DEVELOPING A RESILIENCE TOOL FOR HIGHER EDUCATION INSTITUTIONS: A MUST-HAVE IN CAMPUS MASTER PLANNING

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INTRODUCTION

Resilience has become a prominent topic in the planning and design industry over the past several years. States, cities and entire regions face an ever-growing threat of environmental and societal challenges, including natural disasters, sea level rise, climate change, terrorism and financial insolvency. Around the world, universities are leading efforts in terms of research and problem solving regarding resilience and sustainability in their broader communities. As campus planners working nationwide with higher education clients, we see an increasing opportunity for higher education researchers, leaders and institutions to bring this same leadership stance to addressing their campus' own resilience. A campus master plan is perhaps the pinnacle opportunity to connect expert researchers with campus stewards and community leaders to engage in dialogue, identify priorities and advance resilience within their campus and community. A comprehensive master plan, by its very nature, will guide and protect an institution's long-range survival and plans. Such long-range planning is now more critical than ever given the deep financial pressures and flat or declining demographics that so many institutions face. Being proactive versus reactive increases the likelihood that institutions will succeed and continue to meet the needs of students and communities. Universities should continue or begin to address resilience challenges and opportunities in whatever scope possible. This paper will give university leaders and industry participants a broad framework to direct discussion and dissect levels of resilience, opportunities and potential shortfalls, and highlight resilient campus planning best practices. The aim is to provide a framework for institutions to measure and strengthen the resilience of their infrastructure, culture, and systems, while contributing to the resilience of their communities.

KEYWORDS

resilience, campus planning, higher education, master plan, sustainability, built environment, community resilience

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The noun "resilience," meaning 'the act of rebounding, was first used in the 1620s and was derived from 'resiliens', the present participle of Latin 'resilire', 'to recoil or rebound'. Later, resilient was used to mean "springing back." We like this modern-day definition, as stated by the National Resilience Initiative: "Resilience is achieved when systems remain adaptable and functioning while faced with a major disruption." Even better, resilience results in a state of being that is stronger after an entity faces a major disruption than before.

Higher education institutions have long been leaders when it comes to sustainability. Yet sustainability and resilience, while related, are not the same. They may also conflict. Having redundant energy systems increases resilience in the face of storm damage, but may sacrifice financial resilience because of higher capital and operational costs. Also, the concept of sustainability starts with or creates a well-functioning system, and then refers to decisions, methods and actions that don't deplete resources to the point of harming the system or rendering it useless. The concept of resilience anticipates a shock to the system or a disaster, and then refers to actions and strategies that respond to the setback, helping the system return to prosperity. Resilience does not necessarily imply returning to the pre-shock state. It is possible that, after a shock, the system may need to change and adapt in significant ways in order to flourish. In that way, resilience is very much a dynamic concept.

RESILIENCE ON CAMPUS

Much scholarly research has been done on resilience as it relates to individual versus community resilience, urban planning and disaster preparedness. Much attention has also been paid to sea-level rise, biological ecosystems, other natural disasters, and the creation of resilient cities and resilient communities.

So far, little research is focused on the university campus. This is probably because most university and college campuses, while exploring sustainability, have done less with the notion of resilience. The environmental and engineering firm, Haley & Aldrich, surveyed colleges and universities and found that many are only in the "early stages" of understanding resilience issues and have not formulated plans because they don't know where to start. They are hampered by lack of guidance, lack of consistent regulations and policies, lack of established best practices and lack of leadership support to make "whole-system resilience planning a top priority," the study concluded. Budgetary constraints also weigh heavily on efforts, as does the need to prioritize limited funds between short term critical needs and long term priorities. Probably as a result of these challenges, we find limited examples of resilient campus planning and operational implementation.

And yet, there is movement and hope. Colleges and universities are among the most proactive groups in addressing climate change. In the Haley survey, about two-thirds of the organizations interviewed were actively combining sustainability measures with resilience. Harvard University, for instance, recently set the goal of being fossil fuel-free by 2025. Such a step, while great for the climate, also makes the university more resilient to energy-price shocks. Within the higher education arena, some institutions also have faculty and centers studying resilience, including the Global Forum on Urban and Regional Resilience at Virginia Tech, the Old Dominion University Resilience Collaborative and NC State University's Coastal Dynamics Design Lab. Some institutions are complementing their research centers with staff to oversee implementation of research and policies regarding resilience. However, there is widespread need to better connect the research and theory with practical application.

