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Surviving and Anticipating Waves of Change in Public Research Universities

Merrill Series on
The Research Mission of Public Universities

A compilation of papers originally presented at a retreat
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Introduction

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The following papers each address an aspect of the subject of the 25th annual research policy retreat hosted by the Merrill Center: Surviving and Anticipating Waves of Change in Public Research Universities. We are pleased to continue this program that brings together university administrators and researcher-scientists for informal discussions that lead to the identification of pressing issues, understanding of different perspectives, and the creation of plans of action to enhance research productivity within our institutions.

Our keynote speaker for the event was Kim A. Wilcox, Chancellor of the University of California, Riverside. In his presentation, he spoke of the need for public research universities to focus on access: higher education must evolve our support services as today's students face growing financial, health, and preparation challenges. We also invited four featured speakers: Joseph Steinmetz, Executive Director of Psychological Clinical Science Accreditation System; Wendy Wintersteen, President of Iowa State University; Bernadette Gray-Little, former Chancellor of the University of Kansas; and Daniel A. Reed, Presidential Professor at the University of Utah.

Collectively, the papers of the keynote and featured speakers provide extraordinary insights from the highest levels of leadership across differing public research universities. These papers, and others in this issue, address themes that recur across the 25 years of the Merrill Research Retreats. A strong common theme is instability on multiple fronts, with attendant challenges, as our society undergoes great change with many points of impact on our great public research universities, creating ongoing challenges in managing the underpinnings of the education of future scientists and scholars. Challenges include: Access of high-quality research education for a wide range of students, public governance of higher education, rapid change in methods of science and inquiry, methods of assessing outcomes of education, and global mega trends on our doorstep. The accelerated pace of change in science and society sets a high bar for public research universities to continue to lead scientific and scholarly breakthroughs. Yet, the high bar is a challenge to be met. Another recurring theme from the 25 years of retreats is a consistent belief in the potential power of our public research universities to meet the challenges of the future and continue to contribute to advances in science and scholarship. Leadership is essential to our success, and research retreats are essential opportunities to gain insights from outstanding leaders.

Benefactors Virginia and Fred Merrill make possible this series of retreats: The Research Mission of Public Universities. On behalf of the many participants over two decades, I express deep gratitude to the Merrills for their enlightened support. On behalf of the Merrill Advanced Studies Center, I extend my appreciation for the contribution of effort and time of the participants and to the authors of this collection of papers who found time in their busy schedules for the preparation of the materials that follow.

Twenty-seven administrators, faculty, and students from eight institutions in California, Indiana, Iowa, Kansas, Missouri, Nebraska, and Utah attended in 2022, which marked our 25th retreat. Though not all discussants' remarks are in-

dividually documented, their participation was an essential ingredient in the general discussions that ensued and the preparation of the final papers. The list of all conference attendees is at the end of the publication.

The inaugural event in this series of conferences, in 1997, focused on pressures that hinder the research mission of higher education. In 1998, we turned our attention to competing for new resources and to ways to enhance individual and collective productivity. In 1999, we examined in more depth cross-university alliances. The focus of the 2000 retreat was on making research a part of the public agenda and championing the cause of research as a valuable state resource. In 2001, the topic was evaluating research productivity, with a focus on the very important National Research Council (NRC) study from 1995. In the wake of 9/11, the topic for 2002 was "Science at a Time of National Emergency"; participants discussed scientists coming to the aid of the country, such as in joint research on preventing and mitigating bioterrorism, while also recognizing the difficulties our universities face because of increased security measures. In 2003 we focused on graduate education and two keynote speakers addressed key issues about retention of students in the doctoral track, efficiency in time to degree, and making the rules of the game transparent. In 2004 we looked at the leadership challenge of a comprehensive public university to accommodate the fluid nature of scientific initiatives to the world of long-term planning for the teaching and service missions of the universities. In 2005 we discussed the interface of science and public policy with an eye toward how to move forward in a way that honors both public trust and scientific integrity. Our retreat in 2006 considered the privatization of public universities and the corresponding shift in research funding and infrastructure. The 2007 retreat focused on the changing climate of research funding, the development of University research resources, and how to calibrate those resources with likely sources of funding, while the 2008 retreat dealt with the many benefits and specific issues of international research collaboration. The 2009 retreat highlighted regional research collaborations, with discussion of the many advantages and concerns associated with regional alliances. The 2010 retreat focused on the challenges regional Universities face in the effort to sustain and enhance their research missions, while the 2011 retreat outlined the role of Behavioral and Social sciences in national research initiatives. Our 2012 retreat discussed the present and future information infrastructure required for research success in universities, and the economic implications of that infrastructure, and the 2013 retreat discussed the increasing use of data analysis in university planning processes, and the impact it has on higher education and research. The 2014 retreat looked at the current funding environment and approaches which could be used to improve future funding prospects. The 2015 retreat addressed the opportunities and challenges inherent in innovation and translational initiatives in the time of economic uncertainty that have an impact on goals to enhance research productivity. The 2016 retreat focused on the building of infrastructure to meet the changing needs in research. The 2017 retreat topic and discussions were on university research planning in the era of big data. The 2018 retreat topic and discussions were on big data and cross disciplinary research. The 2019 retreat topic centered on challenges for implementation of cross-disciplinary research in the Big Data era. The 2020 retreat was cancelled in accordance with COVID pandemic public safety protocols. In 2021 the focus was on the impact of the COVID pandemic on our universities, with a focus on the challenges for research in the wake of the pervasive effects of the pandemic.

Once again, the texts of this year's Merrill white paper reveal various perspectives on only one of the many complex issues faced by research administrators and scientists every day. It is with pleasure that I encourage you to read the papers from the 2022 Merrill policy retreat on Surviving and Anticipating Waves of Change in Public Research Universities.

Executive Summary

Surfing Tsunamis and Deserts: Educational Access in an Era of Extreme Conditions

Kim A. Wilcox
Chancellor, University of California, Riverside

- In a world where widening gaps in wealth, political extremity, and climate change threaten access to even the most basic needs, public research universities provide a source of opportunity and solutions. Therefore, as we ride waves of change, focus on access is our charge. Historically, Higher Education has been a great equalizer (albeit, not equally for all populations) while providing needed answers for many of the world's greatest challenges. Investments for infrastructure were critical in the past and remain important now. But we must also evolve with support services for today's students who are facing greater financial, mental health, and preparation challenges. Fortunately, by working together, we can continue moving forward through these extreme conditions.

- The Morrill Act of 1862 was the first in a series of land grant acts to provide land or financial resources through the sale of land to expand higher education. The land-grant act had a profound impact on engineering and technical education. In 1866, only 300 men in the United States had graduated with engineering degrees. But by 1870, that number had grown to 866. And by 1911, there were 38,000 engineers. Within 50 years of the passage of the first Morrill Act, the United States had become the world leader in engineering and technical education.

- During the Gilded Age, in the years from 1860 to 1900, 30% of the country's wealth was owned by the top 2% while the bottom 40% had no wealth at all, similarly to the unrest we are facing now: equally divided between two parties; prohibition, education, tariffs, ethnic and racial tension; powerful trusts dominate some industries; and political organizations exert influence over politicians who award jobs and contracts to loyal supporters.

- To compensate for widening gaps in wealth inequality, persistence, and mental health while continuing to address inequities among underrepresented populations, the University of California, Riverside utilizes a full suite of wraparound services. But focus on graduation gaps led to new services by mapping programs to current student needs. The results have been significant. Investments in education remain important in driving economic progress, innovation, and improved equality. Working together to expand access, therefore, serves as both pragmatic and moral imperative.

Assessing Quality in Higher Education in a Changing Environment

Joseph E. Steinmetz, PhD
Executive Director, Psychological Clinical Science Accreditation System

- Institutions of higher education have always been engaged in assessing quality of their faculty, staff, and students and the effectiveness of their research, teaching, and service missions. In addition, the federal government and federal and state licensing agencies often require that accrediting agencies assess the viability and effectiveness of institutions and individual programs within the institutions. Over the last 10-20 years there has been an increasing call for accountability in higher education. As the cost of attending college has increased, students and their parents have demanded more from universities, and state legislators are demanding that universities produce graduates that can immediately find jobs, have an impact on their states' economies, and do so with fewer resources.

- The Psychological Clinical Science Accreditation System (PCSAS) is a program-level accreditor, one of two recognized accrediting agencies for doctoral programs. PCSAS provides rigorous, objective, and empirically based accreditation of PhD programs that adhere to a *clinical science* training model. PCSAS does what all programmatic accreditation organizations do: performs reviews of programs to assess overall excellence so that graduates of these programs can pursue careers in a specific area.

- Since its creation, PCSAS has accredited 46 programs in the United States and Canada, and that number is steadily growing. PCSAS programs are highly regarded and considered the best clinical psychology programs in the country. All 20 programs that are ranked as the top 20 by *U.S. News & World Report* are PCSAS accredited, and 42 PCSAS programs in the U.S. are listed among the top 50. All 46 PCSAS programs are ranked highly by the National Academies of Sciences, higher than non-PCSAS programs on several dimensions, such as their graduates' scores on state licensing exams, students' placements in internships, and publication records of their faculties.

- Like the rest of higher education, program accreditors like PCSAS face issues and challenges as the environment in higher education is changing. Some of these changes have been caused by the COVID pandemic and its effects on higher education. Others have been emerging over the last several years. There has been a movement toward greater accountability for our colleges and universities from the public, government, and the media. COVID-19 affected finances, the way classes are taught and how learning is/is not achieved, and research at our universities. Like other areas of higher education, accreditors will have to deal with the dynamic environment changes that have occurred in higher education and that will likely continue well in the future.

Kindling, Spark, Oxygen: The Wave of Change for Students at Public Research Universities

Wendy Wintersteen
President, Iowa State University

- Students are struggling to regain a sense of continuity and connection as we continue to emerge from the high-anxiety years of COVID-19. "Student disengagement" is a phrase we hear more often. The number of college dropouts increased in 2020, the highest levels seen in the past decade. Twenty-six percent of students who started college in 2019 did not return the next year during the pandemic. A significant number cited mental health concerns for the reason why; also, mental health was a contributing factor for a third of the students who didn't finish degrees. The most frequently mentioned reason for leaving college was change in motivation or focus. These students struggled to see how their college education connected to a meaningful career or a successful life in the future.

- Iowa State is a land-grant university, a university of science and technology. Our hallmark is helping students make that leap into their futures; to equip them so that when the waves of change come rolling in, they are able to surf. Faculty in every discipline mentor students toward the opportunities and resources that might best serve them and move them forward from wherever they are. They believe deeply in helping all students excel — a land-grant university idea and ideal.

- One of the waves of change for students is the voices today whispering to them that they don't need a college degree to succeed. For some students, the choice not to attend college will be the appropriate one. However, intentional or not, the voices that downplay the value of a university education feed into the persistent anti-science sentiment that has become more pronounced during the pandemic. There are students with intrinsic motivation to work harder, persist longer, and maintain a pursuit toward a goal. High-impact practices such as undergraduate research can create intrinsic interest or coax it forward.

- Our task as leaders is to add oxygen to what's already there — the kindling of desire to make a better life and a better future, and the spark of intellect, curiosity, and creativity. With all the global challenges facing us today, the worst that can happen is to have fewer flames of innovation, or to see a flame flicker or die for lack of oxygen. The best we can strive for is to fan the flames of our students' hopes and goals and help them burn steady.

Political Influence in the Governance of Public Higher Education

Bernadette Gray-Little
Former Chancellor, University of Kansas

- Both universities and their governing boards seem to care about ensuring college access to a large number of state residents; both aspire to prepare job-ready students to the benefit of the students, the universities, and the economy. And although they may differ regarding the cause and remedy for high tuition, they share concern about the cost to students. But there often seem to be fundamental differences in the values and language of system boards and university communities.

- Governing boards vary in size, and methods of selecting board members also vary. No board composition entirely insulates higher education from politics, nor is there strong evidence that board structure determines whether elected officials intrude on educational procedures; however, the process for selecting board members can be critical in whether the board protects institutions from political influence or serves instead as the conduit for it. Many variations in the manner of selection and size of boards can work to build strong public universities that prepare students to make a living and make a good life, advance research, and benefit their states in multiple ways, especially in economic development and health—as long as institutions *have sufficient bureaucratic independence* to eliminate or modulate the influence of politics on educational procedures.

- In several states the relationship between public universities and their governing boards has changed in the past five to 10 years. One manifestation of the shift is an erosion in the distinction between university administration/bureaucracy, on the one hand, and the political strategy of governing boards, legislators, and governors, on the other. A subtheme of this shift is that high-status university and system positions are increasingly viewed as "a jobs program" for former political figures or allies of political figures. There have been striking examples of strong political intrusions that threaten the norms of higher education governance in numerous states, including Indiana, North Carolina, and Florida, that illustrate this disruption and consider contributing factors.

- Questions to consider: Why is the public not incensed? It's possible that who runs universities or whether board members use their positions for financial or professional gain does not rise to the level of concern for most people. Will the return to more normal, post-pandemic conditions carry over to the way universities are governed, or will the longer-term social, economic, and political impacts of the pandemic and ongoing political polarization continue? And importantly, what steps can university communities take to ensure the integrity of university governance?

Global Megatrends: Be the Change You Seek

Daniel A. Reed
Presidential Professor, University of Utah

- The historical rate of socio-technical change has occurred on a scale roughly commensurate with a human lifetime. Across lifetimes, this evolutionary change has allowed societies and organizational structures to adapt incrementally. Today, a set of rapidly shifting, global megatrends is triggering major structural changes in our society. As that change accelerates, it is triggering deep social and economic disruptions.

- The depopulation of rural areas in the United States and the associated "brain drain," exacerbated by the rise of industrial scale agriculture, have had profound effects on rural communities and created economic and social tensions – the urban-rural divide. Concurrently, globalization has created deep couplings and interdependent supply chains in almost all product domains, as the COVID-19 pandemic's disruptions quickly exposed. The shifting demographics of the United States, political battles over immigration policy, and a mismatch between employee skills and workforce needs are further challenging social norms. In the midst of all this, we are seeing increasingly political polarization and income stratification, with a shrinking middle class, declining political middle ground, and a growing fraction unwilling to compromise on a variety of social and economic issues.

- In a world increasingly dominated by the knowledge economy, where those with high-demand skills thrive, and those lacking those skills struggle, how can we best ensure the door of opportunity is open wide? The National Science Board (NSB) released *Vision 2030*, a blueprint for addressing some of these challenges. It calls on all of us to (a) expand the geography of innovation, (b) expand educational opportunities, (c) ensure the benefits of academic research are accessible, and (d) foster a global science and engineering community that reflects the values of open collaboration and empowerment.

- In a world of accelerating change, universities must be more flexible, nimbler in addressing societal challenges, just as they have proven capable of doing in the past. We are at an important inflection point, one where higher education must respond with alacrity to pressing societal issues. We can build Renaissance teams that couple knowledge across diverse disciplines, build deep community partnerships, engage in hands-on problem solving, and use those opportunities to expose students to integrative perspectives on these complex and important problems.

Surfing the Leadership Pipeline – Growing Leaders from Within STEM

Peter K. Dorhout
Vice President for Research, Professor of Chemistry, Iowa State University

- Survive and anticipate – two words that might have been used by Lord Robert Stephenson Smyth Baden-Powell, the founder of a movement that would become Boy Scouts. He came to refine such terms into the Scout motto: Be Prepared. According to legend, someone asked Baden-Powell, "Be Prepared – for what?" His reply, "Why, for any old thing, of course." Surviving and anticipating waves of change in public research universities requires us to Be Prepared – for any old thing. Building diverse leadership pipelines will enable higher education to be prepared to successfully survive and anticipate waves of change. Afterall, those waves of change could be any old thing.

- The Academic Leadership Training (ALT) Workshop incorporates some of the learning principles embedded within Scouting: explain, demonstrate, guide, and enable. ALT was designed to engage experienced academic leaders and 40-50 ALT "students" in learning the general principles of leadership, engaging in case study discussions, and developing work products. The three-day workshop includes a pre-workshop 360-degree feedback assessment with input from 12-15 professionals identified by each participant, interactive panel discussions, case study discussions, and breakouts on critical topics for success in a variety of academic leadership positions. The goal for participants: be prepared for academic leadership roles; use skills and tools from ALT to be more effective academic leaders; be prepared for interviews and their start as an academic leader. In addition, the ALT participants will have a cadre of peers who may serve as collaborators and informal mentors throughout their leadership journeys.

- A longitudinal study of the ALT participants and their perceived impact of the skills learned at the workshops determined 45% leaders are in the same role while the remaining respondents are in new leadership roles; respondents felt that the workshops significantly prepared them to continue in their role and be more successful; new leaders agreed the workshop prepared them for the job; and 93% would recommend the ALT Workshop to an emerging academic leader.

- In an environment of shared governance, growing faculty leadership with shared values for public higher education – research, teaching, service, and outreach – should be an imperative. Emerging leaders in the ALT Workshop discovered that building trust is one of the most important aspects of leadership. For universities to not just survive but succeed and thrive through waves of change, they will need to build a pipeline of trustworthy leaders across the academy to rekindle the trust that has been damaged, if not lost, according to our stakeholders, over the past few decades.

Public Universities as Agents of Economic Prosperity

Beth A. Montelone, PhD
Senior Associate Vice President for Research, Kansas State University

- All of higher education is facing challenges, most pervasively declining student enrollment due to demographics and changes in societal attitudes regarding the value of post-secondary education. Costs of tuition and fees at public institutions continue to outpace inflation. And the pandemic continues to create its own challenges and exacerbate others, including faculty and staff burnout, student mental health issues, political polarization, and an evolving conception of the workplace.

- As the nation moves in halting steps away from the pandemic, researchers and research administrators are looking to the future. Many of the recently released (summer 2022) and forthcoming opportunities authorized under the American Recovery Plan and the Chips and Science Act seek to rebuild and strengthen the economy. This is coupled with an increasing trend of state and local governments looking to universities, particularly research universities, as engines of economic development.

- K-State has designed a blueprint for the future developed in response to the 2020 strategic plan from the Kansas Board of Regents and defines three pillars: (1) Helping Kansas Families, (2) Supporting Kansas Businesses, and (3) Advancing Kansas Economic Prosperity. KBOR made Pillar 3 a charge for the six Kansas Regents universities, and K-State chose four focus areas, reflecting our land-grant mission and the disciplinary areas in which we have primarily benefited from partnerships with the private sector: (1) Food and Agriculture Systems Innovation, (2) Digital Agriculture and Advanced Analytics, (3) Biosecurity and Biodefense, and (4) K-State 105.

- Groups of faculty members were empaneled in spring 2022 to identify the highest value sectors with the greatest potential to create jobs and/or attract investments, larger sponsored research opportunities that would be relevant, and companies with whom the university could partner to advance the efforts. An emphasis will be placed on developing sustainable systems, alternative crops, a novel approach to the pet food industry, and new opportunities to improve foods to positively impact human health. Goals include a greater integration across disciplines, including artificial intelligence, unmanned autonomous systems, sensor technology and networks, and relationships with multiple kinds of companies. Progress has been made with completion of the Biotechnology Development Module and a collaboration with Manhattan Area Technical College and Scorpion Biological Services. A programming plan has been established that includes an innovation education series, workforce development assistance services, and seed capital funding.

Intentional Research Team Building

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- The University of Nebraska-Lincoln is taking an intentional approach toward research team building, focused on team formation and supporting the professional growth and development of research team leaders—distinctive because academic leadership programs focused on preparing departmental executive officers, deans, and provosts are common. However, initiatives focused on developing research team leaders are far more rare. The Research Leaders Program (RLP) is an initiative to identify and develop the next generation of research leaders at Nebraska.

- RLP focuses on the fundamentals of management and cutting-edge topics that high-impact research leaders need to know, including strategic, strengths-based leadership; goal setting; team science; and innovation and design thinking. Participants are coached on a one-on-one basis to develop growth plans aimed at strengthening and elevating their research activities. All faculty members who complete the program are granted a course release, funded by ORED, to support the implementation of their growth plans. Two of the 30 UNL faculty who have completed the RLP thus far are Amanda Ramer-Tait, PhD, Maxcy Professor of Agriculture and Natural Resources, Department of Food Science and Technology (2021-2022 RLP) and Timothy Nelson, PhD, Professor, Department of Psychology (2020-2021 RLP):

    - My participation was very rewarding and provided professional development beyond the lab bench and my research area. It connected me with other faculty on campus with whom I would typically not have the chance to interact. The program also provided a framework to develop a strategic growth plan for our program. My RLP experiences have empowered me to think more strategically about how to grow a research program with impact. - *Amanda Ramer-Tait, PhD*

    - I developed a growth plan outlining new directions for my research with an emphasis on opportunities to build on my program while setting ambitious goals for expanding my work. The process has been incredibly useful in strategically building a research team and increasing the impact of our work. - *Timothy Nelson, PhD*

The Impact of Automation on the Future of Work and Higher Education

Donna K. Ginther
Roy A. Roberts and Regents Distinguished Professor of Economics; Director, Institute for Policy & Social Research
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University of Kansas

- Until the turn of the 21st century, higher education was impervious to technological change. The rise of the internet and related technologies has transformed higher education and the labor market in new and interesting ways. The COVID-19 pandemic required higher education to move online and teach remotely. Technology enabled these rapid changes and will have long-lasting effects on higher education and the type of work that our students will do in the future. This essay illustrates the demographic challenges facing higher education, the role of robots, automation, and artificial intelligence (AI) in the labor market, and the downstream effects of AI on the student test score gap, concluding with a set of social science research recommendations that respond to the creative destruction of technological change.

- Kansas had below-average population growth of only 3% between 2010 and 2020, less than half the rate of U.S. growth of 7.4%. If matriculation patterns do not change, this means there will be fewer students attending universities in Kansas in the next decade. This likely reflects two factors: we are in the echo of the "Baby Bust" and U.S. enrollment in higher education tends to be highest for white students and lower for students of color who most often are first-generation college students.

- Technology is changing work as we know it. It eliminates jobs and industries. Resources shift from declining industries to new industries; however, in the United States, where the social safety net is often an afterthought, individual workers bear the costs of creative destruction in the form of job loss and lower wages. Any task that can be broken into codifiable steps, regardless of complexity, is increasingly prone to AI-driven automation. This leaves humans the inherently non-routine tasks that involve higher order capabilities.

- Although AI penetration has a negative impact on the educational achievement of future generations, the same forces provide significant opportunities for social science research. The COVID-19 pandemic underscored the importance of social science research. Models of the spread of COVID-19 failed to adjust for the endogeneity of behavior. The internet, social media, mobile phone technologies, and the government have generated an ocean of data that can be used to address the fundamental questions facing society. In addition, basic research funding is increasing to address these questions. Evidence-based policy that uses data to inform decisions will be critical as we confront the challenges of climate change, political polarization, and the future of work. Science and social science research will provide answers to these pressing challenges, but we as academics need to do a better job of communicating our findings to a broader audience.

Persistent and Consistent Underpromotion of Women in Academic Medicine: It's Time to Make Some Waves

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- Twenty years ago, a landmark longitudinal cohort study of medical school graduates from 1979 to 1997 demonstrated that high rates of women physicians were entering the ranks of academic medicine as assistant professors but were not advancing in rank to associate or full professor at the same pace as men. Since then, studies have focused on the promotion gap. We here summarize findings from an update of Nonnemaker's study that includes additional cohorts from 1997 to 2018. We also report analyses of the intersection of race and gender on promotion, as well as analyses of the impact of gender on attrition.

- In an era where women have closed the medical school admission gender gap, women remain underrepresented in upper faculty ranks. Compared to men, women are less likely to be appointed to department chair; survival analysis suggests that women never close the promotion gap. There are numerous potential causes of disparities in promotion and retention, including a persisting "old boys club" mentality, lack of gender parity in leadership and compensation, and difficulties in achieving work-life balance. A nationally representative survey at U.S. medical colleges found that female faculty had similar leadership aspirations as male faculty but a lower sense of belonging and were less likely to perceive their institution as family friendly or willing to make changes to address diversity goals.

- Women are still less likely to advance into upper faculty ranks than men, barriers appear to be worse for faculty of color, and retention rates are lower for women and faculty of color. To address this, two recent reports propose changes to the academic work environment designed to remove systemic barriers to career advancement and supplement programs in place for women at signal institutions. Making academic medicine a better environment for women would likely improve the environment for all faculty. Concerted efforts are needed to remove the additional barriers to advancement and retention among faculty of color.

Sustainable and Total Recovery of Resources (Energy, Clean Water, and Fertilizers) from Wastewaters through the Anaerobic Membrane Bioreactor (AnMBR) Platform

Prathap Parameswaran, PhD
Department of Civil Engineering, Kansas State University

- While several wastewater treatment facilities have been able to achieve energy neutral operation through limited carbon (mainly methane) and nutrient (struvite alone) sequestration options, the need to enhance digested biosolids quality while decreasing the quantity and high capital/operation costs remain challenges that limit widespread adoption of these platforms. Anaerobic membrane bioreactors (AnMBRs) are an emerging environmental biotechnology platform that can address these challenges by enabling efficient anaerobic treatment along with volatile solids reduction, tailored and separate sequestration of high-quality ammonia and phosphorus, and significantly lower biosolids production.

- A pilot scale AnMBR operated by the PI's team at Ft. Riley, Kansas, under ambient conditions continuously for 270 days treating 1,000 gallons per day of municipal wastewater has consistently achieved these goals. Specifically, this AnMBR process configuration was able to achieve approximately 73% energy neutral operation by maximizing gaseous and dissolved methane energy capture while minimizing gas sparging and mixing energy requirements. The AnMBR was also paired with downstream nutrient recovery using a coagulation-flocculation-sedimentation process, removing 94±3% of phosphorus and over 99% of nitrogen, as well as both gaseous and dissolved methane capture, which could generate an estimated 72.8% of the power required for energy neutrality. The successful integration of AnMBRs in a treatment train that addresses the critical challenges of dissolved methane and nutrients demonstrates the viability of the technology in achieving holistic wastewater treatment.

- Successful long-term operation of the AnMBR at the bench and pilot demonstrates a viable circular bioeconomy platform for revolutionizing animal operations, especially the swine and dairy sectors, with significant beneficial impacts on the arid/semi-arid region, producing indirect potable water supply and protecting sensitive watersheds from the runoff of the algal bloom triggers – N and P – that will now be sequestered. The research also generates tailored nutrient products for agriculture, namely ammonia-N and Phosphate fertilizers, which can be blended in farmlands at pre-requisite ratios, supporting local crops for supplying the animal operations while supporting a wide variety of crops and vegetables. The project will spawn new innovations within all public utilities in the rural areas to consider AnMBRs as a means to achieve energy positive operation, while still meeting stringent nutrient discharge goals. AnMBRs will create a greener workforce in the rural American communities, pivoted around nutrient product marketing, water and renewable energy (biogas) management, as well as reused water reallocation budgeting, without compromising the cropland and food safety.

Physician Leadership During COVID-19

Robert D. Simari, MD
Executive Vice Chancellor, University of Kansas Medical Center

- As a physician-leader, I have been struck by those who suggest that physicians are insufficiently trained to lead organizations. With the skills and achievements required to get into medical school, doctors are trained to define and solve problems and learn to work collaboratively and communicate clearly. While medical training is not sufficient for all doctors to lead, it is a sound basis for those inclined to do so, and never before has medical training been more applicable for the physician-leader than during the COVID-19 pandemic.

- It became essential to protect the health and safety of employees (and customers and patients) and to ensure the continuity of the organization regardless of the challenges. Physicians in academic medical centers were asked to serve as county or community healthcare leadership, to serve on school boards. Physicians were providing emergency and inpatient care throughout their healthcare systems. One of the major roles for physician-leaders during the pandemic was in the leadership of pandemic emergency management teams. At the University of Kansas and empowered by Chancellor Girod, a Pandemic Medical Advisory Team (PMAT) was led by Dr. Steven Stites, vice chancellor of clinical affairs at KUMC and senior VP of clinical affairs at the University of Kansas Health System.

- PMAT consisted of medical and public health experts, members of the emergency management team, and communications and campus leaders. The goals were to determine the safety level for the university, as well as the impact on activities and campus protocols. The challenges for PMAT were real. Recent studies suggest there were important effects of behaviors and policies on college campuses that impacted their broader communities. At the beginning of the pandemic, PMAT had to quickly consider whether students should return to campus following spring break. Mangrum and Niekamp demonstrated that university students who returned from spring break contributed to the growth of cases and deaths in the community. Similarly, opening of campuses in the fall of 2020 and 2021 led to increased COVID cases.

- The critical role of physician-leaders during the pandemic raises a question also addressed in the Harvard Business Review: Does your company need a chief medical officer? The selection and training of doctors results in competencies, expertise, and skills that support the assumption and high-level performance in diverse leadership roles. COVID-19 made it crystal clear that in cases where the health of the community is at risk, physician-leadership is a necessity. With the likely impact of pandemic and global warming on human health, organizations of every kind should strongly consider a chief medical officer in the c-suite.

Implementing a Comprehensive Hiring Strategy to Enhance Research Activity: The MizzouForward Initiative

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Vice Chancellor for Research and Economic Development
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- The University of Missouri has the Carnegie Classification of Doctoral Universities: Very High Research Activity and takes pride in its status as the premier public research institution in the state of Missouri. After research activity at the institution stagnated in the 2000s, it has experienced a significant increase in expenditures in recent years, but research expenditures and other important measures of scholarly output at MU lag many of its peer institutions. Consequently, MU President and Chancellor Mun Choi conceptualized the MizzouForward initiative; its centerpiece is an effort to hire up to 150 new tenured/tenure-track faculty members over the next 5-10 years who will make important contributions to our research mission. Estimated cost of the overall MizzouForward initiative is $1.5 billion, with approximately half of these funds earmarked for direct (e.g., salary, benefits, startup) and indirect (e.g., enhanced research facilities and instrumentation) new faculty support.

- Less than one calendar year old, MizzouForward has achieved several initial successes; the most notable is the ability to effectively implement a centralized hiring initiative. Secondly, MU has received hundreds of nominations and applications from across the country and internationally, and candidates often cite the institutional commitment associated with MizzouForward as a primary factor for their interest in the university. The initiative has not been without challenges; the most salient has been establishing buy-in across campus. Units where external grant activity is low have expressed some resistance, as they feel it reflects a lack of institutional commitment toward their areas. Other challenges involve skepticism about long-term central funding for the initiative and maintaining consistent messaging and decision-making about the outcomes we are trying to achieve.

- We are already seeing benefits from the initiative, in particular many faculty hires. Future directions include more targeted hiring areas that take advantage of unique university strengths and/or opportunities, such as materials science, infectious disease, and a broad school of medicine area, and enhancing buy-in and support for the initiative from the academic units. There is no doubt that MizzouForward is a time-consuming, resource-intensive initiative, but we are convinced our efforts will have a transformational impact on MU.

Science with Practice on a Three-Legged Stool

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- There are a multitude of approaches to surviving change, and probably an equal number of approaches to anticipating those changes. There are the changes we are already experiencing, like demographic cliffs, accelerating climate change, and dwindling state support for public research universities. There are changes we can imagine are coming, like AI-based tutors that teach more effectively than a disengaged instructor, or hybrid/virtual face-to-face degree programs that are shorter and lower cost to students. Then there are black swan events that are beyond the imagination; the obvious example being the global pandemic we are slow-burning through. The uncertainties inherent in our situation mean that success or failure will be driven more by principles and culture than by strategy and planning.

- Public research institutions improve the lives of people far beyond what most people recognize. The land grant mission is the "three-legged stool" to which this talk's title refers; the three legs being extension, research, and education. The ISU department of Agricultural and Biosystems Engineering serves all three parts of the land-grant mission, and ISU's motto of *Science with Practice* informs our departmental efforts, because working with stakeholders (e.g., downstream communities, ag industries, farmers) forces us to address the practical implications of the science and engineering that we do. *Science with Practice* is a reminder that while theory may be beautiful and insightful, it alone cannot make changes in the world.

- The impacts we have on people's lives through our extension, research, and teaching transcend dollars. Furthermore, only valuing what's measurable is a lousy way to run an enterprise. We have to quantify the economic impacts of our institutions because they're generally far higher than perceived, and we deserve to be funded (and to have accessible tuition for students). In our day-to-day extension, research, and teaching efforts, we cannot just be bean counters! We need to do good science, publish in high-quality journals, and have accredited degree programs. And the non-measurable qualities—the care we give all students, the decency with which we treat each other, and the integrity with which we conduct our research—are the strongest bulwarks against losing support for these institutions. Numbers matter, but they're not the only thing. A culture of integrity, excellence, and kindness is as important as a strategy to be more competitive (or should be a core part of such a strategy).

Resilient Institutions and Social Norms: Some Notes on Ongoing Theoretical and Empirical Research

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- Community resilience describes the capacity to withstand and bounce back from an adverse event or perturbation. Inevitably, our societies are subject to a variety of significant threats, and it is prudent to assume that we will simply be unable to prevent all disruptions. Thus, cultivating and supporting resilience has become a high priority for responsible leaders. Government, industry, and charitable organizations have increasingly focused programming and funding aimed at community resilience. However, as we learn more about the kinds of disruptions and threats faced by the United States, it becomes clear that the concept of resilience itself needs to be carefully rethought.

- Much of the resilience of our societies is due to cultural and normative factors that have generally escaped attention in research on resilience. Most obvious perhaps is the role of social institutions in community resilience. The use of social media in malicious interventions by adversaries of the United States has forced attention to the vulnerability of social institutions and social norms. This new attention has widened our understanding of the factors affecting the resilience of communities. Given the prominence of hacks, security science has focused attention on the vulnerability of individuals. However, our work aims to encourage a new focus on the distinctively social aspects of the social attack surface, rather than on interventions targeting individual beliefs or attitudes.

- Traditional approaches to the ontology of critical social institutions miss the role of social norms in the constitution and maintenance of institutions. The resilience of institutions, we argue, is dependent on associated social norms. Once we see the role of social norms in institutions, we can recognize that those norms pose a potential vulnerability that can become an attack surface for adversaries. Social infrastructure is as important to national security as physical infrastructure, and national defense requires that we understand the norms, expectations, and choice architectures (especially at the cyber-social interface) that constitute social institutions. Defense of our nation no longer depends just upon *national* security, but also *human* security—which includes the weakening of social norms and, subsequently, institutions by our adversaries. On a theoretical level, this work contributes to our understanding of the relationship between social norms and institutions.

Surfing Tsunamis and Deserts: Educational Access in an Era of Extreme Conditions

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When it comes to research universities, you could say I'm a superfan. For me, fall 2022 marks 50 years of work in research universities. After starting as an undergraduate and graduate student, I taught and conducted research before serving in a variety of administrative positions in Kansas and Michigan. Nine years ago, I joined UC Riverside (UCR) and moved to California.

The word "California" often conjures thoughts of beaches and surf, locations popularized by The Beach Boys, *Baywatch*, and *Beverly Hills 90210*. Sometimes, the state name brings to mind Hollywood with its celebrities on red carpets. Silicon Valley and young tech billionaires signify yet another popular image of California.

But I don't live in those versions of California. I live in Riverside, a community 55 miles east of Los Angeles, 48 miles northeast of Newport Beach, and 400 miles southeast of Silicon Valley. Those distances don't begin to explain the difference between the symbols of California that often come to mind and the other California, where incomes, philanthropy dollars, infrastructure investment, and physicians are in short supply even as the population keeps growing and growing and growing.

For years, the region known as the Inland Empire has been one of the fastest growing areas of the country and currently holds the nation's fifth fastest growing metro designation.[1] More than 50% of the region's population identifies as Hispanic or Latino.[2],[3] Inland Empire politics are red *and* blue. The geography is snow-capped mountains *and* desert with a mélange of urban, suburban, and rural communities. It's a place where extremes intersect. And in that way, the region serves as a microcosm for our country by representing the problems we face, the promise of public research universities, and needed support systems.

In a world where widening gaps in wealth, political extremity, and climate change threaten access to even the most basic needs, public research universities provide a source of opportunity and solutions. Therefore, as we ride waves of change, focus on access is our charge. Historically, Higher Education has been a great equalizer (albeit, not equally for all populations) while providing needed answers for many of the world's greatest challenges. Investments for infrastructure were critical in the past and remain important now. But we must also evolve with support services for today's students who are facing greater financial, mental health, and preparation challenges. Fortunately, by working together, we can continue moving forward through these extreme conditions.

Public Research Universities: A Success Story

In the history of discovery, American public research universities are a standout success. Before considering the ways in which we might improve access, we should consider the history of public research universities in the United States and the investments that paved a path of progress—the land-grant acts and the creation of the National Science Foundation.

The Morrill Act of 1862 was the first in a series of land grant acts to provide land or financial resources through the sale of land to expand higher education. The purpose of this act as written in United States code reads as follows:

> *[T]o teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education* ***of the industrial classes*** *in the several pursuits and professions in life.*[4]

Even as the original land-grant act sought to expand education access, it was fraught with problems. First, it called for the distribution of 30,000 acres for each congressional district, allowing for either the land or the proceeds of sale of that land, to fund universities. This structure ensured that more densely populated eastern states received a greater share of resources, effectively giving more resources to those that already had the most. However, the legislation could not garner enough support in Congress without that provision. Second, the majority of land to be distributed was taken from 245 Indigenous tribes through violent means. Third, the act, which was adopted during the American Civil War, specifically excluded those states "in a condition of rebellion or insurrection," creating geographic disadvantage for some states.[5]

Subsequent rounds of funding offered partial adjustment for inequities. The Morrill Act of 1890, for example, provided cash to the formerly Confederate states but required that they either establish a college for persons of color or show that race was not a factor in admissions. One hundred thirty-two years after the establishment of the original land grant, the Elementary and Secondary Education Reauthorization Act authorized tribal colleges as land-grant colleges.[6]

The land-grant act had a profound impact on engineering and technical education. In 1866, only 300 men in the United States had graduated with engineering degrees. But by 1870, that number had grown to 866. And by 1911, there were 38,000 engineers. The country was graduating 3,000 engineers a year. As means of comparison, Germany was only graduating 1,800 engineers a year at that time.

Stated another way, within 50 years of the passage of the first Morrill Act, the United States had become the world leader in engineering and technical education.[7] In addition to transforming education in the United States, land grants transformed technological discovery, industrial progress, and land development. After investment in "mechanic arts" proved fruitful, similar acts provided foundation in other disciplines. The Hatch Act of 1887 established agricultural research stations.[8] In 1966, the National Sea Grant College Program Act funded development of university-based programs for coastal research and education.[9],[10] Later, in 1988, the National Space Grant College and Fellowship Program supported 52 consortia conducting research related to outer space.[11] The Sun Grant Research Initiative Act of 2003 created six regional centers for the study of sustainable, environmentally friendly energy sources.[12]

Vannevar Bush and National Science Foundation Infrastructure

For the annual research policy retreat hosted by the Merrill Center in 2016, I highlighted the work of Dr. Vannevar Bush and the three core principles in his publication, *Science: The Endless Frontier*. Dr. Bush's recommended framework for a national research infrastructure led to federal investments in research embedded within universities and establishment of the National Science Foundation (NSF). Both the infrastructure and funding have been instrumental in training scientists and delivering discoveries with broad public impact. GPS, the internet, and Google are but a few examples of innovations born in research universities touching American lives each day.

One of Dr. Bush's principles that has not yet been fully realized, however, relates to access. Dr. Bush wrote:

"There are talented individuals in every segment of the population, but with few exceptions those without the means of buying higher education go without it. If ability, and not the circumstance of family fortune, determines who shall receive higher education in science, then we shall be assured of constantly improving quality at every level of scientific activity."
--Summary Report, Science: The Endless Frontier, p. 25

The land and subsequent sea, space, and sun grants in combination with a federal funding infrastructure transformed not only the United States but the world. And yet, we have room to grow.

Extreme Conditions: Widening Gaps and the Implications for Research Universities

Wealth Inequality Surpassing Gilded Age Levels

Following the Civil War, industrialization quickly drove increases in both wealth and inequality. During the Gilded Age, in the years from 1860 to 1900, 30% of the country's wealth was owned by the top 2% while the bottom 40% had no wealth at all.[13]

The turmoil during the Gilded Age[14] shares similarity with the unrest we are facing now:

- The country was equally divided between two parties.
- Prohibition, education, tariffs, ethnic and racial tension were leading issues.
- Powerful trusts dominated some industries.
- Political organizations like Tammany Hall exerted influence over politicians who awarded jobs and contracts to loyal supporters.

In the early 20th century, new tax laws decreased the gap between those who had the most and lower income earners. However, the capital gains tax laws provided a loophole. In 1997, the capital gains tax was decreased from 28% to 20%. In 2003, the tax was decreased from 20% to 15%.[15] In a period of six years, the capital gains tax had shifted from 28% to 15%, a decline of 46%. Along with these changes, the shift in inequality shot upward. (Figure 1)[16]

For that same period, according to Berkeley's Realtime Equality tool, U.S. incomes for the bottom 50% decreased by

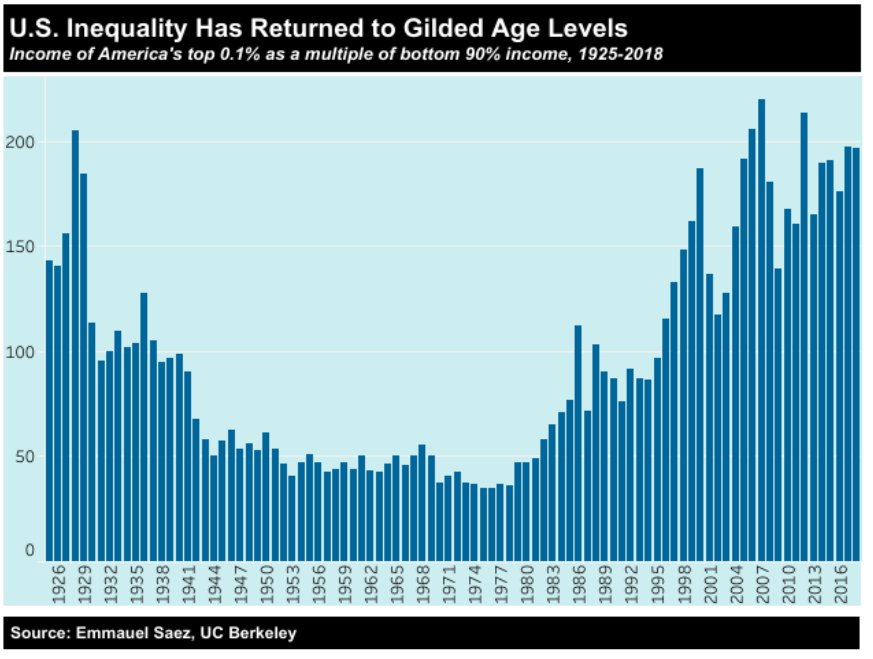

Figure 1.

