

The National Higher Education and Workforce Initiative:

Forging Strategic Partnerships for Undergraduate Innovation and Workforce Development



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The Business-Higher Education Forum (BHEF) is the nation's oldest organization of business and higher education executives dedicated to advancing innovative solutions to U.S. education and workforce challenges. Composed of Fortune 500 CEOs, prominent college and university presidents, and other leaders, BHEF addresses issues fundamental to our global competitiveness. BHEF and its members drive change locally, work to influence public policy at the national and state levels, and inspire other leaders to act.

Infographic: Elefant Designs, page 7.

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Executive Summary

Assuring dynamic growth in the U.S. economy in the 21st century will require a workforce with mastery of core content knowledge in key emerging fields in addition to well-developed workplace competencies, such as the ability to think critically and solve complex problems, work collaboratively, communicate effectively, and engage in continuous learning. Business and education leaders have engaged in discussions about the gap between the outputs of higher education and the needs of 21st century innovation and commerce for some time. Despite these discussions, the misalignment between student outcomes and workforce needs persists.

Through the collaboration of its business and academic members, BHEF has launched the National Higher Education and Workforce Initiative, a five-year effort that includes regional projects focused on business-higher education partnerships in selected states, as well as a national effort to disseminate the learning from the projects and scale effective practices. The initiative deploys a model of strategic business engagement in higher education to address the highest priority workforce development needs.

BHEF has compiled a set of tools and materials that enables business and higher education to move from transactional engagement—that is, limited to low-touch, piecemeal activities such as on-campus recruiting or research related to business products and services that are often disconnected from undergraduate education—to strategic and long-term partnerships to align undergraduate education with workforce needs. The tools include (1) systems dynamics modeling to simulate the impact of various policies and programs on the number of graduates in the STEM disciplines who go on to pursue STEM careers; (2) student migration analysis to understand why students enter into, persist in, or exit from STEM undergraduate education pathways; and (3) business needs assessment and supply analysis to identify the sectors of the economy in a given region that could benefit from partnering with higher education. From project launch through implementation, BHEF has developed metrics and processes for planning, launching, and assessing the projects, partnerships, and scaling strategies.

Currently, regional projects are under way in areas such as data science and analytics, cybersecurity, water and energy sciences, materials sciences, and engineering. BHEF has implemented a comprehensive, four-phase strategy to scale at the project, university system, network, and national levels. BHEF has already launched networks in cybersecurity at the system and national levels and plans to launch networks in other emerging fields, and it will continue to expand the scope and reach of its work through the ongoing launch of projects through 2015.

This is the first in a series of BHEF playbooks intended to assist companies, higher education institutions, private philanthropies, membership associations, professional societies, government agencies, and other stakeholders seeking to understand the potential value of investing in coordinated strategic, long-term partnerships to increase the persistence of undergraduate students, particularly women and minorities, toward degree attainment and entering the 21st century workplace.

Letter from the Chair



Dear Colleagues,

I am pleased to present this report, *The National Higher Education and Workforce Initiative: Forging Strategic Partnerships for Undergraduate Innovation and Workforce Development*. This report sets forth a strategy for addressing two interrelated national challenges: increasing the persistence of students—particularly women and underrepresented minorities—in key fields of emerging importance to U.S. economic competitiveness and aligning workforce needs in these fields with undergraduate education. At the heart of this strategy are new kinds of partnerships that the Business-Higher Education Forum (BHEF) is developing between business and academic institutions.

BHEF is the nation's oldest organization of senior business and higher education executives dedicated to advancing innovative solutions to U.S. education and workforce challenges. Partnerships between higher education and business have long been an important part of the academic landscape, but often they are based on shorter-term transactional objectives rather than on longer-term strategic goals. In the BHEF regional partnerships, business and academia come together to create sustainable new opportunities for undergraduates to learn about emerging fields such as data analytics, cybersecurity, energy, and water and materials science through direct engagement with the companies working in these areas. These partnerships are built on a base of evidence and design principles detailed in this report.

My institution, Case Western Reserve University, has been deeply engaged in BHEF regional projects that bring three Cleveland-based companies into the undergraduate learning experience. The university is partnering with The Sherwin-Williams Company, a global leader in paints and coatings; the Eaton Corporation, internationally known for its work in diversified power management solutions; and Rosetta, a consulting-centered interactive agency engineered to transform marketing for the connected world. Working with these corporate partners, students apply the knowledge and skills acquired in the classroom to workplace problems early in their undergraduate experience.

It is crucial that the insights and learning from these projects are shared widely. BHEF has launched regional and national networks and a partnership of business and higher education associations, government agencies, and professional societies to disseminate information about effective practices and to collectively address the national challenge to develop a globally competitive workforce of the future. This report, intended as the first in a series, offers a roadmap for others to follow in developing partnerships within their own regions to address local workforce needs and expand opportunities for students. I think you will find it to be informative and inspiring.

Sincerely,

A handwritten signature in black ink that reads "Barbara R. Snyder". The signature is fluid and cursive, written in a professional style.

Barbara R. Snyder
President, Case Western Reserve University
Chair, Business-Higher Education Forum

Letter from the CEO

Dear Colleagues,

The Business-Higher Education Forum's (BHEF) members recognize that the demands of the global economy have fundamentally increased the competitive challenges facing our nation's businesses, economy, and workforce. Innovation and the ability to develop and use new technology have become defining drivers of productivity in business and in addressing societal challenges, such as those related to energy and national security. In this context, college and university graduates in science, technology, engineering, and mathematics (STEM) disciplines provide critical talent that fuels America's competitive ability and prosperity. Yet the United States is not producing enough STEM graduates, STEM teachers, or STEM-literate citizens to sufficiently drive innovation, spur economic growth, and produce engaged, informed leaders and citizens.



In response to the President's Council of Advisors on Science and Technology's report, *Engage to Excel*, President Obama established a goal of increasing the number of STEM graduates by one million in a decade. BHEF has developed an evidence-based approach for producing more highly trained STEM graduates to meet this goal. Working first with Raytheon and then with the Office of Naval Research, BHEF applied system dynamics modeling to help identify the most promising strategies and scaling opportunities to increase the persistence of STEM undergraduates, particularly in the first two years of undergraduate study when attrition in STEM majors exceeds 50 percent, and therefore increase the number of STEM graduates.

The leadership of BHEF's business and academic members provides a unique opportunity to more closely align higher education with the needs of the workforce in general and the STEM workforce in particular. We have forged business-higher education partnerships that create new pathways for undergraduate students—in particular, women and underrepresented minorities—to careers in competitive and emerging sectors of the economy.

BHEF's *National Higher Education and Workforce Initiative* recognizes that workforce planning and development are most effective at the state and regional levels, because they differ dramatically across sectoral needs, population demographics, and higher education resources. For example, the workforce needs for Silicon Valley, Boston/Route 128 corridor, and the metropolitan Washington, D.C., area—all technology-intensive and higher education-rich regions—dramatically differ from other regions that might require an advanced manufacturing or an agricultural workforce. Consequently, the initiative incorporates a state and regional focus, and BHEF member-led projects address the workforce needs most crucial to innovation and growth.

The following report—which will live organically on *BHEF.com*—introduces the initiative, its evidence base, and the essential steps to develop successful regional higher education workforce projects.

We look forward to growing the regional projects beyond the 12 currently under way and are working to scale these existing projects and build networks among collaborating institutions. We welcome your feedback and input on this critically important effort.

Sincerely,

A handwritten signature in black ink, reading "Brian K. Fitzgerald". The signature is fluid and cursive, with the first name "Brian" being the most prominent.

Brian K. Fitzgerald, Ed.D.
Chief Executive Officer
Business-Higher Education Forum

Closing the Gap Between Higher Education and Requirements of the 21st Century Workforce

Assuring dynamic growth in the U.S. economy in the 21st century will require a workforce with mastery of core content knowledge in key emerging fields in addition to well-developed workplace competencies, such as the ability to think critically and solve complex problems, work collaboratively, communicate effectively, and engage in continuous learning.

