.
- BHEF advances policy on behalf of its members through thought leadership that influences national dialogue and public policy.

Address Workforce Needs through Programmatic Initiatives

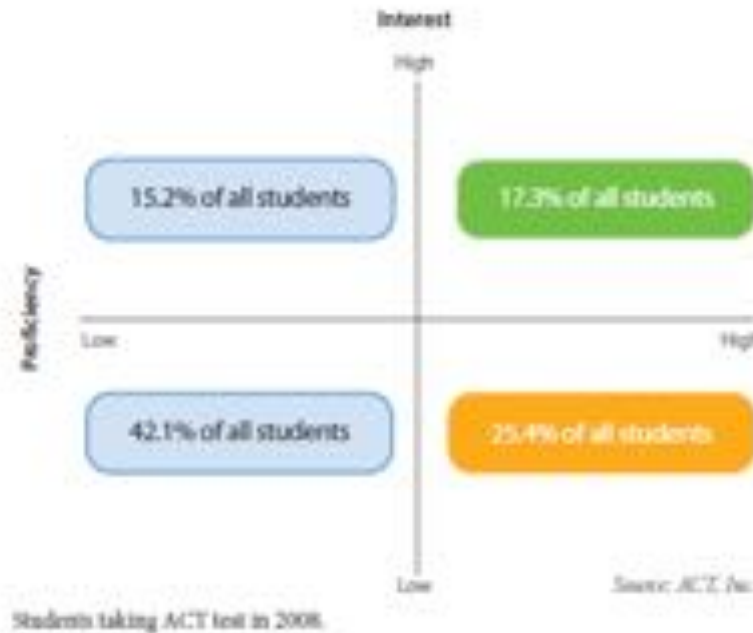
- BHEF's National Higher Education and Workforce Initiative (HEWI) promotes strategic business-higher education partnerships to advance projects that address regional workforce needs in emerging fields that drive innovation.
- On the national level, BHEF disseminates the learnings from its regional workforce projects and supports the scaling of effective practices through field and sector networks.

**BHEF's work is rooted in a deep,
evidence-based understanding of the
education & workforce challenges facing
this country**

The STEM Education-Workforce Challenge

Despite decades of investment in P-12 STEM education, interest in STEM careers among college-ready 12th graders remains low

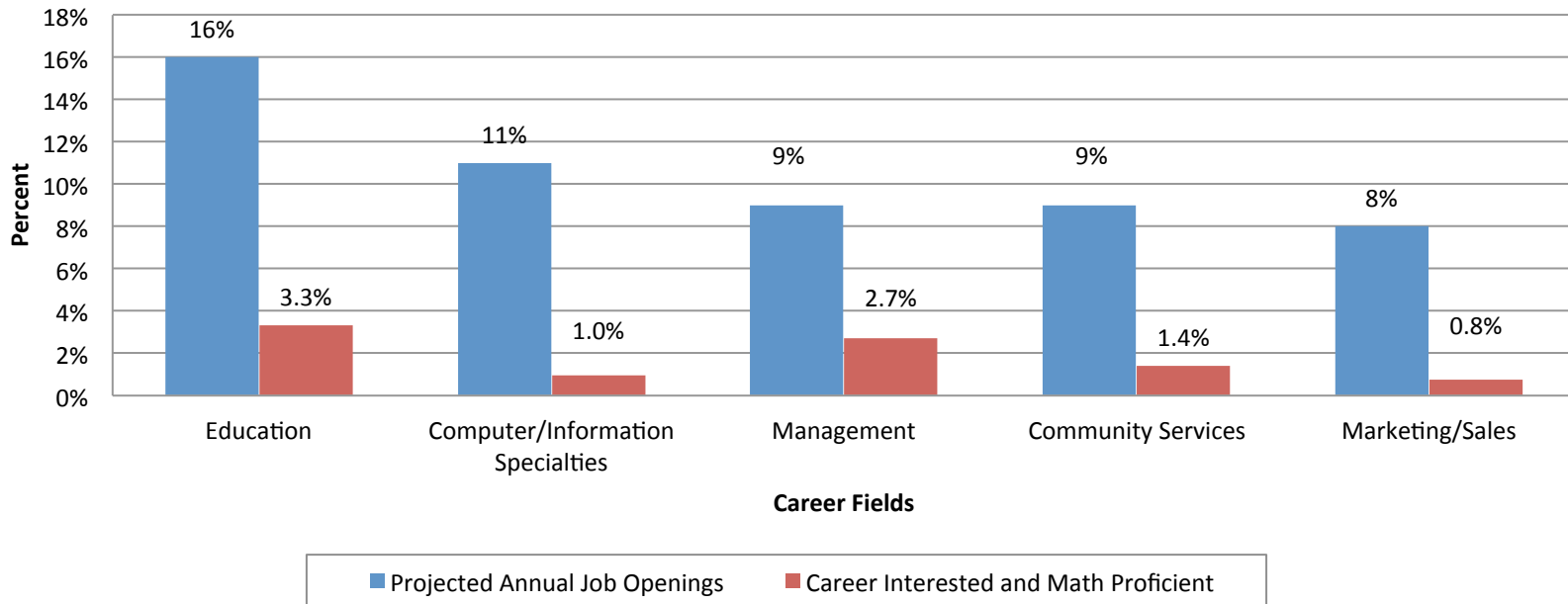
Figure 5: Distribution of STEM Interest and Mathematics Proficiency among 12th Graders