3.3% when adjusted for inflation while the top 0.01% saw growth of 34.7%. (Figures 2 and 3)[17]

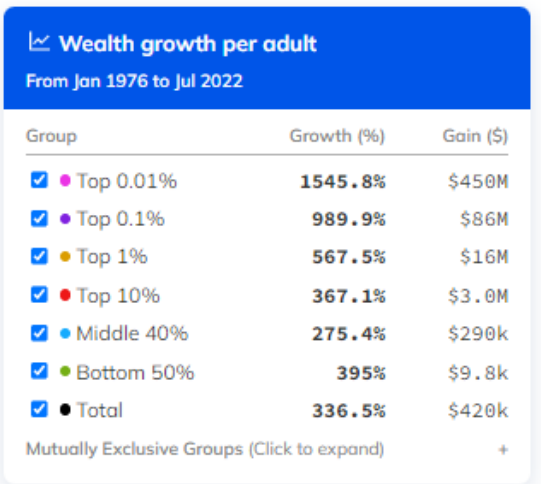

Figure 2.

During the Gilded Age, four families (Baker, Carnegie, Frick, and Rockefeller) held 0.85% of the country's wealth, but according to research from French economist Gabriel Zucman, the same equivalent, the top 0.00001%, held 1.35% of the wealth as of July 1, 2021.[18] Furthermore, the inequality gap, which was already known to be a problem, worsened during the pandemic. According to the Federal Reserve, there was $13.5 trillion in wealth added to American households during the pandemic but one third of that, $4.5 trillion, went to the top 1% of households, and 70% of that, $9.45 trillion, went to the top 20% of households.[19]

The problem of wealth inequality is not uniquely American. A study from economist Thomas Piketty's World Inequality Lab showed that the world's 2,750 billionaires now control 3% of all wealth, which has tripled since 1995. This relatively small group of individuals now holds as much wealth as half of the planet's population.[20]

Other Gaps—Persistence and Mental Health

Mark Kantrowitz calls attention to the disturbing statistic that more than two-thirds of all dropouts are low income in a *Forbes* article on college completion. He also highlights some of the expected factors affecting persistence, such as full-time employment and academic performance.[21]

Like the wealth gap, the pandemic exacerbated persistence problems. Data from the National Student Clearinghouse indicates that one million fewer students are enrolled in college now than before the pandemic began.[22] For the first time in 20 years, the number of Hispanic-Serving Institutions (HSIs) has declined as the Latino student population numbers dropped just over 4%, below 2019 enrollment.[23] When Gallup asked students why they were considering withdrawing from college, the top reasons were emotional health, cost, and difficulty of coursework.[24,25]

As noted above, emotional health is

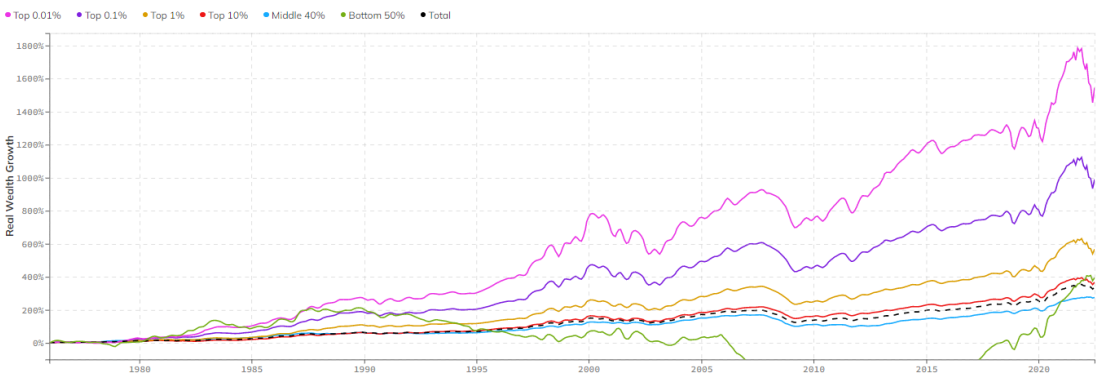

Figure 3.

increasingly cited as a reason that students are leaving college. Researchers at Boston University working with data from the Healthy Minds Study showed that between 2013 and 2021, students reported a 135% increase in depression and 110% in anxiety. The number of students reporting mental health problems doubled over those eight years.[26]

"Lost Einsteins"

In the *Quarterly Journal of Economics* article, "Who Becomes an Inventor in America? The Importance of Exposure to Innovation," authors Alex Bell, Raj Chetty, Xavier Jaravel, Neviana Petkova, and John Van Reenen linked patent records with de-identified IRS data and school district records for more than one million inventors and found that children born into the richest 1% were 10 times more likely to become inventors than those born into the bottom 50%. The result is what they term "lost Einsteins," children whose ability goes unrealized because of social circumstance. The authors posit that economies can improve their results in innovation, and thereby increase economic output, if they offer pathways to success for underrepresented populations, which includes those impacted by income level, gender, and race. The same study found that White children were three times as likely to be inventors as Black children. In the United States, innovation could quadruple if women, underrepresented minorities, and low-income people became inventors at the same rates as men from high-income families.[27]

Addressing the Challenges

To compensate for widening gaps in wealth inequality, persistence, and mental health while continuing to address inequities among underrepresented populations, UCR utilizes a full suite of wraparound services. Some, like UCR's Chicano Student Programs and African Student Programs, have offered support systems for 50 years.

But focus on graduation gaps led to new services by mapping programs to current student needs. The results have been significant. As one example, in 2020, UCR's Pell grant recipients graduated at a 77% rate, one point higher than our overall six-year graduation cohort.[28]

Today, in addition to traditional advising, writing, and career services, UCR offers food distribution to address food insecurity, a range of mental health services, immigration law support, stop-out pathways, and transfer pathways. Our current fundraising initiative spotlights student needs, including experiential learning opportunities through study abroad and internship programs. The campus health services center is getting an upgrade through new construction, new technology, new offerings, and expanded capacity.

Scaling Enrollment While Riding Waves of Change

As we look to expand access while riding waves of change, collaboration has become increasingly important. Partnerships at both the local and national levels expand our knowledge through shared learning and improve our advocacy through strength in numbers. Two examples of organizations to which UCR belongs are the University Innovation Alliance (UIA) and Alliance of Hispanic Serving Research Universities (HSRU).

The UIA began as a coalition of 11 institutions with a goal of graduating 68,000 more low-income and first-generation students above an established baseline among member schools. Currently, the group has increased annual graduates by 30% and increased low-income graduates by 36% (2012-13 compared to 2020-21) with a total increase of more than 118,000 graduates (est.) for 2021-22. The UIA has also expanded membership and now includes 14 member institutions.

The HSRU was established after a consortium of R1 HSIs joined forces on a project to prepare Latino scholars for faculty positions in humanities studies. Recognizing

the need to do more to prepare Latino students for careers in academia, HSRU launched as a 20-member organization in June 2022 with two goals: double the number of Latino doctoral students at HSRU schools and increase by 20% the Latino professoriate in HSRU universities.

Partnerships like these offer three primary benefits to member institutions. First, they establish relationships and connect leaders across the country, deepening networks for additional collaboration. Second, through their aspirations, organization goals often lead to progress in unplanned ways. And third, the achievement of outcomes provides a playbook for others to follow.

In extreme conditions, increasing access can seem impossible. However, we do not have to go it alone.

Conclusion

In 1831, the man who would become President James Garfield was born in a log cabin. Born into poverty and fatherless at the age of 2, he became a janitor to pay his way at Western Reserve Eclectic Institute (later named Hiram College). He transferred to Williams College where he was both Phi Beta Kappa and salutatorian. After returning to Western Reserve Eclectic Institute to teach classics, he was appointed as the school's principal.

Though President Garfield was able to work his way through college, he also serves as an example of the talent we may lose without expanding access. His story gives weight to advocacy for education and low-income students. Investments in education remain important in driving economic progress, innovation, and improved equality. Yet, President Garfield emphasized that the stakes are higher than higher education. He said:

> *"Next in importance to freedom and justice is popular education, without which neither freedom nor justice can be permanently maintained."*

Some of our nation's fundamental values, the ones for which we have fought through civil action and legislation domestically or wars abroad, rely on our continued investment in education. Working together to expand access, therefore, serves as both pragmatic and moral imperative.

References

1. Lansner, J. (2022, March 28). Inland Empire population growth 5th largest in the US. Press Enterprise; Digital First Media. https://www.pe.com/2022/03/28/inland-empire-population-growth-5th-largest-in-the-us/
2. *U.S. Census Bureau QuickFacts: Riverside County, California*. (n.d.). Www.census.gov. Retrieved September 9, 2022, from https://www.census.gov/quickfacts/fact/table/riversidecountycalifornia
3. *QuickFacts: San Bernardino County, California*. (2021). Census Bureau QuickFacts; United States Census Bureau. https://www.census.gov/quickfacts/fact/table/sanbernardinocountycalifornia/AFN120217
4. Wikipedia Contributors. (2019, October 20). *Morrill Land-Grant Acts*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Morrill_Land-Grant_Acts
5. Wikipedia Contributors. (2019, October 20). *Morrill Land-Grant Acts*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Morrill_Land-Grant_Acts
6. Wikipedia Contributors. (2020, September 9). *Tribal colleges and universities*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Tribal_colleges_and_universities
7. Williams, D. E. (2009). *Morrill Act's Contribution to Engineering's Foundation*. The Tau Beta Pi Association. https://www.tbp.org/pubs/Features/Sp09Williams.pdf

8. *The Hatch Act of 1887*. (n.d.). National Institute of Food and Agriculture. Retrieved September 9, 2022, from https://www.nifa.usda.gov/grants/programs/capacity-grants/hatch-act-1887
9. *Sea Grant > About*. (n.d.). Seagrant.noaa.gov. Retrieved September 9, 2022, from https://seagrant.noaa.gov/About
10. Wikipedia Contributors (Ed.). (2022, September 4). National Sea Grant College Program. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/National_Sea_Grant_College_Program
11. Wikipedia Contributors. (2022b, September 7). *National Space Grant College and Fellowship Program*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/National_Space_Grant_College_and_Fellowship_Program
12. Wikipedia Contributors. (2021, October 2). *Sun Grant Association*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Sun_Grant_Association
13. Wikipedia Contributors. (2022c, September 8). *Gilded Age*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Gilded_Age#cite_note-Census1890-1
14. Wikipedia Contributors. (2019b, November 28). *Gilded Age*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Gilded_Age
15. Wikipedia Contributors. (2022d, September 12). *Capital gains tax*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Capital_gains_tax#United_States
16. Balkir, A., & Feng, J. (n.d.). *Realtime Inequality*. Realtimeinequality.org; Department of Economics, UC Berkeley. Retrieved July 8, 2022, from https://realtimeinequality.org/ Research conducted by Thomas Blanchet, Emmanuel Saez, and Gabriel Zucman.
17. Balkir, A., & Feng, J. (n.d.). *Realtime Inequality*. Realtimeinequality.org; Department of Economics, UC Berkeley. Retrieved July 8, 2022, from https://realtimeinequality.org/ Research conducted by Thomas Blanchet, Emmanuel Saez, and Gabriel Zucman.
18. Wolff-Mann, E. (2021, July 7). *Super rich's wealth concentration surpasses Gilded Age levels*. News.yahoo.com; Yahoo Inc. https://news.yahoo.com/super-richs-wealth-concentration-surpasses-gilded-age-levels-210802327.html
19. Wolff-Mann, E. (2021, July 7). *Super rich's wealth concentration surpasses Gilded Age levels*. News.yahoo.com; Yahoo Inc. https://news.yahoo.com/super-richs-wealth-concentration-surpasses-gilded-age-levels-210802327.html
20. Picchi, A. (2021, December 7). *The new Gilded Age: 2,750 people have more wealth than half the planet*. Www.cbsnews.com; CBS Interactive Inc. https://www.cbsnews.com/news/wealth-inequality-billionaires-piketty-report/
21. Kantrowitz, M. (2021, November 18). *Shocking Statistics About College Graduation Rates*. Forbes; Forbes Media LLC. https://www.forbes.com/sites/markkantrowitz/2021/11/18/shocking-statistics-about-college-graduation-rates/?sh=53304c2b2b69
22. Nadworny, E. (2022, January 13). *More than 1 million fewer students are in college. Here's how that impacts the economy*. Www.wbur.org; WBUR. https://www.wbur.org/npr/1072529477/more-than-1-million-fewer-students-are-in-college-the-lowest-enrollment-numbers-
23. Herder, L. (2022, March 17). *Number of HSIs Decrease for the First Time in 20 Years*. Diverse: Issues in Higher Education. https://www.diverseeducation.com/demographics/latinx/article/15289872/number-of-hsis-decrease-for-the-first-time-in-20-years

24. Gallup Inc. (n.d.). The State of Higher Education 2022 Report. Gallup.com; Gallup, Inc. Retrieved September 13, 2022, from https://www.gallup.com/analytics/391829/state-of-higher-education-2022.aspx
25. Marken, S. (2022, April 27). A Third of U.S. College Students Consider Withdrawing. Gallup.com; Gallup, Inc. https://news.gallup.com/opinion/gallup/391823/third-college-students-consider-withdrawing.aspx
26. Colarossi, J. (2022, April 21). *Mental Health of College Students Is Getting Worse*. Boston University; Trustees of Boston University. https://www.bu.edu/articles/2022/mental-health-of-college-students-is-getting-worse/#:~:text=They%20found%20that%20the%20mental
27. Bell, A., Chetty, R., Jaravel, X., Petkova, N., & Van Reenen, J. (2018). Who Becomes an Inventor in America? The Importance of Exposure to Innovation*. *The Quarterly Journal of Economics*, *134*(2), 647–713. https://doi.org/10.1093/qje/qjy028
28. Warren, J. D. (2021, March 10). *UC Riverside reaches 77.3% for six-year graduation rate*. News. https://news.ucr.edu/articles/2021/03/10/uc-riverside-reaches-773-six-year-graduation-rate

Assessing Quality in Higher Education in a Changing Environment

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Institutions of higher education have always been engaged in assessing quality of their faculty, staff, and students and the effectiveness of their research, teaching, and service missions. For example, annual reviews are conducted to evaluate contributions made by faculty, students are graded on their performance in the classroom, peer reviews are used to assess the relative merits of research and scholarship, and external ranking agencies like the Carnegie Foundation and *U.S. News & World Report* use institutional or program data to rate and sometimes rank institutions. In addition, the federal government and federal and state licensing agencies often require that accrediting agencies assess the viability and effectiveness of institutions and individual programs within the institutions. For example, financial aid from the federal government cannot be distributed unless the institution is accredited by a regional accreditor such as the Higher Learning Commission (HLC). Physicians must be graduates of a medical education program that is accredited by the Liaison Committee on Medical Education to be eventually licensed. Engineering programs are accredited by the Accreditation Board for Engineering and Technology (ABET). In the end, accrediting agencies are doing what institutions have been doing for many years—assessing quality.

Over the last 10-20 years there has been an increasing call for accountability in higher education, which I detailed in a previous Merrill Conference presentation (Steinmetz, 2021). As the cost of attending college has increased, students and their parents have demanded more from universities, and some have even begun questioning the overall value of a college education given these skyrocketing costs. State legislators, who have generally reduced funding to public universities in their states, are also demanding that universities produce graduates that can immediately find jobs and have an impact on their states' economies and do so more efficiently with fewer resources. This scrutiny has put additional pressure on accreditors to accurately assess the quality and viability of institutions and programs.

In this paper, I will introduce one program-level accreditor, the Psychological Clinical Science Accreditation System (PCSAS), and use it as an example of how assessment of quality is done and what may lie in the future as we continue to experience a volatile time in higher education.

What Is PCSAS?

To practice as a clinical psychologist in the United States, all states require that a person graduate from an accredited clinical psychology program before they can sit for an examination that may lead to a license to practice clinical psychology in that state. PCSAS is one of two recognized accrediting agencies for doctoral programs. The American Psychological Association is the other organization. PCSAS is an independent, non-profit organization that provides rigorous, objective, and empirically based accreditation of PhD programs that adhere to a *clinical science* training model (see PCSAS Website). Programs that earn PCSAS accreditation are ones that support and expand the scientific foundation for mental and behavioral health care to increase the quality and quantity of clinical scientists contributing to all aspects of public health. Above all, PCSAS does what all

programmatic accreditation organizations do: performs reviews of programs to assess overall excellence so that graduates of these programs can pursue careers in a specific area.

A Brief History of PCSAS

In 1992, a summit on the future of accreditation of clinical psychology programs was held. About 140 leading clinical scientists, directors of clinical training, and department chairs attended the summit that was sponsored by the Association of Psychological Science, National Institute of Mental Health, and Council of Graduate Departments of Psychology. The main reason that the meeting was convened was a growing dissatisfaction with the [then-sole] accreditation system that was established just after World War II. The accreditation system developed in the 1940s was seen by many as too rigid and too rooted in a bygone era of clinical psychology. Several key questions were raised during the summit: Is some form of accreditation necessary for doctoral programs that intend to train students for the practice of psychology as well as research? Is the current process of accreditation, in particular, compatible with the goals of the PhD as a research degree? Is it compatible with the goals of the science-practitioner model of training? And finally, are alternative accreditation systems possible? By the end of the summit a consensus emerged that there was a "need for urgent reform of the [then-sole] accreditation system in psychology." (See Accreditation Summiteers in Agreement on Change – Association for Psychological Science – APS.)

Another idea that grew out of the summit was the creation of the Academy of Psychological Clinical Science (APCS) in 1995. APCS currently has 65 member programs, all which are doctoral training programs in clinical and health psychology or psychology internship programs. Academy members are committed to the education and training of *psychological clinical scientists*. Because of this shared commitment to the advancement of psychological clinical science, APCS eventually reached a consensus that a new accreditation system was needed to promote science-centered doctoral education that stressed the integration of excellent research and delivery of comprehensive mental and behavioral health services to the public.

The formation of PCSAS came out of a special meeting on accreditation held in January 2006 that was organized by the executive committee of the APCS. The formal idea was eventually overwhelmingly ratified by the whole membership of the APCS in October 2007. The Psychological Clinical Science Accreditation System, Inc. (PCSAS) was officially incorporated in Delaware on December 27, 2007. A PCSAS Board of Directors was quickly formed and met February and May 2008, at which time officers were selected and an executive director selected.

Once established, PCSAS sought national recognition as an accreditor of clinical psychology programs and began the process of pursuing official recognition by the Council for Higher Education Accreditation (CHEA). In May 2011, the CHEA Board of Directors deemed PCSAS eligible to apply for recognition, an application was submitted, and at its September 2012 meeting the CHEA Board granted full CHEA recognition to PCSAS for a period of 10 years. In May 2022, the CHEA board extended PCSAS's accreditation for another seven years, after a thorough reaffirmation review.

Several important agencies recognize PCSAS accreditation for licensing and employment purposes. The U.S. Department of Veteran's Affairs (VA) was one of the first agencies to recognize PCSAS accreditation, a very important endorsement since the VA was the original impetus for creating an accreditation system after World War II. Other agencies that recognize PCSAS accreditation include

the Commissioned Corps of the U.S. Public Health Service; the Health Resources and Services Administration (HRSA), within the U.S. Dept. of Health and Human Services; the National Institutes of Health; and the Association of Psychology Postdoctoral and Internship Centers (APPIC), which oversees the national internship match process. PCSAS is also recognized in the licensing laws and regulations of states representing nearly 35 percent of the U.S. population (and this list is steadily growing).

PCSAS has had three executive directors. Dr. Richard McFall from Indiana University served as the inaugural director and was largely responsible for taking PCSAS through the initial accreditation process and for many years serving tirelessly as an advocate for the psychological clinical science education and training model. His influence on the organization and on clinical science, in general, has been significant. Dr. Alan Kraut served for six years as the executive director. Before his PCSAS service, Alan was the executive director of the Association for Psychological Science, during which time he advocated and supported the development of PCSAS. During his term as executive director, the number of PCSAS accredited programs grew significantly, and he led the effort that resulted in the reaffirmation of PCSAS recognition by CHEA. I became the third executive director of PCSAS in November 2021. I have had a variety of experiences that I hope can benefit PCSAS: I served as a chair of the Indiana University psychology department (where the clinical science model was adopted very early); I have had other university administrative positions at public universities, including dean, provost and chancellor; I served a four-year term as a trustee of the HLC (a regional, institutional accreditor), so I am familiar with accreditation processes; and I served as a member of the original PCSAS Board of Directors.

What Distinguishes PCSAS Accreditation?

PCSAS accredits doctoral training programs in clinical psychology that grant PhD degrees in psychology with a core focus on the specialty of *psychological clinical science*. To receive PCSAS accreditation programs must subscribe to an empirical epistemology and a scientific model: An educational and clinical training model in which the discovery and advancement of knowledge and its application to real world problems are driven strongly by research evidence. In the psychological clinical science model, research and application are integrated and reciprocally informing.

PCSAS programs must produce graduates who are competent and successful at conducting research relevant to the assessment, prevention, treatment, and understanding of health and mental health disorders. And PCSAS programs must use scientific methods and evidence to design, develop, select, evaluate, implement, deliver, supervise, and disseminate empirically based clinical assessments, interventions, and prevention strategies. The integration of research and practice is emphasized and must be demonstrated.

Importantly, programs are evaluated with an emphasis on outcomes instead of inputs. Flexibility in curriculum is allowed to achieve the desired clinical science outcomes that are required. While many content areas within clinical psychology must be covered to ensure that PCSAS graduates have the necessary education and skills to function as clinical psychologists, PCSAS does not require a list of specific courses that must be taken but rather requires each program demonstrate how its curriculum successfully prepares students for the many career paths a clinical science student may eventually take, including practice. And solid research training is an important part of the PCSAS accreditation requirement

Table 1: Current PCSAS Accredited Programs

Arizona State U	Oklahoma State U	U of Illinois	U of South Florida
Binghamton U	Penn State U	U of Iowa	U of Southern California
Boston U	Purdue U	U of Kentucky	U of Texas
Duke U	Rutgers U	U of Maryland	U of Virginia
Emory U	Stony Brook U	U of Michigan	U of Washington
Harvard U	Temple U	U of Minnesota	U of Wisconsin
Indiana U	U of Arizona	U of Missouri	Vanderbilt U
McGill U	U of Buffalo Suny	U of New Mexico	Virginia Tech U
Michigan State U	UC Berkeley	UNC Chapel Hill	Washington U
Northwestern U	UCLA	U of Oregon	Yale U
Ohio State U IDD	U of Delaware	U of Pennsylvania	
Ohio State U Psych	U of Georgia	U of Pittsburgh	

not only for graduates who may choose research-oriented academic careers but also for graduates that eventually choose practitioner-oriented careers so that application continues to be informed by science.

What Programs Are Accredited by PCSAS?

Since its creation, PCSAS has accredited 46 programs in the United States and Canada, and that number is steadily growing with several other programs in various stages of the application process. Currently, all PCSAS accredited programs are also accredited by the APA. However, three programs (University of California Berkeley, Washington University, and Stony Brook University) have begun admitting students as a PCSAS-only program and plan to drop their APA accreditation in the future. Also, the Ohio State University Intellectual Developmental Disabilities program is solely accredited by PCSAS. To date, 20 other programs have indicated publicly the possibility of becoming PCSAS-only accredited programs in the future.

By many metrics PCSAS programs are highly regarded and considered the best clinical psychology programs in the country. All 20 programs that are ranked as the top 20 by *U.S. News & World Report* are PCSAS accredited, and 42 PCSAS programs in the U.S. are listed among the top 50. All 46 PCSAS programs are ranked highly by the National Academies of Sciences, higher than non-PCSAS programs on several dimensions such as their graduates' scores on state licensing exams, students' placements in internships, and publication records of their faculties. Table 1 provides a list of PCSAS accredited programs as of fall 2022.

Current Issues for Program Evaluation and Assessment

Like the rest of higher education, program accreditors like PCSAS, as well as institutional accreditors like HLC, face issues and challenges as the environment in higher education is changing. Some of these changes have been caused by the COVID pandemic and its effects on higher education. Others have been emerging over the last several years. I will discuss a few examples here.

Over the years assessments of quality of institutions and programs have been based largely on input-based data, such as ACT scores, GRE scores, financial support available for undergraduate and graduate students, and sometimes pedigree of faculty, to name a few. Quality is often assumed from the perceived strength of the inputs. However, there is a great need these days to move away from input-based assessment data to more output-based data, such as retention and graduation/completion rates, employment, number of publications and grants produced, community service, and general impact (such as economic impact and societal impact).

There is a major reason why assessment and evaluation has been dependent on inputs: Inputs are easier to document and evaluate. Outputs can be more difficult to assess and require clear definition to effectively measure quality and this can present a challenge. For PCSAS, the challenge is how to establish that a program is functioning as a clinical science program; that is, integrating research and practice. This can't be done by simply looking at the GRE scores of incoming students or at a check list of required courses (input data). Rather, PCSAS accredited schools are required to demonstrate that their students are performing as clinical scientists after they graduate (output data). One way this is accomplished during a PCSAS accreditation assessment is to look at what every program graduate is doing at the time of review. These are generally more difficult data to get but necessary to determine the success of the clinical science program under review.

One thing accreditors have been accused of (and sometimes guilty of) is using a cookie-cutter approach to evaluation and assessment. Having a rigid template for review that assumes all programs are the same or very similar has sometimes been used even though we know there are considerable variations across institutions and programs in many areas, such as mission, size, resources, programs offered, and geographical location. There needs to be more movement among accreditors to empower programs and to embrace flexibility. That is, programs should have a freer hand in designing ways to reach standards, goals, objectives, and desired outcomes. This presents a challenge for the evaluator as this flexibility makes it more difficult to make assessments and can reduce or eliminate comparisons across programs. I would argue, however, that the variations across institutions and programs will only increase in coming years as the higher education environment changes. We should be prepared for this.

A third challenge I can cite is how, over the years, the role that research plays in teaching and learning at both the undergraduate and graduate levels has often been ignored or minimized in assessments. At the undergraduate level, student involvement in experiential learning has emerged as an important part of a college education. Involvement in research is an example of experiential learning. Yet, assessments of undergraduate research experiences are at best a minor factor in many institutional and program reviews. Likewise, at the graduate level, evaluation of research should be a prominent feature of institutional and program reviews and should be featured more prominently. And often overlooked are the contributions made by graduate students in the teaching and research of undergraduates. Again, these assessments may be hard to do, but in my opinion necessary for assessing the quality of a program or institution.

Ongoing Concerns about Assessment and Evaluation

The general environment of higher education has changed dramatically over the last several years and that includes the role of assessment, evaluation, and accreditation. In general, there has been a movement toward greater accountability for our colleges and universities from the public, government, and the media. I covered this in depth in a previous publication in this retreat series (Steinmetz, 2021). This has led to increased efforts within our universities to evaluate the impact that faculty have in teaching research and service. Although many outside our universities have the belief that faculty aren't scrutinized and evaluated, this is simply not true. Peer evaluation, as well as administrative evaluation, has been used for decades to determine progress toward promotion and compensation changes. Recently, however, there has been a trend toward scrutinizing the

role of accreditors in higher education. A few examples largely affecting institutional review and accreditation are presented here.

There seems to be a growing desire by the state and federal governments to become involved in evaluation and assessment and in some ways taking away the flexibility of review that I wrote about above as desirable. The goal of some is to adopt standards that create "bright-lines": absolute standards that are achieved to be considered a passable institution or program. Test scores and specific retention or graduation rates are examples of bright-lines. Institutions or programs are considered successes or failures if they either exceed or fall short, respectively, of the defined metric. Institutions are then rated by how they are positioned around the desired metric or score. An example would be eliminating federal financial aid if a university doesn't meet a predefined graduate rate. The problem with this approach can be that it assumes all institutions are generally very similar. They are not. Institutions differ by geography, finances, the students they serve, and whether they support research and discovery.

Given this variation, how does one choose the score or metric that must be obtained? Some states have recently expressed a desire to either take over the evaluation process or have more say on how accreditors are selected. In these states there seems to be a distrust in accreditors and their ability to evaluate and assess programs and institutions. An example of this can be seen in Florida's governor Ron DeSantis's recent signing of a bill that mandates colleges and universities change accreditors every 10 years, and in the process stating that accreditors have "inordinate amount of power." Comparisons were made with the business world, where auditors are changed regularly. The problem with this is that institutions have histories with their accreditors—each review is based on continued progress since the last review. (See Education Department Warns Florida About Accreditation Bill, insidehighered.com.) This could also encourage institutions to "shop around" to find accreditors that are more "friendly."

Accreditors evaluate many aspects of institutions and programs, including financial condition; academic freedom of the faculty; diversity, equity and inclusion; tenure; and curricular requirements. Accreditors at both the institutional and program levels require that these issues be addressed. There seems to be movement in some states to ignore accreditation or move it to the state level; that is, treat universities more like primary and secondary educational institutions, which are under more local control. This would create, of course, a patchwork of accredited universities that reflect the individual state views (and perhaps politics) on higher education–not ideal for creating more universal referents. Accreditors must go through a rigorous approval process by either the Department of Education or CHEA before they can conduct assessments of programs or institutions. It is difficult to see how states could oversee this process and maintain the high standards that now exist.

Similarly, there has recently been increased involvement and management by university governing boards on matters that have been in the domain of campuses and their faculty for many years. This includes responses to accreditors when they disagree with findings or actions. Probably worse yet is the impact a dysfunctional oversight board can have on institutions and their evaluations. Boards are supposed to set general direction for the institutions they oversee and are often ultimately fiscally responsible for the institution. When a board is not functioning well, the evaluation of the institution will be affected.

Other issues and concerns that can af-

fect assessments of universities and their programs include fiscal issues that have recently become more acute, an increase in regulations in general at the federal and state levels that put additional burdens on universities, and the general devaluation of higher education we have witnessed over the last decade or so.

Special Issues Related to the COVID Pandemic

Higher education was impacted by the COVID-19 pandemic in many ways, and it is likely that this impact will be seen for many years to come. COVID-19 affected finances, the way classes are taught, and learning is (or is not) achieved, and research at our universities, just to name a few. The world of assessment and accreditation was also affected by the pandemic, and like other areas of higher education these effects seem to be long-lasting. Here are a few examples.

As I mentioned above, peer review is a cornerstone of evaluation in higher education. Indeed, peer review is critical for accreditation review and evaluation. I have heard from several individuals in institutions and other accrediting agencies that during the pandemic there was a decline in the number of faculty willing to serve as peer reviewers, and this has continued as the pandemic has subsided. This may be due to several factors. For example, during the pandemic faculty members were very busy transitioning to remote teaching and trying to figure out how to complete their research. Review service may have been a relatively low priority given how much our faculty had to do to deal with the pandemic, as well as the fact that serving on review teams is not usually rewarded well when faculty are evaluated for promotions or salary increases. I also note here that I believe faculty have been asked to do more locally to support their teaching and research and contribute to their institutions. This has impacted the time available for national service.

During the pandemic, in-person reviews were eliminated as travel was unsafe and face-to-face meetings nonexistent. Faculty largely worked from home for two years and, like many in the business world, discovered they could be as productive at home as they could be on campus. As the pandemic has subsided, many faculty want to continue to work at home. Similarly, we have heard from several of our PCSAS reviewers that they would like to continue remote reviews instead of traveling to the universities that are being assessed. They cite several reasons, including lower costs to the organization, more efficient time usage since travel is eliminated, and an equity factor we generally haven't considered to date: faculty with children must arrange childcare when they travel; this is less of an issue when reviews are done remotely. Institution permanent remote reviews could increase the pool of available reviewers.

Other reviewers believe that in-person reviews are necessary. First, they often cite a "retreat from community" that is caused by remote meetings and gatherings, especially as it relates to the dynamics of a working review team. Second, some reviewers believe that in-person meetings with faculty, students, administrators, and staff from the university being evaluated are an advantage because they typically result in a better back-and-forth during discussions. Also, accreditation reviews involve assessments of facilities and the university environment. This can't be done during a wholly virtual review. My prediction is that when the pandemic is behind us, we will end up with a hybrid review process where one or more of the review team visits the university while the other reviewers make assessments remotely.

Another issue created by the pandemic is difficulty assessing the quality of remote experiences (such as teaching and delivery of clinical services) that

were created to deal with the pandemic. These experiences will likely remain after the pandemic. How do we know that these remote experiences lead to the same teaching/learning outcomes seen with traditional approaches? There will also be long-lasting financial issues after the pandemic. How will these issues affect institutional and program quality? Lastly, the pandemic has accelerated the considerable devaluation of higher education over the last decade. Will this continue and how will this affect the operations of our institutions and programs?

Summary

I have attempted here to provide insights into how the changing environment of higher education is affecting how we assess and evaluate higher education, especially as it relates to accreditation. Like other areas of higher education, accreditors will have to deal with the dynamic environment changes that have occurred in higher education and that will likely continue well in the future.

References

1. Steinmetz, J. E. (2021). The pandemic seems to be waning: What's next for our universities? *Merrill Series on The Research Mission of Public Universities,* 1-12.

Kindling, Spark, Oxygen: The Wave of Change for Students at Public Research Universities

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A suggestion I received from our retreat organizers was to consider providing, as a university president, a "view from the top." As a prologue to the view I see, I want to share a story of an undergraduate student whose path crossed mine several times during his years at Iowa State. This past spring, Jackson Orr earned his B.S. at Iowa State in biological systems engineering. In the fall of 2018, his freshman year, I first met Jack as I greeted new students moving into our residence halls.

We continued to cross paths randomly over the next few years. Before he graduated this past spring, Jack contacted me because he wanted to share how meaningful his undergraduate research experience had been for him. It truly changed his path to the future.

Jack conducted research for faculty in our agricultural and biosystems engineering department and in our chemistry department. As an engineering major, he conducted an honors chemistry project. After taking the "organic chemistry for engineers" course, he immediately enrolled, as a sophomore, in an organic chemistry course designed for chemistry majors, emphasizing a more in-depth treatment of the subject. His insightful questions caught the attention of the faculty instructor who invited him to join a lab group, where he contributed to a peptide chemistry project looking at folded biomolecules. He also conducted biological systems engineering research with faculty in his home department.

Jack told me his undergraduate research experience made him appreciate the application of fundamental knowledge. Without his involvement in research, he did not think he would have truly appreciated the full value of his coursework. For Jack, bringing research into the equation of lecture and class lab work brought everything into focus — it tied it all together into a cohesive picture. For him, research exposed how the principles of science and engineering could be used to constantly transform the way we view the world. He told me that, with each new experiment and each new published paper, the world as we know it takes on a different light.

Jack came to the realization that the researcher's job is to share with a larger community the value of these ideas, these new steps of progress, and their potential to contribute to the betterment of humanity.

He also came to realize that, in research, there were no answers at the back of the book, and that a research problem may not have just one "correct" answer. The process almost always is accompanied by failures along the way, but Jack found motivation in his underlying passion for the science — and that potential for making a contribution to society.

I marveled at Jack's sense of understatement: He told me that "there was something to be said about contributing to novel problems." This fall, Jack Orr will begin a graduate program in chemistry at the University of Minnesota. I am certain we will be hearing more about him and his work in the coming years.

Today's Students, University Landscape

I wanted to put Jack Orr's experience in the foreground, against the backdrop of the challenges that beset our broader

student population.

Students are struggling to regain a sense of continuity and connection as we continue to emerge from the high-anxiety years of COVID-19. While we are hopeful that we may be past the worst of the COVID-19 years, uncertainty lingers. "Student disengagement" is a phrase we hear more often. During the pandemic, faculty have shared, anecdotally, that fewer students are showing up to class and turning work in on time. The wave of pandemic-induced change resulted in many students feeling overwhelmed and facing financial and technological difficulties.

The number of college dropouts increased in 2020, the highest levels seen in the past decade. Twenty-six percent of students who started college in 2019 did not return the next year during the pandemic. A significant number cited mental health concerns for the reason why; also, mental health was a contributing factor for a third of the students who didn't finish degrees.

The most frequently mentioned reason for leaving college was change in motivation or focus, or a life change. These students struggled to see how their college education connected to a meaningful career or a successful life in the future.

My view — my lens — is one of a president of a land-grant university, a university of science and technology. For 165 years, our mission has been one of access, opportunity, research, extension and outreach, and practical, purposeful education. Our hallmark — our number-one job — is helping students make that leap into their futures; to equip them so that when the waves of change come rolling in, they are able to surf.

We do so in countless ways. Faculty in every discipline mentor students toward the opportunities and resources that might best serve them and move them forward from wherever they are. They believe deeply in helping all students excel — a land-grant university idea and ideal.

But we have a special opportunity to invite and welcome undergraduate students into the world of research.

Kindling, Spark, Oxygen

The title of my presentation comes from something one of our faculty said in front of more than 200 donors to our university. He was part of a faculty research panel explaining how our research teams were using innovation and partnerships to advance benefits to society. He made the point that students were an important part of the research team. He said that to make a fire, you need a fuel source — kindling —, a spark, and oxygen. He said students bring the kindling and the spark, and it's our faculty who provide the oxygen — the environment — to set a blaze of innovation going.

For his audience, this faculty member was speaking in context of the resources made possible by donor-funded, endowed faculty positions. A faculty with an endowed position sees the spark in a student and know it's ready to take off, and it's those flexible philanthropic dollars that help supply the oxygen. It's an investment in the future, helping to align talented students who have the energy and excitement to make their impact on the world — who are ready to start a fire.

Science has been described as humankind's most cooperative endeavor. The barriers that separate us in other parts of our world can be lowered in a lab. Research on the benefits of undergraduate research demonstrates, most compellingly, its efficacy for students of diverse identities and demographics. Students of color, indigenous students, low-income students and first-generation students experience the greatest gains from participating in research, including persistency to graduation, the pursuit of advanced degrees, and self-efficacy. Not

surprisingly, these students particularly respond to supportive relationships with mentors and peers.

Over a decade ago, the prediction was that a wave of change would expand the opportunity for undergraduate research beyond the "boutique experience" of a small percentage of science majors. More efforts are incorporating undergraduate research into the curriculum — course-based undergraduate research experiences, or CUREs.

The Freshman Research Initiative concept, developed at the University of Texas at Austin, has been one way to engage students right away with scientific research. At Iowa State, we used funding from the Howard Hughes Medical Institute to establish a Freshman Research Initiative, to promote student interest and retention in science through 13 faculty-designed introductory courses. The implementation of first-year research experiences in association with learning communities was found to provide instructional support and build on ongoing retention efforts in the communities. In examining affective and behavioral gains of first-year students, it was found that after a single semester, students involved in research reported positive gains relating to research, and to thinking and working like scientists. Students expressed comfort working collaboratively and communicating science — outcomes that scored highly among personal gains. Experimental design and problem solving were some of the highest reported gains in the category of "Thinking and Working like a Scientist." Under "Attitudes and Behaviors of a Researcher," project ownership was a major gain.

When offered to list additional gains not included in other categories, the most common theme from students related to working with others. CURE had a positive impact on students' belonging as they worked collaboratively with others. It was noted that a one-semester experience probably was too short to achieve greater gains in a sense of belonging. That sense of belonging develops significantly over time as the number of collaborations increase and external validation by the broader scientific community becomes a possibility.

Drawing Students into Research

The value of undergraduate research as a high-impact practice should be made more available and within reach of more students. Clearly, the role of faculty mentors is the number-one factor. In interviews with 33 international scientists honored for their achievements in undergraduate research mentoring, a defining characteristic was their ability to balance structure and personal consideration for their students. Faculty mentors provided the environment — the oxygen — that allowed students to simultaneously experience both a sense of freedom and a sense of control within the research process. The "inculcation of enthusiasm" was the key element, and the earlier the better.

In May our graduating senior Jack Orr credited four faculty members for being influential mentors to him. He said they were nothing but supportive throughout his journey, always taking the time to make sure he felt valued as a person and as a student — while at the same time pushing him to be his best. What stood out for him, he said, was how inspired he felt when he interacted with each of these mentors. The excitement and passion they infuse into their work were contagious; Jack reported he could not help but feel uplifted and energized.

So I asked Jack's faculty mentors what it was they did or said when a student like Jack appeared at their doors — or any student who expressed an interest in research. Here's what they told me:

- Look for how a research program overlaps with interests they already have; find that spark.
- Listen to a student's plans on where

he or she honestly wants to go, and work on the transferrable skills that will help them get where they want to go.

- Help them not to get lost. Research is challenging because there's so much you can get lost in. It's easy to try to do too much, so focus on one step or one aspect of the problem. Talk regularly about each step, and what the next step will be. Find out what's going well and what's not, but always talk about next steps. What's the next incremental step in the series of small steps that keep adding up.
- Provide assurance, and reassurance, that what they are producing is meaningful. Students often struggle with "Am I good enough? Is this the right step?" Work to build up their confidence.
- Reach out to the students who are inquisitive. Sometimes it's planting the seed of an idea: Have you ever thought about working in a research lab?
- Try your best to get students to understand that if they put in the work, there will be a return on investment — you arm yourself with useful knowledge when you realize it's time well-spent. It helps to solidify the notion of "I can succeed."
- Our teaching programs give students the tools; innovation is taking those tools and putting them to use to build something. Tell students that, with these tools, they can create something new, solve a previously unsolvable problem — a problem that doesn't have an answer in the back of the textbook.
- In our research projects, we give them real responsibilities. It's a true way to create experiential learning for students and build their portfolio.

