FEATURE ARTICLE

Integrating Resilience Planning Into University Campus Planning

Measuring Risks and Leveraging Opportunities

by Elizabeth Foster and Chris Smith

Incorporating resilience planning into the campus planning process provides an opportunity to engage key stakeholders to address a campus's vulnerabilities, align resilience-related investments with the broad campus vision, and ensure the long-term viability of the institution.

THE NEED FOR RESILIENCE PLANNING

OVER THE LAST 10 YEARS, WE HAVE SEEN AN INCREASE in the need for cities and communities to become more resilient to crises and natural disasters. Environmental, financial, and social impacts linked to events such as hurricanes, earthquakes, floods, tsunamis, tornadoes, strong storms, drought, fire, and sea level rise are soaring. Natural hazard threats and climate change impacts vary across the United States, but no region appears to be secure. Many U.S. counties have been or are projected to be affected by earthquakes. Low-lying coastal areas are threatened by storm surge, sea level rise, saltwater intrusion, and land subsidence. Western states are facing declining water supplies and threats to forests from fire and insect infestation. Midwestern and northeastern areas are experiencing extreme heat waves. Flooding is widespread due to increased precipitation or intense storms following drought (National Academy of Sciences 2010); and rising temperatures and worsening air quality are increasing risks to human health (Buizer 2011). Four out of five Americans live in counties that were hit by at least one federally declared weather-related disaster in the last six years (Resilient Communities for America, n.d.).

We are coming to understand the importance of planning for increasing occurrences of natural hazards and the effects of climate change. Leaders across the political spectrum have included the need to address climate change and its associated environmental, financial, and social impacts as a key item in their platforms. The topic of resilience has been increasingly prevalent in the publications, initiatives, and meetings of professional planning organizations such as the American Planning Association (Schwab 2015) and the Urban Land Institute (n.d.). The resilience conversation has been particularly active at the city scale with initiatives like the Rockefeller Foundation's 100 Resilient Cities (www.100resilientcities.org) and Resilient Communities for America (www.resilientamerica.org) providing resources for city governments.

Within the higher education community, the dialogue around resilience is increasing as well. Most notably, Second Nature (n.d.) has recently added a Resilience Commitment to its long-standing Climate Commitment program, calling for higher education leaders to take steps to understand and increase their adaptive capacity and partner with communities to assess and enhance regional resilience.

Many institutions are starting to understand the limits of their insurance coverage and the operational and financial risks posed by the increased threat of natural disasters and climate change. Severe weather poses the most obvious

threats to property, but other, more subtle threats from drought and temperature extremes can include the rising costs of irrigation, stress on infrastructure, and limits to campus use during extreme heat. All of these threats can be reduced through resilience planning, mitigation measures, and prudent investment.

The National Academy of Sciences defines resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events (National Academies 2012). The Multihazard Mitigation Council of the National Institute of Building Sciences estimates that for every $1 spent on mitigation, society saves $4 in future losses (Multihazard Mitigation Council, National Institute of Building Sciences 2005). Increasing resilience through better planning and mitigation is necessary to reduce the potential impacts of natural disasters and climate change. "Disaster resilience is everyone's business and is a shared responsibility among citizens, the private sector, and government," writes Susan Cutter in the recent report *Disaster Resilience: A National Imperative* (National Academies 2012, p. vii).

A significant factor in many institutions' vulnerability to natural hazards and climate change relates to building codes. Buildings and infrastructure are designed and constructed to comply with the code requirements in place at the time of their design. The primary natural hazard-related objective of the building code is to protect against loss of life. There is little or no emphasis on safeguarding an investment, sustaining operations, or ensuring business continuity. In addition, codes have no retroactive provisions for improving older infrastructure and buildings with known weaknesses in order to conform to current standards. Over time, if left unchecked, the impact of a major event on older infrastructure and buildings could place catastrophic stress on the financial well-being of a campus.