The STEM Education-Workforce Challenge

Workforce projections indicate on-going shortages, especially in high growth career fields

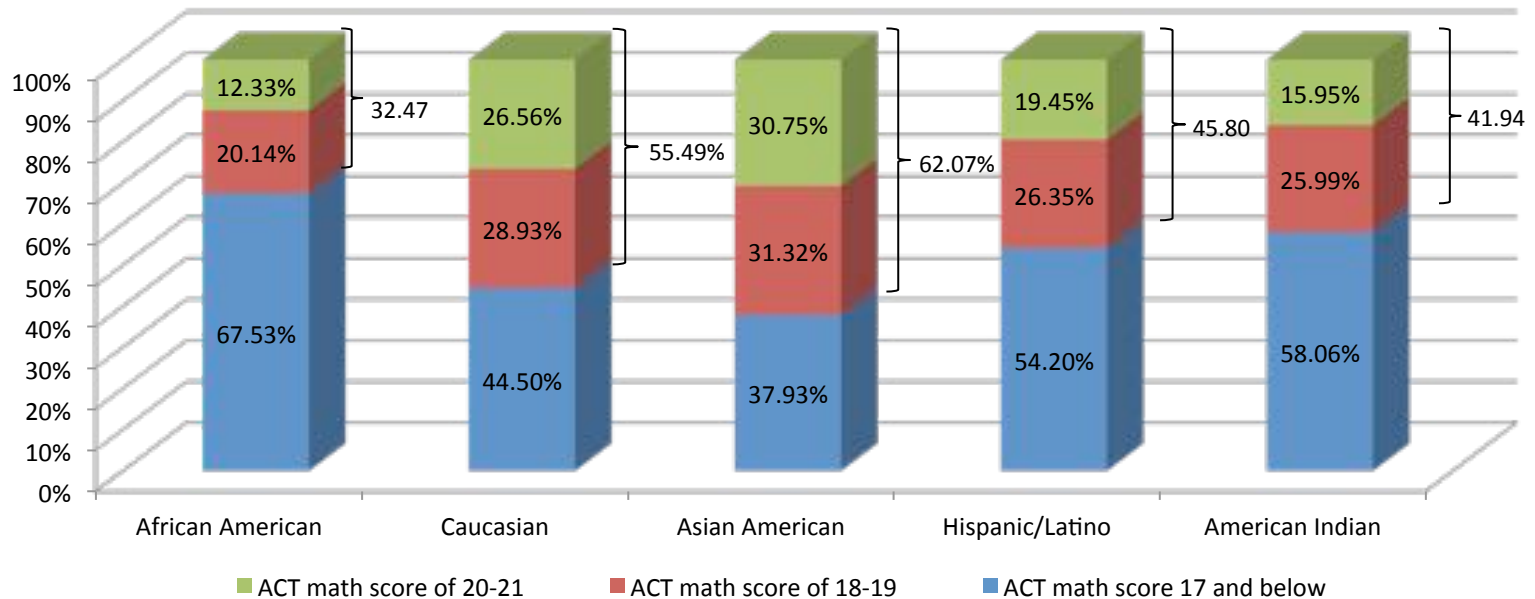
12th Grade Student Interest and Proficiency in High-Growth Career Fields



**BHEF has explored
evidence of policies and
practices that moves
students into the
northeast quadrant and
boosts persistence in
STEM majors**

How much can we increase the STEM workforce if we accelerate math learning?

12th grade STEM-interested students scoring below the math proficiency benchmark, by race/



SOURCE: This analysis is derived from a 2008 longitudinal data set provided to BHEF by ACT, that provides student interest and proficiency scores on scores on 8th grade (Explore), 10th grade (Plan), and 12th grade (ACT) exams (collectively known as EPAS), along with demographic data (n=148,540). Only students with scores from all three exams are included in this dataset.

