Annex A

ANALYSIS OF NATIONAL TRENDS AND EMERGING ISSUES

December, 2020

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Executive Summary

I. Managing the size and composition of the student population of the University of Hawai‘i system in the third decade requires an understanding of demographic trends—globally, nationally, and statewide.

FINDINGS AND IMPLICATIONS:

This section examines the growth trends in global population and the predicted declines in population growth rates and it suggests opportunities for increases in enrollment of international and non-traditional students.

1. Global population and educational attainment are both growing. Yet, U.S. universities have been encountering greater difficulties in recruiting internationally. Foreign student enrollment at UH is unusually low when compared to other public colleges in the Western U.S. and offers an opportunity for higher international enrollment.

2. An often-overlooked effect of the Great Recession that began in 2008 was a steep drop in the birthrate in the U.S., which will lead to a decline in the number of high school graduates after 2025. In the light of this trend, it is even more significant that the volume of immigration to the U.S. is now falling.

3. Rather than concentrate solely on increasing enrollment of new students, UH, like other leading institutions, should step up its investment in improving retention and graduation rates of students already recruited.

II. Globally, political trends will converge at an unprecedented pace, making governance and cooperation harder and changing the nature of power—fundamentally altering the global landscape. The growing dysfunctionality of political systems presages a more challenging environment for higher education in the coming decade.

FINDINGS AND IMPLICATIONS:

A major shift in geopolitics toward the Indo-Pacific region would seem to offer unprecedented long-term opportunities for Hawai‘i, but partisan politics makes the timing of such benefits unpredictable.

1. The locus of global power and the focus of U.S. policy are shifting toward Asia. Defense spending in the state will grow with the growing prominence of Indo-Pacific in U.S. foreign policy, but at the same time, there are risks associated with changing partisan control in Washington that could cause cuts to Hawai‘i’s defense industry.

2. U.S. is likely to continue to experience a hyper-partisan political climate with limited ability to undertake major policy initiatives and growing public skepticism about the value of investment in higher education. Amid stagnation in state and local budgets, higher education is often getting a lower share of public revenues. Public skepticism and partisan gridlock will require more pointed public relations and lobbying efforts for public university support.

3. Populist, anti-growth resistance movements can pose challenges to desired changes at UH.

III. Global, national, and statewide economic and workforce trends are of particular significance for universities, given both the rising expectations of students and their families and the growing difficulties of preparing the student population for satisfying workforce experiences.

FINDINGS AND IMPLICATIONS:

Sluggish economic growth, coupled with mounting environmental and health challenges, will limit funding for education and research. At the same time, there are immense opportunities for higher education to fill current gaps in talent supply chains in fields such as healthcare, renewable energy, and information technology, and to create opportunities in the emerging “future of work”.

1. Challenges to the stability of the global economy — climate change, environment, and health issues — will demand increasing public attention and threaten to diminish funds available for the education sector.

2. Rates of economic growth will continue to fall in Japan and China, and this will likely have an adverse effect on the state's economy.

3. Declining U.S. economic growth and its ballooning federal budget deficits limit prospects for expanded funding for research and student aid.

4. Occupations requiring postsecondary education will experience higher rates of growth than those requiring just on-the-job training. This will make college degrees more attractive. In times of adverse economic conditions, more students may seek degrees, but their financial needs are likely to be greater. On the other hand, in conditions of near-full employment, attracting students who might otherwise enter the workforce becomes more challenging.

5. The current mismatch between jobs and educational attainment is evidenced not only by the large numbers of "underemployed" college graduates, but also in the large number of skilled and relatively high-paying jobs, especially in STEM-related fields, that go unfilled because of an inadequate supply of workers with proper credentials. UH must respond to the skills gap requiring such educational credentials.

IV. Anticipating when, where, and how technology will alter economic, social, political, and security dynamics is a hard game, but it seems clear that online education is here to stay.

FINDINGS AND IMPLICATIONS:

We examined the marketplace for online education, showing how some late entrants are able to craft successful online strategies. We also studied how artificial intelligence (AI) and other new technologies are customizing education based on individual preferences.

1. There has been a profound and pervasive disconnect between employing new technologies and leveraging them to enhance quality of education. Universities need to address the tension between employment of technology and assurance of quality.

2. Thousands of colleges offer online courses, but latecomers to the online marketplace are finding it difficult to compete beyond their own institutions. Unless they can offer distinctive, region-specific programs, they are not likely to prosper from their online divisions. The best chance for UH to increase online enrollment is to emphasize region-distinctive programs and courses aimed at specific job needs in the state and targeted on adult learners. Appendix A-1 describes four such programs: UCLA's online Professional Program in Screenwriting, Tulsa's online Master of Energy Business Management, Case Western Reserve's Master's in Biomedical Engineering, and Stanford's online graduate certificate in Artificial Intelligence.

3. Given adequate budgets and staffing, and augmented by new developments in artificial intelligence and big data, information and communication technology — especially in partnership with employers — will help universities to open more digital options and to make significant advances both in instruction and in the monitoring of student progress.

V. Global and national trends in higher education and new directions in higher education policies will affect the University system in the coming decade.

FINDINGS AND IMPLICATIONS:

We examined the globalization of education through higher education partnerships and explored higher education's affordability crisis, in the context of the decline in the percentage of Hawai'i's high-school graduates who are opting for college in Hawai'i.

1. Transnational higher education — the delivery of higher education programs by a provider across national boundaries by physical or electronic means — is an increasing feature of global higher education. To expand its global influence and its enrollment, UH should consider additional ways of linking with colleges and students abroad (particularly in Asia).

2. Undergraduate enrollment in the U.S. is projected to be relatively flat, increasing by only three percent between 2017 and 2028, and even these growth rates are subject to business cycle fluctuations.

3. Reduced state support and shrinking federal student aid has shifted a greater portion of the cost of education to students and their families, through rising tuitions and fees,

exacerbating the “affordability crisis” in higher education and prompting a variety of proposals for “free tuition” and relief of student debt. Recruitment and retention of low-income students are threatened by rising tuition and declining levels of Pell Grant assistance.

VI. The University of Hawai‘i system can benefit from the study of innovative approaches at university systems across the country that address financing, community service, development of job-producing academic programs, renewal and modernization of facilities, and other ways of stimulating the economy.

FINDINGS AND IMPLICATIONS:

There is significant decline in public support for most state universities. High-quality education and research come at an ever-increasing cost to the student. In this section, we examine how higher education institutions multiply their revenue streams and add new value to the communities they serve.

1. In the face of falling state appropriations and rising tuitions, both rigorous control of costs and a search for innovative ways of financing universities are needed. Options include:

    a. Recruiting international and out-of-state students who will pay higher rates of tuition (though this can arouse political opposition from those who believe that only in-state students should benefit from the state’s subsidy to public higher education).

    b. Cutting expenses by allowing students to earn credits for prior experience.

    c. Seeking economies by partnering with outside entities (such as Trilogy Education or Orbis Education) to deliver programs.

    d. Deferring students’ tuition payments until they are employed.

    e. Increasing accountability by changing patterns of state funding to depend more on outcomes.

    f. Working with corporate partners to explore income-sharing plans.

2. Higher education institutions have been tailoring their offerings of academic programs to adjust to changing economic conditions. Several examples of innovative programs are described in Appendix A-2. Programs in healthcare-related occupations (such new programs as Johns Hopkins's Nursing School and the interdisciplinary College of Health Solutions at Arizona State) are increasing, while concerns about a "skills mismatch" in computer-related fields has contributed to a move toward development of certificate-earning courses that can eventually be "stacked" into a degree (such as the digital technology certificate developed at several Washington-area universities by Capital CoLAB). UH should further develop programs in cybersecurity (such as the innovative programs at Carnegie Mellon) in partnership with NSA and explore selective expansion of certificate programs, especially in IT fields (such as Stanford's graduate certificate in artificial intelligence), to address the skills mismatch. The growing threats of global climate change have produced rising demand for graduates in fields such as renewable energy (pioneered at Oregon Institute of Technology) and sustainability (led by Michigan's innovative School for Environment and Sustainability). Finally, even in established occupations in the hospitality industry, new technologies are demanding new training, such as the pioneering work in "smart tourism" at Central Florida's Roche College of Hospitality Management. Finally, UH should expand competency-based education opportunities to address needs of adult students without demand for extensive in-class time.

3. Universities have also been devising new ways to serve their communities, including student "service learning" internship programs and programs for meeting lifelong learning needs of older adults. For example, University of Washington's "Continuum College" offers a model for serving lifelong learning and career needs of the older population. UH can also take a lead in community development projects (e.g. sustainability) or expand service-learning programs as attractions for students and to enrich academic programs.

4. As public funds for renewal and modernization of facilities have been cut, universities have been able to forge public-private partnerships with municipalities and private developers (P3 contracts) for designing, building, financing, operating and maintaining the facilities, or by "stretching" funds through multi-use facilities and spaces for collaborative learning.

5. Innovative programs to stimulate the local economy and create high-quality jobs include creating regional "clusters" to address job shortages in critical areas through training programs or turning research programs toward "incubators" of new commercial

enterprises. Another strategy is for enterprises to contract with higher education institutions to provide academic programs for their employees. UH should forge stronger partnerships with industry for collaborative planning of academic programs. UH can play a foundational role in creating regional clusters involving UH and partner enterprises (e.g., in cybersecurity). Similarly, it can develop incubators for converting research centers into entrepreneurial ventures.

VII. Implications for academic programming

UH must refine its academic programming in light of important trends, opportunities, and challenges. From emergence of transnational programs, to the ever-growing importance of technology in education and the need to prepare students for the next generation workforce, the implications for programming in higher education are enormous. UH can seize the opportunities presented by Hawai‘i’s unique geography and the growing geopolitical prominence of the Indo-Pacific region.

1. UH should offer programming attractive to international students and forge transnational partnerships.

2. Programs can be introduced in response to the increased importance of Hawai‘i in the nation’s defense and the changing needs of the military, for example, in the area of cybersecurity.

3. Non-traditional students need flexible and continual learning opportunities. For example, the working adults interested in going back to college may need flexible scheduling and “stackable” credentials for programs, which enable career advancements.

4. As a latecomer to online education, UH should be selective in its programming to focus in areas where it has a distinctive advantage or those that need Hawai‘i-specific programming.

5. By leveraging new technologies, like artificial intelligence, programs can be increasingly personalized to the individual student. This leads to better student engagement and higher graduation rates.

Future trends, especially disruptive ones, are far from foreseeable. UH needs to be agile and collaborative in experimenting with new programming and invest in those that demonstrate real promise.

Demographic Conditions: Present Situation and Outlook

I. Managing the size and composition of the student population of the University of Hawai‘i system in the third decade requires an understanding of demographic trends — globally, nationally, and statewide.

GLOBAL POPULATION:

*C*urrently at 7.8 billion, the global population is growing, though at a slower rate than in the last century. The annual growth rate, which peaked at 2% a year in the 1960s, is now 1.05%. Current projections are for a total population of 8.6 billion in 2030 and 9.8 billion in 2050.

Asia, Africa, and Latin America will account for virtually all population growth. Asia, the most populous continent at 3.9 billion, will still add the largest numerical growth, despite a substantial decline in birth rates. Europe's population is expected to decline from 736 million in 2008 to 685 million in 2050.

The world's urban population will reach two-thirds of the total by 2050. Urban population will more than double in Asia. In North America, it is expected to reach 90% by 2050. Among the many effects of this rural-to-urban shift is the projected drop in the number of people who live in "education deserts"—areas underserved by institutions of higher education.

PACIFIC RIM:

China's population (currently at 1.39 billion) will begin to decline well before 2050, as a result of its "one child" population policy. This means not only that China's workforce will shrink, but also that the proportion of its population that is dependent will grow significantly.

The 21 APEC countries have about 40% of the global population (2.9 billion in 2017); their populations are currently growing at a rate of 0.7%. The Philippines, the U.S. and Mexico are the fastest growing of the APEC countries. Japan's population, currently about 127 million, is expected to fall below 106 million by 2050. Not only is Japan's population declining but also its inhabitants (median age 48.4) are aging out of the work force. As a group, APEC countries have an aging population: the proportion aged 0-14 has fallen from 22.7% in 2005 to 19.7% in 2017, while the proportion aged 65 and older has grown from 8.7% to 11.2% in that period.

THE EFFECTS OF DEMOGRAPHIC TRENDS ON INTERNATIONAL EDUCATION:

Although global population growth is slowing, education levels are growing rapidly. The number of people in the world with a post-secondary education — estimated at 422 million at the beginning of the 21st century — is expected to grow four-fold (to 1.68 billion) by the century's halfway mark.[i]

While sub-Saharan African countries still educate fewer than 10% of their college-going age cohort, almost all countries have dramatically increased participation rates. China (51% enrolled) and India (28% enrolled), currently the world's largest academic systems, have been growing rapidly. However, the recent decline of the traditional student age cohort in China is causing some universities there to scramble for students.

Globally, the percentage of the relevant age cohort enrolled in tertiary education has grown from 19% in 2000 to 26% in 2007 and 38% in 2018. In 2014 there were 207 million tertiary students globally, roughly twice the number in 2000. By 2040 this number is projected to be almost 600 million.

These trends are clearly not evenly spread across the globe. Cost remains an enormous barrier to access. Even where tuition is free, students have to bear indirect costs such as living expenses and loss of current income. Inequality among national higher education systems as well as within countries has increased in recent decades. A June 2020 study found that the leading East Asian universities continue to be dominated by male students, even as overall student populations there decline.[ii] For the world's poorest countries and most resource-deprived universities, the opportunities to engage internationally can be extremely limited.

According to UNESCO, there were 5.3 million students studying outside their home countries in 2017 (up from 4.2 million in 2013 and only 2 million in 2000). Of this number 22% came from

East Asia (17.4% from China alone), 18.4% from Europe, and 6.25% from India. Just under half were enrolled in only four countries: the U.S. (24%), U.K. (11%), Australia and France (7% each). A relative newcomer to the list of host countries is China, which enrolled 10% of these students.

However, for the past three years, U.S. universities have encountered greater difficulties in recruiting internationally. In November 2019, the Institute of International Education reported that in the 2018-19 academic year, new enrollment of international students at U.S. universities was 269,383, compared to 300,743 in 2015-16, a decline of 10.4%. In part this is because students from leading "sending" countries such as China and India have better homegrown opportunities than they did earlier. In the case of China, the numbers coming to the U.S. have also been adversely affected by the recent rise in tensions between the two countries. But in general, the tightening of visa restrictions by the Trump administration as well as widespread publicity given to shootings on U.S. campuses are thought to have had especially adverse effects on enrollments of international students.

The percentage of international students enrolled at the University of Hawai'i lags significantly behind that of other public universities in the Western U.S. Whereas international students at the University of California campuses at San Diego, Berkeley, and Los Angeles amount to 19%, 13%, and 12% respectively, and the Universities of Washington and Oregon show international enrollments of 16% and 10%, the figures at UH-Hilo and UH-Mānoa are only 4% and 3%, respectively.[iii]

When international students travel abroad for education, they are usually focused on a field of study (unlike U.S. students going to college, who are often "undecided" or "undeclared" at the outset). Students from several of the major "sending" countries are seeking accredited engineering degrees or business degrees putting a significant number of U.S. institutions that lack these programs at a recruiting disadvantage.

The table below shows the fields of study for all international students in the U.S.

FIGURE 1

Field of Study	*2018/19*	*2019/20*	*% Change*
Agriculture	13,754	13,134	-4.5%
Agriculture	8,538	7,857	-8.0%
Natural Resources and Conservation	5,216	5,277	1.2%

Business and Management	182,170	174,470	-4.2%
Communications and Journalism	24,017	23,925	-0.4%
Communication, Journalism	19,797	20,587	4.0%
Communications Technologies/Technicians	4,220	3,338	-20.9%
Education	16,786	15,700	-6.5%
Engineering	230,780	220,542	-4.4%
Engineering	214,331	202,697	-5.4%
Engineering Technologies/Technicians	13,275	14,081	6.1%
Transportation and Materials Moving	2,085	2,690	29.0%
Mechanic and Repair Technologies/Technicians	605	587	-3.0%
Construction Trades	313	147	-53.0%
Military Technologies	89	263	195.5%
Precision Production	82	77	-6.1%
Fine and Applied Arts	63,097	64,501	2.2%
Visual and Performing Arts	48,407	49,542	2.3%
Architecture	14,690	14,959	1.8%
Health Professions	35,446	34,934	-1.4%
Health Professions	35,269	34,711	-1.6%
Residency Programs	177	223	26.0%
Humanities	17,013	16,992	-0.1%
Foreign Languages, Literatures and Linguistics	7,357	7,293	-0.9%
English Language and Literature/Letters	4,916	4,715	-4.1%
Philosophy and Religious Studies	2,673	2,896	8.3%
Theology and Religious Vocations	2,067	2,088	1.0%
Intensive English	22,026	21,301	-3.3%
Legal Studies and Law Enforcement	16,483	16,269	-1.3%

Legal Professions and Studies	14,161	14,198	0.3%
Homeland Security, Law Enforcement, and Firefighting	2,322	2,071	-10.8%
Math and Computer Science	203,461	205,207	0.9%
Computer and Information Sciences	156,654	157,566	0.6%
Mathematics and Statistics	46,807	47,641	1.8%
Physical and Life Sciences	81,580	81,971	0.5%
Biological and Biomedical Sciences	45,338	45,298	-0.1%
Physical Sciences	35,349	35,773	1.2%
Science Technologies/Technicians	893	900	0.8%
Social Sciences	84,320	84,440	0.1%
Social Sciences	54,651	54,404	-0.5%
Psychology	16,139	16,984	5.2%
Public Administration and Social Service Professions	8,248	7,739	-6.2%
Area, Ethnic, Cultural and Gender Studies	2,697	2,695	-0.1%
History	2,585	2,618	1.3%
Other Fields of Study	86,057	81,837	-4.9%
Liberal Arts and Sciences/General Studies	51,270	45,775	-10.7%
Multi/Interdisciplinary Studies	21,052	21,738	3.3%
Parks, Recreation, Leisure and Fitness Studies	6,008	5,963	-0.7%
Family and Consumer Sciences/Human Sciences[6]	3,951	3,891	-1.5%
Basic Skills	2,790	3,481	24.8%
Personal and Culinary Services	671	669	-0.3%
Library Science	307	263	-14.3%
Reserve Officer Training Corps	8	57	612.5%
Undeclared	18,309	20,273	10.7%
Total	1,095,299	1,075,496	-1.8%

Source: Open Doors report of the Institute of International Education, https://www.iie.org/Research-and-Insights/Open-Doors/Data/International-Students/FieldsStudy

The recruitment of international students has been a major lifeline for many graduate degree programs in Engineering and related STEM disciplines. As shown in the table below, a 2015 survey by the National Science Foundation listed a dozen graduate degree fields in which international students comprised more than half (and as high as 81%) of the full-time student population.

FIGURE 2

Field	*% of Intl. Students*	*Number of Full-time Graduate Students - Intl. Students*	*Number of Full-time Graduate Students - U.S. Students*
Electrical Engineering	81%	32,736	7,783
Petroleum Engineering	81%	1,258	302
Computer Science	79%	45,790	12,539
Industrial Engineering	75%	7,676	2,539
Statistics	69%	4,321	1,966
Economics	63%	7,770	4,492
Mechanical Engineering	62%	12,676	7,644
Civil Engineering	59%	9,159	6,284
Chemical Engineering	57%	5,001	3,834
Pharmaceutical Sciences	56%	1,931	1,502
Metallurgical/Materials Eng.	55%	3,723	3,103
Agricultural Engineering	53%	726	654
Agricultural Economics	53%	881	796

Source: National Science Foundation, Survey of Graduate Students and Post doctorates, NFAP calculations. US Students include lawful permanent residents. http://nfap.com/wp-content/uploads/2017/10/The-Importance-of-International-Students.NFAP-Policy-Brief.October-20171.pdf

Enrolling in a STEM-related graduate program makes international students eligible for a special student visa status, the Optional Practical Training (OPT) extension. Students with this status (three-quarters of whom are from Asia) are eligible to remain in the U.S. for three years after graduation, during which many can earn an H-1B visa allowing temporary employment in the country. Graduate programs in business—especially MBA programs—have experienced falling applications for five straight years, and some business schools are applying for a STEM designation that would allow them to offer the OPT extension. Duke University and the University of Wisconsin-Madison are two schools whose business programs have achieved this status, thereby strengthening their international student recruitment programs.[iv]

UNITED STATES:

The U.S. population (308.7 million in the 2010 census, a 9.7% increase over 2000) stood at 328 million at the beginning of 2020 and is forecast to reach 438 million by 2050. It is expected that 82% of U.S. population growth between 2005 and 2050 will be due to immigrant families that arrived after 2005. The U.S. is home to more foreign-born residents than any other country. Non-Hispanic whites will not be a majority of the U.S. population in 2050. The median age of the U.S. population (37.8 in 2015) will reach 40.8 in 2035, and life expectancy will increase from 76.9 for males and 81.6 for females in 2015 to 80.4 for males and 83.9 for females in 2035.[v] A report released by the Census Bureau in January 2020 sounded a note of caution about U.S. population growth, however. The population growth in 2019 was the lowest annual growth since 1918. And when the 2020 census is taken, the bureau predicted, the growth between 2010 and 2019, at 6.3%, will be the lowest 10-year growth rate since the first census was taken in 1790.

Four states lost population in the 2010's, and nine others (including Hawai'i) would have lost population were it not for foreign immigration. (All states but one saw the birthrate decline in the decade.) An added note of caution in the report: the volume of immigration — the engine of population growth given continuing declines in the domestic birthrate — is now falling.

