STEM Skills for All:
Quantitative Literacy in the 21ˢᵗ Century

SENCER 2015 Summer Institute

Worcester Polytechnic Institute

Creating Solutions. Inspiring Action.

Overview

The session will explore:

- The changing economic and educational landscape

- How BHEF has attempted to address tectonic shifts in both

- 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**	Influence Practice & Policy through **Research & Thought Leadership**	Address Workforce Needs through **Programmatic Initiatives**
• 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.	• 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.	• 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

Tectonic Shifts: High-Skill Jobs are Increasing, Middle-Skill Jobs are Changing, and Low-Skill Jobs are Declining Dramatically
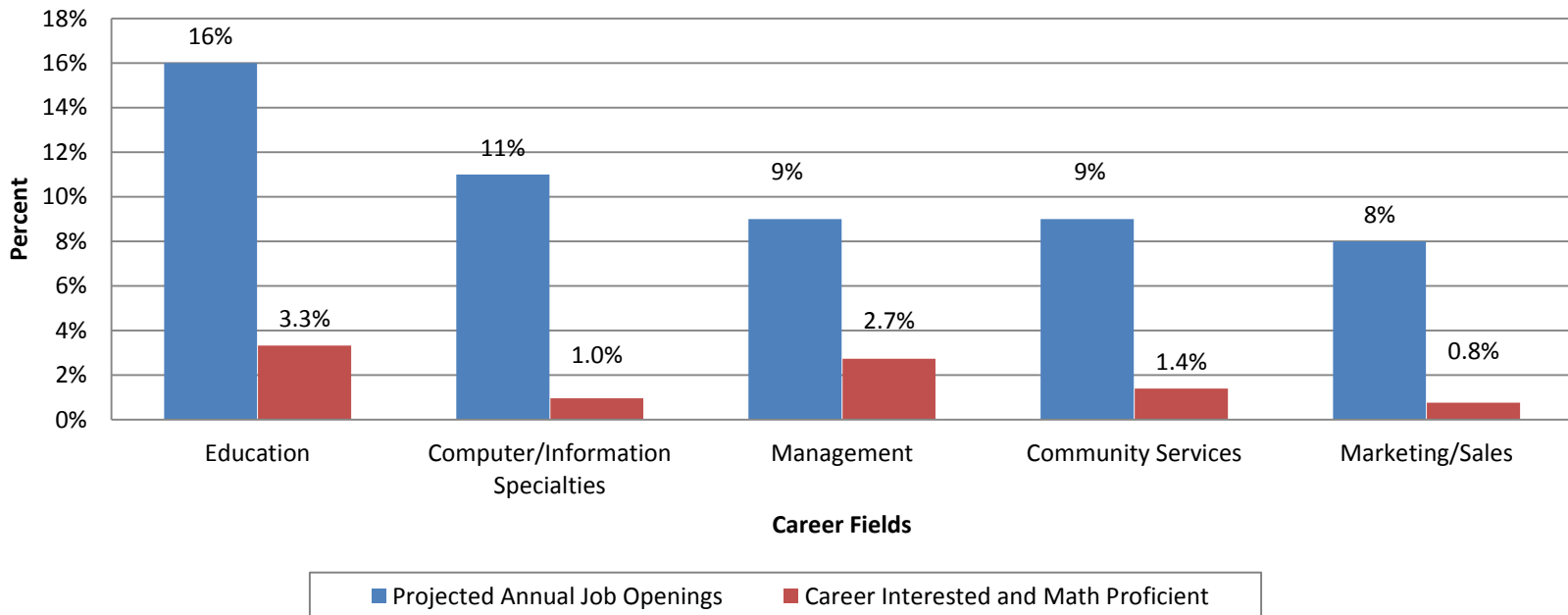

SOURCE: 2015, Georgetown University Center on Education and Workforce analysis of data from the U.S. Census Bureau, 1967-2007. *Values may not sum to total due to rounding