Each of us, myself included, could tell our own story of how research, science, and technology molded our young lives — how we began to feel like we belonged, that we were part of something incremental yet significant. How the long hours in the lab or out in the field instilled an unspoken but hard-wired definition of teamwork. How the faculty, staff, and graduate students and post-docs we worked with became a community we wanted to live on in some way, extending beyond our diplomas. As many of us also know, former students often stay in contact with a faculty mentor years later. They felt a personal connection. They formed personal relationships and friendships in the lab despite the fact that many students did not actually take classes together. There was a cross-pollination of ideas and skills, a sense of community, and a common interest in the work at hand.

Earlier this summer, we instituted a new nine-year strategic plan for Iowa State University, with a set of strategic goals expressed as "to be" statements — What do we want Iowa State to be? Our number-one "to be" statement is to be the most student-centric leading research university. Our institution's full and formal name is Iowa State University of Science and Technology. We are owning that full title, in all its implications for our students' futures. Reaching that goal means ramping up our students' participation in high-impact practices, such as undergraduate research, that prepare them through hands-on, experiential, and real-world opportunities.

Private Funding Opportunities

To be able to extend to more students the brand of community and engagement that research offers, we should take a closer look at philanthropy. Private giving should not be a missed opportunity, or one that remains mostly untapped.

We know extremely well that donors love to support students, primarily through scholarships. Other than scholarships, lifting up private funding for

more undergraduate research experience is a missed opportunity. At Iowa State University, our portfolio of donor-funded undergraduate research opportunities is a fairly modest one. Some are expendable, others have been endowed.

One privately funded undergraduate research internship program in our College of Engineering annually funds 10 students studying chemical and biological engineering. The program also funds seminars in which students learn about intellectual property, patents and trademarks, and copyright law — strengthening a commitment to transfer innovations to help society. The donors were an alumni couple, with the husband a former student who did undergraduate research that was instrumental in a successful career as a patent attorney.

The Science With Practice program in our College of Agriculture and Life Sciences takes its name from Iowa State University's official motto. For nearly 20 years, the experiential learning and work program has provided undergraduate students from across the college the opportunity to work closely with faculty and staff on research projects, earn academic credit, and get paid for hands-on work on a research project. Hundreds of students have participated, with more than 200 mentors across the college. The program was made possible by an investment of private funds from the ISU Agricultural Endowment, a nonprofit organization stewarding private gifts that date back 85 years. Another couple established a separate endowment with their own private giving to support Science With Practice students who work on projects directly related to sustainability in production agriculture. These endowments match funds a mentor pays the students and provide central support overall for administering the program.

Surveys conducted of students who completed the Science With Practice coursework and research experience found that they were able to communicate more effectively and professionally with mentors, clients, and co-workers. A high percentage aspired to attain more advanced degrees.

We are entering our second year of programming with the Student Innovation Center, a new building made possible by both private funds and state support. It's a "playing field" — another way we add oxygen to the kindling and spark. The Student Innovation Center is meant to be a hub in which we invite students from every major to explore their creativity in labs and other creative spaces and experiment with entrepreneurship. In its first full year, the center offered more than 80 elective innovation programs, including competitions with company sponsors, for students or student teams to pitch problem-solving new products or services.

In June 2022, to jump-start our new strategic plan, we announced an investment of $10.5 million in private gift funds for nine initial projects. Six of the projects totaling $3.8 million are pegged to our aspiration to be the most student-centric leading research university.

Embedded in our strategic plan is an annual process to request proposals for possible investment that bring us closer to our aspirational goals. I have already received one idea from a trio of distinguished professors who propose that the university create 100 paid undergraduate research positions to work on new-frontier research with the Ames National Laboratory, our U.S. Department of Energy lab on campus. It is an exciting idea, and it is one that I could foresee generating significant donor interest.

As large public universities struggle to maintain or increase state support — to demonstrate the value of the social contract established at our earliest founding — private funds from donors and industry partnerships play an even larger role. Donor funding of scholarships,

completion grants, and emergency funds are critically important in helping to keep the cost of a college education accessible to first-generation and Pell Grant-eligible students.

We do have an opportunity, through philanthropy, to connect more undergraduates to research. In 2016, the College of Natural Sciences at University of Texas-Austin launched an effort to grow an endowment for its Freshman Research Initiative program. We need more of those kinds of efforts. I picture again that faculty member, in front of a roomful of donors, talking about research, the potential for students, the connections to industry and progress. He may not have known at the time — but perhaps he did — that he was making a pitch.

Sallie Mae's How America Completes College 2022 report states that COVID-19 brought a renewed focus on why some students complete a college degree while others do not. Students need help connecting the dots between their curriculum and their future career. I believe that for many, undergraduate research can help make that connection. The report says that colleges and corporations — and, I would add, other kinds of donors — can step in to provide professional mentorship opportunities, internships, and other options to help students explore and visualize careers and professional success.

Summary

One of the waves of change for students is the voices today whispering to them that they don't need a college degree to succeed. For some students, the choice not to attend college will be the appropriate one. However, I think that in a subtle or indirect way, intentional or not, the voices that downplay the value of a university education feed into the persistent anti-science sentiment that has become more pronounced during the pandemic. From my view as a university president, it denies the oxygen needed for an idea, a creative angle, an innovative product to catch fire. There are students with intrinsic motivation to work harder, persist longer, and maintain a pursuit toward a goal. High-impact practices such as undergraduate research can create intrinsic interest or coax it to forward.

Back to my prologue about our recent graduate, Jack Orr. He had intrinsic motivation to succeed and the mindset to explore beyond the borders of his chosen curriculum. He brought home to me the message that what happens at a public research university doesn't happen at every university. It takes faculty willing, able, and eager to supply the oxygen needed for this tremendous supply of kindling and spark to catch fire.

Jack Orr's story is more than just about believing in yourself. It's one about believing in others and contributing to a greater cause to achieve something beyond what any one individual can do. I believe we can expand that opportunity through more intentional initiatives with private donors who love to see our students succeed, who think outside the box of scholarships, and who envision making possible a more research-directed pathway for more students.

Our task as leaders is to add oxygen to what's already there — the kindling of desire to make a better life and a better future, and the spark of intellect, curiosity, and creativity. With all the global challenges facing us today, the worst that can happen is to have fewer flames of innovation, or to see a flame flicker or die for lack of oxygen. The best we can strive for is to fan the flames of our students' hopes and goals and help them burn steady.

References

1. Izbicki, P., Stegemoller, E. L., Compton, J., & Thompson, J. (2021). Dancing for Parkinson's: A Gateway for Connectedness to Peers and Social Assurance. *CBE – Life Sciences Education*, 20:ar27, 1-7.
2. Koenig, R. (2022, June 8). As Student Engagement Falls, Colleges Wonder: "Are We Part of the Problem?" *EdSurge*.
3. Krupnick, M. (2022, February 10). More students are dropping out of college during Covid — and it could get worse. *The Hechinger Report*.
4. Leonhardt, M. (2022, June 15). 14% of students say they dropped out of college because of mental health challenges, *Fortune*.
5. Linn, M. C., Palmer, E., Baranger, A., Gerard, E., & Stone, E. (2015). Undergraduate research experiences: Impacts and opportunities. *Science*, 347 (6222), 1261757. DOI: 10.1126/science.1261757
6. Mahoney, B. A., & Retallick, M. (2015, December). The Impact of Two Experiential Learning Programs: The Graduates' Perspective. *NACTA Journal*.
7. Miller, R. L., Ryceka, R. F., & Fritsona, K. (2011). The effects of high impact learning experiences on student engagement. *Procedia Social and Behavioral Sciences,* 15, 53–59.
8. Russell, S. H., Hancock, M. P., & McCullough, J. (2007). Benefits of Undergraduate Research Experiences. *Science*, 316 (5824). DOI: 10.1126/science.1140384
9. Sallie Mae. (2022, June). How America Completes College: Understanding What Helps Students Graduate.
10. Sandquist, E. J., Cervato, C., & Ogilvie, C. (2019). Positive Affective and Behavioral Gains of First-Year Students in Course-Based Research across Disciplines. *Scholarship and Practice of Undergraduate Research,* 2, no. 4: 45-57.
11. Schulman, M. (2022, June 12). Alan Alda Is Still Awesome. *The New Yorker*.
12. Walkington, H., Ackley, E., Olin Shanahan, J., Stewart, K., & Hall, E. E. (2020). "Undergraduate Research: Ensuring a High-Impact and Resilient Experience for All." Center for Engaged Learning (blog), Elon University.

Political Influence in the Governance of Public Higher Education

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Thanks to Mabel Rice for inviting me to the Merrill conference this year. Early in my tenure at Kansas I recognized hers to be a sage voice on campus. Her conversation always included wise words and valuable observations.

I am especially pleased that we can meet in-person this year. Two years ago, Mabel asked me to give a keynote on the topic of "*Challenges and opportunities for research in public universities: The view from the Chancellor's office*." I had published an article on that topic, and I thought I was still close enough to the chancellor's office to have that perspective. Then, of course, the conference was canceled because of COVID-19. I was invited again to come to speak on the same topic in 2021 but was unable to do so. When Mabel contacted me about this year's conference, the things I previously wanted to say were out of date and I was too removed from the chancellorship to have a view from that position.

Instead, I want to talk about public universities and their governing boards, and more broadly the intrusion of politics into the governance of public universities. This topic has always been of importance, but recent experiences increased my interest. In late fall 2018, the newly appointed interim president of the University of North Carolina System asked me to serve as an advisor/consultant, a position I held until 2020, when a permanent system president was named.

There are commonalities between universities' goals and those of their governing boards. Both groups seem to care about ensuring college access to a large number of state residents; both aspire to prepare job-ready students to the benefit of the students, the universities, and the economy. And although they may differ regarding the cause and remedy for high tuition, they share concern about the cost to students. But there often seem to be fundamental differences in the values and language of system boards and university communities. Today, I want to address values reflected in controversial actions taken by some governing boards, legislatures, and governors regarding university governance.

Structure and Selection of Governing Boards

Governing boards vary in size: for example, Kansas has 9 Regents, the University of California system has 26, and the North Carolina system had 32 governors, but that has been decreased to 24. Methods of selecting board members also vary. In a few states—Colorado, Michigan, Nebraska, and Nevada—governing boards are elected. In others, system-wide board members are appointed by state legislators or governors, as is true in Kansas. Still other states have individual boards for each university, appointed by the legislature (e.g., Ohio) or by the governor (e.g., Indiana) or by both (e.g., Florida, Missouri). In addition, some lucky universities have both a state level governing board and a university-specific board (e.g., Florida and North Carolina).

No board composition entirely insulates higher education from politics, nor is there strong evidence that board structure (e.g., coordinating vs. governing) determines whether

elected officials intrude on educational procedures (Nicholson-Crotty & Meier, 2003)[1]; however, the process for selecting board members can be critical in whether the board protects institutions from political influence or serves instead as the conduit for it.

That said, many variations in the manner of selection and size of boards can work, and have worked, to build strong public universities that prepare students to make a living and make a good life, advance research, and benefit their states in multiple ways, especially in economic development and health. That is, various models can work as long as institutions *have sufficient bureaucratic independence* to eliminate or modulate the influence of politics on educational procedures, but this may depend more on norms and expectations than structure.[2]

Times Are Changing

In several states the relationship between public universities and their governing boards has changed in the past five to 10 years. One manifestation of the shift is an erosion in the distinction between university administration/ bureaucracy, on the one hand, and the political strategy of governing boards, legislators, and governors, on the other. A subtheme of this shift is that high-status university and system positions are increasingly viewed as "a jobs program" for former political figures or allies of political figures.[3]

In a September 2020 review of recent actions by governing boards, Ellis et al. concluded that the appointment of public university trustees or governors "reveals a system that is vulnerable to, if not explicitly designed for, an ideologically driven form of college governance rooted in political patronage and partisan fealty."[4] Intrusion of *political patronage and partisan fealty* can be seen in multiple facets of governance affecting not only the selection of Board members, but also the selection of system heads, university presidents and chancellors, the control of faculty hiring including the conditions of tenure, and attempts to control the content of the curriculum.

Echoing Ellis, Gene Nichol, a vocal critic of the UNC Board of Governors and a member of the law faculty at UNC-Chapel Hill recently wrote: There is no evidence that most members of the Board subscribed to *"the fundamental values, core tenets and essential traditions of American public universities."*

> Most "*don't believe in or respect competitive, merit-based decision-making in the hiring of university officials. They often opt, instead, for poorly qualified political partisans, or for officials who, in order to obtain or cling to their now-diminished, even pitiful "academic" positions, exercise a visibly humiliating subservience to their overseers…"*[5]

What Nichol describes in that statement and what observers around the country have noted is the often-contrasting cultures of Board members and the university community. The difference in culture (norms and expectations) seems apparent in multiple areas:

- the rightful role of politics in Board policy and decision,
- the level of autonomy universities might be expected to exercise,
- the legitimacy of university governance,
- the inviolability of free speech and academic freedom, and
- the value of having outsiders as students, faculty, or administrators.

Symons (2022)[6] notes that the norms of a university are an important part of its structure, and that institutions can be undermined by disrupting its norms. Over the past few years there have been striking examples of strong political in-

trusions that threaten the norms of higher education governance in numerous states (Colorado, Florida, Georgia, Indiana, North Carolina, South Carolina, and Wisconsin, among others). Today, I will highlight three examples (Indiana, North Carolina, and Florida) that illustrate this disruption and consider contributing factors.

1. Purdue—Collaboration between a Governor and Board of Trustees

I call this a clean example as it seems straightforward**,** almost elegant. Mitch Daniels was governor of Indiana from 2005 to 2013. Although there is no limit on the number of terms a person may serve as governor in Indiana, there is a limit on the number of terms that can be served within a 12-year period. Thus, Daniels was term-limited after completing his second consecutive term, but he can run again in the 2024 gubernatorial election.

Purdue has 10 trustees. As governor, Daniels was responsible for appointing seven (including a student) of the 10 Board members at the state's public universities and was thereby able to create a board of his choosing at Purdue. (Alumni select the other 3.)

When the presidency of Purdue came open late in Daniels' second term, there was a search of several months and Daniels was selected by his appointees. If I remember correctly, he delayed taking over as president because he had to finish the last few months of the governorship.

In June 2022, Daniels announced that he will retire in December, having completed 10 years as president. On that same day he announced his successor. That a search was in progress was apparently a surprise to the University community.[7]

The Board said that it conducted a private internal search, mostly without the candidates' knowledge. The person they chose, Mung Chiang, has outstanding academic credentials in his field, is dean of engineering at Purdue, and has also served as Daniels' EVP for strategic initiatives. Chiang was in a search for the presidency at the University of South Carolina in December of 2021 and withdrew after being identified as the favorite candidate, citing family considerations and his responsibilities to Purdue. One might wonder whether he was convinced to withdraw by assurances that he could be Daniels' successor at Purdue.

Note that my observations are not a comment about the qualifications of Purdue's new president, nor Mitch Daniels' performance as president. It is rather a comment on process.

Purdue's faculty vociferously protested the secretiveness of the recent search. The Board responded by underscoring its responsibility for making the selection and noted their use of the search model frequently used to select business executives. If Daniels were to run for governor in 2024 and win, he would again be able to control board selection, and thus the presidency at Indiana's universities.

2. University of North Carolina System—Selection of System Heads and University Chancellors

Unlike the Purdue example, there is little straightforward or elegant about the workings of the UNC system over the past 10 years, with multiple examples of direct political intrusion into system and university-level functioning. The UNC System Board of Governors (BOG) members are appointed by the legislature. (In 2016 the Republican legislature changed the law to prevent the incoming democratic governor from having input into board appointments.) As a consolidated governing board, the BOG has significant and broad authority, including selection of the system president. The system president, in turn, has the important job of selecting university chancellors on recommendation from university-based committees, which are led by university-level trustees chosen by the BOG and the legislature.

Politically generated instability in system presidency

In the nine years between 2011 and 2020, four different people served as UNC system president. In 2011, Tom Ross, a Democrat, was appointed as system president after a search. He had served previously as president of Davidson College, a highly regarded private college in NC, and as a judge of superior court, among other roles. Ross was regarded as doing a good job but was not Republican. He declined to change his party affiliation and was forced out after Republicans took control of the Board. That his party affiliation was the sole reason for his leaving is widely accepted as fact.[8,9]

Margaret Spellings, G. W. Bush's Secretary of Education, was appointed early in 2016 after a search and resigned less than three years later, two years shy of her contract.

Although some members of the constituent university communities were initially wary of Spellings, she was gradually accepted, viewed as having an emphasis on policy, and as not overly intrusive in the internal management of the universities. Although Spellings was hired by a Republican board, the membership changed significantly during her three-year tenure and, apparently, the new board members thought her name recognition made her too independent and that she did not hew hard enough to the right. She experienced significant interference, and allegedly harassment from some board members, who wanted to appoint a person of their own choosing.[10]

(Her situation recalls that of Melody Rose, who resigned as chancellor of the Nevada System of Higher Education this summer after less than two years on the job. Rose, the third chancellor in five years, filed a complaint with the system's general counsel in 2021, alleging, among other things, harassment by members of the system's Board of Regents based on her gender and their political views.)[11]

At Spellings' departure, William Roper was named interim president and remained in that role until summer of 2020, when a permanent president, Peter Hans, president of the North Carolina Community College System, was chosen. Hans had previously been a member of the UNC BOG; in fact, he was had served as chair (2012-14) and was a finalist in the search that hired Spellings.

Challenges in the selection and exit of university chancellors

When Hans was hired as system president in 2020, one of his early actions was to work with the board to change the selection process for university chancellors, such that the system president may now add two names to the list of semifinalists, and at least one of those names must be on the list of finalists submitted to him. In other words, a chancellor could be hired with little regard for a duly constituted university search committee.[12]

This policy change, approved on 9/16/20, was not academic. On 9/23/20 a sitting member of the Board of Governors (Darrel Allison) who worked as a lobbyist for charter schools, resigned from the Board. He then entered the ongoing search for the position of chancellor of Fayetteville State University (FSU). Allison had no higher education experience and was not chosen as a semifinalist or finalist by the search committee, which considered him unqualified, but was named chancellor (February 2021). There was considerable public protest as well as petitions against the appointment.

In 2019, East Carolina University Chancellor Cecil Staton reportedly was forced out by the Board chair with whom he had clashed more than once; but there was a prominent disagreement about the chair's plan to develop apartment housing adjacent to the campus and his wish to change university rules to help him fill the apartments.[13]

In 2018 another Board member, Tom Fetzer, who was a lobbyist and past mayor of the city of Raleigh, intervened in the search at Western Carolina University. He reportedly engaged a private detective to investigate the chosen finalist outside the context of the search, and claimed his efforts revealed inaccuracies in the candidate's statements. The search committee denied this claim. The candidate withdrew, citing privacy concerns, just as the committee was about to vote on his selection. It later became apparent that Fetzer had spoken to Spellings about becoming interim chancellor at Western Carolina.[14]

Retribution against university critics

It may not be surprising that Gene Nichol, whom I quoted above as saying there was no evidence that most members of the Board subscribed t*o "the fundamental values, core tenets and essential traditions of American public universities,*" has been a critic of the BOG. The poverty center he ran was closed. The complaint was that he advocated for anti-poverty measures that board members did not like. A civil rights center was also hobbled, allegedly because its work sometimes involved civil litigation against discriminatory practices by city, county, or state government.[15] Both the Poverty Center and the Civil Rights Center were heavily funded by private sources, rather than being solely state-funded entities. A staff attorney at the Civil Rights Center asked why they (BOG) were doing this and reported that one BOG member responded, "What you don't understand is that we won."[16]

3. Florida—Systematic and Comprehensive Control

The Florida example is not as succinct as Purdue, but possibly presents more profound challenges than the North Carolina example. Florida's governor, with the support of the legislature, has proposed or enacted changes that touch almost every level of university functioning and could affect higher education in Florida for decades through his current control of the legislature and appointments that will be operative for years.

Power of university presidents

The authority of university presidents to make hires will be curbed, with the Board having direct responsibility for approving or disapproving hires.

Curriculum

Faculty are losing the authority to determine the content of their courses: they may be forbidden to include content that differs with political views of the current majority of the legislature. According to Florida HB 7, or the *Stop Woke Act*, passed earlier this year, Florida colleges and universities can lose performance-based funding for teaching certain "divisive concepts" such as Critical Race Theory.[17] General education courses must *promote* the philosophical underpinnings of Western civilization, including studies of the U.S. Constitution, the Bill of Rights and amendments, and the Federalist Papers."[18]

Faculty review

DeSantis has signed a bill that requires that every faculty member be reviewed every five years by the board, with a variety of possible outcomes, including dismissal.[19]

Professional activities of faculty

University of Florida faculty members were prevented from giving expert testimony in a lawsuit challenging a new law that appears to restrict voting rights. They were told they could not testify because their testimony would go against the University's interest as it conflicted with the administration of the governor.

Accreditation

Many of us have participated in, and possibly cursed, accreditation processes, but accreditation can provide protection as well as burdens. The Southern Association of Colleges and Schools (SACS), Florida's regional accrediting agency,

raised concerns about the way a recent president search was conducted in Florida and about the impingement of proposed legislation on the integrity of curricular offerings, and academic freedom. SACS also rebuked the University of Florida for its handling of the three professors who wanted to testify as expert witnesses in a lawsuit against the state over voting rights, arguing that it violated the agency's academic freedom rules and threatened UF's accreditation.[20]

DeSantis expressed dismay about the power that "self-anointed" entities held over Florida's universities. Now there is legislation that will require universities periodically to change accreditors (passed, effective July 1, 2022), a move that could embolden like-minded governors and legislators to support creation of new ideologically consistent accrediting agencies.

Why Is This Happening Now?

Does the public value higher education?

The examples above address the actions of elected officials or their appointees and all have been covered in public media. Why is the public not incensed? It's possible that who runs universities or whether board members use their positions for financial or professional gain does not rise to the level of concern for most people. It is also possible that the public trusts the academic community less than it trusts politicians and will not defend universities against political intrusions.

There continues to be significant discussion of how the public regards higher education. Is higher education viewed as a public good, do most people trust universities or believe that a college degree is worth the personal and financial resources necessary to achieve it? Although the social and economic benefits of having a college degree versus just a high school diploma have been documented, only about 60% of college students graduate after six years. Those who do not earn a degree may nevertheless end up with substantial debt, creating a well of resentment in them and their families toward colleges and universities.[21]

Public discontent seems to be tied to the cost of tuition and the extent to which graduates are competitive for high-paying jobs. The higher tuition rises, the more families want to see a fast, significant economic return. Politicians and governing boards are often seen as champions of low tuition and publicly accuse universities of having needlessly inflated costs. Moreover, much of the public views universities as too liberal. On the other hand, recent surveys suggest a mild rebound in public support for higher education in the past five years, following a decline in the early 2000s.[22, 23, 24]

Deep political polarization

The increasing strength of conservative politics and the public's seeming wariness of the liberal ideas may embolden governing boards and politicians to exercise more direct control of universities. Wippman and Altschuler (2022) believe that because colleges and universities are often a focal point of our nation's deep political polarization, they are inevitably part of the "struggle to shape Americans' understanding of our country's history, institutions and values in a clash between a progressive antiracist agenda and conservative resistance to that agenda."[25]

The pandemic

The literature on pandemics suggests a relationship between pandemics or other frightening pervasive crises and creating fertile ground for extremism, including violence. In particular, pandemics and similar crises can generate a search for certainty and absolutes, echoing and reinforcing political poles.[26]

Wippman & Altschuler (2022)[27] argue that the COVID pandemic in the U.S. changed the relationship between universities and the governmental entities

with which they interact, that is, between universities and their boards, between universities and state, federal, and local government. The pandemic necessitated collaboration and, at the same time, supported intervention of government into university operations. For example, universities accepted billions of dollars in federal subsidies to ensure their survival during the pandemic. The pandemic also provided an opportunity for states to provide greater direction to universities and facilitated the replacement of public health principles by politically inspired compliance. For example, governors and boards in some states directed universities to take steps that countermanded university plans regarding masking or vaccinations or in-person classes. Other states enacted policies to make it easier to terminate tenured faculty during the pandemic, a move they attributed to financial strains caused by the pandemic.

As the pandemic eases, will the return to more normal conditions carry over to the way universities are governed, or will the longer-term social, economic, and political impacts of the pandemic and ongoing political polarization continue?[28] And importantly, what steps can university communities take to ensure the integrity of university governance?

References

1. Nicholson-Crotty, J., & Meier, K. J. (2003). Politics, Structure, and Public Policy: The Case of Higher Education. *Educational Policy*, 2003, 17, 80-97.
2. Nicholson-Crotty & Meier (2003). op cit.
3. Seltzer, R. (2016, October 7). Picking Political Presidents: Search processes prove to be a key point of contention as West Florida and Kennesaw State have considered making politicians university presidents. *Inside Higher Education*.
4. Ellis, L., Stripling, J., & Bauman, D. (October 25, 2020). The new order. How the nation's partisan divisions consumed public-college boards and warped higher education. *Chronicle of Higher Education*.
5. Nichol, G. (2022, April 28). Faculty empowerment in an age of authoritarianism. Appalachian State University, Boone, NC. https://drive.google.com/file/d/1JssMun_20oLbfYaU4lMzyPhaY_XpP1Le/view
6. Symons, J. (2022, July). What makes an institution resilient? Paper presented at the Merrill Research Retreat Conference. Kansas City, MO.
7. Moody, J. (2022, June 13). Daniels to retire at Purdue; Successor already named. *Inside Higher Education*.
8. DeWitt, D., Philip, L., & Baier, E. (2018, October 25). Margaret Spellings resigns as head of UNC System. *North Carolina Public Radio*, 4:42 PM
9. Osaka-Few, S. (2015, May 14). Emails between Tom Ross, UNC Board of Governors show concern about Ross' dismissal. *NC Policy Watch*.
10. Dalesio, E. P. (2018, October 16). Margaret Spellings quits UNC system post amid turmoil. *Associated Press, Citizen Times*.
11. (In an exception to what seems interference by Republican politicians and boards, the University of Colorado System President Mark Kennedy when the Democrats won control of their board for the first time in 40 years.)
12. Killian, J. (2020, September 16). In voting to change chancellor search policy, UNC Board of Governors could expand System president's power. *NC Policy Watch*.
13. Jackson, L. (2019, March 18). As East Carolina chancellor resigns, one board member accuses chair of forcing him out. *Chronicle of Higher Education*.
14. Killian, J. (2018, October 11). After Western Carolina controversy, UNC Board of Governors overhauls chancellor search process.

15. Roll, N. (2017, September 11). UNC Board bars litigation by law school center. *Inside Higher Education*.
16. Ellis, Stripling, & Bauman. (2020). *op. cit*.
17. Reilly, K. (2022, April 22). Florida's governor just signed the "Stop the Woke Act". Here's what it means for businesses and schools. *Time*.
18. Moody, J. (2022, June 6). A grab for power. *Inside Higher Education*. https://www.insidehighered.com/news/2022/06/06/draft-legislation-shows-desantis-plan-control-higher-ed
19. Kumar, D. (2022, April 19). DeSantis signs bill limiting tenure at Florida public universities. *Tampa Bay Times.*
20. Staff. (2022, April 21). Florida governor signs bill requiring colleges and universities to change accreditors. *Insight into Diversity*.
21. Kantrowitz, M. (2021, November 18). Shocking statistics about college graduation rates. *Forbes*.
22. Lederman, D. (2022, March 14). Public's impression of higher education improves (somewhat). *Inside Higher Education*.
23. Drezner, N. (2018). An investment that pays off for society. https://www.tc.columbia.edu/articles/208/july/americans-believe-in-higher-education-as-a-public-good-a-new-survey-finds/
24. Brink, M. (2022, July 12). Public Opinion on Value of Higher Ed Remains Mixed. *Inside Higher Education*.
25. Wippman, D., & Altschuler, M. (April 11, 2022). Political interference in higher ed is becoming endemic. *Inside Higher Education*.
26. Grossman, M. (2021, October 15). How has COVID-19 changed the violent extremist landscape? Centre for research evidence on security threats. https://crestresearch.ac.uk/comment/how-has-covid-19-changed-the-violent-extremist- landscape
27. Wippman & Altschuler. (2022). *op. cit*.
28. Wippman & Altschuler. (2022). *op. cit*.; Grossman. (2021). *op. cit*.

Global Megatrends: Be the Change You Seek

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With notable exceptions – the industrial revolution and global wars – the historical rate of socio-technical change has occurred on a scale roughly commensurate with a human lifetime. Across lifetimes, this evolutionary change has allowed societies and organizational structures to adapt incrementally. Today, a set of rapidly shifting, global megatrends is triggering major structural changes in our society. As that change accelerates, it is triggering deep social and economic disruptions, leading to what Toffler presciently called "future shock."[1]

One need look no further than the effects of urbanization, with over 50% of the world's population now living in cities, a percentage expected to reach 70% in just a few decades. The depopulation of rural areas in the United States and the associated "brain drain," exacerbated by the rise of industrial scale agriculture, have had profound effects on rural communities and created economic and social tensions – the urban-rural divide. Concurrently, globalization has created deep couplings and interdependent supply chains in almost all product domains, as the COVID-19 pandemic's disruptions quickly exposed. The shifting demographics of the United States, political battles over immigration policy, and a mismatch between employee skills and workforce needs are further challenging social norms. In the midst of all this, we are seeing increasingly political polarization and income stratification, with a shrinking middle class, declining political middle ground, and a growing fraction unwilling to compromise on a variety of social and economic issues.

As noted above, these socioeconomic challenges are themselves convolved with rapid technical changes, many of which are change accelerants. Perhaps foremost among these are the transformative effects of inexpensive, global communication and ubiquitous social media. While digital access has democratized communication, all too often, it has also enabled the social media and digital echo chambers that have contributed to strident dialog and the reinforcement of social and political views.

In addition, the accelerating pace of technology – automation, advanced manufacturing, computing and artificial intelligence, digital agriculture, bioengineering and biosciences – have disrupted traditional businesses and business models. As a result, economic sectors and job niches have evolved or even disappeared increasingly rapidly, leaving large numbers of workers unemployed or underemployed, with job skills ill-matched to a shifting economy. With increasing worries about global climate change and the associated food, water, and environmental issues, society faces a witch's brew of economic, social, education, and environmental issues.

It is no surprise then that societal frustrations and concerns now loom large, with many feeling the American dream is increasingly out of reach, or worse, rigged to the advantage of the rich and powerful.[2] Tellingly, that fear is shared across the political spectrum; nor is it wholly unfounded. Data show that U.S. children born into poor families are statistically unlikely to break into the upper end of the income distribution.[3] Perhaps

even more worrying, even as the economic value of a college degree remains demonstrably real, the cost of acquiring such a degree is being pushed further out of reach for a substantial fraction of the population, particularly those from lower economic strata.

The results of a recent survey by the Association of American Universities (AAU) reflect these concerns, with over 50% of respondents saying that a degree from one of America's leading research universities is valuable but not worth the cost. To be sure, an educated citizenry is an essential element of democracy, and economic return is not the only reason to seek a college degree, but it is repeatedly listed by both students and parents as the primary reason for seeking a degree.

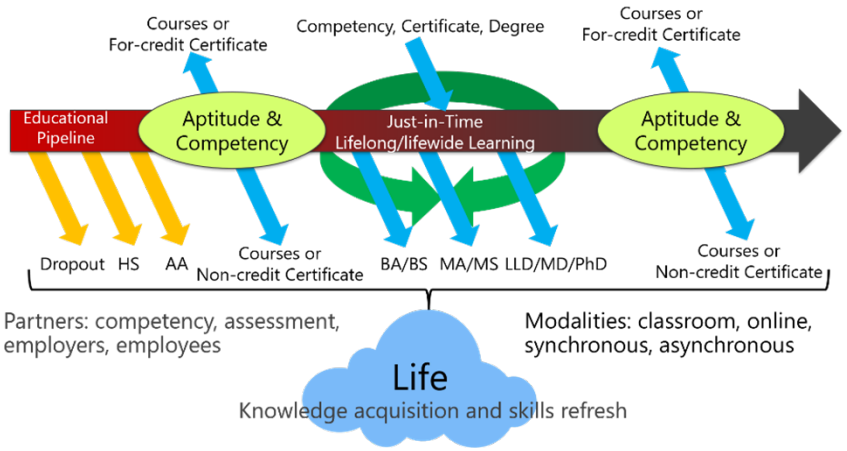
In a world increasingly dominated by the knowledge economy, where those with high-demand skills thrive, and those lacking those skills struggle, how can we best ensure the door of opportunity is open wide? How do we empower the largest possible fraction of the population, recognizing that talent arises everywhere, and is not a respecter of socioeconomic status? How do we ensure each individual's future is defined not solely by the circumstances of their birth or their zip code, but by the content of their character, the magnitude of their talent, the scope of their dreams, and a willingness to work in pursuit of their dreams? These are important questions, perhaps the most important questions any society faces, how it supports the dreams of its children and the hopes of its parents.

All of these moral and practical issues must be resolved against the backdrop of a changing world order, where other countries are increasing their investments in the innovation ecosystem and its most critical, renewable element, an educated citizenry. Meanwhile, the U.S. has seen declines in mathematics and science scores by its students, accelerated by the COVID-19 pandemic. Data from the National Center for Science and Engineering Statistics (NCSES)[4] show that students from *all* ethnic groups perform below expected performance levels if they are eligible for free or reduced school lunches. In addition, NCSSES data also show that poor school districts are those most likely to have science and mathematics teachers with the least experience. Simply put, those born into economically challenging circumstances face deep challenges.

The National Science Board (NSB), of which I am honored to currently serve as its chair, recently released *Vision 2030*,[5,6] a blueprint for addressing some of these challenges. It calls on all of us to (a) expand the geography of innovation, ensuring that all parts of the country participate in knowledge economy opportunities, (b) expand educational opportunities for all, (c) ensure the benefits of academic research are accessible and deployed for societal benefit, and (d) foster a global science and engineering community that reflects the values of open collaboration and empowerment.

Inherent in this vision is the need to both preserve academic values while embracing the responsibility to respond to shifting societal needs. Universities work in that most ineffable of media, the realm of ideas. In our minds, we in academia aspire to be and believe we are the very embodiment of Raphael's *Causarum Cognitio*, The School of Athens, dispassionate and thoughtful intellectual explorers, unfettered by spurious emotion, using only logic and reason to pursue knowledge, truth, and wisdom. At times we are all that and more, but flawed beings that we are, we also sometimes see our tawdry reflection in Pieter Brugel the Elder's The Tower of Babel, divided in our objectives, separated by the arcane vernacular of our disparate disciplines. In the words of Alexander Pope, we are but beings "darkly wise and rudely great."

At their very best, universities can and do offer new and important perspec-



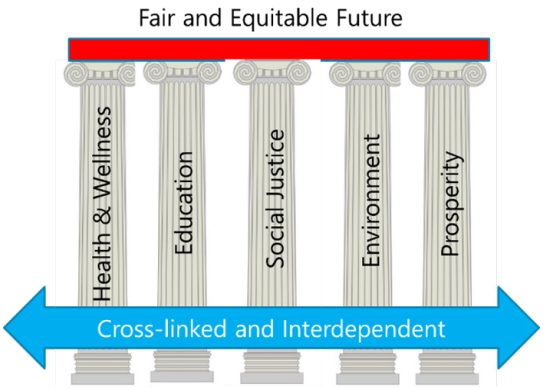
tives on complex issues, both old and new, and they create new knowledge and heightened understanding of the heretofore unknown or unexplained. These new and important insights and ideas, forged in the fire of critical inquiry and illuminated by fact-based debate, can continue to reshape our world – socially, culturally, artistically, technically, and economically. However, we must also be honest and admit that at their worst, universities can be rigid in their orthodoxy and unwelcoming of discordant ideas, as hidebound as any other human institutions.

In a world of accelerating change, universities must be more flexible, nimbler in addressing societal challenges, just as they have proven capable of doing in the past. After all, the land-grant universities, created via the Morrill Act in the 19th century, were charged with broadening access to education and bringing new knowledge and skills to the field and the factory. After World War II, the Servicemen's Readjustment Act (i.e., the G.I. Bill) opened higher education to millions of returning veterans, expanded federal investment in university research, and made universities active partners in creating new knowledge, powering the innovation economy, advancing health care, and supporting national security. Since then, the Civil Rights Act of 1964 and Title IX have rightly focused on persistent inequalities and driven change in higher education.

I believe we are at another important inflection point, one where higher education must respond with alacrity to pressing societal issues. First, while preserving traditional degree models, we must embrace the need for lifelong education support as an equally important part of the higher education mission. Rather than viewing one's experience as clearly demarked by education, then life and career, it must be an evolving, just-in-time, lifelong partnership, where individuals return repeatedly for new knowledge and new skills, whether validated by competency tests, certificates, or traditional degrees.

In a world where entire economic sectors can be disrupted or destroyed in just a few years, an expectation that the knowledge and skills gained at twenty will be sufficient for a lifetime is no longer realistic. Nor can the delivery models be solely based on weekday, in-person instruction. We must embrace all delivery modalities and offer educational content and services in ways and at times convenient and accessible to potential students. It's about meeting students where they are, with the support and services they need, recognizing that the "hidden curriculum" of expectations and processes can be both off-putting and daunting.

Second, I believe we must rededicate ourselves to our public engagement mis-



sion. As universities, we exist to serve society, via education, via research, via technology transfer and economic development, and via community outreach and partnerships. This means examining our reward metrics and rebalancing the mix of academic accomplishment, perhaps fewer papers but more societal benefit.

The complex issues facing our society are deeply intertwined – social justice and equity, health and wellness, housing, natural and built environments, educational opportunity, and prosperity – and universities have the expertise to help address them, working in a spirit of humility and partnership. We can build Renaissance teams that couple knowledge across diverse disciplines, build deep community partnerships, engage in hands-on problem solving, and use those opportunities to expose students to integrative perspectives on these complex and important problems.

How we in higher education respond to the megatrends shaping our world will define our shared future. Opening the door of opportunity and improving the lives of our citizens is a moral responsibility.

References

1. Toffler, A. (1970). *Future Shock*, Random House.
2. Public Agenda. (2022). *America's Hidden Common Ground on Public Higher Education: What's Wrong and How to Fix It.* https://www.publicagenda.org/wp-content/uploads/2022/07/Public-Agenda-HCG-Higher-Ed-Report-FINAL.pdf,
3. Hamilton Project. (2008). Income Quintile of Adults Born into Lowest-Quintile Families by College Attainment. https://www.hamiltonproject.org/charts/income_quintile_of_adults_born_into_lowest-quintile_families_by_colleg
4. National Center for Science and Engineering Statistics. (2022). *Science and Engineering Indicators*. https://ncses.nsf.gov/indicators
5. National Science Board. (2020). *Vision 2030*. http://www.nsf.gov/nsb/publications/2020/nsb202015.pdf
6. Reed, D. A. (2022). "For Science and Society, the Future Begins with Better Dreams." https://www.elsevier.com/connect/for-science-and-society-the-future-begins-with-better-dreams

Surfing the Leadership Pipeline – Growing Leaders from within STEM

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The Merrill Retreat topic for 2022, *Surviving and Anticipating Waves of Change*, elicited in me a wave of self-reflection during what would reveal itself to me as one of my own personal years of tumult. Survive and anticipate – two words that were impressed upon me during my youth as a Boy Scout, not during my years as a university administrator. Two words that might have been used by Lord Robert Stephenson Smyth Baden-Powell, otherwise known as Lord Baden-Powell of Gilwell, England, the founder of a movement that would become Boy Scouts in 1908, and more recently Scouting. Survive and anticipate – Baden-Powell came to refine such terms into the Scout Motto: "Be Prepared." Lord Baden-Powell published his renown book, *Scouting for Boys*, in 1908, which launched a world-wide movement.[1]

According to legend, upon hearing the Motto, "Be Prepared," someone asked Baden-Powell, "Be Prepared – for what?" His reply, "Why, for any old thing, of course."[2] Surviving and anticipating waves of change in public research universities requires us to Be Prepared – for any old thing.

Baden-Powell's British Scouting movement was really a grass-roots self-assembly of boys and girls who arranged themselves in patrols, per his book, and then troops, with volunteer adults to serve as guides and teachers. With growing interest for Scouting by youth in Britain, Baden-Powell came under public pressure to create separate organizations for boys and girls, so he invited his sister, Agnes, to lead the Girl Guides in 1910. Nevertheless, in the early days of Scouting and Guides, the Oaths, Laws, and Mottos were built around the same principles of youth leadership. In 2018, girls were formally welcomed back into Scouting in the U.S. with the formation of girl Cub packs and Scout troops.[2]

This year, 2022, began with the death of my father, Albert J. Dorhout, who, by age 85, had led a life committed to service as a public school music teacher and leader in gifted education in the U.S. While helping my mother sort through his books, I came upon his 1948 copy of *Handbook for Boys*,[3] the U.S. edition of Baden-Powell's book. Within its tattered covers are dog-eared pages and hand-written notes made by a 12-year-old boy. In his own hand, my father recorded his thoughts on leadership, being prepared, and being a servant leader in the margins beside meaningful passages by Baden-Powell on the same.

Al Dorhout earned his Eagle Scout in 1951, like his uncle before him in 1934. I earned my Eagle Scout in 1977. We are members of an elite group of people – only 4% of Scouts earn the rank – that includes leaders like President Gerald R. Ford, Secretary Rex Tillerson, Nobel Laureate Dudley Hirschbach, and President E. Gordon Gee, president of the University of West Virginia. My leadership style, which was formed by Scout leaders and my own experiences in Scouting, continues to build on principles like servant leadership, do a good turn daily, and be prepared. Through this paper, I will argue, through demonstrative examples, that building diverse leadership pipelines will enable higher education to be

prepared to successfully survive and anticipate waves of change. Afterall, those waves of change could be any old thing.

Leading in the Profession

Although I had been connected with my professional organization, the American Chemical Society (ACS), as a member and subscriber to my favorite chemistry journals and attendee at the regular national meetings to present papers for many years, participating in the ACS as an engaged member didn't occur until I was invited by a local ACS member in Colorado to consider joining a committee in 1995 – the Younger Chemists Committee. This national ACS committee is dedicated to creating programming and professional development opportunities for chemistry professionals who are early in their careers, whether they be in the academic, private, or government sector. As a complement to this programming, the ACS organized an annual retreat for newly elected leaders to provide a professional kit of management tools – how to run meetings, how to create programs, and how to promote chemistry to the general public. The missing elements to this retreat were in leadership development.