The BHEF U.S. STEM Education Model

- Developed by BHEF staff and Raytheon engineers and donated to BHEF in 2009
- Provides a systems perspective on strategies for intervening in STEM education
- Available through www.bhef.com
- Web version at:
<http://forio/simulate/bhef/u-s-stem-education-model-overview/>

The U.S. STEM Education Model

The U.S. STEM Education Model allows users to simulate the impact of various scenarios designed to increase the number of students who pursue science, technology, engineering and mathematics (STEM) majors and careers.

How to Simulate STEM Education Policy Decisions

The U.S. STEM Education Model begins in equilibrium, with no expected change to the annual number of STEM college graduates. This model allows you to simulate how various policy changes might be expected to affect this number.

The Model Management Team

The U.S. STEM Education Model is managed through a partnership between the Raytheon Company, the Business-Higher Education Forum, and The Ohio State University. Email questions and comments to bhef@bhef.com

Start Simulation



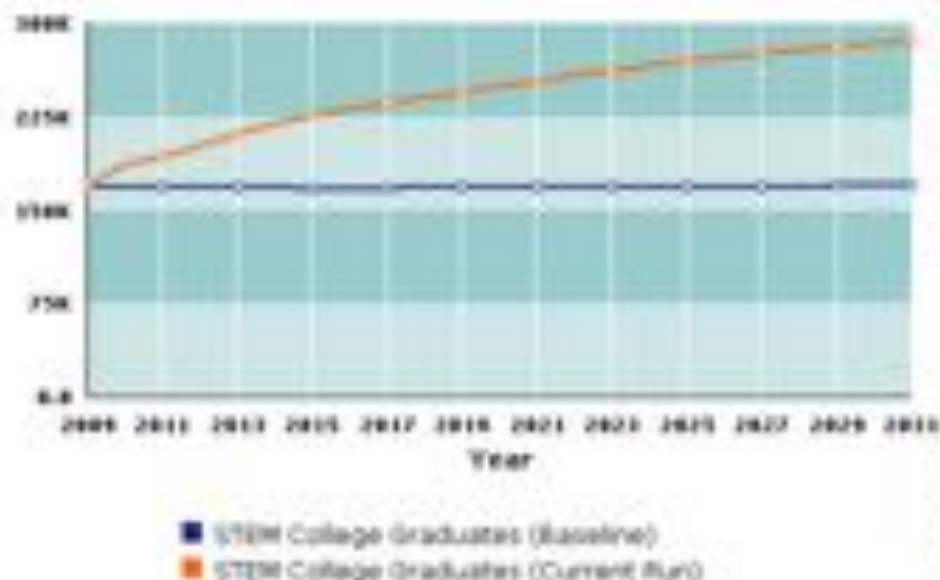
Policy Scenario 3

Adopt Complimentary P-16 Education Approaches

This policy scenario examines how multiple policy scenarios combine to increase the number of college students earning STEM degrees.



STEM Students



The baseline shows the model of equilibrium, with a constant 13% annual attrition of all teachers and limited student participation in cohort programs.

But what if we adopted two policies, one to retain more STEM capable teachers and the other to increase student participation in college cohort programs?

[Run This Scenario](#)

This scenario decreased the annual percentage of STEM capable teachers leaving a teaching position from 13% to 7% and increased student participation in cohort programs to 50%. As a result of the combined policy intervention, the model forecasts greater increase in STEM graduates than we would have seen from just one of the policy changes.

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Relevant Findings from the BHEF STEM Education Model

- Interest in STEM and proficiency in math are key and independent factors in student choice of STEM majors/careers
- Strengthening undergraduate education yields an early and significant return on investment
- Interventions such as student team/cohort learning can significantly increase student persistence in STEM fields

Introduction

Metropolitan College (MC)

Metropolitan College (MC) Results

Customized Learn & Earn

Customized Learn & Earn Results



Learn and Earn

This model allows users to simulate the effects of integrating postsecondary education 'Learn and Earn' programs into the workplace.

In particular, you will be able to see how current workload, desired workforce expansion, and participation in Learn and Earn Programs effect workforce composition, employee productivity (workforce productivity and morale), and employer benefits (potential labor pool, desired workforce, and hiring per slot).