The STEM Education-Workforce Challenge

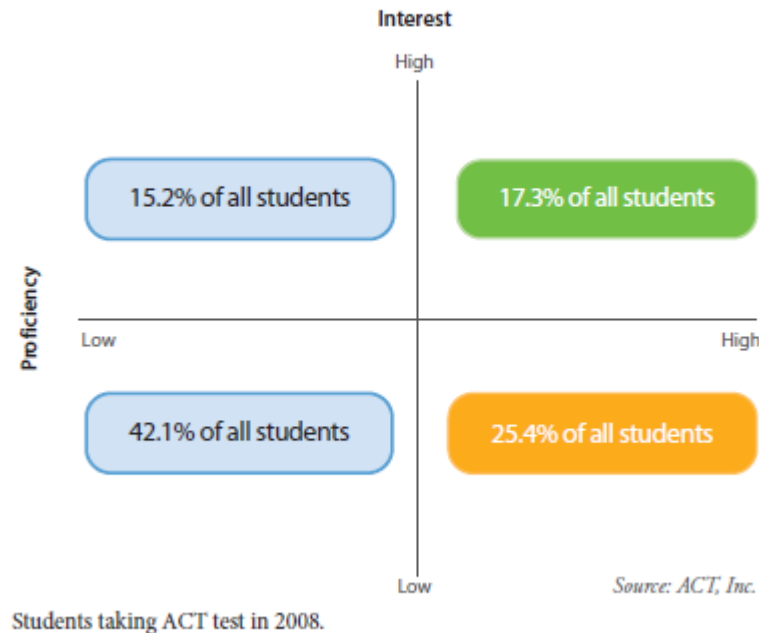Workforce projections indicate on-going shortages, especially in high growth career fields

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

Bar chart — Percent vs Career Fields:

- Education: Projected Annual Job Openings 16%, Career Interested and Math Proficient 3.3%
- Computer/Information Specialties: 11%, 1.0%
- Management: 9%, 2.7%
- Community Services: 9%, 1.4%
- Marketing/Sales: 8%, 0.8%

Legend: ■ Projected Annual Job Openings ■ Career Interested and Math Proficient

SOURCE: Derived from ACT's *The Condition of College and Career Readiness*, 2010

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

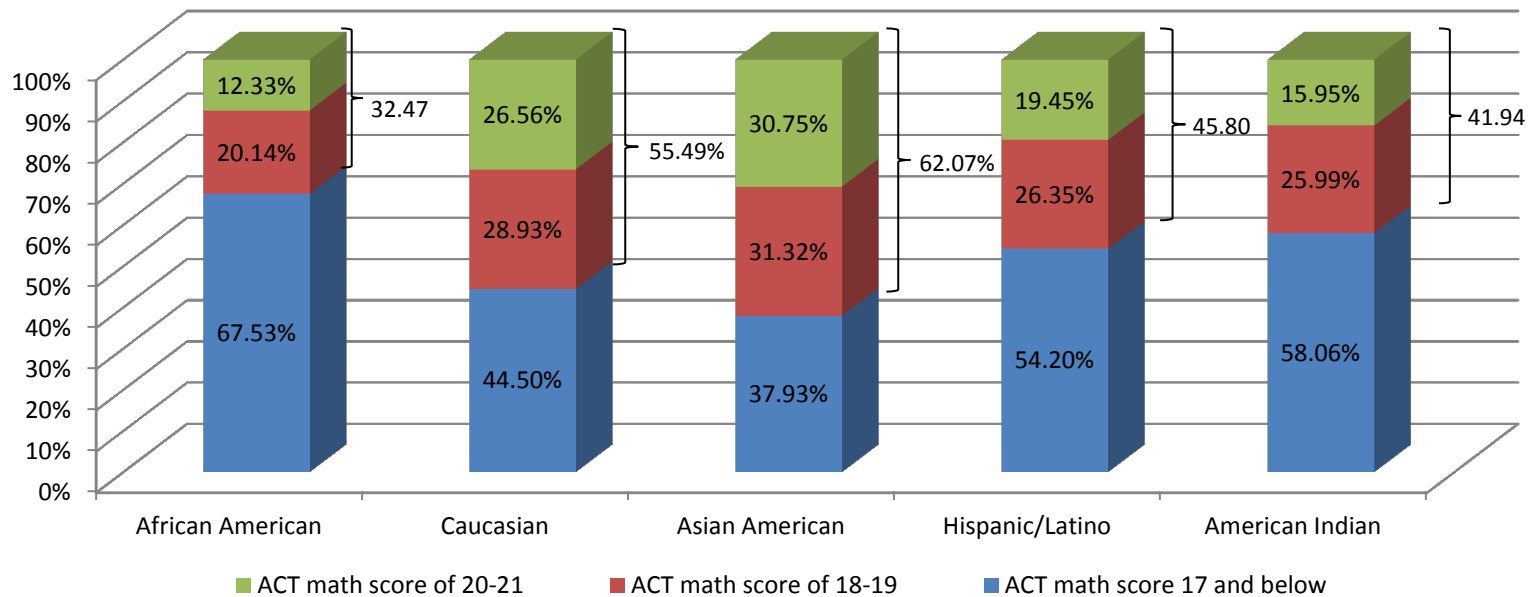Figure 5: Distribution of STEM Interest and Mathematics Proficiency among 12th Graders