While many colleges and universities have offices and/or directors of sustainability, few have offices and/or directors of resilience. In fact, those that incorporate resilience into their organizational structure often do so inside the office of sustainability, a logical first step. Ideally, institutions should work toward inverting this structure. The concept of resilience—with its focus on long term system wellbeing, dynamically planning for, responding to, and recovering from unplanned events—should be the overarching framework. Sustainability should represent a vital and complementary component of that.

ASSESSING CAMPUS RESILIENCE

As we discussed resilience with campus leaders, the overarching question was "What actions should we take to be more resilient"? It was this question that sparked our search for answers. We identified the need for the development of a practical tool and process with which higher education institutions can measure their resilience, and then use that information to inform planning and investments. To address this question, Hanbury partnered with Virginia Tech's Global Forum on Urban and Regional Resilience. The goal was to combine Hanbury's expertise in campus planning and infrastructure with the deep research, knowledge base and academic network of the Global Forum, connecting research with industry practitioners and campus stewards.

The most relevant study for our inquiry was the City Resilience Index conducted by a team at ARUP in collaboration with The Rockefeller Foundation. The CRI's primary purpose is to diagnose strengths and weaknesses of city resilience and measure relative performance over time. It is structured around four dimensions: people, organization, place and knowledge, 12 goals and 52 indicators, including financing and sanitation. The CRI is intended to provide a common basis of measurement and assessment to better facilitate dialogue and knowledge-sharing between cities.

The CRI was an exhaustive three-year effort. We found the research around it to be an excellent foundation for our campus resilience study and have utilized input from ARUP and its team's conclusions to inform the framework for our study.

Along with CRI, there are other frameworks to measure the resilience of cities and universities. The non-profit, Second Nature, is committed to accelerating climate action in, and through, higher education. Second Nature created the Alliance for Resilient Campuses. It helps colleges formulate programs that respond proactively to the effects of climate change. Also, the National Oceanic and Atmospheric Administration led an effort to create the U.S. Climate Resilience Toolkit that helps users understand and address their climate risk. Lastly, the Community and Regional Resilience Institute (CARRI) has created the Campus Resilience Enhancement System to help colleges and universities "test and verify the resources, processes, and tools that would be useful and effective in campus resilience."

Our approach to measuring and planning for campus resilience builds on and aims to contribute to these frameworks. Our methodology is holistic. We don't focus on any particular type of risk. Instead, we explore how the infrastructures, systems and characteristics of a university contribute to its resilience against various risks. Second, our approach emphasizes the quantitative analysis of objective data that is readily available at most institutions. Certainly, each university's situation is unique. They face different risks and have different comparative advantages. But in order to measure an institution's resilience at a more fundamental level, our approach focuses less on an institution's self-perception of its situation and the idiosyncratic risks it faces, and more on quantifiable and objective data that better measure its true ability to overcome setbacks.

Self-assessments can play a role, but objective measures of a university's environment are less subject to biases and distortions contained in responses to survey questions about subjective performance. If "resilience" is the ability to overcome setbacks, then our methodology is designed to measure a university's capacity to survive and thrive in the face of different types of threats.

The basis for our study will initially include assessment of resilience conditions at Virginia Tech, NC State University and Florida Atlantic University. This work is part of a larger project on defining, assessing, and describing the resilience of campuses and their host communities. In addition to assessing resilience at these three schools, the full project includes a more thorough collection of data on large land grant universities in the Southeast U.S, as well as the construction of an online data analysis and visualization tool.

Our campus resilience measurement tool identifies the key areas that we believe campuses should assess to arrive at a general level of knowledge regarding the resilience of the campus and of the institution's ability to assist the broader community with resilience. Our study highlights three dimensions of a campus ecosystem that are critical to resilience, and which can and should be a component of any comprehensive campus master plan. Those three dimensions are the built and natural environment, the financial and economic environment, and the broader community environment of resilience, to which universities often contribute leadership, facilities and resources. Effective leadership is the linchpin connecting these three dimensions and making sure that they work in tandem, not in opposition.

The Resilient Campus Tool will provide a clear framework for advancing the topic of resilience in the campus master planning process. The tool highlights three dimensions of a campus ecosystem that are critical to resilience, with leadership, knowledge and planning as essential linchpins in creating and maintaining set goals for resilience. A holistic review of university resources, strategic goals, campus and community relationships, and inter-campus culture will help universities assess their strengths and vulnerabilities.