Questions? Email bhef@bhef.com

Simulation
sponsored by:



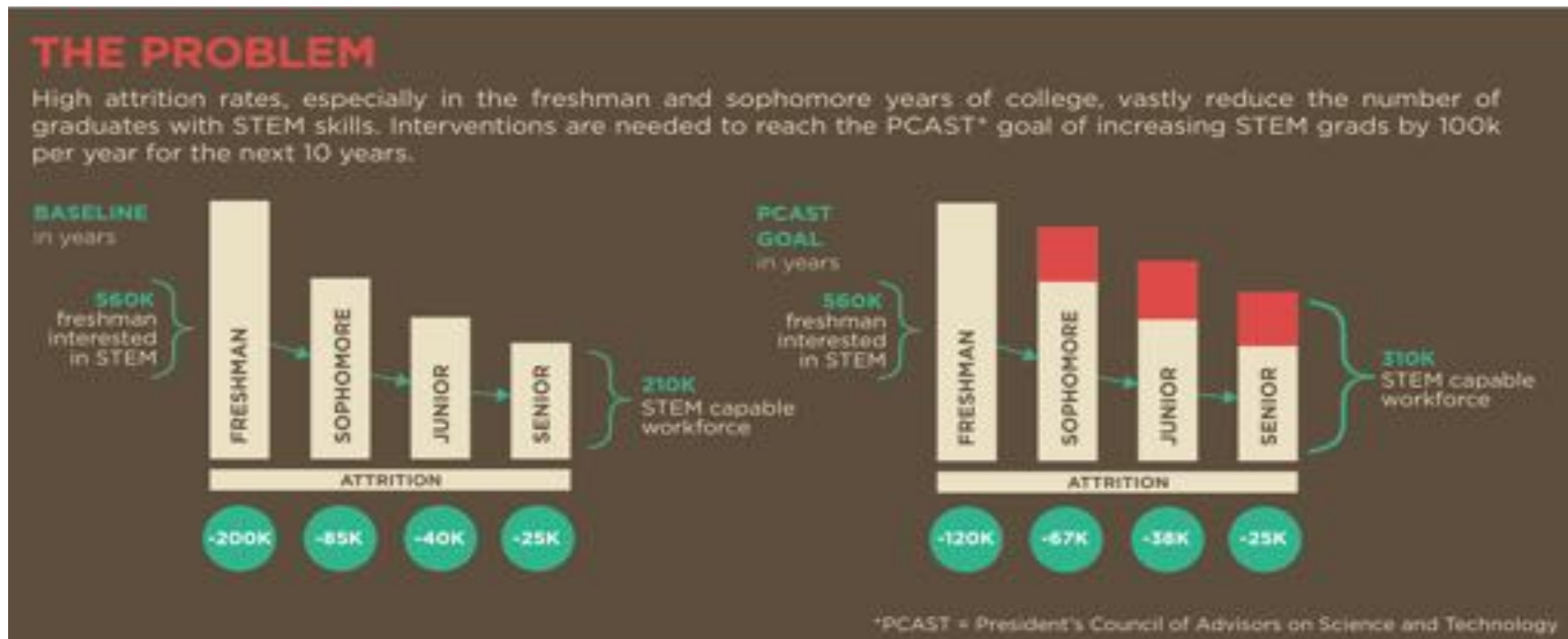
Enter the simulation

Why simulation modeling?



The STEM Undergraduate Challenge

Few Proficient and Interested High School Students + High Attrition of STEM Undergraduates = STEM Workforce Shortage