Interest

	Low	High
Proficiency High	15.2% of all students	17.3% of all students
Low	42.1% of all students	25.4% of all students

Source: ACT, Inc.

Students taking ACT test in 2008.

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

Category	ACT math score of 20-21	ACT math score of 18-19	ACT math score 17 and below	Bracket
African American	12.33%	20.14%	67.53%	32.47
Caucasian	26.56%	28.93%	44.50%	55.49
Asian American	30.75%	31.32%	37.93%	62.07
Hispanic/Latino	19.45%	26.35%	54.20%	45.80
American Indian	15.95%	25.99%	58.06%	41.94

■ ACT math score of 20-21   ■ ACT math score of 18-19   ■ ACT math score 17 and below

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

BHEF BUSINESS-HIGHER EDUCATION FORUM®

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
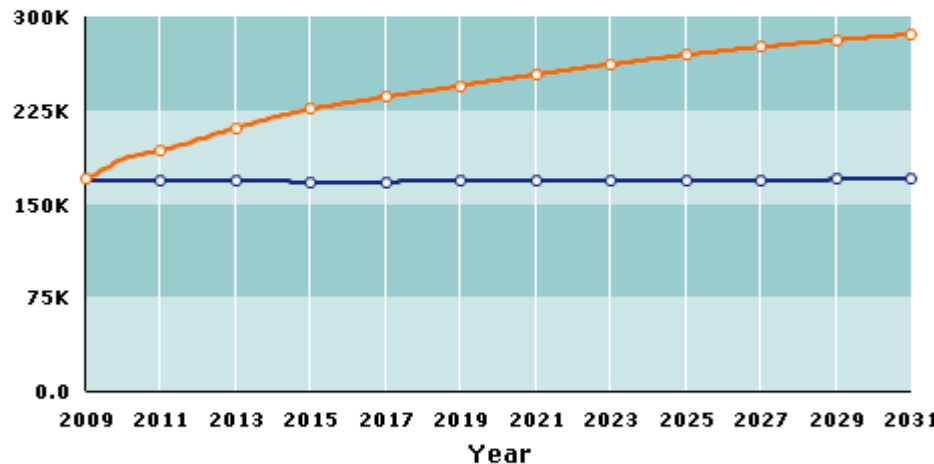
bhef@bhef.com

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

- STEM College Graduates (Baseline)
- STEM College Graduates (Current Run)

The baseline shows the model at 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.

Back

Relevant Findings from the BHEF
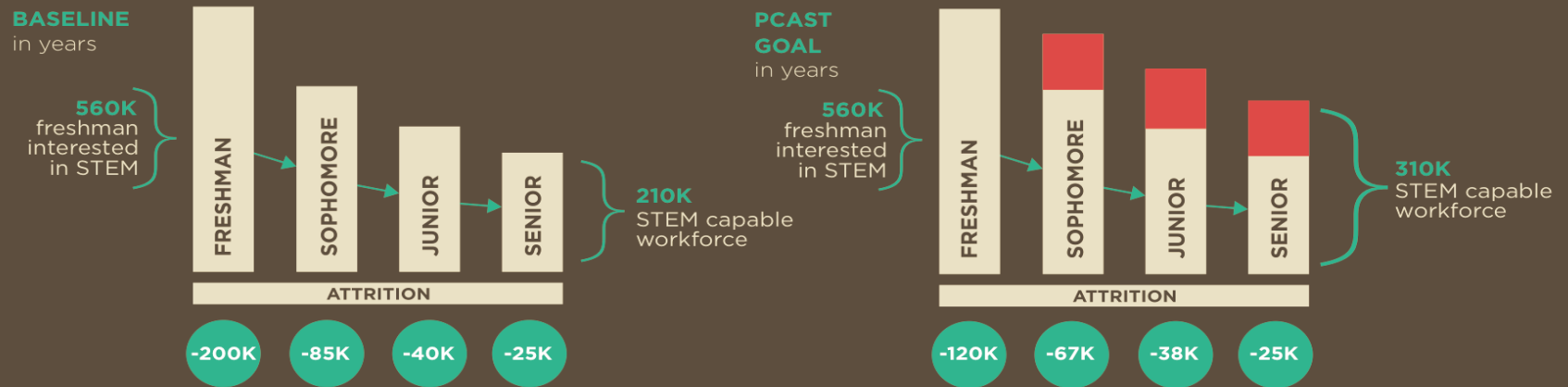# STEM Education Model