As my volunteer commitments expanded, I found myself in discussions with senior leaders in ACS who often lamented the lack of a "leadership pipeline" for the ACS and the profession. A gap analysis revealed that we were assuming that our elected leaders possessed a set of leadership skills and ACS provided them with management tools to help them succeed in their volunteer roles – that assumption about leadership was far from reality. I was invited to join a task force that was established by ACS to create a formal Leadership Development System (LDS) that would provide leadership training, as well as management tools, in order to improve the ACS and its members.[4]

The new LDS was designed in partnership with Joseph Folkman using his book on extraordinary leaders.[5] Over the course of three years, the LDS emerged as a system of 16 modules comprising four-hour facilitated sessions combining leadership competencies built on ACS principles, as well as a suite of project management tools. These modules were organized in core competency areas, each with increasing leadership responsibilities aligned with the needs of not only the ACS but also the broader professions within the chemical sciences. A 360-degree feedback assessment tool combined with an eight-hour workshop on leveraging strengths was designed for senior leaders. By 2009, ACS had created a system that was designed to build leaders among its many thousands of volunteers, offering the modules at local, regional, and national meetings as well as online.

Leading in Academics

Along my personal leadership journey, I was invited to serve on many local and national committees related to chemistry and academics. One particular service role that I have embraced since 2002 has been as a member of the Board of Directors of Research Corporation for Science Advancement (RCSA). I embraced this opportunity with RCSA because I believed in the principles of the foundation. Created in 1912 by Frederick Gardner Cottrell, RCSA has been dedicated to supporting education and basic research in chemistry, physics, and astronomy, preceding the National Science Foundation by decades and serving as one of only a handful of foundations in the early decades of the 20th Century to do so.[6] In 1994, RCSA launched a new award for pre-tenure faculty who were dedicated to the principles of Cottrell: research and teaching – the Cottrell Scholar. When the Board created this award, it did so in order to recognize faculty, early in their careers, who would be leaders not only in their fields but also at their colleges and universities. I was fortunate enough to

be selected a Cottrell Scholar in the inaugural class of 1994, which began my decades-long relationship with RCSA.

The goal of creating leaders through the early recognition of talent as a faculty member, while laudable, lacked assessment, metrics, and a thoughtful correlation of early career success in a discipline with increased skills in leadership. The RCSA Board struggled with this apparent dichotomy of skill sets, as did the Cottrell Scholars Collaborative, a self-assembled group of Cottrell Scholars who met each year to discuss strategies for moving academic science forward through teaching and research. Tangible outcomes of the Collaborative in the areas of research and teaching include the RCSA/ACS New Faculty Workshop started in 2011,[7] the effective evaluation of teaching in STEM,[8] and techniques in course-based undergraduate research,[9] among many others.[10] Together with a core of three other Scholars, I tackled the challenge of building academic leaders in 2015 by creating a partnership with the ACS and its counterpart, the American Physical Society (APS), in 2015, that would leverage the ACS LDS offerings while tailoring a workshop to the unique needs of building leadership for the college or university environment: the Academic Leadership Training Workshop.[11]

The Academic Leadership Training Workshop

The Academic Leadership Training Workshop (ALT) grew out of many of the basic principles of learning that the Collaborative developed over the years and incorporated some of the learning principles embedded within Scouting: Explain, Demonstrate, Guide, and Enable – the learning EDGE in Scouting.[2] ALT was designed to engage Experienced Academic Leaders (EALs) and roughly 40 to 50 ALT "students" in learning the general principles of leadership, engaging in case study discussions, and developing work products, such as personal leadership statements, visioning exercises for example leadership positions, and mock interviews for leadership positions. The methodologies and approaches for engaged learning also followed the Discipline-Based Education Research (DBER) principles.[12] A paper describing the initial ALT Workshops and our design was published in 2017.[13]

One foundational element of the ALT Workshops is the principle of shared governance in academics, regardless of whether the setting is a research-intensive graduate university or a predominantly undergraduate institution. One of the key challenges of academic shared governance is the lack of formal leadership development within colleges and universities, programs like HERS,[14] ELATES,[15] and ACE Fellows[16] notwithstanding. An additional challenge with the shared governance model of leadership is the apparent dichotomy of the research and teaching missions of colleges and universities – one funded through primarily extramural funding and the other through tuition and public general funds. The unique model of the Cottrell Scholar, and the Collaborative, is the intentional integration of teaching with research that this group of over 300 faculty Scholar "alumni" has embraced since the creation of the Cottrell Scholars program in 1994.

The objectives of the ALT Workshop were covered in our 2017 paper[13] and are articulated here. The three-day workshop includes a pre-workshop 360-degree feedback assessment with input from 12-15 professionals identified by each participant. The results of those assessments are discussed at a tailored half-day session at the start of the workshop. The remaining workshop sessions include interactive panel discussions, case study discussions, and breakouts on critical topics for success in a variety of academic leadership positions:

1. Why you should become an aca-

demic leader
2. Vision (opportunities and challenges) at the start
3. Leadership: finding and leveraging your strengths
4. Conflict resolution for academic leaders
5. Engaging and motivating colleagues & staff
6. Managing outside research: outreach
7. Managing outside research: diversity
8. Managing outside research: legal concerns
9. Friend raising and stewardship
10. Managing up and managing down
11. Time-management and other challenges for academic leaders

Following the three-day workshop, our goal was that participants will: be motivated and prepared for academic leadership role; be able to use skills and tools from ALT to be more effective academic leaders; focus on improving their leadership strengths towards being extraordinary leaders; know the range of duties and obligations required of academic leaders and be prepared to address them; be prepared for interviews and their start as an academic leader. In addition, the ALT participants will have a cadre of peers who may serve as collaborators and informal mentors throughout their leadership journeys.

By early 2020, four ALT Workshops had been held, and an assessment of pre- and post-workshop assessments had been performed across two core growth areas: knowledge and confidence gained. On a Likert Scale of 1 to 5, where 5 indicated the highest score, the pre- and post-workshop assessment showed significant increases in knowledge gained for: leading above and below on the organizational chart; fundraising activities; managing legal concerns; engaging and motivating colleagues and staff; managing conflict; personal leadership talents; creating, articulating, and managing a vision; and knowledge of rewards and opportunities to advance science and the profession through academic leadership. The pre- and post-workshop assessment showed significant increases in confidence gained for the same areas.

Where Are They Now?

Following the last in-person ALT Workshop in late February 2020, an abridged version of the Workshop was held in 2021 as a virtual workshop. Shortly thereafter, several key staff members at ACS, who had helped organize and host the in-person workshops since 2016, changed roles or left ACS. In the late spring of 2022, with the ALT Workshops in hibernation and in need of renewed funding, a longitudinal study of the ALT participants and their perceived impact of the skills learned at the workshops was in order. Working with the Iowa State Center for Survey Statistics & Methodology-Survey Research Services (CSSMSRS) and the ISU Institutional Review Board, I set out to assess the strengths and challenges with the ALT Workshop through a comprehensive survey.

As the ALT Workshops were designed and initially funded, the ALT leadership team invited members of the Cottrell Scholars cohorts, from 1994 to the present, as well as other emerging academics in chemistry, physics, and astronomy, to attend each workshop, with an ideal cohort of participants numbering between 40 and 50. Out of 237 ALT participants, 37% responded to the assessment survey. Although the community of Cottrell Scholars is fairly diverse in gender identity relative to the disciplines (26% identify as female), the nomination process was intentional at creating cohorts with greater ethnic and gender diversity. The survey respondents self-identified as 39% belonging to traditionally underrepresented populations in STEM, which is close to the data from the workshop reg-

istrants.

The survey sought to determine which cohort members had been in a leadership role prior to the workshop and which did not. The assessment kept these two groups separate in order to determine whether the workshop had an impact on only new leaders, new or continuing leaders, or only on continuing leaders. Of the respondents, 53% started the workshop with a leadership role and 30% of those were at R1 universities. The leadership positions were distributed across a set including department chair, center director, associate/dean, and associate/vice president for research. Of those participants with leadership positions when they attended the workshop, 45% are continuing in the same role. Of the remaining respondents, 73% are in new leadership roles. The remaining have served out a full term or have decided to seek other leadership roles.

Respondents continuing in leadership roles were asked to identify how well the ALT Workshop helped them continue to be successful in their roles and how well it prepared them to seek new leadership roles. Overall, respondents felt that the workshops significantly prepared them to continue in the role (76% indicating "well" or "very well") and significantly helped them be more successful (72% indicating "well" or "very well").

Of the respondents who did not begin the workshop already in a leadership role but who attained one since the workshop, 50% of those were at Carnegie Classification R1 research intensive graduate universities. Those new leadership positions were distributed across a set including department chair, center director, associate/dean, and associate/vice president for research. At the time of the survey, 82% remained in that role. From these respondents, 67% agreed/highly agreed that the workshop prepared them for the job and 88% said that the workshop prepared them to be successful in the role. Of all the respondents who were not currently in academic leadership positions, 75% remained interested in attaining one. Of all the respondents, 76% attained or continue to hold leadership positions in academics. Finally, of all the survey respondents, 93% would recommend or highly recommend the ALT Workshop to an emerging academic leader.

Along with Likert scale responses about the workshops, respondents provided free text responses to several questions about aspects of the workshop they liked, items they wish they had learned, and points of pride during their term in leadership. The first two items will factor into a refresh of the workshop. The last item is worth providing some concrete examples for this paper.

Unfortunately, little time is spent reflecting on the very positive, non-remunerative aspects of leadership in higher education in leadership training sessions. Leadership, especially servant leadership, should reflect on the challenges a group has and recognize the collective success towards reaching goals and milestones. Nevertheless, servant leadership should not be without personal goal setting and success, so I hold up selected points of pride from the survey here:

> "Brought together the team of staff to really start to feel like a team and not a group of individuals; professional development of staff."

> "Increasing participation rates from under-represented groups in our graduate program."

> "More transparent communication to the whole department on the behind the scenes running of the department – built trust."

> "Increased equitable access to available resources."

"Continuity of programs through research slowdowns during the pandemic."

"Good communication and transparency with faculty."

"I was able to redesign faculty governance, clarifying faculty roles and making service more purposeful."

"Increasing transparency about criteria used for faculty evaluations (periodic and rank/tenure decisions)."

Surfing the Leadership Pipeline

Surviving and anticipating waves of change in public higher education will rely on building a pipeline of leadership from within our colleges and universities. In an environment of shared governance, growing faculty leadership with shared values for public higher education – research, teaching, service, and outreach – should be an imperative. Emerging leaders in the ALT Workshop discovered that building trust is one of the most important aspects of leadership. This bears out in the points of pride through improved communications strategies, transparency of process and budgeting, and the continuity of programs through significant adversity. For universities to not just survive but succeed and thrive through waves of change, they will need to build a pipeline of trustworthy leaders across the academy to rekindle the trust that has been damaged, if not lost, according to our stakeholders, over the past few decades.

I will close this paper by reflecting on two final aspects of Scouting that have stayed with me, and these were underscored by my father in his bedraggled Scout *Handbook*.[3] The first item in a list of 12 tenets of the Scout Law is Trustworthy. "A Scout is trustworthy" has stayed with me since I first spoke the Scout Law in 1972. I believe that it is first among the tenets because it is the most important one. To be a successful servant leader is to be trusted. Whether you are a young person of 10 or 11 years, a junior faculty member establishing an academic reputation, or a novice leader in a program or department, being trustworthy is at the foundation of shared governance.

The second aspect is Do Your Best. The Scout Oath begins with, "On my honor, I will do my best…." It does not state that "I will be the best" or that "I will accomplish everything I try"; the Oath says, "I will do my best." Leadership, through trust, relies on each of us to do our best. Leadership is a commitment to a collective vision for a college or university. To do our best requires that we are prepared for the unexpected and have built the trust of our faculty, students, staff, and external stakeholders that we will act in the best interests of those whom we lead. Simply put, surviving and anticipating change in higher education will require a commitment to build leaders, to be prepared, and to do our best.

References

1. Bezucha, R. D. (1959). "The Golden Anniversary Book of Scouting." Golden Press, NY.
2. "Scouts BSA – A Handbook for Boys," 14th Ed. (2019). Boy Scouts of America, Irving, TX.
3. "Handbook for Boys," 5th Ed. (1948). Boy Scouts of America, New York, NY.
4. https://www.acs.org/content/acs/en/careers/leadership.html (last accessed on 11/19/2022).
5. Folkman, J., & Zenger, J. H. (2002). "The Extraordinary Leader." United States: McGraw Hill LLC.

6. https://rescorp.org/ (last accessed on 11/19/2022).
7. https://www.acs.org/content/acs/en/education/educators/coursesworkshops/csc-new-faculty-workshop.html (last accessed on 11/19/2022).
8. Shelton, R. N., & Rawlings III, H. R. (2015). "Searching for Better Approaches: Effective Evaluation of Teaching and Learning in STEM." Research Corporation for Science Advancement.
9. Waterman, R., & Heemstra, J. (2018). "Expanding the CURE Model: Course-based Undergraduate Research Experiences." Research Corporation for Science Advancement.
10. https://rescorp.org/cottrell-scholars/cottrell-scholar-collaborative-resources (last accessed on 11/19/2022).
11. The ALT Collaborative began with Cottrell Scholars Karen Bjorkman, Peter K. Dorhout, Bo Hamer, and Rigoberto Hernandez. http://oxide.jhu.edu/ALT/ (last accessed on 11/19/2022).
12. Singer, S. R., Nielsen, N. R., & Schweingruber, H. A. (2012). "Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering." The National Academies Press: Washington, DC.
13. Hernandez, R., Stains, M., Bjorkman, K. S., Donovan, A., Dorhout, P. K., Feig, A. L., Hammer, P. W., Ross, J. L., Wesemann, J., & Iyer, S. K. (2017). "Leadership Training for Teacher-Scholars." *ACS Symposium Series*, Educational and Outreach Projects from the Cottrell Scholars Collaborative Professional Development and Outreach, Volume 2, A. Feig, R. Waterman, eds., 35-49.
14. Higher Education Resource Center (HERS). https://www.hersnetwork.org/programs/hers-institute/ (last accessed on 11/19/2022).
15. Executive Leadership in Academic Technology, Engineering, and Science. https://drexel.edu/provost/priorities/initiatives/elates/ (last accessed on 11/19/2022).
16. American Council on Education Fellows program. https://www.acenet.edu/Programs-Services/Pages/Professional-Learning/ACE-Fellows-Program.aspx (last accessed on 11/19/2022).

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Public Universities as Agents of Economic Prosperity

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All of higher education is facing challenges, most pervasively declining student enrollment due to demographics and changes in societal attitudes regarding the value of post-secondary education (Drozdowski, 2022; Milton, 2022). Public universities may feel these challenges more acutely; a study by the National Student Clearinghouse Research Center (2022) showed that public institutions had higher enrollment declines than private institutions. Meanwhile, costs of tuition and fees at public institutions continue to outpace inflation (Drozdowski, 2022).

Meanwhile, the pandemic continues to create its own challenges and exacerbate others, including faculty and staff burnout, student mental health issues, political polarization, and an evolving conception of the workplace (Higher Learning Commission, 2022).

Where do we go from here?

As the nation continues to move in halting steps away from the COVID-19 pandemic, researchers and research administrators are looking to the future. Many of the recently released (summer 2022) and forthcoming opportunities authorized under the American Recovery Plan and the Chips and Science Act seek to rebuild and strengthen the economy. This is coupled with an increasing trend of state and local governments looking to universities, particularly research universities, as engines of economic development.

K-State will continue to build on our traditional strength areas, particularly in the natural sciences, engineering, and agriculture; foster interdisciplinary work; and adhere to our land-grant mission to support communities and the state with innovations promoting economic prosperity.

KBOR Pillar 3: Advancing Kansas Economic Prosperity

Universities have historically worked to provide trained workers needed to fill jobs dictated by the economic conditions at the time, such as following the Civil War with the passage of the Morrill Act (Thelin et al.), which dictated the establishment of institutions that would provide practical education to larger portions of the citizenry than traditionally served by elite institutions.

K-State has designed a blueprint for the future developed in response to the 2020 strategic plan from the Kansas Board of Regents (KBOR), *Building a Future* (KBOR, 2020). This document defines three so-called pillars:

1. Helping Kansas Families
2. Supporting Kansas Businesses
3. Advancing Kansas Economic Prosperity

KBOR, with its articulation of Pillar 3, seeks to advance the *creation of jobs* and *direct investments* beyond state borders into Kansas. Creating the jobs of the future will require:

- Alignment of education and local, state, and federal government;
- Partnerships with private business, industry, and investors;
- Actively working, engaging, and leveraging the attraction of investment capital in Kansas' core strength areas; and

- Infrastructure investments, including in people, process, information, and technology (*e.*g., broadband).

KBOR made Pillar 3 a charge for the six Kansas Regents universities, with the responsibility for Pillar 3 initiatives residing with the university CEOs, and they went further to identify the leads for Pillar 3 working groups at each university. K-State's Pillar 3 planning team was the then-Vice President for Research Peter Dorhout, K-State Foundation CEO Greg Willems, and K-State Innovation Partners CEO Kent Glasscock. The charge from KBOR stressed that proposed programming and strategies must be focused on the two key metrics of jobs and investments.

K-State chose four focus areas for our Pillar 3 plan, reflecting our land-grant mission and the disciplinary areas in which we have primarily benefited from partnerships with the private sector. Small working groups of faculty and administrators developed the initial articulations of the goals for each focus area:

- Food and Agriculture Systems Innovation
  - Will build on our historic strengths in advanced breeding techniques and integrated cropping systems
- Digital Agriculture and Advanced Analytics
  - Will exploit existing computing capacity, work with artificial intelligence systems and precision agriculture
  - Will take advantage of the geographic one of a range of climatic zones across the state that mimic many of the significant agricultural regions globally
- Biosecurity and Biodefense
  - Will leverage BSL-1 through BSL-4 assets on and adjacent to campus and our partnership with USDA facilities including the National Bio- and Agro-Defense Facility
- K-State 105
  - Will build on the statewide research and extension network and its presence in all 105 Kansas counties to create a statewide economic development network

The final plan was submitted to KBOR in spring 2021 and subsequently approved. The Pillar 3 leadership team then turned its attention to rolling out and socializing the plan, which was redubbed as the Economic Prosperity Plan (EPP) (https://www.k-state.edu/research/economic-prosperity/).

Progress on the EPP

Four larger groups of faculty members were empaneled in spring 2022 to refine the vision for three of the focus areas and plan next steps. The charge was to identify the highest value sectors with the greatest potential to create jobs and/or attract investments, larger sponsored research opportunities that would be relevant, and companies with whom the university could partner to advance the efforts. The working groups were also asked about gaps in needed expertise or opportunities to build on selected areas of strength in order to help direct faculty recruiting. Finally, short-term implementation strategies were to be suggested.

The charge for the K-State 105 working group differed, appropriate to its distinctive vision. They were asked to identify a region of Kansas to conduct a two-year pilot in conjunction with a regional economic development partner working with appropriate K-State resources and other organizations.

Food and Agriculture Systems Innovation

This focus area in a nutshell:

- *New scalable multi-disciplinary links to enable sustainable systems-level food and ag research*

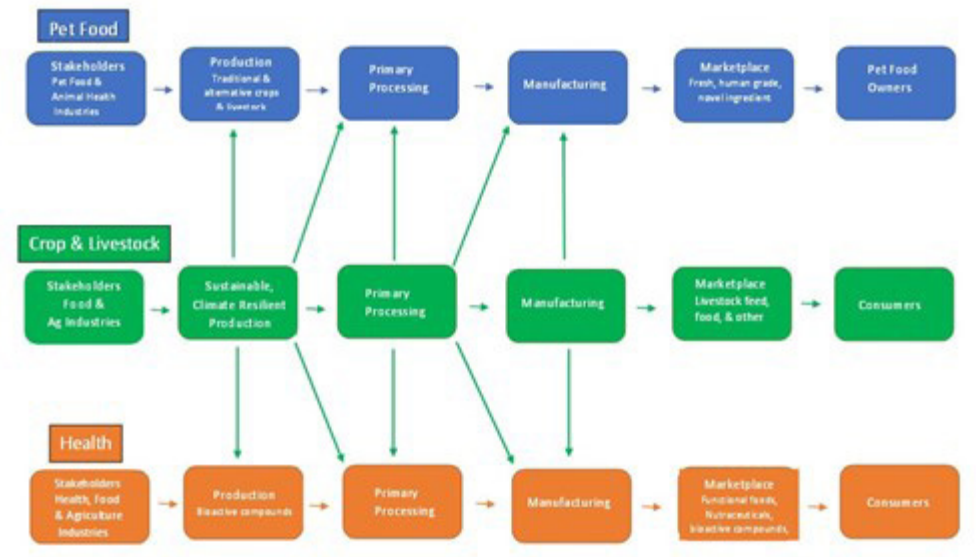

Figure 1. The proposed systems in pet food and health innovation.

- *Potential innovations in alternative crop development, value-added opportunities, and ag tech innovation and applications*

The Kansas Framework for Growth (KS Department of Commerce, 2021) focuses on five tradable industries. Kansas is twice as specialized as the national average in one of these industries: food and agriculture. The Framework for Growth specifically calls out leading higher education institutions specializing in food and agriculture to utilize extension systems and research facilities to make Kansas "a world-class home to research, development, and testing of new technologies in animal health, crop science, ag-tech and data analytics." This proposal directly responds to all four Kansas Framework for Growth strategic pillars—talent, innovation, community assets and policy—and how the shared strategies are seeking value-added opportunities, ag tech innovation, sustainability initiatives, and the targeted support of producers.

The Food and Ag Systems focus area proposes a stakeholder-driven, systems-level strategy that includes a transdisciplinary team of researchers, as well as regular engagement with an advisory board to identify appropriate opportunities and venues. Partners across food and agriculture systems will include industries, producers, processors, regional foundations, commodity and trade organizations, as well as government. Consumers will be involved at both ends of the food production pathway.

The spring 2022 working group proposed building upon traditional crop and livestock agroecosystems to support two new transformative focused systems, pet food and health. The emphasis will be on developing sustainable systems in this area, developing alternative crops, a novel approach to the pet food industry, and new opportunities to improve foods to positively impact human health (Figure 1).

Digital Agriculture and Advanced Analytics (DAAA)

This focus area in a nutshell:

- *Artificial intelligence for production agriculture*
- *Scale-independent precision agriculture, current and emerging threats to crops & precision livestock production*

This focus area envisions the incorporation of existing K-State expertise in advanced breeding techniques and integrated cropping systems research to better attract opportunities and establish strategies that grow the capabilities and capacity needed to firmly establish K-State as a global leader in DAAA. It draws on expertise from multiple K-State colleges to firmly establish K-State as a true "cyber-land grant" institution.

Kansas is uniquely positioned to serve as a DAAA development hub. The extreme variability of climatic and production conditions found in Kansas positions the state as an analog for a significant portion of U.S. and global dryland and irrigated agricultural regions. K-State's distribution of regional research and extension centers (Figures 2A and 2B) span this climatic gradient, making it an ideal laboratory for developing DAAA in the most variable and challenging environments.

The spring 2022 working group identified needs/goals that included a greater integration across disciplines, including artificial intelligence, specifically deep learning and machine learning; unmanned autonomous systems; sensor technology and networks; cyber-physical systems and cybersecurity; and relationships with multiple kinds of companies—traditional ag as well as equipment, sensor, and data/AI firms.

The group felt it important to establish an interdisciplinary center with dedicated physical space and eventually develop new academic programs that would emphasize the interdisciplinary nature of the field.

Biosecurity and Biodefense

This focus area in a nutshell:

- *K-State will add a Biologics Development Module under BSL-3 containment to the BRI, enabling private sector vaccine/therapeutics manufacturers and their university researcher partners a pilot production facility.*

K-State has made significant investments in biosecurity and biodefense and is currently the only university in the world at which researchers have access to a full spectrum of BSL1-4 facilities located on or adjacent to campus. BSL1-3 spaces exist on the Manhattan campus, with most of the latter at the Biosecurity Research Institute (BRI). The BSL-4 USDA National Bio- and Agro-Defense

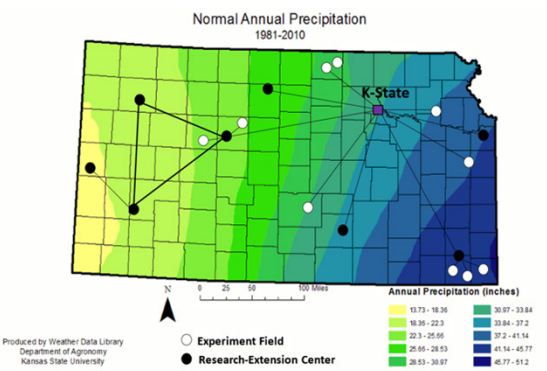

Figure 2A. Precipitation gradient across KS superimposed with locations of experiment fields and research-extension centers. Data from Weather Data Library, Department of Agronomy, Kansas State University.

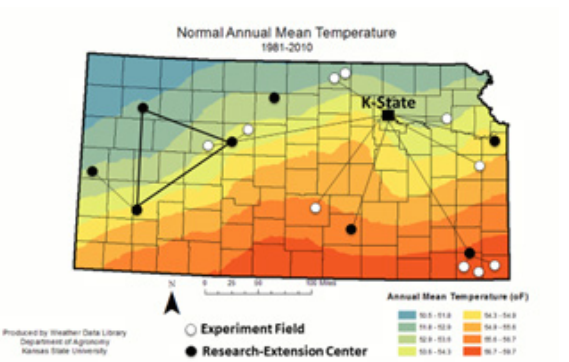

Figure 2B. Temperature gradient across KS superimposed with locations of experiment fields and research-extension centers. Data from Weather Data Library, Department of Agronomy, Kansas State University.

Facility (NBAF) is located immediately adjacent to the BRI and has established a number of partnerships and cooperative agreements with K-State units and individual researchers.

While extensive, K-State's biocontainment capacity for intellectual discovery at these facilities is not sufficient to advance economic development. We proposed to address this by adding a Biologics Development Module to the BRI. This BSL-2 facility strategy would increase capacity for commercialization and manufacturing to ensure technological advancements are utilized in practical application. This structure would streamline the discovery to commercialization process for industry partners by reducing the regulatory burden associated with conducting containment/non-containment and live animal/benchtop research at multiple institutions. The extensive talent and infrastructure in Manhattan will attract companies, entrepreneurs, and venture capitalists to the region. New technology will be developed for economically important plant, animal, and zoonotic infectious diseases. No other university will have comparable assets.

During the COVID-19 pandemic K-State has been in a unique position to pivot research and contribute solutions for global human health using existing resources. The BRI was instrumental in securing for K-State $12 million in funded grants, as well as several licensing agreements related to COVID-19. The notable limitation was the capacity for commercialization at this facility. The proposed strategies will allow K-State to become the foremost U.S. resource to facilitate private-public collaboration for research on pathogens of worldwide significance. These assets will strengthen relationships with industry and increase access to export markets for food and agricultural products. K-State's collective expertise in vaccine development, regulatory affairs, and flexible manufacturing capacity will not exist anywhere else in the world. A global reputation for success in discovery and commercialization will enhance our opportunities to attract corporate pharmaceutical partners, licensing agreements, and workforce talent.

Progress made on this focus area includes the Biotechnology Development Module being completed at the BRI—pilot plant for vaccine/biologics production; active planning underway to expand the Large Animal Research Center to support K-State researchers, NBAF scientists, and others; and a collaboration with Manhattan Area Technical College and Scorpion Biological Services to develop biomanufacturing education capabilities to serve Scorpion, as well as other biomanufacturing firms in the region.

K-State 105

This project in a nutshell:

- *K-State will augment its presence in 105 counties in Kansas, creating an "Every Town to Gown" initiative designed to deploy cutting-edge research and development, workforce development initiatives, and new practices that solve relevant problems, support community and economic development, and encourage connectivity between urban and rural areas. K-State will establish streamlined mechanisms for businesses and communities across the state to access our innovation, talent, and training through local liaisons and coordinated resources. This initiative will further our status as a leader in community vitality and focus on creating sustainable growth across the state.*

With research centers, experiment fields, and extension services throughout the state, K-State's campus literally extends to every county in Kansas. While our statewide presence and network already attracts state, federal, and private funding, strategically leveraging this core capacity will attract additional investment and corporate partners seeking

to build their workforce and advance the development of new innovations. From local rural communities to state-of-the-art laboratories, our network connects resources to regional needs and opportunities. K-State 105 promotes local collaboration and investments in the human, social, and financial capital of our Kansas communities.

Our statewide research presence, combined with the climate and soil variability across the state, provides unique opportunities for agricultural research. K-State can be expected to achieve this aspirational goal because of our well-established network of highly respected Extension professionals throughout the state, as well as through partnerships with existing state and local economic development professionals.

Initial phases will utilize existing resources to convene stakeholders to better understand statewide needs and match relevant university resources to assist with targeted solutions. The goal of these efforts is to have our existing resources engage communities at a deeper level to identify challenges they are facing and bring them forward to determine if K-State resources can be used to assist in accomplishing their goals. Later phases will include adding dedicated liaisons and more effectively coordinated operational units to deploy needs-based solutions. As these phases are deployed, the university will examine existing engagement processes and alter them in ways that streamline the engagement pipeline.

In order for aggressive implementation to occur, the K-State 105 initiative will require external resources, particularly to fund the convening and coordination capacity needed to truly leverage K-State's existing presence in 105 counties and the centralized resources that can support statewide needs. In addition to investment from federal, state, local, private industry, and nonprofits, this initiative will require a commitment from communities and regions, as well as university stakeholders and partners. Public and private partners who will help execute the strategies, include, but are not limited to:

- Small Business Development Center (SBDC) - Coordinate small business and entrepreneur research and technical assistance needs with university.
- Kansas Department of Agriculture (KDA) – Coordinate the implementation of the Kansas Agriculture Growth Strategy.
- Kansas Department of Commerce - As the state's lead economic development agency, administer programs and services to support businesses, grow the economy, and improve quality of life across the state.
- NetWork Kansas - Leverage statewide network of non-profit business building resources to assist small businesses and entrepreneurs.
- Kansas Board of Regents (KBOR) - Coordinate on the implementation of strategic initiatives across the Pillar 3 Economic Prosperity focus of the KBOR strategic plan.
- Business Resources for Innovation and Exporting (BRITE) Center – Assist in matching regional needs with resources including access to capital.
- Local Economic Development Partners - Partner with local county Extension to identify regional needs and opportunities related to business recruitment, retention, and growth, as well as workforce development and community vitality needs.

The spring 2022 working group established a programming plan that includes an innovation education series, innovation assistance services such as market research; workforce development assistance services; capacity building assistance services; and seed capital funding.

Two pilot projects are being planned

	Baseline 2019	2 years (2020-2021)	3 years (2020-2022)	5 years (2020-2024)	10 years (2020-2029)
Direct Jobs (FTE)	587	1,000	1,100	1,500	3,000
Annual Direct Wages	$41.1M	$70M	$77M	$105M	$225M
Direct Investment	$154M	$400M	$550M	$1B	$3B

Figure 3. EP Plan Metrics

with regional partners, one in rural northwest Kansas, working with the Northwest Kansas Economic Innovation Center, and one in Topeka, in conjunction with *Go Topeka*.

Summary

Our plan includes metrics and an ambitious 10-year goal (Figure 3).

To quote from our Pillar 3 strategic plan document submitted to KBOR: "K-State's Pillar 3 plan creates an initiative that will become a part of the university's long-term strategic plan and will be aligned with other related initiatives to increase efficiencies and impact and avoid duplication. The initiative will be focused on issues of primary importance to state policymakers and citizens of the state, jobs, and prosperity. This initiative will connect university efforts directly to the national and international marketplace where jobs and prosperity are a match between our capabilities and market needs at a scope and scale that has never happened before. The institution will naturally evolve in ways to take full advantage of the initiative, the global marketplace, and the issues of importance to Kansans. As with any other innovative advancement, K-State of the 21st century will evolve at much greater velocity than ever before."

References

1. Drozdowski, M. J. (2022). Seven challenges threatening the future of higher education. https://www.bestcolleges.com/news/analysis/7-challenges-threatening-future-of-higher-education/
2. Higher Learning Commission. (2022). 2022 trends. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi-0LP1soj6AhXLkYkEHQRLCRAQFnoECEUQAQ&url=https%3A%2F%2Fdownload.hlcommission.org%2FHLCTrends_INF.pdf&usg=AOvVaw2p5l-OToAjsIIo4a-T7g9u
3. Kansas Board of Regents. (2020). *Building a Future: Higher Education's Commitment to Kansas Families, Businesses, and the Economy*. https://www.kansasregents.org/about/building-a-future
4. Kansas Department of Commerce. (2021). *Kansas Framework for Growth*. https://www.kansascommerce.gov/kansas-framework-for-growth/
5. Milton, J. (2022). University and college presidents face challenges on the frontlines of higher education. https://www.forbes.com/sites/forbestechcouncil/2022/03/17/university-and-college-presidents-face-challenges-on-the-frontlines-of-higher-education/?sh=532aeaec59ad
6. National Student Clearinghouse Research Center. (2022). Current term enrollment estimates. https://nscresearchcenter.org/current-term-enrollment-estimates/
7. Thelin, J. R., Edwards, J. R., Moyen, E., Berger, J. B., & Calkins, M. V. (n.d.). Higher education in the United States. Retrieved September 9, 2022, from https://education.stateuniversity.com/pages/2044/Higher-Education-in-United-States.html

Intentional Research Team Building

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Many contemporary research challenges are associated with a level of complexity that requires solutions toward them to be developed by teams of scholars bringing relevant experience, innovative techniques, and interdisciplinary perspectives. As a result, over the last two decades, the scientific community has begun to pay considerable attention to team science as a method to enable advances not possible by a single laboratory or group.[1] Team science is now known to accelerate scientific and technological innovation and serve as an effective vehicle through which to translate research and scholarship into practice and policy.[2] More recently, team science scholars documented that the outputs of diverse research teams tend to be more novel and highly cited.[3] Because the fundamentals of team science and leadership are transferrable, and given the demonstrated affordances associated with inclusive team leadership, institutions are beginning to explore how they might best support faculty interested in obtaining the skills and experiences needed to lead large, collaborative, and diverse research teams.

The University of Nebraska-Lincoln (UNL) is taking an intentional approach toward research team building. It is focused on team formation and starts at the very beginning of the process by supporting the professional growth and development of research team leaders. This approach is distinctive because academic leadership programs focused on preparing departmental executive officers, deans, and provosts are common. However, initiatives focused on developing research team leaders—faculty with the confidence, skills, and experience required to shepherd large-scale, collaborative, and team science projects—are far more rare.

This paper introduces the Research Leaders Program (RLP), an initiative to identify and develop the next generation of research leaders at Nebraska.[4] It outlines the background and framework for the RLP, which started during the 2020-2021 academic year. In addition, this paper showcases research growth plans developed by two faculty who completed the program and concludes by summarizing program benefits and opportunities for additional refinement.

Background

UNL's Office of Research and Economic Development (ORED) has a long record of providing services and programs focused on supporting early career faculty ramping up their programs and senior, more established investigators pursuing large-scale extramural funding.[5, 6] However, around a decade ago,

senior research leaders at Nebraska noticed something of a gap that represented an opportunity space in the institution's portfolio of faculty support offerings. On the UNL campus, it was observed that a small number of faculty were routinely serving as magnet principal investigators and taking the lead on developing complex interdisciplinary, multi-institutional proposals. This led to thinking about what it would take for the institution to proactively develop the next generation of research leaders through a program to help faculty at mid-career and beyond win major external funding.

At the time, there were few examples of programs at U.S. institutions with an exclusive focus on research leadership development. The bulk of discoverable programming was focused on cultivating future academic leaders and growing the pipeline for future departmental executive officers, deans, and provosts.[7,8,9] The most relevant work chronicled in the literature was led by institutions in the United Kingdom.[10,11] Since the body of evidence was scant, ORED undertook something of a customer discovery process.

Senior ORED team members first met with six Nebraska faculty well-positioned to become future research leaders to find what they felt they needed to advance to the next level. The next step was asking a focus group of 12 established campus research leaders: "What do you know now that you wish you'd known then?" Collectively, faculty informants emphasized the importance of networking, a focus on innovation and impact, leadership development, and access to those at the highest levels of the university. These faculty-administrator conversations revealed that UNL's rising faculty research leaders are motivated and incredibly talented, but they indicated they would appreciate and benefit from support developing the skills needed to lead large, collaborative efforts.

The data from these conversations were used to have a conversation with colleagues in the Center for Executive and Professional Development (CEPD) in UNL's College of Business. Together, ORED and CEPD staff worked to create a program framework to help UNL research leaders maximize their potential and develop playbooks to achieve their research growth goals. The program framework is designed to help propel emerging research leaders—those individuals with the interest, vision, and motivation—to take their research programs to a higher and more collaborative level. It empowers research-active faculty with the information, skills, and connections they need to assemble and lead large-scale teams in the pursuit of major extramural funding. To achieve this, RLP centers on three objectives:

1. Develop the skills necessary to effectively build and manage large teams and projects.
2. Produce actionable roadmaps to secure major external funding.
3. Network with like-minded colleagues, university leaders, and public/private partners who can help advocate for and support the development of large, innovative, and impactful research programs.

RLP Content

RLP content focuses on the fundamentals of management and cutting-edge topics that high-impact research leaders need to know, including strategic, strengths-based leadership; goal setting; team science; diversity and inclusion; strategic communication; and innovation and design thinking. The program is delivered through five day-long modules. The group meets for one full Friday a month during the academic year (in September, October, November, December, and February). These sessions rely heavily on active learning and participant engagement. Many sessions are delivered by UNL faculty, but several are led by ex-

ternal instructors from the Santa Fe Institute; University of Arizona; University of California, Santa Barbara; University of Alabama at Birmingham; and University of Tennessee at Chattanooga.

The development of a personal research growth plan is a key element of the program. Participants are coached on a one-on-one basis to develop growth plans aimed at strengthening and elevating their research activities. Faculty spend half a day in March workshopping their research growth plan presentations. They receive peer and program instructor feedback before delivering final presentations in April. All faculty members who complete the program are granted a course release, funded by ORED, that they may use within the next two academic years to support the implementation of their growth plans.

Exemplar Research Growth Plans

Thirty UNL faculty have completed the RLP thus far. Each of them developed and presented their individual research growth plans as part of the program's capstone activity. During the program's final session each spring, participants present overviews of their research growth plans to their peers, associate deans for research, and executive campus leaders (e.g., chancellor, vice chancellors). When developing their research growth plans, faculty participating in the RLP are encouraged to develop a vision and mission for their program or laboratory, articulate a set of goals and a corresponding action plan, inventory existing resources available to support the actualization of their plan, and identify any resource gaps that may impede progress toward the fulfillment of their plans. Overviews of growth plans developed during the first two RLP cohorts are included below.

Amanda Ramer-Tait, PhD, Maxcy Professor of Agriculture and Natural Resources, Department of Food Science and Technology (2021-2022 RLP)

My participation in the RLP was very rewarding, and it benefitted me and our research program in multiple ways. First, it provided me with professional development beyond the lab bench and my research area. Second, it connected me with other faculty on campus—from history, English, and psychology—with whom I would typically not have the chance to interact. Finally, the program provided me with a framework to develop a strategic growth plan for our research program.

As a scientist, I was never exposed to the concept of strategic planning, but because RLP is delivered, in part, by faculty from UNL's College of Business, I learned to think about our research program as an enterprise—to think about our vision, our mission, our strengths, and how to set goals that move us forward. Now, I can more clearly articulate a vision for our team, which revolves around transforming human health through discovery and application of the principles and mechanisms underlying microbiota-host-diet interactions.

Our lab also now has a defined mission: to identify the causal relationships among gut microbes, diet, and disease processes. Our research team seeks to identify these causal relationships by creating and maintaining synergistic and multidisciplinary research collaborations and by combining molecular and bioinformatic tools with unique, preclinical gnotobiotic mouse models. Importantly, we support our research mission by mentoring students and postdocs in a safe and supportive environment that fosters their success as independent scientists.

RLP also taught me to think about what enables our lab to pursue this mission (i.e., our distinctive competencies). Critical to delivering on our lab's mission are my expertise and personal research accomplishments. I have been studying host-microbe interactions for over 20 years. Also enabling our mission is

our lab's strong track-record for student and trainee successes and the high value we place on teamwork, which we foster through social activities and togetherness.

The RLP also taught me to think about key resources that enable our growth. For us, our most important resource is our lab team. Another important resource is our network of collaborators in Nebraska, from across the U.S., and around the world. Also critical to our success is the Nebraska Gnotobiotic Mouse Program. Our germ-free mouse facility allows researchers to ask mechanistic questions about the role of the gut microbiota in health and disease. Another key resource and strategic partner in our growth is the Nebraska Food for Heath Center. The center's mission is to identify food crops and molecules that provide clinically proven health benefits through modulation of the gut microbiota.

Because of these unique competencies and key resources, our lab is now well-positioned to tackle three strategic research initiatives. We want to (1) establish causal roles for gut microbes and their metabolites in chronic diseases, (2) identify the diet-microbiota interactions that improve disease outcomes, and (3) design microbiome-based strategies for treating diseases. To focus our efforts, the strategic growth framework I developed during RLP allowed me to clearly define projects where our lab was the lead versus others where we play a supporting role. For each of these projects, I created multiple SMART goals and assigned them timelines. This exercise allowed me to identify resource gaps for the key projects we wanted to grow, to think about how to fill those gaps, and to select which of our projects to sunset.

The next steps for our research team include regular re-evaluation of where we are with respect to our goals and our mission—we accomplish more when we make these decisions together. I also want to use this strategic growth plan framework for my own personal professional growth and to build a sustainability plan for our Nebraska Gnotobiotic Mouse Program. Altogether, my RLP experiences have empowered me to think more strategically about how to grow a research program with impact.