The Model Shows What it Will Take to Answer the President's STEM Call to Action

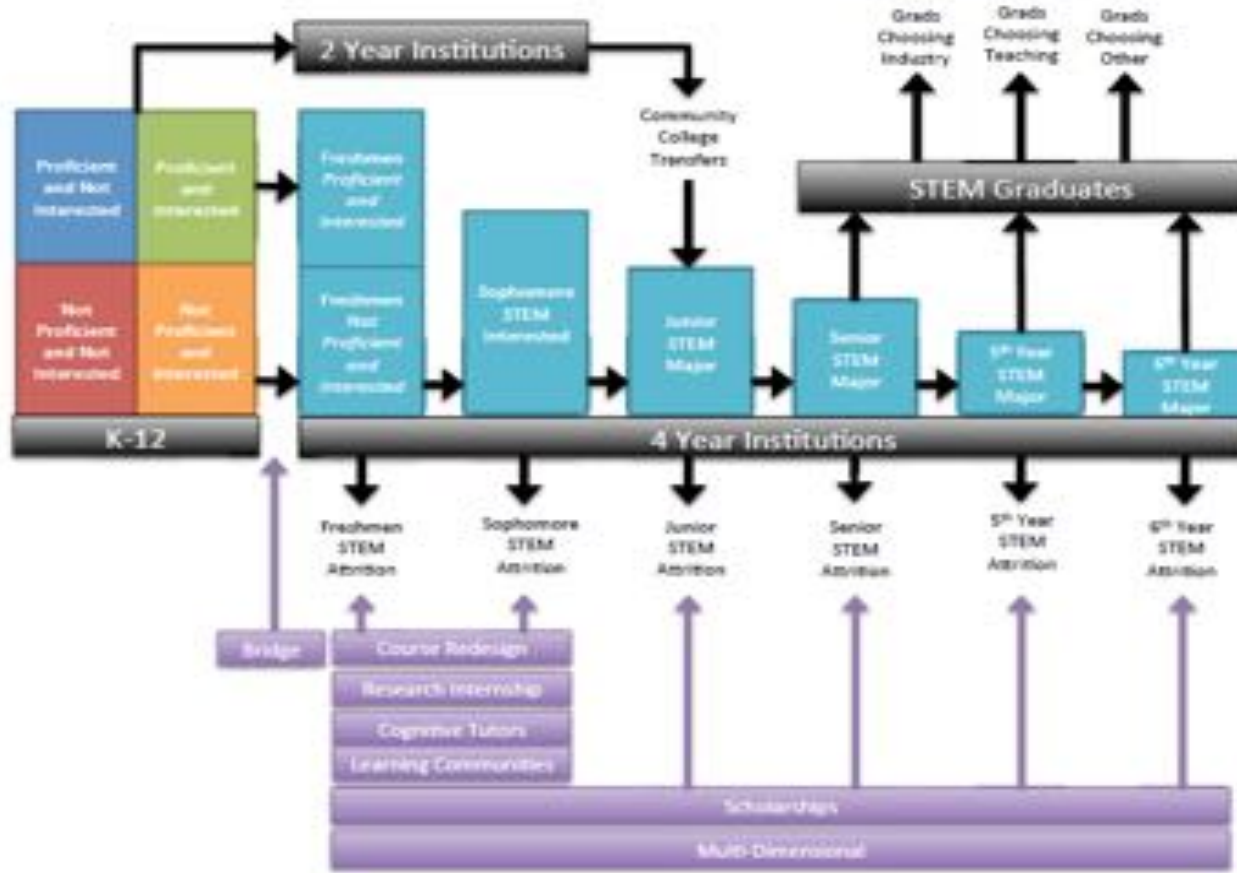
- The PCAST *Engage to Excel Report* Created a Common Metric
 - Built consensus around the first two years of undergraduate education (a key finding from the U.S. STEM Education Model®)
 - Created a central resource for identifying high-impact exemplar programs
- The U.S. STEM Undergraduate Model is Calibrated to the 1M Goal
 - Simulate evidence-based interventions at scale to understand response required
 - Test highest-leverage impacts under 100% scale and fidelity
 - Test combinations of interventions through multidimensional programs



Evidence-based Intervention Strategies Modeled

1. Undergraduate Research Internships
2. Bridge Programs
3. Student Learning Communities
4. Scholarships for Service
5. Course Redesign to Induce Active Engagement
6. Cognitive Tutors
7. Multidimensional Programs

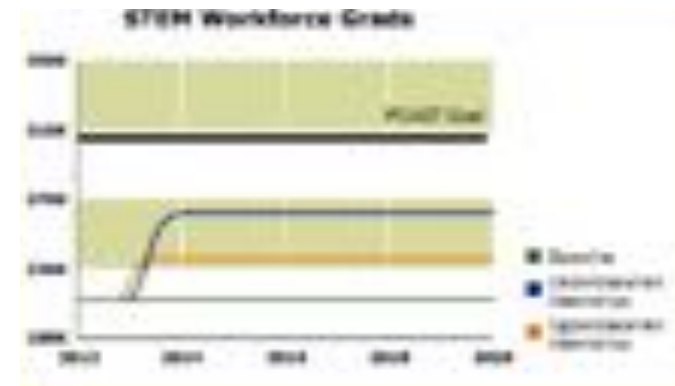
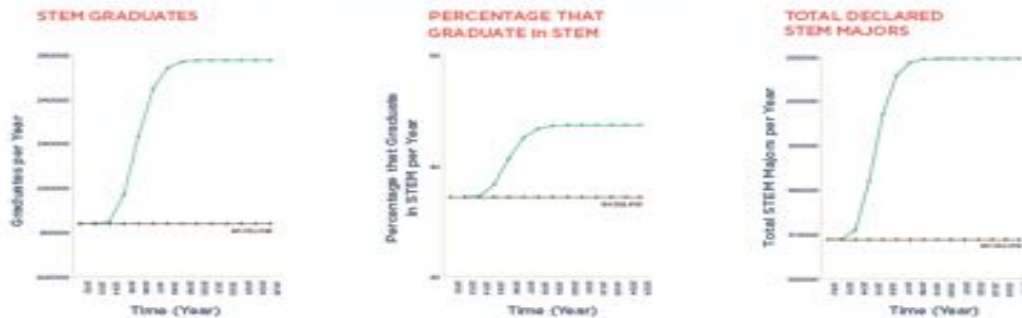
Representation of the U.S. STEM Undergraduate Model