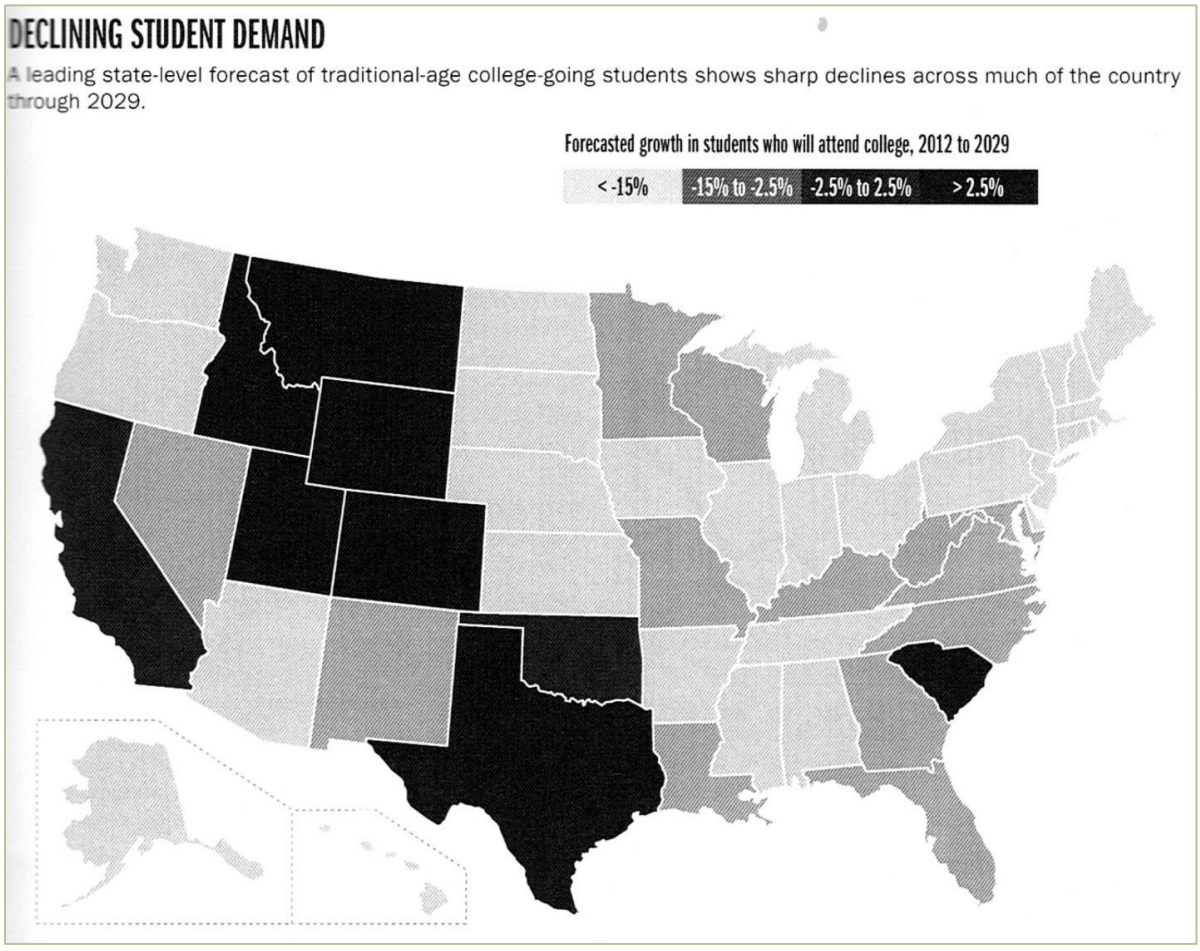
THE EFFECTS OF DEMOGRAPHIC TRENDS ON EDUCATION ENROLLMENTS:

An often-overlooked effect of the Great Recession that began in 2008 was a steep drop in the birthrate in the U.S. This will lead to a decline in the number of high school graduates after

2025. While the number of high school graduates is expected to grow in the U.S. between 2020 and 2025, it will then fall more than 8% between 2025 and 2029.[vi]

The map below shows the regional contrasts in these effects: the number of high school graduates is already dropping in the Northeast and Midwest, while expansion will continue for a few years in parts of the South and West. (This map, from demographer Nathan Grewe, shows that the projection for Hawai'i is for a decline in the number of traditional-age college-going students in excess of 15% between 2012 and 2029. A different estimate, from WICHE statistics, will be examined in Annex B.)

FIGURE 3



Source: *Chronicle of Higher Education*, The Looming Enrollment Crisis, p. 9.

Birthrates in the nonwhite population currently exceed those of whites, affecting the ethnic composition of school populations. Though the effect varies by region, in the early years of this decade the number of non-white public high school graduates is projected to replace the numerical decrease in white high school graduates.

In the light of this demographic trend, the issue of accessibility of U.S. higher education institutions for nonwhite students — long a topic of concern — became an even more urgent in 2020. In the wake of highly visible incidents of racial injustice — most significantly the killing of George Floyd by Minneapolis police in May — and the subsequent mass protest under the banner "Black Lives Matter" brought the issue of racial equity even more to the forefront. Colleges and universities throughout the country engaged in intense discussions about the racial and ethnic diversity of their student bodies and faculties. Many added the administrative position of "chief diversity officer" to the ranks of campus leadership.
In July an influential study, "Segregation Forever: The Continued Underrepresentation of Black and Latino Undergraduates at the Nation's 101 Most Selective Public Colleges and Universities," was published by the Education Trust, a nonprofit research organization.[vii] This study assigned a letter grade to each of the 101 public colleges, depending on what share of their students were Black or Latino in 2017, compared with the percentage of college-eligible 18-to-24-year-olds from those demographic groups in each college's state. About half of the colleges received passing grades for Latino-student representation, while less than a quarter did for Black-student representation. As summarized by an article on the report in *The Chronicle of Higher Education*, "one way public colleges measure equity is by achieving an enrollment that mirrors the diversity of their state. By that standard, the report underscores that colleges have a steep climb ahead to meet the diversity and equity demands that they've faced for years and that have intensified in recent months."[viii]

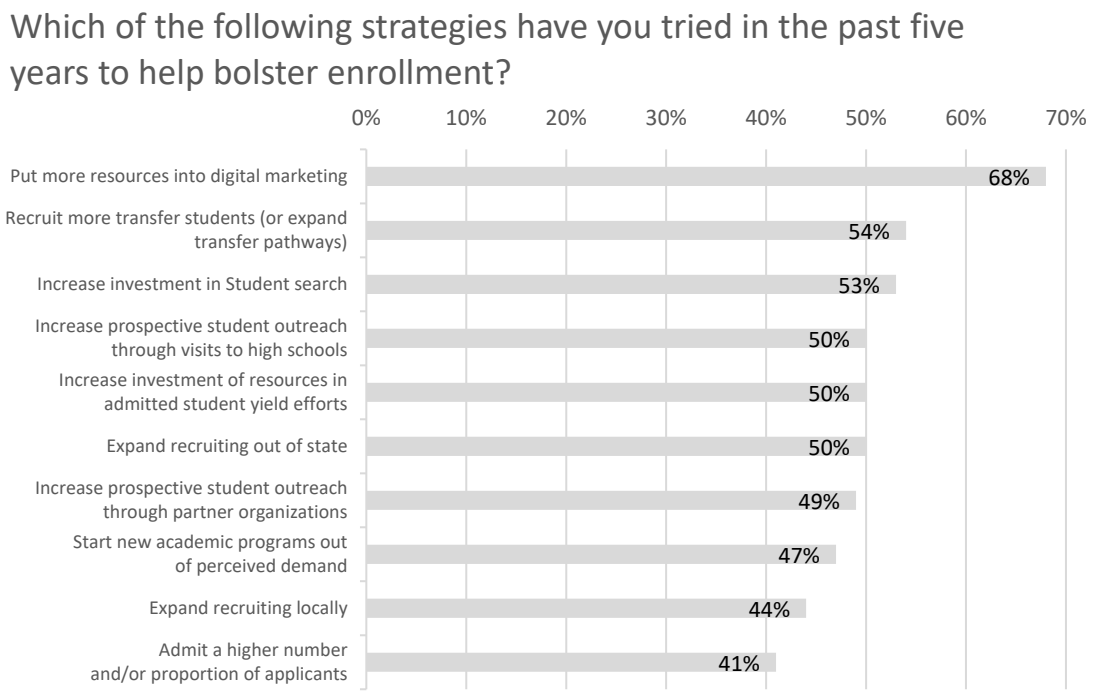
(Notably, the University of Hawai'i's Mānoa campus was one of the 101 colleges included in the study. Even though the state's population includes relatively small proportions of Blacks and Latinos, the University received grades of F (for Blacks) and C (for Latinos) for its 2017 enrollments, which fell below the standards found "equitable" in the report.)

Looking beyond the "traditional-aged, college-going" cohort, there is a specific population of adult learners who are still a relatively untapped market: the more than 30 million Americans who have some college credits but no degree. Although overall enrollment of undergraduate students over age 25 dropped nationally by 1.5 million in the 2011-2017 period, degree

completion programs aimed at attracting this portion of the adult population would seem to hold particular promise. In light of the clear advantages that bachelor's degree holders gain in achieving higher lifetime earnings, these adults would seem to have an incentive to finish their degrees. To best take advantage of this recruitment opportunity, universities may need to liberalize their policies on acceptance of transfer credit (or their policies of granting credit-by-exam) and ensure that they have adequate counseling resources to assist adults who are returning to school. Moreover, flexible scheduling is required at a time of "full employment."

Given the bleak outlook provided by analyzing demographic trends and the recent drop in numbers of undergraduate students, the overwhelming majority of U.S. higher education institutions (79%, according to a recent national survey of enrollment managers) are examining strategies for increasing (or even holding onto) enrollments. *The Chronicle of Higher Education* commissioned a survey by Maguire Associates in September 2019 that produced the following results:

FIGURE 4



Source: Chronicle of Higher Education, *The Looming Enrollment Crisis*, p 27

In fact, however, adverse demographic trends are incontestable and higher education institutions cannot reverse them. Rather than concentrate solely on increasing the recruitment

and enrollment of new students, colleges may be better advised to spend a larger portion of their energies and resources on improving retention and graduation rates of students already recruited. (Six-year graduation rates at the University of Hawai‘i-Mānoa, though improving, were 60.5% in 2019. The University’s Hilo campus reported a rate of only 44.1%).

Political Climate and Outlook

II. Globally, divisive political trends will converge at an unprecedented pace, making governing and cooperation harder and changing the nature of power—fundamentally altering the global landscape. Even more so following the outbreak of the novel coronavirus pandemic, the growing dysfunctionality of political systems presages a more challenging environment for higher education in the coming decade.

GLOBAL:

In its most recent report on global trends, the authoritative U.S. National Intelligence Council highlights the following political trends:

“Ideas and identities” are driving a wave of exclusion.

Growing global connectivity amid weak growth will increase tensions within and between societies. Populism will increase on the right and the left, threatening liberalism. Some leaders will use nationalism to shore up control. Religious influence will be increasingly consequential and more authoritative than many governments. Nearly all countries will see economic forces boost women’s status and leadership roles, but backlash also will occur.

Governing is getting harder.

Publics will demand that governments deliver security and prosperity, but flat revenues, distrust, polarization, and a growing list of emerging issues will hamper government performance. Technology will expand the range of players who can block or circumvent political action. This gap between government performance and public expectations — combined with

corruption and elite scandals — will result in growing public distrust and dissatisfaction. It will also increase the likelihood of protests, instability, and wider variations in governance.

The nature of conflict is changing.

The risk of conflict will increase due to diverging interests among major powers, an expanding terror threat, continued instability in weak states, and the spread of lethal, disruptive technologies. Disrupting societies will become more common, with long-range precision weapons, cyber, and robotic systems to target infrastructure from afar, and more accessible technology to create weapons of mass destruction.

The bottom line.

These trends will converge at an unprecedented pace to make governing and cooperation harder and to change the nature of power — fundamentally altering the global landscape. Within states, political order will remain elusive and tensions high until societies and governments renegotiate their expectations of one another. Between states, the post-Cold War, unipolar moment has passed and the post-1945 rules based international order may be fading too."[ix]

PACIFIC RIM:

Numerous experts on global politics have been writing for the past decade that the locus of world power has moved from the Atlantic to the Pacific. In 2012 the *Financial Times* reported that "Asia Defense Spending to Overtake Europe,"[x] and Christopher Layne published an influential piece in *The National Interest* entitled "The Global Power Shift from West to East."[xi] In 2017 the National Intelligence Council wrote that "leading forecasters broadly agree that emerging market economies like China and India will control a much larger share of global GDP … shifting the focus of the world's economic activities eastward" while the EU's "internal divisions, demographic woes, and moribund economic performance threaten its own status as a global player."[xii]

U.S. Defense Strategy documents stress the rising threat of China, and Bloomberg News reported in December 2020 that "U.S. Pentagon Chief Wants to Reallocate Forces to Indo-Pacific."[xiii] However, the pronounced diversity of political systems in the Pacific Rim region, the strong nationalism, the withdrawal of the U.S. from the Trans-Pacific Partnership, and the high

degree of economic competitiveness make it unlikely that APEC (in spite of the presence of the word "cooperation" in its name) can become a functioning free trade zone very soon, much less a cooperative trading bloc in any way resembling the European Union (fractious as that entity has become). Trade wars between the U.S. and China are now the companion to competitive military build-ups.

UNITED STATES:

Short of a major crisis (such as a terrorist attack with weapons of mass destruction) the U.S. is likely to continue to experience a hyper-partisan political climate with limited ability to undertake major policy initiatives. The result of the 2020 elections — a closely divided vote for President and a continuation of divided government in Washington — underscores the expectation that bold new policies are not likely forthcoming. Near-term forecasts for overcoming the federal deficit and the debt crisis via major changes in entitlement programs or sharp increases in tax revenues are uniformly pessimistic, and again the results of the 2020 elections seem to confirm this forecast. Had the Democrats gained outright control of both the White House and the Congress, sharp cuts in defense spending might have been expected, with severe consequences for several U.S. states, including Hawai'i, where the defense sector is such a large part of the economy. Such a shift in priorities seems less likely.

In downgrading its rating of U.S. creditworthiness for the first time in August 2011, Standard & Poor's specifically cited Washington's toxic political climate: "… the downgrade reflects our view that the effectiveness, stability, and predictability of American policymaking and political institutions have weakened at a time of ongoing fiscal and economic challenges …."[xiv] The credit-rating firm is unlikely to restore the AAA rating in the foreseeable future.

Many state and local governments are also facing enormous budgetary challenges, exacerbated by the fact that — unlike the federal government — most of them have no choice but to achieve balance through cuts. Also, a part of the political climate, as revealed in polling data, is the growing skepticism among the American public about the value of investing in higher education. A 2018 American Trends Panel survey conducted by the Pew Research Center revealed that 61% of Americans said that higher education is going in the wrong direction. The major reason: 84% said that tuition costs were too high, and 65% expressed the opinion that graduating students aren't getting the skills they need to succeed in the workplace —

challenging universities to make a better case for their "value added" to the marketplace and to the society at large.[xv]

Economic and Workforce Conditions: Present Situation and Outlook

III. Global, national, and statewide economic and workforce trends are of particular significance for universities, given both the rising expectations of students and their families and the growing difficulties of preparing the student population for successful workforce experiences.

GLOBAL:

The following four findings are from the 2017 report of the U.S. National Intelligence Council:

1. The global economy is shifting.

Weak economic growth will persist in the near term. Major economies will confront shrinking workforces and diminishing productivity gains while recovering from the 2008-09 financial crisis with high debt, weak demand, and doubts about globalization. Developed and developing alike will be pressed to identify new services, sectors, and occupations to replace manufacturing jobs that automation and other technologies will eliminate — and to educate and train workers to fill them.

2. The rich are aging; the poor are not.

Working-age populations are shrinking in wealthier countries like China, and Russia, but growing in developing, poorer countries, particularly in Africa and South Asia, increasing economic, employment, urbanization, and welfare pressures and spurring migration. Training and continuing education will be crucial in developed and developing countries alike.

3. Technology is accelerating progress but causing discontinuities.

Rapid technological advancements will increase the pace of change and create new opportunities but will aggravate divisions between winners and losers. Automation and artificial intelligence threaten to change industries faster than economies can adjust, potentially displacing workers and limiting the usual route for poor countries to develop. Biotechnologies such as genome editing will revolutionize medicine and other fields, while sharpening moral differences.

4. Climate change, environment, and health issues will demand attention.

A range of global hazards poses imminent and longer-term threats that will require collective action to address — even as cooperation becomes harder. More extreme weather, water and soil stress, and food insecurity will disrupt societies. Sea-level rise, ocean acidification, glacial melt, and pollution will change living patterns. Tensions over climate change will grow. Increased travel and poor health infrastructure will make infectious diseases harder to manage.[xvi]

Global economic growth will continue to put pressure on a number of highly strategic resources, including energy, food, and water — with demand outstripping supplies over the next decade or so. Demand for food alone will rise 50% by 2030, according to World Bank projections, as a result not only of population growth but also of rising affluence. Access to clean water, already stressed in areas of rapid population growth (especially in Africa) will become an even greater challenge as population continues to grow. Climate change is expected to exacerbate resource scarcities. Although new technologies could provide solutions, much will depend on the pace of innovation. Conflicts over resources—rare in recent decades—could re-emerge.

The projected tempo for growth of the world's working-age population in the next two decades will be half of what it was in the past two decades, and nearly half of the expected growth will occur in sub-Saharan Africa, Pakistan, and Bangladesh. In modern economies, younger workers bring higher levels of education and technical skill to the workplace, but in the next 20 years sub-Saharan Africa will account for almost all the total growth in the age 15-29 population. Japan will have more octogenarians and nonagenarians in 2030 than children under 15, and despite in-migration, Europe's manpower pool will also shrink.

PACIFIC RIM:

Established in 1989, the 21-member APEC forum encompasses virtually all of the Pacific Rim. Since its inception, APEC has worked to reduce tariffs and other trade barriers across the Asia-Pacific region, creating more efficient domestic economies and dramatically increasing exports. APEC economies are the most dynamic, fastest growing in the world, and they were considered the engine of global economic recovery after the 2008 recession. APEC's 21 member economies today account for 60 percent of global GDP, purchase 58 percent of U.S. goods exports, and comprise a market of 2.7 billion consumers. Seven of America's top 15 trade partners are in APEC.

APEC nations had in 2017 a combined GDP (in current U.S. dollars) of $48 trillion, up from $31.7 trillion in 2009 and $25.4 trillion in 2005. This translates per capita to $16,606, up from $9,620 in 2005. The labor force participation rate was 66.4% overall, and almost 58% for females, and the unemployment rate in 2017 was 4.2%, down from 7% in 2009. In 2017 there were 60.1 internet users per 100 population. Thanks to individuals with multiple subscriptions, cell phone subscriptions in the APEC countries were 119 per 100 people (up from 67.2 in 2008).

The most drastic drop in young manpower will occur in China — a fact that raises serious doubts about China's ability to continue high growth rates indefinitely. As demographer Nicholas Eberstadt put it, "how China's coming tsunami of senior citizens is to be supported remains an unanswered question."[xvii]

UNITED STATES:

Economic outlook.

In January, prior to the outbreak of the coronavirus pandemic in the U.S., the Congressional Budget Office (CBO) projected that, if current federal tax and spending policies remained in place, the economy would expand by 2.2 percent in 2020 and then grow at an average annual rate of 1.7 percent over the next decade, largely determined by underlying trends in the growth of the labor force and productivity The then-current pace of job gains was expected to remain solid. The unemployment rate was near its lowest point in five decades, and wages had shown modest growth. Nationally, the labor market was expected to continue to grow at a healthy, albeit slower, pace over the next several years. CBO projected that the unemployment rate would average 3.7 percent in 2020 and then steadily rise to 4.6 percent by the end of 2023 as

output growth slowed. In CBO's projections, wage growth would pick up further as employers bid up the price of labor to recruit and retain workers.

According to the CBO's January report, a number of international factors did pose significant risks to their economic outlook over the next five years. For instance, a disorderly exit of the United Kingdom from the European Union or a government debt crisis in Europe could weaken the U.S. economic outlook by disrupting the international financial system, interfering with international trade, and weakening domestic business and consumer confidence. Slower growth in China—relating to the ongoing trade disputes with the United States and other issues within the country, including the coronavirus pandemic, could worsen China's credit markets, sparking even larger declines in the demand for U.S. exports.[xviii]

In the months since this report was issued, the pandemic and associated social-distancing measures to contain it (uneven and sporadic though they were) "ended the longest economic expansion and triggered the deepest downturn in output and employment since World War II." CBO's mid-summer report on the outlook for the U.S. economy projected that from 2020 to 2030 annual real GDP would be 3.4% lower, on average, than it projected in January. The annual unemployment rate was now projected to average 6.1% over the coming decade.

However, in July CBO was expecting that, "if current laws governing federal taxes and spending generally remain in place, the economy will grow rapidly" at a 12.4% annual rate and would recover to its pre-pandemic level by mid-2022. The agency noted that "these projections are subject to an unusually high degree of uncertainty" — not only about the course of the pandemic itself, but about the effectiveness of monetary and fiscal policy and the reaction of global financial markets to the substantial increase in federal budget deficits and debt[xix]

A report issued in September on the 2020 long-term budget outlook was much more sobering: even after the effects of the pandemic fade, budget deficits would be at historically high levels, increasing from 5% of GDP in 2030 to 13% by 2050 (compared to an average deficit of 3% of GDP over the past 50 years). Thanks largely to these escalating budget deficits and the interest payments required, debt held by the public would reach 98% of GDP by the end of 2020, 107% of GDP by 2023, and a whopping 195% of GDP by mid-century.[xx]

Few if any economists would argue that this level of deficit spending and national debt is sustainable. On the revenue side, while the White House was still speculating about the need for a "middle class tax cut," former Vice President Biden and the Democrats were offering

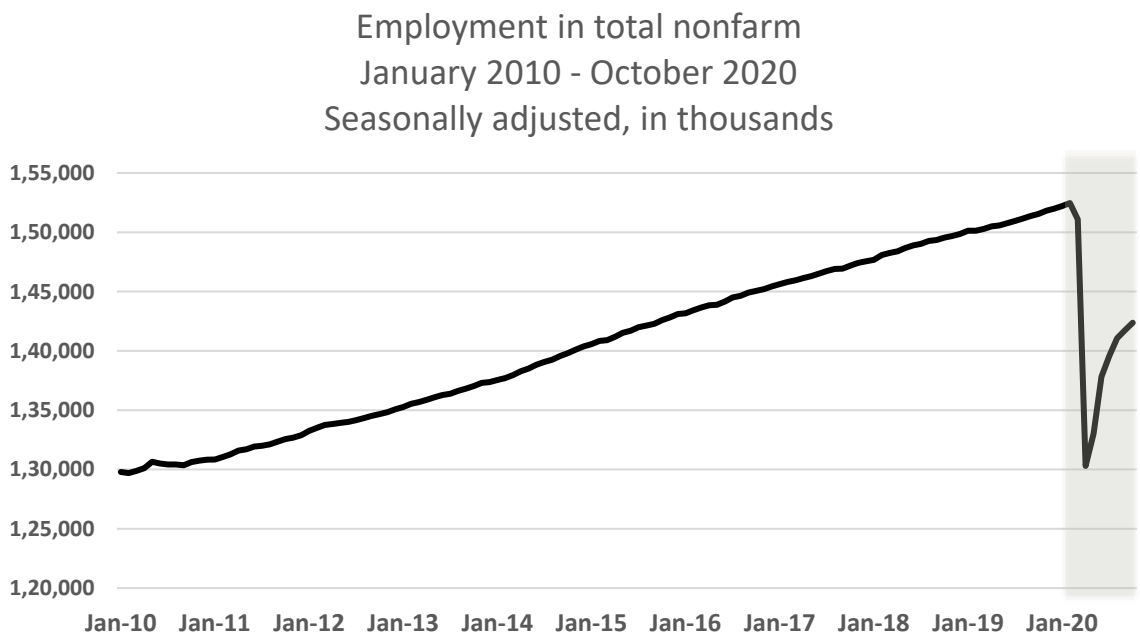
various plans for effectively rolling back the 2017 measure that produced large cuts in taxes paid by corporations and high-income individuals. On the expenditure side, neither political party appeared to want to engage in serious discussions about cutting back on entitlements. As a consequence, discretionary domestic spending programs (including student aid and research grants) as well as defense budgets will surely continue to be closely scrutinized by the next Congress.