Timothy Nelson, PhD, Professor, Department of Psychology (2020-2021 RLP)

As a part of my participation in the RLP, I developed a growth plan outlining new directions for my research with an emphasis on opportunities to build on my existing research program while setting ambitious goals for expanding my work. I am a pediatric health psychologist, and my research focuses on the interplay between early cognitive development, particularly executive control, and developmental trajectories of key health behaviors that affect long-term risk for obesity. I serve as principal investigator on multiple longitudinal studies funded by the National Institutes of Health.

In thinking about next steps for my research program, I identified an overarching goal to increase the impact and scope of my work in two important ways. First, I want to move toward conducting intervention and prevention research with children and adolescents. Up to this point, my research has been one step removed from intervention—focusing on identifying new potential targets for intervention but not actually designing and testing those new interventions. So, I want to take that next step and build on the findings of our longitudinal work and move into intervention development and evaluation to increase the applied impact of this research. Second, and also with an eye toward enhancing impact, I identified a goal of building strategic community partnerships to support the development and eventual dissemination of the inter-

ventions we will create into settings that serve children and adolescents.

Taken together, these new directions are intended to maximize the impact of our work on the health of children by translating our findings into new approaches for health promotion.

In considering how to tackle these ambitious goals, I identified some of the resources available to me and my team, as well as some of the gaps I needed to bridge.

In terms of resources, I found I could leverage existing NIH funding within my lab, the exciting findings emerging from our longitudinal studies, and some existing connections with community organizations. I also recognized there were significant gaps to fill. Most notably, I have relatively limited experience leading large-scale intervention research (particularly using randomized controlled trial designs). This is where I want my research to go, but I need to bolster my record in this area. It also became clear that I would need a plan for even more robust engagement with community partners to realize the dissemination goals of my plan. We have the beginning of this, but really need to step up the engagement to accomplish our goals.

With resources and gaps in mind, the next step in developing the growth plan was to develop specific strategies to achieve my goals. The big-picture summary is that I developed a multi-pronged approach to create strategic collaborations that would enhance our team's capacity to do intervention research and meaningfully engage with community partners.

To build capacity in intervention research, I am pursuing new collaborations with researchers who have extensive experience conducting large-scale, NIH-funded intervention studies in pediatric obesity. Their expertise and existing infrastructure for conducting randomized clinical trials will allow me and my team to rapidly scale up our capacity for translating findings from our longitudinal studies into new interventions. I have been fortunate to build on connections with consultants on my existing grants who have this specialized expertise, and we now have multiple intervention R01 proposals under review.

I am also pursuing more significant and formalized connections with community partners, including a network of local pediatric primary care practices and public schools. These relationships take time to build, but we are making excellent progress. For example, we strengthened our connections with a large pediatric primary care practice in town and wrote a grant that would explicitly focus on further developing this collaboration. This process has left us well-positioned to really engage with our community partners as this line of work matures. Overall, the process of developing and implementing a growth plan has been incredibly useful in directing my efforts to strategically build a research team to increase the impact of our work.

RLP Logistics

Currently, participation in RLP is limited to 15 faculty annually. Associate and full professors, as well as research associate and full research professors, are eligible to participate. A primary program goal is to leave many ladders down to attract the most diverse pool of potential participants. Each spring, ORED widely solicits nominations for prospective participants; however, nomination is not required, and all eligibly faculty may apply.

Applications are screened by senior leaders in ORED, and final selections are made based on conversations with associate deans for research and departmental executive officers. Three RLP cohorts have been seated: 2020-2021, 2021-2022, and 2022-2023. To date, faculty interest in

RLP has exceeded program capacity, and acceptance rates have ranged from 40% to 65% across the first three years of the program. Direct costs for RLP instruction average $5,000 per participant. Costs for course release vary by academic college at Nebraska—they range from a flat rate of $7,500 to one-sixth of a faculty member's salary. As a result, ORED invests $12,500 to $25,000 in each faculty member selected for RLP.

Conclusion

At Nebraska, the emphasis on developing research leadership is emerging as one of the cornerstones of the institution's approach toward supporting intentional research team building. For research teams to succeed, it is not enough for their leaders to be at the top of their game in pure research or creative activity. Through the RLP, the institution has intentionally made research leadership a focus. To date, program evaluation has been almost exclusively qualitative. Faculty participants have observed numerous benefits when asked to reflect on their RLP experiences. These benefits include being connected to like-minded, similarly motivated individuals; learning how to develop a research vision, mission, and growth plan; spending focused time reflecting on the innate strengths individuals bring to their leadership roles; and discovering opportunities for connecting and potentially collaborating with faculty from other units. Going forward, there is opportunity to assess program impacts and outcomes in a more rigorous way. The need for this will increase as additional institutions begin to implement faculty development programs focused explicitly on research leadership.

References

1. Bennett, M. L., Gadlin, H., & Levine-Finley, S. (2010). Collaboration and Team Science: A Field Guide. Available at https://www.researchgate.net/publication/220041906_Collaboration_and_Team_Science_A_Field_Guide.
2. Uzzi, B., Mukherjee, S., Stringer, M., & Jones, B. (2013). Atypical Combinations and Scientific Impact. Science, 342, 468-72.
3. Yang, Y., Tian, T., Woodruff, T., Jones, B., & Uzzi, B. (2022). Gender-diverse teams produce more novel and higher-impact scientific ideas. Proceedings of the National Academy of Sciences, 119(36), 18.
4. University of Nebraska-Lincoln Office of Research and Economic Development. (2022). Research Leaders Program. Available at https://research.unl.edu/researchleaders/.
5. University of Nebraska-Lincoln Office of Research and Economic Development. (2022). Proposal Development. Available at https://research.unl.edu/proposaldevelopment/home/.
6. University of Nebraska-Lincoln Office of Research and Economic Development. (2022). Research Development Fellows Program. Available at https://research.unl.edu/proposaldevelopment/rdfp/.
7. University of Nebraska-Lincoln Office of the Executive Vice Chancellor. (2022). Faculty Leadership in Academia: From Inspiration to Reality. Available at https://executivevc.unl.edu/faculty/leadership-development/flair.
8. Big Ten Academic Alliance. (2022). Department Executive Officers Seminar. Available at https://btaa.org/leadership/department-executive-officers-seminar/Introduction.
9. Big Ten Academic Alliance. (2022). Academic Leadership Program. Available at https://btaa.org/leadership/academic-leadership-program/introduction.

10. AdvanceHE. (2022). Research Leadership Development Programme. Available at https://www.advance-he.ac.uk/consultancy-and-enhancement/research-leadership-development-programme.
11. University of Leeds. (2022). Research Leadership Package. Available at https://researchersupport.leeds.ac.uk/research-leadership/research-leadership-package/.

The Impact of Automation on the Future of Work and Higher Education

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Higher education takes the inputs of faculty and students and produces the outputs of education credentials and scientific discovery. Until the turn of the 21st century, higher education was impervious to technological change. Faculty would lecture to students in person, assign readings, and conduct assessments designed to result in credentials that would be used in the labor market. The rise of the internet and related technologies has transformed higher education and the labor market in new and interesting ways. The COVID-19 pandemic required higher education to move online and teach remotely. Technology enabled these rapid changes and will have long-lasting effects on higher education and the type of work that our students will do in the future. In this essay, we consider the demographic challenges facing higher education, the role of robots, automation, and artificial intelligence (AI) in the labor market, and the downstream effects of AI on the student test score gap. We will conclude with a set of social science research recommendations that respond to the creative destruction of technological change.

Depressing Demographics

Kansas had below-average population growth of only 3% between 2010 and 2020, less than half the rate of U.S. growth of 7.4%. There were 35,000 fewer children in the state of Kansas in 2020 than there were in 2010. If matriculation patterns do not change, this means there will be fewer students attending universities in Kansas in the next decade. The Kansas Board of Regents estimated the number of high school graduating seniors by race for the next decade. Because there are meaningful correlations between race and higher education enrollment, we applied enrollment rates by race from 2019 to these projections in Figure 1 (on page 58). This figure shows that, at best, enrollment rates will remain flat in the next decade.

This likely reflects two factors: first we are in the echo of the "Baby Bust." The "Baby Bust" generation was much smaller than the preceding "Baby Boom," and their numbers of children are also lower. Total enrollments peaked in 2011 with 20.6 million students enrolled in higher education institutions. These were the children of the "Baby Boom." Since then, enrollments have dropped as the much smaller cohort of children of the "Baby Bust" went to college. In the fall of 2019, there were 18.2 million students, a drop of enrollments of 12%. COVID-19 made things worse and, as of the spring of 2021, only 16.9 million students were enrolled nationwide (National Clearinghouse, 2022).

The second factor pertains to race and higher education enrollment. U.S. enrollment in higher education tends to be highest for white students and lower for students of color who most often are first-generation college students. In Kansas and across the nation, there are proportionally fewer white children. These students historically have been more

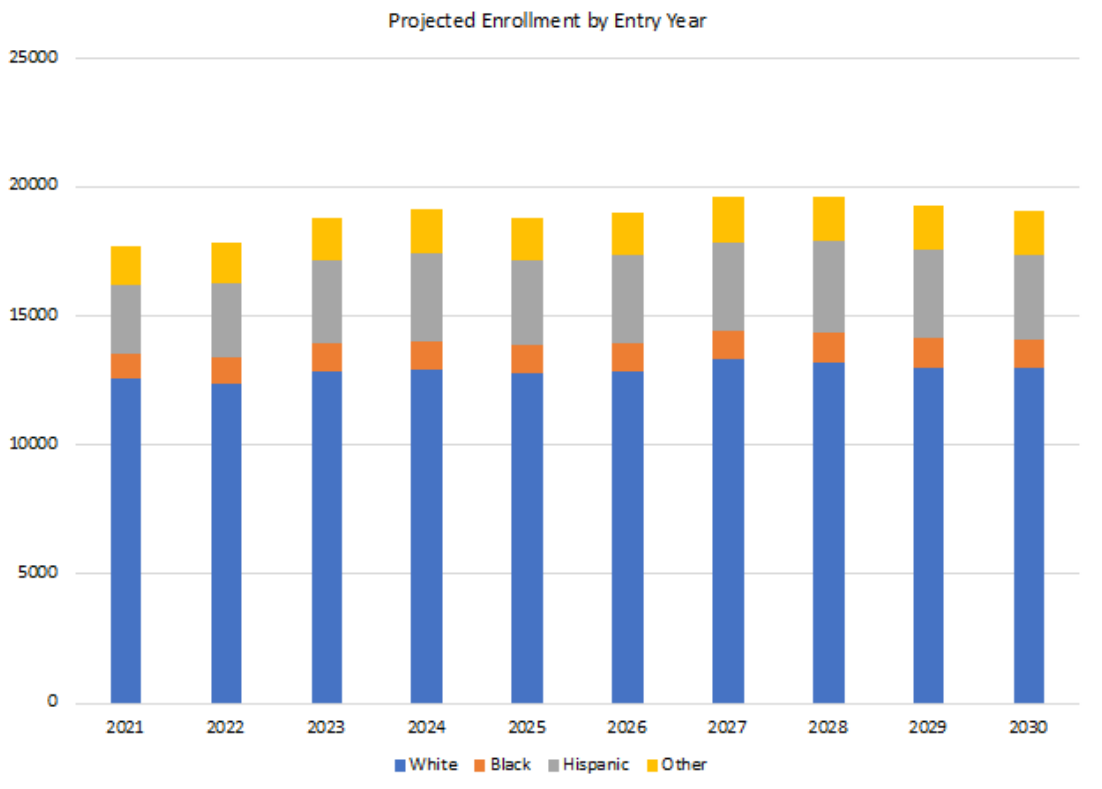

Figure 1: Projected Enrollment in Higher Education Institutions. Source: Kansas Board of Regents.

likely to attend college. Figure 2 (on page 59) shows the share of the Kansas population under the age of 18. Kansas has a higher share of the population under the age of 18 (24%) than the U.S. as a whole (22%). Color saturation for a geographic area in Figure 2 indicates a higher concentration of children in the population. Southwestern Kansas counties have higher concentrations of children. These counties also have higher numbers of immigrants. Because immigrants are more likely to be children of color, this suggests that the future students in Kansas will be more likely to be children of color. In the past decade, over 2,600 more Hispanic students graduated from Kansas high schools while 1,900 fewer white students graduated. Again, students of color have been less likely to enroll in higher education than white students. These depressing demographics suggest that fewer students will be enrolling in Kansas universities for the foreseeable future.

Creative Destruction and the Future of Work

With the backdrop of these depressing demographics, technology is changing work as we know it. In *Capitalism, Socialism & Democracy*, Joseph Schumpeter discussed how the dynamic economy evolves (p. 83):

> The opening up of new markets, foreign or domestic, and the organizational development from the craft shop to such concerns as U.S. Steel illustrate the same process of industrial mutation—if I may use that biological term—that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism.

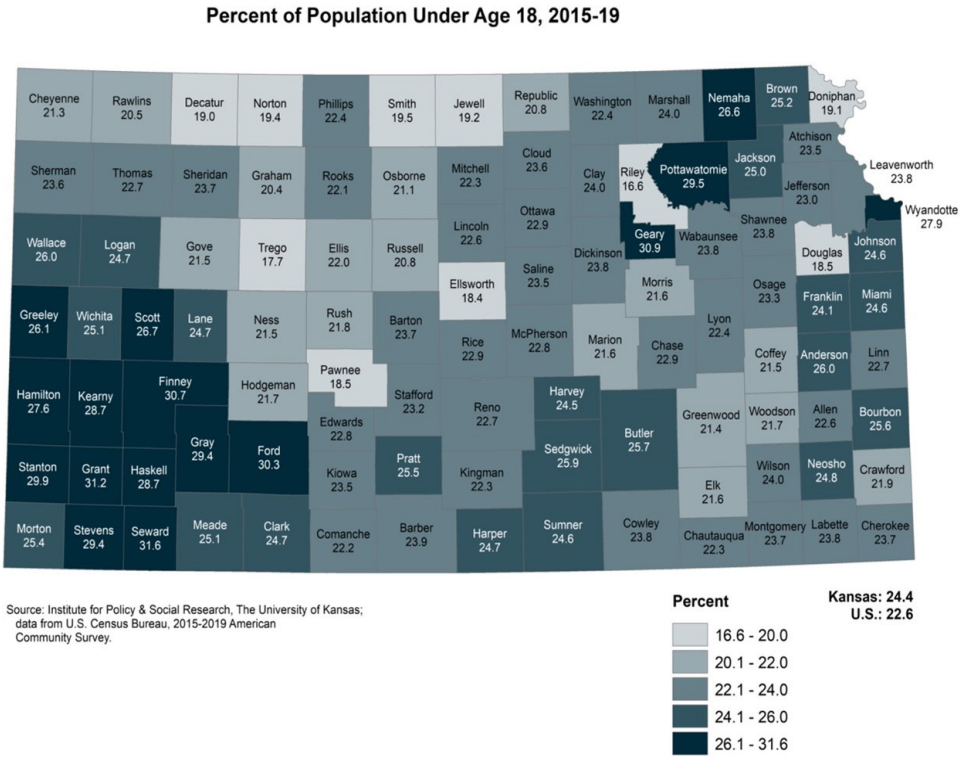

Figure 2: Percent of Population under the Age of 18. Source: Estimates from the American Community Survey 2015-2019.

While Schumpeter was not discussing technological change per se, technology "incessantly revolutionizes the economic structure from within." Technology eliminates jobs and industries. Desktop publishing eliminated the job of typesetter, and those who worked for printing companies left to find new work. Resources shift from declining industries to new industries so that former typesetters now become web designers. However, in the United States, where the social safety net is often an afterthought, individual workers bear the costs of creative destruction in the form of job loss and lower wages.

A seminal paper by David Autor, Frank Levy, and Richard Murnane (2003) developed a taxonomy of tasks that were subject to automation (job destruction). Tasks were divided into a quadrant of routine, non-routine, cognitive, and non-cognitive. Computers and robots displace workers in routine cognitive and non-cognitive tasks. For example, computers and robots replaced workers on assembly lines (routine, non-cognitive) and in bookkeeping (routine, cognitive). However, Autor, Levy, and Murnane (2003) also argued that non-routine tasks, both cognitive and non-cognitive, would be less likely to be displaced. Truck driving, the largest occupation of men in the United States, is an example of a non-routine, non-cognitive occupation. Legal work would be an example of non-routine, cognitive work.

The long-term effects of the creative destruction of technology can be observed in the agriculture industry. As agriculture became increasingly automated, farm labor declined significantly. Figure 3 (on page 60) shows the number of farmers and farm laborers in the U.S. from 1850 to 2015. The number of farmers peaked at 6.5 million in 1920. Automation decreased the number of farmers and

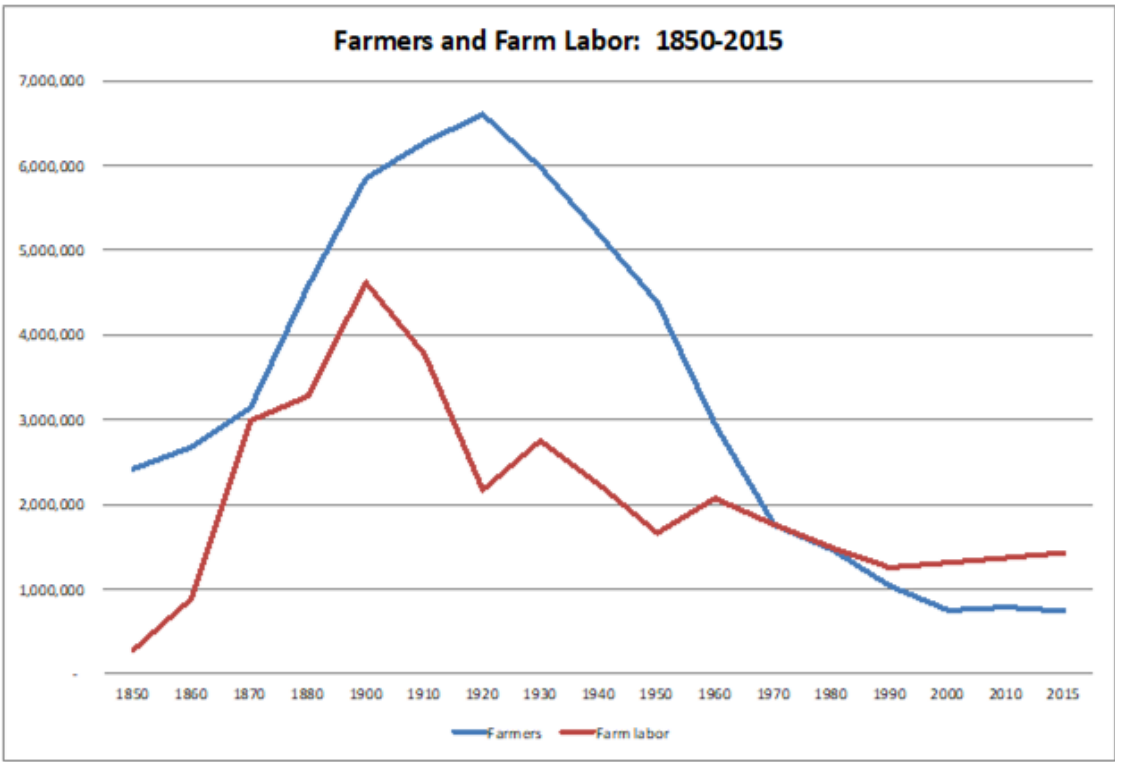

Figure 3: Farmers and Farm Laborers in the United States, 1850-2015.

farm laborers. Farms grew in size over time, so that the number of farm laborers now exceeds the number of farmers. Automation, coupled with economies of scale reduced total employment in agriculture. This trend continues with the introduction this year of the John Deere Fully Autonomous Tractor. The tractor uses a GPS guidance system and can be controlled by a mobile phone app. Now a farmer can plow a field from the comfort of his living room. In the next two or three decades, the production of wheat in Kansas may no longer require labor.

Clearly, agriculture was a victim of its own success in terms of employment, and former farm workers moved into other sectors such as trucking or transportation. Twenty years ago, the non-routine, non-cognitive work of driving a truck could not be automated. Now as many as 18 companies are developing autonomous trucks (Ribiero, 2021). Autonomous vehicles may soon replace truck drivers—again, the largest occupation for men. As technology makes rapid improvements, jobs that are non-routine and non-cognitive tasks may soon be eliminated by artificial intelligence.

This is also happening for highly skilled workers. For example, attorneys are being displaced by artificial intelligence systems. Electronic discovery products reduce the demand for attorneys and paralegals. Today, non-routine, cognitive and non-cognitive jobs are increasingly subject to automation and creative destruction.

Consider the following projections. Any task that can be broken into codifiable steps, regardless of complexity is increasingly prone to AI-driven automation. This leaves humans the inherently non-routine tasks that involve higher order capabilities (Jaimovich et al., 2021). Other researchers have predicted that AI will replace between 20% and 47% of all occupations in the U.S. economy by 2035 (Frey and Osborne, 2017, Felten, Raj, and Seamans, 2018; Nedelkoska and Quintini,

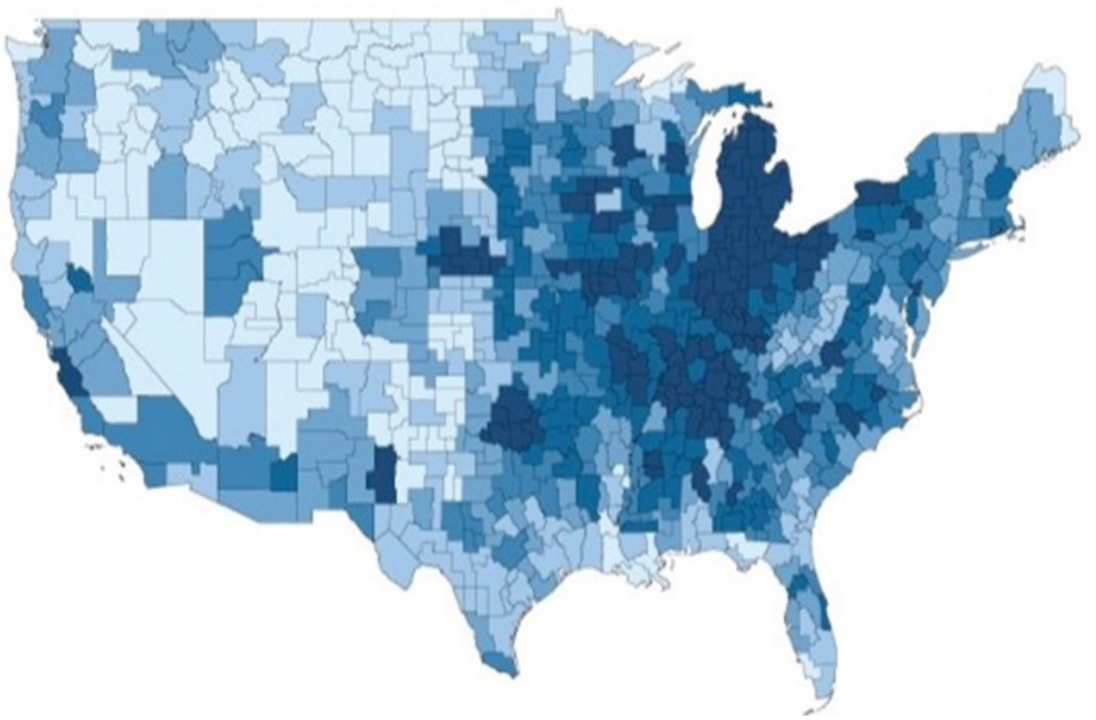

Figure 4: Occupation Automation Risk (OAR) by Commuting Zone.

2018). According to Manykia et al. (2017) about 60% of occupations will have at least a third of tasks that can be fully automated within a decade. This translates into 51% of the U.S. economy accounting for $2.7 trillion in wages. We now consider the impact of artificial intelligence in the labor market on the children of these workers.

Robots, AI, and the Test Score Gap

Economists Daron Acemoglu and Pascual Restrepo examined the impact of industrial robots on the U.S. labor market (Acemoglu & Restrepo, 2020). They estimated that each new AI-powered robot per 1,000 employees in a commuting zone eliminates 3.5 employees and reduces real wages by 0.5%. Over five years, more than 5,000 jobs would be lost, and real wages would decline by 7.5%. In our study, we investigate whether these jobs and earnings losses affect the families, communities, and student achievement. We hypothesize that AI automation coupled with import competition and offshoring has negative externalities for family structure, affected communities, and school resources. We expect that children living in commuting zones that experience increased exposure to AI-automation will experience declines in achievement in mathematics and reading.

Using the American Community Survey (ACS), we assigned an AI exposure score to each occupation. Figure 4 (above) shows the Occupation Automation Risk (OAR) by commuting zone in the U.S. The darker colors indicate higher OAR. Eastern Kansas faces a significantly higher OAR than western Kansas, but not as high as Missouri. Using two-way fixed effects estimation, we estimated the effect of commuting zone OAR on the test score gap—the gap between test scores for the economically advantaged and disadvantaged in mathematics in Figure 5 (on page 62). Economically advantaged students have higher achievement than the disadvantaged students. The gap grows with each year and is significantly different from zero. By 2018, economically advantaged students have 4% of a standard deviation in higher mathematics test scores controlling for the OAR.

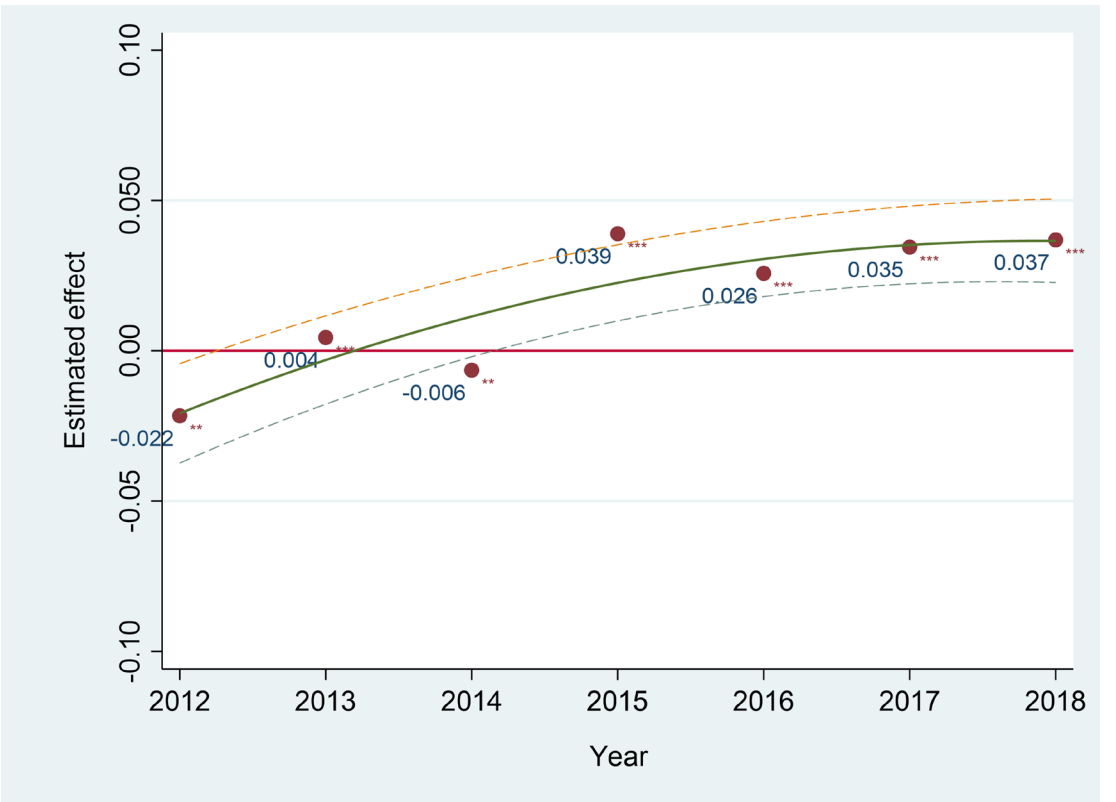

Figure 5: Estimated test score gap in mathematics between Economically Advantaged and Disadvantaged Students controlling for Occupation Automation Risk. ** p<.01, ***p<.001

This gap is troubling because students of the future are more likely to come from groups that have been historically disadvantaged. Technological change in the form of AI will increase the demand for non-routine skills. The jobs of the future will require quantitative skills and advanced degrees. This is good news for the higher education sector. However, AI and robot penetration increases the gaps between economically advantaged and disadvantaged students. Economically disadvantaged students are already less likely to matriculate in postsecondary institutions, and AI penetration appears to generate further academic and economic disadvantage.

AI and the Future of Social Science Research

Although AI penetration has a negative impact on the educational achievement of future generations, the same forces provide significant opportunities for social science research. The availability of big data sets and causal analysis revolution have created a "Golden Age" of social science research (Buyalskaya, Gallo, & Camerer, 2021). The COVID-19 pandemic underscored the importance of social science research. Despite the significant health hazards caused by the pandemic, many people did not heed expert advice and were opposed to wearing masks and getting vaccinated. Models of the spread of COVID-19 failed to adjust for the endogeneity of behavior. These are research questions that are the purview of social scientists.

The internet, social media, mobile phone technologies, and the government have generated an ocean of data that can be used to address the fundamental questions facing society. In addition, basic research funding is increasing to address these questions. There are a series of grand challenges facing social scientists:

- Economic inequality and poverty persist by race, gender, nativity, and educational attainment.
- What is the future of work? As discussed earlier, robots and AI will destroy jobs and undermine educational attainment. How do we equip the next generation with the skills they need to live successful lives?
- Science and innovation will be needed to address social challenges. How do we convert research discovery into products and policies that improve our world?
- Political polarization, fueled by technological change, social media, misinformation, and the mistrust of experts is giving rise to authoritarianism. How do we preserve our democratic institutions?
- Climate change is upon us, and massive population displacements have begun already. Will we be able to feed 8 billion people when droughts and disasters destroy agricultural capacity?
- In the face of climate change, automation, and education inequality, how will we, as a society, address health disparities?

Social science addresses these challenges with the same data that is used to develop artificial intelligence. Evidence-based policy that uses data to inform decisions will be critical as we confront the challenges of climate change, political polarization, and the future of work. Science and social science research will provide answers to these pressing challenges, but we as academics need to do a better job of communicating our findings to a broader audience. We need to transform Big Data to Knowledge (NIH, 2021).

The future of social science research will rest upon large administrative data sets that are linked together, generating Big Data to Knowledge (BD2K). Employers are desperate for workers with data skills. According to *Fortune*, data science jobs have grown 480% since 2016. While data skills are important, AI algorithms are only as good as the data used to train the system. Social science is necessary to develop unbiased algorithms and ensure that approaches to dataset development and deployment are sound.

Social science focuses on bias and inequality in society. Data collected by surveys or algorithms reflect these biases. If data scientists adopt a naïve approach to model-building, their AI algorithms and models will reinforce the bias baked into the data. Studies have shown that racial bias in algorithms have discriminated against black patients (Obermeyer et al., 2019). Using these algorithms without understanding how bias and historical inequality influences predictions will exacerbate the bias and inequality in society. Thus, data science approaches should be informed by social science perspectives. Left to its own devices, data science focuses on data reduction and prediction. However, to draw fundamental insights from data, it is important to understand the data generating process: in other words, society. Social science builds these skills in our students while investigating pressing questions facing society.

Conclusions

In this essay we have argued that demographics and technology are reshaping higher education, employment, and educational attainment. Kansas' low population growth means that higher education enrollments will remain flat for at least the next decade. We demonstrated that artificial intelligence and robots are the driving force behind creative destruction in the economy and employment.

Artificial intelligence is skill-biased, meaning that higher education will be

needed to obtain the jobs of the future. Our preliminary evidence suggests that AI is associated with an increase in the mathematics test score gap. More work remains to be done to understand the mechanisms behind the growth in the test score gap between the economically advantaged and disadvantaged. That said, it appears that AI and robots destroy jobs today and may generate additional disadvantage and inequality for the next generation.

The same factors that have created job destruction have also contributed to the "Golden Age of Social Science." The world is awash in data, and the skills taught by social scientists will prepare our students for high-demand occupations such as data scientists. Data scientists will benefit from a firm understanding of social science in order to prevent AI algorithms from reinforcing the bias and inequality that exists in society.

References

1. National Student Clearinghouse Research Center. (2022). *National Student Clearinghouse*. https://nscresearchcenter.org/current-term-enrollment-estimates/
2. Schumpeter, J. A. (1976). *Capitalism, Socialism and Democracy.* Oxfordshire: Routledge.
3. Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics*, 118 (4), 1279–1333. DOI: 10.1162/003355303322552801
4. Ribiero, J. (2021). 18 companies and startups that are leading the race for the autonomous trucks. *The AI Enthusiast.* Accessed at https://medium.com/tech-cult-heartbeat/18-companies-and-startups-that-are-leading-the-race-for-the-autonomous-trucks-4ba5a50e6dee
5. Jaimovich, N., Saporta-Eksten, I., Siu, H.E., & Yedid-Levi, Y. (2021). The macroeconomics of automation: Data, theory, and policy analysis. *Journal of Monetary Economics,* 122:1-16.
6. Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change,* 114, 254-80.
7. Felten, E. W., Raj, M., & Seamans, R. (2018). A method to link advances in artificial intelligence to occupational abilities. *AEA Papers and Proceedings,* 108, 54-7.
8. Nedelkoska, L., & Quintini, G. (2018). Automation, skill use, and training. *OECD Social, Employment and Migration Working Papers,* #202. Paris, France.
9. Manyika, J., Chui, M., Mermadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst. M. (2017). *A Future That Works: Automation, Employment, and Productivity*. Brussels, Belgium: McKinsey Global Institute.
10. Acemoglu, D., & Restrepo, P. (2020). Robots and jobs: Evidence from US labor markets. *Journal of Political Economy*, 128 (6), 2188-2244.
11. U.S. Census Bureau. (2022). *American Community Survey (ACS).* Accessed at https://www.census.gov/programs-surveys/acs
12. Buyalskaya, A., Gallo, M., & Camerer, C. F. (2021). The Golden Age of social science. *Proceedings of the National Academy of Sciences*, 118:5. DOI: 10.1073/pnas.2002923118
13. National Institutes of Health Office of Strategic Coordination – The Common Fund. (2021). *Big Data to Knowledge.* Accessed at https://commonfund.nih.gov/bd2k
14. Obermeyer, Z., Powers, B., Vogeli, C. & Mullainathan, S. (2019). Dissecting racial bias in an algorithm used to manage the health of populations. *Science,* 336, 447–453.

Persistent and Consistent Underpromotion of Women in Academic Medicine: It's Time to Make Some Waves

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Merging medical school graduate and faculty data spanning 1979-2018 from the Association of American Medical Colleges, we compared expected versus actual proportions of women promoted. We calculated survival curves and hazards models to examine differences between early and later cohorts. The sample included 559,098 students graduating from 134 U.S. medical schools. For promotion to upper ranks (associate/full professor) and department chair, the great majority of class cohorts had fewer women than expected achieve promotion. Findings were similar across basic science and clinical departments. In adjusted analyses, women assistant professors were less likely to be promoted to associate professor after adjusting for graduation year, race, and work in clinical versus basic science department. Similar gender disparities were found for women's promotion to full professor and appointment to department chair. Women from recent medical school cohorts were less likely to be promoted to associate or full professor, and less likely to be appointed chair, than women from original study cohorts. Twenty years later, women physicians are no closer to promotion equity.

Introduction

Twenty years ago, a landmark longitudinal cohort study of medical school graduates from 1979 to 1997 demonstrated that high rates of women physicians were entering the ranks of academic medicine as assistant professors, but were not advancing in rank to associate or full professor at the same pace as men (Nonnemaker, 2000). Since then, a number of studies have focused on the promotion gap. A 2014 cross-sectional study (Jena et al., 2015) found that gender disparity in promotion remains even after accounting for age, experience, specialty, and research productivity. We here summarize findings from an update of Nonnemaker's study that includes additional cohorts from 1997 to 2018 (Richter et al., 2020). We also report analyses of the intersection of race and gender on promotion, as well as analyses of the impact of gender on attrition.

Methods

Data from the AAMC Student Records System (SRS) include every gradu-

ate of U.S. MD-granting medical schools. Data from the AAMC Faculty Roster include information on every full-time faculty or department chair appointment ever held by a graduate of a U.S. MD-granting medical school. Our main outcome measures were full-time faculty appointments at the level of assistant, associate, full professor, and department chair. We calculated the actual versus expected numbers of women who were promoted to each rank. The expected number was the number of women who would have achieved a given rank under conditions of parity between women and men on the basis of their representation in a given graduation cohort. For the analysis of appointment to department chair, we included all faculty who held associate or full professor positions.

We used nonparametric Kaplan-Meier survival curves to depict time to promotion by gender and rank across all study cohorts (1979-2013) and between original (1979-1997) versus later (1998-2013) cohorts. We estimated differences in the average "hazards" for promotion between genders using four sets of Cox Proportional Hazards models. The first set of models used the censoring criteria as described (above) and described the risks for promotion/appointment across all cohort years adjusting for year of graduation, race, and department type (where applicable). The second set of models examined whether hazards for promotion have changed between the original cohorts included in the 2000 landmark paper (1979-1997) versus later cohorts (1998-2013) added by this paper. Details of the methods and results are available in our full publication (Richter et al., 2020).

Results

Our sample consisted of 559,098 medical students. Women accounted for 38.9% of graduates and 40.8% of assistant professors, reflecting women being slightly more likely to choose a career in academic medicine than men. Woman graduates were more diverse than male graduates with 33.3% versus 24.4% racial/ethnic minorities, respectively.

Actual Versus Expected Representation of Women in Faculty Ranks

Cohort analysis, appointment/promotion to associate, full professor, and chair.

Among assistant professors, across 32 of 35 medical school graduating cohorts, fewer women than expected were promoted to associate professor (Table 1). This difference ranged from 3% (1979 cohort) to 10% (2010 cohort) (not shown). In no cohort did women exceed the rate of promotion of males to associate professor. Among associate professors, across 28 of 35 cohorts fewer women than expected were promoted to full professor. This difference ranged from 3% (1986 cohort) to 19% (2000 cohort) (not shown).

Table 1. Summary of actual versus expected promotion to associate professor, full professor, and department chair.

Promotion/Appt to:	No. cohorts in which actual is equal to or greater than expected	No. of all cohorts in which actual is less than expected	No. of all cohorts in which fewer women were promoted than expected and 95% CIs did not cross 0
Associate professor	3	32 of 35	28 of 35
Full professor	7	28 of 35	22 of 35
Chair	4	31 of 35	19 of 35

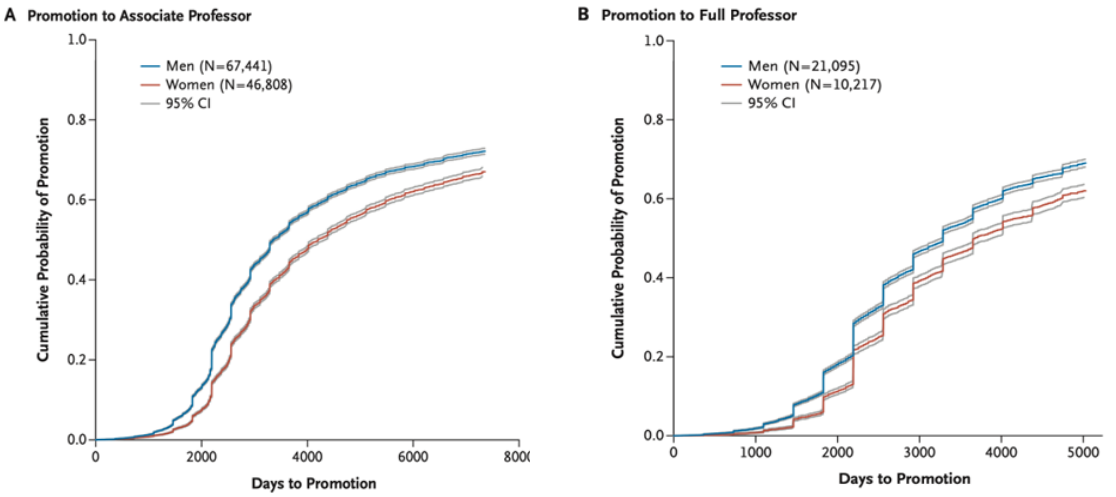

Figure 1. Kaplan-Meier survival curves depicting time to promotion for male versus female faculty.

In two cohorts women exceeded proportional promotion by just one more promotion than expected. Across 31 of 35 cohorts, fewer women than expected were appointed to lead a department as chair. This difference ranged from 7% (1981 cohort) to 25% (1999 cohort) (not shown). In no cohorts did women exceed the proportion of appointments of males to department chair.

Survival Analysis

Kaplan-Meier survival curves for time to promotion by gender suggest that women are appointed to assistant professor earlier and at higher rates than men (not shown). Men, however, are promoted more quickly to associate and full professor (Figure 1) and appointed more quickly to chair (not shown). Curves by gender never converge or cross—women never catch up to or exceed rates of promotion achieved by men.

Cox Proportional Hazards Models

With respect to promotion to associate professor, across all cohorts, women were 24% less likely to be promoted compared to men (0.757, CI=0.739, 0.776) (not shown). Women's odds for promotion in later cohorts were approximately the same as women's odds for promotion in earlier cohorts (Table 2).

Table 2. Summary of odds for promotion to associate professor among assistant professor, comparison of early versus late cohorts.

	Hazard Ratio (95% CI)
Female for 1979-1997	0.754 (0.733, 0.776)
Male for 1979-1997 (reference)	--
Female for 1998-2013	0.755 (0.723, 0.788)
Male for 1998-2013 (reference)	--

Trends are actually worse for promotion to full professor and appointment to chair. To full professor, across all cohorts, women were 23% less likely to be promoted compared to men (0.773, CI=0.740, 0.807) (not shown). The hazards model with sex by cohort interaction terms finds that women in the later cohorts had 27% lower odds for promotion compared to women in the earlier cohorts (not shown). Across all cohorts, women were 54% less likely to be appointed to chair compared to men (0.458, CI=0.392, 0.536) (not shown). The hazards model with sex by cohort interaction terms finds that wom-

Table 3. Hazards of promotion to associate professor by race/ethnicity, sex, and graduation decade.