Strategies and Solutions

1. Focus interventions in the critical **first two years of college** of STEM undergraduate education
2. **Disruptive/systemic institutional interventions**, such as cognitive tutors can lower per-student costs and improve retention
3. A strategy of employing **blended intervention types** (i.e. student-focused and institutional) creates synergistic effects
4. Single interventions alone at reasonable scale are not enough to reach PCAST's goal, **multidimensional programs** are required

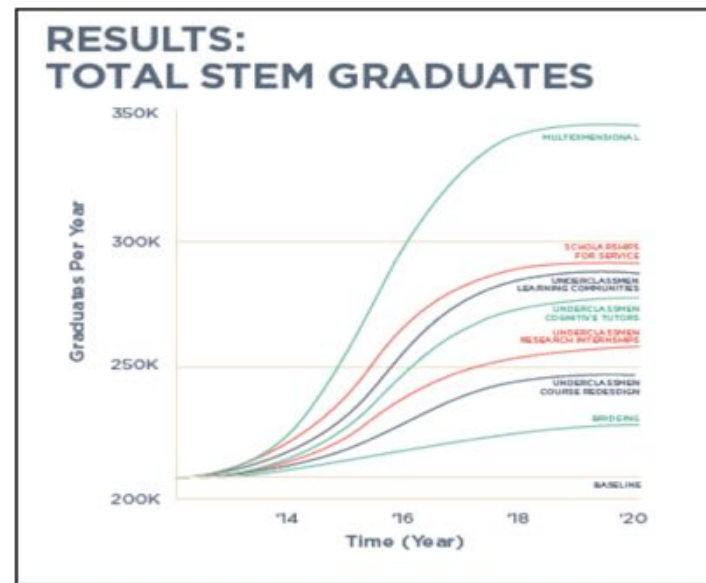
OUTPUTS The model simulates effects of selected interventions and comparisons of interventions.



Multidimensional Interventions

- To simulate the effect of combinations of multiple interventions, three highly successful multidimensional programs were modeled
 - The Meyerhoff Scholars Program (*The University of Maryland, Baltimore County*)
 - The Freshman Research Initiative (The University of Texas, Austin)
 - The Louis Stokes Alliances for Minority Participation
- Multidimensional programs can have a greater impact than single-focus efforts due to intervention synergies

The President's One Million goal is attainable through investments in multidimensional programs