Whereas the enormous fiscal stimulus enacted by a bipartisan majority in Congress in the spring of 2020 had aroused hopes for an imminent "V-shaped" recovery, the failure of the Congress to agree on a second round of stimulus prior to the November election wiped out hopeful signs of economic activity, leading a senior economics correspondent for the *New York Times* to warn in October that "The Pandemic Recession Has Just Begun." Closely examining new government employment data, Neil Irwin saw "a jobs crisis that penetrates deeply into the economy." It was no surprise that sectors such as travel and tourism, arts and entertainment, and education had lost large number of jobs as a result of lockdowns and social distancing. But Irwin found that even if those jobs are excluded, the number of jobs in the U.S. was 4.6% lower in September than in February — close to the 5.3% contraction that occurred during the entirety of the Great Recession. His conclusion posed a Third-Decade challenge not only to policymakers but also to educators:

When the economy does get back to full health, many jobs will no longer exist, and American workers will need to find other types of work — and historically, those kinds of readjustments take time … what makes a recession a recession is that the initial economic pain, whatever its source, transmits broadly to affect nearly every industry and drive millions of people not into newer and fast-growing sectors but onto the rolls of the unemployed. The challenge for economic policymakers is not to prevent these structural adjustments. It is to ensure that, as public health concerns wane, there is strong enough demand for goods and services across the economy that even as some jobs disappear forever, new ones are being created and the pain is short-lived.[xxi]

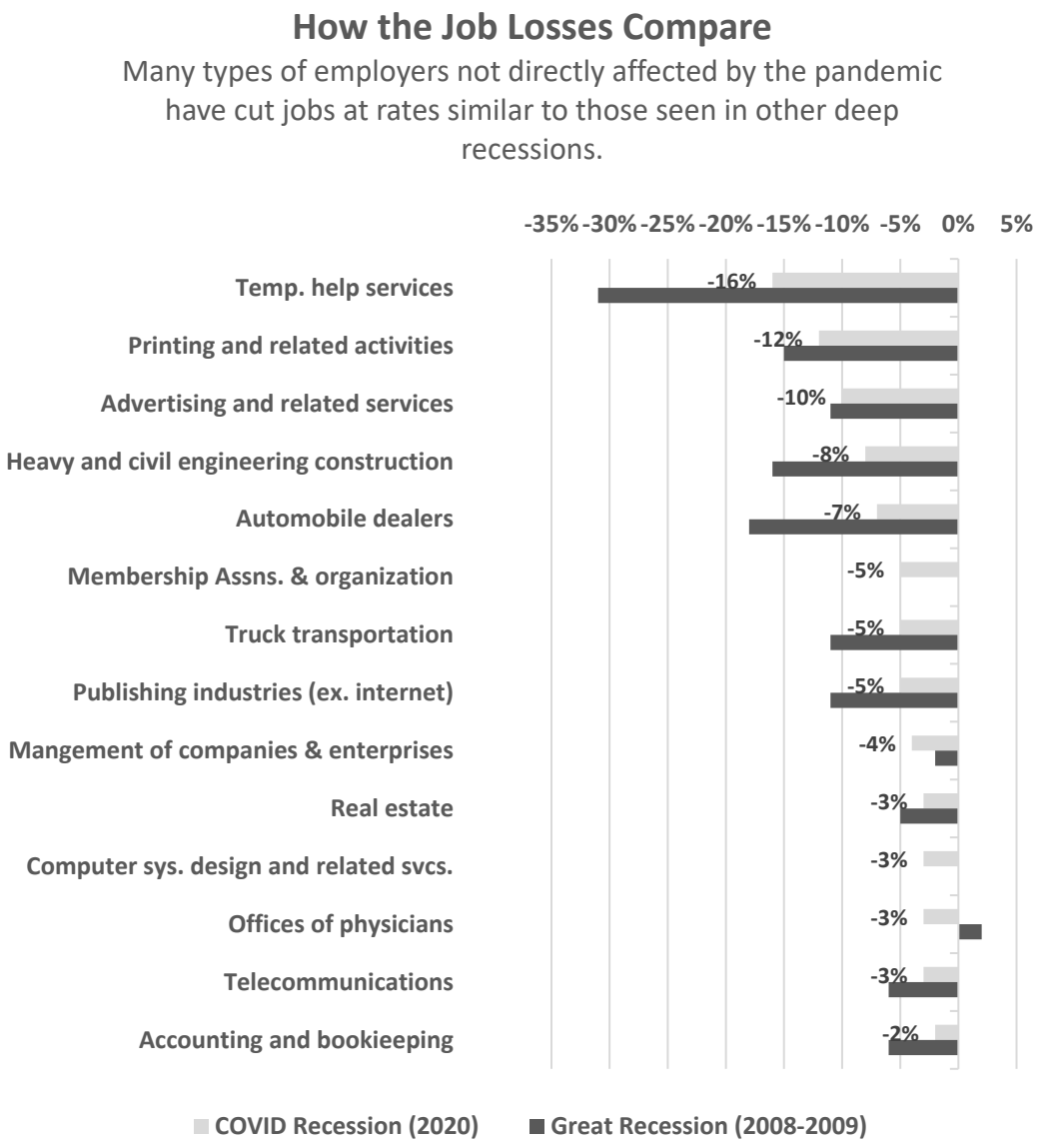
The two figures below, drawn from Bureau of Labor Statistics data, are shown in Irwin's article to illustrate this last point. Figure 5 depicts the incomplete recovery from the sharp drop in non-farm total employment in the first half of 2020. Figure 6 provides the data to document Irwin's point that industries across the economic spectrum have suffered job losses in the first half of 2020 that rival in size the losses during the entire Great Recession.

FIGURE 5



Source: Bureau of Labor Statistics, Current Employment Statistics survey. November 30, 2020. Shaded are indicates recession.

FIGURE 6



Source: Bureau of Labor Statistics – The New York Times

Prior to the pandemic, U.S. states had showed increasing signs of fiscal stability by 2019, with estimated general fund expenditures rising at their fastest rate since before the Great Recession, according to a June 2019 report released by the National Association of State Budget Directors (NASBO). States were also increasingly reserving revenue in rainy day funds, with 37 states growing fund balances in fiscal 2019 and 32 governors projecting increases in fiscal 2020

through their recommended budgets. NASBO's survey offered a positive assessment of gains states had made since the Great Recession but cautioned that progress has not been felt evenly across all fifty states.

The Pew Charitable Trusts found state spending in areas like public education and infrastructure was still lagging behind where it stood before the recession took its toll. According to the NASBO report, states spent $883 billion from general funds in fiscal 2019, an estimated 5.8 percent increase from 2018. That marked the greatest single-year increase since fiscal 2007, when spending jumped 9.4 percent. [xxii]

Although the Democratic majority in the U.S. House proposed legislation in the summer and fall of 2020 that would have provided a sizable additional boost in federal funds to states and municipalities, the Trump Administration and the Republican majority in the Senate resisted what they termed a "bailout," and the states were left to confront huge deficits that sharply limited available funding for public education.

Workforce outlook.

Of the now-developed nations, only the U.S. will age slowly; America in 2035 will be more youthful (average age 41) than either Japan or Western Europe today, and its ratio of working age manpower to senior citizens (3.2:1) will be significantly higher than either of theirs. But supplying the right mix of workers and ensuring the continuing productivity of the American workforce will depend critically on the quality of the K-12 public education system and the support and incentives given to research and development.

In 2018 more than three out of four jobs in the U.S. economy were in the service sector; this dominance is expected to persist in the coming decade. (In 2018, 1.42% of the workforce in the US was employed in agriculture, 19.44 percent in industry and 79.14% in services.)

As shown in the chart below, the Occupational Outlook Handbook of the Bureau of Labor Statistics projections state that six of the ten fastest growing occupations in the U.S. are related to healthcare, due in part to the aging of the baby-boom generation. But as healthcare costs continue to rise, work is being shifted to lower-paid workers. Two others in the fastest growing occupations are in the field of renewable energy: solar photovoltaic installers and wind turbine service technicians. Of the 20 fastest-growing occupations, twelve require an associate degree

or higher; eleven of these occupations earn at least $10,000 more than the national annual median wage. All are in the service sector.

FIGURE 7

Fastest Growing Occupations

20 occupations with the highest percent change of employment between 2018-2028

Occupation	Growth Rate 2018-28	2018 Median Pay (annual)
Solar photovoltaic installers	63%	$42,680
Wind turbine service technicians	57%	$54,370
Home health aides	37%	$24.200
Personal care aides	36%	$24,020
Occupational therapy assistants	33%	$60,220
Information security analysts	32%	$98,350
Physician assistants	31%	$108,610
Statisticians	31%	$87,780
Nurse practitioners	28%	$107,030
Speech-language pathologists	27%	$77,510
Physical therapist assistants	27%	$58,040
Genetic counselors	27%	$80,370
Mathematicians	26%	$101,900
Operations research analysts	26%	$83,390
Software developers, applications	26%	$103,620
Forest fire inspectors and prevention specialists	24%	$39,600
Health specialties teachers, post-secondary	23%	$97,370
Phlebotomists	23%	$34,480
Physical therapist aides	23%	$26,240
Medical assistants	23%	$33,610

Source: U.S. Bureau of Labor Statistics, Occupational Outlook Handbook, at *https://www.bls.gov/ooh/fastest-growing.htm*

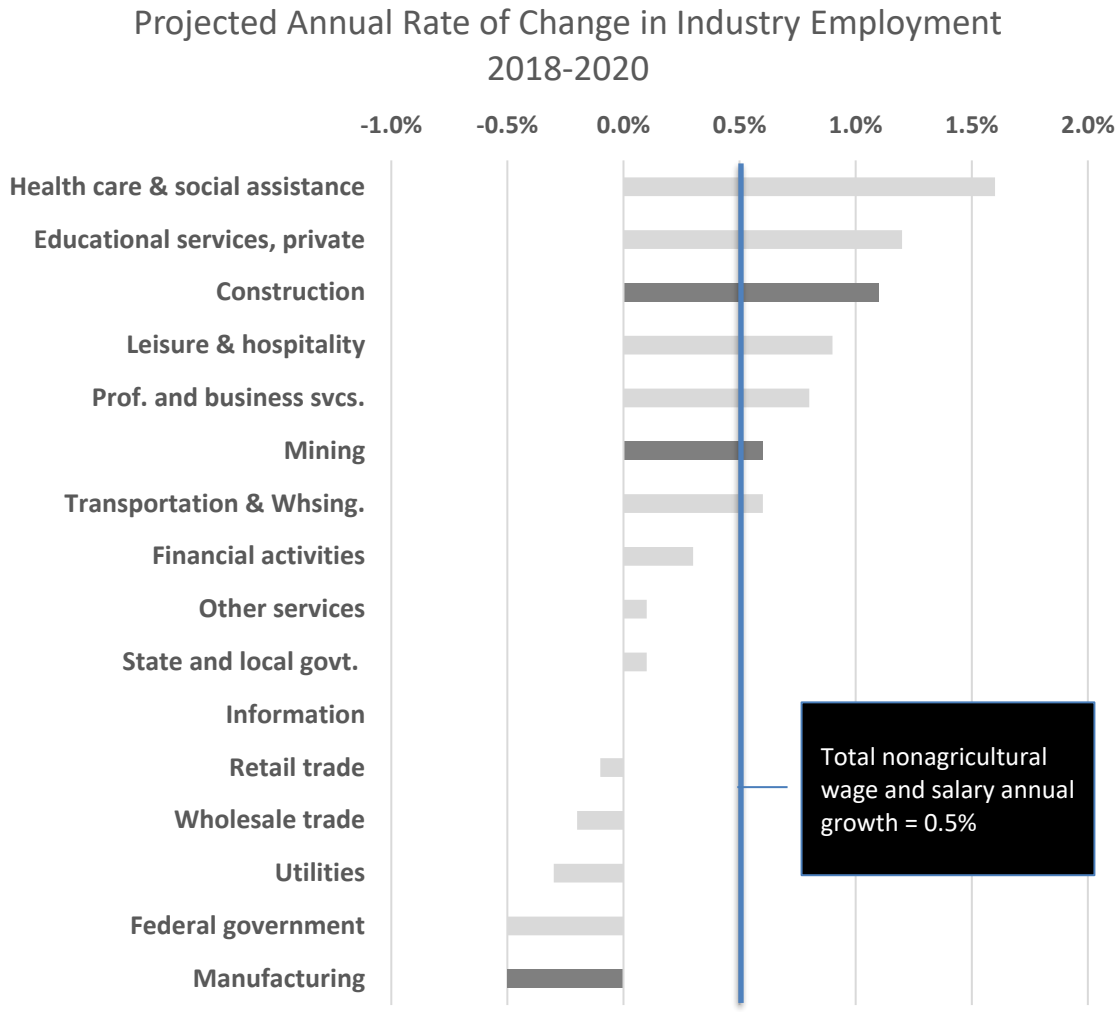
Appendix A-3 below, authored by Dr. Fiorella Penaloza, provides a more detailed examination of the characteristics of the fastest growing occupations in the healthcare industry and renewable energy industry, as well as a closer look at the new analytical occupations that will span a variety of industries.

Interestingly, only three of the twenty *fastest growing occupations* (home health aides, medical assistants, and computer software application engineers) are also projected to be among the twenty occupations with the *largest numerical increases* in employment. Moreover, the educational categories and wages of occupations with the largest numbers of new jobs are significantly different: just eight will require any postsecondary education, and nine of the twenty earn less than the national median wage. Of the twenty industries with the fastest decline, fourteen are goods-producing industries, the demand for which is reduced by plant and factory automation. Very few of these declining occupations require any postsecondary education.

The educational services sector (teaching, administrative, and support positions in schools and colleges) is expected to add nearly half a million jobs by 2028; professional and business services will add one and two-thirds million. In 2010 the industry group that was expected to be the largest source of output growth in the service sector was information services. In fact, however, employment in this sector is not expected to grow at all between 2018 and 2028. U.S. information technology jobs have in fact been outsourced to developing countries. (In 2010, some Indian IT leaders estimated that 350,000 U. S. jobs had moved to India over the preceding decade, but American experts say the number was much higher.)

Women constitute a majority of the workers in the service industry. However, in 2019, women in the service sector earned a median weekly salary that was only about 80% that of their male counterparts. In 2019, for the first time, college-educated women matched the number of college-educated men in the work force (though college-educated women have outnumbered college-educated men in the general population since 2007); however, women constitute only 25% of college-educated workers in computer-related occupations and only 15% in engineering occupations.

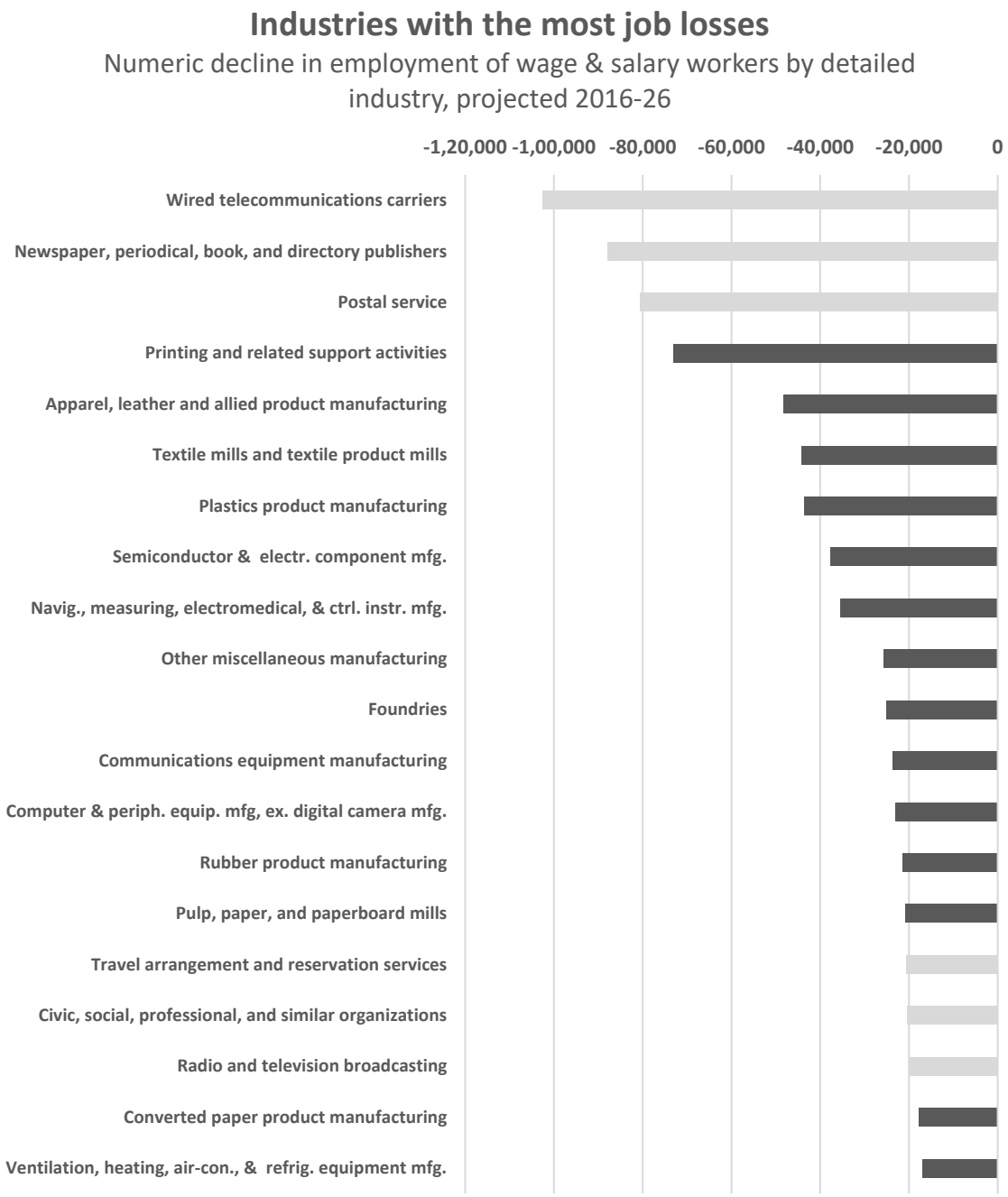
FIGURE 8



Light bars are service providing. Dark bars are goods producing.

Source: U.S. Bureau of Labor Statistics, Occupational Outlook Handbook.

FIGURE 9

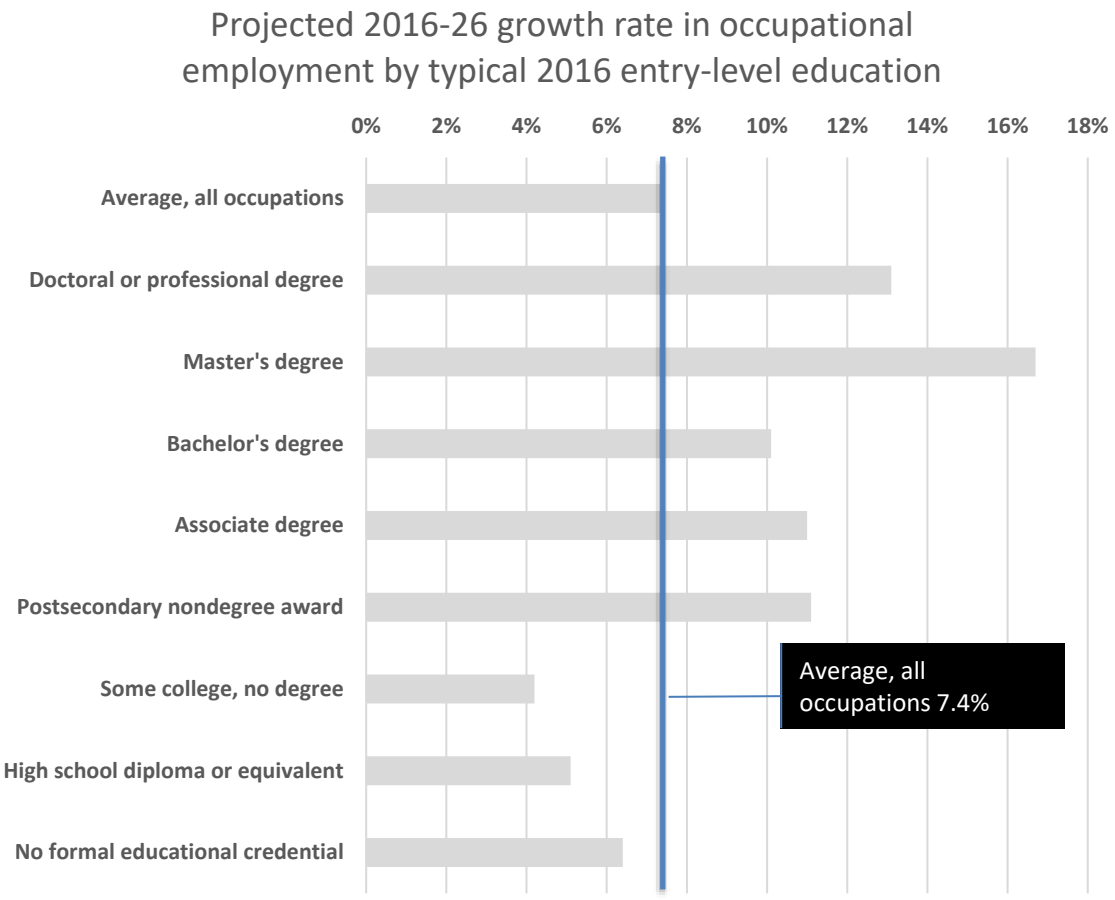


Light bars are service producing industries. Dark bars are goods producing industries.

Source: U.S. Bureau of Labor Statistics

In general, federal statistics show that occupations in a category requiring some postsecondary education will experience higher rates of growth than those in an on-the-job training category. The same studies show that occupations in the master's degree category and in the doctorates and first professional degree categories will grow the fastest — underscoring the continuing importance of supporting graduate and professional schools — and occupations in the bachelor's and associate degree categories will grow well above the average. However, occupations in the high school diploma and on-the-job training categories will fall well below the 7.4% average growth. One-third of U.S. adults 25-and-older are college-educated, but they generate 57% of the economy's earnings, according to a 2019 Pew Research study.

FIGURE 10



Source: U.S. Bureau of Labor Statistics

What these forecasts about educational requirements of various occupations cannot measure, however, is the current mismatch between jobs and educational attainment. A recent study by Burning Glass Technologies examined some four million resumes of persons who graduated from college between 2000 and 217 and found that, on average, 43% of college graduates are underemployed in their first jobs. Of those, roughly two-thirds remain for five years or more in jobs that do not require a college degree.[xxiii]

Moreover, although it has long been true that persons with a college degree are only half as likely to be unemployed as persons with only a high school diploma, other studies have shown that many available (and relatively well-paying jobs) require some "post high-school credential" short of a four-year degree. A study by the Harvard Graduate School of Education, conducted a decade ago, stressed the need to abandon the single-pathway "college for all" mindset and instead promote alternative pathways to further education beyond high school.[xxiv] The report urged better career counseling, more diversified high school curricular requirements, more opportunities for work-linked learning in high school, all developed through partnerships between schools and businesses. Colleges should offer both high school graduates and adults who are changing careers options other than just two- or four-year degrees.

The rapid advance of automation makes this greater flexibility more urgent. The World Economic Forum estimates that machines will perform almost half (42%) of all task hours in the workplace by 2022, compared to 29% today, leading to some seventy-five million jobs being displaced while simultaneously creating an even larger number of new roles for those with proper skills. Micro-credentials, or badges, designed in cooperation with industries looking for certain skills and competencies, can often better address the needs of this population of displaced workers.

Credential Engine, a nonprofit group supported by former Secretary of Education Arne Duncan and former Florida governor Jeb Bush, has counted almost three-quarters of a million distinct credentials currently being offered in the U.S. As shown in the chart below, about half of these are offered through post-secondary educational institutions (including a large number of for-profit schools), most of which are eligible to offer Pell grants. Many others are offered through employers, and almost 50,000 are available through secondary schools.