By assessing the condition of these three areas, university leaders and campus planners will be better informed about what's missing in their long and short-term campus master plans as it pertains to resilience, what needs boosting now and what can wait. These assessments also help university planners make better informed decisions on trade-offs between competing options.

Beyond providing guidance for our framework, the CRI research was relevant to our work because of the deep links between higher education campuses and their broader communities and cities. Universities and their host communities are inextricably linked at multiple scales and levels. In fact, universities are often stalwarts of a community. Campus and community share natural resources, personnel and infrastructure. Colleges and universities have also historically been considered bellwethers for local economies, hubs of community activism and keepers and expanders of community culture and aspiration. For these reasons, it is critically important for university and community planning to be integrated regarding the topic of resilience.

Our goal with the resilient campus tool is to provide a clear framework to advance this critical planning initiative and to provide relevant information for decision making. Our tool has not yet been tested by any college or university and is currently under development. More work needs to be done. Eventually, we expect to complete our data set with information from ten to twelve institutions, to build a web application and to establish benchmarks and standards for each criterion. We are choosing metrics based on readily available information at most institutions. While more data will sharpen our approach, our early work has developed a framework for colleges and universities to begin to address resilience at a deep and more communal level.

For instance, this initial work has helped inform our campus master plan currently in process at Florida Atlantic University. The campus and community was struck hard by Hurricane Irma a year ago and faces recurrent threats from severe weather and concerns over sea level rise. Part of the planning effort involved an extended work session with faculty and students from the School of Architecture and the Center for Urban & Environmental Solutions. Our goal was to address resilience and sustainable planning; again connecting research with industry practitioners and campus stewards.

Over thirty students and faculty from the School of Architecture and the Center for Urban & Environmental Solutions participated in a workshop led by the Hanbury planning team this fall at FAU's Metro Lab in Fort Lauderdale.

RESILIENCE OF THE BUILT ENVIRONMENTS

One distinguishing feature of many universities and colleges is their geographical size. Sometimes, the institution comprises a substantial portion of its host community. The built environment of such universities is extensive and has diverse components. For our assessment tool, we identified buildings, utilities, transportation networks, and shelter and emergency services as the four most critical areas pertaining to campus and community resilience.

Buildings

Building infrastructure comprises the largest financial investment of most institutions. If buildings have high deferred maintenance needs, they'll be less able to withstand shocks and continue to function. That leads to decreased resilience for the university. Moreover, universities are often well-positioned to help campus occupants and host communities in the event of a disaster by providing shelter, emergency services and support. This capacity will be compromised if the university's buildings are damaged and unsafe.

Our analysis of buildings includes three basic metrics to evaluate their resilience to unexpected shocks. The characteristics are their age, their state of disrepair, and to what extent they are built to sustainable design guidelines. In general, newer, less dilapidated, and more self-sufficient buildings can better survive stressors, and continue to provide services during and after adverse events. Combining these characteristics gives a more complete picture of campus buildings to withstand shocks and provide shelter and services.

Natural Environment and Landscape

Where an institution sits in the world is key to its resilience concerns and many of these will differ by location. While threats from sea level rise will likely be of primary concern for coastal universities and colleges, withstanding shocks from tornadoes or earthquakes will rank high for institutions in other parts of the world. In this arena, our tool will begin with an assessment of primary threats and primary opportunities offered by the natural environment.

Storm water runoff and flood mitigation is one common site planning element that almost all campuses face, and it is a key component impacting resilience. The Haley survey, for instance, found numerous schools incorporating natural wetlands into planning to reduce flood risk. "Land use decisions that may result from resilience considerations include locating sports fields or open spaces rather than buildings in low-lying areas that may be affected by floods or sea level rise," says authors Elizabeth Foster and Chris Smith in their 2015 article, "Integrating Resilience Planning Into University Campus Planning," in the *Planning for Higher Education Journal*.

Utilities

Utility infrastructure is a vital backbone of any campus and host community. Colleges and universities typically provide utility services to their students and staff, and sometimes to the broader community. While heating and cooling infrastructure is the most prominent service that universities provide, some schools also provide electricity, water and wastewater services, and telecommunications. Having a well maintained and redundant utility infrastructure increases resilience. If institutions have the capability to provide for themselves and their host communities, they have more assurance of uninterrupted service in times of need rather than having to rely completely on outside providers. Our resilience tool includes an assessment of utility conditions and redundancy.