The emergency response plans developed by many institutions focus on short-term safety and security issues. In the transition from response to recovery, a clear vision for moving forward is required. A well-developed, integrated campus plan that includes resilience planning can provide this vision and accelerate an institution's long-term goals. Efforts to strengthen resilience are very effective when they are integrated into wider strategies for sustainable campus development and driven by the collective will of campus leadership and staff.

Only a minority of universities have an approach to crisis management in the form of a business continuity plan. Stronger disaster risk management opens the door to cost savings and provides an avenue for value creation. Universities that have invested the most in resilience planning and risk management may financially outperform their peers. In addition, resilient campuses that are operational in times of stress are a critical element of a successful post-disaster community recovery.

INTEGRATING RESILIENCE PLANNING INTO CAMPUS PLANNING

There are synergies and efficiencies to be gained by leveraging the campus planning process to address issues of resiliency. A comprehensive campus planning process generally follows three primary phases. The first involves gathering data and assembling stakeholders in order to understand what is needed and develop the plan's goals. The second broad phase typically involves the exploration of several possible directions for campus development and investment. The third phase entails the refinement of the plan and the steps required for its implementation. These phases are very similar to the typical steps in risk management planning during which information is gathered on potential hazards and campus vulnerabilities, a series of short- and long-term improvements is considered, and the chosen risk reduction strategies are compiled in a campus resilience plan. There are numerous advantages to integrating these two planning processes and, in particular, to using the comprehensive,

inclusive nature of the campus plan to raise the visibility and level of planning around resilience-related challenges.

CAMPUS ANALYSIS

During the comprehensive data gathering and analysis stage of the campus planning process, collecting data on the campus's vulnerabilities will strengthen the plan's conclusions. For example, when analyzing building maintenance needs and assessing the ability of buildings to accommodate planned enrollment and pedagogy, considering their vulnerability to natural hazards or extreme weather will paint a more complete picture of their long-term potential. Giving thought to what kind of swing space may be needed during disaster recovery will inform a space needs analysis. When determining the necessary infrastructure upgrades to accommodate campus expansion as is typically done during a campus planning process, issues such as redundancy and resistance to extreme stress, which would be important in the face of natural hazards and climate change, should also be considered. The outcomes of this analysis are likely to affect decisions about infrastructure investments.

A key aspect of the campus planning process is the assembly of a broad group of stakeholders to collectively craft a campus vision. Decisions around resilience are relevant to the entire campus constituency; they go beyond facilities management and risk management and include finance, academic affairs, student life, athletics, and others. It is prudent to capitalize on the broad campus planning conversations to raise awareness of resilience-related vulnerabilities and choices. As a group, participants in the process should consider the extra complexities of disaster recovery and climate change adaptation as they imagine and plan for the campus's future.

Early in a campus planning process, goals and principles intended to guide campus development decisions are usually established. Including resilience-related objectives, such as which resources are essential to protect from hazards or climate change impacts and how much damage or exposure can be tolerated, can facilitate a dialogue around priorities and trade-offs. For example, while investment in new facilities may be desirable to meet a university's strategic goals, resilience priorities may point to dedicating those resources to relocating a central plant or campus egress route that is vulnerable to flooding or sea level rise. While many of these issues are often considered simultaneously within an institution, the campus planning process offers an opportunity to address them in an integrated and efficient way.

CAMPUS DEVELOPMENT OPTIONS

The second phase of a campus plan typically involves consideration of short- and long-term options for campus development. These alternatives should be developed and evaluated with an eye toward resilience objectives, including the financial cost of potential property damage and business interruption. 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 or tightly clustering buildings to limit the walk between them during periods of severe rains or extreme heat. Transportation improvements should be informed by resilience-related issues as well; for example, new roads may potentially serve double duty as flood barriers or sea walls. Further, campus entrances and exits should be located in a manner that maximizes evacuation options. On-site and off-site infrastructure investments should be planned so as to minimize disruption from climate change impacts or natural disasters.