- 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

The STEM Undergraduate Challenge

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

THE PROBLEM

High attrition rates, especially in the freshman and sophomore years of college, vastly reduce the number of graduates with STEM skills. Interventions are needed to reach the PCAST* goal of increasing STEM grads by 100k per year for the next 10 years.

BASELINE in years

560K freshman interested in STEM

FRESHMAN · SOPHOMORE · JUNIOR · SENIOR

ATTRITION

210K STEM capable workforce

-200K · -85K · -40K · -25K

PCAST GOAL in years

560K freshman interested in STEM

FRESHMAN · SOPHOMORE · JUNIOR · SENIOR

ATTRITION

310K STEM capable workforce

-120K · -67K · -38K · -25K

*PCAST = President's Council of Advisors on Science and Technology

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 <u>the first two years of undergraduate education</u> (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

# Representation of the U.S. STEM Undergraduate Model
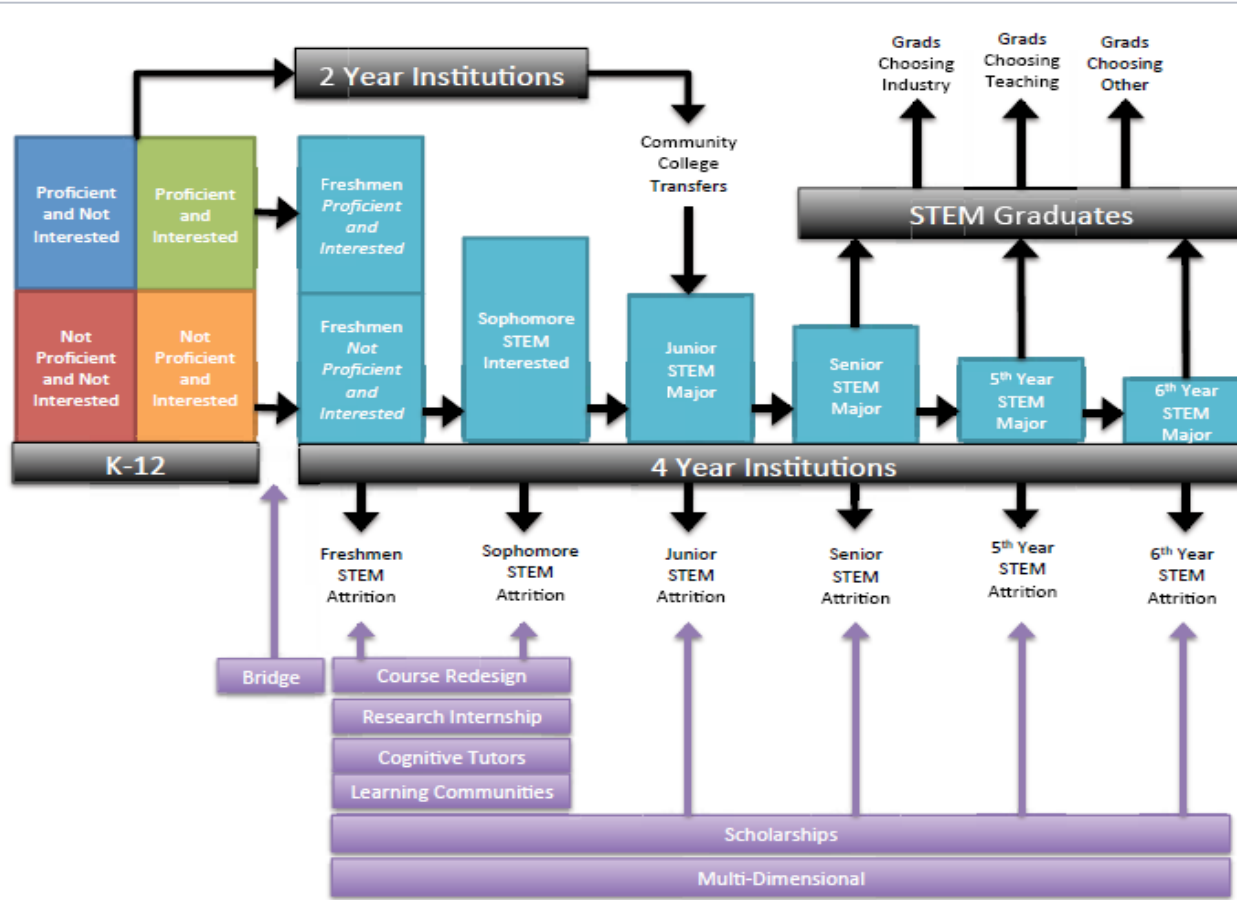
Strategies and Solutions

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
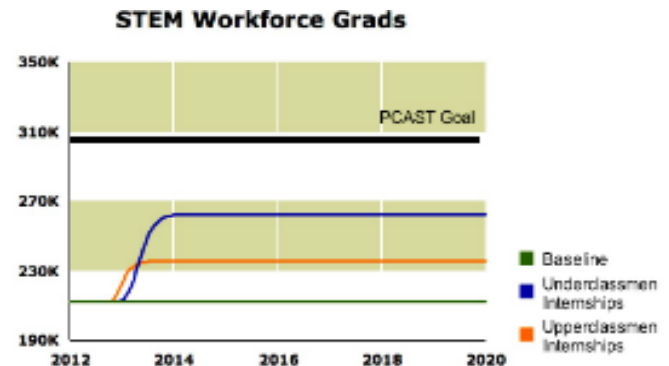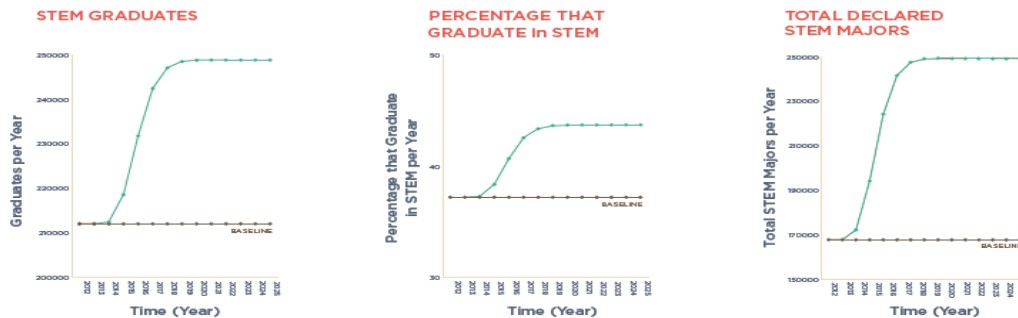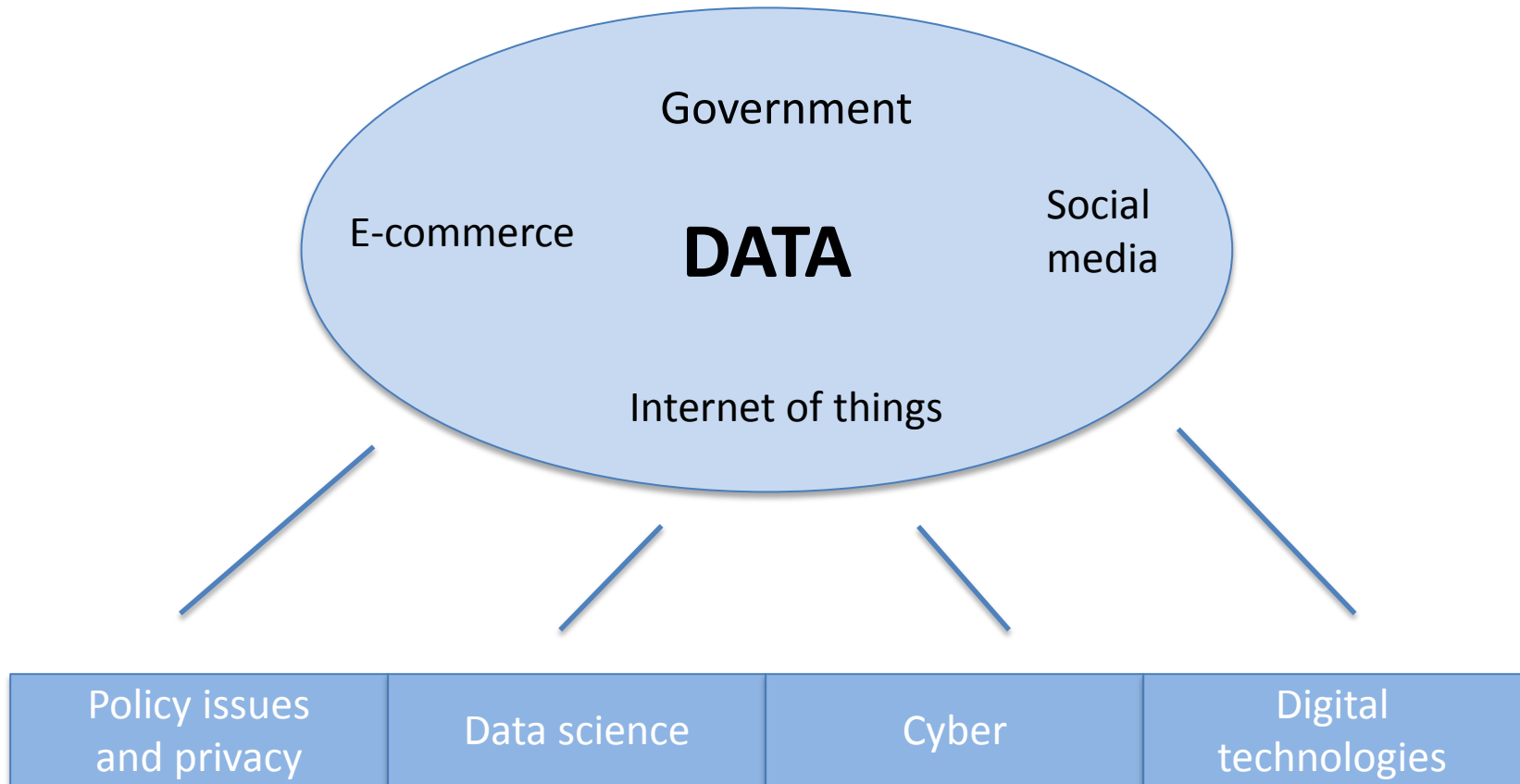
STEM Skills in the 21st Century Workplace