FIGURE 11

Count of U.S. Postsecondary and Secondary Credential Programs			
Credential Type	Program Count	Nature of Current Count	Method and Sources
Total	738,428		
Postsecondary Educational Institutions	370,020		
Title IV Schools – Degrees	212,802	Enumeration	Count – IPEDS
Title IV Schools – Certificates	111,941	Estimate	Count – IPEDS plus Extrapolation from 8 states' lists
Non-Title IV Orgs. – Degrees	3,188	Rough Estimate	Count – IPEDS plus Extrapolation from 8 states' lists
Non-Title IV Orgs. – Certificates	42,089	Rough Estimate	Count – IPEDS plus Extrapolation from 8 states' lists
MOOC Providers	7,132		
Microcredentials	629	Enumeration	Count – Class Central
Degrees from Foreign Universities	28	Enumeration	Count – Class Central
Course Completion Certificates	6,475	Enumeration	Count – edX, Coursera, FutureLearn, Kadenze
Non-academic Organizations	315,067		
Occupational Licenses	11,837	Estimate	Count – ETA License Finder plus Extrapolation from 10 states' lists
Industry-recognized Certifications	6,724	Estimate	Count – ETA Certification Finder and program accreditors plus Extrapolation from 3 industry lists
Military Certifications	1,378	Partial Enumeration	Count – COOL (accredited certificates not in Certification Finder)
Registered Apprenticeships	22,488	Enumeration	Count – ETA Apprenticeship Registry
Unregistered Apprenticeships	50	Partial Enumeration	Count – German- and Swiss-American company programs (less Registered Apprenticeships)
Coding Bootcamp Course Completion Certificates	1,014	Estimate	Count – Coursereport.com (less programs not available in U.S.)
Online Course Completion Certificates	80,117	Estimate	Sums provided by Udemy, Lynda, SkillSuccess
Digital Badges	191,459	Enumeration	Count – badge vendors (Badgr, Credly, Acclaim, LRNG, MyMantle, Participate)
Secondary Schools	46,209		
Public School Districts – Diplomas	33,540	Estimate	Count of number of public school districts, by state — CCD Count of number of diploma options, by state – Achieve
Private Schools – Diplomas	12,669	Estimate	Count of number of private secondary schools – PSS (Assume one diploma option per school)

Credential Engine: Counting Post-Secondary and Secondary Credentials, https://credentialengine.org/wp-content/uploads/2019/09/Counting-US-Postsecondary-and-Secondary-Credentials_190925_FINAL.pdf

Karen Stout, CEO of Achieving the Dream, an NGO focused on improving outcomes for community college students, stresses that colleges should not only pinpoint which industries are in demand when designing their programs but also look to what skills and competencies those jobs require so they can offer specific credentials that will encourage employers to hire their graduates. [xxv]

A recent article by Professor David Deming of the Harvard Kennedy School argued that U.S. workforce training requirements in the aftermath of the 2020 pandemic should especially lead to a significant expansion of public investment in community colleges. He pointed out that the previous surge in unemployment, in the wake of the Great Recession, spurred a large increase in demand for job training at a time when states were imposing deep cuts on funding for community colleges. "Many people who were turned away or placed on long waitlists found their way to for-profit colleges, which nearly doubled their total enrollment from 2007 to 2010. We are already seeing a reprise of this pattern in the last few months."

The results were far from ideal, as many of the new enrollees incurred heavy debt without gaining employable job skills. "Community colleges," Deming argues, "should be the main place to train America's workers, because they are mission-oriented and well trusted. They can do so in close partnership with local employers and, yes, private providers.

As a promising model he cites the example of Broward College in Florida, which "has built industry certifications into its curriculum, along with internships and other work-based learning opportunities provided by local employers." It was funded by the U.S. Department of Labor's Trade Adjustment Assistance Community College and Career Training program, part of the 2009 economic stimulus, which spent $1.9 billion to fund work-based learning credentials for more than 350,000 students. Deming also cites Google's public-private partnership with more than 100 community colleges to offer training in IT support careers, a model combining private-sector innovation and market responsiveness with the support system and local knowledge of community colleges. "The lesson is clear. In the aftermath of the Great Recession, the United States outsourced job training to for-profit colleges, and many students are still suffering the consequences. Community colleges need to be at the center of talent development for millions of American workers." [xxvi]

Technology

IV. "Anticipating when, where and how technology will alter economic, social, political, and security dynamics is a hard game."

The National Intelligence Council wrote in its latest "Global Trends" estimate, "Technology — from the wheel to the silicon chip — has greatly bent the arc of history, yet anticipating when, where and how technology will alter economic, social, political, and security dynamics is a hard game." Among the major trends in technology discussed in the NIC report are advanced information communications technologies (ICT) including artificial intelligence (AI), automation, and robotics; biotechnologies; advances in energy technology; climate intervention via geo-engineering; developments in advanced materials and manufacturing; and space-based technologies.

In summarizing possible impacts, the NIC wrote: "As one expert wryly observes: 'technology is the greatest cause for my optimism about the future…and my greatest cause for pessimism.'… Each technological advance bears a cost — sometimes in natural resources, sometimes in social cohesion, and sometimes in hard-to-predict ways." For emerging information technologies, for example, increased data reliance will require "establishing clear limits and standards on data ownership, data privacy and protection, cross-border data flows, and cyber security that could become increasingly important points of domestic and international policy conflict."

Each of the major trends noted above has clear implications for higher education, both in the development of new academic programs and in the mapping of new research agendas. Universities around the world will be seeking to engage their students, faculty, and stakeholders at the frontiers of technological discovery. For the present discussion, the focus will be on a particular set of technological advances — ICT, AI, and big data — that have already brought about major changes in both instruction and student support systems.

Distance learning represents an area of enormous potential for higher education systems around the world struggling to meet the needs of growing and changing student populations. Information and communications technologies (ICT), types of providers, curriculum developers, modes of delivery, and pedagogical innovations, have transformed the distance learning landscape. It is extremely difficult to calculate the numbers of students engaged in distance

learning worldwide, but the existence of dozens of mega-universities, a half dozen of which boast over one million students each, speaks to a quantitatively significant phenomenon. But as international education expert Philip Altbach has noted, there has been a "profound and pervasive disconnect between employing new technologies and leveraging them to enhance quality."[xxvii]

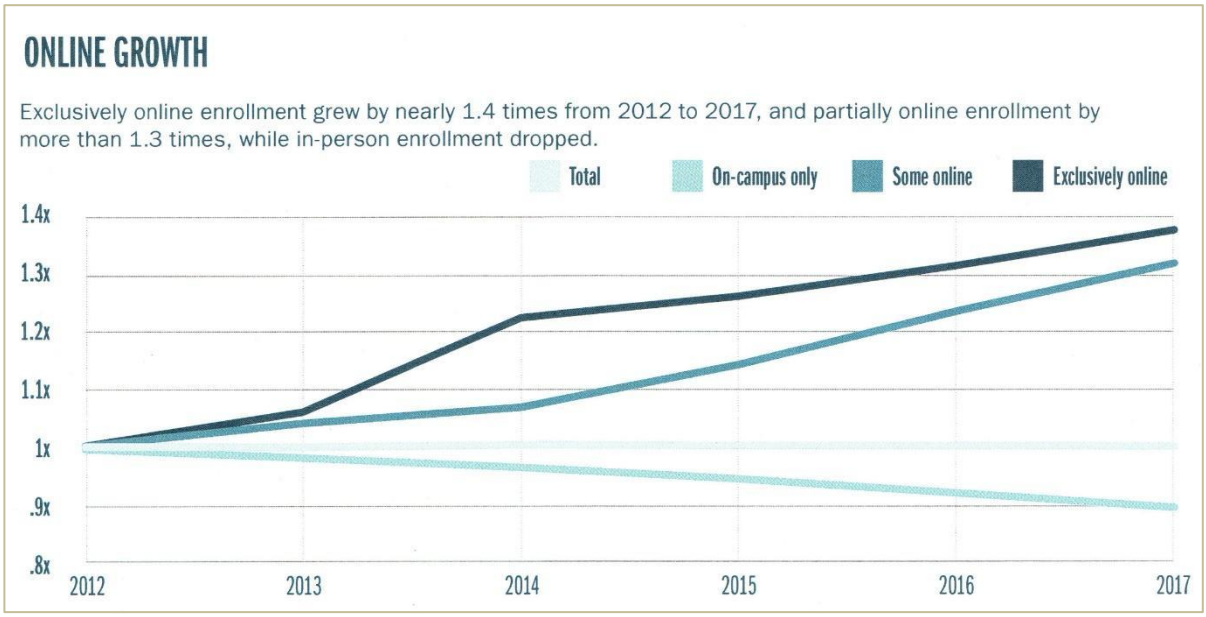
The internet has truly revolutionized how knowledge is communicated. In the world's most developed economies, the presence of ICT has expanded exponentially and touched virtually all dimensions of the higher education enterprise. Email and online social networking spaces provide avenues for academic collaboration and joint research. Electronic journals have become widespread and, in some fields, quite substantive. Traditional publishers of books and journals have increasingly turned to the internet to distribute their publications. The open educational resources movement (OER) has picked up significant momentum, providing free access to courses, curricula, and pedagogical resources not available locally.

Though they had begun to emerge a few years earlier, 2012 became known as the "year of the MOOC" — the Massive Open Online Course. Originally seen as the harbingers of the demise of the place-based university, the enthusiasm for MOOCs faded after a few well-funded consortia with impressive pedigrees failed to deliver on their original promises. Typically, even though many thousands of learners enrolled, only a very small portion usually completed the course. However, in terms of initial enrollments, the numbers are still very impressive: Class Central estimated that there were 900 universities offering courses to over 110 million registered learners (excluding China) in 2019. [xxviii]

Nevertheless, offerings of courses in a more restricted environment (fee-based for-credit offerings with less ambitious enrollment goals) have continued to expand. Offering the promise of access regardless of where students live or when they can participate, and augmented by artificial intelligence to provide pacing and content fitted to the individual student's needs, online courses are now offered by thousands of higher education institutions at almost every level and in almost every imaginable field of study. Public university systems such as those in Louisiana and Minnesota have invested heavily in online offerings, though most seem to be targeted toward their own students. One-third of college students take at least one such course during their college career, and the number of students who opt for curricula that are taken exclusively online is growing rapidly. (For the UH system as a whole, 13.8% of students are fully

online, compared to a national average in public institutions of 12.4%. At UH West O‘ahu, 39% of students are fully online and 81% have at least some online courses.)

FIGURE 12



NOTE: Scale uses 1 to represent all students in each category in 2012, and then shows by how many times each enrollment figure increased or decreasing over the years. Figures include public, private, nonprofit, and for-profit institutions.

Source: Moody's Investors Services, 2019 Sector in-depth report, analysis of National Center for Education Statistics data.

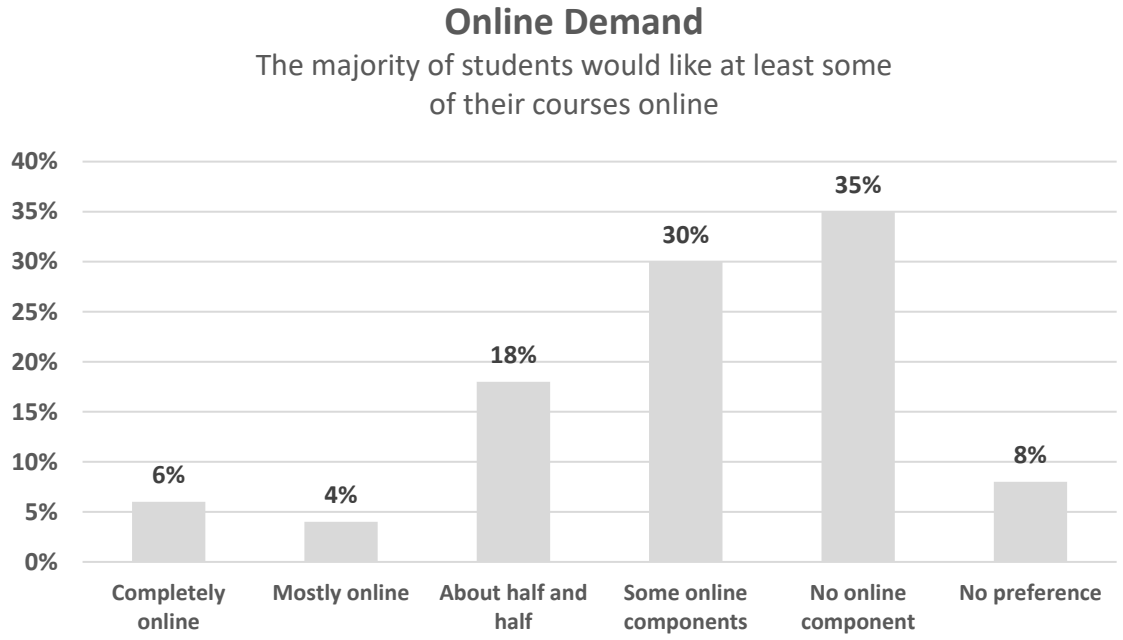
Initially enticed by the early successes of (and competition from) for-profit institutions such as the University of Phoenix and heavily marketed online divisions of universities such as public Arizona State and Western Governors and private Southern New Hampshire, hundreds of institutions that face challenges of declining enrollments have added online divisions. Often these are entirely homegrown curricula, but many have outsourced the marketing and enrollment functions to commercial firms.

Latecomers to the online marketplace are finding it difficult to compete with longstanding programs with ample funds available for development and marketing. Smaller primarily liberal arts colleges have had dreams of significant new revenues dashed by these realities. Even some of the for-profit chains — which have been criticized for overselling the worth of their degrees to students whose Pell grants constitute the largest share of their revenues — have seen profits drop or have had to close their doors. Although distance learning courses in existing programs

are essential, especially in attracting adult students, the goal of capturing a wider market is difficult to attain. Unless late entrants can offer distinctive programs on a wider scale that target the work force needs of their particular region, they are not likely to prosper from their online divisions. Examples of targeted online programs (described in greater detail in Appendix A-1) include the University of Tulsa's online Master of Energy Business program, UCLA's online Professional Program in Screenwriting, Stanford's Graduate Certificate in Artificial Intelligence, and Case Western Reserve's online Master's in Biomedical Engineering.

Examples of workforce partnerships can be found in the growing number of cases in which industry is increasing its investments in human resources and professional development through contracts to pay employees' tuition at the online divisions of universities (e.g., Disney's contracts with the University of Florida and the Starbucks College Achievement Plan with Arizona State). The University of Hawai'i could seek similar strategic partnerships with major employers in the state, including the military.

FIGURE 13



Source: Educause Center for Analysis and Research, "ECAR Study of Undergraduates and Information Technology, 2018

Even though student demand for online courses is high (as shown in the chart above) and has risen, recent research findings suggest some caution about the effectiveness of online courses for at-risk students. A study by two economists at the Brookings Institution concludes that, "in the current design, online courses are difficult, especially for the students who are least prepared. These students' learning and persistence outcomes are worse when they take online courses than they would have been had these same students taken in-person courses."

The Brookings study analyzed a database drawn from DeVry University, and including 230,000 students enrolled in 168,000 sections of more than 750 different courses. The results may be alarming for institutions considering expansion of online offerings: in addition to finding that "taking a course online reduces student grades by 0.44 points…[w]e also find that taking a course online, instead of in person, increases the probability that a student will drop out of school." The researchers concede that online courses provide access to students who would not have the opportunity to take classes in-person, and they offer hope that advances in AI may allow improvements in design that can be of special benefit to at-risk students.[xxix] Frequently cited as an example of how ICT has been enhanced by AI is the case of a Georgia Tech professor who was teaching an AI online course to 250 students from around the globe. The online forum designed to answer student questions was being overwhelmed by heavy volume, and the instructors devised a teaching assistant "chatbot" powered by IBM Watson (and dubbed "Jill Watson") that worked so well that most students were fooled into thinking they were dealing with a real person.

Analytics employing AI and "big data" have obvious application to both student recruitment and student retention by allow forecasts of which prospective students have the best chance of persisting to graduation or by focusing attention on students who are struggling and allowing timely intervention. Examples include:

- Dartmouth College created a smart app to predict GPA based on studying, sleep, exercise, and face-to-face interactions. This 10-week experiment ran in the background and didn't require any manual input by the students.
- Temple University implemented a chatbot to lighten the customer call center's load and improve the website experience. The chatbot has been a hit and answers common questions from current students, employees, and prospective students.

- Georgia State University deployed an AI program focused on identifying and stepping in early for at-risk students using eight hundred academic and fourteen financial risk factors. The AI looks at how well students are doing in class, whether they've skipped class recently, or if a payment has been missed to identify students in need of instruction or advising."[xxx]

Given adequate budgets and staffing, ICT can bring significant advances in both instruction and student support to universities. Numerous studies of adult education have concluded that most adults actually learn best when a combination of "high tech" and "high touch" instruction is utilized. Accordingly, there is a growing use of "blended" or "hybrid" courses, which utilize online asynchronous instruction for theoretical or informational content and face-to-face instruction for discussion and "hands-on" experiences. For best results, students and instructors need to be IT literate, learning materials need to be "state of the art," and the classroom needs to be equipped with appropriate technology.

A survey of Chief Information Officers in Fall 2019 identified the top campus priorities.

FIGURE 14

Top 10 Campus IT priorities, Fall 2019

The Top Four	%
IT Data Security	83%
Hiring/Retaining IT talent	77%
Leveraging IT to Support Student Success	73%
Providing Adequate User Support	71%

The Next Six	%
Data analysis/learning and managerial analytics	60%
Digital accessibility/ADA compliance	57%
Supporting online/distance education	53%
Assisting faculty with the instructional integration of IT	52%
IT business continuity/IT disaster recovery	50%
Professional development for IT personnel	49%

Source: Kenneth C. Green, 2019 Campus Computing. The 30th National Survey of Computing and Information Technology in American Higher Education, at *https://www.campuscomputing.net/content/2019/10/15/the-2019-campus-computing-survey*

Trends and Issues in Higher Education

V. Global and national trends in higher education and new directions in higher education policies will affect the University system in the coming decade.

GLOBAL:

OECD (Organisation for Economic Co-operations and Development), Higher Education to 2030:

"Higher education drives and is in turn driven by globalization. It trains the highly skilled workers and contributes to the research base and capacity for innovation, which determine competitiveness in the knowledge-based global economy. It facilitates international collaboration and cross-cultural exchange. Cross-border flows of ideas, students, faculty, and financing, coupled with developments in information and communication technology, are changing the environment where higher education institutions function. Cooperation and competition are intensifying simultaneously under the growing influence of market forces and the emergence of new players." [xxxi]

In European higher education, the Bologna Process (the term designating EU intergovernmental cooperation in higher education) has initiated reforms aimed at increasing global competitiveness through regional cooperation, providing an interesting example for other regions. While this has already led to some convergence of degree structures and to common frameworks for quality assurance and qualifications, the emergence of a fully integrated European higher education system is not yet in sight.

Public expenditure on higher education per student will decline globally, as pressure on provision of social services — from aging populations and shrinking revenue bases — increases. More of the cost is being pushed to students and institutions. As public funds become more limited, pressures for increased accountability will grow.

Today some 30% of global higher education enrollment is private. On average, the growth of private higher education and research funding has been faster than that of public funding in the OECD area, although in the majority of OECD countries higher education is still largely funded

publicly. In general, the private sector is “demand absorbing,” offering access to students who might not be qualified for the public institutions.

Legally for-profit institutions constitute a small higher education sub-sector, but there is notable growth in all developing regions. The sector is run on a business model, with power and authority concentrated in boards and chief executives; faculty hold little authority and students are seen as consumers. A related trend is the “privatization” of public universities: countries such as Australia, the U.K, and China have been explicit in asking universities to earn more of their operating expenses by generating their own revenue — from tuition fees, but also from research, sale of university-related products, and university-industry linkages.

The need to respond to “massification” has caused the average qualification for academics in many countries to decline. Philip Altbach and his associates estimate that up to half of the world’s university teachers have only earned a bachelor’s degree

The overall emphasis on quality assurance has started to move towards assessing educational and labor market outcomes instead of inputs, but there are still notable differences between audit and evaluation approaches across regions. At the same time, one can observe the emergence of cross-border accreditation and a general strengthening of cooperation across borders; several regional networks of quality assurance agencies have been established and there is an increasing interest in establishing common regional criteria and methodologies, particularly in Europe

Transnational higher education — the delivery of higher education programs by a provider across national boundaries by physical or electronic means — is an increasing feature of global higher education, often spurred by lack of local capacity, desire to raise local quality and access, and revenue needs of the overseas provider. Delivery models vary from offshore campuses to franchising of a program to a partner or third party. Partnership models include twinning programs, joint degrees, credit transfer agreements, and preparatory programs. International partnerships, formerly concentrated on student exchange, are now much more comprehensive.

PACIFIC RIM:

Although the U.S., Canada, and Australia currently have a large share of the global higher education student market, other Pacific Rim Countries — notably Japan, Hong Kong, South

Korea, Singapore, and China — have a national strategy and funding to increase their number of "world class" universities.

UNITED STATES:

While total undergraduate enrollment in U.S. post-secondary institutions increased by 37 percent between 2000 and 2010 (from 13.2 million to 18.1 million students), enrollment decreased by 7 percent between 2010 and 2017 (from 18.1 million to 16.8 million students). Undergraduate enrollment is projected by NCES to increase by three percent (from 16.8 million to 17.2 million students) between 2017 and 2028.

The projected increase in enrollment could, of course, fail to materialize now that the U.S. economy has entered another recession and uncertainty about the economy abounds. Changes in college enrollment during the Great Recession were consistent with research showing that economic contractions lead individuals to enroll in school to obtain additional training. During economic contractions, attending college becomes a more attractive option for some people as the worsening labor market reduces the amount of potential earnings foregone in order to obtain additional education. A study by the U.S. Census Bureau reports that among those not enrolled in school in the prior year, and therefore likely engaged in the labor market, there was an increase in enrollment during the recession and a return to prerecession levels of enrollment by 2015.[xxxii]

The overall decline from 2018 was 1.7% (roughly 300,000 students). Enrollment at two-year colleges declined 3.4%, while four-year public colleges lost just under 1%. (Four-year private institutions bucked the trend, growing 3.2%, though much of this increase was due to the conversion of large for-profit institutions to nonprofit status.) Nationally, enrollment of graduate students has grown, but not nearly enough to offset the drop in undergraduate enrollments.

States with the largest decrease in student enrollment numbers in 2019 were Florida, California, Illinois, Michigan, and Pennsylvania in that order. Alaska, Florida, Illinois, North Dakota, Hawai'i, and Kansas had the largest percentage declines.[xxxiii]

One factor in the enrollment decline has been the decreasing affordability of higher education, as a higher proportion of the cost of attendance has been shifted to the student. According to

the College Board, at public four-year colleges net tuition per student has doubled over the past twenty years, from $1,870 in 1998-99 to $3,740 in 2018-19 (in constant 2018 dollars).