Transportation

Transportation networks and services are important for the resilience of a university's built environment for two reasons. First, transportation networks help move people away from danger. This may involve evacuating students, faculty, and staff from the campus in the event of an attack or other hazardous situation. Alternatively, it may mean moving people from a dangerous situation in the broader community onto campus, into shelters or other safe areas. Second, a well-functioning transportation network, along with efficiently running services, can help to limit the number and negative consequences of any attacks or other hazardous situations. Public transportation also enhances sustainability.

To quantify the effects of the university's transportation network on campus resilience, we record whether the university operates a public transportation system, and, if so, how large and costly it is. We also check whether the university contributes to the provision and/or maintenance of an emergency route that could be used to evacuate people should the need arise.

Shelter and Emergency Services

Universities often provide space for students, faculty and local residents to shelter after catastrophic events. Universities are well suited for this task because they often have large, secure spaces, such as lecture halls, unions, and arenas that can accommodate large numbers of people. We collect data on their capacity to provide shelter. We also record whether the university provides services such as emergency rescue and medical treatment. Lastly, we check whether the university has an emergency plan and, if so, how detailed it is with respect to providing shelter and medical care to the university and host communities. When Hurricane Florence hit in September 2018, UNC-Chapel Hill's center for continuing education served as an emergency shelter. Lecture halls were screening movies for children and classrooms were converted to sleeping accommodations.

FINANCIAL AND ECONOMIC RESILIENCE

Financial shocks to a university and its host community can be severe and have significant consequences. In addition, financial hardships can bleed into other areas, affecting a university's ability to maintain buildings and provide services like transportation and rescue, further impacting its resilience. There are many specific strategies universities can use to increase their resilience to these types of financial and economic risks. Facing expansion and renovation needs without ample funds, the University of Kansas, for instance, approved a $350 million public-private partnership, or P3, to redevelop its campus and build a new science building and other facilities. More institutions are deploying P3s to boost their financial resilience in the face of dwindling state funding.

It is this kind of diversification of risk that guides our analysis and measurement of universities' financial resilience. It is better, from a financial resilience standpoint, to limit the exposure to any one particular risk. Our starting point in financial resilience is to look at the size of the university's endowment relative to the student population. While not perfect, endowment dollars per student gives a useful measure of the financial resources available to a university should other revenue streams shrink or dry up. We also measure the university's diversity of revenue streams. Over-reliance on one source of revenue or another exposes the university to

unnecessary risks. For instance, many small liberal arts colleges rely extensively on fees and tuition as a source of funding. When broader economic conditions change and enrollments drop, schools struggle to stay open.

Due to the peculiarities of how endowments at public institutions work, the size of the endowment and the diversity of revenue streams do not tell the entire story. In particular, some assets in the endowment are restricted, in that they can only be spent on certain things. For instance, a donor may specify that a gift only be spent on providing scholarship funds for certain students.

Our analysis accounts for these limitations by analyzing two ratios which utilize the university's expendable net assets, defined as assets owned by the university that can be quickly liquidated in times of need. One ratio, the primary reserves ratio, measures expendable net assets relative to total expenses. The other, the viability ratio, measures expendable net assets relative to total long-term debt. Together, these ratios measure the ability of the university to liquidate assets in order to cover expenses and debt, should other sources of revenue disappear. That is, they provide a glimpse into how long the university could last during a financial worst-case scenario.

COMMUNITY RESILIENCE/LEADERSHIP

A key aspect of the campus planning process is the assembly of a broad group of stakeholders to collectively craft a vision. Decisions around resilience are relevant to the entire campus ecosystem which extends, in many cases, to the surrounding community. Having diverse participant involvement in the master planning process from beginning to end is crucial to the long-term success of planning goals and projects.

Second Nature, for instance, believes that "Resilience doesn't come with a specific roadmap and a universal set of steps to follow . . . The resilience of any campus or community will be based on its own unique set of characteristics, future goals, existing capacity and strengths, and current and future vulnerabilities. Part of developing increased resilience is undertaking the social engagement, assessment, and planning process itself."