Assistant to Associate: Hazard Ratio (95% CI)

		Graduation Decade				
Race	Sex	70s	80s	90s	00s	10s
AI/AN/ NH/PI	F	0.83 (0.47, 1.47)	0.85 (0.57, 1.25)	0.87 (0.65, 1.15)	0.89 (0.63, 1.24)	0.91 (0.55, 1.51)
	M	0.66 (0.38, 1.15)	0.67 (0.47, 0.97)	0.69 (0.53, 0.88)	0.70 (0.51, 0.95)	0.71 (0.43, 1.16)
Asian	F	0.88 (0.79, 0.99)	0.83 (0.77, 0.89)	0.77 (0.74, 0.81)	0.73 (0.68, 0.77)	0.68 (0.62, 0.75)
	M	1.30 (1.18, 1.42)	1.21 (1.14, 1.28)	1.13 (1.08, 1.17)	1.05 (1.00, 1.10)	0.98 (0.90, 1.06)
Black	F	0.40 (0.34, 0.47)	0.44 (0.39, 0.48)	0.47 (0.44, 0.51)	0.51 (0.46, 0.56)	0.55 (0.48, 0.64)
	M	0.53 (0.46, 0.61)	0.57 (0.52, 0.63)	0.61 (0.57, 0.67)	0.66 (0.59, 0.74)	0.71 (0.61, 0.84)
H/L/ MRH	F	0.57 (0.48, 0.67)	0.56 (0.50, 0.63)	0.56 (0.51, 0.61)	0.56 (0.50, 0.62)	0.55 (0.47, 0.64)
	M	0.75 (0.65, 0.86)	0.74 (0.67, 0.81)	0.73 (0.68, 0.78)	0.72 (0.65, 0.79)	0.71 (0.61, 0.82)
O/MRNH /U	F	0.52 (0.35, 0.75)	0.53 (0.40, 0.71)	0.54 (0.44, 0.68)	0.56 (0.45, 0.69)	0.57 (0.44, 0.75)
	M	0.87 (0.64, 1.18)	0.89 (0.72, 1.11)	0.91 (0.78, 1.07)	0.93 (0.78, 1.11)	0.95 (0.74, 1.22)
White	F	0.76 (0.72, 0.80)	0.77 (0.74, 0.79)	0.77 (0.75, 0.79)	0.78 (0.75, 0.81)	0.78 (0.74, 0.83)
	M	Reference	Reference	Reference	Reference	Reference

en in the later cohorts had 55% lower risk for being appointed compared to women in the earlier cohorts (not shown).

Promotion by Race/Ethnicity, Sex, and Graduation Decade

We provide here preliminary, unpublished data based on analyses of a data set with several additional years of medical school cohorts. White males had better odds of promotion to the rank of associate professor than almost all other racial/ethnic and sex groups identified, and these differences were reflected over the span of four decades of data analyzed (Table 3). Trends are similar for promotion to full professor and department chair (not shown).

Retention by Race/Ethnicity, Sex, and Graduation Decade

We describe here preliminary, unpublished data based on analyses of a data set with several additional years of cohorts. We are finding that women faculty leave academic medicine a median of one year earlier than men. Racial and Ethnic minority faculty leave academic medicine a median of one to four years earlier than White faculty.

Discussion

The glass ceiling persists in academic medicine. In an era where women have closed the medical school admission gender gap (Colleges, 2020), women remain underrepresented in upper faculty ranks. These new analyses find that compared to men, women are less likely to be appointed to department chair. Results are consistent across 35 years of graduating classes. Survival analysis suggests that women never close the promotion gap. Adjusting for race/ethnicity, year of graduation, and type of department did not eliminate gender differences in promotion. Notably, woman associate/full professors are half as likely as men of equal rank to be appointed to department chair.

Interaction terms examining early versus late cohorts by sex find that women, if anything, are losing ground in terms of promotion. This confirms findings from other recent studies. A study published in 2018 found that, over 17 years among 1,273 faculty at 24 U.S medical schools, women were less likely to attain leadership positions such as dean, associate dean, provost, and department chair than men, even after adjusting for publication-related productivity (Carr et al., 2018). A cross-sectional analysis of cardiology faculty at U.S. medical schools found that women were less likely to be full professors after accounting for years

since residency, cardiology sub-specialty, publications, NIH grants, and registered clinical trials (Blumenthal et al., 2017) .

Academic medicine appears to be falling behind Science, Technology, Engineering, and Mathematics (STEM) in eliminating gender differences in promotion (Williams & Ceci, 2015). Across 2,966 assistant professors in science and engineering tracked over time at 14 U.S. universities, men and women were retained and promoted at the same rate in all departments except for mathematics (Kaminski & Geisler, 2012).

Our preliminary analyses of the intersection of race/ethnicity and sex on promotion suggest that women of color face a "double-whammy." Analyses of retention by race/ethnicity and sex yield similar findings.

There are numerous potential causes of disparities in promotion and retention. These include a persisting "old boys club" mentality and climate; lack of gender parity in leadership and compensation; lack of retention of women; disproportionate burden of family responsibilities; and difficulties in achieving work-life balance (Carr et al., 2015). A nationally representative survey at U.S. medical colleges found that female faculty had similar leadership aspirations as male faculty but a lower sense of belonging and were less likely to perceive their institution as family friendly or willing to make changes to address diversity goals (Pololi et al., 2013).

Lack of women at higher ranks, especially in chair positions, may perpetuate the cycle. Women are underrepresented among residency program directors, who are role models and sponsors for career advancement (Long et al., 2011), and on medical journal editorial boards, which prioritize areas of research and select who gets published (Amrein et al., 2011).

Lower earnings, harassment, or disproportionate family responsibilities could cause women to drop out of academic medicine (Jena et al., 2016) or forgo advancement. Nearly one in three woman physicians and clinician-researchers report experiencing workplace sexual harassment (Adesoye et al., 2017; Jagsi et al., 2016), which appears to be more common in academic medical centers than in community or outpatient medical settings (Nora et al., 2002). Most woman physicians have children (Jolly et al., 2014), and most physician mothers report they experienced discrimination due to being pregnant, taking maternity leave, or breastfeeding on the job (Adesoye et al., 2017).

Conclusions

Twenty years later, women are still less likely to advance into upper faculty ranks than men, barriers appear to be worse for faculty of color, and retention rates are lower for women and faculty of color. To address this, two recent reports propose changes to the academic work environment (Butkus et al., 2018; Carr et al., 2019) designed to remove systemic barriers to career advancement and supplement programs in place for women at signal institutions (Laver et al., 2018). Making academic medicine a better environment for women would likely improve the environment for all faculty. Concerted efforts are needed to remove the additional barriers to advancement and retention among faculty of color.

References

Adesoye, T., Mangurian, C., Choo, E. K., Girgis, C., Sabry-Elnaggar, H., Linos, E., & Physician Moms Group Study, G. (2017, Jul 1). Perceived Discrimination Experienced by Physician Mothers and Desired Workplace Changes: A Cross-sectional Survey. *JAMA Intern Med, 177*(7), 1033-1036. https://doi.org/10.1001/jamainternmed.2017.1394

Amrein, K., Langmann, A., Fahrleitner-Pammer, A., Pieber, T. R., & Zollner-Schwetz, I. (2011, Dec). Women underrepresented on editorial boards of 60 major medical journals. *Gend Med, 8*(6), 378-387. https://doi.org/10.1016/j.genm.2011.10.007

Blumenthal, D. M., Olenski, A. R., Yeh, R. W., DeFaria Yeh, D., Sarma, A., Stefanescu Schmidt, A. C., Wood, M. J., & Jena, A. B. (2017, Feb 7). Sex Differences in Faculty Rank Among Academic Cardiologists in the United States. *Circulation, 135*(6), 506-517. https://doi.org/10.1161/CIRCULATIONAHA.116.023520

Butkus, R., Serchen, J., Moyer, D. V., Bornstein, S. S., Hingle, S. T., Health, & Public Policy Committee of the American College of, P. (2018, May 15). Achieving Gender Equity in Physician Compensation and Career Advancement: A Position Paper of the American College of Physicians. *Ann Intern Med, 168*(10), 721-723. https://doi.org/10.7326/M17-3438

Carr, P. L., Gunn, C. M., Kaplan, S. A., Raj, A., & Freund, K. M. (2015, Mar). Inadequate progress for women in academic medicine: findings from the National Faculty Study. *J Womens Health (Larchmt), 24*(3), 190-199. https://doi.org/10.1089/jwh.2014.4848

Carr, P. L., Helitzer, D., Freund, K., Westring, A., McGee, R., Campbell, P. B., Wood, C. V., & Villablanca, A. (2019, Mar). A Summary Report from the Research Partnership on Women in Science Careers. *J Gen Intern Med, 34*(3), 356-362. https://doi.org/10.1007/s11606-018-4547-y

Carr, P. L., Raj, A., Kaplan, S. E., Terrin, N., Breeze, J. L., & Freund, K. M. (2018, Nov). Gender Differences in Academic Medicine: Retention, Rank, and Leadership Comparisons From the National Faculty Survey. *Acad Med, 93*(11), 1694-1699. https://doi.org/10.1097/ACM.0000000000002146

Colleges, A. o. A. M. (2020). *2019 Fall Applicant, Matriculant, And Enrollment Date Tables* A. o. A. M. Colleges. https://www.prod.cms.aamc.org/system/files/2019-12/2019%20AAMC%20Fall%20Applicant%2C%20Matriculant%2C%20and%20Enrollment%20Data%20Tables_0.pdf

Jagsi, R., Griffith, K. A., Jones, R., Perumalswami, C. R., Ubel, P., & Stewart, A. (2016, May 17). Sexual Harassment and Discrimination Experiences of Academic Medical Faculty. *JAMA, 315*(19), 2120-2121. https://doi.org/10.1001/jama.2016.2188

Jena, A. B., Khullar, D., Ho, O., Olenski, A. R., & Blumenthal, D. M. (2015, Sep 15). Sex Differences in Academic Rank in US Medical Schools in 2014. *JAMA, 314*(11), 1149-1158. https://doi.org/10.1001/jama.2015.10680

Jena, A. B., Olenski, A. R., & Blumenthal, D. M. (2016, Sep 1). Sex Differences in Physician Salary in US Public Medical Schools. *JAMA Intern Med, 176*(9), 1294-1304. https://doi.org/10.1001/jamainternmed.2016.3284

Jolly, S., Griffith, K. A., DeCastro, R., Stewart, A., Ubel, P., & Jagsi, R. (2014, Mar 4). Gender differences in time spent on parenting and domestic responsibilities by high-achieving young physician-researchers. *Ann Intern Med, 160*(5), 344-353. https://doi.org/10.7326/M13-0974

Kaminski, D., & Geisler, C. (2012, Feb 17). Survival analysis of faculty retention in science and engineering by gender. *Science, 335*(6070), 864-866. https://doi.org/10.1126/science.1214844

Laver, K. E., Prichard, I. J., Cations, M., Osenk, I., Govin, K., & Coveney, J. D. (2018, Mar 22). A systematic review of interventions to support the careers of women in academic medicine and other disciplines. *BMJ Open, 8*(3), e020380. https://doi.org/10.1136/bmjopen-2017-020380

Long, T. R., Elliott, B. A., Warner, M. E., Brown, M. J., & Rose, S. H. (2011, Dec). Resident and program director gender distribution by specialty. *J Womens Health (Larchmt), 20*(12), 1867-1870. https://doi.org/10.1089/jwh.2011.2906

Nonnemaker, L. (2000, Feb 10). Women physicians in academic medicine: new insights from cohort studies. *N Engl J Med, 342*(6), 399-405. https://doi.org/10.1056/NEJM200002103420606

Nora, L. M., McLaughlin, M. A., Fosson, S. E., Stratton, T. D., Murphy-Spencer, A., Fincher, R. M., German, D. C., Seiden, D., & Witzke, D. B. (2002, Dec). Gender discrimination and sexual harassment in medical education: perspectives gained by a 14-school study. *Acad Med, 77*(12 Pt 1), 1226-1234. https://www.ncbi.nlm.nih.gov/pubmed/12480632

Pololi, L. H., Civian, J. T., Brennan, R. T., Dottolo, A. L., & Krupat, E. (2013, Feb). Experiencing the culture of academic medicine: gender matters, a national study. *J Gen Intern Med, 28*(2), 201-207. https://doi.org/10.1007/s11606-012-2207-1

Richter, K. P., Clark, L., Wick, J. A., Cruvinel, E., Durham, D., Shaw, P., Shih, G. H., Befort, C. A., & Simari, R. D. (2020, Nov 26). Women Physicians and Promotion in Academic Medicine. *N Engl J Med, 383*(22), 2148-2157. https://doi.org/10.1056/NEJMsa1916935

Williams, W. M., & Ceci, S. J. (2015, Apr 28). National hiring experiments reveal 2:1 faculty preference for women on STEM tenure track. *Proc Natl Acad Sci U S A, 112*(17), 5360-5365. https://doi.org/10.1073/pnas.1418878112

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Sustainable and Total Recovery of Resources (Energy, Clean Water, and Fertilizers) from Wastewaters through the Anaerobic Membrane Bioreactor Platform

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Energy positive and sustainable wastewater treatment through Anaerobic Membrane Bioreactors (AnMBRs) with simultaneous recovery of valuable nutrients (Nitrogen, Phosphorus) and water for indirect potable reuse is emerging as a viable option for municipalities, agro-businesses, and other utilities. A pilot scale AnMBR operated by the PI's team at Ft. Riley, Kansas, under ambient conditions continuously for 270 days treating 1000 gallons per day of municipal wastewater has consistently achieved these goals. Specifically, this AnMBR process configuration was able to achieve approximately 73% energy neutral operation by maximizing gaseous and dissolved methane energy capture while minimizing gas sparging and mixing energy requirements. The AnMBR also achieved an average removal efficiency of 88±7% and 88±6% for COD and BOD_5, respectively, at temperatures ranging from 12.7°C to 31.5°C, demonstrating its feasibility for ambient temperature operation. The AnMBR was also paired with downstream nutrient recovery using a coagulation-flocculation-sedimentation process, removing 94±3% of phosphorus and over 99% of nitrogen, as well as both gaseous and dissolved methane capture, which could generate an estimated 72.8% of the power required for energy neutrality. The successful integration of AnMBRs in a treatment train that addresses the critical challenges of dissolved methane and nutrients demonstrates the viability of the technology in achieving holistic wastewater treatment.

Background

While several wastewater treatment facilities have been able to achieve energy neutral operation through limited carbon (mainly methane) and nutrient (struvite alone) sequestration options, the need to enhance digested biosolids quality while decreasing the quantity and high capital/operation costs remain challenges that limit widespread adoption of these platforms.

Anaerobic membrane bioreactors (AnMBRs) are an emerging environmental biotechnology platform that can address these challenges by enabling efficient anaerobic treatment along with volatile solids reduction, tailored and separate sequestration of high-quality ammonia and phosphorus, and significantly lower biosolids production.[1,2] In addition to the benefits conferred by anaerobic technologies, the use of membranes enables AnMBRs to be a low-footprint technology that can effectively operate at longer solids retention times (SRT) by decoupling hydraulic retention time (HRT) and SRT for the treatment of high organic loads, and produce high-quality effluent amenable to reuse.[3-6] However, the introduction of membranes necessitates fouling control measures that can consume up to 50% of the total energy demand and increase chemical use.[7-12] While the pairing of membranes with anaerobic treatment represents an advancement, it still falls short of accomplishing holistic treatment. An alternative option, proven at the bench-scale by author Parameswaran, combines energy, nutrient, and water recovery from municipal wastewater with significantly lower net energy requirements (0.11 KWh/m^3)

compared to the conventional activated sludge-based wastewater treatment (0.49 KWh/m^3).[13]

Feasibility

AnMBRs are an emerging environmental biotechnology with greatest potential to enable agricultural, industrial, and municipal waste treatment to achieve simultaneous, energy-positive treatment and valuable recovery of water for reuse and nutrient products.[14-16] Concentrated waste streams such as animal wastes and food wastes should yield greater value proposition through AnMBR operation due to the higher organic load, based on preliminary TEA analyses.[17] It is important to note that little to no research has focused on beneficial nutrient recovery from wastewaters in an AnMBR platform through the coagulation/flocculation or other recovery platforms.

The system operated by the author's team is one of the largest pilot AnMBRs in the world (Figure 1) and has demonstrated successful operation on municipal wastewater to produce treated water meeting ANSI reuse standards (BOD_5 ⊚ 10 mg/L) under ambient temperatures for more than a year, with an HRT of around 6 hours.[18-22] The level of fecal coliforms in the treated water was below detection during the continuous operation. As pointed earlier, this pilot system provides the basis for process innovation, modification, and system integration for various configurations.

Moreover, AnMBR research has demonstrated that the ability to achieve energy-positive treatment increases as the Organic Loading Rates (OLRs) increase, often at values greater than 4.5 kg COD/kg VS m^{-3}, as occurs with animal wastewater.[23-25] AnMBR as a sustainable wastewater treatment platform was supported by the EPA through a project, in partnership with the Department of Defense through the ESTCP program [Project Number: ER-201434 – Anaerobic Membrane Bioreactor (AnMBR) for sustainable wastewater treatment], in which Drs. Prathap Parameswaran and Stacy Hutchinson were investigators on this project, which was one of the proud recipients of the 2019 ESTCP Project of the Year award.

Results from this project demonstrate the ability of the AnMBR platform to achieve superior treatment of the municipal wastewater as demonstrated by the effluent COD/BOD_5 values under ambient temperature conditions, which even meets ANSI reuse standards. A separate coagulation-flocculation system downstream of the AnMBR enabled superior nutrient capture efficiency (NH_4-N > 98% and PO_4-P >90%), while meeting strin-

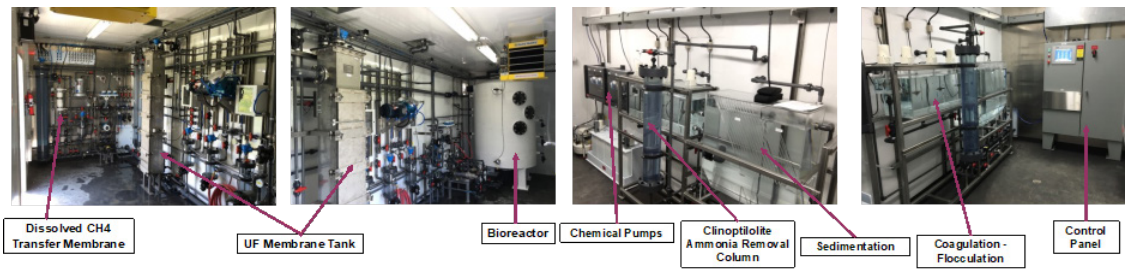
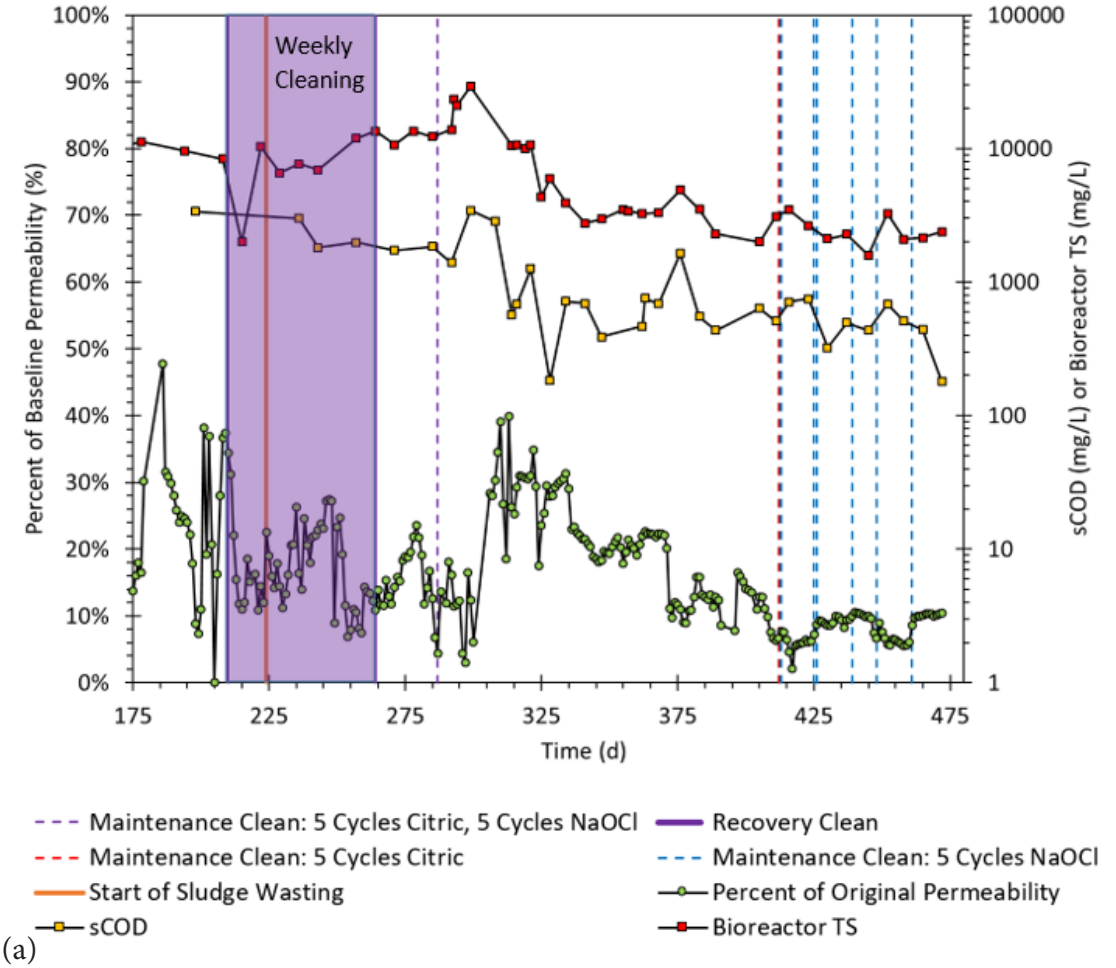
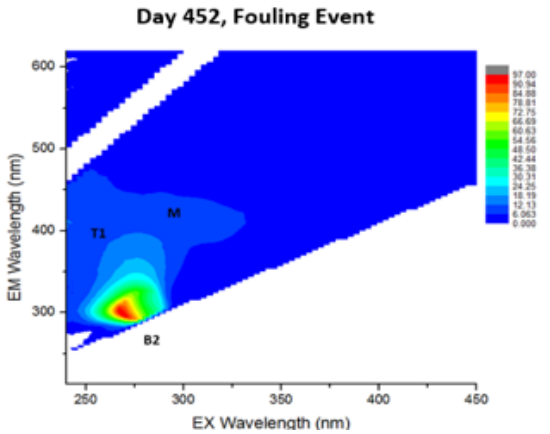


Figure 1. Schematic of the pilot-scale AnMBR (from left to right) located at the K-State animal farm to be used for this study, showing the gaseous and dissolved-methane capture from the primary and gas-sparged membrane bioreactor, coagulation-flocculation process for phosphorus recovery and clinoptilolite ion-exchange resin for ammonia capture, from municipal wastewater. The system will be available for carrying out the proposed research.



(a)



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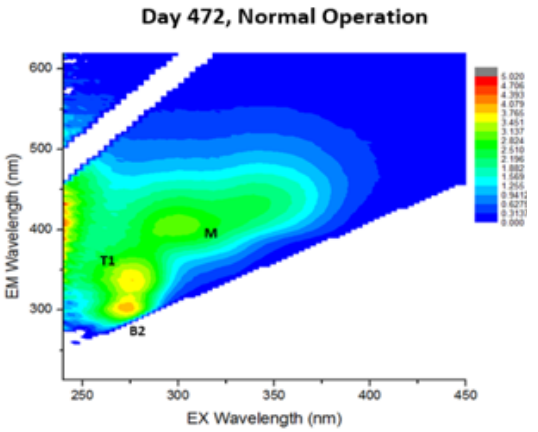


(c)

Figure 2. (a) Membrane permeability a function of cleaning events in pilot scale AnMBR. Specific interest from days 278 to 420 without membrane cleans (b) EEMS profile during fouling event and (c) EEMs profile during normal operation.

gent effluent nutrient standards for N and P to produce output water superior to conventional municipal wastewater treatment.[13]

Proactive and targeted membrane fouling management on electrode and membrane surfaces

Membrane fouling is a critical factor for successful AnMBR operation. The pilot scale gas sparged AnMBR operation on dilute wastewater revealed that while maintenance cleaning was effective initially, its ability to restore permeability decreased with time. Wasting bioreactor solids appeared to be effective in restoring permeability where chemical cleans were unable to.[26] The restoration mechanism appears to be associated with a **decrease in colloidal material**, measured by semi-soluble chemical oxygen demand (ssCOD), rather than bioreactor total solids concentration (Figure 2A).

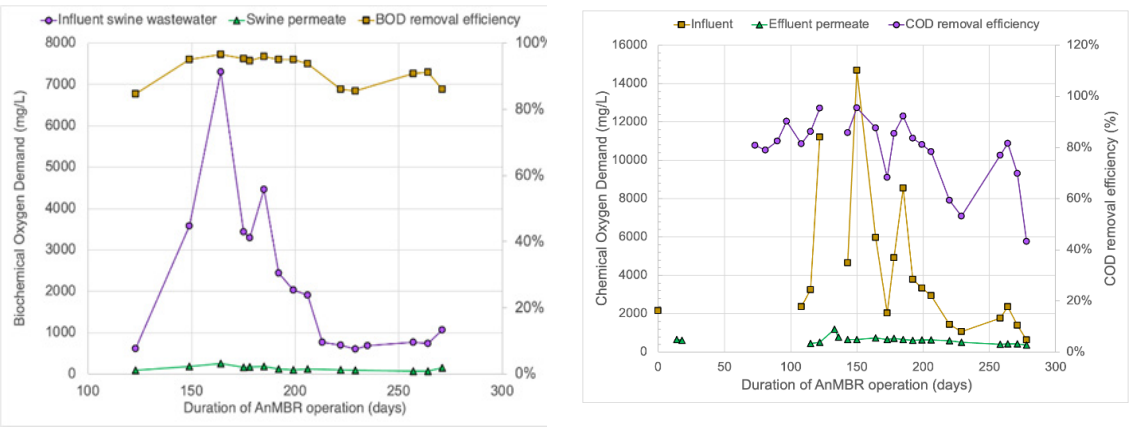
This was further supported through the use of fluorometry during AnMBR operation, which showed an increase in tyrosine-like compounds during heavy fouling conditions, suggesting that proteinaceous materials have a large influence on fouling (Figures 2B and 2C).

This was corroborated during membrane autopsy using Fourier Transform Infrared Spectroscopy (FTIR, data not shown). FTIR, scanning electron microscopy with energy dispersive x-ray spectroscopy, and transmission electron microscopy were used to characterize inorganic scalants and predominantly found phosphate salts and calcium sulfate. Fundamentally characterizing foulants and introducing novel and dynamic monitoring parameters during AnMBR operation such as ssCOD and fluorometry can enable more targeted fouling control, **leading to significant savings in fouling management expenditure and downtime**.[27] Extended periods of pilot-scale gas sparged AnMBR operation without maintenance cleaning due to **proactive monitoring of colloidal COD and commensurate solids wasting** is shown in Figure 2A.

Suitability of AnMBRs for resource recovery from animal waste slurry – Preliminary Results

The author's team has been operating a lab-scale AnMBR unit, described in prior publications, with swine lagoon wastewater as the primary waste fed, for about 350 days. The swine waste was collected from a swine lagoon input pipe located in the Swine Teaching and Research Unit at Kansas State University's north farm. After a startup phase of about 100 days, key process parameters that indicate successful treatment were initiated. The health and stability of the membranes were continuously monitored by tracking the TMP during the production cycles. ***Successful average COD (>80%) and BOD_5 (~95%) removals were achieved during steady state operation*** between 150 and 270 days, shown in Figure 3. It is to be noted that the COD removal efficiency responded more strongly to the influent COD fluctuations, compared to the BOD removal efficiency. This likely indicated that the biodegradable fraction was effectively being metabolized by the anaerobic consortia, while the recalcitrant organics were being removed primarily by membrane filtration. COD and BOD_5 removals were accompanied by commensurate generation of biogas. The headspace biogas composition revealed an average methane content of around 62 ±8% in the headspace, indicating a robust anaerobic environment. This is one of the first long-term demonstrations of superior organics removal from a swine lagoon waste.

Matching with the organics removal, **the AnMBR permeate also achieved superior removal of indicator bacterial pathogens (total and fecal coliforms), as well as viruses that are commonly detected in swine operations,** as shown in Table 1. These preliminary results indicate the utility of the AnMBR treated permeate (water) for high quality reuse



(a) (b)

Figure 3. (a) Lab scale AnMBR COD characteristics and removal efficiency during steady state operation. Average COD removal efficiency of around 80% was achieved with fluctuations corresponding to influent wastewater variations. (b) BOD_5 removal efficiency for the lab scale AnMBR system averaged around 95% during steady state operation, which is superior and leads to effluent quality amenable for reuse.

within the animal operations, provided the concentrations of pharmaceuticals and other contaminants of emerging concern are at acceptable levels.

Beneficial recovery of ammonia-N and Phosphorus-P from the membrane permeate for high value commodity products

Significant research has focused on struvite, vivianite, and apatite recovery from anaerobic centrates with limited to no studies on their bioavailability in soil or ultimate end-use as commodity products.[28,29] Clinoptilolite is a naturally occurring zeolite capable of selectively removing ammonium ions from water via an ion-exchange mechanism.[30] The relative abundance of clinoptilolite in the U.S., its inexpensive cost, and environmentally friendly nature makes it an ideal nitrogen-removal technology.

Removing ammonia using clinoptilolite in a separate ion-exchange (IX) column process has generated interest due to its ability to handle various ammonia loadings and shocks, and its resilience to

Pathogen of concern	Raw swine wastewater	AnMBR treated permeate
Total coliforms (CFU/100 mL)	$(350 \pm 5.1) \times 10^4$	$(5.2 \pm 1.4) \times 10^4$
Fecal coliforms (CFU/100 mL)	43000 ± 3500	300 ± 90
Porcine Coriovirus 3 (PCV3)	Positive	Negative
Porcine Rotavirus Group C	Suspect	Negative
C. perfringens alpha toxin	Suspect	Negative

Table 1. Summary of key bacterial and viral pathogens of concern detected in the raw swine lagoon wastewater influent and the AnMBR treated swine permeate. The bacteria and viruses were measured using the Colilert and a Tetra core multiplex Realtime PCR unit, respectively.

temperature variations.[31] Additionally, spent clinoptilolite can be regenerated or used as a fertilizer.[32,33] Long-term operation of the clinoptilolite IX process led to >99.5% removal of ammonia-N from the permeate of a pilot-scale, gas-sparged anaerobic membrane bioreactor (AnMBR) treating municipal wastewater (Figure 4A).[34]

The use of iron to precipitate and potentially recover phosphorus is an attractive solution because it simultaneously removes sulfide, which can be hazardous, corrosive, and odorous. Long-term pilot scale operations with municipal wastewater have yielded >85% P capture efficiency from the treated wastewater. Additionally, the recovered sludge contains phosphorus and sulfide or elemental S, in forms amenable to plant uptake.[13,15] Recent efforts in the author's group involve the addition of lime as a coagulant to produce Recovered Nutrient Products (RNPs) that are primarily Calcium Phosphate solids, whose release rates and plant availability can be tunable, an immense advantage to the product, making it superior than conventional fertilizers for food cultivation and other applications (Figure 4B).[35]

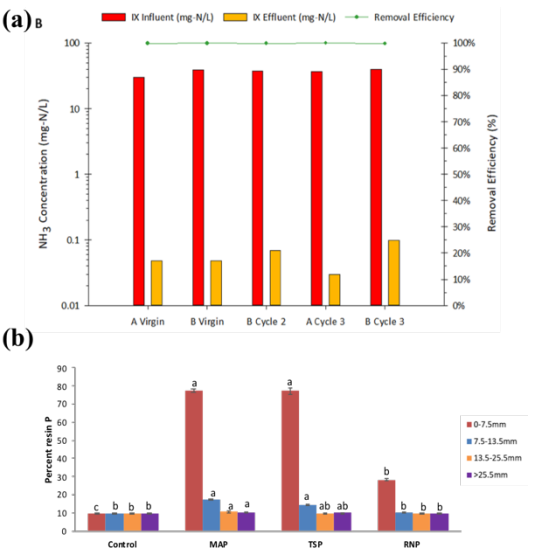


Figure 4. (a) Successive reuse of spent clinoptilolite did not diminish its ammonia sequestration capacity. (b) Resin extractable P (plant available P) indicates promising plant available for the AnMBR derived Phosphorus product.

The author's research has established the lowered energy requirement for the AnMBR platform when it primarily produces methane as shown in Figure 5, compared to conventional activated sludge. Further process optimization will focus on decreasing fouling energy requirements even further by periodic pulse sparging at high flow rates rather than continuous sparging; bioreactor mixing profile modifications in the primary bioreactor.

Broader Significance of the Research

Successful long-term operation of the AnMBR at the bench and pilot demonstrates a viable circular bioeconomy platform for revolutionizing animal operations, especially the swine and dairy sectors, with significant beneficial impacts on the arid/semi-arid region, producing indirect potable water supply and protecting sensitive watersheds from the runoff of the algal bloom triggers – N and P – that will now be sequestered. The research also generates tailored nutrient products for agriculture, namely ammonia-N and Phosphate fertilizers, which can be blended in farmlands at pre-requisite ratios, supporting local crops for supplying the animal operations while supporting a wide variety of crops and vegetables. The generated products will range from organic acids for use as food preservatives, bioplastic manufacturing; ammonia-N as feedstock to fertilizer industry or direct farm use as slow-release fertilizer, or transported for commodity use in renewable energy capture, cosmetics manufacturing; tailored Phosphorus fertilizers for the appropriate soil type, and stabilized biosolids for sustainable land application. Decarbonization of a conventional waste disposal platform integrated with animal operations will be demonstrated through the cross-dis-

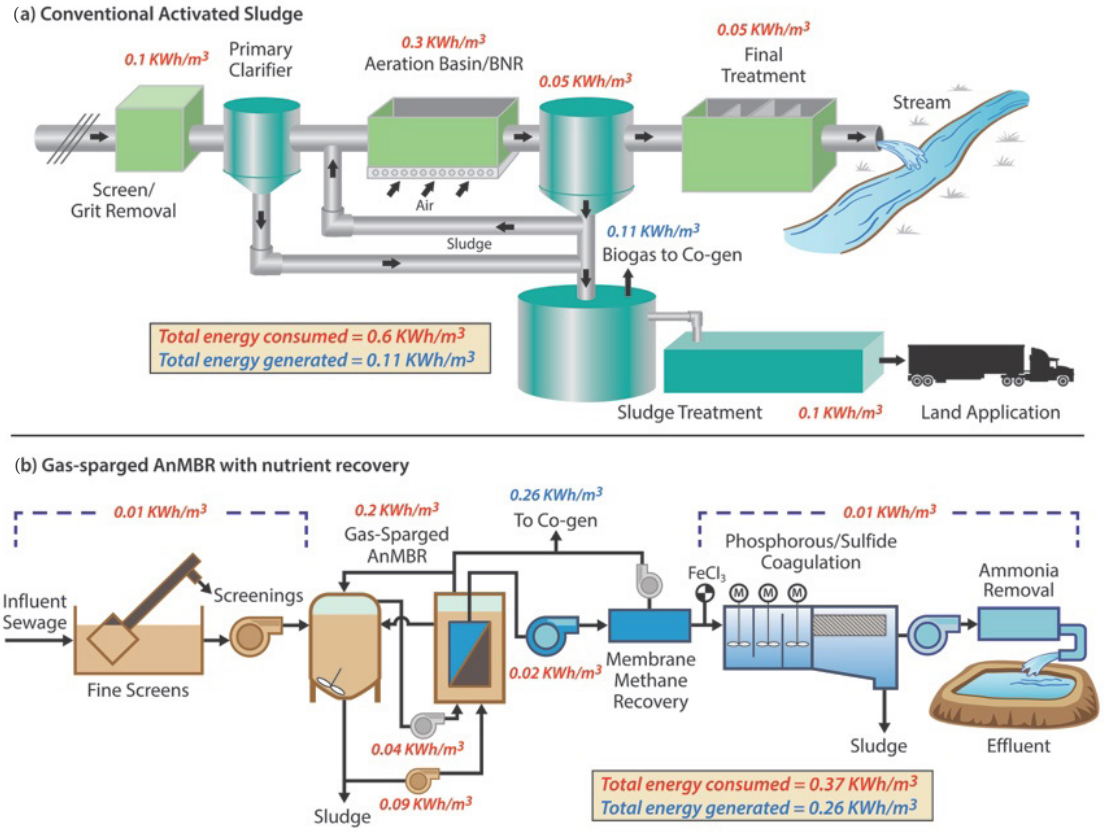


Figure 5. Net energy requirement comparison for (a) conventional activated sludge; (b) AnMBR platform for methane & nutrient capture

ciplinary research proposed, which will inspire other parallel technology platforms at the food-energy-water nexus to replicate these approaches.

The project will spawn new innovations within all public utilities in the rural areas to consider AnMBRs as a means to achieve energy positive operation, while still meeting stringent nutrient discharge goals. Finally, AnMBRs will create a greener workforce in the rural American communities, pivoted around nutrient product marketing, water and renewable energy (biogas) management, as well as reused water reallocation budgeting, without compromising the cropland and food safety.

References

1. McCarty, P. L., Bae, J., & Kim, J. (2011). Domestic Wastewater Treatment as a Net Energy Producer–Can This Be Achieved? *Environ. Sci. Technol.*, *45*, 7100-7106.
2. Dagnew, M., Parker, W., Seto, P., Waldner, K., Hong, Y., Bayly, R., & Cumin, J. (2011). Pilot testing of an AnMBR for municipal wastewater treatment. *WEFTEC Conference Proceedings*, *11*, 4931-4941.
3. Smith, A. L., Skerlos, S. J., & Raskin, L. (2013). Psychrophilic Anaerobic Membrane Bioreactor Treatment of Domestic Wastewater, *Water Research*, *47*(4), 1655–1665.
4. Lee, S., Jung, J., & Chung, Y. (2001). Novel method for enhancing permeate flux of submerged membrane system in two-phase anaerobic reactor. *Water Research*, *35*, 471-477.