Some U.S. state public systems have sought to address the twin challenges of falling enrollments and declining state expenditures — exacerbated by the pandemic — by considering some form of consolidation of campuses in the system. Citing examples from several states (Alaska, Connecticut, Georgia, Maine, Pennsylvania, Vermont, and Wisconsin) a recent article in *The Chronicle of Higher Education* examines several variations of the effort to use consolidation of campuses within public higher education systems as a way to address under-enrollment at certain campuses or, more generally, to cut expenses in the public higher education sector. The author concludes that savings do not always result. But he cites authorities on public systems who expect the trend to continue:

"With the pandemic putting enrollments further in doubt and sucking away state revenues, and therefore state support for higher education, says Thomas L. Harnisch, vice president for government relations at the State Higher Education Executive Officers Association, 'COVID-19 could very well accelerate the trend toward making structural changes to these colleges.' Structural change is probably what needs to happen, says Aims C. McGuinness, a senior fellow with the National Center for Higher Education Management Systems. Considering widespread demographic declines and waning state support, he says, 'virtually every state has got to think more systemically.'" [xxxiv]

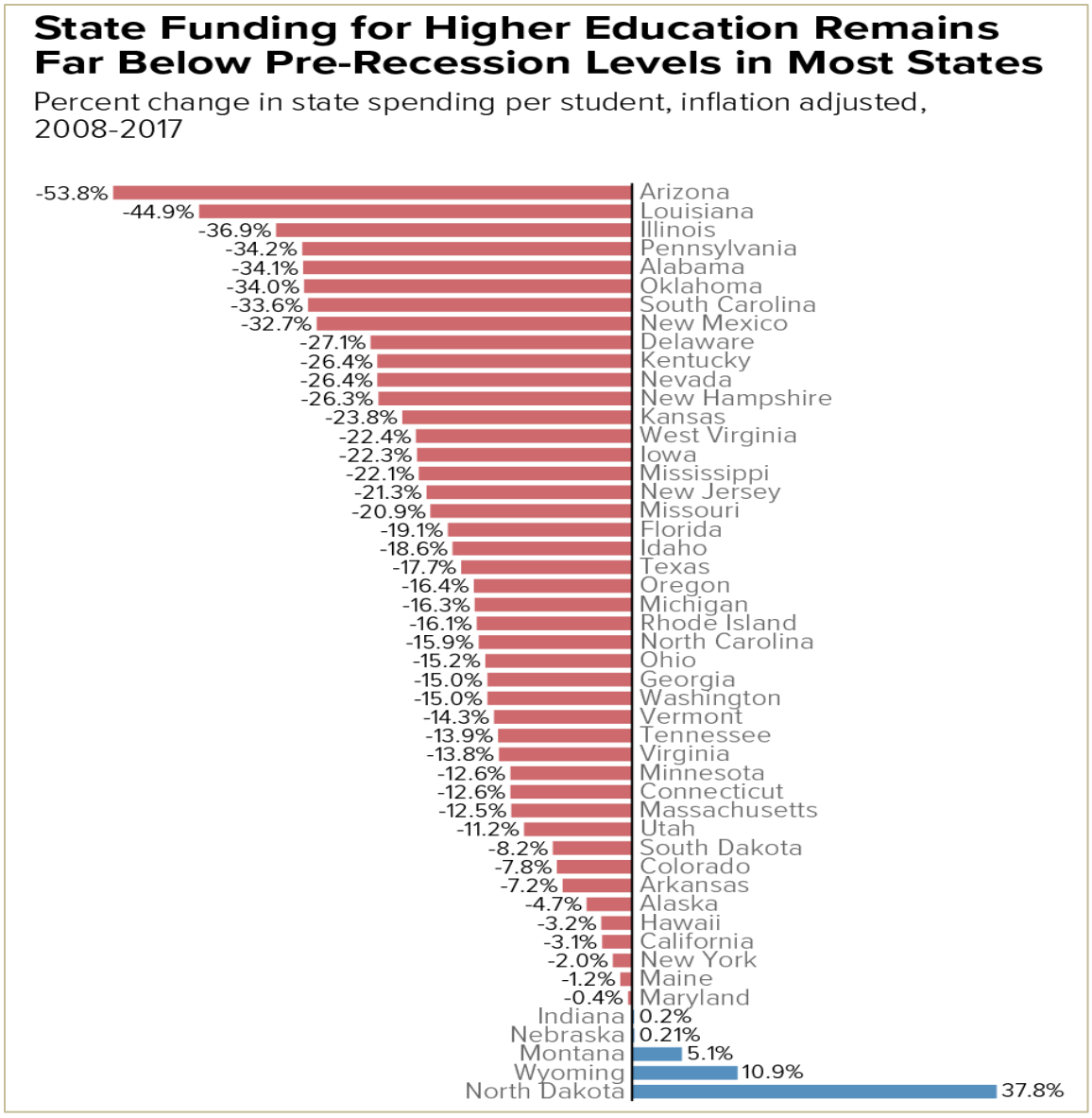
In the U.S. the inflation-adjusted average state appropriations per full-time student fell from $9,290 per student in 1998 to $7,900 in 2018, causing the revenue from tuition to increase to 47% of the public institution budgets compared to 31% a quarter-century ago. Yet another factor in declining enrollments, especially for adult students in community colleges, was the growth of employment and consequent increase in job opportunities that marked the recovery from the Great Recession.

For a second year in a row, Moody's in 2019 issued a negative outlook for higher education, as operating expenses grew faster than revenue. The charts below show state-by-state comparisons of changes in state spending per student and percent change in average tuition at public four-year colleges.

Notably, Hawai'i had one of the lowest decreases in per-student funding by the state in the 2008-17 decade. However, its increase in average tuition, at 79.7%, was third highest in the

nation. And, in fiscal year 2019-20, Hawai‘i was on the other end of the ledger, as one of only three states that cut appropriations to higher education (by 2.2%, as compared to an average increase of state appropriations of five percent).[xxxv]

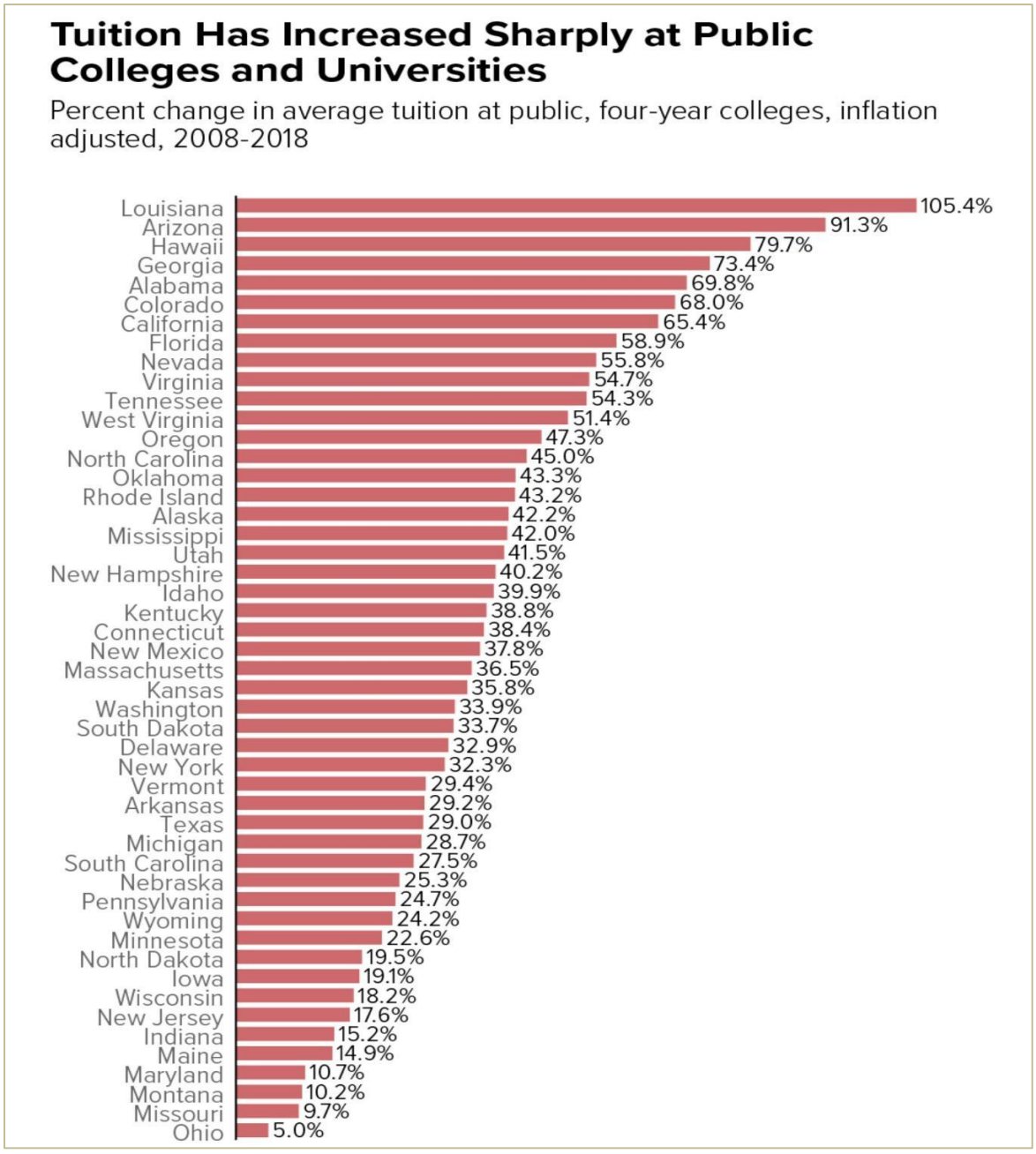
FIGURE 15



Note: Wisconsin was excluded because the data necessary to make a valid comparison are not available. Since enrollment data Is only available through the 2015-16 school year, we have estimated enrollment for the 2016—17 school year using data from past years.

Source: Center on Budget and Policy Priorities (*www.cbpp.org*) CBPP calculations using the "Grapevine" higher education appropriations data from Illinois State University, enrollment and combined state and local funding data from the State Higher Education Executive Officers Association, and the Consumer Price Index, published by the Bureau of Labor Statistics. Illinois funding data is provided by Voices for Illinois Children.

FIGURE 16



Note: Illinois was excluded because the data necessary to make a valid comparison are not available. Since enrollment data are only available through the 2016-17 school year, we have estimated enrollment for the 2017-18 school year using data from past years.
Source: Center on Budget and Policy Priorities (*www.cbpp.org*) CBPP calculations using the "Grapevine· higher education appropriations data from Illinois State University, enrollment and combined state and local funding data from the State Higher Education Executive Officers Association and the Consumer Price Index, published by the Bureau of Labor Statistics.

The U.S. formerly ranked first in the world in the proportion of its 25-34-year-old population with a four-year degree or higher; it now ranks #18. The Census Bureau's American Community Survey for 2013-17 estimated that 13% of Americans over 25 years old do not have a high school degree; 27% have a high school diploma or GED; 21% have some college but no degree. Adults with a higher education degree total 39% of the population — 8% with an associate degree, 19% with a bachelor's degree, and 12% with a graduate degree. While 35% of white adults hold a bachelor's degree or higher, only 18% of underrepresented adults do. And overall, just 8% of bachelor's degree holders live in rural counties. [xxxvi]

Most of the post-2002 increase in U.S. natural science and engineering (NS&E) doctorate production reflects degrees awarded to temporary and permanent visa holders. Foreign nationals earned more than half of U.S. doctorates in engineering, mathematics, and computer science in 2016.

U.S. HIGHER EDUCATION POLICY: TRENDS AND ISSUES

Regulation of higher education in the U.S. has traditionally been primarily a matter for state governments, but the balance may be shifting. Congressional hearings in 2010 that focused on for-profit higher education institutions prodded the U.S. Department of Education to issue new regulations responding to certain alleged abuses in this sector. At the time the for-profit institutions enrolled 12% of students in higher education, but these students represented 26% of all federal student loans and 46% of all student loan dollars in default. The new USDOE regulations, however, applied not only to the proprietary institutions but also, in most cases, to private not-for-profit and public institutions as well.

Several of the new regulations, which took effect on July 1, 2011, applied to "program integrity." Institutions were required to show their accreditors that students receiving federal financial aid measured in semester credit hours were getting the equivalent of a "Carnegie unit" (two hours work out of class for every hour in class, over a 15-week period) for each credit hour. There were also requirements that institutions offering distance learning have authorization from all the home states of enrolled students.

These provisions proved especially controversial and were struck down by federal court order in 2011, sending the Department and higher education lobbyists back to the negotiating table. A new "final" version was issued by the Obama administration in its waning weeks, scheduled

to take effect in July 2018. In the intervening months, though, the Trump administration took a much more skeptical stance on many higher education regulations, identifying state authorization as one target. In June 2018, the Department of Education announced that it would delay issuing regulations for two more years while it negotiated with the American Council on Education and other lobbying groups.

Such "program integrity" regulations governing eligibility for federal student aid and institutional accreditation have relied on traditional concepts of student participation in "full time instruction," thus limiting the ability to expand innovative models of distance education.

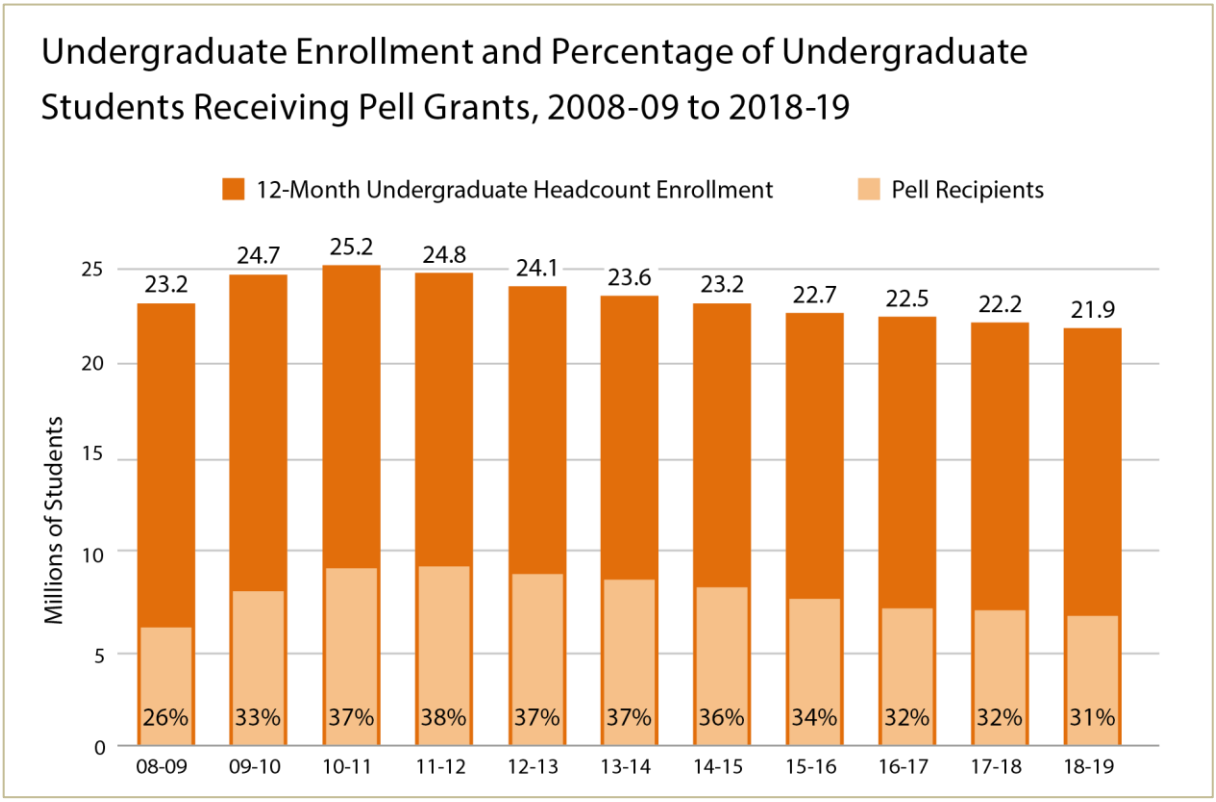
In April 2020, the U.S. Department of Education announced that it would propose changes to distance education regulations that promised to result in a loosening of these limitations. These would amend the definitions of "clock hour" and "credit hour" to provide flexibility to distance education and other types of educational programs that emphasize demonstration of learning rather than seat time when measuring student outcomes. In addition, the definition of "academic engagement" would be expanded to include active participation by a student in activities "such as an online course with an opportunity for interaction or an interactive tutorial, webinar, or other interactive computer-assisted instruction. Such interaction could include the use of artificial intelligence or other adaptive learning tools so that the student is receiving feedback from technology-mediated instruction." These changes in federal regulations will also likely be followed by additional changes in regulation set by regional accrediting agencies. [xxxvii]

Another set of new rules addressed "gainful employment," and applied to not only for-profit institutions but also to private not-for-profit and public institutions that offer certificate programs. These institutions would be denied federal financial aid for students if they offered career-oriented programs where large numbers of graduates failed to earn enough to pay back their student loans.

Though never fully enforced, these rules played a role in the closure of several of the worst offenders in the for-profit education industry. Since 2010 nearly half of the for-profit programs have closed and the student population in for-profit schools has declined by 1.6 million. In 2015 two of the largest firms, ITT Tech and Corinthian Colleges, collapsed. In June 2018, the Department of Education announced that it would delay implementing the strictest accountability measures, opting instead to publicize on its "College Scoreboard" the information on the earnings and debt prospects of particular programs.

The federal government continues to play a large and increased role in student financial aid, but in recent years inflation-adjusted spending on both grants and loans decreased. While the number of Pell Grant recipients increased from 4 million in 1992-93 to 8.8 million in 2012-13, the number has since dropped to 6.8 million (a decline of 28% in eight years). This is partially accounted for by the 12% drop in the population of undergraduate students in the same period.

FIGURE 17



Notes: IPEDS headcount enrollments are adjusted for the difference between total headcount, which counts students more than once if they are enrolled in more than one institution at the same time, and unduplicated headcount reported by the National Student Clearinghouse (NSC). Twelve-month undergraduate headcount for 2017-18 and 2018-19 is estimated from NSC data.

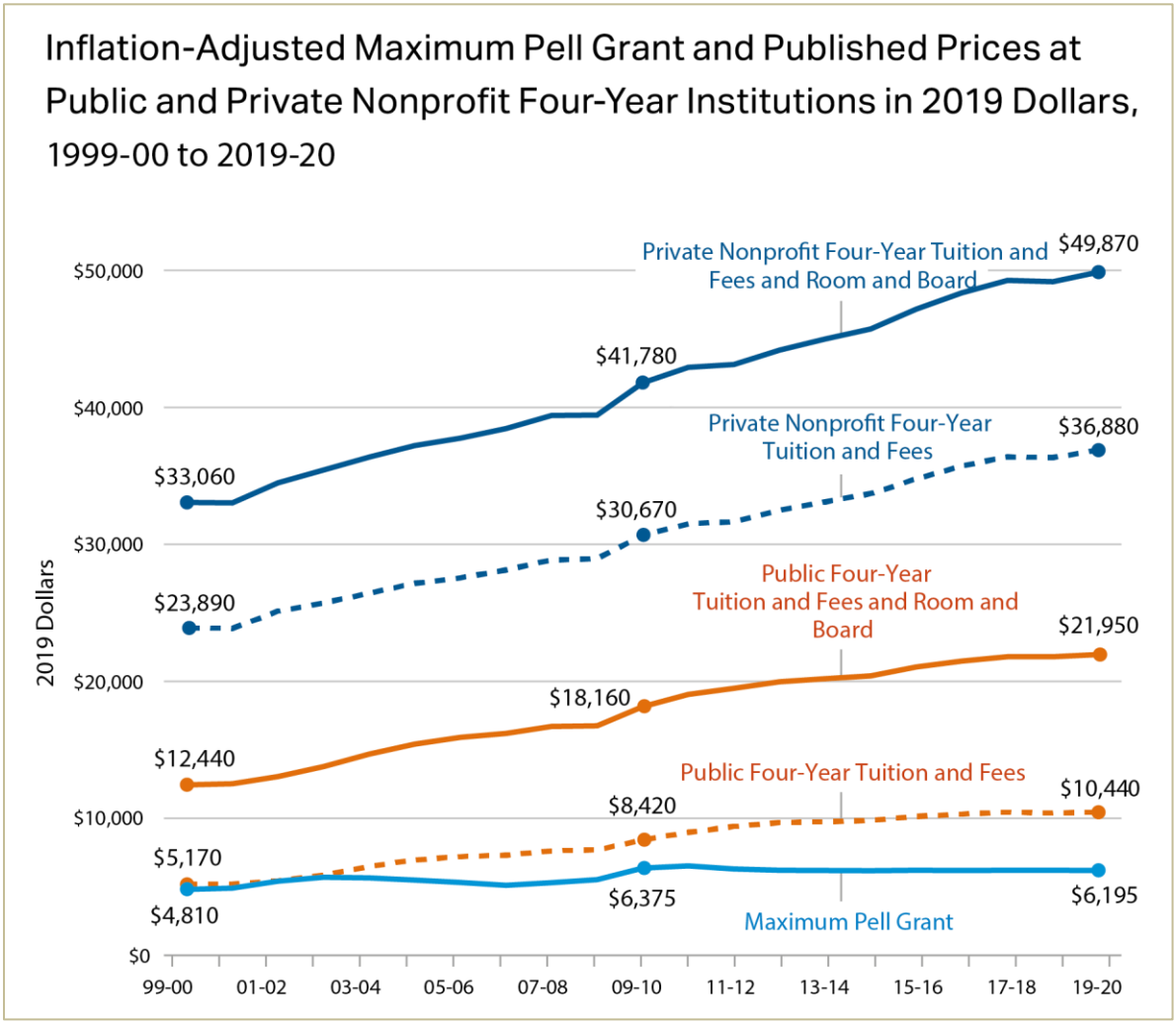
Source: NCES, IPEDS 12-month enrollment data; National Student Clearinghouse, Current Term Enrollment Estimates: Spring 2019; U.S. Department of Education, Federal Pell Grant Program End-of-Year Report 2017-18; U.S. Department of Education, Federal Student Aid Data Center, Title IV Program Volume Reports and Aid Recipients Summary; calculations by the authors.

Federal spending on Pell Grants since 2000 has amounted to about $400 billion and now averages about $30 billion a year. The maximum grant in 2019-20 (for which fewer than one in three is eligible) is $6,195, while the average actually awarded in the prior year was $4,160.

College costs have continued to rise as the size of the Pell Grant declines, however. The maximum Pell Grant covered 87% of average public four-year tuition and fees in 2003-04 but only 59% in 2013-14. (It covers only 17% of average tuition and fees at private four-year institutions.) Whereas public college tuition and fees have risen an average of 2% per year in the past decade, the maximum Pell award, adjusted for inflation, has fallen 0.3% annually in the same period. In an effort to curb the burden on students posed by the rising costs of textbooks and other learning materials, a significant number of universities, including the University of Hawai'i system, have joined in the movement to develop and promote open educational resources (OERs), which assist faculty in improving the quality, currency and accessibility of learning materials. [xxxviii]

Timely reauthorization of the federal Higher Education Act that since 1965 has governed student aid and many other matters has been a victim of the partisan gridlock in Congress. A newly authorized version was due after 2013, but disputes over many issues, including regulation of distance education and of the extent of Title IX requirements, have been especially intense.