This growing need has received the attention of policymakers at multiple levels. For example, the Obama administration has elevated a college completion agenda as a critical strategy to reverse high unemployment and to prepare a workforce ready to fill current and projected job openings. In fact, President Obama committed the United States to achieve the highest proportion of college graduates in the world by 2020.

In February 2013 the U.S. Census Bureau reported an important milestone toward the President's 2020 goal—for the first time ever, more than 30 percent of American adults hold a bachelor's degree.¹ But even this increase in the college completion rate has not yielded the expected returns. Employers still struggle to find talent to fit their growing demands, leaving job openings unfilled even as the average unemployment rate remains high.²

A 2012 study by the McKinsey Global Institute reported that by 2020 employers worldwide could face a shortage of 85 million high- and medium-skilled workers.

The number of job openings in the United States has grown to nearly 4 million, with many going unfilled for long periods of time because approximately half of employers now claim they cannot find employees with the competencies, skills, and degrees they need. A 2012 study by the McKinsey Global Institute reported that by 2020 employers worldwide could face a shortage of 85 million high- and medium-skilled workers.³ The President's Council on Jobs and Competitiveness noted that only 1.5 percent of 25- to 34-year-olds in the workplace in 2011 had earned a higher education degree in a science-related field, putting the United States in the bottom third of all OECD countries.⁴ The McKinsey Global Institute report also noted that by 2020 the supply of college graduates is projected to be 1.5 million less than the demand. The cumulative effect of these deficiencies impedes U.S. economic competitiveness and security, as well as equity and civic engagement.

In addition, the United States faces a series of national security and competitiveness challenges rooted in a significant shortage of highly educated and skilled employees, particularly in engineering and in vital emerging transdisciplinary fields such as data science and analytics, cybersecurity, water and energy sciences, materials science, and engineering. Increasingly, innovation and competitiveness require new types of employees with either expert or “enabled” competencies in emerging fields, or in the traditional fields of science, technology, engineering, and mathematics (STEM). These employees need not be scientists trained in the traditional sense, with years of postgraduate work. Rather, they need to be sufficiently trained in STEM to apply their knowledge to solving some of our most pressing problems and fueling the innovation engine.

Whether driven by the demands of an increasingly competitive global workplace or the realities of a rapidly changing and evolving innovation economy, corporations have come to place a high value on deeper learning. Deeper learning nurtures and enhances the skill sets required by many 21st century professions, for example, competence in oral and written communication, the ability to think critically and analytically, analyze and solve complex problems, apply knowledge to real-world settings, innovate, work in a team, and make ethical decisions.

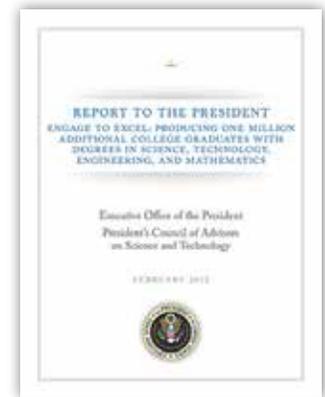
Business and education leaders have engaged in discussions about the gap between the outputs of higher education and the needs of 21st century innovation and commerce for some time. Despite these discussions, the misalignment between student outcomes and workforce needs persists.

In February 2012, the President’s Council of Advisors on Science and Technology (PCAST) reported that if the United States wants to remain economically competitive, then approximately one million more STEM professionals would need to be produced over the next decade than would be produced at current rates.⁵ The creation of one million new STEM graduates requires a large-scale disruption of the undergraduate education model. Further, educating a workforce capable of re-inventing itself and responding to technological, economic, and social change requires fostering higher order skills, such as critical thinking and analytical reasoning that can translate across cultures.

Business and education leaders have engaged in discussions about the gap between the outputs of higher education

and the needs of 21st century innovation and commerce for some time. Despite these discussions, the misalignment between student outcomes and workforce needs persists.

The P-16 curriculum is not sufficiently aligned with workforce needs to provide students with the knowledge and skills needed to compete successfully in the workplace. Similarly, employers have failed to adequately articulate their expectations for the workforce. To bridge this gap, educators and business leaders must develop a deeper partnership that enables the adaptation of curricula and co-curricular experiences to build core competencies and promote deeper learning.



The BHEF National Higher Education and Workforce Initiative

Through the collaboration of its business and academic members, BHEF has launched the National Higher Education and Workforce Initiative, a five-year effort that includes regional projects focused on business-higher education partnerships in selected states, as well as a national effort to disseminate the learning from the projects and scale effective practices. The initiative deploys a model of strategic business engagement in higher education to address the highest priority workforce development needs.

Currently, regional projects are under way in data science and analytics, cybersecurity, water and energy sciences, materials sciences, and engineering. BHEF has implemented a comprehensive, four-phase strategy to scale these projects at the project, network, university system, and national levels. Additionally, BHEF plans to expand the scope and number of its projects in the future.

Based on its experience in designing, planning, and implementing these projects, BHEF is compiling a set of tools and materials that enables business and higher education to move from transactional approaches to interaction—that is, limited to low-touch, piecemeal activities such as on-campus recruiting or support of research related to business products and services—to strategic and long-term partnerships to align human capital with workforce needs.

This is the first in a series of reports intended to assist companies, higher education institutions, private philanthropies, government agencies, and other stakeholders seeking to invest in long-term partnerships to increase the persistence of undergraduate students, particularly women and minorities, toward degree attainment and to create connections between undergraduate education and the 21st century workplace.

Steps in Building an Evidence Base for Action

Recognizing the important role that business and academia can play in addressing workforce challenges together and the need to act based on evidence, over the past five years BHEF has engaged in intensive research, system dynamics modeling, and project management. As a result, BHEF has developed a robust process for initiating business-higher education partnerships that respond to local or regional workforce needs. Business and academic partners can use tools to assess their needs and available resources and to identify interventions that can be deployed to attract and retain undergraduates in key emerging fields.

BHEF has developed a robust process for initiating a business-higher education partnership that responds to local or regional workforce needs.

BHEF's process of building its evidence base for solutions involves several steps, the first of which is a comprehensive review of the research literature on STEM undergraduate education. The second is the development of a system dynamics model, which, in its initial version, produced powerful insights and informed BHEF's model of strategic business engagement. Modeling provides decision makers with the information needed to understand their funding options and opportunities at scale. It can suggest potentially more productive avenues for investments in STEM undergraduate education and identify pathways to collaboration that leverage resources and efforts.

A third step is student migration analysis, which combines quantitative student academic data with qualitative survey responses from students to inform participating institutions about patterns of their students' migration into and out of STEM fields. Finally, a regional workforce assessment informs all parties about the workforce development challenges unique to a given geographic area. This includes determining whether the region needs additional specialists in a particular sector or whether there is a skills gap in an emerging field.

These steps, described in detail below, implemented simultaneously or serially, converge to inform the development of a comprehensive initiative that addresses the capacities of higher education institutions and the needs and resources of regional business. BHEF has developed a comprehensive, four-part strategy that scales this initiative at the project, network, university system, and national levels.

Review of the Research Literature

Integral to its modeling projects was BHEF's review of the research on educational practices to identify highly effective undergraduate intervention strategies. A principal source of information was the 2012 PCAST report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*, which describes a rich collection of highly vetted studies focusing on interventions to improve STEM undergraduate education during the critical first two years of college when students, especially women and underrepresented minorities, are most likely to drop out of STEM courses of study.

Several approaches have been found to increase persistence of students in completing degrees, achieving better grades and higher satisfaction, and learning how to apply knowledge in real-world settings.

- **Introductory course redesign**—moving away from traditional lectures and the lecture-homework-exam format to a student-centered format, which engages students through active learning with business partners providing business-relevant, real-world projects, guest lectures, or course co-development, matching more closely the classroom experience to the professional setting and motivating students to actively apply their coursework. Redesigned curricula have been found to improve performance and satisfaction, improve professional competencies, and enhance instructor confidence.