In our planning work, we find that involving local planning councils, community interest groups and alumni in the conversation, along with the university leadership and stakeholders, leads to more productive conversations and a shared sense of purpose. When people have their voices heard and understand the logic behind decisions made by the master planning team and leadership, there is more chance that initiatives will be supported and championed by these diverse groups. Such relationships are also critical in the face of an emergency. While Hurricane Florence battered the coast, UNC-Chapel Hill worked with the governor's office of North Carolina, the American Red Cross and state emergency management officials to set up emergency services on campus.

The Community and Regional Resilience Institute (CARRI) also looks at resilience based on a whole community concept, treating communities as a collection of systems, each with its own resilience. In two pilots, CARRI found that college campuses can be "crucial catalysts for enhancing the resilience of civil communities," and that leadership is perhaps "the key element in the success of a community resilience initiative." CARRI also found that rapid recovery from disruption "requires a unity of purpose across the entire community, which in turn implies that the entire community is in general agreement over the action being taken." CARRI's experience

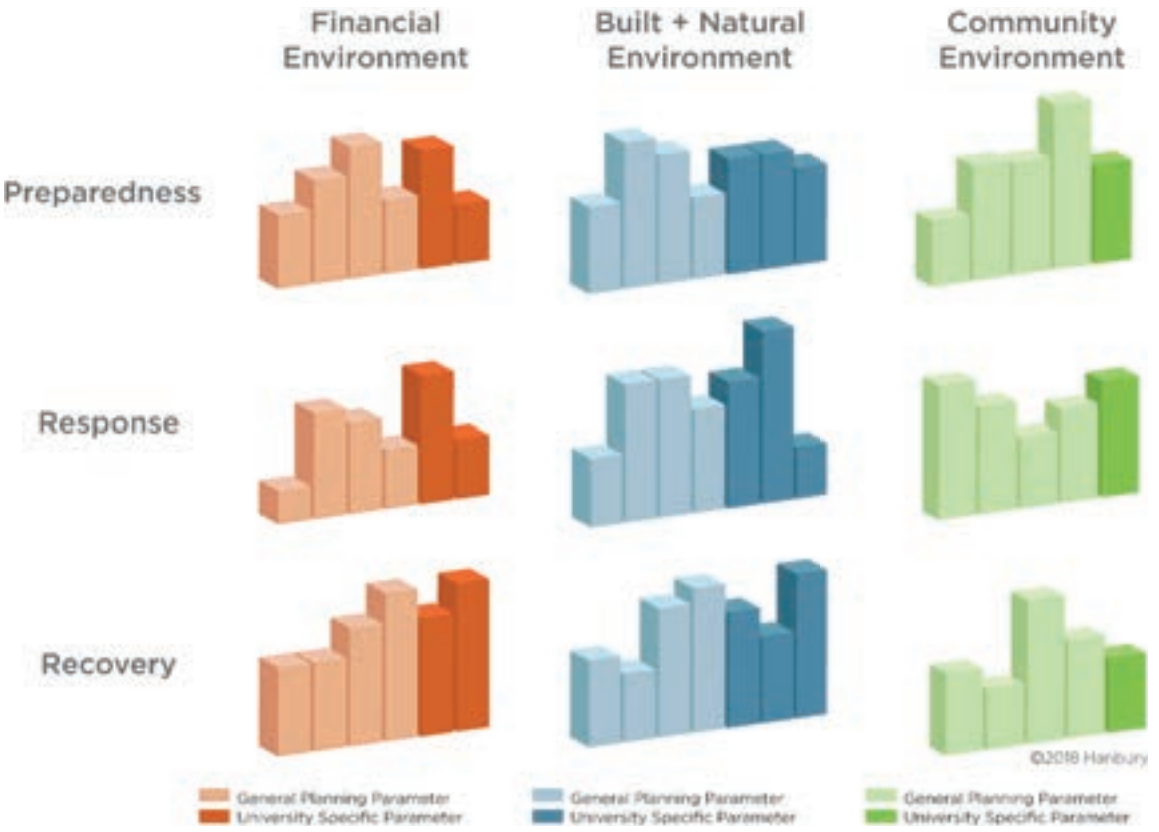
underscores the impact that a leader can have on a community's resilience, especially in terms of overcoming inertia and providing the impetus to start and sustain resilience processes.

INTEGRATING RESILIENCE INTO PLANNING

Campus planning is a vital lever for enabling resilience, and our work is meant to inform how institutions can best integrate resilience into the planning process. To this end we have developed a simple framework for planners to use in addressing the topic of resilience with campus and community stakeholders. This framework focuses on three phases of resilience, Preparedness, Response, and Recovery, as outlined by Brian Walker and David Salt in "Resilience Practice, Building Capacity to Absorb Disturbance and Maintain Function." Using this framework, planners can engage stakeholders in dialogue to identify, prioritize and address resilience related to both general and campus specific topics.