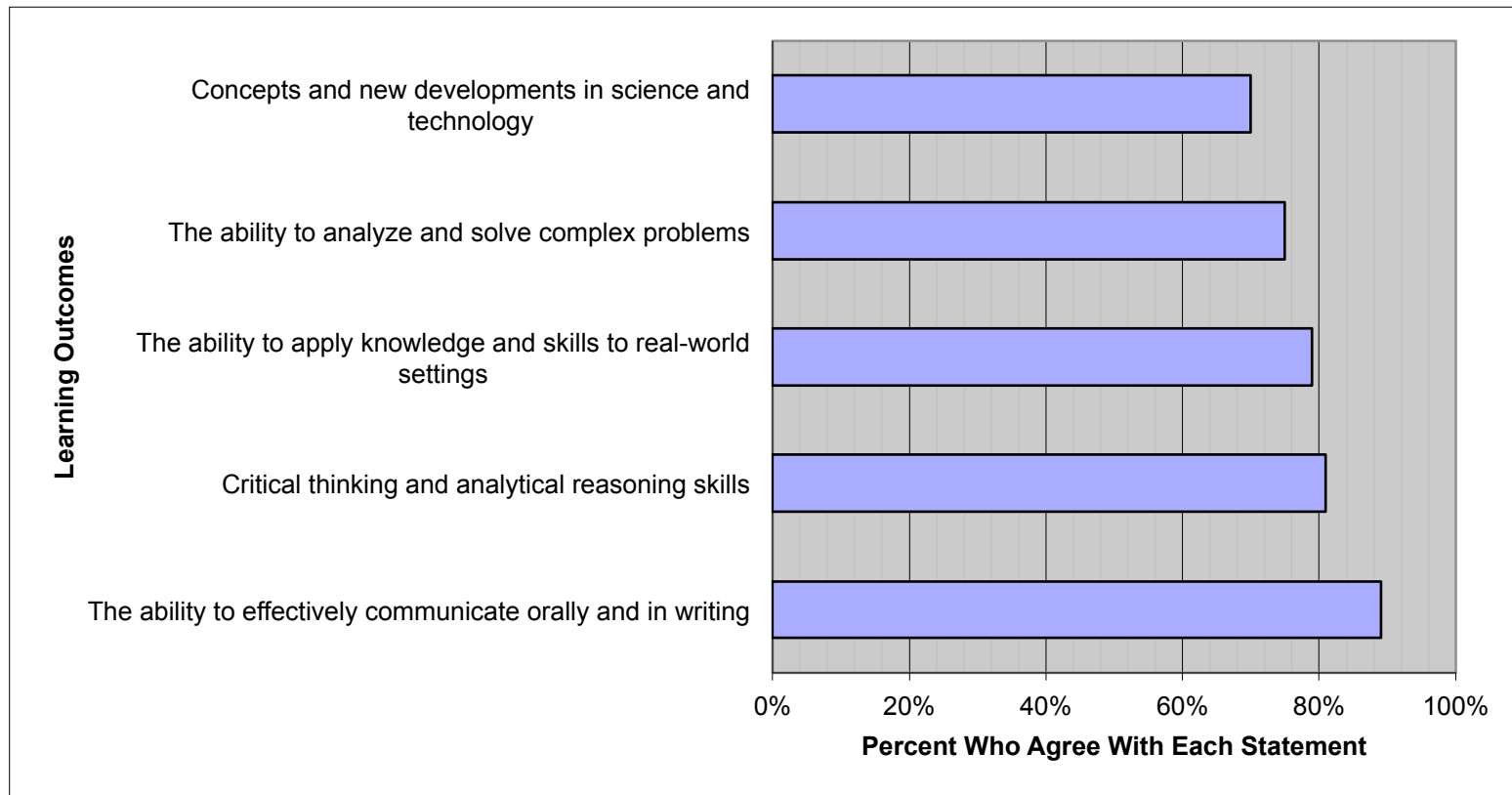


Key Impacts of the ONR Modeling Project

By including a range of options for research-backed interventions, the Model provides federal and state agencies, university systems, private and corporate philanthropy, and other stakeholders a tool for envisioning new pathways for collaboration and leverage to ensure limited funds are having the greatest effect.

- Provides a range of stakeholders with an evidence-based mechanism for understanding funding opportunities and options at scale
 - Cross-sectoral partnerships will be essential to reach the one million goal
- Enables common understanding for how we can achieve the one million goal
 - Shared responsibility around a joint goal
 - Targeted, informed investments to maximize STEM education and workforce outcomes
- Creates a means for cutting-edge peer-reviewed research to continuously inform policy decisions