- **Earlier research internships**—exposing students to research, training, and a professional environment outside of their university. Internships should begin the summer after freshman year and be explicitly tied to a student’s coursework, mutually reinforcing the content relevancy and real-world application of the subject matter. Longer and frequent experiences yield greater benefits.
- **Freshman research experiences**—preparing students to conduct research through a sequence of courses beginning their first semester of freshman year, in which business partners co-develop, co-teach, or validate the courses, matching students’ training to business needs. Students who engage in undergraduate research at any time are more than twice as likely to graduate with a STEM degree.
- **Cognitive tutors**—providing educational software containing an artificial intelligence component that tracks students’ progress and challenges to learning and tailors feedback to their individual needs. Use of such tutors increases learning and enhances student engagement and satisfaction.
- **Multiple mentors**—providing students with a team of year-round academic, corporate, and peer mentors to maximize their support network.
- **Student learning communities**—involving a defined group of students taking together two or more classes that are often organized around a common theme and may require involvement in out-of-class activities. Such experiences increase retention, improve grades and satisfaction with college, and increase confidence in pursuing STEM courses and careers.
- **Bridge programs**—providing cohort-style series of courses, activities, and learning experiences intended to help students make a smooth transition from high school to college. In some cases, bridge programs support students transitioning from one postsecondary institution to another (e.g., community college to a four-year institution). Such programs have been found to increase retention, improve grades, and foster success in introductory classes.

Modeling: The U.S. STEM Undergraduate Model

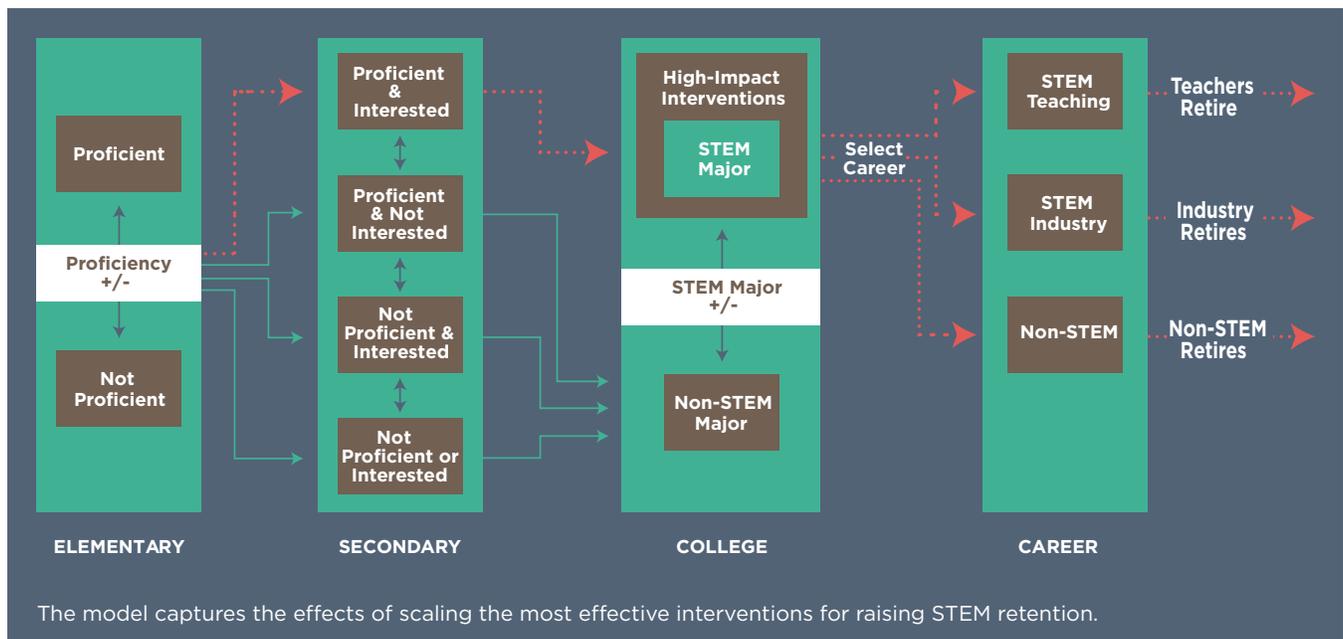
Modeling can play a critical role in informing policymakers about the most relevant and potentially effective actions to take in wedding workforce needs with academic programs.

BHEF’s original U.S. STEM Education Model® is a system dynamics model developed by systems engineers at Raytheon in collaboration with BHEF staff and donated to BHEF in 2009. It simulates the impact of various policies and programs on the number of graduates in the STEM disciplines who go on to pursue STEM careers. This first-of-its-kind model illustrates for policymakers, educators, and researchers the complex structure of the U.S. STEM undergraduate education system and enables users to test different interventions that could help strengthen student outcomes in STEM. This initial model provided the first step in understanding the impact of individual discrete interventions, such as increasing a teacher’s salary or placing all students into cohort living/learning programs, on the production of STEM-capable graduates.

Because of its interest in maximizing the impact of its investment in undergraduate STEM education, the U.S. Navy awarded BHEF a grant to develop a next-generation U.S. STEM Undergraduate Model. (See Figure 1, page 7.) Applying system dynamics, this model shows how implementation of high-impact, cutting-edge strategies to retain students in STEM programs can have the strongest impact on the Navy’s ability to satisfy its future workforce needs. This model has broader implications and can be used beyond the Navy environment. It retains components of the original model, but it deepens the ability to simulate interventions that can improve outcomes for students pursuing STEM degrees.

Research used in developing the U.S. STEM Undergraduate Model has shown that implementing multiple interventions simultaneously can have a significant impact on the retention and academic success of undergraduates, particularly women and underrepresented minorities.⁶ BHEF’s model demonstrates similar outcomes with combined, integrated intervention strategies.

FIGURE 1: SIMPLIFIED REPRESENTATION OF THE U.S. STEM UNDERGRADUATE MODEL



The model simulations revealed a number of key findings, including:

- Focusing on undergraduate education generates the highest potential return on investment in developing the STEM workforce.
- Implementing high-impact retention strategies during the first two years of college, rather than later in an undergraduate program, has a greater positive effect on the STEM pipeline.
- Providing opportunities for students outside of the university (e.g., internships and scholarships that link funding to service) can increase STEM graduation rates.
- Introducing new and innovative teaching and learning models, such as course redesign, cognitive tutors, and intelligent courseware, improves student learning in STEM, which in turn improves retention and graduation.
- Increasing persistence creates capacity challenges in third- and fourth-year courses, which must be addressed immediately to maintain the positive impact of the retention programs.

When viewing the model's findings more broadly, several high-level implications come into focus:

- Reaching the PCAST goal of one million new STEM graduates will require a large-scale disruption of undergraduate education practices.
- New models of engagement between business and higher education in which students receive multiple interventions, some relatively low-cost, during the freshman and sophomore years can maximize persistence and yield higher returns on investment.
- Interventions in the early undergraduate years can be targeted to the most at-risk students and the highest-demand fields—including emerging transdisciplinary specialties such as cybersecurity and data analytics—to maximum effect.
- Disruptive strategies, including course redesign and intelligent course tools, and new programs, such as cybersecurity, offer powerful scaling opportunities.

These findings point to many key opportunities that can be leveraged to identify the most effective practices for increasing the number of STEM-proficient graduates eligible for a given workforce. Moreover, they can help business and higher education to identify agencies in both the public and private sectors with which they might partner to advance mutual goals.

STEM Student Migration Analysis

Even in the face of the intensifying demand for STEM-proficient workers, the production of STEM graduates is stagnating. During the past five years the absolute number of degrees awarded in STEM fields increased modestly, but the number of STEM degrees as a percentage of overall degrees decreased.⁷ Understanding why students migrate away from STEM fields is a critical piece of evidence when designing an intervention.

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The Consortium for Undergraduate STEM Success (CUSTEMS), funded by the Alfred P. Sloan Foundation, is a collaboration of postsecondary institutions interested in addressing issues relating to undergraduate degree completion in STEM fields, with particular focus on underrepresented students. CUSTEMS combines student academic data with survey responses from those same students to inform participating institutions about patterns of their students' migration into and out of STEM fields.

The ability to track data over time allows departments, colleges, and universities to make adjustments and monitor for improvement. This information aids institutions in making informed decisions regarding programmatic offerings, formulating funding requests, and seeking partners. Findings are specific to institutions, even to colleges or universities within one university system.

