

Aligning Postsecondary Education with Regional Workforce Needs: A Tale of Two States

by Stephen Barkanic



THE UNITED STATES FACES A PRESSING NATIONAL SECURITY and competitiveness challenge rooted in a shortage of a diverse, highly skilled workforce, particularly in vital cross-disciplinary fields such as data science and analytics, cybersecurity, and information technology. To address this challenge, the Business-Higher Education Forum launched the National Higher Education and Workforce Initiative, employing a model of strategic business engagement with postsecondary education to meet the highest priority workforce needs. Through the initiative, the Business-Higher Education Forum plans, launches, and assesses projects, partnerships, and scaling strategies that are designed to enable business and higher education to move from transactional engagement in low-touch, piecemeal activities to strategic, long-term partnerships that align postsecondary education with workforce needs. Two of these projects—in Maryland and Ohio—offer models of such partnerships.

THE MISALIGNMENT OF POSTSECONDARY EDUCATION WITH EMERGING WORKFORCE DEMANDS

The number of job openings in the United States has grown to nearly 5 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.

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 34 countries belonging to the Organization for Economic Cooperation and Development. 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.

Increasingly, innovation and competitiveness require new types of employees with either expert or enabled competencies in emerging, transdisciplinary fields. An example of such a competency is data science, where The McKinsey Global Institute predicts a nationwide shortage of 140,000 to 190,000 data science workers with deep analytical skills and a deficit of 1.5 million managers capable of using big data analytics for actionable insights in their decision-making. Whether driven by the demands of an increasingly competitive global workplace or the realities of a rapidly changing and evolving innovation economy, corporations also have come to place a high value on deeper learning.

Deeper learning, which has been championed by the William and Flora Hewlett Foundation through grants to the Business-Higher Education Forum—otherwise known as BHEF—and other partners, nurtures and enhances the skill sets required by many 21st-century professions. These skills include competence in oral and written communication, and 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.

The P-16, preschool through higher education 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 increasingly are required to build deeper partnerships that enable the adaptation of curricula and applied learning experiences to build core competencies and promote deeper learning.

THE BHEF NATIONAL HIGHER EDUCATION AND WORKFORCE INITIATIVE

The Business-Higher Education Forum, the nation's oldest organization of senior business executives and presidents of higher education institutions, brings together its members and other partners in flexible, mutually beneficial partnerships to address gaps in content knowledge and workforce skills at the undergraduate level. Through the collaboration of its business and academic members, BHEF has launched the National Higher Education and Workforce Initiative, which includes regional projects focused on business-higher education partnerships in selected states, as well as a national effort to disseminate information 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.

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, it 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. Currently, regional projects are underway in data science and analytics, cybersecurity, water and energy sciences, materials sciences, engineering, and other fields.

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.

BUILDING AN EVIDENCE BASE WITH RESEARCH TOOLS

The Business-Higher Education Forum'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 science, technology, engineering, and math—otherwise known as 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.

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. The Business-Higher Education Forum'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 teacher' salary or placing undergraduates 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 the Business-Higher Education Forum a grant to develop a next-generation U.S. STEM Undergraduate Model™. Applying system dynamics, this model shows how implementation of high-impact 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 showed that implementing multiple interventions simultaneously (e.g., student learning communities and early undergraduate research experiences) can have a significant

impact on the retention and academic success of undergraduates, particularly women and underrepresented minorities in the first two years of college. BHEF's model demonstrates similar outcomes with combined, integrated intervention strategies.

Even in the face of the intensifying demand for highly skilled workers, the production of graduates in fields fueling the innovation economy is stagnating. In recent years, the absolute number of degrees awarded in STEM fields increased modestly, but has decreased or remained flat in key fields. In computer science, for example, bachelor's degrees have declined, especially for women and underrepresented minorities. Understanding why students migrate away from STEM fields is a critical piece of evidence when designing an intervention.

The Consortium for Undergraduate STEM Success is a collaboration of postsecondary institutions interested in addressing issues relating to undergraduate degree completion in STEM fields, with particular focus on underrepresented students. It 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 academic departments, colleges, and universities to make adjustments and monitor for improvement and make informed decisions regarding programmatic offerings, formulating funding requests and seeking partners. The consortium is a partner with the Business-Higher Education Forum on a multi-year grant from the National Science Foundation that studies the impact of industry-driven interventions on increasing the persistence of students transferring from two- to four-year STEM programs.