BHEF member and staff have documented that demand for "STEM skills," e.g., data science and analytics skills extends well beyond STEM fields.

Organizations in every sector have become "data-intensive enterprises" using date to innovate and unlock value requiring new skills from all employees

How we think about data and the tools and talent to drive innovation and value in data-intensive enterprises

Government

E-commerce

DATA

Social media

Internet of things

Policy issues and privacy	Data science	Cyber	Digital technologies

The Data Science-Enabled Liberal Arts Major

| Core Competencies	Majors	21st Century Skills (Interdisciplinary skills)	Analytics-intensive Organizations (Opportunities organizations can provide to students, faculty and the higher education institution)		
Programming	Astronomy	Working effectively in cross-disciplinary teams	Undergraduate student research experiences	Funded research	
	Economics				
Data systems	Education	Communications	Co-design curriculum with higher education partners	Co-ops	
	Finance				
Analytics	Literary History	Problem solving	Internships	Mentorships	
	Political Science				
Statistics and Modeling	Psychology	Critical thinking	Recognition of the B.S. in data science in the hiring process		
	Visual Arts				

Inspiring Action.

BHEF has explored the implications for the liberal arts and a new definition of the:

"Work-Ready Graduate"

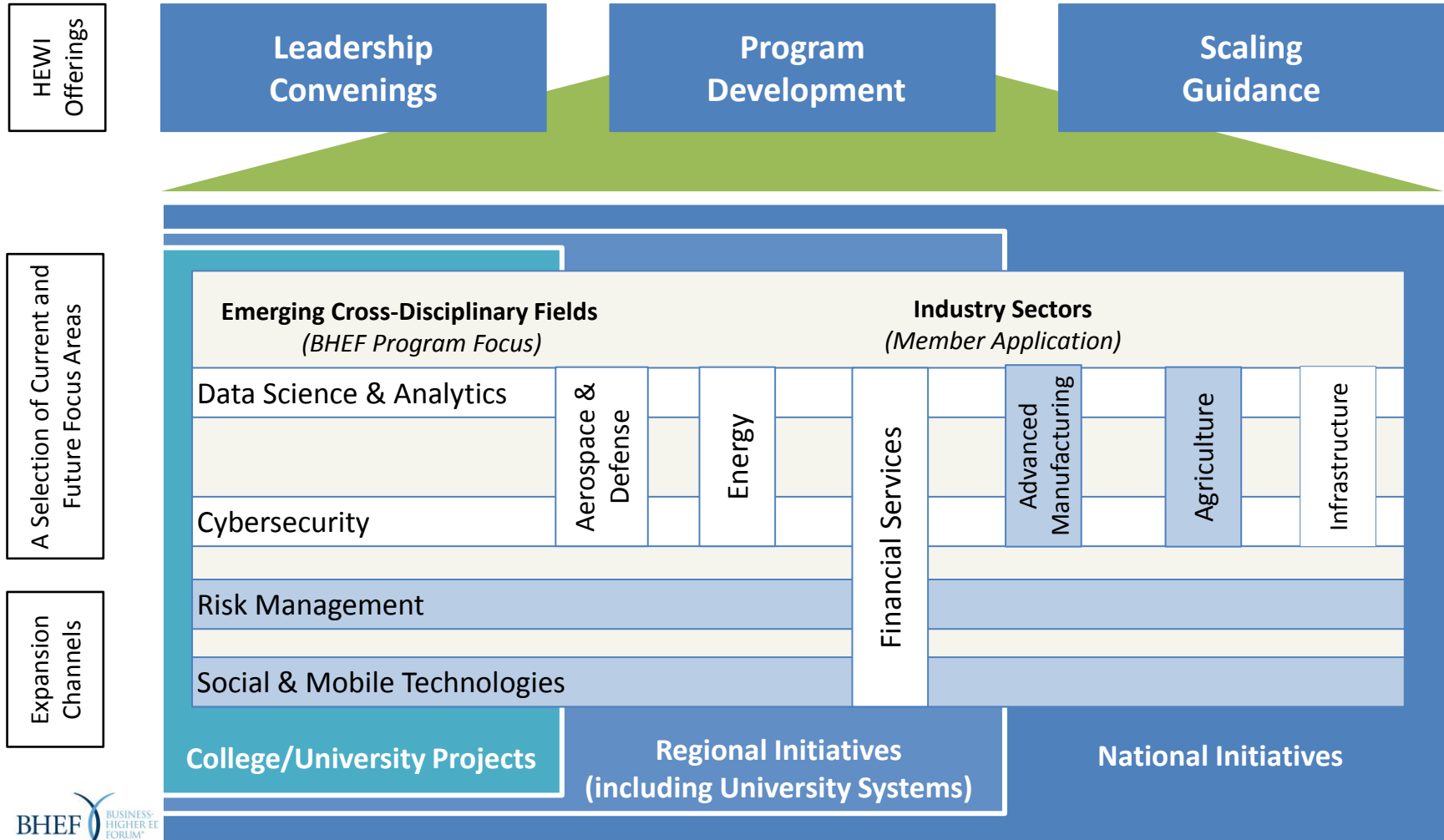# Employer Priorities on College Learning Outcomes Leading to Work Readiness
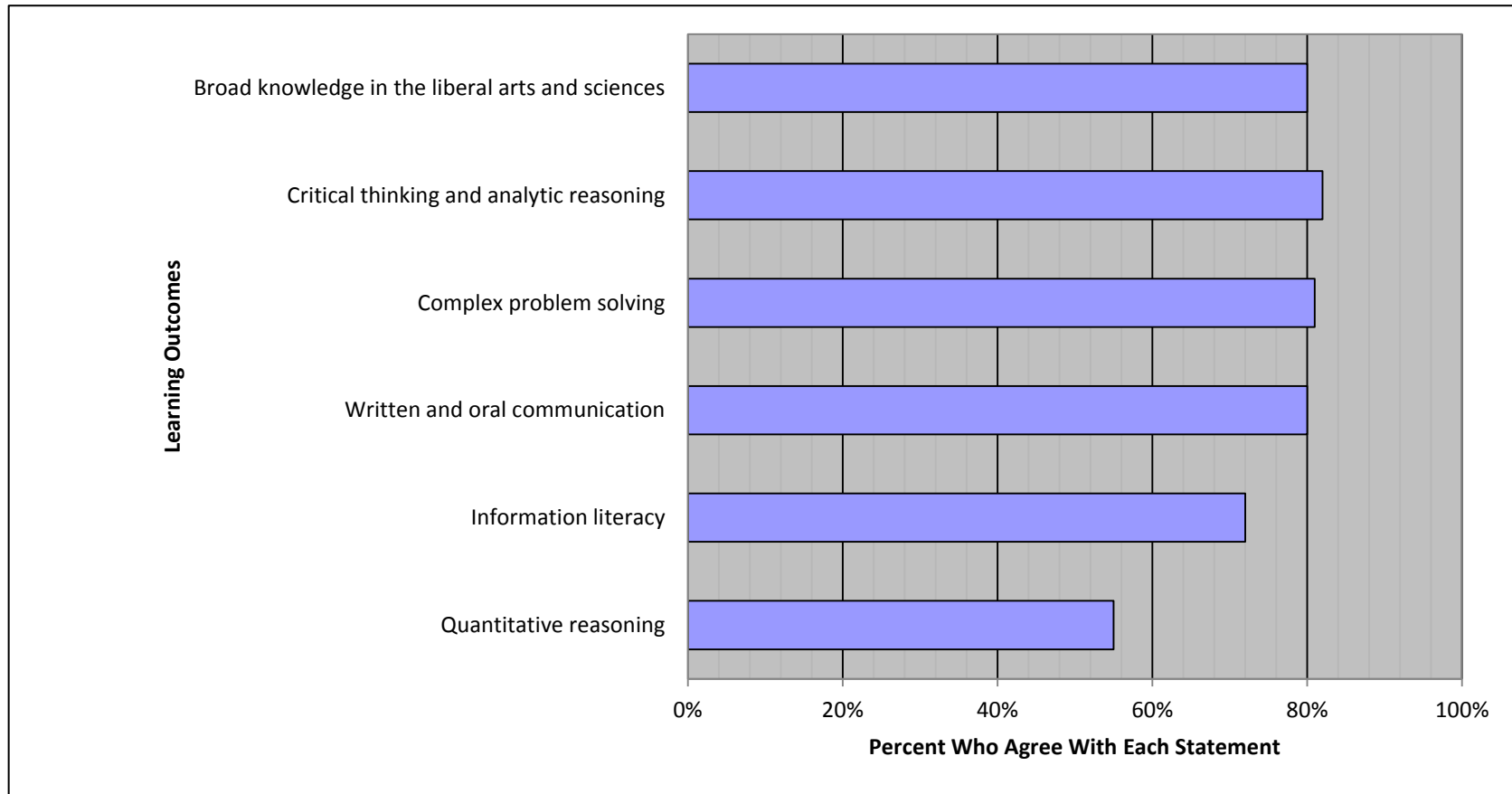
SOURCE: Hart Research Associates. (2013). It Takes More Than a Major: Employer Priorities for College Learning and Student Success.

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.

| HEWI Offerings | Leadership Convenings | Program Development | Scaling Guidance |

Emerging Cross-Disciplinary Fields *(BHEF Program Focus)* — **Industry Sectors** *(Member Application)*

A Selection of Current and Future Focus Areas:
- Data Science & Analytics
- Cybersecurity
- Risk Management
- Social & Mobile Technologies

Industry Sectors: Aerospace & Defense, Energy, Financial Services, Advanced Manufacturing, Agriculture, Infrastructure

Expansion Channels: **College/University Projects**, **Regional Initiatives (including University Systems)**, **National Initiatives**

Key: Current focus areas / Future focus areas

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
Sloan Foundation has provided a grant to launch the New York City Data Science Task Force	Data Science/Media, Arts, Technology, Health, FInance	CUNY, Columbia, Barnard, Cornell, St. John's U. Fordham U.	Support, facilitate development of Rio Grande Compact; Engage partners in BHEF's national data network; Connect project with BHEF members working in data science
U.S. Navy has provided grant funding to expand Cybersecurity in Greater Washington, D.C. and Tidewater, VA	Cybersecurity / Aerospace and defense	Accenture, McAfee, Northrop Grumman, U.S. Navy's ONR, Parsons, Raytheon, 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)	CUNY, 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