Examples of analyses that are provided by CUSTEMS include the following:

- Detailed descriptions of student migration patterns into and out of STEM fields, including students who enter into, persist in, or leave STEM disciplines;
- Statistical analyses of migration patterns of particular groups of interest, such as underrepresented minorities, women, and first-generation students;
- Presentation of data that allow for identification of groups by retention rates; and
- Benchmarking against group/subgroups of institutions.

In general, BHEF analyses of student migration have revealed that only 17 percent of 12th graders are both interested in STEM careers and college-ready in math—the two features of the most likely pool of STEM majors. Although 85 percent of these students enroll in four-year colleges, fewer than 40 percent of students who initially declare a STEM major go on to earn degrees in STEM.⁸

Attrition of STEM students is particularly severe in the first two years of the undergraduate experience and for women and underrepresented minorities. The picture for students starting at community colleges is especially grim. Only 7.3 percent of students who start undergraduate education in STEM at a community college earn a STEM baccalaureate degree within six years.⁹ Community colleges are a critical gateway into four-year baccalaureate programs and have been a central focus of many of the initial regional projects.

Business Needs Assessment and Supply Analysis

Each BHEF project addresses a unique workforce need in regions around the country, examples of which include water science in Wisconsin (University of Wisconsin System with the Milwaukee Water Council); energy in the greater New York City area (City University of New York with IBM); and cybersecurity in the Maryland/Washington, D.C., region (The University of Maryland, College Park and Northrop Grumman Corporation) and Louisville, Kentucky's 55,000 Degrees initiative. (See overview, page 10.) These partnerships not only leverage local resources toward undergraduate STEM education but also bring in new corporate and government players who recognize the value of early engagement with students to building their future workforce. Thus, a critical step in establishing regional higher education and workforce development initiatives is assessing local or regional workforce needs. This activity creates the common framework for all parties in planning the project by documenting needs and identifying shared goals. (See Appendix A for examples.)

A critical step in establishing regional higher education and workforce development initiatives is assessing local or regional workforce needs. This activity creates the common framework for all parties in planning the project by documenting needs and identifying shared goals.

By focusing on key, high-demand sectors of the economy, a project has the potential to demonstrate new ways to strengthen the workforce and increase U.S. global competitiveness and national security. Project sites must have deep expertise in addressing the pipeline, major workforce deficits in the sectors and disciplines to be addressed, and be particularly interested in adopting interventions that will improve transfer student retention from two- to four-year institutions and baccalaureate degree completion for these students.

The endpoint of a comprehensive business needs assessment and supply analysis is the identification of strategies for addressing the necessity for both specialists in a given field and “enabled workers,” or professionals, such as managers, grounded in another field but requiring the knowledge, skills, and competencies of another field to be effective in their occupations. For example, a strategy to develop a regional workforce capability in data analytics might focus on both data scientists with in-depth knowledge of the field and “data analytics-enabled” professionals, which could involve

engaging with students from a variety of majors and providing them with a core set of courses sufficient to constitute an academic minor, concentration, or professional certification.

These assessments build learning incubators designed to resolve America's toughest workforce issues in today's high-demand fields. Regional workforce projects demonstrate the commitment and urgency of business and higher education to confront critical workforce challenges in their regions by strategically connecting companies' core competencies with undergraduate education to increase persistence of students, particularly women and underrepresented minorities, toward degree completion and careers in high-demand fields.



10/17/2012: Northrop Grumman Foundation announced \$1 million grant to launch the University of Maryland, Baltimore County (UMBC) Cyber Scholars program. Pictured from left are Freeman Hrabowski, president of UMBC; Sandra Evers-Manly, president of the Northrop Grumman Foundation; Alex Markowski, UMBC CWIT Scholar; Alec Pulianas, UMBC CWIT Scholar; and Anupam Joshi, director of the UMBC Center for Cybersecurity and head of the UMBC Cyber Scholars program.



Louisville's 55,000 Degrees Initiative

In 2009, members of Louisville's Business Leaders for Education joined forces with the mayor, representatives from P-12 and higher education, and community leaders to form the Mayor's Education Roundtable and with one voice committed to improve education outcomes in the Louisville region. Participating leaders signed the Greater Louisville Education Commitment, dedicated to improving education attainment in the region by 40,000 bachelor degrees and 15,000 associate degrees by 2020.

The commitment includes five key objectives:

1. Create and support a college-going culture
2. Use the business community's unique points of leverage to accelerate attainment
3. Prepare students for success in college, career, citizenship, and life
4. Make postsecondary education accessible and affordable
5. Increase educational persistence, performance, and progress

The resulting public/private initiative, "55,000 Degrees," facilitates new regional education goals. Louisville business leaders are looking to improve the signaling between business needs and education production. These leaders realize that raising the education level by 55,000 degrees is not enough—the region must strive for degrees that lead to 21st century careers. For the next phase of work, the group seeks to directly link regional education learning outcomes to workforce demand, ensuring that students graduate with the technical and higher order skills that will lead to employment upon graduation.

BHEF, as a strategic partner, co-sponsored with the American Fidelity Foundation *Cities for Success: A BHEF Leadership Summit* in Louisville to support the 2010 launch of the initiative and to convene stakeholders articulating a shared vision. BHEF also parlayed its own national network of business and higher education leaders to support the emerging network of business and education leaders in Louisville.

55,000 Degrees has begun promoting the value of a college degree through a wide range of channels—from news media to a new website rich with information aimed at guiding students, families, and educators. Jefferson County Public Schools and community-based organizations are also spreading the message and promoting the value of college to all ages.

BHEF's Model of Strategic Business Engagement with Higher Education

Using the tools and strategies described above, BHEF's members—Fortune 500 CEOs and college and university presidents—are implementing a new model of strategic business engagement with higher education that aligns five levers, or strategies, to move from transactional relationships to strategic partnerships between the two sectors. When fully implemented, the model enables business and higher education to effectively build sustainable, high-impact regional projects to increase student interest and persistence toward degree completion and to align undergraduate education with emerging workforce needs.

- **Engage and Deploy Corporate and Academic Leadership.** Specifically, C-suite executives and academic administrators provide “grass-top” engagement to (a) shape internal and external messaging to raise community awareness of 21st century workforce requirements and the academic response to those requirements; (b) build a critical mass of peers focused on undergraduate education in support of workforce development goals; and (c) guide corporate and academic policy development to ensure that both sectors align with shared strategic education and workforce development goals.
- **Focus Corporate Philanthropy.** When undertaken in concert with college or university strategic planning and regional workforce assessment, philanthropy can serve as a vital catalyst for positive, lasting, and high-impact change in higher education and workforce alignment.
- **Identify and Tap Core Competencies and Expertise.** Expertise is represented on the corporate side by managers, engineers, and other subject matter experts and on the academic side by faculty members, researchers, postgraduate fellows, and graduate students. These individuals bring intellectual resources, field experience, skills, and competencies to bear on strengthening the education-to-workforce pipeline through efforts such as co-development of new courses focused on active learning, student research opportunities, and other learning experiences.
- **Facilitate and Encourage Employee and Staff Engagement.** Partnerships can organize the hundreds or thousands of employees within an organization to support strategic educational goals. This human capital can be mobilized to act both inside and outside the corporation or higher education institution, providing grassroots support and advocacy in the planning and implementation of educational reform.
- **Fund Research.** Research conducted in college and university laboratories can serve as platforms for early research experiences for freshmen and sophomores, which has been shown to increase student persistence. Corporate laboratories and research centers can provide unique real-world learning opportunities for undergraduates and can expand the capacity of higher education institutions to offer such experiences to students.

Positioning these strategies requires (1) commitment to sustained engagement to improve education outcomes; (2) collaboration to develop a shared understanding of academia's and business' interconnected problems, based on research and data that link college readiness and success to workforce requirements; (3) development of a shared vision for systemic solutions; (4) collaboration with each other and with other strategic partners to implement solutions; (5) advocacy for public policies needed to achieve goals; and (6) raising of public awareness about the urgency of these issues at the regional, state, and national levels.