5. Dereli, R. K., Ersahin, M. E., Ozgun, H., Ozturk, I., Jeison, D., van der Zee, F., & van Lier, J. B. (2012). Potentials of Anaerobic Membrane Bioreactors to Overcome Treatment Limitations Induced by Industrial Wastewaters. *Bioresource Technology*, *122*, 160–170.
6. Bérubé, P. R., Hall, E. R., & Sutton, P. M. (2006). Parameters Governing Permeate Flux in an Anaerobic Membrane Bioreactor Treating Low-Strength Municipal Wastewaters: a Literature Review. *Water Environment Research*, *78*(8), 887–896.
7. Kanai, M., Ferre, V., Wakahara, S., Yamamoto, T., & Moro, M. A. (2010). Novel Combination of Methane Fermentation and MBR — Kubota Submerged Anaerobic Membrane Bioreactor Process. *Desalination*, *250*(3), 964–967.
8. Aslam, M., Charfi, A., Lesage, G., Heran, M., & Kim, J. (2016). Membrane Bioreactors for Wastewater Treatment: a Review of Mechanical Cleaning by Scouring Agents to Control Membrane Fouling. *Chemical Engineering Journal*, *307*, 1–17.
9. Dunaev, T.I., Urban, D.R., Jordan, J.A., Ewing, J., & Rosenberger, G.T. (2010). Performance of pilot scale anaerobic membrane bioreactor (AnMBR) treating ethanol thin stillage. *WEFTEC Conference Proceedings*, New Orleans, *8*, 4056-4063.
10. Di Bella, G., Durante, F., Torregrossa, M., Viviani, G., Mercurio, P., & Cicala, A. (2007). The Role of Fouling Mechanisms in a Membrane Bioreactor. *Water Science and Technology*, *55* (8-9), 455–464.
11. Matar, G. K., Bagchi, S., Zhang, K., Oerther, D. B., & Saikaly, P. E. (2017). Membrane Biofilm communities in Full-Scale Membrane Bioreactors Are Not Randomly Assembled and consist of a Core Microbiome. *Water Research*, 123, 124–133.
12. Meng, F., Liao, B., Liang, S., Yang, F., Zhang, H., & Song, L. (2010). Morphological Visualization, componential Characterization and Microbiological Identification of Membrane Fouling in Membrane Bioreactors (MBRs). *Journal of Membrane Science*, *361* (1-2), 1–14.
13. Lim, K., Evans, P., & Parameswaran, P. (2019). Long term performance of a pilot-scale gas-sparged anaerobic membrane bioreactor under ambient temperatures for holistic wastewater treatment. *Environmental Science & Technology*, *53*, 7347-7354.
14. Evans, P., Parameswaran, P., Lim, K., Bae, J., Shin, C., Ho, J., & McCarty, P.L. (2019). A comparative pilot-scale evaluation of gas-sparged and granular activated-carbon fluidized anaerobic membrane bioreactors for domestic wastewater treatment. *Bioresource Technology*, *288*, 120949.
15. Evans, P., Brower, A., Doody, A., Harclerode, M., Vila, P., Parameswaran, P., Lim, K., Bae, J., Shin, C., Lee, P.-H., Tan, A., McCarty, P., Parker, W., Guy, K., Page, M., & Maga, S. (2018) Anaerobic Membrane Bioreactor (AnMBR) for Sustainable Wastewater Treatment. Project ER-201434. Department of Defense Environmental Security Technology Program Final Report. https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Wastewater-and-Drinking-Water/ER-201434
16. Evans, P. J., Bae, J., McCarty, P., Parameswaran, P., & Ho, J. (2019, September). Comparison of Membrane Performance of Pilot-Scale Gas-Sparged and GAC-Fluidized Anaerobic Membrane Bioreactors (AnMBRs) for Domestic Wastewater Treatment. In *WEFTEC 2019*. Water Environment Federation.
17. Harclerode, M., Doody, A., Brower, A., Vila, P., Ho, J., & Evans, P. J. (2020, September 1). Life cycle assessment and economic analysis of anaerobic membrane bioreactor whole-plant configurations for resource recovery from domestic wastewater. J Environ Manage, *269*:110720.
18. Lim, K., Parameswaran, P., Evans, P., Penfield, T., Schmidt, B., & Olney, C. (2017, October 1-4). Characterization of startup phase performance in an Anaerobic Mem-

brane Bioreactor. *WEFTEC Conference Proceedings*, *4*, 5456-5466.
19. Evans, P., Chungheon Shin, J. B., Lim, K., McCarty, P. L., Parameswaran, P., Penfield, T., & Schmidt, B. (2017, October 1-4). Pilot-Scale Comparison of Gas-Sparged and GAC-Fluidized Anaerobic Membrane Bioreactors Treating Domestic Wastewater. *WEFTEC Conference Proceedings*, 4, 5446-5455.
20. Lim, K., Parameswaran, P., Evans, P., Penfield, T., Schmidt, B., & Olney, C. (2017, October 1-4). Characterization of startup phase performance in an Anaerobic Membrane Bioreactor. *WEFTEC Conference Proceedings*, *4*, 5456-5466.
21. Evans, P., Chungheon Shin, J. B., Lim, K., McCarty, P. L., Parameswaran, P., Penfield, T., & Schmidt, B. (2017, October 1-4). Pilot-Scale Comparison of Gas-Sparged and GAC-Fluidized Anaerobic Membrane Bioreactors Treating Domestic Wastewater. *WEFTEC Conference Proceedings*, 4, 5446-5455.
22. Lim, K., & Parameswaran, P. (2022). Critical evaluation of heat extraction temperature on soluble microbial products (SMP) and extracellular polymeric substances (EPS) quantification in wastewater processes. *Water Science and Technology*, *85*(8), 2318-2331.
23. Galib, M., Elbeshbishy, E., Reid, R., Hussain, A., & Lee, H.S. (2016). Energy-positive food wastewater treatment using an Anaerobic Membrane Bioreactor (AnMBR). *Journal of Environmental Management*, *182*, 477-485.
24. He, Y., Xu, P., Li, C., & Zhang, B. (2005). High-concentration food wastewater treatment by an anaerobic membrane bioreactor. *Water Research*, *39*(17), 4110-4118.
25. Hribar, C. (2010). Understanding concentrated animal feeding operations and their impact on communities. National Association of Local Boards of Health; National Center for Environmental Health (U.S.). Environmental Health Services.
26. Lim, K., Evans, P. J., Utter, J., Malki, M., & Parameswaran, P. (2020). Dynamic monitoring and proactive fouling management in a pilot scale gas-sparged anaerobic membrane bioreactor. *Environmental Science: Water Research & Technology*, *6*(10), 2914-2925.
27. Lim, K. (2021). Anaerobic membrane bioreactors for domestic wastewater treatment: Treatment performance and fouling characterization (Doctoral dissertation, Kansas State University).
28. Rosemarin, A., Macura, B., Carolus, J., Barquet, K., Ek, F., Järnberg, L., Lorick, D., Johannesdottir, S., Pedersen, S. M., Koskiaho, J., Haddaway, N. R., & Okruszko, T. (2020). Circular nutrient solutions for agriculture and wastewater – a review of technologies and practices. *Current Opinion in Environmental Sustainability*, *45*, 78-91.
29. Egle, L., Rechberger, H., Krampe, J., & Zessner, M. (2016). Phosphorus recovery from municipal wastewater: An integrated comparative technological, environmental and economic assessment of P recovery technologies. *Science of The Total Environment*, *571*, 522-542.
30. Margeta, K., Logar, N. Z., Šiljeg, M., & Farkaš, A. (2013). Natural zeolites in water treatment–how effective is their use. *Water treatment*, *5*, 81-112.
31. Huang, H., Xiao, X., Yan, B., & Yang, L. (2010). Ammonium removal from aqueous solutions by using natural Chinese (Chende) zeolite as adsorbent. *Journal of Hazardous Materials*, *175*, 247-252.
32. Montégut, G., Michelin, L., Brendlé, J., Lebeau, B., & Patarin, J. (2016). Ammonium and potassium removal from swine liquid manure using clinoptilolite, chabazite and faujasite zeolites. *Journal of Environmental Management*, *167*, 147-155.

33. Milan, Z., Sánchez, E., Weiland, P., de Las Pozas, C., Borja, R., Mayari, R., & Rovirosa, N. (1997). Ammonia removal from anaerobically treated piggery manure by ion exchange in columns packed with homoionic zeolite. *Chemical Engineering Journal*, *66*, 65-71.
34. Kannan, A. D., & Parameswaran, P. (2021). Ammonia adsorption and recovery from swine wastewater permeate using naturally occurring clinoptilolite. *Journal of Water Process Engineering*, *43*, 102234.
35. Heronemus, E., Gamage, K. H. H., Hettiarachchi, G. M., Parameswaran, P. (2021). Efficient recovery of phosphorus and sulfur from Anaerobic Membrane Bioreactor (AnMBR) permeate using chemical addition of iron and evaluation of its nutrient availability for plant uptake. *Science of the Total Environment*, 146850.

Physician Leadership during COVID-19

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In life, we are often faced with discordant information. As a physician-leader, I have been struck by those who suggest that physicians are insufficiently trained to lead organizations. In the Harvard Business Review in 2018, Rotenstein[1] stated that "nearly all physicians take on significant leadership responsibilities over the course of their career, but unlike any other occupation where management skills are important, **physicians are neither taught how to lead nor are they typically rewarded for good leadership**."

Yet, in my career as executive dean of the University of Kansas School of Medicine and now as the executive vice chancellor of the University of Kansas Medical Center, I have worked for a physician who has served as chancellor (Douglas Girod) in a state in which the governor (Jeff Colyer) and a United States senator (Roger Marshall) have also been physicians. Furthermore, there are a dozen or more physicians who direct large universities and pharmaceutical companies, as well as the European Union and the World Bank. So, how can a group that has not been trained to lead so commonly rise to leadership positions? Furthermore, how can they be successful in doing so?

The central thesis of my book, *A Prescription to Lead*, is that medical school and training is solid preparation for organizational leadership. Together with the skills and achievements required to get into medical school, doctors are trained to define and solve problems and learn to work collaboratively and communicate clearly. While medical training is not sufficient for all doctors to lead, I believe it is a sound basis for those inclined to do so. I further believe that never before has medical training been more applicable for the physician-leader than during the COVID-19 pandemic.

In spite of widely divergent strategic goals and plans, almost all organizations faced similar challenges in early 2020. These challenges focused the immediate needs of the organizations on two immediate goals. It became essential to protect the health and safety of their employees (and customers and patients) and to ensure the continuity of the organization regardless of the challenges that they faced. With these goals in mind, I believe physician-leaders had advantages over leaders who were not physicians.

Physician-leaders share a knowledge base provided by their training that allowed them a greater understanding of the challenges presented by COVID-19. These advantages included an understanding of: (1) the basics of virology, (2) the basics of viral testing, (3) the tenets of epidemiology, viral spread and prevention, and (4) the importance and challenges of vaccine development. They also shared important contacts within organized medicine and, in many cases, local healthcare systems.

Physician-leaders were trained to develop skill sets that allowed them to successfully lead their organizations. These included: (1) sharing a work ethic to meet the demands of the pandemic, (2) the ability to work within and to lead teams, (3) a commitment to serve others, (4) communication capabilities, and (5) the ability to maintain and provide hope to individuals within their organizations. Each of these skills was modeled and cul-

tivated during their many years of medical training.

During COVID-19, physicians in academic medical centers (AMC) were asked to play diverse roles inside and outside of AMC. Many physicians were asked to serve as county or community healthcare leadership or to serve on school boards as they struggled to deal with the novel coronavirus. Physicians were providing emergency and inpatient care throughout their healthcare systems. Testing centers were being established as diagnostic capacities evolved and many centers were run by physician-leaders. Vaccines were developed by teams of MDs and PhDs throughout the public and private sectors.

One of the major roles for physician-leaders during the pandemic was in the leadership of pandemic emergency management teams. At the University of Kansas and empowered by Chancellor Girod, a Pandemic Medical Advisory Team (PMAT) was led by Dr. Steven Stites, vice chancellor of clinical affairs at KUMC and senior VP of clinical affairs at the University of Kansas Health System. PMAT consisted of medical and public health experts, members of the emergency management team, and communications and campus leaders. PMAT met biweekly for over 12 months and weekly thereafter.

The goals of PMAT were the goals of the university: safety and continuity. At the end of each meeting the safety level for the university was determined. From that determination, its impact on activities and campus protocols were determined. Each meeting included reports from campus testing and vaccine sites, data from county (including wastewater) and community partners, and reports from each of the local health systems. As individual members were also on regional and national calls, PMAT provided a one-stop for COVID information gathering.

The challenges for PMAT were real. Recent studies suggest there were important effects of behaviors and policies on college campuses that impacted their broader communities. At the beginning of the pandemic, PMAT had to quickly consider whether students should return to campus following spring break. Mangrum and Niekamp demonstrated that university students who returned from spring break contributed to the growth of cases and deaths in the community.[2] Similarly, opening of campuses in the fall of 2020 and 2021 led to increased COVID cases.[3]

So, did campus policies impact the spread of COVID in the community? A provocative manuscript by Acton and colleagues used a variety of sources to conclude that campuses with vaccine mandates reduced COVID cases and deaths in surrounding communities.[4] They concluded that these policies were associated with 7,300 fewer deaths in the U.S., or 5% of deaths, during the 13-week period studied.

As a scientist, I would ask whether there are data to support my contention that physician-led organizations might have performed better through the pandemic. Unfortunately, I do not believe such data exist. First, many large member organizations try to avoid comparisons of their membership as to avoid making some look inferior. Second, it is plausible that all such groups included physicians given the nature of the crisis. Likely control groups would be difficult to find. Finally, politics may have prevented some physician-leaders to implement preferred public health policies. In the absence of such data, I would posit that physicians were a required part of all such emergency management teams regardless of the nature of the organization. Whether these doctors were procured internally or externally, I believe they were universally required.

The critical role of physician-leaders during the pandemic raises a question also addressed in the Harvard Business Review: **Does your company need a chief medical officer?**[5] Neely suggests that the CMO can play a tripartite role protecting the safety of employees and of customers while creating a culture of global compliance. This is not to be confused with employee health and certainly not limited to healthcare organizations. The combination of employee and customer safety and compliance create a likelihood of business continuity and success.

A former colleague of mine at Mayo Clinic, Dr. Henry Ting, was recently named the Senior Vice President and Chief Health Officer for Delta Airlines. At his hiring, Delta stated that Dr. Ting is a voice for Delta *"as we work to protect the health and safety of our people and customers and emerge stronger and better prepared for the future."* Perhaps there has never been a time in the history of the airline that medical knowledge and training were more important.

I believe that the selection and training of doctors results in competencies, expertise, and skills that support the assumption and high-level performance in diverse leadership roles. Evidence to support that contention comes for diverse and global organizations choosing physician-leaders and the importance and performance of these organizations both public and private and inside and outside of healthcare. Furthermore, COVID-19 made it crystal clear that in cases where the health of the community is at risk, physician-leadership is a necessity. With the likely impact of pandemic and global warming on human health, organizations of every kind should strongly consider a chief medical officer in the c-suite.

References

1. Rotenstein, L., Sadun, R., & Jena, A. (2018). Why Doctors Need Training, *Harvard Business Review.*
2. Mangrum, D., & Niekamp, P. (2020). College Student Travel Contributed to Local COVID-19 Spread. J Urban Economics, 127 103311.
3. Andersen, M., Bento, A., Basu, A., Marsicano, C., & Simon, K. (2022). medRxiv. doi.org/10.1101/20202.09.22.20196048
4. Acton, R., Cao, W., Cook, E. E., Imberman, S., & Lovenheim, M. (2022). The Effect of Vaccine Mandates on Disease Spread: Evidence from College COVID-19 Mandates. www.nber.org/papers/w30303
5. Neeley, T. (2020). Does Your Company Need a Chief Medical Officer? *Harvard Business Review.*

Implementing a Comprehensive Hiring Strategy to Enhance Research Activity: The MizzouForward Initiative

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The University of Missouri (MU) has a long history as a major research institution. It has the Carnegie Classification of Doctoral Universities: Very High Research Activity and has been a member of the Association of American Universities (AAU) since 1908. MU takes pride in its status as the premier public research institution in the state of Missouri and expects its faculty members to be engaged in high-impact research and scholarship. Despite its traditions and expectations, research activity at the institution stagnated in the 2000s. For example, between 2010 and 2015, MU's HERD expenditures were essentially flat ($239 million in 2010; $247 million in 2015), while most of its peer institutions experienced much more dramatic increases. MU has experienced a significant increase in expenditures in recent years, with a total of $332 million in HERD expenditures in 2020. Despite this increase, research expenditures and other important measures of scholarly output at MU lag many of its peer institutions (e.g., other AAU public universities).

To alter the research trajectory of MU, university President Mun Choi in his role as MU chancellor conceptualized the MizzouForward initiative. This initiative contains several components, but its centerpiece is an effort to hire up to 150 new tenured/tenure-track faculty members over the next 5-10 years who will make important contributions to our research mission. These new faculty will be in addition to hires that occur through traditional unit-initiated hiring processes. In the past, MU has attempted to implement centralized hiring initiatives, but nothing close to the scope and scale of MizzouForward. Estimated cost of the overall MizzouForward initiative is $1.5 billion, with approximately half of these funds earmarked for direct (e.g., salary, benefits, startup) and indirect (e.g., enhanced research facilities and instrumentation) new faculty support. In this paper, we address details of the initiative, successes and challenges we have experienced, and anticipated future directions.

Details of the Initiative

At MU, the typical hiring process for faculty is one that is like most universities across the country. An academic unit makes a request to the office of the provost for a new position, which includes a strategic rationale for the new position and source of funds for the hire. After the office of the provost approves the request, the unit conducts the search and recommends a candidate, who is approved by department head and dean. The provost or their delegate then provides final approval for the hire. There are several advantages to this traditional hiring model, including units making hires that fill specific needs within schools and colleges

and fiscal accountability in that hires are only made when local resources are available to support them.

A major limitation of the traditional unit-initiated hiring model is that it can be difficult to make focused hires that link to larger university priorities, due to both fiscal and strategic considerations (e.g., hiring units may have limited resources to allocate to new hires; priorities of a unit may not be in full alignment with current university strategic goals). To address these limitations, universities will sometimes engage in centralized hiring initiatives, where a pool of resources is allocated centrally to hire some number of new faculty that align to specific university strategic goals. A common model is a "cluster hire" initiative, where the university devotes a certain amount of money to strategic hires in a specific research area or discipline. MU has attempted more centralized hiring initiatives in the past, with limited success. Factors that inhibited the success of these prior efforts include relative lack of centralized support, over-reliance on coordination among academic units, and lack of clearly defined characteristics of strategic hires.

The MizzouForward hiring initiative differs from these previous efforts in two important ways. First, MU has clear criteria for faculty that are hired through the initiative, namely a track record of significant external funding as a principal investigator. Second, MizzouForward is almost fully funded from centralized resources. In some instances, units may need to provide a portion of support from their own budgets if there are specific candidate needs outside the scope of MizzouForward funding, but most funds for faculty hires and startup will come from central administration.

Criteria for MizzouForward Hires

MU leadership initially defined three broad hiring areas for the initial stage of the MizzouForward initiative: Next-Gen Precision Health; New Frontiers in Science, Engineering, and Technologies; and Innovations in Social Science, Humanities, and the Arts. Within each hiring area, we seek candidates who have a demonstrated track record of securing significant external funding as a principal investigator. We chose a track record of major external funding as a principal characteristic of our hires for two main reasons. First, we want to hire researchers whose work is aligned with major national health, scientific, educational, and/or creative priorities, and funding from organizations like the National Institutes of Health, the National Science Foundation, the Institute for Education Sciences, and the National Endowment for the Humanities is a good proxy for such a link. Second, external funding is a critical institutional metric for universities like MU that are members of organizations like the AAU, and external funding typically drives other important research outcomes like publications and citations.

External funding is a necessary but not sufficient characteristic of individuals we want to consider for faculty positions. Candidates are also evaluated on factors like ability to collaborate with existing faculty, availability of relevant resources and infrastructure, commitment to students, commitment to inclusion, diversity, and equity, and willingness to work effectively in a team environment.

Funding for the MizzouForward Initiative

As one would expect from a $1.5 billion initiative, funding for the MizzouForward initiative is derived from several different sources. Some of the funds are already available to the institution, while others are based on anticipated new revenue streams. Historically, MU has had an extremely decentralized fiscal model, where a very small percentage of the overall institutional budget was held centrally. This fiscal model hampered the university's ability to make major strate-

gic investments and initiatives, as such efforts would often require fiscal support and collaboration from multiple campus entities (e.g., deans of multiple schools and colleges agreeing to support a targeted hiring program). By increasing the amount of funds held centrally, the president has been able to identify sufficient resources to initiate MizzouForward. For example, a higher percentage of funds from sources such as a university system "dividend" that is provided annually to each university in the system, patient revenue from the healthcare system, and general mission support funds are now being directed to support MizzouForward. Anticipated future revenues that will support the initiative include net tuition increases, philanthropic efforts targeted for MizzouForward, and increased state support. In the event of an economic downturn that negatively impacts the university's finances and/or not realizing anticipated future revenues, specific goals associated with MizzouForward will need to be adjusted (e.g., decreasing the target number of hires). But, existing resources are more than sufficient to initiate MizzouForward, and the anticipated future revenues are based on realistic assumptions and projections.

Recruitment and Hiring Processes

The recruitment and hiring process for MizzouForward has many similarities to traditional faculty hiring models, but also several important differences. One of the most important differences is that unlike most traditional faculty searches, we use professional recruiters from our human resources team to reach out to potential candidates. Candidates are nominated through a variety of means, and our recruitment team reaches out to nominees to encourage them to consider applying to MU, answer questions about the initiative, and support their application process. Applications that meet our minimum criteria are reviewed by a faculty committee affiliated with one of the hiring areas, who decide on whether the candidate should be offered an initial virtual interview. Particularly exceptional candidates may be recommended for an on-campus interview without an initial virtual interview. The recommendation from the faculty committee is reviewed by the MizzouForward leadership team, who makes the final decision regarding an on-campus interview in conjunction with the dean and department chair of the candidate's likely academic home.

Once an on-campus interview has been confirmed, our recruitment team works with the relevant college/department(s) on scheduling the interview. The bulk of the schedule is similar to what one would see in a traditional faculty interview, including a research colloquium, meetings with departmental faculty/staff/students, and meetings with potential research collaborators. In addition, the candidate is scheduled for one-on-one meetings with senior administrators, including the president, provost, and vice chancellor for research. After the visit, the MizzouForward leadership team and relevant dean and department chair decide on whether to pursue an offer and, if so, work with the recruitment team on identifying expectations for salary, start-up, and other relevant needs. Once the parameters of a preliminary offer are in place, the leadership team requests permission from the president and provost to pursue an offer.

In sum, similarities of the MizzouForward hiring process to traditional faculty hiring processes include candidates applying to an open position, initial review by a faculty-led committee, on-campus interviews with relevant constituent groups, and feedback and final hiring decisions being made by an administrative hiring authority after receiving feedback from relevant faculty and department/college administrators. Important differences, though, include using professional recruiters to engage in an active recruit-

ment process, direct involvement of the president and provost in the interview process, and the decision to make an offer and specific offer parameters being directly approved by the president and provost.

Successes and Challenges

Although less than one calendar year old, we can point to several initial successes of the MizzouForward initiative. The most notable foundational success has been our ability to effectively implement a centralized hiring initiative. Such initiatives often fail for a variety of factors, including an unwillingness to persist despite resistance from some campus constituents, lack of funding, and unclear priorities and standards. In our case, the president and provost have been steadfast in terms of their commitment to the initiative, while other MizzouForward staff members have designed and implemented systematic recruitment, interviewing, and hiring processes. A second success is that we have already generated significant interest from many highly qualified candidates. We have had hundreds of nominations and applications from across the country and internationally, and candidates that we interview often cite the institutional commitment associated with MizzouForward as a primary factor for their interest in the university.

Third, we have already hired individuals that we probably would not have been able to recruit via a traditional department-initiated search. Many of our new hires require considerable start-up costs associated with transferring their existing research programs to MU, which likely could not have been met by relying solely on resources at the department/college level. The relatively large, central pool of resources associated with MizzouForward allows us to address these costs, when warranted. Fourth, we have seen a number of units recognize the potential to expand and improve their faculty ranks via the MizzouForward process, as well as embrace the initiative in an effort to build their own internal capacity. Finally, the term *MizzouForward* has proved to be an effective, concise identifier for new strategic processes at MU. For example, when a senior administrator refers to MizzouForward efforts in some type of communication, the university community knows they are referring to efforts to enhance research activity on campus.

The initiative has not been without its initial challenges. The most salient challenge has been establishing buy-in across campus. Units where external grant activity is low have expressed some resistance to the initiative, as they feel it reflects a lack of institutional commitment toward their areas. While acknowledging the reality of probable hiring areas of the MizzouForward initiative, we regularly remind units that department-initiated faculty searches continue to be approved. We have also experienced resistance from some deans and department chairs who feel they have lost autonomy over hiring processes in their units. Again, we regularly remind deans and chairs that their feedback is a critical component of evaluating the viability of MizzouForward candidates and that we would not hire someone into their units over their objections. However, some of our leaders have yet to fully embrace the opportunities afforded by the initiative.

A second challenge involves skepticism about long-term central funding for the initiative, despite assurances to the contrary and explanations regarding specific sources of funding. A third challenge has been maintaining consistent messaging and decision-making about the outcomes we are trying to achieve with this initiative. For example, we regularly receive inquiries from units about potentially nominating an otherwise strong scholar who has not secured significant external research funding. In such cases, we are consistent in letting the unit know

that the individual would probably not be a successful MizzouForward applicant.

A fourth challenge involves internal administrative capacity, given the degree to which so much of the initiative is centralized. We have had to hire several additional staff in order to manage all of the tasks associated with recruitment (e.g., reaching out to hundreds of nominees and answering inquiries from interested candidates), reviewing applications for minimum criteria and routing to the appropriate review committee, staffing initial interviews, coordinating campus visits with schools/colleges/departments, and assisting with candidate expectations and the negotiation process. Further, several senior administrators devote a high percentage of work hours per week on MizzouForward tasks like deciding on on-campus interview offers, meeting with candidates during their visits, working with schools/colleges on specific offers, and engaging with candidates during the negotiation process.

A final challenge has been the large number of requests for partner/spousal hires. These requests are of course a common challenge in faculty recruitment, but are more prevalent among already established faculty in comparison to individuals who may be coming right out of graduate school or a post-doc. We have already had several cases where our inability to meet the needs of a candidate's partner has been a contributing factor in their decision to not accept our offer.

Future Directions

Launching the MizzouForward initiative has been a massive undertaking that required coordination across a number of key university entities, including academic affairs, research, finance, human resources, and numerous schools and colleges. We are already seeing benefits from the initiative, in particular many faculty hires that we believe would not have been possible without the initiative. We recognize that MizzouForward will need to evolve over time, as we learn from our initial efforts and consider new strategic opportunities. One future direction of the initiative will be to initiate more targeted hiring areas that take advantage of unique university strengths and/or opportunities. We have begun to implement three such areas: materials science, infectious disease, and a broad school of medicine area, while maintaining our existing initial three hiring areas.

A second future direction will be to continue to enhance buy-in and support for the initiative from the academic units. An initial change we have implemented includes asking department chairs to take more ownership for candidate recruitment (e.g., introducing candidate colloquiums and working with candidates to identify initial startup and salary expectations), and we anticipate exploring additional efforts in the upcoming year. A third future direction involves continually adjusting our messaging campaign to highlight MizzouForward successes. We are in the process of designing a strategy to inform campus of the new MizzouForward hires, as it is important to show that our efforts are bearing fruit. We also continue to evaluate and modify our efforts to promote candidate visits, generate enthusiasm, and present the initiative in the best possible light.

Finally, over time we will assess the research productivity of our MizzouForward hires to gauge the overall success of the initiative. There is no doubt that MizzouForward is a time-consuming, resource-intensive initiative, but we are convinced our efforts will have a transformational impact on MU.

Science with Practice on a Three-Legged Stool

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Our conference topic is *Surviving and Anticipating Waves of Change in Public Research Universities*. There are a multitude of approaches to surviving change, and probably an equal number of approaches to **anticipating** those changes. There are the changes we are already experiencing, like demographic cliffs, accelerating climate change, and dwindling state support for public research universities. There are changes we can imagine are coming, like AI-based tutors that teach more effectively than a disengaged instructor, or hybrid/virtual face-to-face degree programs that are shorter and lower cost to students. Then there are black swan events that are beyond the imagination; the obvious example being the global pandemic we are slow-burning through.

I am going to argue today that the uncertainties inherent in our situation mean that success or failure will be driven more by **principles and culture** than by strategy and planning, and I'll suggest some principles to consider.

This meeting matters, because public research institutions improve the lives of people far beyond what most people recognize. To that end, I'll begin with two semi-quantitative stories: The first is about land grant institutions, the second about my home department in particular.

The land grant mission is the "three-legged stool" to which this talk's title refers. As you are all likely aware, these three legs are:

(1) Extend knowledge to practitioners in the state (and beyond) – this is Extension.

(2) Create new knowledge – this is Research.

(3) Educate the people in a wide variety of subjects, including agriculture and the mechanical arts – this is Education (typically residential education).

To try to grasp the impact of these institutions, consider just one area of instruction – engineering. Prior to the establishment of the land grants, there were barely a half-dozen departments offering degrees in engineering (Reynolds, 1992). Less than two decades later, there were over 80 such departments (Reynolds, 1992).[1] This explosion of opportunity, combined with strong demand for engineers, increased the number of engineers in the U.S. by two orders of magnitude from 1850 to 1910. The mind boggles at how that growth of technical know-how impacted the trajectory of U.S. history through the 20th century.

The second quantitative story is about my home department of Agricultural and Biosystems Engineering (ABE). That department serves all three parts of the land-grant mission. Furthermore, ISU's motto of *Science with Practice* informs our departmental efforts, because working with stakeholders (e.g., downstream communities, various ag industries, farmers) forces us to address the practical implications of the science and engineering that we do. There are many problems faced by agriculture that have simple solutions—if you ignore the vagaries of economics, technological lock-in, peer pressure, and so on. *Science with Practice*

[1] Reynolds is in a line of revisionists who argue that the impact of land grants on engineering is overstated. I am skeptical of their argument but recognize my lack of scholarly expertise in this realm.

is a reminder that while theory may be beautiful and insightful, it alone cannot make changes in the world. It's also a reminder that while common sense and hard work are valuable, they are not substitutes for the scientific method as a way of understanding the material world. Instead, it's the union of the two – *Science **with** Practice* – that is extraordinarily powerful and world-changing. (And, just to be sure that you don't think of me as a complete techno-optimist, I am well aware that the many world-changing impacts of science and technology have had multiple unintended consequences.)

Back to my department: We have active extension programming in six major areas, ranging from farm safety to water quality, from grain processing to machinery systems. We are research active, with annual research expenditures expanding from about $8 million to $13 million over the last decade. We have four accredited undergraduate degrees – two in technology, two in engineering, as well as graduate degree programs in both technology and engineering.

In 2014, we moved into a new $74 million lab/office complex on the west side of ISU's campus. I served as associate chair for teaching from 2011to 2016, so during the move, as our enrollment was climbing through 700 undergraduates, and I felt simultaneously ecstatic at the wonderful new facility, and yet terribly guilty about it.

Yes, guilty. Such an amazing building, reflecting a $74 million expenditure, with $60 million from the taxpayers of the state, and the remaining $14 million from donors. How could this be justified?

To try to answer this question, I ran some numbers, pertinent to our undergraduate teaching programs, as follow.

Across the four undergraduate programs, we were graduating approximately 140 students per year at the time. The **net present value** of the average income increase of one student (i.e., compared to what they could have made with a high school diploma) was somewhere between $500,000 and $900,000 depending on the assumptions about time in workforce and discount rate. Taking the more conservative number, the net present value of the degrees granted each year – just to the degree holders – was on the order of $70 million. That's a conservative estimate because salary is normally considerably lower than value added to the economy.

For this talk, I took a step further, and made a rough estimate of the research impact. I found that in 2019, Deleidi et al., at University College London, estimated the GDP multiplier of non-military R&D as 7.7x (Deleidi et al., 2019). They arrived at that value by examining quarterly historical data from 1947 to 2017 in the U.S. That means that a single $10 million annual research expenditure might have GDP impacts on the order of the building's cost.

For extension, things are harder. As a first approximation, examining the programs of two of my colleagues who work in animal waste management and animal environmental systems, numbers on the order of $1 million to -$25 million per year are found based on conservative assumptions related to increased nutrient use efficiency or disease prevention.

Combining these numbers from all three legs of the stool results in an estimated impact on the order of $150-$175 million per year; making the state's investment in our building far more reasonable.

Forgive me for quoting numbers at you; hopefully they are relevant to making the case for public funding of our institutions. And – and this is a big caveat **– I recognize the terrible danger in making it all about money.**

The impacts we have on people's lives through our extension, research, and teaching **transcend dollars.** Furthermore, **only valuing what's measurable**

is a lousy way to run an enterprise – as many formerly great companies can tell you.

For these reasons, I am unapologetically of two mindsets:

(1) We have to quantify the economic impacts of our institutions because they're generally far higher than perceived, and we deserve to be funded (and to have accessible tuition for students). It's a given that spending on college athletics is not questioned, because brand recognition, local economic development, etc. It needs to become a given that high-quality research/extension/teaching is a similar boon to the state and nation.

(2) In our day-to-day extension, research, and teaching efforts, we cannot just be bean counters! We need to do good science and publish in high-quality journals, but it's not just "number of papers" or h-index that reflect the quality of scholarly output. We need to have accredited degree programs and to deliver programs that attract reasonable numbers of students, yet it's not just accreditation or student-credit hours generated, or fundamentals-of-engineering exam pass rates that reflect teaching quality. There are ineffable qualities that determine the greatness of our efforts: the degree to which we actually inspire and engage students, our thoughtfulness in handling a question from a farmer, an insight into how to approach a scientific problem that arises from a conversation with a grad student. Furthermore, those non-measurable qualities—the care we give all students, the decency with which we treat each other, and the integrity with which we conduct our research—are the strongest bulwarks against losing support for these institutions.

One last point: Some of you may know that RAGBRAI is a 50-plus-year-old mass bike ride across Iowa. Call it a rolling festival of bad '70s rock (I sometimes do), a 15,000-person COVID-super-spreader event (as a friend of mine described it last year), an opportunity to roll across the Iowa countryside without worrying about distracted drivers (a rant I'll spare you), or an oddly Iowa mode of providing an economic boost to small towns. Regardless, it is an important thread in Iowa's cultural fabric. I've done it thrice, and each time, while stopped at small towns or rest areas, I met people who knew colleagues of mine or who had had classes with me. It drove home to me that my adopted state – and many of yours – is not that big a place. People know how the extension faculty member responded (or not) to their question; they hear about their family member's experience in first-year engineering, or physics, or agronomy; and they form critical impressions about the institution on this basis, which amplifies the case for using both strategy **and heart** to navigate the uncertainties of the future.

Let me summarize (and extend) what I've learned trying to do *Science with Practice* on a three-legged stool: Numbers matter, but they're not the only thing. A culture of integrity, excellence, and kindness is as important as a strategy to be more competitive (or should be a core part of such a strategy).

I think a fair critique of what I've just said is that it's platitudes: "This person made me sit for 15 minutes to tell me everyone should be nice!" This audience is disproportionately leaders, and we have more control over the culture in our spheres of influence than we may recognize. The way I, as a faculty member, treat my undergraduates and graduate students tells them something about expectations and possibility. The same is true for the way chairs and deans treat faculty members, and so on. Recognizing that culture exists, and that it is not equally welcoming to all members of our community, and being intentional about making a program, department, college, or unit more welcoming is worthwhile. Recognizing that teaching and research

are deeply complementary, not oppositional, and finding ways of promoting that synergy is worthwhile. These are efforts we are uniquely positioned to engage in, and I hope that in so doing, we strengthen our institutions and amplify the positive impacts we can make.

References

Deleidi, M., De Lipsis, V., Mazzucato, M., Ryan-Collins, J., & Agnolucci, P. (2019). The macroeconomic impact of government innovation policies: A quantitative assessment. *UCL Institute for Innovation and Public Purpose, Policy Report (IIPP 2019-06)*. https://www.ucl.ac.uk/bartlett/public-purpose/wp2019-06

Reynolds, Terry S. (1992). The Education of Engineers in America before the Morrill Act of 1862. *History of Education Quarterly* Winter, 1992, Vol. 32, No. 4, pp. 459-482. Cambridge University Press. Stable URL: https://www.jstor.org/stable/368959

RegenPGC

The RegenPGC[2] project (https://www.regenpgc.org/) seeks to perennialize working lands, thereby improving soil conservation and water quality while maintaining or increasing profitability, enhancing biomass production, and improving overall system resilience. Below are two references to recent review papers about this approach published by members of our team.

Schlautman, B., Bartel, C. A., Diaz-Garcia, L., Fei, S., Flynn, E. S., Haramoto, E. R., Moore, K. J., & Raman, D. R. (2021). Perennial groundcovers: an emerging technology for soil conservation and the sustainable intensification of agriculture. *Emerging Topics in Life Sciences* 5(2): 337 – 347. https://dx.doi.org/10.1042/etls20200318

Moore, K. J., Anex, R. P., Elobeid, A. E., Fei, S., Flora, C. B., Goggi, A. S., Jacobs, K. L., Jha, P., Kaleita, A. L., Karlen, D. L., Laird, D. A., Lessen, A. W., Lübberstedt, T., McDaniel, M. D., Raman, D. R., & Weyers, S. L. (2019). Regenerating agricultural landscapes with perennial groundcover for intensive crop production. *Agronomy* 9(8): 458. https://doi.org/10.3390/agronomy9080458

[2] Regenerating America's Working Landscapes to Enhance Natural Resources and Public Goods through Perennial Groundcover (PGC)

Project Overview

Zero-competition agriculture (ZCA) dominates our region for multiple reasons – simple, high-yielding, reliable, scalable

But there are serious downsides!

Cover crops reduce the long periods of bare-soil associated with ZCA, but deployment rates are low

Why? – Likely a combination of tangible ($) and intangible (complexity) costs

Can we simplify cover cropping while perennializing the landscape?

We believe so, and this is the core of the **RegenPGC** *vision!*

Key Collaborator Locations (Major Land Resource Areas)
a – The Land Institute (H)
b – Kansas State (H/M)
c – Univ. of Missouri (M/N)
d – Univ. of Kentucky (N)
e – Univ. of Wisconsin (M/K)
f – Corteva Agriscience / Iowa State Univ. (M)

H – Central Great Plains Winter Wheat and Range Region
K - Northern Lake States Forest and Forage Region
M – Central Feed Grains and Livestock Region
N – East and Central Farming and Forest Region

REGENPGC

Quad Chart: RegenPGC

Timeline and Funding:

Start and End Dates: *9/15/21 – 9/15/26 (5 yr)*

Funding amount: *$9.99M*

USDA Award #: *2021-68012-35923*

Key Near-term Milestones:

Research: Establish best management practices for Gen-1 PGC systems; generate enterprise-level budget impacts (w/ risk distributions) of Gen-1 PGC

Extension: Support multiple on-farm trials through multi-modal extension programming, and highlight findings (+/-) at field days

Education: Train first two cohorts of RET/REU pairings

Collaborators:

Research: *Brandon Schlautman, The Land Institute*

Extension: *Daniel Andersen, Iowa State University*

Education: *Kenneth Moore, Iowa State University*

Commercialization: *Sara Lira, Corteva Agriscience*

Admin (Deputy Dir.): *Anne Kinzel, Iowa State University*

End of Project Outcomes:

Significant increase in US cropland acres with year-round groundcover – **target 5% of Iowa by PY5**

Decrease in soil erosion from corn and soybean cropland in the US corn belt

Decrease cropland nitrogen and phosphorus exports

REGENPGC

Resilient Institutions and Social Norms: Some Notes on Ongoing Theoretical and Empirical Research

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Stacy Elmer
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Community resilience" describes the capacity to withstand and bounce back from an adverse event or perturbation. The term is most often used in reference to the ability of a community to recover from disruptions caused by terrorist attacks or natural disasters. One of us (Stacy Elmer) was partly responsible for disaster recovery in President Obama's White House, and among the responsibilities of this role was the development of national-level policies on resilience, in the context of cybersecurity, natural disasters, and bioterrorism preparedness.[1] Inevitably, our societies are subject to a variety of significant threats, and it is prudent to assume that we will simply be unable to prevent all disruptions. Thus, cultivating and supporting resilience has become a high priority for responsible leaders. Government, industry, and charitable organizations have increasingly focused programming and funding aimed at community resilience. However, as we learn more about the kinds of disruptions and threats faced by the United States, it becomes clear that the concept of resilience itself needs to be carefully rethought.[2]

In this paper we review some of the reasons for refocusing on social determinants of resilience rather than on physical infrastructure. Much of the resilience of our societies is due to cultural and normative factors that have generally escaped attention in research on resilience. Most obvious perhaps is the role of social institutions in community resilience. We also argue that traditional approaches to the ontology of critical social institutions miss the role of social norms in the constitution and maintenance of institutions. The resilience of institutions, we argue, is dependent on associated social norms. Once we see the role of social norms in institutions, we can recognize that those norms pose a potential vulnerability that can become an attack surface for adversaries. The paper closes by considering some of the ways that our adversaries can undermine adherence to social norms and some of the ways that such attacks might be studied empirically.

What is resilience?

Let's begin with the basics: Given the notorious vagueness of the concept of resilience, an initial reaction might be to say that it is not the kind of concept that really has any significant empirical con-

[1] Stacy Elmer served as Director for Incident Management in The Obama White House, National Security Staff where she managed the National Exercise Program portfolio, including the development and coordination of senior-level disaster response exercises. She led the Interagency Policy Sub-Committee on Exercises and Evaluation, contributed to the development of national-level policies on resilience, cybersecurity, and bioterrorism preparedness and provided incident management for the President during disaster response.

[2] While studies show that there is no evidence of a common definition of community resilience, nine core elements that are common to the idea of resilience have been identified: local knowledge, community networks and relationships, communication, health, governance and leadership, resources, economic investment, preparedness, and mental outlook.

tent. While many of the standard definitions are subject to criticism, we can offer a rough list of characteristics that capture the important features associated with resilience without attempting a philosophically rigorous definition in terms of necessary and sufficient conditions.

A system can be said to be resilient if it:

- is prepared for intervention or perturbation.
- maintains its identity and bounces back after attack.
- adapts in ways that are guided by its identity in a timeframe that is appropriate to its identity.
- learns from past perturbation or intervention.

To say that some community is resilient or that one community proved more resilient than another has some significance insofar as it seems to mark something about the properties of cities, communities, or institutions that is responsive to empirical reality. We seem to correctly recognize that some features of social reality have the capacity to endure in ways that others don't. In other words, in spite of metaphysical or ontological scruples, our capacity to rank some systems as more resilient than others in virtue of evidence from both ordinary experience and scientific inquiry is sufficient to ground further investigation.

It's also the case that we can misjudge the resilience of some social systems. The fact that we can be surprised by or proven wrong about the resilience of a system counts as some evidence that resilience should be understood realistically. It's often remarked that the resilience of the Soviet system in the 1980s was overestimated and that the resilience of the global financial system was underestimated in the period following the 2008 financial crisis. Our judgments of the resilience of social systems can be corrected by the course of history, but our intuitive sense that there is something or some cluster of things that makes some systems resilient and others fragile seems reasonably clear and certainly sufficient to warrant further investigation.

While much of our research focusses on highly theoretical aspects of the philosophy of social science, we recognize that policy making operates at a different timescale than philosophy. Policy makers do not have the luxury of waiting until fundamental questions in social ontology are settled.[3] Instead, they are tasked with making practical and often urgent decisions concerning the resilience of critical social systems. To date, on our view, policy making around resilient communities and institutions has largely focused in the wrong place. Our theoretical work aims to correct this error by refocusing debates around community resilience on genuinely social aspects of communities and institutions rather than on either physical infrastructure or individual psychology.

From Physical Infrastructure to Social Infrastructure

Historically, discussions of resilience have tended to focus on the underlying physical infrastructure (roads, power grids, water sources, etc.) supporting the basic functioning of a community. Network measures and features have been a primary means of measuring resilience in, for example, computer and telecommunications networks (Modarresi and Symons, 2021; 2020a; 2020b). While there is a vital role for these approaches, especially in the study of engineered systems, we have argued that the bottom-up approach to resilience is inadequate (Pipa and Symons, 2019). Bridges, roads, and power grids are built and maintained by complex social institutions.[4] If those so-

[3] Elsewhere, one of us has argued in detail as to why scientific inquiry into emergent properties like the resilience of social systems need not wait for the metaphysical status of non-fundamental properties to be established (Symons, 2018).

[4] Thanks to Bert Westbrook for pressing us on this point.

cial institutions fail to perform their role, physical infrastructure quickly disintegrates. Thus, there is a top-down role for social infrastructure in relation to physical infrastructure. In fact, an intact and resilient society can generally rebuild physical infrastructure or successfully adapt to its loss. By contrast, a society in which critical institutions have failed and is thereby unable to solve problems collectively will be unable to maintain complex physical infrastructure.