SYNTHESIS

As the campus plan is developed and finalized, resilience strategies should be prominent. Including a set of resilience-oriented design guidelines in the campus plan can help protect the institution and ensure its ongoing health. These guidelines should include practices to minimize risk and maximize comfort. Examples include:

- Enlist building and landscape design strategies that reduce energy and water use and mitigate extreme temperatures.
- Maximize the use of clean and renewable energy sources to reduce greenhouse gas emissions and increase energy independence and reliability. Consider establishing net zero or other long-term energy targets.
- Incorporate retention, recharge, and grading to mitigate sea level rise in landscape design.

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A campus plan should also include phasing and implementation strategies that support resilience objectives. Phasing plans should incorporate hazard and climate change mitigation, considering short- and long-term steps to address these issues. The pressing nature of hazard and climate change risks, including the threat to life and property, suggests that resilience-related campus investments should be included in the earlier phases of implementation as feasible. These may be interim projects that minimize risk in the period before more significant projects can be undertaken. For example, there may be a near-term justification for bioretention or flood mitigation equipment prior to completion of larger infrastructure projects. As part of the implementation plan, risk reduction strategies should be prioritized and integrated with the institution's capital plan, and emergency response plans should be developed based on the hazard scenarios analyzed during the campus planning process.

Implementation steps may also include follow-on technical studies to further analyze natural hazard or climate change threats. Most resilience-related issues require in-depth study before they can be addressed. If these are identified as priorities during the planning process, experts can be engaged and research can be undertaken before problems arise.

A further advantage to integrating resilience considerations into campus planning strategies is the potential for securing funding targeted to these challenges, such as nonprofit grants and tax credits. These available funding sources can help an institution to accomplish multiple goals simultaneously.

UNIVERSITY OF CANTERBURY, CHRISTCHURCH, CASE STUDY

The experience of the University of Canterbury, Christchurch, illustrates some of the difficulties resulting from not having a resilience-oriented campus plan ready to support post-crisis decision making and recovery.

The university was founded in 1873 and relocated to its current 190-acre main campus in the 1960s. The campus today consists of new and old, mostly 3- to 12-story, concrete buildings totaling 2.8 million square feet and has 18,000 students and 1,500 full-time staff.

On September 4, 2010, an M7.1 earthquake occurred to the west of the campus. The campus closed for two weeks. On February 22, 2011, an M6.3 aftershock occurred to the east of

Figure 1 **Books Shaken from Shelves at the University of Canterbury Library**

Photograph courtesy of Earthquake Engineering Research Institute, Mary Comerio.

the campus, beneath the city of Christchurch. Eight buildings were unusable, two buildings were eventually demolished, and the campus was closed for three weeks. On June 13, 2011, M5.6 and M6.0 aftershocks occurred to the east of the campus. The campus closed for one week. The primary losses in all three events were due to building content and equipment damage (figures 1 and 2).

The restart of teaching in February 2011 required students to be allowed to study elsewhere for the semester and the university to construct temporary facilities. Fifteen tents to be used for new teaching spaces were constructed within three weeks (figure 3). Offices, study areas, teaching rooms, and laboratory spaces were also required to accommodate staff and students while buildings were being assessed and remediated. Two villages totaling 163,000 square feet made up of over 100 prefabricated wooden buildings were created within six months to replace the tents and provide the additional flex spaces required.

The cumulative effects of these three major seismic events can be summarized with respect to enrollment, financial consequences, and renewal.

ENROLLMENT

The recruitment of students was negatively impacted by the changed environment (figure 4). International enrollments in 2011 were down 31 percent. Enrollments of all part-time and full-time students in tertiary education in Christchurch declined by 17 percent from 2009 to 2013 and have now levelled off. The greatest decrease in total enrollments occurred from 2010 to 2011 (Parker and Steenkamp 2012; Potter et al. 2015).

Figure 2 **Resilience Books at the University of Canterbury Library**

Photograph courtesy of Earthquake Engineering Research Institute, Lucy Arendt.

Figure 3 **Temporary Classrooms at the University of Canterbury**

Photograph courtesy of Earthquake Engineering Research Institute, Lori Peek.

