Executive Summary

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

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- 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
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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. 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
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- 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
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- 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
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- 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
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- 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

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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. 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):

    o 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*

    o 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
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- 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

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- 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
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- 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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- 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.