Circling back to our initial question "What actions should we take to be more resilient?" Here are a few simple resilient campus planning best practices:

The framework matrix allows planners and university stakeholders to begin conversing about the specific elements that contribute to resilience before, during and after an acute shock or chronic stressor. While general planning principles and resources will be common among all campuses, universities should outline what unique challenges and opportunities set them apart relative to their size, geography, and community context.



- Start the conversation. Bring key campus stakeholders together, connecting researchers with practitioners where possible. Then expand the conversation to include community leaders and municipal planners once campus priorities have been established. A campus master plan is an excellent opportunity to begin or enhance the communication.
- Keep the conversation positive and focus on successful outcomes. Let's face it, talking about and planning for worst case scenarios can be a real downer. Encourage participating stakeholders to try to estimate as best as possible the likelihood and potential damage of different types of threats. But don't let fear or paranoia overshadow visionary planning.
- Identify synergies and potential conflicts between campus resources and community resources. Engage leadership from the campus and community to strengthen communication and work through scenarios.
- Work with planners and university leadership to integrate resilient strategies into capital building and infrastructure projects as well as operations.
- Start with smaller tactical moves that could have immediate impact.

To some extent, the process of master planning ensures a basic element of resilience. Intentionally integrating resilience into the planning process further safeguards that intention.

CHALLENGES

Today's higher education institutions face a myriad of challenges when it comes to resilience, as do communities and cities. Only half of the finance chiefs at private, nonprofit colleges in the U.S. expect their institutions to be financially stable or sustainable over five years, according to polls conducted last year by Inside Higher Education and Gallup. Moody's Investors Service in December changed its outlook for higher education from "stable" to "negative." Meanwhile, the need for investment in higher education facilities is critical. In the U.S and Canada, the average age of buildings is about 34 years, meaning more renovations on the horizon.

As with most endeavors, higher education institutions will have to make tradeoffs when it comes to resilience implementations. While renewable energy, for instance, is an obvious choice for sustainability and long-term resilience, the upfront costs of purchasing or building systems may mean that a campus goes without some other improvement. Building in redundant systems to protect against power outages would be an obvious vote for resilience, but the cost of doing so throughout an entire ecosystem may compromise financial resilience. Donors are much more likely to fund new facilities or academic programs than to address deferred maintenance or an aging, overtaxed infrastructure network. But a compelling plan, logically ordered, can show donors and leadership how resilient strategies can ensure overall success of a broader long-term vision.

CONCLUSION

Such trade-offs are also not new to higher education administrators or to design and build professionals. They are part and parcel of managing an ecosystem that's ever growing and changing at different levels of need and crisis. This is exactly where a strong master plan is most fruitful. Master plans lay out broad initiatives, goals and aspirations from which succeeding projects should and can almost always be measured. If an institution's master plan is aggressive in terms

of new building growth, certain resilience efforts, such as installing redundant infrastructure systems, may not be as important as making new buildings energy self-sustaining from the outset. Likewise, urban campuses facing dwindling enrollment may need to concentrate more on new efforts that garner excitement and prestige for new donor-supported efforts versus underground infrastructure improvements that boost resilience. The cost of doing nothing is not an option, or even a wise financial one. For every $1 spent on hazard mitigation, the U.S. saves $6 in future disaster costs, indicates research from the National Institute of Building Sciences.

In every case, master plans should be developed with resilience in mind and will provide needed guideposts to temper aspirations impacted heavily by current events. "Long-term facility or campus development plans, strategic plans, and institutional effectiveness measurement programs all provide convenient ways (institutions of higher education) can embed resilience in their day-to-day activities," concluded the authors of "Applications of a "Whole Community" Framework for Enhancing Community or Campus Resilience."

With a master plan in place, resilience efforts will be more easily prioritized as an institution's growth and history unfolds. Resilience is about understanding the interrelation of a system of systems, and creating an ongoing evaluation process. Balancing general resilience standards with specific institutional needs and goals is vital to comprehensive planning. The Master Plan is a unique opportunity to integrate resilience planning for universities, cities, and communities, thus strengthening relationships and boosting overall community resilience. Start the conversation