BHEF catalyzes change by equipping its members with the information and tools they need to understand the challenges inherent in aligning education outcomes and workforce needs and by providing a strategic framework for addressing them. BHEF's goal is to continuously expand the number of partnerships in the overall initiative. Lessons learned from BHEF's activities to date have significantly advanced knowledge in the area of four-year STEM undergraduate education. As the initiative evolves, validated evidence-based models will be available for others to adapt and adopt.



Workforce Challenges in Data Science and Analytics

Data analytics is now ubiquitous in both the public and private sectors. Companies of all sizes are using data science and analytics as key transformational components of their core operations. A 2011 report by the McKinsey Global Institute, *Big Data: the Next Frontier for Innovation, Competition, and Productivity*,¹⁰ noted that big data is growing at a rate of 40 percent each year and has the potential to add \$300 billion of value to the nation's health care industry. Projections by Gartner, Inc. indicate that by 2015, 4.4 million information technology jobs will be created globally (1.9 million within the United States) to support big data with the potential of creating three times that number of jobs outside of computing.¹¹ Despite the potential of big data and the need for both data scientists specialized in the field and "data analytics-enabled" professionals, the United States is facing severe shortages of employees trained in data analytics. According to the McKinsey report, the United States faces a shortage of 140,000 to 190,000 workers with "deep analytical skills" and 1.5 million managers capable of using big data analytics for actionable insights in their decision making.

Building on nearly a decade of research, BHEF has launched projects designed to increase higher education's capacity to recruit and retain students in emerging fields through targeted business-driven interventions at the undergraduate level. BHEF is engaged with its members to implement two projects in large-scale data analytics. IBM and The Ohio State University are collaborating on an advanced design principles and undergraduate data analytics curriculum in Columbus, Ohio; in New York City, IBM's work with The City University of New York focuses on data analytics and sustainability in an urban environment.

In addition, two analytics projects are in the planning stages. BHEF member David Jones, Humana board member, will lead a joint project between Humana and Bellarmine University that will focus on data analytics and health sciences. Case Western Reserve University will spearhead a project specializing in health analytics in the Cleveland Health-Tech Corridor.

Each project grew out of a process in which business leaders identified a need and searched for solutions, sometimes through approaching a local or regional economic development group, convening chief information officers of local IT businesses, or building a coalition of interested parties. For example, Columbus 2020! is the outgrowth of a group of four corporations dedicating millions of dollars to data analytics and working with The Ohio State University to train the next generation of employees. Columbus 2020! has grown into a community-wide effort, which, during its development, engaged more than 500 community leaders and is now led by a team of community members representing public, private, and academic institutions from throughout the region.

Regional Higher Education and Workforce Projects

The first cohort of BHEF's National Higher Education and Workforce Initiative was launched on June 11, 2012, and its projects focused initially on STEM undergraduate education (see Appendix B for program summaries). Backed by some of the most important business and academic leaders in the nation, these projects demonstrate BHEF's members' willingness and ability to meet America's higher education and workforce challenges head-on. To date, 12 regional projects are under way, developed in response to each region's available STEM resources and workforce needs. The initiative facilitates and supports organic partnerships among BHEF member corporations and higher learning institutions, with a focus on the following goals:

- Increasing the number of undergraduates (particularly women and underrepresented minorities) who persist beyond their first two years in a STEM major and graduate in high-need STEM disciplines;
- Deepening STEM learning and increasing the relevance of studies to skills and careers, with a focus on the first two years of college;
- Strengthening the alignment of STEM undergraduate education and degree production with regional public- and private-sector workforce needs with a focus on high-demand STEM fields;
- Demonstrating the effectiveness of different interventions in retaining STEM undergraduate students and modeling such interventions to simulate their impact at scale; and
- Developing a national network to scale evidence-based practices and influence broader policy through collaborations among government, business, and higher education.

Backed by some of the most important business and academic leaders in the nation, these projects demonstrate BHEF members' willingness and ability to meet America's higher education and workforce challenges head-on.

Students are provided with opportunities to work side-by-side with business' greatest innovators to tackle some of our nation's most pressing problems. Many programs specifically target students at the community college level with the goal of facilitating the transition from a two-year to a four-year program (so-called 2 + 2 approach).

Once under way, similarly themed programs are linked to share expertise and learning outcomes. The programs collectively provide hubs for testing, linking, and leveraging strategies that are founded on an evidence base of effective practice. Several programs intend to expand their pilot to encompass other content areas in the future.



The Case Western Reserve University Department of Materials Science and Engineering has revised its undergraduate curriculum to (1) demonstrate the relevance of STEM undergraduate education; (2) connect students with practicing engineers and manufacturing companies in Northern Ohio; and (3) emphasize hands-on and problem-based learning. In these photos, first-year students who have completed independent computer-aided designs use novel additive manufacturing methods and on-campus metal processing equipment to produce sand molds that are then invested in a bronze alloy supplied by corporate partner Federal Metal.

Incorporating Deeper Learning into Regional Projects

To move current strategies one step further and to expand beyond STEM undergraduate programs, BHEF has partnered with the William and Flora Hewlett Foundation to better understand the business community's needs for, deficits in, and uses of 21st century workplace competencies—skills that arise from deeper learning. BHEF conducted interviews with key corporate representatives about the value attached to these competencies and the role they play in hiring, evaluation, training, and promotion and how businesses communicate competencies internally and externally.

BHEF is developing a strategy to incorporate deeper learning and the skills it engenders into its current regional projects.

The interviews revealed that college graduates generally possess the content knowledge but not the core competencies—critical thinking, problem solving, analytical reasoning, communication, and working in multi-cultural teams—needed to succeed in the 21st century workplace. In other words, potential hires exit the education pipeline lacking the balance between technical skills and workplace competencies that employers increasingly want and need.

BHEF is developing a strategy to incorporate deeper learning and the skills it engenders into its current regional projects. As BHEF implements this strategy, it envisions three principal streams of work to achieve its goals:

- Validate the importance of deeper learning skills with the business community;
- Contextualize deeper learning by identifying the tools businesses use to assess deeper learning capacities and determine potential employee fit, then share these assessments/tools with those spearheading education reform efforts; and
- Develop a business-led strategy to promote effective practices, business needs, and the assessment tools that can achieve widespread employment of deeper learning.

“T-shaped” professionals possess not only a deep knowledge of a discipline (the vertical leg of the T), but also the ability to interact, communicate, and work with other disciplines and in various settings (the horizontal arm of the T).¹² Not only can such professionals contribute to multiple dimensions of a company's operations, but also they are more resilient to changes in technology and market conditions. Undergraduate programs that develop both sets of proficiencies in their students, in partnership with business, can be at the forefront of aligning higher education with workforce requirements.

Framework for Project Initiation, Planning, and Design

Based on its modeling, research, and implementation of current projects, BHEF has developed a common framework for choosing strategies and taking action with the following key elements:

- A common goal;
- Articulation of high-demand workforce needs and a sector of focus;
- A list of high-impact interventions to increase student persistence and address workforce needs;
- A description of how business adds value to the interventions;
- A description of the business-higher education partnership in terms of BHEF's model of strategic business engagement; and
- A vision for how the project could serve as a national model of business-higher education collaboration and produce insights and materials such as new courses, micro-credentials for business, new models for engaging women and underrepresented minorities in emerging fields, and effective transfer agreements between two-year and four-year institutions.

Project Initiation

| Strategies | Academic Action | Company Action |
|--|--|--|
| Build a common understanding of key regional workforce needs. | Host or participate in a regional planning activity to understand challenges in the higher education pipeline, including patterns of student migration. | Host or participate in regional planning activity to identify workforce needs in specific sectors. |
| Develop a joint statement articulating vision and strategic goals of the relationship. | Obtain signed letter of commitment from president or chancellor of college/university. | Obtain signed letter of commitment from CEO or appropriate C-Suite leadership. |
| Designate key leadership. | President or chancellor personally selects the key individual who will lead the effort. This point of contact will (1) put together a project team that includes individuals from relevant departments and (2) provide two-way communication between the project team and the president or chancellor. | CEO or C-Suite leader personally selects key individuals to lead the effort, including subject matter experts from relevant departments and divisions. |
| Identify high-level programmatic goals and metrics. | The academic project team provides a short strategic document outlining the goals, actions, and metrics for a discrete project to be shared with corporate partner. | The corporate project team uses the strategic outline provided by the academic team, and incorporates a distinct role the corporate partner can play, using elements of the model for strategic business engagement. |

Once letters of commitment have been obtained, leadership identified, and a strategic outline agreed on, the next step is planning and design.