Over the past 10 years it has become clear that the focus on the physical basis of resilience must change (Patel et al., 2017). On the one hand, researchers increasingly recognize the importance of cultural factors and social relationships in the resilience of communities. On the other hand, the use of social media in malicious interventions by adversaries of the United States has forced attention to the vulnerability of social institutions and social norms. This new attention has widened our understanding of the factors affecting the resilience of communities. Cyberattacks on institutions involved in banking, healthcare, and commerce have likewise drawn attention to the role of the non-physical, social relations and institutions that play a critical role in community resilience.[5] Attacks on Google (2009), RSA (2011), JP Morgan, (2014), the Ukrainian power grid (2015), etc., all leveraged social engineering hacks either via phishing/spear-phishing emails, by telephone (voice phishing), or by gaining physical access through the use of a deceptive pretext or via physical media. Understandably, given the prominence of these hacks, security science has focused attention on the vulnerability of individuals. However, our work aims to encourage a new focus on the distinctively social aspects of the social attack surface, rather than on interventions targeting individual beliefs or attitudes.

For the remainder of the paper, we will sketch some of the core issues around community resilience in the context of traditional theories concerning the nature of institutions. These debates are interdisciplinary in nature, involving history, political science, sociology, economics, and anthropology, and within philosophy these debates cut across subdisciplines such as social ontology, political philosophy, and game theory. While we cannot survey all aspects of the debate, we argue that one of the most prominent contemporary views of institutions in economics and philosophy, the rules and equilibria approach, fails to account for the resilience of social institutions. Currently, there is no good explanation of why and how some institutions are more or less resilient. We argue that examining institutional failure provides a useful way to understand what makes a social system resilient, and offers a way to explain how resilience can be cultivated within our communities.

Understanding what kinds of things count as real and what criteria we use to decide such questions falls to a branch of philosophy known as ontology.[6] Our work assumes a stance towards basic questions in social ontology that we do not defend in detail in this paper. However, our ontological commitments are guided by a commonsense attitude towards our policy responsibilities. Practical decisions concerning, for example, defensive measures in the social attack surface would be impossible if we took the view, for example, that there is "no such thing as society." The denial of the role of the social in interstate conflict would be a grave mistake even if we do not have a well-grounded theory of the ontology of social phenomena ready to hand.

[5] Even in cases where our focus involves modeling physical infrastructure around, for example, food, energy and water, social and economic factors are increasingly recognized as directly relevant. See, for example, Modarresi & Symons (2021).

[6] In analytic philosophy, ontology has taken a variety of forms in the 20th and 21st centuries. For an overview see Symons (2010).

The study of the ontology of social things, for example, money, nations, communities, institutions, etc., is the domain of a subdiscipline known as social ontology. Social ontology explains the structure of social reality by exploring how social entities exist and relate to other things in the world. Institutions comprise a key focus of social ontology. Social ontology studies the function that institutions play in society and the reasons for their existence. Our view is that explanations of resilience in social systems raise questions about the nature of institutions to which social ontology must respond. Our approach is broadly consonant with the position defended by Brian Epstein (2015). We argue in particular that social ontology, especially when it attempts to tackle social properties like resilience should not take an individualist methodological strategy.

Rules vs. Equilibria

Early investigations into the nature of the firm in the 1960s by Ronald Coase helped to frame later debates concerning the ontology of institutions. Coase suggested that firms function to lower transaction costs that would otherwise be incurred in forming contracts among individuals (1990, p. 3-13). He noted the role of institutions like firms in economic processes, but other economists sought to give an account of the nature of the firm itself rather than its role in the broader economic system. For example, Douglass North argued for a rules-based conception of institutions in which rules serve to structure political, economic, and social interactions in society; institutions are the codification of these rules that shape human behavior in the "game of society" (1991, p. 97-112). According to North, institutions function to improve the welfare of society by enabling human beings to achieve their goals. The trouble with North's account for our purposes is that it does not explain why some rules are followed while others are not. While rules are clearly constitutive of institutions in some important respects, some account of the relationship between human decision-making and rules is required.

Game theoretic approaches to institutions attempt to respond to concerns of this kind. Most prominently, David Lewis' equilibria account of institutions applies game theoretic principles to explain why human beings follow the rules that comprise institutions. Lewis describes institutions as behavioral patterns that human beings settle into within a society and suggests these patterns can be explained as solutions to coordinated games with multiple equilibria (2008, p. 21). Actions that are in equilibrium will be repeated in the course of many actions because they are stable, while choices that reflect non-cooperative equilibria are unstable and thus unlikely to be repeated (Lewis, 2008, p. 42).

We share a version of Avner Grief's criticism of Lewis' account. If institutions are simply equilibria in a coordination game as Lewis suggests, then rules would not be necessary for establishing institutions (Grief, 2006, p. 12). Grief points out that rules play a vital role in shaping behavior so as to reach the equilibria that form institutions by acting as strategies that *ought* to be followed. Rules are statements of what ought to be done; they specify what behaviors are expected, which in turn creates regularities in behavior that people recognize and use to condition their own behavior (Grief, 2006, p. 15). This "rules-in-equilibrium" approach recognizes that there are incentives for people to follow the rules that are established by an institution and is an attempt to ground the relationship between human agency and institutional structures from an individualistic perspective (Grief, 2006, p. 211).

What is missing in these analyses is the role of social norms in relation to institutional rules. In practice, social norms determine whether people in fact follow

institutional rules. For example, laws against corruption in bureaucratic life exist in most countries. Whether such rules are followed is a matter of the social norms that operate in those societies and these vary widely.

John Searle's "constitutive rules" account is another prominent approach to the ontology of institutions that in some respects is closer to our view. However, as we shall see, Searle's account also misses the essential role of social norms in institutions. For Searle, institutions are systems of constitutive rules. Constitutive rules are those that take the form "X counts as Y in C" where X is a brute fact, Y is an institutional fact, and C is the context in which the institutional fact is accepted (Searle and Willis, 1995, p. 44). Brute facts are those for which no explanation is possible.[7] Institutional facts are those that exist only in the context of human institutions. Institutional facts exist only because human beings believe them to exist, communicate them, and act in accordance to these beliefs. For this reason, language is critical to institutional facts. According to Searle, institutions exist only because people believe them to exist.

On Searle's account, in order for institutional facts to exist there must be a system of constitutive rules that govern their existence. A constitutive rule differs from a regulative rule (one that follows the form "do X" or "if Y, do X") in that regulative rules regulate preexisting forms of behavior or activities that exist independent of the rule (e.g., imperatives); these activities or behaviors are logically independent of the rules. Constitutive rules constitute the activities or behaviors that they regulate; these activities or behaviors logically depend on the rules. Thus, constitutive rules constitute new forms of activities or behaviors; they create institutional facts (Searle, 2018, p. 51-54). A constitutive rule for money might go something like "these pieces of paper" (X) count as "money" (Y) in the United States (C).

Institutions can be understood as systems of constitutive rules, or the rules that a person must follow (or follow at least a large subset of) to be considered to be participating in the activity. In the case of money, the constitutive rules are the rules that comprise the recognized system for exchange within a society. For an institution to exist this system of constitutive rules must continually be recognized and accepted by a sufficient number of people within a society. This recognition creates what Searle calls a "status function." A status function is the power that human beings collectively attribute to certain things. Searle thinks of these as "deontic powers" such as rights, duties, obligations, requirements, and entitlements (2010, p. 224).

For an institution to exist it must have a status function, and for a status function to exist there must be a status function declaration, which is a verbal declaration that communicates a social practice that is recognized and accepted by persons within a society. Assigning a status function to a brute fact signifies the acceptance of that institution (Searle 1995, p. 34). Searle further differentiates between kinds of rules. A status rule defines the meaning of a status given to a thing, while a base rule spells out the conditions a thing must have to achieve that status. The status rule for money is that money is a means of exchange, while the base rule is money must be a piece of paper printed in a specific way by a specific entity.

According to Searle a status function can be represented as a constitutive rule (a rule of the form "X counts as Y in C"). The "counts as" component of the formula is where the status function does the critical work, as the function cannot

[7] See Symons (2019) for a discussion of the relationship between brute facts, scientific explanation, and ontology.

be achieved by the brute fact (X) alone. In addition, for an institutional fact to exist, collective recognition and acceptance is critical only for the function associated with the brute fact. For the pieces of paper to count as money people have to recognize and accept the function: these pieces of paper function as a means of exchange. It is not necessary for people to recognize that a function has been attributed to a physical substance (e.g., these pieces of paper had no economic value until they were assigned as valuable means of exchange) only that these pieces of paper (money) are a means of exchange.

According to Searle once a status function acquires collective acceptance and becomes a general policy it gains a normative status and becomes a constitutive rule (1995, p. 48). It is normative because people acknowledge that there are behaviors that align (thus also behaviors that do not align) with the rule; in other words, there are established ways to both follow and not follow the rule. Searle's reliance on individual belief in his social ontology of institutions has encouraged a focus on an individualist and epistemically focused understanding of influence campaigns against critical social infrastructure. Our perspective emphasizes the role of social rather than individual epistemic factors in norm adherence. It is common for people with exotic beliefs to act in ways that are in adherence to social norms and are not disruptive to the institutions with which they interact. By contrast, when norms erode, even agents with Searle-style beliefs about the institution and its rules will act in ways that undermine the institution. Thus, we can see the limitations of an account of institutional resilience that relies on epistemic states of individual agents. One's beliefs concerning the existence of a constitutive rule are distinguishable from the likelihood that one will adhere to the rule. This is where social norms play a central role in bringing institutions to life.

To this point, variations on two main approaches to the ontology of institutions have been explored: the rules-based approach and the equilibrium approach. The rules-based approach positions institutions as behavioral rules that guide and constrain behavior during social interaction, while the equilibrium approach treats institutions as equilibria of strategic games. Francesco Guala's theory of institutions falls somewhere between Grief's rules-in-equilibrium approach and Searle's constitutive rules approach and is designed to show that Searle's constitutive rules approach can be encompassed within the rules-in-equilibria approach (Hendriks and Guala, 2015).

Guala accepts that institutions guide, and in some circumstances mandate, people's behavior, which he believes also aligns with our intuitive understanding of institutions (2016). However, he contends that the rules approach does not provide an account of why some rules are followed while others are not. From the equilibrium approach he endorses the idea that successful institutions are comprised of rules that people are motivated or are incentivized to follow (Guala, 2016, p. 10). Incentives can be represented by strategic games, specifically coordinated games with multiple equilibria. In these games, each equilibrium represents a solution to a problem of coordination where the beliefs and behaviors of people are mutually consistent. This latter point is important – not all equilibria are institutions. If an equilibrium can be reached without any player correlating their strategy with the strategy of any other player, then it fails to be an institution.

Institutions require human interaction, and as such require correlation devices. Not all real-world circumstances mirror coordination games with symmetric equilibria. In games with asymmetric equilibria where one of the players must accept to a lower payoff, there has to be some way of coordinating the actions of

the players. A correlation device serves this purpose by acting as a signaling mechanism. A traffic light (green means go, red means stop) is an example of a correlation device. Although all players may wish to pass through the intersection first, they recognize that the best move for everyone is to abide by whichever light they happen to arrive to (red or green). In this way correlation devices lead to correlated equilibria.

However, not all correlated equilibria are institutions. For example, non-human animals use correlation devices to signal certain behaviors in certain circumstances. A male seal protects his harem by barking loudly in the water. If another male seal approaches the rookery and hears this barking it will retreat. If it doesn't hear this barking it will proceed. This is an example of non-human animals using a correlation device to solve a coordination game. However, this correlated equilibrium requires that the seal use one strategy, coordinated through a specific signal that dictates a specific behavior. The stimulus (sound of barking) is coupled with the behavior (retreating). For human beings the social world is filled with a multitude of signals and correlation devices that can be decoupled by creating representations.

Representations enable people to draw on a multitude of equilibrium strategies in symbolic form to determine the best course of action and to create new equilibria. Rules are simply symbolic representations of the strategies that ought to be followed in a game (Guala, 2015). Rules serve to coordinate behavior by stipulating behavioral patterns that can be expected of everyone. Rules represent equilibria (in some cases multiple rules together represent correlated equilibria where each rule is a strategy and the equilibrium are the set of strategies/rules). While the rules are general and accepted by all players, each rule/strategy will be followed by a particular player depending on the specific circumstances in which they find themselves.

To this point we have explored the idea that institutions function to provide solutions to coordination games and drive actions of people towards these solutions through institutional rules. Institutional rules create the rights and obligations that dictate how people should or must act in specific circumstances, and in this respect have deontic powers. Unlike Searle, Guala does not think a joint commitment to follow the rules is required for effective institutions because the main role of institutions is to drive solutions to coordination problems. Thus, all people need is concordant expectations about one another's behavior, which are built from both public signals and social interaction.

Guala also modifies Searle's account of a constitutive rule. Recall that according to Searle constitutive rules comprise institutions by governing human behaviors in societies. Constitutive rules are normative when they are collectively recognized, and they correspond to rights and obligations that dictate actions that people can/must perform in certain situations. Such rules are effective only if there are incentives that motivate people to follow them.

Searle's account of constitutive rules takes the form:

X counts as Y in C

Where X represents a brute fact, Y represents an institutional fact, and C is the context in which the institutional rule is accepted.

Guala revises this statement in the form:

If C then X is Y, and if Y then Z

He does this by translating "X counts as Y" to "X is collectively accepted as Y" and interpreting "is collectively accepted as" to "is," resulting in the translation of "counts as" to "is" (Guala, 2016):

counts as ↔ is collectively accepted as

counts as ↔ is collectively accepted

as ↔ is
counts as ↔ is

In the money example, certain pieces of paper count as money, thus certain pieces of paper are collectively accepted as money, thus certain pieces of paper are money.

certain pieces of paper count as money ↔
certain pieces of paper are collectively
accepted as money ↔
certain pieces of paper are money

This approach undermines Searle's concept of a status function. Recall that a status function is assigned when there is collective acceptance of the purpose of a certain thing (such as money having the status function of being a means of exchange). Guala eliminates the role of the status function by distinguishing between a *status rule* and a *base rule*. Status rules focus on defining what it means to possess that status (e.g., if the status is money, the status rule is money is a means of exchange). They are the rules that define the behaviors that come with that status, including the rights and obligations. A base rule defines the conditions of acceptance, or what is needed, to possess that status (e.g., pieces of paper or discs of metal printed by the U.S. mint); they are concerned with the ontological basis of the status (Hindricks and Guala, 2015). Thus the base rule is "certain pieces of paper are money in the United States"; which applies today in the U.S. because money in the United States is certain pieces of paper that collectively are accepted as a means of exchange.

Guala takes the "counts as" component of Searle's constitutive rule and relates it to what is needed to possess the status (base rules). If "X counts as Y" and "counts as is equivalent to the conditions of acceptance, then X are the conditions of acceptance for Y, where Y is the content of the status function (aka a status rule). Then these two pieces comprise the following constitutive rule:

If C then X is Y, and if Y then Z

Where "if Y then Z" is a status rules that enumerates the actions that are made available to people.

Searle claims that this process of transforming constitutive rules into regulative rules enables the introduction of institutional terms, such as money, property, or marriage, which (when they have collective acceptance) contain a wealth of information about the presuppositions for the conditions of the terms. These terms provide an efficient explanation of the sets of strategies that presuppose institutions. In this sense institutions are symbolic representations of equilibria that are denoted by the term (e.g., money, property, marriage) used to describe the institution. Thus, constitutive rules are linguistic transformations of regulative rules, which rely on a new term being introduced that is used to name the institution (Hindricks and Guala, 2015, p. 473). Hindricks and Guala claim that this transformation shows that the rules-in-equilibrium approach and the constitutive rules approach are consistent.

Furthermore, Guala claims that this unified account aligns the concepts of multiple realizability and multiple equilibria. Multiple realizability, or the idea that multiple iterations of the same property, in this case base rules, can occur in different contexts (e.g., pesos, dollars, and gold nuggets are all collectively accepted as money in different contexts) or that in one context there may be a base rule that describes characteristics that satisfies more than one X-term (e.g., coins and pieces of paper are both money in the United States), which is consistent with multiple equilibria in game theory. Thus institutions are defined by the types of strategic problems they solve, and the types of strategic problems are identified by their function (e.g., institution of money: gold nuggets are money because they fulfill some of the classic functions

of money). While Guala's theory of institutions provides useful explanatory power for understanding the functional role of institutions, it does not provide an account robust enough to explain or predict why some institutions are resilient in some contexts but fail in others.

Wlodek Rabinowicz objects to Guala's general rules-in-equilibrium account on the grounds that it (1) excludes morality and other non-instrumental forms of action that do not seem to be in equilibrium and (2) does not account for critical components of institutions, such as the physical properties that comprise them (Rabinowicz, 2018). Rabinowicz distinguishes rules that one is motivated to follow from rules that one *ought* to follow, noting that the former is generally less stringent than the latter, which comprise the requirements of morality. Since Guala claims that institutions are systems of rules in equilibrium, Rabinowicz notes that systems of moral rules are not always in equilibrium and therefore systems of moral rules do not constitute institutions.

For Guala, morality is not a particular kind of institution. Moral rules are normative elements of institutions. Since individuals' decisions to adhere or not adhere to norms often results in rewards or punishments, on this view moral rules motivate behaviors by signaling how individuals *ought* to act. In this way norms make human actions more predictable and promote cooperation in circumstances where behaviors would otherwise have been motivated by self-interest. Since institutional rules facilitate coordination in situations where human behavior is unpredictable, and norms make behaviors more predictable, Guala infers that norms are institutional rules that facilitate coordination.

As described, norms are not limited to a particular set of contexts, but instead present in all institutions. Framed as changes in the way incentives are structured, norms do not pose problems for the rules-in-equilibrium framework as Rabinowicz suggests. Instead, norms shift the equilibria of games. A set of actions that is in equilibrium of a game with only self-interested payoffs may be out of equilibrium when norms are considered as a part of the rules; actions that result in self-interested payoffs are not always considered moral ways of acting.

Rabinowicz also objects to Guala's theory on the grounds that Guala defines institutions too narrowly by limiting their scope to the systems of rules that govern them. He argues that Guala makes a *pars pro toto* mistake by taking one aspect of institutions (rules) as representative of the whole, leaving out the material components (buildings, people, etc.) that also comprise systems of institutions. Guala responds that physical properties are still a part of institutions but are secondary to the rules. The rules are the elements of an institution that are essential to comprising its function. Physical materials may exist without a system of rules, but without rules material objects do not serve the functions that comprise institutions. For example, the institution of money sets the rules for when a person can exchange certain pieces of paper for goods. While the people, pieces of paper, and goods exchanged are necessary components to the functioning of the institution of money, these physical elements are of secondary importance to the rules that determine how people are able to exchange these pieces of paper for goods. Money functions as a means of exchange. There must be some material object (pieces of paper, round pieces of metal, gold nuggets, etc.) to participate in the exchange but the specific object is irrelevant (Guala, 2018).

According to Guala, the physical objects, such as pieces of paper in the case of money, serve as correlation devices helping coordinate the actions of the people making the exchange. When understood this way, the rules-in-equilibrium approach acknowledges material compo-

nents as necessary but not sufficient for the establishment of institutions. Whether the physical object for the institution of money is a piece of paper or a gold nugget, the rules are of primary importance because they define the function (a means of exchange) of the object (piece of paper or gold nugget). Guala's theory of institutions rests on the idea that the primary work of social ontology is to understand the functioning of institutions in general, not to explicate the ontology of institutional objects. It also requires allowing that abstract game theoretic models can capture the functional essence of a particular institution by accepting the idea that there can be a definite set of activities that comprise an institution, such as money or marriage (token/type distinction).

While Guala responds to Rabinowicz criticism from morality by reference to self-interest and payoffs in equilibrium games, this strategy misses the role of non-moral norms. Social norms around corruption, for example, can be distinguished from the moral beliefs that people in corrupt societies might have about corruption. As Bichierri notes, social norms around corruption will generally trump the moral views of their participants. I might know that it is morally wrong to bribe the official, but I also expect that everyone does it and that no one would criticize me too harshly for doing it.

Another way to understand the role of norms is to think about the kinds of things that would bring down or destroy an institution and work backwards from there. Take the institution of academic grading—the institution of grading is assigning marks that reflect the quality of students' work. If faculty were paid different amounts based on the grades they assigned (e.g., $1,000 for every A, $10 for every C) the marks would no longer signal the academic value of the student's work. Instead grading would signal wealth, rather than academic excellence, and would destroy the institution of grading.

The fact that grading is a non-mercenary or a non-market service or transaction is a *constitutive feature* of the institution of grading. This feature was not part of the rules that established the institution, not because it couldn't be written into the rules of grading, but because it is effectively unnecessary to write it in.

Some constitutive features of institutions can be distinguished from the rules that are written to establish those institutions. Knowing only the rules that constitute an institution is not enough to know what that institution is; there are norms that are not written into the rules that must also be understood. In the case of grading, what grading is depends on certain kinds of norms being in place that cannot be found in the rules (e.g., *grading is non-mercenary* was not included in the rules when the institution was established). The rules that establish an institution are a different kind of thing than the function or the norms that constitute the institution.

It is also true that a single violation of these norms does not destroy an institution. If one faculty member or even a group of faculty members take bribes for grades, the institution of grading will not be destroyed. However, if enough faculty violate the norm and grading now signals wealth instead of the quality of a student's work, then the institution of grading is destroyed.

As another example, consider the concept of friendship. You cannot pay for friendship because doing so would undermine the conditions for friendship. Paying someone to be your friend does not actually make them your friend, and the monetary transaction undermines the institution of friendship. This does not mean that friendship does not have value or that you could not put a price on friendship, as you can sacrifice other goods for the sake of friendship, but the relation-

ship of friendship itself is not constituted via market transactions. When examining the positive rules or norms that characterize the maintenance of friendship, the notion that friends cannot be purchased need not figure explicitly. In some sense it goes without saying. However, this constitutive feature of friendship reveals itself upon examination of the things that could destroy the relationship.

Both of these examples illustrate our perspective that understanding the ways that an institution can be destroyed provides meaningful insight into the foundation of that institution beyond what the consideration of rules or equilibria alone can offer. If we want to build resilience into institutions and/or systems of institutions, then we must think about more than just the rules and equilibria. In thinking about institutions and non-market values, for example, it clearly makes no sense to reduce institutions to optimization games or some collective emergent calculation of coordinated interest. Our ongoing research aims to understand how interventions at the level of social norms can undermine institutions. Our assumption is the focusing on ways that institutions can fail will helps us to understand how they are constituted and what makes them resilient.

Interventions Aimed at Disrupting Social Infrastructure

In the foregoing discussion of theoretical work on the nature of institutions we have emphasized the constitutive role of norms. If we have correctly characterized the role of norms then we can begin to ask a set of empirical questions concerning the resilience of institutions. For example, what would count as an attack on the social infrastructure of the United States? Consider the ongoing use of social media platforms by the intelligence agencies of the Russian Federation. These platforms are widely recognized to have allowed low-cost, deniable, distributed, highly networked, and asymmetric interventions on the social infrastructure of the United States (NATO, 2020). While there are effective methods of tracking the means by which disinformation and propaganda are cultivated by the Russian defense establishment, we do not fully understand whether and how Russia intervenes against critical social infrastructure.[8] If it is the case that our adversaries target social institutions, evaluating and measuring the effectiveness of those interventions is a significant challenge.

At present, the nature and efficacy of different attacks are typically understood in individualist and epistemic terms focusing on measures of political dysfunction such as affective polarization and increased instances of contentious politics. This approach has value, but lacks the broader, system-level analysis of how social relations and norms are harmed and how those harms affect critical social institutions. Typically, indicators for the effects of social attacks are measures of either polarization or the growth of polarized online communities that are imputed to be the result of social media influence campaigns. Given our view of the role of social norms in social institutions as discussed above, we regard traditional focus on disinformation and misinformation as an excessively narrow approach to measuring Russian interventions on the social attack surface. Research into the efficacy of defensive strategies to counteract attacks on social infrastructure is in its early stages (Courchesne, Inglehart, & Shapiro, 2021).[9] Our ongoing work focus-

[8] The U.S. Government has a dedicated center for countering foreign disinformation, the Global Engagement Center (GEC) at the U.S. Department of State. In a 2020 report entitled *Pillars of Russia's Disinformation and Propaganda Ecosystem,* the GEC outlined the major components of Russian disinformation campaigns. This document provides an excellent overview of the official, proxy, and unattributed communication channels that Russia uses to create and amplify false narratives.

[9] The Carnegie Endowment's Partnership for Countering Influence Operations provides analysis of studies done thus far and has identified

es specifically on social norms in order to sketch strategic and practical capacities to understand and defend against social attacks.[10]

The extent to which Russian authorities are intentionally targeting the social and cultural resilience of their adversaries is obviously unknown. Nevertheless, figures from the Russian military establishment have explicitly and publicly connected cultural considerations to their cyberwarfare efforts for over two decades.[11] Moreover, Russian philosophers and intellectuals, most notoriously Alexander Dugin, have regularly framed international relations in terms of competing cultural and spiritual values with varying degrees of strength and resilience. The extent to which such expressions can be understood as indicating strategic military principles is highly debatable. Nevertheless, in December 1996 Chief of the Russian General Staff General Viktor Nikolaevich Samsonov publicly observed that:

The high effectiveness of information warfare systems in combination with highly accurate weapons and nonmilitary means of influence makes it possible to disorganize the system of state administration, hit strategic installations, and affect the mentality and moral spirit of the population. In other words, the effect of using these means is comparable with the damage resulting from the effects of weapons of mass destruction (Grovsdev, 2012).

These comments indicate that the Russian military establishment has at least considered the cyberwarfare role of normative and cultural interventions.[12] Russia's efforts to cultivate grievances and amplify the forces of contentious politics illustrates Russia's use of cyber-enabled information operations as another domain, alongside air, land and sea, to attack adversaries. Contemporary studies have relied on individual-level theories and conceptual frameworks to understand these attacks. For example, Edwards et al. (2017) represent the mainstream view that the "social engineering attack surface is the totality of an individual or a staff's vulnerability to trickery. Social engineering attacks usually take advantage of human psychology: the desire for something free, the susceptibility to distraction, or the desire to be liked or to be helpful." Our approach focuses on the social, rather than the individual. Instead of inferring social consequences from psychological operations at scale, we analyze efforts to undermine norms critical to social infrastructure (Mckay and Tenove, 2021). To this end, we aim to test the hypothesis that Russian attacks aim broadly at the likelihood of adherence to two particular kinds of expectations in a relevant population. These two kinds of expectation are theorized by Christina Bicchieri to undergird adherence to social norms (2016). These are *empirical expectations*: The prediction that people typically act in accordance with the norm, and *normative expectations*: The prediction that people in the relevant community typically judge a norm violator to be blameworthy in some way. Our interdisciplinary approach aims to uncover the specific social mechanisms targeted within such operations.

Our ongoing research begins with a

significant gaps in understanding and prescriptive measures to combat influence efforts.

[10] The Carnegie Endowment has usefully gathered much of the existing research here: https://carnegieendowment.org/specialprojects/counteringinfluenceoperations#latestAnalysis.

[11] The theory and practice of Russia's diverse approach to communication technology for information warfare and influence operations is well documented (see RAND, 2022).

[12] The *Doctrine of Information Security of the Russian Federation* emphasizes "applying information technologies for the preservation of cultural, historical, spiritual and moral values of the multiethnic people of the Russian Federation" (Russian Ministry of Foreign Affairs, 2016) and "neutralizing the information impact intended to erode Russia's traditional moral and spiritual values" (2016).

bounded case to chart Russian efforts to influence the "defund the police" discussions from 2019 to the present, in order to determine whether those efforts functioned as interventions in the social norms of the United States. These norms might include, for example, respect for and trust in law enforcement, norms around cooperation with police, reliance on police, and expectations with respect to interactions with police officers. We use a combination of data drawn from Twitter and content from newspapers to explore the dynamics of these interventions. Newspaper content data allows us to document the changing nature of public discourse concerning policing. Twitter data allows us to identify both sources of Russian influence and document how and whether empirical and normative expectations are influenced, evidenced through content propagation, engagement data (sharing, etc.), and the formation of online communities around expressed positions on norms.

While Russia's efforts in social media interventions have been mapped and described by the Global Engagement Center at the Department of State (GEC, 2020), a comprehensive analysis of specifically normative interventions is still ongoing. The reason that we target normative investigations is because we assume (as argued above on theoretical grounds) that social norms are at least partly constitutive of institutions and that institutions can be undermined by destabilizing social norms. While research has identified disinformation as an increasingly *participatory* and social act, emerging from social networks exposed to influence efforts, it is less clear how (and whether) adversaries act to undermine social norms.[13] This set of challenges has been identified by the Department of Homeland Security as a whole-of-society issue and we believe that our efforts to measure and analyze the social aspects of these interventions is a step towards addressing this.[14]

Twitter now permits access to its historical and real-time data archive.[15] Together with collaborators April Edwards, Deborah Pfaff, and Craig Hayden, we use text mining applications on the Twitter archive in relation to known influence campaigns on social media. The data we hope to generate will allow us to test our hypothesis concerning targeting efforts directed towards normative expectations as described above. Among the strategies that we use are text mining of key phrases involving social knowledge, i.e., "everybody knows," "no one thinks," "[some social group] knows…" and related terms.[16] The computational text analysis approach will be designed to identify and capture "social and cultural concepts."[17] When found together with relevant key words, hashtags, and known Internet Research Agency accounts, we count these as instances of a social norm intervention. The diffusion of these interventions (and the IRA-driven amplifications via retweets, bots, etc.) can be tracked through time, and the main lines of transmission beyond Russian-controlled accounts can be observed.

In addition to tracing the dynamics

[13] For example, see the study of Russian "participatory propaganda," funded by the Office of Naval Research, Kate Starbird, Ahmer Arif, and Tom Wilson, "Disinformation as Collaborative work: surfacing the participatory nature of strategic information operations." https://dl.acm.org/doi/pdf/10.1145/3359229

[14] https://www.dhs.gov/sites/default/files/publications/ia/ia_combatting-targeted-disinformation-campaigns.pdf

[15] https://developer.twitter.com/en/use-cases/do-research

[16] For background on the logic of social or collective aspects of epistemic phenomena, see Rendsvig and Symons (2021).

[17] This methodology differs from traditional sentiment analysis approaches and is necessary, given the research objective. See Dong Nguyen, Maria Liakata, Simon DeDeo, Jacob Eisenstein, David Mimno, Rebekah Tromble, Jane Winters "How We Do Things With Words: Analyzing Text as Social and Cultural Data" *Front. Artif. Intell.*, 25 August 2020 Sec. Language and Computation. https://doi.org/10.3389/frai.2020.00062

of these interventions, we use newspaper content to examine the extent to which observed shifts in normative expectations are evidenced in subsequent media framing within national U.S. news coverage. Our research has focused initially on norms around trust in police in the United States from early 2020 to the present. We make use of the existing corpus of Black Lives Matter related tweets (Giorgi et. al, 2021) in addition to tweets related to "Defund the Police" discussions. The initial goal will be to determine whether Russian efforts are explained in terms of the theoretical framework we have described. This work is ongoing and we hope to be able to report back to future Merrill Seminars.

Conclusions

The United States is an open, diverse, and liberal society and, as a result, has a more limited range of defensive options available for the defense of our social institutions as compared with our autocratic adversaries. At present, U.S. laws prevent social media companies from being held liable for content posted on their platforms. Our research will inform options for both practical defensive measures and regulations in response to interventions that are targeted to harm critical social institutions. Nevertheless, we must learn the full scope by which our adversaries threaten our political and social order in order to develop countermeasures that are effective and comport with our values. At this point, the extent to which adversaries manage to successfully target social norms is unknown.

In principle, as we have shown, social infrastructure is as important to national security as physical infrastructure, and national defense requires that we understand the norms, expectations, and choice architectures (especially at the cyber-social interface) that constitute social institutions. Defense of our nation no longer depends just upon *national* security, but also *human* security—which includes the weakening of social norms and, subsequently, institutions by our adversaries. On a theoretical level, this work contributes to our understanding of the relationship between social norms and institutions. This is a topic of great interest in economics, sociology, and political science. We are also hopeful that work of this kind can help to move Security Studies away from an excessively individualist focus in the study of the social attack surface towards recognition of the role of social norms in interstate rivalry.

References

Aceves, W. J. (2018). Virtual hatred: How Russia tried to start a race war in the United States. *Mich. J. Race & L.*, *24*, 177.

Arif, A., Stewart L., & Starbird, K. (2018). Acting the Part: Examining Information Operations Within #BlackLivesMatter Discourse, 2 *Proceedings of the ACM on Human Computer Interaction*, *20*.

Amadae, S. (2011). Normativity and Instrumentalism in David Lewis' *Convention*. *History of European Ideas, 37*, no. 3, 325-35.

Aydinonat, N., & Ylikoski P. (2018). Three Conceptions of a Theory of Institutions. *Philosophy of the Social Sciences, 48*, no. 6, 550-68.

Bedau, M., & Humphreys, P. (2008). *Emergence: Contemporary Readings in Philosophy and Science.* MIT Press.

Bicchieri, C. (2005). *The Grammar of Society: The Nature and Dynamics of Social Norm*s. Cambridge University Press.

Bicchieri, C. (2016). *Norms in the wild: How to diagnose, measure, and change social norms*. Oxford University Press.

Binmore, K. (2015). Institutions, Rules and Equilibria: A Commentary. *Journal of Institutional Economics, 11*, no. 3, 493-96.
Boyd, R. (1999). Kinds as the "Workmanship of Men": Realism, Constructivism, and Natural Kinds. *Rationalität, Realismus, Revision, 52-89*.
Bradshaw, S., DiResta, R., & Miller, C. (2022). Playing Both Sides: Russian State-Backed Media Coverage of the #BlackLivesMatter Movement. *The International Journal of Press/Politics*. doi:10.1177/19401612221082052
Brennan, G., & Philip P. (2004). *The Economy of Esteem: An Essay on Civil and Political Society*. OUP Oxford.
Coase, R. H. (1995). The Nature of the Firm. In *Essential Readings in Economics, 37-54*. Springer.
Courchesne, L., Ilhardt, J., & Shapiro, J. (2021, September 13). "Review of Social Science Research on the Impact of Countermeasures Against Influence Operations." *Harvard Kennedy School Misinformation Review*. https://doi.org/10.37016/mr-2020-79
Day, Jamison M. (2014). "Fostering Emergent Resilience: The Complex Adaptive Supply Network of Disaster Relief." *International Journal of Production Research, 52*, no. 7:1970-88.
Edwards, M., Larson, R., Green, B., Rashid, A., & Baron, A. (2017). Panning for gold: Automatically analysing online social engineering attack surfaces. *Computers & Security*, *69*, 18-34.
Epstein, B. (2015). *The Ant Trap: Rebuilding the Foundations of the Social Sciences*. Oxford University Press.
Epstein, B. (2016). "Replies to Guala and Gallotti." *Journal of Social Ontology, 2*, no. 1:159-72.
Farrell, H., & Schneier, B. (2018). Common-knowledge attacks on democracy. *Berkman Klein Center Research Publication*.
Gauss, G. (2010). *The Order of Public Reason: A Theory of Freedom and Morality in a Diverse and Bounded World*. Cambridge University Press.
Gerber, T. P., & Zavisca, J. (2016). Does Russian propaganda work? *The Washington Quarterly*, *39*(2), 79-98.
Giles, K. (2017). Countering Russian Information Operations in the Age of Social Media. *Council on Foreign Relations*.
Giorgi, S., Guntuku, S. C., Himelein-Wachowiak, M., Kwarteng, A., Hwang, S., Rahman, M., & Curtis, B. (2022). Twitter Corpus of the #BlackLivesMatter Movement and Counter Protests: 2013 to 2021. In *Proceedings of the International AAAI Conference on Web and Social Media,* Vol. 16, pp. 1228-1235.
Greif, A. (2006). *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. Cambridge University Press.
Guala, F. (2010). "Reciprocity: Weak or Strong? What Punishment Experiments Do (and Do Not) Demonstrate." University of Milan Department of Economics, Business and Statistics Working Paper, no. 2010-23.
Guala, F. (2016). *Understanding Institutions: The Science and Philosophy of Living Together*. Princeton University Press.
Guala, F. (2018). Replies to Critics. *Philosophy of the Social Sciences, 48*, no. 6, 630-45.
Guala, F., and Hindriks, F. (2015). A Unified Social Ontology. *The Philosophical Quarterly, 65*, no. 259:177-201.
Gvosdev, N. K. (2012). The Bear Goes Digital: Russia and Its Cyber Capabilities. *Trans. Array Cyberspace and National Security: Threats, Opportunities, and Power in a Virtual*

World. Derek S. Reveron. Washington DC: Georgetown University Press.
Hauswald, R. (2018). "Institution Types and Institution Tokens: An Unproblematic Distinction?" *Philosophy of the Social Sciences, 48*, no. 6:594-607.
Heath, J. (2008). Following the Rules: Practical Reasoning and Deontic Constraint. OUP USA.
Helmus, T. C., Bodine-Baron, E., Radin, A., Magnuson, M., Mendelsohn, J., Marcellino, W., & Winkelman, Z. (2018). *Russian social media influence: Understanding Russian propaganda in Eastern Europe*. Rand Corporation.
Hindriks, F., & Guala, F. (2015). "Institutions, Rules, and Equilibria: A Unified Theory." *Journal of Institutional Economics, 11*, no. 3, 459-80.
Hodgson, G. M. (2018). "Understanding and Defining Institutions: The Contribution of Francesco Guala." Taylor & Francis.
Hendrix, J. (2018, October 24). Two New Reports Expose How Black Americans are Targeted by Russian Disinformation, *Just Security*). https://www.justsecurity.org/
Lee, D. (2018, February 16). The Tactics of a Russian Troll Farm. BBC. https://www.bbc.com/news/technology-43093390
Lewis, D. (2008). *Convention: A Philosophical Study*. John Wiley & Sons.
Linvill, D. L., Boatwright, B. C., Grant, W. J., & Warren, P. L. (2019). "THE RUSSIANS ARE HACKING MY BRAIN!" Investigating Russia's internet research agency twitter tactics during the 2016 United States presidential campaign. *Computers in Human Behavior*, *99*, 292-300.
Mäkelä, P., Hakli, R., & Amadae, S. (2018). "Understanding Institutions without Collective Acceptance." *Philosophy of the Social Sciences, 48*, no. 6:608-29.
McKay & Tenove. (2021). "Disinformation as a threat to deliberative democracy." *Political research Quarterly, 74*, 3:703-717.
Modarresi, A., & Symons, J. (2021). Modeling Resilience for Sustainable Food, Energy, and Water Systems. In *AGU Fall Meeting Abstracts,* Vol. 2021, pp. IN45F-0501.
Modarresi, A., & Symons, J. (2020). Resilience and technological diversity in smart homes. *Journal of Ambient Intelligence and Humanized Computing*, *11*(12), 5825-5843.
Modarresi, A., & Symons, J. (2020). Technological heterogeneity and path diversity in smart home resilience: A simulation approach. *Procedia Computer Science*, *170*, 177-186.
NATO Science & Tech Trends 2020-2040, Exploring the S&T Edge (p. 32 – the Infosphere).
North, D. C. (1991). *American Economic Association*. The Journal of Economic Perspectives, 5, no. 1: 97-112.
Pacherie, E. (2011). "Framing Joint Action." *Review of Philosophy and Psychology, 2*, no. 2:173-92.
Patel, S. S., Rogers, M. B., Amlôt, R., & Rubin, G. J. (2017). "What Do We Mean By 'Community Resilience'? A Systematic Literature Review of How It Is Defined in the Literature." PLoS currents 9.
Phillips, W. (2015). *This is why we can't have nice things: Mapping the relationship between online trolling and mainstream culture*. MIT Press.
Pihelgas, M. (2015). Mitigating risks arising from false-flag and no-flag cyber attacks. *CCD COE, NATO, Tallinn*.
Pipa, F., & Symons, J. (2019). Towards an understanding of resilience with complex networks. In *Proceedings of the 6th annual symposium on hot topics in the science of security* (pp. 1-1).

Rabinowicz, W. (2018). "Are Institutions Rules in Equilibrium? Comments on Guala's Understanding Institutions." *Philosophy of the Social Sciences*, *48*, no. 6:569-84.
Rendsvig, R. & Symons, J. (2021). "Epistemic Logic." *The Stanford Encyclopedia of Philosophy* , Edward N. Zalta (ed.). https://plato.stanford.edu/archives/sum2021/entries/logic-epistemic/
Rozenshtein, A. (2019) *No, Facebook and Google Are Not State Actors.* https://www.lawfareblog.com/no-facebook-and-google-are-not-state-actors
Searle, J. (2010). *Making the Social World: The Structure of Human Civilization*. Oxford University Press.
Searle, J. (2008). "Language and Social Ontology." *Theory and Society*, *37*, no. 5:443-59.
Searle, J. (2015). "Status Functions and Institutional Facts: Reply to Hindriks and Guala." *Journal of Institutional Economics, 11*, no. 3:507-14.
Searle, J. (2018). "Constitutive Rules." *Argumenta*, *4*, (1):51-54.
Searle, J. and Willis, S. (1995). *The Construction of Social Reality*. Simon and Schuster.
Starbird, K., Arif, A., & Wilson, T. (2019, November). "Disinformation as Collaborative work: surfacing the participatory nature of strategic information operations." *Proceedings of the ACM on Human-Computer Interaction*, Volume 3, Issue CSCW, Article 127. pp 1–26. https://doi.org/10.1145/3359229
Stewart, L. G., Arif, A., Nied, A. C., Spiro, E. S., & Starbird, K. (2017). Drawing the lines of contention: Networked frame contests within #BlackLivesMatter discourse. *Proceedings of the ACM on Human-Computer Interaction*, *1*(CSCW), 1-23.
Sugden, R. (2004). *The Economics of Rights, Co-Operation and Welfare*. Springer.
Symons, J. (2019). Brute Facts About Emergence. In Vintiadis, E., and Mekios, C. eds. *Brute facts*. Oxford University Press.
Symons, J. (2018). Metaphysical and scientific accounts of emergence: Varieties of fundamentality and theoretical completeness. *Emergent Behavior in Complex Systems Engineering: A Modeling and Simulation Approach, 2-20*.
Symons, J. (2010). Ontology and methodology in analytic philosophy. In *Theory and applications of ontology: Philosophical perspectives* (pp. 349-394). Springer, Dordrecht.
Tenove, C. (2020). Protecting democracy from disinformation: Normative threats and policy responses. *The International Journal of Press/Politics*, *25*(3), 517-537.

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