FIGURE 18



Source: College Board, Trends in College Pricing 2019, Table 2 online; US Department of Education, Federal Student Aid Data Center

While state-operating support is being cut back, limits are being imposed on enrollment at many state colleges and universities, especially in the Western states. Eleven states capped enrollment at their public flagship universities at some point during the last decade, including four of the five largest states. California was the only state to limit even community college enrollment. Throughout California institutions, thousands of students have been denied classes due to fiscal limitations, often prolonging the time to attainment of the degree. This may increase receptivity of California high school graduates to the prospect of out-of-state study.

Some states have imposed caps on enrollment of out-of-state students in their public colleges. The cap is 10% in Florida and 18% in North Carolina. In contrast, at the University of Hawai'i the out-of-state enrollment in 2017 (officially capped at 35% for undergraduates at four-year campuses and 15% at two-year colleges) was 37% of the student body at Mānoa and 31% at Hilo. On the other hand, some regions — including the Midwest, New England, Southern, and Western regions — have formed consortia that allow tuition of out-of-state students for most programs at their public institutions to be capped at 150% of the in-state rate.

Numerous states have sought to deal with the affordability issue at their public campuses through variants of "promise programs" (which usually tie state aid to academic performance) or even plans for "free tuition." The most ambitious is New York's Excelsior Scholarship, phasing in between 2017 and 2020, which waives tuition for SUNY or CUNY students from households earning less than $125,000 per year who take at least 30 credits per year and commit to live and work in the state for at least as many years as they are supported by the scholarship. (The amount of tuition supported is net of Pell or similar awards.) The program is expected to support almost one million students by 2020. (Hawai'i's Promise program currently applies only to the two-year colleges). Tennessee was the first state to offer tuition-free community college enrollment. In 2015 President Obama proposed a national program of "free community college." (Such plans usually do not cover the costs of attendance beyond tuition and fees.)

"Free [public] college for all" proposals were a staple of recent presidential campaign platforms of Democratic candidates, beginning with Bernie Sanders (and then Hillary Clinton) in 2016. Senators Sanders and Elizabeth Warren had versions of this proposal in their 2020 platforms, and Warren went further with a sweeping proposal for student debt relief. Critics of these plans express concern not only about the enormous cost but also about their impact on enrollments in private colleges and the disproportionate benefit they offer to more affluent students. [xxxix]

The issue of debt from student loans has drawn the attention not only of education reformers but analysts of the nation's long-term financial health. The Board of Governors of the Federal Reserve System estimated in 2019 that the total student loan indebtedness from federal and private sources exceeded $1.6 trillion. An estimated 65% of the graduating class of 2018 left with debt, averaging $29,200. (2018 graduates of Medical Schools had average indebtedness of $196,520, Pharmacy School graduates $166,528, and Dental School, $285,184.)

Although average student debt of graduates of the University of Hawai'i ($24,539 for 2018 graduates at UH-Mānoa) is much lower than the national average ($28,566), it has been creeping upwards. Analysts of student loan debt in the U.S. have expressed alarm not only at its enormous size but also its harmful social and economic effects, especially when combined with slow wage growth in the years since the Great Recession. Studies have shown that the debt burden has caused delays of marriage and formation of families, reluctance to start or grow small businesses, inability to finance home ownership, and erosion of household net worth.[xl]

An innovative program called "Know More, Borrow Less," has been established by the University System of Georgia, to enhance the financial literacy of students and help encourage the reduction of student debt. Components of the program include "streamlining the federal student aid process; providing timely, accurate information regarding college costs and student debt; educating students and families about sound borrowing principles, including borrowing what is necessary rather than the maximum amount offered; and helping students understand monthly debt payments upon graduation." [xli]

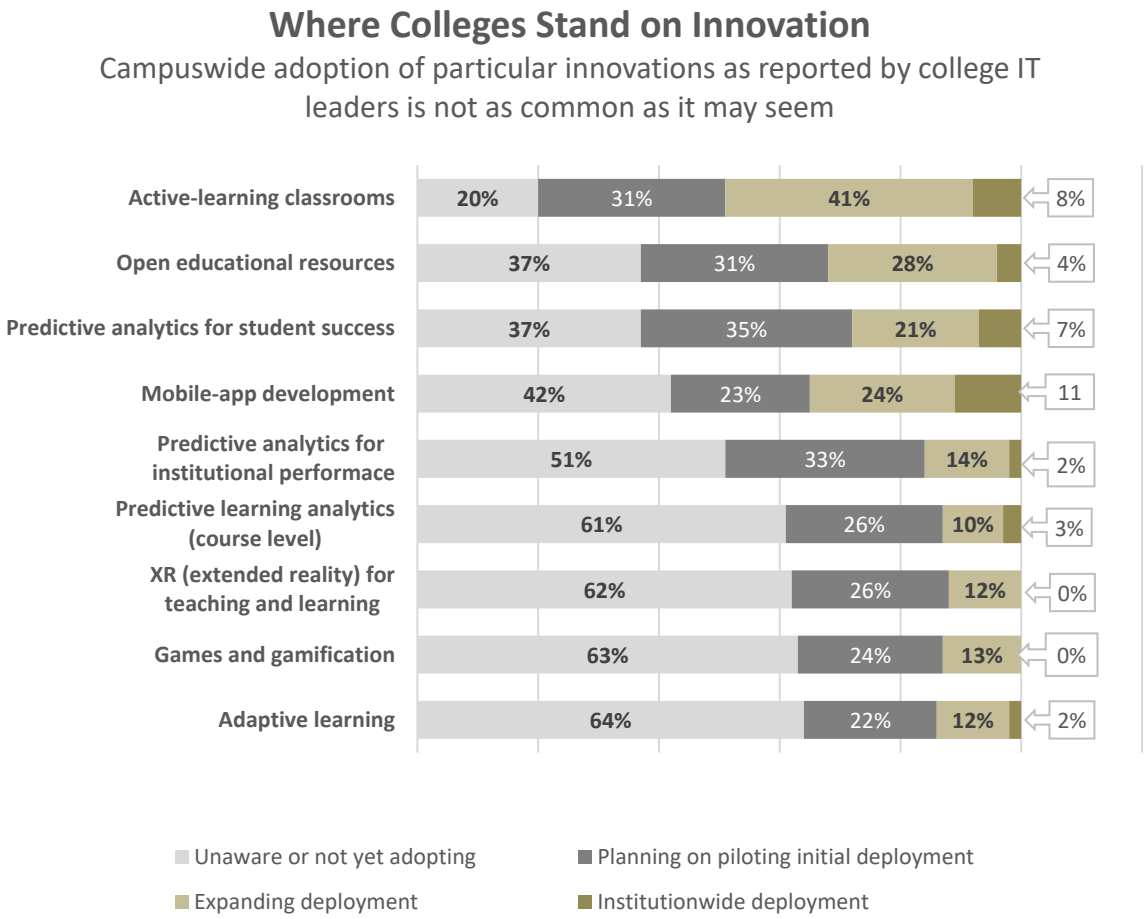
U.S. households with student loan indebtedness owed, on average, more than $47,000. The U.S. Department of Education owns 92% of student loans. There are various plans for repayment, including deferral and forbearance as well as income-contingent plans, but 5.2 million of the federal loans are currently in default. [xlii] Often the same politicians who are calling for "free college for all" are also presenting proposals for forgiveness of student debt.

Innovative Approaches Drawn from National Models

VI. The University of Hawai‘i system can benefit from the study of innovative approaches at university systems across the country that address financing, community service, development of job-producing academic programs, renewal and modernization of facilities, and other ways of stimulating the economy.

As noted by the *Chronicle of Higher Education* in its 2019 publication, *The Innovation Imperative*, “Everyone is abuzz about ‘innovation’ these days, and the hype can overshadow real work and progress.” This section of the report seeks to identify some areas in which innovative approaches might benefit the University of Hawai‘i system as it plans for its “third decade” efforts. Already, in the section above on technology, the report has identified ways in which information and communication technology, augmented by artificial intelligence and big data, can have transformative effects at universities. But even in this realm, as the *Chronicle* publication demonstrates in the chart below, “campus-wide adoption of particular innovations, as reported by college IT leaders, is not as common as it may seem.”

FIGURE 19



Note: Percentages may not add to 100 due to rounding.

A. New approaches to managing university finances that have been successful in the face of limited state investment and rising tuition:

1. Increasing recruitment of students who will pay higher rates of tuition: For example, Purdue University has reduced its in-state student intake by approximately 4,000 over the last ten years — while increasing its out-of-state and international student intake by about 5,000 — as these students pay higher tuition largely without the need of financial aid. As pointed out above, however, in recent years U.S. universities have had difficulties in navigating the highly competitive international student market. And at its two main university campuses the UH System already appears to have more than 30% of its undergraduate student body drawn from out-of-state — with Mānoa above and Hilo just below the state's 35% cap on

such enrollments. An option for the state, in the face of heavy out-migration by Hawai‘i resident students, is to raise the caps.

2. Increasing use of Prior Learning Assessment (PLA), which validates learning outside the institution. PLA thereby allows students to reduce the number of classes needed to earn an academic credential by receiving credit for their prior knowledge and life experience. A student's progress toward the degree thus tends to be less expensive, more self-paced, and more career oriented. If students — either through workplace training, outside reading, or purely life experience — happen to have the competence and knowledge required for a particular subject, they can take an exam or submit a portfolio and get credit without having to take a class, thus having a positive impact on both retention and graduation rates. Title IV funding (financial aid) is available for some of these programs (e.g., at the University of Wisconsin and Southern New Hampshire University) — a sign that the U.S. Department of Education recognizes their validity. By one estimate, more than 600 institutions are either exploring or have launched PLA programs. Their popularity with students and employers will continue to rise in the wake of the pandemic-induced disruption of the U.S, labor market and the need for more efficient pathways for economic mobility. Given the relatively high proportion of Hawai‘i adults with some college credit but no degree, the market would seem to exist for UH.

   A 2020 report from the Council on Adult and Experiential Learning and WICHE, "Recognizing Learning in the 21st Century," studied the relationship between student outcomes and PLA, involving almost 25,000 adult students at 72 institutions. The study found that PLA increased by 17% the likelihood that an adult student would complete a degree program. Completers with PLA credit had a shorter time to degree, while increasing the number of additional credits earned in residence by roughly the equivalent of a semester. The study recommends that institutions make sure that PLA options are available and promoted. [xliii]

   The University of Memphis is partnering with West Tennessee Healthcare to help adult learners make faster progress toward earning their degree. The initiative uses credit-by-exam, adaptive learning, and experimental learning to eliminate the need for adult learners to fulfill coursework that they have already mastered. They are scaling the partnership to engage additional employers in the region through the Association of Public and Land Grant Universities (APLU)'s Collaborative Opportunity Grants program. Portland State University

has worked with APLU to develop reTHINK PSU, a campus-wide effort to deliver an education that serves more students with better outcomes, while containing costs through curricular innovation, community engagement and effective use of technology. One example is the university's flexible degree program. Initiated in 2014, this program offered greater access to undergraduate and graduate offerings by creating online pathways for adult learners. [xliv]

3. Increasing use of distance learning can have beneficial financial results by reducing instructional costs and improving student retention. A five-year study conducted by the National Center for Academic Transformation (NCAT), entitled the "Program in Course Redesign," annually involved 50,000 students at 30 public institutions. The program showed that use of technology could both enhance quality ((contrary to the Brookings study cited earlier) and reduce cost. "Results show improved student learning in twenty-five of the thirty projects; the remaining five show learning equal to that found in traditional formats. All thirty institutions reduced their costs by 37% on average (from 20% to 77%) and produced a collective annual savings of $3.1 million. Of the twenty-four that measured retention, eighteen showed noticeable increases." [xlv]

4. Online Program Manager (OPM) organizations can benefit both universities and nontraditional, working-adult students. OPMs help traditional universities build and maintain their online degree or program offerings, while opening new and flexible options to nontraditional students. Generally, through a revenue share model, the university provides the content, while the OPM primarily puts it online and leads the marketing efforts. One leader in this market is 2U, which, for example, partners with the University of North Carolina to deliver an online master's degree in public health. A well-publicized player in this market is Coursera, which works with the University of Pennsylvania, Michigan, and HEC Paris, among others offering 3900+ courses and specializations in partnership with more than 190 universities and companies, according to its website. Companies like Trilogy Education partner with top universities to deliver in-person skills training ("coding bootcamps") on-campus in fields such as coding and cybersecurity. Other companies like Orbis Education partner with universities to help bridge the healthcare provider shortage through a hybrid approach to pre-licensure healthcare programs, while ExecOnline partners with top business schools to deliver executive leadership courses online. As noted above, however, the online marketplace is crowded with well-established university players and

company partners, and a later-starter needs to have special strengths to hope for a larger role in it.

5. Income Share Agreements (ISA): Instead of charging students tuition — which often requires them to take out thousands of dollars in loans — students go to school for free and are required to pay back a percentage of their income after graduation, but only if they get a job with a good salary. The idea has been experimented with and talked about for years. "But what's happening at Lambda School, an online learning start-up founded in 2017 with the backing of Y Combinator, has captivated venture capitalists. Their investments are being used to turn Lambda, which has focused on subjects like coding and data science, into a multidisciplinary school offering half-year programs in professions where there is significant hiring demand, like nursing and cybersecurity. It's an expansion that could be a precursor to Lambda becoming a full-scale university. Lambda is being closely watched by educators, the student debt complex and even Wall Street." [xlvi]

   Purdue University says it is the first four-year institution in the country to offer the ISA option. Under Purdue's Back a Boiler program, graduates make payments for ten years after graduation. The percentage graduates pay depends on their major and the amount of funding they receive. The less they make, the less they are required to pay. And if they do not work, they do not pay anything.

6. Outcomes-based funding (or performance funding) uses public money to encourage colleges and universities to increase the numbers and percentages of students who earn high-quality degrees, certificates, and other credentials. It funds colleges and universities based on how well they perform on key metrics. Historically, public institutions were funded by state tax dollars primarily based on the number of students enrolled.

   Performance funding shifts a portion of these dollars from an enrollment-based model to an outcomes-based model. Commonly used outcomes include student retention rates, transfer rates from two- to four-year institutions, credit hours earned, graduation rates, degrees conferred, and job placement rates. Institutions earn funds by graduating, not simply enrolling, students. Performance funding was deemed the solution to a funding mechanism that failed to reward colleges for actually graduating students

A primary goal is to better align state's goals with the institution's to increase postsecondary educational attainment. For example, in Maine's funding model, four-year universities receive additional funding for students who earn degrees in science, technology, engineering, math and nursing. In the state of Washington, community colleges receive additional funding for students who complete apprenticeship training programs. In Florida, wages earned by in-state graduates is factored into funding decisions. The Louisiana funding model allocates funding based, in part, on how well graduates perform on professional licensure and certification exams. By 2018 there were twenty-nine states that operated performance funding policies, with four more states in the process of developing a policy. [xlvii]

In 2016 the Hawai'i state legislature provided $6.3 million to UH to create a performance funding system. Six measures that aligned with the UH Strategic Directions were established and targeted goals were set. The targets included degrees awarded to Native Hawaiians, to Pell recipients, and in STEM fields, as well as targets for graduate rate and for inter-system transfers. For FY 2020, $2.49 million was earned by the campuses—well below the amount allocated.

B. Types of academic programs that should be established to meet changing national needs:

An analysis of data from the National Center for Educational Statistics, published by the *Chronicle of Higher Education* in *The Looming Enrollment Crisis,* produced the following charts that indicate academic programs at various levels that have been growing and declining in the period between 2010 and 2017. Although the particular program changes that are reported here may not be as applicable to changing manpower requirements in Hawai'i, they give an indication of national trends in academic program offerings.

Interestingly, six of the ten programs that are said to be expanding at the 2-year and 4-year levels are in health-related fields.

FIGURE 20

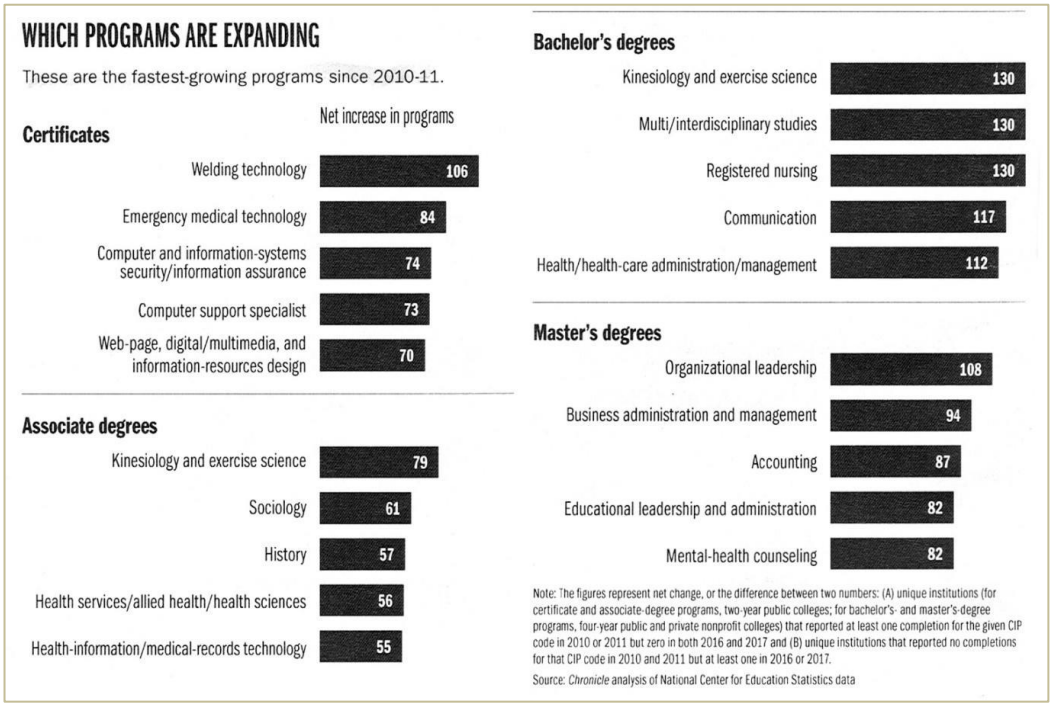
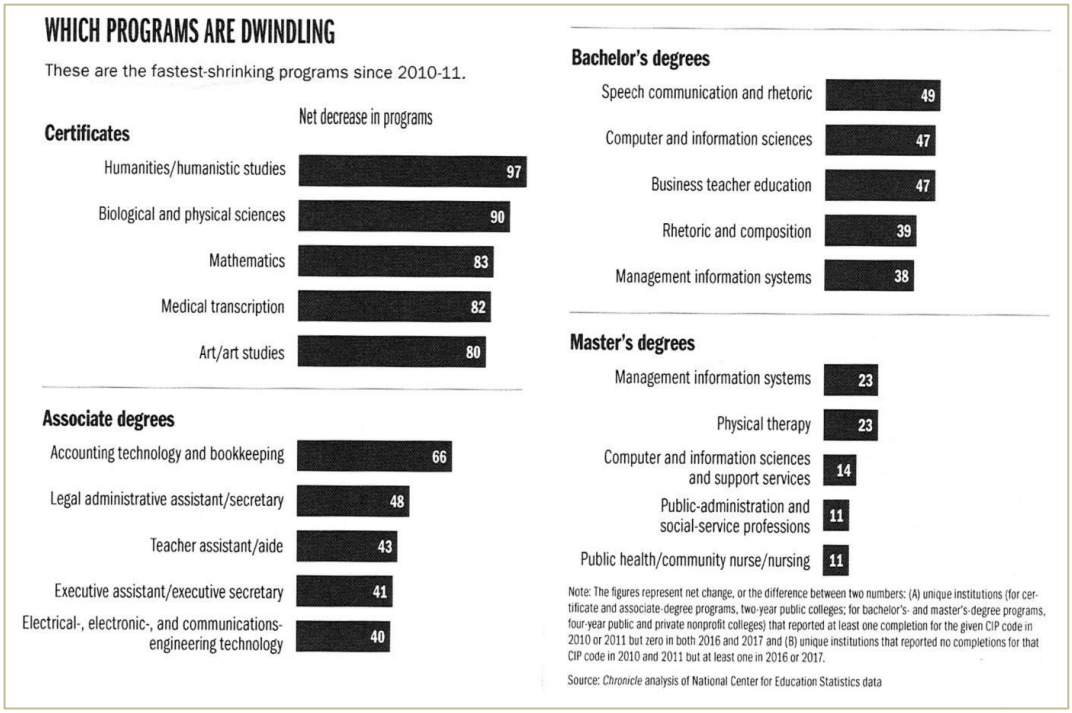


FIGURE 21



Source: Chronicle analysis of National Center for Education Statistics data.

The intriguing finding that programs in information technology seem to be on the decline at the bachelor's and master's levels may in fact suggest not that jobs are unavailable in these fields but rather that university programs in computer-related fields may not be preparing students for jobs in these areas. Two researchers at the Brookings Institution have identified a "skills mismatch" issue.

"The skills mismatch is particularly acute in fields like computer science where developments in real-world practice easily outpace academic curricula. By 2020, one million computer science-related jobs will go unfilled, and many computer science programs at universities are outdated. In the words of one college student attending its innovative tech program after taking computer science classes from the elite public university where he received a B.A., 'My university courses taught me all about the theory of computer science, but I couldn't actually code.'"[xlviii]

One suggested remedy for the "skills mismatch" between standard university programs and job requirements is the concept of "stackable credentials." A growing number of colleges are allowing students to "test" degrees by taking certificate-earning courses that can eventually be "stacked" into a degree, thus lowering their risk. The academic credits that students earn can be reused — "stacked" — later in life to fulfill academic requirements of more advanced programs, including four-year bachelors' degrees. Students can re-use the credits they earn. The "coding bootcamp" concept described above, offered in various formats by Trilogy Education and Lambda, suggests a pathway that some universities have taken in attempt to remedy this particular "skills mismatch."

A new generalist digital-technology credential has been developed by an alliance of 12 universities and fourteen companies, members of Capital CoLAB, which has formed along a corridor between Baltimore and Richmond. The strength and credibility of this credential arises from the fact that its development began with strong employer buy-in. Once the criteria were determined by the group of employers, partner universities were given considerable autonomy in the ways in which they proceeded to develop the credential. It was offered as a "Fundamentals of Computing" certificate at Virginia Commonwealth University and as the equivalent of a minor at George Mason University. In addition to the generalist credential, CoLAB is planning to create three additional specialized certificates — in cybersecurity, data analytics, and AI and machine learning.[xlix]

Higher education institutions have been tailoring their offerings of academic programs to adjust to changing economic conditions. Several more examples of innovative programs are described in Appendix A-2. Programs in healthcare-related occupations (such as new programs as Johns Hopkins's Nursing School and the interdisciplinary College of Health Solutions at Arizona State) are increasing. UH should further develop programs in cybersecurity (such as the innovative programs at Carnegie Mellon) in partnership with NSA and explore selective expansion of certificate programs, especially in IT fields (such as Stanford's Graduate Certificate in Artificial Intelligence). The growing threats of global climate change have produced rising demand for graduates in fields such as renewable energy (pioneered at Oregon Institute of Technology) and sustainability (led by Michigan's innovative School for Environment and Sustainability). Finally, even in established occupations in the hospitality industry, new technologies are demanding new training, such as the pioneering work in "smart tourism" at Central Florida's Roche College of Hospitality Management.