Employers expect employees to use a broad set of skills

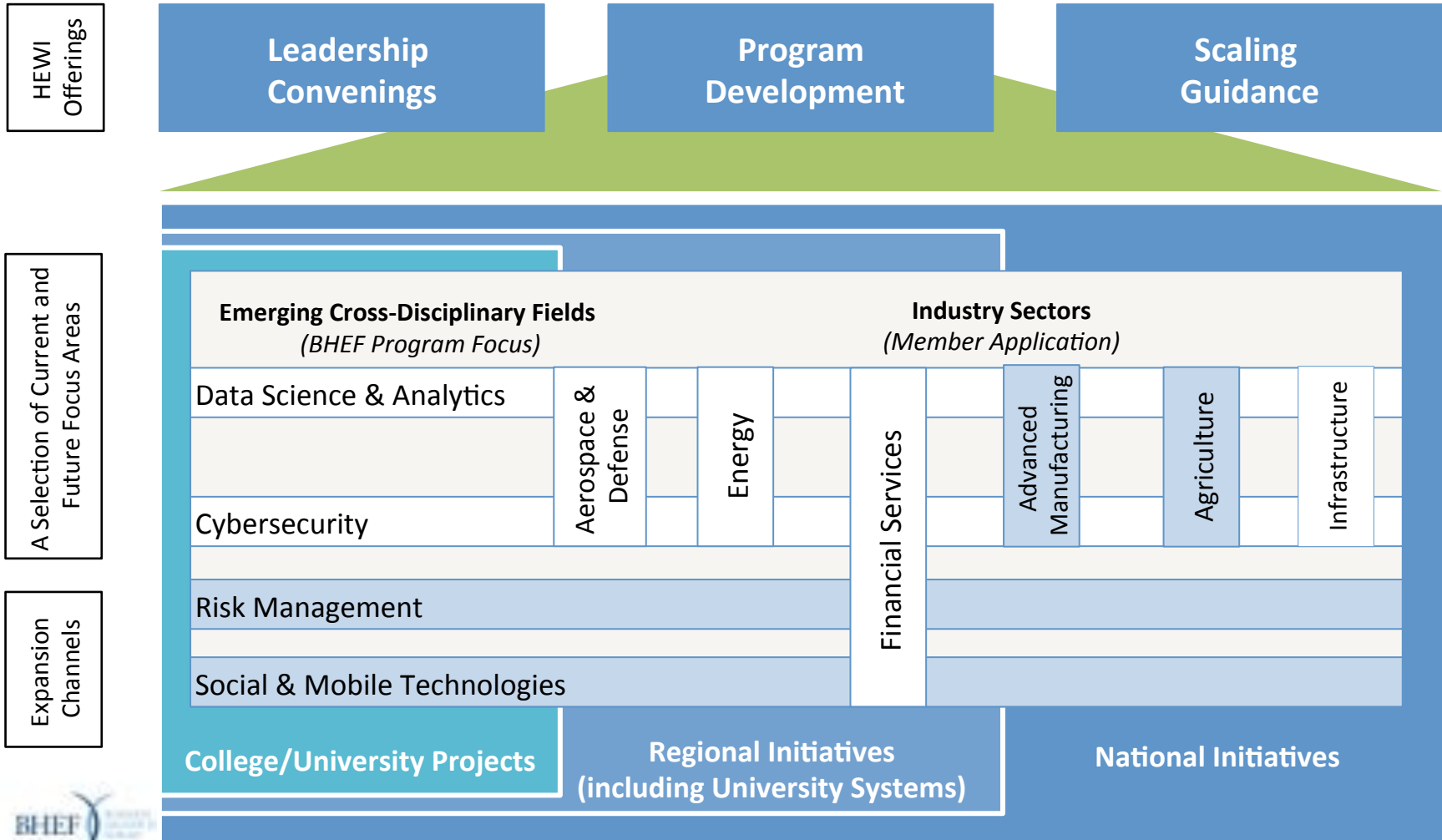


SOURCE: Hart Research Associates. (2010). *Raising the Bar: Employers' Views on College Learning in the Wake of the Economic Downturn.*

BHEF Strategy

National Higher Education and Workforce Initiative Framework

Through HEWI, BHEF catalyzes regional market-driven projects in emerging cross-disciplinary fields in partnership with member academic institutions and companies in high-demand industries.



National Higher Education and Workforce Initiative: *Programmatic Expansion Opportunities*

BHEF has identified regional and institution-level opportunities to expand impact; we are in the process of evaluating the opportunities and defining the level of effort to fund and resource each.

| Opportunity | Field / Sector | Potential Partners | BHEF Role |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Water Science Data Science Infrastructure | Utilities / Sustainability | CSU, UTEP, UNM, NMS, Parsons | Support, facilitate development of Rio Grande Compact; Engage partners in BHEF's national data network; Connect project with BHEF members working in data science |
| Cybersecurity in Greater Washington, D.C. and Tidewater, VA | Cybersecurity / Aerospace and defense | Accenture, McAfee, Northrop Grumman, ONR, Parsons, Raytheon, Greater Washington Board of Trade, George Washington University | Leverage BHEF regional cyber network infrastructure and program experience to create initiatives in higher education institutions in D.C., Northern and Tidewater, VA |
| Data science in Columbus metropolitan area | Data science / Health care, retail, energy, insurance, financial services, R&D | OSU, IBM, Columbus Collaboratory (AEP, Battelle, Cardinal Health, Huntington Bancshares, L. Brands, Inc., Nationwide, OhioHealth) | Member-led project by OSU |
| Financial services in NYC | Cybersecurity, data science, risk management, and social and mobile technologies / Financial services (banking, investment, services, and insurance) | TIAA-CREF, Perella Weinberg Partners, Accenture, State Farm Insurance Companies, Principal Financial Group, Business Roundtable | Member-led project by BHEF Financial Services CEO Leadership Group |

For additional information:

- U.S. STEM education Model:
<http://forio.com/simulate/bhef/u-s-stem-education-model/overview/>
- U.S. STEM Undergraduate Model:
<https://forio.com/simulate/bhef/u-s-stem-undergraduate-model/overview/>
- National Higher Education and Workforce Initiative (HEWI)
<http://www.bhef.com/our-work>
- HEWI Publications, including *Forging Strategic Partnerships for Undergraduate Innovation and Workforce Development* and *Strategy in Action: Building the Cybersecurity Workforce in Maryland*
<http://www.bhef.com/publications/national-higher-education-and-workforce-initiative-forging-strategic-partnerships>
<http://bhef.com/publications/strategy-action-building-cybersecurity-workforce-maryland>