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, significant workforce deficits in the sectors and disciplines to be addressed, and be particularly interested in adopting high-impact interventions that will improve transfer student retention from two- to four-year institutions and baccalaureate degree completion for these students.

Each BHEF project addresses a unique workforce need in regions around the country:

- Cybersecurity in the Maryland/Washington, D.C., region (University of Maryland, College Park and Northrop Grumman Corporation)
- Data science in Cleveland and Columbus, Ohio, (Case Western Reserve University and The Ohio State University with multiple corporate partners)

- Water science in Wisconsin (University of Wisconsin System with The Water Council)
- Sustainability in the greater New York City area (City University of New York with IBM)

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.

Often, regions conduct their own analyses of current and projected workforce needs that provide a framework for building regional partnerships. In Maryland, for example, a series of studies and reports by the governor's office, the University System of Maryland, and other agencies and foundations pointing to a sharp demand for workers specializing and enabled in cybersecurity was instrumental in planning and implementing projects and, ultimately, a network in cyber for the region. In regions where such analyses are not available, BHEF has partnered with Burning Glass Technologies, a Boston-based company that conducts studies of regional and national job markets, in helping to understand skill demands of regions targeted for BHEF projects.

THE BUSINESS-HIGHER EDUCATION FORUM'S STRATEGIC BUSINESS ENGAGEMENT MODEL (SEE DETAILS ON PG. 7, FIG. 1)

Using these tools and strategies, 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.

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 develop regional demonstration projects that lead to national adoption. 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.

CYBERSECURITY IN MARYLAND

Maryland has been an early and vigorous adopter of the type of program envisioned all along for the National Higher Education and Workforce Initiative (HEWI). At the time of the initiative's launch, Maryland already had identified cybersecurity as a strategic focus for education and economic development, given the presence in the region of such federal agencies as the National Security Agency, National Institute of Standards and Technology, and Department of Homeland Security, and major defense and high-tech companies.

Working with its membership, BHEF partnered with the University System of Maryland (USM) to build a system-wide response to the state's (and nation's) cybersecurity workforce challenges. BHEF's leadership role in sparking innovation resulted in the creation of premier undergraduate programs in cybersecurity at two USM institutions and their adaptation at two additional institutions. Together, all partners have created vibrant and relevant educational programs to meet the needs of the cybersecurity industry, which provides proof of principle for HEWI, the workforce initiative.

With a three-year implementation grant from the Alfred P. Sloan Foundation to BHEF, USM conducted a student migration analysis and focus groups with students and campus career services professionals. The initial undergraduate cyber project launched in the USM was the landmark Advanced Cybersecurity Experience for Students (ACES) program, the nation's first honors undergraduate program in cybersecurity. Supported by a major grant from the Northrop Grumman Foundation and subsequent support from Parsons, the program educates future leaders in cybersecurity through rigorous, hands-on learning experiences, an intensive interdisciplinary curriculum, collaborative projects, and professional insight from corporate leaders.

The advanced cybersecurity curriculum consists of two linked academic programs over the course of four years: (1) a freshman-sophomore living-learning program in a new honors dormitory leading to an Honors College Citation in Cybersecurity and (2) an upper-level course of study in cybersecurity. Students in this program take general cybersecurity courses as well as courses on cybersecurity forensics, reverse engineering, secure coding, criminology, law, and public policy, among other topics. Seniors complete a yearlong capstone project that addresses a foundational challenge in cybersecurity. Students graduating from the program receive a designation of completion on their academic transcripts. The first cohort of advanced cybersecurity students started their studies in fall 2013—less than two years after the program was first conceptualized—and in its first two years has approximately doubled its enrollments over projected demand.

As a second major achievement in its cyber-related work in Maryland, the Business-Higher Education Forum supported a partnership between the University of Maryland Baltimore County (UMBC) and Northrop Grumman that resulted in the launch of the UMBC Cyber Scholars program. The program has a strong focus on increasing diversity in the cyber workforce and draws on significant insights gained through the university's nationally renowned Meyerhoff Scholars program—which is widely considered to be at the forefront of efforts to increase diversity among future leaders in STEM fields—and UMBC's Center for Women and Information Technology.