The University of Washington has created a Continuum College, offering 99 certificate programs and 111 graduate-degree programs, which broadens the concept of continuing education and lifelong learning by focusing on workplace and career aspects and by adding fifteen enrollment coaches who counsel prospective students about achieving their educational and career goals. "A team at the university is also looking at efforts to change the way the credentials and certificates are tracked, so they can be both more flexible and more portable. A digital transcript could include degrees, certificates, and other credentials earned at various institutions and on the job." Courses are offered in four different formats, including an online, on-demand version.[l]

On the whole, although more master's degrees are awarded nationally than post-baccalaureate certificates, between 2002 and 2017 the number of certificates conferred has more than doubled, while master's degrees have seen much smaller growth rates.

C. New and innovative ways colleges and universities can serve their communities:

1. Required or paid internship programs for students: Examples of community projects or of undergraduates working with high school students in summer programs can be found at Michigan State University and Utah Valley State University. A particularly strong program has been established at Vanderbilt University, under the label "Service learning or community engagement." It features a teaching and learning strategy that "integrates

meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities. Students seek to achieve real objectives for the community and deeper understanding and skills for themselves." The experience is typically incorporated into a course by way of a project that has both learning and community action goals. These can include one-time group service projects, options within a course, required units within a course, action research projects, disciplinary capstone projects, and multiple course projects.

2. Beginning in the 1980s, an expanding movement within higher education has been attempting to make universities more relevant and responsive to the communities and states in which they are located. At one level, more than eight hundred university presidents have signed the "Presidents' Declaration on the Civic Responsibility of Higher Education" committing themselves "to helping catalyze and lead a national movement to reinvigorate the public purposes and civic mission of higher education." As the Declaration concludes, "We believe that now and through the next century, our institutions must be vital agents and architects of a flourishing democracy." Additionally, 677 university presidents have signed the "Presidents' Climate Commitment" ensuring their universities' dedication to slowing global warming.

   At another level, several institutions have done pioneer community-building work. A much-cited example is the University of Pennsylvania, which has garnered much praise for its work in West Philadelphia. Portland State is a national leader in programs in community development and training to increase the capacity of community-based organizations. The University of Minnesota's Center for Democracy and Citizenship's "Community Information Corps" has launched an initiative to bridge the digital divide in St. Paul's West Side (largely immigrant) community. And many land grant institutions such as Penn State and Michigan State have launched broad efforts to re-emphasize outreach, while Oregon State became the first Research I institution to alter tenure rules to better reward community-based scholarly work.

3. EPICS is a unique program in which teams of undergraduates are designing, building, and deploying real systems to solve engineering-based problems for local community service and education organizations. EPICS was founded at Purdue University in Fall 1995 and has since spread to a diverse group of universities in the United States and abroad, as well as to

a number of K-12 programs.

Community service agencies face a future in which they must take advantage of technology to improve, coordinate, account for, and deliver the services they provide. They need the help of people with strong technical backgrounds. Undergraduate students face a future in which they will need more than solid expertise in their discipline to succeed. They will be expected to work with people of many different backgrounds to identify and achieve goals. They need educational experiences that can help them broaden their skills. Programs like EPICS bring these two groups together in a mutually beneficial way.

D. Addressing unfunded needs for renewal and modernization of facilities and determining how this knowledge can be applied to University facilities:

Historically, cuts in spending on facilities are among the easiest to make in the short term when money is scarce. Philanthropy is not a good solution to long-term maintenance issues. Big donors can be coaxed to give money for new buildings, but they seldom want to make significant gifts to renovate old ones. No workarounds are in sight to pay for deferred maintenance. Public-private deals build new buildings but don't fix up old ones. And every campus has an old building or two — or a dozen — with crumbling concrete or sagging ceilings or outdated infrastructure or all of the above.

In lieu of a comprehensive solution from the state, California's College Futures report suggests several alternatives to make good use of precious space and resources. One alternative is joint ventures, such as the collaboration in the early 2000s between San Jose State University and the City of San Jose to fund and build a library on university property that serves both students and the public.

Another is public-private partnerships (P3), in which colleges enter into long-term contracts with private developers, many of whom take responsibility for funding and construction in exchange for long-term payments from the institutions. Such partnerships have become increasingly common in higher education, especially to build new housing, which enjoys a clear revenue stream. The deals, which free colleges from additional debt or fund-raising challenges, appeal to both small colleges and some large institutions. This year the University of Kentucky finished construction on a $450-million public-private project to expand its housing by nearly 7,000 beds.

"The emergence of the P3 option is happening where it matters most: projects that would be otherwise unattainable under the traditional public-improvement delivery models. For instance, 10 years ago, only a handful of higher education P3 projects were up and running; today, we are approaching three dozen such projects. The biggest challenge is, of course, the financing component, but P3 teams bring much more to the table than money — they give public entities access to expertise and innovation that can add significant value to projects at each phase of development."

Several recent higher education P3 projects demonstrate how the P3 delivery model and team approach can enable colleges and universities to take on projects they might not have otherwise been able to pursue:

Wayne State University student residential facility. Wayne State sought out private partners for a project to demolish an existing 407-bed apartment building and replace it with new and renovated residential space. It went from issuing a request for proposals to obtaining financing in relatively record time and began leasing new beds in August 2018. To expedite construction, the private partner secured bridge financing as part of the overall capital stack, enabling the project to tap into generally favorable financing for the larger private placement of debt.

University of California, Merced, 2020 campus expansion. While residential projects have long been the focal point of higher education P3s, we are beginning to see more ambitious uses of the model. UC Merced 2020 is one example: a campus-wide expansion covering some 219 acres and almost two million square feet of new facilities. The $1.2 billion project is likely the largest and most comprehensive P3 in American higher education. The mix of uses features academic learning, administration, research, residential and utilities, among others. The project includes all project phases and employs an "availability" method of payment whereby the university will compensate a concessionaire directly according to a predetermined formula and schedule for the post-construction operations and maintenance of the facilities over a 39-year life cycle.

Colleges have long outsourced services such as food and laundry services, bookstores, custodial work and building construction. In recent years, however, those partnerships have expanded to include academics and other pieces of the student experience that traditionally have been closely held, including online education, recruitment, and even immersive learning experiences.

In a survey of 249 college executives *by The Chronicle of Higher Education*, the majority of respondents (83%) said their institutions are partnering more with private firms. While more

than half (53%) are doing so on campus infrastructure projects, others are using them to outsource online programs (42%), student housing (39%) and predictive analytics (31%). Colleges are drawn to these companies primarily for their specialized skills, access to investment capital and the ability to quickly bring a project to market, respondents said.[li]

Other ways that universities are trying to stretch their funding for facilities involve finding ways to utilize buildings for multiple purposes. Design teams are being asked to design flexible buildings that can be used as classrooms now and faculty or staff offices in the future. A variety of health and wellness features are being integrated into student recreation centers. Libraries are becoming multimedia collaborative learning spaces; books are being archived and indexed for quick and easy retrieval by robotic arms, freeing up space for research space and for student collaboration. Such spaces, including student unions, that allow communal gathering and co-working are ways of responding to growing student demand for common and collaborative areas.

Finally, universities seek long-term savings by designing sustainable infrastructure that offers long term utility savings (e.g., use of rainwater harvesting to reduce water consumption and utility bills).

E. Emerging opportunities that can stimulate the local economy and create high-quality jobs for residents:

1. WORKFORCE DEVELOPER

Colleges and universities are in the business of developing tomorrow's workforce by educating students who graduate and assume public, private, and civic positions.

This role, however, can extend beyond conventional academic programs. Universities can develop executive and continuing education programs to serve regional clusters, and better align existing programs with those fields where there are local undergraduate and graduate hiring needs. Universities can conduct research on labor supply and demand, as well as workforce development best practices. They can enhance local job growth and economic development by facilitating partnerships among institutions, government, and industries in key regional clusters to identify and fill specific areas of need. In the Chicago area, for example, a collaboration of higher education institutions, community and industry organizations, and the mayor's office has been working for nearly ten years to meet the shortage of manufacturing

workers there by preparing Chicago's inner-city residents for such jobs. Each partner contributes unique expertise to the effort.

The former Executive Vice Chancellor of Workforce and Digital Futures of California Community Colleges described an approach taken by a system of community colleges: "we prioritized which industry sectors drove each regional economy as a foundational decision for aligning programs with labor market needs. Based on this prioritization, Strong Workforce Program resources were made available to ensure 'more and better' career education. For example, advisors in the energy, construction and utility industry gathered and pinpointed the HVACR (heating, ventilation, air conditioning and refrigeration) Excellence credential as being most valued within the industry. At the time, there were also 1,261 job openings projected across the state, while supply from all our colleges was only 393. Faculty at our colleges that offered training in this area were invited to have their curriculum cross-walked against the competencies outlined in HVACR Excellence. Five accepted and found gaps. Faculty found a common basis for closing curriculum gaps and decided to work together on outreach and production to enlarge the talent pool." [lii]

A workforce development project with high potential, already involving the University of Hawai'i, is the effort to expand the state's cybertechnology industry, and especially its workforce in cybersecurity. A recent article in *Civil Beat* described the opportunities clustered around the National Security Agency's operations center near Wahiawā. Employing more than 3500, one-quarter of who are civilians, the NSA center is in the process of becoming the neighbor of the Cyber Security and First Responder Tech Park, the "brainchild" of state Senator Donovan Dela Cruz. The *Civil Beat* article quotes Mike Janke, a business accelerator working on a similar project in Maryland, as saying that there is no reason Hawai'i cannot do what has been done elsewhere: "That means a robust technology ecosystem with professional services, access to capital, educational resources, and people willing to take the lead. Oftentimes all you need is a spark." [liii]

2. TECHNOLOGY TRANSFORMER AND INCUBATOR

Rapid technological innovation and its commercialization are the hallmarks of modern economic competitiveness and growth. Universities have a crucial role in developing technology and catalyzing its commercialization. In Michael Porter's view, "this is often best accomplished using a cluster model." Business or industry clusters are geographic

concentrations of interconnected suppliers, producers, and associated institutions in a particular field. Porter argues that companies in the cluster drive innovation and increase productivity, leading to a sustainable competitive advantage. Two world-famous clusters in California — Silicon Valley and Hollywood — are often cited as successful pioneers in "clustering."

Universities can play a role by operating incubators. A bold new venture to build a "tech hub" from scratch has been launched in Portland, Maine, by Silicon Valley hedge fund executive David Roux in partnership with Boston's Northeastern University. Roux's $100 million gift is establishing a research institute in Portland which "could provide a template for the many American cities struggling to share in the nation's prosperity." [liv]

Through more than 150 incubators affiliated with colleges and universities across the country (70% of which are focused on technology companies), academia encourages aggressive commercialization of research and supports faculty business start-ups. In partnership with governments, community organizations, training centers, large established businesses, and venture capital firms, universities can help to offer valuable resources to incubator businesses—including, simply, space in which to do business. "The phenomenal growth of knowledge-based economies along Route 128 in Boston, in Silicon Valley in California, and in the Research Triangle in North Carolina is a testament to the power of these partnerships." [lv]

At a time when companies are reducing spending on early-stage research and the government is allocating research funds less generously, innovative universities have been increasingly turning to corporations for long-term collaborative arrangements. Going beyond early-stage research to the stage of translating research into new products that produce economic growth, such deals have been occurring in research centers such as Boston and the North Carolina Research Triangle as well as in less prominent locations such as Cincinnati, Minneapolis and Phoenix. Companies co-fund PhD candidates or postdoctoral researchers and their scientists and engineers co-mentor promising researchers. Advance agreements on non-disclosure and patent licensing help bridge the "cultural divide" between academia and industry, and both benefit from long-term cooperation. As summed up by Boston University's Dean of Engineering, "Companies will gain greater access to cutting-edge research and scientific talent at a time when corporate R&D budgets are increasingly under pressure. Universities will gain access to financial support and partners in research at a time when government funding is shrinking. Most importantly, society will benefit from a stream of previously unimaginable advances …"[lvi]

Appendix A-1

Examples of Online Programs that serve "Niche" Regional Needs

ENERGY BUSINESS MANAGEMENT:

University of Tulsa

From the web site description (https://business.utulsa.edu/energy-economics/masters-energy-business/)

Centered in the heart of energy-rich Oklahoma, this energy master's degree blends sound business principles and practices generally found in an MBA program with contemporary energy issues and perspectives to create an energy focused professional educational experience. *U.S. News & World Report* ranks the program among the top online graduate business programs (excluding online MBA programs) in the country. The program is designed for working energy professionals with backgrounds in business, engineering, geosciences, law, and related disciplines who are seeking to advance their careers in the energy industry.

The Master of Energy Business is delivered in a technology-enriched online instructional format. Full lectures (audio and video) plus other course materials are available on-demand, and instructors and students routinely communicate via contemporary electronic media. Live sessions are periodically conducted via web conferencing, allowing instructors, guest speakers, and students to communicate directly. Students receive the same instruction and complete the same kinds of assignments as they would in a traditional graduate classroom setting using communication facilities and technologies that are already familiar to them on-the-job.

Students also participate in two executive-style weekend seminars, called residency seminars, conducted over the course of the program on The University of Tulsa campus. Courses are taught by seasoned, full-time faculty from across the university who have direct energy company experience, along with industry practitioners and other experts.

SCREENWRITING:

UCLA online Professional Program in Screenwriting Standards

(From the web site: https://professionalprograms.tft.ucla.edu/screenwriting-online)

Based in **Los Angeles, the global center of the motion picture industry**, this is the only graduate-level non-degree screenwriting program that has oversight by the UCLA School of Theater, Film and Television. Upon successfully finishing the program, students receive a certificate of completion from the UCLA School of Theater, Film and Television

The thirty video lectures are taught by UCLA Screenwriting instructors, and include structural breakdowns of feature films, screenwriting techniques, exercises, thoughts on the writing process, and more. Lectures can be watched weekly or binged at the student's leisure.

The screenwriting workshop meets in an online video conference once per week and focuses on roundtable readings and an analysis of each student's work. It is limited to no more than 10 students per class. Students see and hear each other and their instructor just like they would in an on-campus classroom.

In Fall Quarter, students are introduced to the concepts of story and structure. They develop their stories in the weekly workshop and begin writing an original feature-length screenplay. In Winter Quarter, students complete their first screenplay. In Spring Quarter, students are assigned to a new workshop instructor and they are guided through the creation and completion of a second original feature-length screenplay. In our virtual campus, students will also participate in forums with fellow students and their instructors and will have access to the UCLA script library.

BIOMEDICAL ENGINEERING:

Case Western Reserve University Master's in Biomedical Engineering Online

From the program web site: https://engineering.case.edu/ebme/

Affiliated with the world-famous Cleveland Clinic, the university **operates the largest biomedical research center in Ohio.**

Biomedical engineering is one of the fastest growing professions today. The Bureau of Labor Statistics forecasts a 23% growth in biomedical engineering jobs from 2014 to 2024.

Founded in 1968 as one of the first biomedical engineering programs in the world, the Case Western Reserve University Department of Biomedical Engineering has established highly successful and comprehensive graduate programs in research and education. The department consistently remains a top-ranked biomedical engineering program for graduate studies according to *U.S. News and World Report*.

The department continues to evolve to match the recent accelerated pace of biomedical engineering developments. As a joint program in the Case School of Engineering and the Case Western Reserve University School of Medicine, our cutting-edge research spans a wide range of new interdisciplinary engineering discoveries and biomedical applications. The department is associated with more than twenty research centers and more than $41.7 million in current grants. Our research and education programs are strongly integrated with industry through job opportunities for graduates, sponsored research, and industrial training activities.

Our online program is designed to provide students with depth and breadth in the field with core courses in the instrumentation and analysis fundamentals as well as physiology, and specialty courses in imaging, neural engineering, and biomaterials. The degree will also provide significant depth in translational skills with courses in regulatory aspects of health technology, bio-design, engineering management and team projects.

The coursework has been designed especially for our online students using best practices for effective online pedagogy adapted for engineering material. In particular, we have focused on teaching presentation and problem-solving skills to engineers online using dedicated simulation software and team projects with on-campus students. The material taught in these classes is the same as that offered to our on-campus students and online students are paired with on-campus students for design projects and presentations.

ARTIFICIAL INTELLIGENCE:

Stanford University: Stanford Online Certificate in AI

Drawn from web site description at:
https://scpd.stanford.edu/public/category/courseCategoryCertificateProfile.do?method=load&certificateId=1226717

From the heart of Tech Country, Silicon Valley, students can take advantage of the opportunity to virtually step into the classrooms of Stanford professors like Andrew Ng, who are leading the Artificial Intelligence revolution.

Classes in the Artificial Intelligence Graduate Certificate provide the foundation and advanced skills in the principles and technologies that underlie AI including logic, knowledge representation, probabilistic models, and machine learning. Students can pursue topics in depth, with courses available in areas such as robotics, vision, and natural language processing. Students can prepare for advanced Artificial Intelligence curriculum and earn graduate credit by taking recommended courses; CS109 Introduction to Probability for Computer Scientists, or STATS116 Theory of Probability.

The certificate is designed to be completed in nine months, but a student may take up to three years to complete it. Courses are available during Autumn, Winter, and Spring quarters.

The certificate is intended for Software engineers interested in artificial intelligence. The fast-paced, academically rigorous classes that are part of this certificate are appropriate for applicants who can demonstrate mastery of the prerequisite subject matter including statistics and probability, linear algebra, and calculus. Students should also have significant programming experience in Java, C++, Python, or similar languages.

Appendix A-2

Innovative academic programs established to meet changing national needs

"SMART TOURISM:"

University of Central Florida Roche College of Hospitality Management

Drawn from web site https://hospitality.ucf.edu/hospitality-technology/lab-location/

As evidence of its leadership among Hospitality programs, in May 2019 the Roche School hosted the first annual conference on smart tourism, smart cities, and enabling technologies. (https://hospitality.ucf.edu/smartconference2019/)

Set in the heart of the tourism capital of the world, Orlando, Florida, for more than 30 years Rosen College has cultivated strong relationships with globally recognized hospitality and tourism industry partners, providing students unparalleled opportunities to apply classroom education in real-world settings through research and academic internships.

The faculty of the college — an international roster of award-winning scholars and former industry executives representing seventeen countries — are renowned for cutting-edge research, making Rosen College one of the most influential hospitality management research institutions in the country. The college is also the largest of its kind in the country, with more than 3,500 students in four undergraduate programs, with two minors, two graduate programs, and two graduate certificates, as well as Florida's only stand-alone doctoral program in Hospitality Management, which is one of only a handful in the nation. Courses are offered at a state-of-the-art campus, based among the industries where the students and graduates make their careers.

As a recognized leader in hospitality management education and research at the Dick Pope Sr. Institute for Tourism Studies, Rosen College launches the Hospitality Technology & Innovation Lab with the potential to transform the hospitality industry.

The benefits of this project to the hospitality industry and the greater community are numerous, but several specific objectives include:

- Provide hospitality technology training programs and consulting services for industry partners
- Address issues in hospitality technology through research and development and by hosting conferences and seminars
- Increase student interest in hospitality technology and better prepare students for hospitality careers through hands-on training
- Develop curriculum and advanced teaching methods using technology
- Learn how to create unforgettable experiences for others with UCF's online Bachelor of Science in Hospitality.

The hospitality industry is one of the largest career sectors in the world and continues to grow at a rapid pace. With your online hospitality degree through UCF Online, you'll learn about more than just the travel agencies, events and hotels at the core of this field. You'll gain a deep understanding of all aspects of the industry including finance, operations, customer service theory, human resources, marketing and communications. You'll also have the opportunity to focus on niche areas of the industry through specialized coursework on theme park and attraction management, golf and club management, and lodging management.

Learn from some of the world's most qualified internationally renowned faculty and network with influential industry leaders from the world's most famous hospitality businesses.

This limited access program is designed to produce top executives across various sectors of the hospitality industry. Applicants must have three years of relevant industry experience before admittance. This degree will further the student's leadership and management knowledge and experience. Upon graduation from UCF Online you will have a solid foundation of skills that will set you apart to help you secure positions in the top hospitality companies around the world.

CYBERSECURITY:

Carnegie Mellon University "CyLab"

Drawn from web site at: https://cylab.cmu.edu/education/programs.html

Carnegie Mellon University has been designated as a National Center of Academic Excellence (CAE) in three distinct areas, Information Assurance/Cyber Defense Education (CAE-IA/CD), Information Assurance/Cyber Defense Research (CAE-R) and Cyber Operations (CAE-Cyber Ops). These designations are reflective of the work of CyLab faculty and researchers.

Across the colleges and schools at Carnegie Mellon, a number of professional graduate degree programs are offered in information networking, information security, and information technology, to create a pool of IA professionals who can address the wide range of technology, policy, and management issues in government, industry, and academia.

Several colleges and departments at Carnegie Mellon offer Ph.D. programs which provide many of the faculty and graduate students active engagement in CyLab research. These include the School of Computer Science and the Departments of Electrical and Computer Engineering and Engineering and Public Policy, both from the College of Engineering.

RENEWABLE ENERGY:

Oregon Institute of Technology Bachelor of Science in Renewable Energy Engineering

Drawn from web site at: https://www.oit.edu/academics/degrees/renewable-energy-engineering

As the first university in North America to design and offer a Bachelor's Degree in Renewable Energy Engineering (BSREE), Oregon Tech has led the field since 2005 in producing graduates who develop, promote, and implement sustainable energy technologies across the country and the world. Oregon Tech's unique Renewable Energy degree prepares graduates for major roles in the clean energy sector, and the renewable energy industry in particular.

Graduates of Oregon Tech's Renewable Energy Engineering program would be ideal candidates for engineering jobs in most any organization where a major emphasis is in power generation, power and energy systems design or applications, and energy conversion technologies. More broadly, organizations that work in these energy and renewable technologies need our graduates: energy efficiency and "green" buildings, solar thermal systems, photovoltaics, hydropower, wave and tidal energy, biomass and biofuels resources, wind energy, energy storage, geothermal systems, and alternative transportation systems.

The Bachelor of Science in Renewable Energy Engineering program is offered at both Klamath Falls and Portland-Metro locations. The Master of Science in Renewable Energy Engineering, first offered in 2012, is offered exclusively at the Portland-Metro location. The concurrent Bachelor of Science degree in Renewable Energy Engineering and Electrical Engineering is available at both locations. The concurrent Bachelor of Science in Renewable Energy Engineering and Environmental Science is offered in Klamath Falls. Dual majors are available for students at the Portland-Metro campus (in Wilsonville).

SUSTAINABILITY:

University of Michigan School for Environment & Sustainability

Drawn from 2016 provost's committee report

http://provost.umich.edu/environsustain/University of Michigan Sustainability Academic Programs FINAL Report.pdf

And from: https://seas.umich.edu/ School for Environment and Sustainability

Committee: The University of Michigan must have a world-renowned, top-ranked, interdisciplinary sustainability school as the focal point and leading voice of the campus community on sustainability in association with environment and society. The Committee therefore recommends that the University of Michigan create a School of Sustainability, Environment, and Society (SSES). This school will provide a dynamic, transformative, interdisciplinary approach as it pursues its mission to "address global sustainability challenges at the intersection of environment and society through research, teaching, and civic engagement." SSES will have permeable boundaries so that it can provide leadership and work collaboratively with other schools and programs at the university to develop solutions to the most challenging global sustainability issues. SSES will replace the School of Natural Resources and the Environment (SNRE) and dramatically expand both its mission and the quality of its partnerships with other schools and programs at UM.