Project Planning and Design

| Strategies | Academic Action | Company Action |
|---|---|---|
| Develop funding plan. | The academic team provides a high-level budget, including internal matching funds, in-kind contributions, and potential sources of funding, corporate or grants. | The corporate team reviews the proposal and determines whether it can provide the seed funds to jump-start the project. It is important for the academic team to know what is on the table so it can begin outreach to gain additional support if needed. |
| Create branding and return on investment (ROI) targets. | The academic point of contact works closely with the corporate lead to clearly articulate the branding opportunities (if desired) and the corporate ROI from the project. | The corporate lead determines whether the company will be the sole partner in the project, whether it would like to seed a consortium, and how it would like to be recognized. |
| Set timeline and milestones. | The academic team provides a timeline for planning and executing the proposed project, including the semester when the first cohort of students will participate. | The corporate team works with the academic team to ensure the timeline is expedited to meet the needs of the company. |
| Develop program evaluation plan. | The lead identifies an internal resource to develop a program evaluation for the project. | The corporate lead identifies an internal resource to host a semi-annual meeting to discuss progress and changes needed. |
| Anticipate project outcomes and new content. | From the outset of a project, partners collect and curate new content developed through the partnership for possible inclusion in courses, massive open online courses (MOOCs), credentialing activities, and other outputs. The academic institution should identify how the program will be recognized internally, for example, as a major, minor, certification, or concentration. | The corporate lead works with human resources to determine how the students or faculty participating in the program will be identified, recognized, and rewarded. Engage core competencies in new content development. |

Assessment and Outcome Metrics

Although each regional project has a unique focus in terms of sector, type of business-higher education partnership, and interventions used, the projects share common goals and expected impacts. The student migration analyses provide a baseline for the higher education partners to understand, at the level of the academic department, the patterns of student enrollment and persistence in the targeted fields prior to the onset of the business-driven interventions. In addition, other methods, such as focus groups conducted with students and faculty, can provide deeper insights into why students migrate out of disciplines critical to workforce development. The University System of Maryland, for example, has been conducting a series of focus groups on its campuses to supplement its student migration analysis and to provide a foundation for determining the most appropriate high-impact interventions.

Regional partners will establish a set of metrics to capture the extent and nature of positive impacts of the projects including:

- Analyzing trends in student enrollment, persistence, and completion of STEM degrees, including that of women and underrepresented minorities;
- Tracking and analyzing STEM student recruitment and persistence in the first two years of college;
- Understanding transfer rates and patterns from two- to four-year institutions, including analysis of demographic data;
- Articulating and measuring business engagement, based on interviews, focus groups, and surveys to identify the explicit role business has played, at multiple levels, in the interventions and projects; and
- Collecting and analyzing data on the number and types of job offers made to students emerging from the projects.

Depending on the types of interventions selected, partners will also track:

- Performance and persistence of students taking redesigned courses;
- Comparative impact of early research experiences on student persistence;
- Impact of cohort or group learning strategies on persistence;
- Impact of business-led mentoring, speaker series, seminars, and other interventions on persistence; and
- Cumulative impact of multi-dimensional strategies that incorporate two or more interventions.

The student migration analyses provide a baseline for the higher education partners to understand, at the level of the academic department, the patterns of student enrollment and persistence in the targeted fields prior to the onset of the business-driven interventions.

A key measure of success for higher education will be determining the uptake of effective interventions within and among academic institutions. A key measure for business will be the extent to which other companies within sectors adopt or adapt the strategic approaches to workforce development. BHEF will work through its emerging networks to disseminate effective practices and encourage wide replication.

Networking and Scaling the Projects

In an effort to disseminate the learning, insights, and outputs from its regional projects, BHEF is pursuing scaling strategies at the project, network, university system, and national levels. These strategies build on each other and, together, provide a coherent and transparent framework for growing and improving individual regional projects and the initiative as a whole. The overall initiative is designed to provide constant feedback and enable rapid prototyping of the most effective practices for increasing student persistence and completion in key fields and aligning undergraduate education with emerging workforce requirements.

- **Project level** by creating successive cohorts of regional projects. A second cohort is in development.
- **Network level** by linking successive groups of projects working in common disciplinary areas. BHEF launched its National Cybersecurity Network in December 2012 at a university workshop hosted by the Alfred P. Sloan Foundation. This event brought together BHEF members and representatives from companies (Battelle Memorial Institute, Next Era Energy, Northrop Grumman, Parsons, and Raytheon), higher education (Bowie State University; Cal Poly; Miami-Dade College; San Jose State University; Towson University; University of Maryland, Baltimore County (UMBC); and University of Maryland College Park), and government agencies (National Institute of Standards and Technology, National Security Agency, and White House Office of Science and Technology Policy) to discuss cyber workforce needs and shape a strategy for addressing them through collaboration among the three sectors. In addition, BHEF plans to launch in 2013 similar networks in data analytics and water science/sustainability, for which there is considerable regional partnership development and interest in dissemination. As projects in other fields are launched, BHEF will look to develop additional sectoral networks.
- **Multi-campus university system level** by adopting and adapting effective projects throughout university-wide systems and connecting those projects to corporate partners. The Sloan Foundation awarded BHEF a \$400,000 multi-year grant to scale undergraduate cyber programs throughout the University System of Maryland (USM), initially with four institutions in the system (Bowie State University, Towson University, UMBC, and University of Maryland College Park). With its inaugural meeting in April 2013, the USM-BHEF Undergraduate Cybersecurity Network was launched with 30 representatives from academia, business, government, and stakeholder organizations. This network will support an overarching system-wide goal of significantly increasing the number and diversity of graduates in cybersecurity fields. It will launch projects aimed to strengthen business-government-academic partnerships; focus on key policy challenges, such as accelerating student security clearances; share curricula and other resources; and develop a clearinghouse on effective cyber education practice and tools. Additionally, the University of Wisconsin System and the Milwaukee Water Council plan to scale water sciences programs to multiple campuses.
- **The national partner level** by launching in June 2012 the National STEM Undergraduate Partnership of key business and academic associations, government agencies, and professional societies that share learning on effective practices, seek opportunities for collaboration, and provide an effective, national scaling mechanism (see page 19 for a list of the members). In November 2012, the partnership was highlighted in the President's Cross-Agency Priority Goals as a primary partner on STEM higher education in achieving the goal to graduate one million new STEM students by 2020. Two national partners—The Aerospace Industries Association and the National Defense Industrial Association—have expressed interest in launching projects in regions requiring intensive aerospace workforce development, such as Huntsville, Los Angeles, Orlando, and San Diego.



National Undergraduate STEM Partnership*

Aerospace Industries Association
American Chemical Society
American Council on Education
American Society for Engineering Education
Association of American Universities
Association of Public and Land-grant Universities
Business-Higher Education Forum
National Defense Industrial Association
Office of Naval Research
TechNet

* 2012 original signatories

As part of its scaling strategy, BHEF is working with members and other partners to develop new projects. BHEF is also examining approaches to scaling existing projects more widely into the business and higher education communities and connecting them through networks based on the sectors they are addressing and the interventions they are deploying. BHEF is seeking ways to identify promising approaches, content, and products developed through the projects that could be pushed out for broad adoption using tools such as massive open on-line courses (MOOCs).



Michel Cukier (right), Professor of Reliability Engineering and Director of the ACES program, and David Maimon, Professor of Criminology and Criminal Justice, at the University of Maryland Cybersecurity Center.



Maryland's Process for Developing a Cybersecurity Network

The University System of Maryland (USM)-BHEF Undergraduate Cybersecurity Network is a coalition of representatives from Maryland-area higher education institutions, business, government, and other stakeholder organizations that joined together to create a strategic regional response to Maryland's and the nation's growing need for cybersecurity talent.