Like the ACES program, the Cyber Scholars program charts new ground in the delivery of effective undergraduate education in cybersecurity. Scholars receive financial awards with special opportunities for advanced research, directed internships, and other forms of academic and social support. They are matched with a faculty research mentor as well as an industry mentor. The program fosters a cybersecurity-focused community through common on-campus living-learning housing, events, and activities. Each week, scholars engage in a cyber practicum that includes talks from field practitioners. Scholars also have the opportunity to visit government agencies and industry laboratories that engage in cybersecurity. Cyber Scholars take a combination of management-oriented and technically focused courses. All scholars are required to take an introductory seminar in their freshman year and at least one cybersecurity course in their junior year.

Industry involvement plays a vital role in the success, impact, and sustainability of these programs. Companies and government agencies help shape curricula, work regularly onsite with program planning, and provide guest lecturers, program advisors, adjunct faculty, paid internships, and mentors for

students throughout their four-year experience. To scale effective cyber programs, the University System of Maryland-BHEF Undergraduate Cybersecurity Network was launched in 2013 with Sloan Foundation support. Comprising more than 30 representatives from academia, business, government, and stakeholder organizations, the network supports an overarching system-wide goal of significantly increasing the number and diversity of graduates in cybersecurity fields.

The network supports projects aimed to strengthen business-government-higher education partnerships; focus on key policy challenges, such as accelerating student security clearances; sharing curricula and other resources; and developing a clearinghouse on effective cyber education practice and tools. With Sloan support, the network is seeding projects at key network institutions including Bowie State University, Towson University, UMBC, and the University of Maryland, College Park. These projects are enabling the institutions to expand partnerships with industry and government and increase the size, diversity, and capability of the region's cyber workforce. The work of the Maryland network feeds into BHEF's National Undergraduate Cybersecurity Network.

DATA SCIENCE IN OHIO

The field of data science and analytics is experiencing explosive growth in both the specialist and enabled professions. Reports indicate that big data is growing at a rate of about 40 percent a year and has the potential to add some \$300 billion of value to the nation's healthcare sector alone. Virtually all sectors, both public and private, are experiencing sharp demand for data science-trained employees.

Despite this growth, there are relatively few opportunities for undergraduates to learn about and become skilled in data analytics. A study by the Business-Higher Education Forum and supported by the Sloan Foundation revealed that most data science programs are available only at the graduate level and typically are offered through STEM departments that often lack the diversity needed in the workforce. Increasingly, employers and students are calling for more courses, concentrations, minors, and majors in data science, but significant challenges remain for academic institutions to develop undergraduate pathways in this rapidly evolving area. BHEF is aggressively moving forward to build partnerships between postsecondary institutions and employers across sectors whose goals are to launch undergraduate programs in data science.

Due in part to its high concentration of data-driven companies and regional efforts to catalyze innovation and workforce development around a rich diversity of leading higher

education institutions, Ohio was a natural choice for BHEF to build partnerships focused on data science and analytics. In Cleveland, home to Case Western Reserve University—a major private research institution with a strong tradition in undergraduate education—and numerous companies acutely concerned about their data-skilled workforce, BHEF facilitated a process by which a range of partners came together to determine the workforce skills needed in data science and develop undergraduate tracks in the field. Case Western Reserve announced the launch of a new undergraduate major and minor in data science in 2014, designed to prepare a new generation of data science experts who will improve performance in health, production, and manufacturing and energy.

Case Western Reserve's new undergraduate bachelor's of science degree in data science focuses on real-world applications. It consists of a core curriculum focusing on each of the specific domain areas of health, energy, and manufacturing and production. It includes such dimensions as mathematical modeling of data sources, examining raw data using analytics that focus on inference through the transformation of data to actionable information that improves decision-making, and visual analytics and user experiences. The program also features an experiential learning component through partnerships with industry that provide co-op assignments and internships to students.

To help bring the application of data science to a variety of fields, Case Western Reserve has developed an applied data science undergraduate minor that can be paired with any undergraduate major at the institution. Students can choose from eight subdomains within engineering and physical sciences, health, and business, all of which include a core curriculum that includes five three-credit courses. Among the tools and applications covered by the minor are data management, distributed computing, statistical analytics, and informatics.