Michigan will develop a new undergraduate Program in Sustainability, Environment, and Society (PSES). The mission of PSES will be to "engage students in developing their interdisciplinary knowledge and skills to understand and solve the Earth's sustainability challenges." Setting a novel model of interdisciplinary education, PSES should be jointly owned by SSES, the liberal arts college and possibly additional schools and colleges that contribute

instructional resources through a shared governance model rather than sitting in any one school or college.

ALLIED HEALTHCARE PROFESSIONS:

Arizona State University College of Health Solutions

Drawn from web site at: https://chs.asu.edu/

ASU College of Health Solutions—founded in 2012—is the only one of its kind. In 2018 the regents voted to reorganize the College of Health Solutions in order to teach in a similar way to how the health care and research fields operate.

"The way the College of Health Solutions was organized was that everything was in these silos but we know in order for us to make an impact … we all need to work together … and so we break down these silos and bring all the faculty together and say 'okay, how do we address these health problems in a much more comprehensive way?'"

Because of this new interdisciplinary shift, the College of Health Solutions is creating teams of researchers, students, and community members to explore more niche areas within healthcare research. We are committed to translating scientific health research and discovery into practice by bringing together researchers, faculty, students and community partners to work on specific health challenges. We prepare students to reimagine health and create a better future by addressing the challenges facing people to stay healthy, improve their health and manage chronic disease.

We are all in for better health outcomes, and there's no place like us — which is what you'd expect from a college at ASU, the most innovative university in the nation.

New Directions in Nursing:

Johns Hopkins University School of Nursing Office for Science & Innovation

Drawn from the web site: Nursing.jhu.edu

The Johns Hopkins School of Nursing ranks #1 nationally among graduate schools of nursing and #3 for online programs, according to *U.S. News & World Report,* and was named the Most Innovative Nursing Graduate Program in the U.S. by *Best Master of Science in Nursing Degrees*. The school ranks #1 among nursing schools for Federal Research Grants and National Institutes

of Health (NIH) funding. Nearly 95 percent of graduates pass the NCLEX on their first try. Among the faculty, more than 40 percent are ranked as Fellows of the American Academy of Nursing. The school has clinics across Baltimore that reach out to abused women, struggling mothers and other underrepresented communities, giving over 12,000 volunteer hours annually and conducting 40 different community-based service programs. The School of Nursing is associated with nursing practice at Johns Hopkins Hospital, ranked #1 in the United States an unprecedented 22 times by *U.S. News & World Report*.

Opening in 1990, the Center for Nursing Research and Sponsored Projects, now known as the Office for Science and Innovation, has encouraged leadership for nursing research within the School, University, community and profession, and facilitates excellence in nursing research. Research is coordinated between the Office for Science and Innovation, Office of Finance Administration, and Johns Hopkins University Research Administration as well as Johns Hopkins Medical Institutes.

Our faculty-led, interdisciplinary centers strengthen a focused area of scholarship in health care by providing an environment to expand the knowledge base, integrate specific education and practice initiatives, and mentor new scholars.

- Center for Cardiovascular and Chronic Care
- Center for Global Initiatives
- Center for Innovative Care in Aging
- Center for Sleep-Related Symptom Science

DIGITAL TECHNOLOGY:

Credential developed through Capital CoLAB (Collaborative of Leaders in Academia and Business) and offered at George Mason University, Virginia Commonwealth University & others

Drawn from Chronicle of Higher Education publication, The Innovation Imperative, 2019, pp. 34-35.

“The challenge: Develop a digitally savvy work force. The change: Create an unusual partnership among universities and companies.”

A new generalist digital-technology credential was developed by an alliance of 12 universities and 14 companies, members of Capital CoLAB, located along a corridor that stretches from Baltimore, MD to Richmond, VA. Employers, including a biotech company, an aerospace giant, and big financial players, agreed on the knowledge, skills and abilities that should be represented in a generalist technology certificate for a college graduate. Colleges in the corridor produce about 20,000 digital technology graduates a year, while the region has about 10 times that many open digital-tech jobs—and that's even before Amazon lands in Northern Virginia with its HQ2 needs. Once the employers agreed on the criteria, the college representatives went to their deans and department chairs to map where those key skills were already being taught in the curricula and where they might need to tweak or add a course. As long as they could cover the material in a sequence of 3-5 courses, the colleges were free to develop the credential as they wished.

George Mason University made the credential the equivalent of a minor, while Virginia Commonwealth University created a "Fundamentals of Computing" certificate; their first graduates completed the program in May 2019. American University, Virginia Tech, Georgetown and the University of Richmond started their programs in the fall of 2019. Capital CoLAB plans to create three additional specialized certificates, in cybersecurity, data analytics, and artificial intelligence and machine learning. From the perspective of the colleges, it allows them to best prepare students for careers, while from the perspective of the businesses, it is a way to create a pipeline to get employees with the right backgrounds.

ARTIFICIAL INTELLIGENCE:

Stanford University Artificial Intelligence Graduate Certificate (see Appendix A-1, Online "Niche" Programs)

Appendix A-3

Overview of National Occupational Projections, 2018-2028

Fiorella Peñaloza, D.M., University of Hawai'i

The fastest growing occupations nation-wide are projected to span the healthcare industry, energy industry, and technology industry according to the Bureau of Labor Statistics (Dubina et al., 2019). This article provides an overview of these industries and associated occupations projected to have the greatest growth over the next decade (from 2018 to 2028). These projections do not include impacts of the coronavirus disease 2019 (COVID-19) pandemic and response efforts, as occupational trends examined precede the pandemic. Given the lack of a systematic method for evaluating occupational supply that accounts for a variety of sources of supply, the national projections of employment examined in this article are based on demand only.

Section 1: The Healthcare Industry

Currently, the middle-aged population outnumber that of children and by 2034 it is projected that people over the age of 65 will outnumber children under the age of 18 (Vespa, 2018). The demographic shift is attributed to declines in fertility rates and international migration rates combined with an increase in life expectancy. This would represent a historic milestone in the demographic shift within the nation and is anticipated to have a widespread societal impact. The Bureau of Labor Statistics anticipates the healthcare and social assistance sector to have the fastest growth among service-providing sectors, increasing at a 2.9% annual rate, largely due to the graying population and increasing prevalence of mental illness, among other illnesses (Dubina et al., 2019; SAMHSA, 2017). The subsequent paragraphs in this section will focus on the anticipated impact the demographic shift will have on the healthcare and social assistance labor market.

According to the National Council on Aging, one in four older adults experience some mental disorder such as depression, anxiety, and dementia. This number is anticipated to double to 15 million by 2030. The needs of behavioral health are beyond those specific to the graying population. In 2016, an estimated 44.7 million adults aged 18 or older (representing 18.3% of all adults) had any mental illness in the past year and an estimated 10.4 million adults

(representing 4.2% of all adults) had a serious mental illness. The prevalence of any mental illness and serious mental illness is on the rise among adults. In 2016, approximately 20.1 million people aged 12 or older had a substance use disorder related to their use of alcohol or illicit drugs. Substance abuse disorders were considerably larger in people aged 12 to 25 in comparison to adults aged 26 or older. Taken together, this data suggests the presence of mental health problems on the rise across all age groups and with a higher prevalence among the elderly population (SAMHSA, 2017).

It is estimated that geriatricians provide care to 30% of patients aged 65 and over and the demand for geriatricians is projected to exceed supply, resulting in a national shortage of 26,980 FTEs, with the greatest shortage projected to be in the Western region of the United States (deficit of 14,530 geriatricians FTEs by 2025; HHS, 2017). Geriatricians typically work as part of a team with other health care providers that specialize in geriatrics to provide care for the elderly (John Hopkins Medicine, 2020). The impact of the shortage in geriatricians is expected to prevail across the health care industry contributing to an increased demand in physician assistants (31% growth rate, 2018-2028), home health aides (37% growth rate, 2018-2028), personal care aides (36% growth rate, 2018-2028), and occupational therapy assistants (33% growth rate, 2018-2028). According to Mercer, a leading global consultancy, the aging population will result in a national demand to hire 2.3 million new health care workers by 2025, with the greatest shortages projected to be in home health aides, medical and lab technologists and technicians, nursing assistants, and nurse practitioners (Kavilanz, 2018). Many of these health care workers are in the allied health professions and are anticipated to be in high demand among long-term healthcare and in-home service care.

The demand of geriatricians is mirrored by the increasing demand of physicians overall, which is increasing the number of physician assistants to help meet this need. According to the National Commission on Certification of Physician Assistants (NCCPA), the percentage of physician assistants working in all practice specialties has grown by 13% from 2015 to 2018 and continues to be one of the fastest nationally growing occupations. The NCCPA's Statistical Report (2017) indicates the top certified physician assistant practice areas to include family medicine/general practice (19.9%), surgical subspecialties (18.5%), emergency medicine (13.1%), internal medicine subspecialties (9.4%), internal medicine general practice (4.9%), dermatology (3.9%), hospital medicine (3.4%), general surgery (2.9%), pediatrics (2%) and occupational medicine (1.5%). Of these practice areas, the surgical subspecialties have increased by over 70% since

2013. Orthopedic surgery and cardiothoracic surgery are two of the most popular surgical subspecialties that physician assistants help with (NCCPA, 2018). Physician assistants have also helped meet growing demands within hospital medicine, including providing emergency room care.

Direct care workers (i.e. nursing assistants, home health aides, personal care aides, and psychiatric assistants/aides) currently comprise about 70% of the long-term services and healthcare support industry (HHS, 2020). In 2015 alone, there was a demand for about 2.3 million direct care workers in long-term services and support settings; this demand is estimated to increase to 3.4 million by 2030. The workforce demand is distributed among homes and community-based settings (50%), residential care facilities (25%) and in nursing homes (25%). Of the direct care workers, psychiatric aides and home health aides are projected to be in the highest demand with a 55% and 51% percent increase in demand respectively within the long-term services and support industry. This projected demand is followed by nursing assistants and personal care aides, whose percent growth is anticipated to increase by 48% and 46%, respectively. In addition to paid long-term services and support, approximately 87% of individuals that need long-term care receive some form of care from unpaid caregivers and is estimated to amount to a $470 billion in savings (HHS, 2020). The consensus is that the United States would not have enough formal caregivers to give the long-term care that family caregivers provide.

Occupational therapy assistants are also projected by the Bureau of Labor Statistics to increase by over 30% between from 2018 to 2028 with the demand driven predominantly by the needs of the aging population. According to the American Occupational Therapy Association, occupational therapy assistants provide services which include low-vision rehabilitation; assist with treatment of Alzheimer's disease and other forms of dementia, including caregiver training; older driver safety and rehabilitation; assisted living; and home safety and home modifications to enable "aging in place" (AOTA, n.d.). Occupational therapy interventions have been found to be effective in supporting productive aging by reducing pain, decreasing disability, mitigating falls and injuries, and improving activities in daily life by increasing physical function (Leland & Elliott, 2012). In addition to providing service to the elderly, occupational therapy practitioners also work as consultants to industry for wellness and prevention with the goal of increasing worker performance (Jaegars et al., 2015).

Section 2: Energy Industry

Clean energy is anticipated to make up half of the word's energy by 2050 (McKinsey and Company, 2019a). The projected increase of electrification is anticipated to be due to road transport, buildings, and industry; with an annual growth in demand averaging about 1% in the United States (EIA, 2020). Electrification is also driven by strong improvements in the lower cost options of electric vehicles that are projected to continue. Recently, an age-energy consumption profile in the U.S. residential sector found that energy consumption increases over the life course, which may be amplified due to the demographic shift, among other changes (Estiri and Zagheni, 2019).

By 2030, renewable energy options for electrification are anticipated to become cheaper than existing coal and gas. Germany and Spain are expected to reach the tipping point in the energy transition from nonrenewable to renewable energy sources before 2025, globally outpacing most regions (McKinsey and Company, 2019b). It is anticipated that by the year 2035 nearly half of the total global power capacity will be in solar and wind, with China and India as the main contributors (McKinsey and Company, 2019b). In contrast the United States is anticipated to reach the tipping point after 2035, later than most regions, largely due to an anticipated delay in energy transition within the Northwest region. Currently in the United States the costs for solar and wind renewable energy are on a declining trend, which are a critical factor in sustaining the energy demand growth (EIA, 2020). However, it is uncertain how long the reduced cost for renewable energy electricity generation will continue.

Clean energy jobs are growing at a rate 12 times as fast as the rest of the US economy and are adding jobs in nearly every state; resulting in over 110,000 net new clean energy jobs nationally (Environmental Entrepreneurs, 2019; Kiersz, and Akhtar, 2019). The states leading in clean energy generation include Kansas, Iowa, Oklahoma, North Dakota, South Dakota, Vermont, California, Maine, Colorado, and Minnesota, which generate more than 20% of their energy from wind and solar energy (Environmental Entrepreneurs, 2019). Clean energy jobs contribute to the value chain of construction (~50%), manufacturing (~20%), professional services (~15%), trade (~9%), and other industries (~6%). By the year 2035, renewable energy is expected to become the world's dominant power source and by 2050, renewables are expected to supply 75% of the world's energy (McKinsey and Company, 2019a). Financial institutions in the U.S. (including banks, asset managers, and private-equity firms) are expected to double planned

investments in renewable energy, with the potential to mobilize $1 trillion in cumulative private capital by 2030 (Deign, 2019).

The Bureau of Labor Statistics anticipates the increase demand in clean energy generation to translate to a projected increase of solar photovoltaic installers and wind turbine service technicians by 63% and 57% from 2018 to 2028, respectively. Presently, 84% of surveyed employers across energy sectors (i.e. electric power generation sector; transmission, distribution, and storage sector; energy efficiency sector; motor vehicles sector; and fuel sector) have reported hiring difficulties and anticipate that they will continue (NASEO and EFI, 2020). Hiring difficulty was highlighted by virtually all sectors as a growing problem. Just over 84% of employers across these sectors reported difficulty hiring qualified workers over the last 12 months, with 29% of employers reporting that it was very difficult (NASEO and EFI, 2020). Hiring difficulties are attributed to a lack of experience, training, or technical skills according to employers across all five surveyed sectors. The need for technical training and certifications was also frequently cited across surveyed employers, suggesting the need for expanded investments in workforce training and closer coordination between employers and the workforce training. The need for expanded workforce development and training may present a unique opportunity for community colleges, particularly in regions where demand is greatest. Furthermore, veterans comprise 8-10% of the energy employment workforce, which is higher than the national average of 6%. Community colleges that provide educational benefits and resources tailored to the military and veteran community may also be well-positioned to offer workforce development and training opportunities in clean energy to this demographic.

In addition to technical skills, there is also a demand of other occupations within the renewable energy industry. Given the anticipated shift from non-renewable to renewable energy, the following occupations are projected to grow substantially by 2026 (Kiersz and Akhtar, 2019):

- service unit operators (in oil, gas, and mining; 23.4% projected growth);
- hazardous materials removal workers (17.2% projected growth);
- personal financial advisors (to provide advice on tax and investment strategies, securities, insurance, pension plans, and real estate; 14.9% projected growth);
- electrical power-line installers and repairers (13.9% projected growth);
- environmental engineering technicians (12.9% projected growth);

- urban and regional planners (12.8% projected growth);
- structural iron and steel workers (12.8% projected growth);
- cement masons and concrete finishers (12.6% projected growth);
- operating engineers and other construction equipment operators (12.3% projected growth);
- environmental science and protection technicians (12.1% projected growth);
- atmospheric and space scientists (12% projected growth);
- training and development specialists (11.5% projected growth);
- systems software developers (11.1% projected growth);
- construction managers (11.1% projected growth);
- environmental scientists and specialists (11.1% projected growth);
- roofers (11.1% projected growth);
- financial analysts for renewable-energy companies (10.9% projected growth); and
- civil engineers for renewable-energy companies (10.6% projected growth).

Recent developments in anticipating the impact of the COVID-19 pandemic have suggested the significance and urgency in helping the nation's economy recover. According to David Terry, the executive director of the National Association of State Energy Officials (EFI and NASEO, 2020),

"The impacts of COVID-19 are devastating, and we remain focused on the health and wellbeing of all Americans as the top priority. At the same time, it is important to begin thinking about how to best help our nation's economy recover by putting people back to work, in high-paying jobs like those in the energy sector. We believe that recovery investments with the greatest potential economic development impact for America's future will be those that prioritize equitable and sustainable energy solutions. Energy and climate investments and the nation's 8.3 million energy jobs are a key part of the COVID-19 recovery solution."

Section 3: Technology Industry

The demographic shift is also anticipated to have a ripple effect on labor participation, with older people (aged 65 and older) increasingly participating in the labor force more than they have historically in the United States, which could challenge productivity and competitiveness (Dubina et al., 2019). The McKinsey Global Institute (2020) identified the adoption of digital technologies as the biggest factor in future economic growth, estimating that it will likely account for about 60% of potential productivity growth by 2030 globally. Businesses are already struggling to find people that can work with digital technologies and the increased demand in artificial intelligence (AI) is anticipated to require most workers to upskill or reskill (Bughin et al., 2018). Up to 14% of people globally may need to change occupations by 2030, a figure that could climb above 30% in more advanced economies with a faster pace of automation (Manyika et al., 2017).

Apple Inc. has also made strategic moves to enhance its AI solutions. In 2018, Apple acquired Silk Labs to achieve visual and audio intelligence and in 2019 it acquired a start-up to achieve an AI powered self-driving car. Amazon began offering AI as a service in 2018 to expand the AI market globally (Fortune Business Insights, 2020). AI investment is growing fast, and despite its main concentration within the technology industry it has great potential in penetrating other industries. According to McKinsey Global Institute, AI can improve performance beyond what other analytics are providing with transport and logistics, retail, automotive and assembly, high tech, oil and gas businesses most likely to see the greatest gains from AI (Chui, 2018). In 2015, the US federal government invested $1 billion into unclassified AI research and development (Executive Office of the President, 2016). The labor market in the United States has begun to shift by adding a new occupation within the labor market for intelligence analysts given their employment demand across various industries (Kochhar, 2020). While the Bureau of Labor Statistics does not have occupational growth projections for intelligence analysts, the demand for business intelligence analysts overall is projected to increase by 7-10% from 2018 to 2028.

The healthcare industry, one of the largest industries in the US, has not been immune to these changes. The advent of the adoption of electronic health records after the passage of the Affordable Care Act (2010) and Health Information Technology for Economic and Clinical Health Act (2009) in the US has facilitated the electronic integration of patient data to support decision-making as it pertains to health care and the development of treatments. Healthcare

data include information about a patient's lifestyle, medical history, encountered visits with practices, laboratory and imaging tests, diagnoses, prescribed medications, performed surgical procedures, consulted providers, and data received from telemonitoring interventions, forming big data repositories (Ahmed and Liang, 2020). In 2018, the "All of Us" research initiative from the National Institutes of Health was launched with the goal of enrolling a diverse group of at least 1 million persons in the US to gather and integrate patient data in a new way. This initiative, while still underway, is anticipated to transform the healthcare industry by developing a systematic approach of integrating a variety of patient data by leveraging information technology to learn more about disease prevention and treatment. Some healthcare experts believe that the effectiveness of precision medicine is dependent on AI; needed to promote a medical revolution focused on reducing medical error and cost, increasing efficiency, and enhancing quality care (Agrawal & Prabakaran, 2020; Ahmed et al., 2020). Some countries, like China, already have AI assisted healthcare screenings and diagnostics in place (Fortune Business Insights, 2020).

The labor market in the United States has begun to shift by adding new analytical occupations within the healthcare industry, such as informatics nurse specialists (Executive Office of the President, 2016). While the Bureau of Labor Statistics does not have growth projections for informatics nurse specialists, it estimates the growth of computer system analysts to be 7% (from 2018 to 2028). The employment demand of database architects, a relatively new occupation within the labor market, is also projected to continue to grow within the healthcare industry. The Bureau of Labor Statistics projects the growth rate of database administrators, the closest listed occupation to that of a database architect, to increase by 9% (from 2018 to 2028). The growing demand in employment of biostaticians has also prompted a new classification within the labor market, despite the fact that it is not a novel occupation (Kochhar, 2020). The Bureau of Labor Statistics projects the growth rate of statisticians (the closest listed occupation to that of the biostatistician listed with a closely related work environment) to increase by 30% (from 2018 to 2028).

The demand in analytical occupations has also been observed within the renewable energy industry. Within the renewable energy industry, newer jobs are requiring analytical skills in programming (35% increase), science (34% increase), mathematics (28% increase), systems analysis (25% increase) and systems evaluation (25% increase). The need for analytical skills outweighs the mechanical needs in most new jobs within the renewable energy industry

(Kochhar, 2020). The demand for renewable energy has increased the need for energy engineers, nanosystems engineers, industrial engineers, and hydrologists as well (Kochhar, 2020). While the Bureau of Labor Statistics does not have occupational growth projections for energy engineers, nanosystems engineers, or industrial engineers, the demand for engineers overall is projected to increase by 4-6% by 2018 to 2028. Hydrologists are projected to have a similar growth rate of 7% from 2018 to 2028.

Conclusions

Demographic shifts over the last several years have influenced changes within the healthcare, energy and technology industries; including the shift in anticipated occupations examined in this article. The current levels of healthcare professionals will not meet the demands of future healthcare needs and some services are already incorporating remote or telemonitoring interventions, to minimize this shortfall. The systematic integration of technologies, such as telemonitoring seen within healthcare, is anticipated to have a pervasive impact across all industries. According to the McKinsey Global Institute, 60% of global productivity will be facilitated by adoption of digital technologies as the biggest factor in future economic growth with artificial intelligence and blockchain technologies emerging as potential global solutions. Lead futurist, George Gilder, predicts that the wide-spread use of artificial intelligence will propel block chain technology, resulting in the fourth industrial revolution globally (known as the cryptocosm). Blockchain technology is intended to enhance organizational efficiencies by managing the data overload, centralizing processes, and enhancing asset and value transfer (i.e. management of a digital currency). While the origins of blockchain stemmed from increasing efficiencies with financial technology, it has quickly diffused across other sectors. The top four invested industries being technology, media, and telecommunications; energy and resources; manufacturing (including farming); and life sciences and healthcare according to Deloitte's 2019 Global Blockchain Survey. Unsurprisingly, the fastest growing occupations fall within the most heavily invested industries. The technological convergence of various industries can present unique opportunities for cross-industry collaboration to collectively address the future demand. Cross functional collaboration between higher education and industry is already being facilitated by legislation (Distance Education and Innovation, 2020), whose collaborative approach to meeting anticipated needs is likely to continue.

Appendix A-3.1: Fastest Growing Occupations, 2018-2028

Occupations	***Nation-wide***
Photovoltaic Installers	63%
Wind Turbine Service Technicians	57%
Home Health Aides	36.6%
Personal Care Aides	36.4%
Occupational Therapy Assistants	33.1%
Information Security Analysts	31.6%
Physician Assistants	31.1%
Statisticians	30.7%
Nurse Practitioners	28.2%

Source: Kevin S. Dubina, Teresa L. Morisi, Michael Rieley, and Andrea B. Wagoner, "Projections overview and highlights, 2018–28," Monthly Labor Review, U.S. Bureau of Labor Statistics, October 2019, https://doi.org/10.21916/mlr.2019.21.

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