Figure 4 **University of Canterbury Curfew**

Photograph courtesy of Earthquake Engineering Research Institute, Lori Peek.

FINANCIAL CONSEQUENCES

The level of business interruption had significant budget, tuition, insurance, and external funding implications. The after-event financial figures were alarming. At the time of the first earthquake, the university had a $100 million cash reserve. The burn rate after the earthquake was $100,000 per day. Significant strains on cash flows immediately after the events negatively impacted business as usual. A small surplus very quickly transitioned into years of continuing deficit.

The tuition shortfall was approximately $19 million per year. The staff was reduced by 170 by the end of 2012, and the forecast model shows academic, general, and technical staff numbers continuing to decline through the end of 2016.

Insurance premiums increased 500 percent in the two renewal periods after the earthquakes with reduced coverage. The deductible was increased from $250,000 per event to $20 million per event. In the case of a campus-wide event with multiple buildings affected, the university is now exposed to hundreds of millions of dollars of loss. The university is now effectively self-insuring for campus-wide small to medium events. From here forward insurance can only be considered as part of the solution, and there is no evidence that the university would be able to access capital markets today.

RENEWAL

In the transition from response to recovery, it became crucial to consider building remediation and betterment activities within the context of the longer-term strategic vision for the campus. A structured framework for making building repair, retrofit, or replace decisions and prioritizing work across all buildings was needed. Although a draft campus master plan was in place at the time of the earthquakes, it had not been widely discussed. This limited its usefulness for immediate post-earthquake decision making. However, many of the key principles within the draft plan provided a useful backdrop for decisions on the future use of key buildings. In the absence of a clear plan, the initiatives that worked were those for which a lot of the preplanning had already been done; the effects of the earthquake simply sped up their implementation.

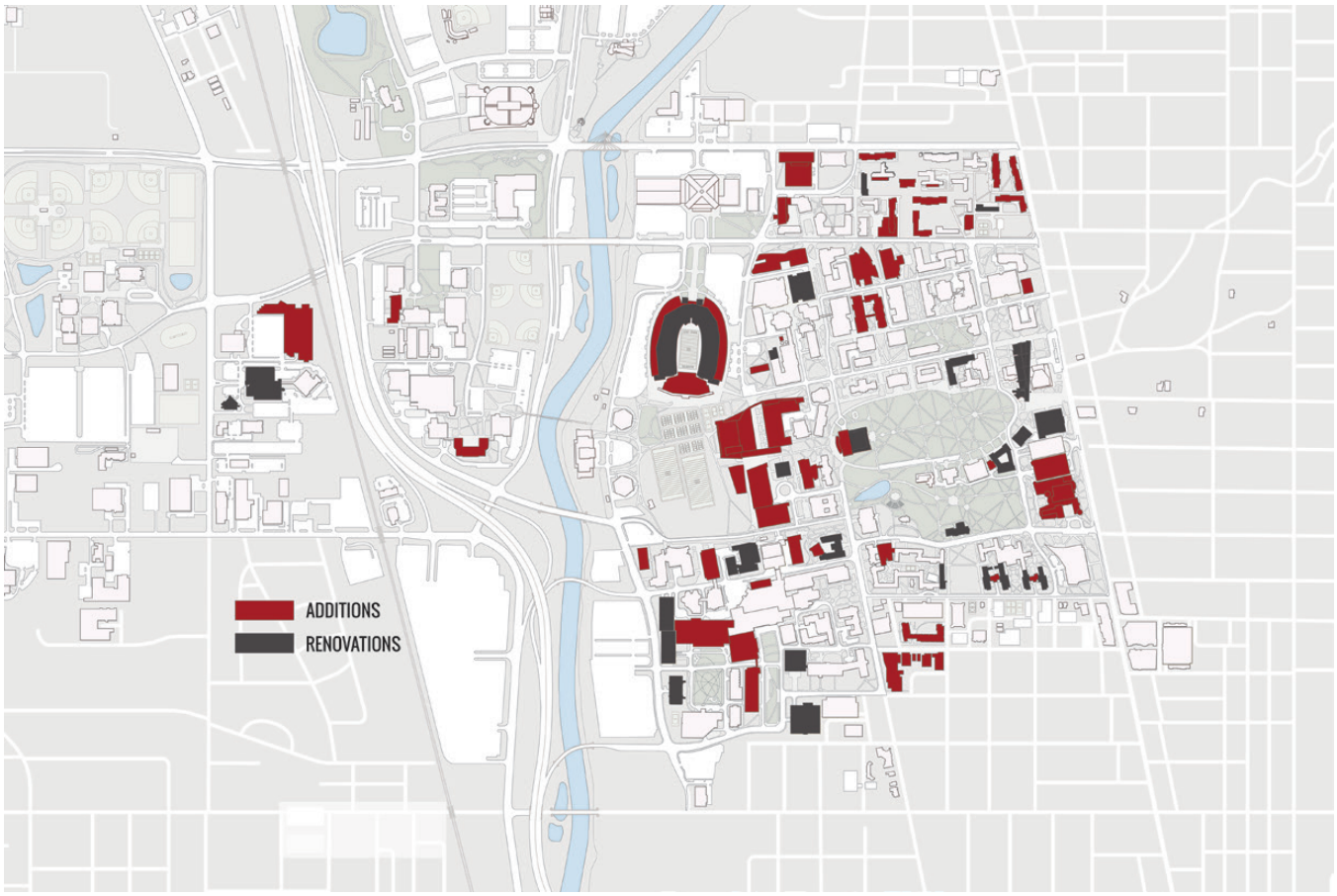
Having an adopted campus master plan with a vision for the future at the time of the earthquakes would have eased recovery, expedited renewal, and possibly made the university more effective in seeking funds for recovery. The campus plan can even be thought of as a springboard for recovery. There is now a redevelopment program underway to modernize the campus and its infrastructure. The primary ongoing risk to the university is the lack of a business continuity plan addressing the effects of natural hazards.