In Columbus, civic leaders, business executives, and others launched the Columbus Collaboratory, an advanced technology company that brings together a range of noncompeting companies and other stakeholders to focus on regional workforce and economic development issues and drive solutions in the areas of big data, analytics, and cybersecurity. Attracting IBM's Client Center for Advanced Analytics to Central Ohio in 2013 was an early achievement of the group. The center brings new analytics and technology talent to the area and encourages existing talent to remain in Central Ohio.

To develop the kind of talent pool needed to help enable the region to continue this progress, the Ohio Board of Regents approved a new interdisciplinary undergraduate major in data analytics at The Ohio State University in 2014. Drawing upon the Business-Higher Education Forum's strategic engagement

model, the university engaged deeply with regional business partners to identify the core elements for both the curricular and co-curricular dimensions of the program.

Opened to students in fall 2014, the major is made up of three basic parts: core courses, a specialization and a capstone—or internship—experience through business partnerships. The College of Arts and Sciences and the College of Engineering are partnering to deliver the core courses in computer sciences, mathematics, and statistics. Students learn principles of data representation and management, computer programming, and statistical modeling and analysis. The core curriculum focuses on principles that are fundamental to all areas of data analytics and consists of courses taken by all majors. In these courses, students investigate the computational, mathematical, and statistical foundations of data analytics, and develop such deeper learning skills as critical thinking and effective communication. Each student in the major chooses an area of specialization to learn how data analytics is applied in a particular field. Coursework in some specializations can be tailored based on a student's interests. The areas of specialization available in the major include biomedical informatics, business analytics, and computational analysis.

The program seeks to develop in students both highly technical skillsets and the ability to function in solutions-oriented teams. All students participate in a capstone or an integrative experiential component as part of their chosen specialization.

NATIONAL SCALING AND NETWORKS

As part of its efforts to scale insights from its regional projects, the Business-Higher Education Forum is launching national networks of effective practice that bring together the kinds of network partners instrumental in building the regional work to focus on a more macro level. The National Undergraduate Cybersecurity Network has been underway since 2012 and has met on an annual basis.

BHEF's vision for this dimension of its work is to sustain a national network of experts from higher education, business, and government who can serve as the intellectual hub of undergraduate cybersecurity and promote cooperation around cybersecurity education among the academic, business, and government sectors. The group has been growing steadily. BHEF plans to launch its national data science network in Columbus in the fall of 2015, bringing together participants in data science projects under development in Florida, North Carolina, New York, Ohio, and elsewhere.

BHEF also works with national partners to expand the reach of the National Higher Education and Workforce

Initiative and launch joint initiatives of mutual benefit to a range of organizations representing both industry and higher education. In higher education, the Business-Higher Education Forum partners with the American Council on Education, the Association of Public and Land-grant Universities, and the Association of American Universities. On the corporate side, national partners include the Aerospace Industries Association and the Business Roundtable.

ABOUT THE AUTHOR

Stephen Barkanic, senior vice president and chief program officer, joined the Business-Higher Education Forum in 2011. Barkanic provides overall leadership for the National Higher Education and Workforce Initiative, aimed at bridging industry and higher education to increase the persistence and diversity of students who go on to earn degrees or credentials in key emerging fields and align undergraduate education with workforce needs. He also provides leadership in BHEF's work in Deeper Learning, or 21st-century workforce skills and competencies that focuses on the business need for such skills as critical thinking, creative problem solving, and teamwork in the workforce of the future, and advocating for the importance of those skills on a national level.

Prior to joining BHEF, Barkanic was senior program officer at the Bill & Melinda Gates Foundation, where his work encompassed an array of policy and programmatic areas focused on improving student readiness and success in college.

ABOUT BHEF

Now in its 38th year, BHEF is the nation's oldest membership organization of Fortune 500 CEOs, prominent college and university presidents, and other leaders dedicated to advancing innovative education and workforce solutions and improving U.S. competitiveness. BHEF's business and academic members collaborate in regions across the country to design and deploy education-workforce solutions in the high-demand and emerging fields that are so critical to innovation and national security. BHEF and its members generate insights from research, modeling, and regional projects, work to influence public policy at the national and state levels, and inspire other leaders to act.

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FIG. 1

BHEF'S STRATEGIC BUSINESS ENGAGEMENT MODEL

BHEF's model of strategic business engagement with higher education 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 (1) shape internal and external messaging to raise community awareness of 21st-century workforce requirements and the academic response to those requirements; (2) build a critical mass of peers focused on the undergraduate education in support of workforce development goals; and (3) 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 education 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.



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