The network grew out a series of planning activities, studies, and assessments. In 2009, Maryland Governor Martin O'Malley's STEM task force recommended increasing by 40 percent the number of college graduates in the state by 2015 to meet the region's growing workforce needs. This recommendation echoed USM's own strategic plan for increasing the number of STEM graduates. In 2010, Governor O'Malley designated cyber as the state's lead workforce focus. Also, in 2010, the Governor's Workforce Investment Board projected that the greatest job growth would be in high-skill occupations, in particular network systems/data communication, computer software engineering, and systems administration.

Subsequently, William ("Brit") E. Kirwan, II, USM chancellor, organized and launched a cybersecurity task force comprised of leading academic and business leaders, as well as federal and state government officials to examine a potential USM response to the rapidly growing field of cybersecurity in the region. The task force determined that USM was not producing sufficient numbers of cybersecurity degrees and certificates annually to meet demand and recommended a steady increase of graduates in this field from USM institutions over a decade. Next steps detailed an evidence-based understanding of the student migration patterns in cyber-related baccalaureate degree programs in USM, as well as predicting the impacts of various intervention strategies to be deployed by each university to increase student persistence and cyber-related degree attainment. These efforts could serve as models for increasing STEM student persistence throughout USM STEM programs and nationally.

The University of Maryland at College Park and Northrop Grumman Corporation were the first to join forces in creating a cybersecurity initiative. Then, in November 2012, BHEF received a \$400,000 multi-year grant from the Alfred P. Sloan Foundation to partner with USM to expand and scale opportunities for Maryland students in the growing field of cybersecurity at additional Maryland universities, including Bowie State University, Towson University, and the University of Maryland, Baltimore County.

Conclusion

BHEF's National Higher Education and Workforce Initiative consists of an integrated, comprehensive approach to better aligning undergraduate education with business workforce needs in key strategic areas.

As shown in Figure 2 (opposite page), the regional projects plant the seeds for change by identifying needs and the resources and capacity to meet those needs at the local or regional level. Partners from the business, higher education, and government sectors jointly develop new and innovative approaches—based on research, theory, or expert judgment—to produce a strategically and tactically educated workforce ready to respond to identified needs.

As the projects mature and opportunities for expansion are identified, partners can take the lead, as appropriate, on group activities and sharing information across wider networks about workforce needs, strategies for workforce recruitment, new approaches to STEM undergraduate education, and data on effective practice. Networks might expand across single university systems or through business and academic associations, government agencies, or other mechanisms.

To share learning and insights and bring regional or local projects to scale, national networks and partnerships incorporate the full range of members from academic and business associations, professional societies, and government agencies in order to leverage individual efforts to achieve larger-scale implementation and impact.

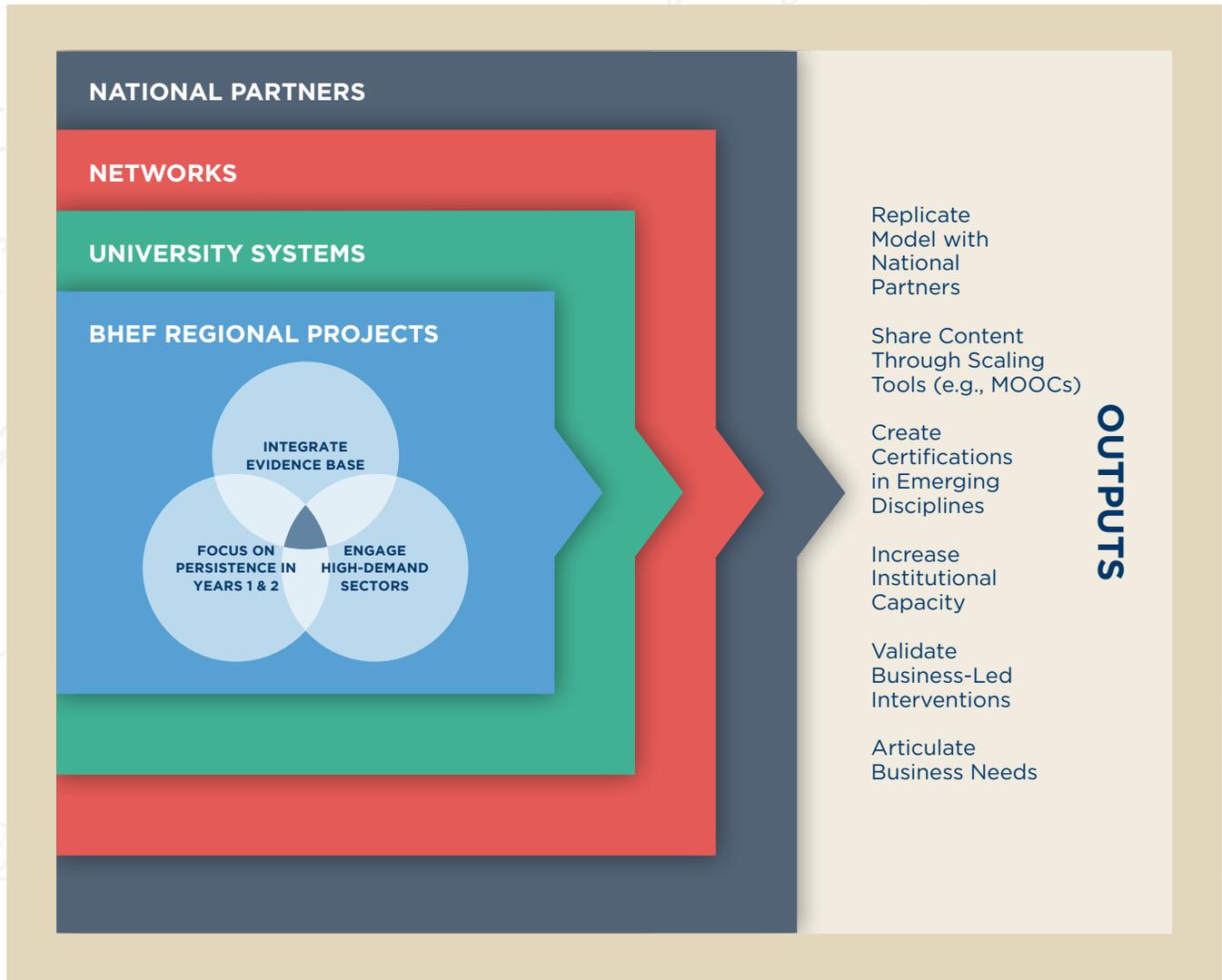
The regional and national networks provide vehicles for existing projects and partners to share learning and scale efforts, as well as platforms for other stakeholders currently not engaged in the initiative to participate in this work.

The outputs of these multi-level approaches are sharing of content, replication of successful efforts, creation of certification in emerging disciplines, increased institutional capacity, and clearer articulation of industry needs.

BHEF's unique position as an organization of business and academic leaders compels it to use its membership to more closely align the resources of higher education with the needs and challenges facing business and the nation. As it moves forward, BHEF seeks to involve a wider circle of companies, higher education institutions, government agencies, research and development centers, associations, professional societies, and others.

This report is the first in a series documenting the progress of the initiative. It is intended to be a “playbook,” or living document, that will be posted on the BHEF website and updated regularly with new information, materials, links, posts by BHEF's regional and national partners, and tools for those interested in developing their own regional partnerships. BHEF welcomes feedback on this site and the overall initiative, and looks forward to learning from users of this playbook about their efforts to forge new workforce partnerships among business, government, and higher education.

**FIGURE 2:
BHEF'S NATIONAL HIGHER EDUCATION
AND WORKFORCE INITIATIVE:
A COMPREHENSIVE STRATEGY**



Appendix A: Examples of Business Needs Assessments and Supply Analyses

Aviation Week Workforce Study 2012

Carole Rickard Hedden

August 13, 2012

In association with Aerospace Industries Association, American Institute of Aeronautics and Astronautics, and National Defense Industries Association

http://www.aviationweek.com/portals/awin/workforce_2012/WF-study2012.pdf

2012 Agribusiness Job Report, U.S. Edition

AG Careers.com

http://www.cals.ncsu.edu/agcomm/news-center/wp-content/uploads/2013/02/us_outlook_report_2012.pdf

Big Data: The Next Frontier for Innovation, Competition, and Productivity

McKinsey Global Institute

June 2011

http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for_innovation

Solving the Talent Equation for Health IT

PWC Health Research Institute

March 2013

<http://www.pwc.com/us/HITtalent>

Report of the Cyber Security Task Force to the University System of Maryland

May 2011

http://mdcao.usmd.edu/USMCyberSecurity_final.pdf

Appendix B: Regional Project Summaries

DATA ANALYTICS



The City University of New York (CUNY)/IBM

- *Interventions: summer bridge program, team projects, internships/externships, business mentors*

CUNY and IBM are drawing on the expertise and resources of seven community campuses in the CUNY system to offer students new academic and career pathways in analytics, energy, and water sustainability in an urban environment. Students are provided a broad-based curriculum and externship opportunities, in which they work on interdisciplinary teams to develop informed, practical, and technically sound solutions to challenging sustainable energy and natural resource management problems.

The Ohio State University/IBM/Battelle Memorial Institute

- *Interventions: course redesign, student research internships, mentoring*

To address the need for a workforce with stronger analytical skills, The Ohio State University and IBM are leveraging the IBM Client Center: Analytics Solutions Lab, a new advanced analytics center in Columbus, and collaborating on new business and technology curricula to help students gain the latest skills in analytics and prepare for high-value jobs in the future. New courses of study have been developed at the undergraduate and graduate levels that will include access to the center's technology assets and thought leaders. As part of its Academic Initiative, IBM is providing Ohio State with curriculum materials, relevant case studies, access to a wide spectrum of software solutions, IBM guest speakers, and faculty incentives to accelerate program development.

CYBERSECURITY AND INFORMATION TECHNOLOGY



California Polytechnic State University (Cal Poly)/Northrop Grumman/Parsons/Raytheon

- *Interventions: student-driven research, course redesign*

Cal Poly is leveraging its “Learn by Doing” approach—undergraduate hands-on opportunities and immersion in engineering—and its large undergraduate engineering base (80 laboratories) to establish a cybersecurity undergraduate program. The initiative consists of a new undergraduate-focused cybersecurity laboratory supporting a new curriculum and student-driven applied research projects and a graduate-level certificate program to attract a more diverse group of students to the high-demand field of cybersecurity. Business partners are deeply involved in the design of the program.

Miami Dade College/NextEra Energy (NEE)

- *Interventions: bridge programs, learning communities, mentored research internships*

Miami Dade College is the largest undergraduate institution in the United States and the nation's largest Hispanic-serving institution. Traditionally a two-year college, it has begun offering a select number of STEM bachelor's degrees in high-demand areas, in particular a B.S. in information systems technology. This creates pathways for students from high school to associate to baccalaureate degrees in information technology fields, including cybersecurity. The initiative, co-lead by NEE and college leadership, provides students with critical skills and knowledge required to direct and control computerized information resources in a range of sectors.

San José State University/IT companies

- *Interventions: internships, business mentors, course redesign*

San José State University and a wide range of stakeholders from business, government, community colleges, and community organizations are establishing the Silicon Valley Center for Cybersecurity to respond to the regional and national workforce need for cyber professionals by creating stackable degree components (certificates) and providing undergraduates with enhanced learning experiences outside the classroom, including internships.

The University System of Maryland (USM)/Northrop Grumman

- *Interventions: student learning communities, course redesign, internships, scholarships*

The University System of Maryland is leading a multi-campus effort to bring the unique resources of institutions in the system to address Maryland's STEM workforce needs. The University of Maryland, College Park in partnership with Northrop Grumman is creating the nation's first undergraduate multidisciplinary residential cybersecurity honors program. The University of Maryland, Baltimore County is developing a project that connects STEM undergraduates to new career pathways by applying their knowledge to innovation and entrepreneurship, which will begin with a focus on chemistry and link STEM undergraduate education to business, R&D, and innovation.

Washington University in St. Louis/Boeing

- *Interventions: bridge program, business-faculty course redesign, mentored research, team projects*

This partnership of local two- and four-year colleges and regionally based companies addresses growing local workforce needs in information technology. Through a joint public-private undergraduate engineering program with Washington University, the University of Missouri, St. Louis, and community colleges, the project aims to increase the diversity, quality of training, and graduation rates of students prepared to fill high-demand information technology positions in the St. Louis region.

WATER SCIENCE



The University of Wisconsin System/Milwaukee Water Council

- *Interventions: research experiences, faculty and peer mentoring, capstone project*

The two partners and other regional stakeholders are addressing regional workforce needs for highly trained professionals in the water industry by tapping the distinct strengths of four universities in the University of Wisconsin system. The project integrates engineering, science, and technology education to create new approaches to the sustainable use of water systems, and it provides students with new learning opportunities with business in this field. The partners will work with local community colleges to recruit students interested in water science to transfer to the University of Wisconsin system, prepare them prior to arrival on campus, and provide opportunities aimed at increasing persistence in attaining a bachelor's degree.

MULTIDISCIPLINARY FOCUS



The University of Massachusetts System/Massachusetts Competitive Partnership (including Raytheon and Suffolk Construction)

- *Interventions: internships, bridge program, team-based projects*

The program is creating a multi-campus strategy focused on community college articulation, persistence, and STEM degree attainment by underrepresented minority students. The overall goal is to double the number of STEM degrees awarded to underrepresented minority students at both the associate and baccalaureate levels within four years. The state has identified needs in the life sciences, engineering, and information technology.

HIGHER EDUCATION-WORKFORCE ALIGNMENT AROUND HIGH-DEMAND CLUSTERS



- *Two programs are focused on supporting community coalitions that identify business needs, educational capacity, and workforce requirements.*

Drake University, in partnership with the Principal Financial Group, is spearheading a partnership in Des Moines, Iowa, to chart a new direction for the capital region through the Capital Crossroads regional effort. The Capital Crossroads effort is comprised of regional education, business, and foundation leaders working to make Des Moines one of the nation's top mid-sized metro areas. This project uses deep cross-sector collaborations focused on strengthening the education-through-workforce pipeline to ensure the region acquires the trained human capital it needs to meet the demands of the 21st century workforce.

Business Leaders for Education (BLE) is a coalition of Louisville, Kentucky's business leaders, including Chrysalis Ventures and LG&E Energy. Over the next two years, BLE will mobilize the senior business leadership in Louisville to drive the alignment of the 55,000 degrees goal with the skills needed for the 21st century workforce in high-demand fields such as advanced manufacturing, food and beverage manufacturing and innovation, value-added logistics and distribution, and lifelong wellness and aging care.

MATERIALS AND POLYMER SCIENCE/INFORMATION TECHNOLOGY



Case Western Reserve University/Sherwin Williams/Eaton

- *Interventions: course redesign, project-based learning, internships, student learning communities*

Case Western Reserve University is working with its business partners to develop a project focused on first-year students in materials and polymer science to provide business internships, co-operative experiences, and other hands-on learning opportunities in the chemistry of materials. An additional focus is to increase the persistence of community college students in the region to continue and succeed in STEM fields, focusing initially on information technology.

Endnotes

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- ⁸ See BHEF's Research and Policy Briefs at <http://www.bhef.com/publications/research-briefs.asp>.
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- ¹⁰ McKinsey Global Institute. (June 2011). *Big Data: The Next Frontier for Innovation, Competition, and Productivity*. Available at: http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for_innovation.
- ¹¹ Gartner Press Release. Available at: <http://www.gartner.com/newsroom/id/2207915>.
- ¹² Donofrio, N., Spohrer, J., and H. Zadeh. (2010). *Research-Driven Medical Education and Practice: A Case for T-Shaped Professionals*. Available at: <http://www.ceri.msu.edu/wp-content/uploads/2010/06/A-Case-for-T-Shaped-Professionals-20090907-Hossein.pdf>.

Additional Information

For additional information on BHEF's work, please visit our Website:

- Our member-led regional projects: <http://bhef.com/our-work/regional-projects>
- Our modeling and evidence tools: <http://bhef.com/our-work/modeling-and-evidence>
- Our efforts surrounding workplace competencies: <http://bhef.com/our-work/workplace-competencies>
- Our national networks: <http://bhef.com/our-work/national-networks>
- BHEF's publications, which include case studies, reports, and research and policy briefs:
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