THE OHIO STATE UNIVERSITY CASE STUDY

The Ohio State University is addressing its flood resilience as part of a broader campus planning vision. The campus is bisected by the Olentangy River, and many significant campus sites and buildings are located along it. On the west side of the river lies the midwest campus and a large athletics district with major sports facilities supporting the university's competitive Division I programs. Immediately east of the river are the Ohio Stadium, in which the campus has invested significant resources; a residential district, including two tall housing towers near the river's edge; and the health sciences district, which includes a large hospital and is the focus of significant planned growth. The university has recently completed approximately $3 billion in building renovation and construction projects, including several facilities in close proximity to the river (figure 5).

In addition, much of the land along the river is currently dedicated to surface parking. Many people feel that the river represents an opportunity to serve as an attractive heart of the campus and a focus of student recreation and campus life while supporting the research and innovation that has become an institutional staple. Ohio State has paid earnest attention to the campus's flood vulnerability while also considering other advantages to be gained by rethinking the river's role on campus. During the planning process, campus leadership and other university stakeholders determined that the realignment of a major campus roadway, Cannon Drive, to more closely follow the river's path will accomplish several objectives. The road could be reconstructed at a higher elevation, allowing it to serve as a permanent levy preventing the river from flooding the campus. This would also effectively remove the road, a regional emergency access route, from its current elevation in the floodplain. As new

Figure 5 **Construction/Renovation at The Ohio State University**



construction, the project would provide the campus with improved utility and roadway infrastructure, thus addressing maintenance needs. In addition to these practical advantages, shifting the road to the west would open up twelve acres of protected developable land (three million square feet of new building space) adjacent to the growing health sciences district. A collaborative partnership has been formed with the City of Columbus in planning and design for the road.

In addition to the road realignment, the university is working with other agencies to restore the riverfront as part of a regional reclamation plan. The restoration project will increase flooding resilience, improve fish habitat and water quality, and enhance the river's appearance and recreational potential. The restored river will offer learning opportunities and enhance student life on campus.

At the conclusion of the campus planning process, the university identified a more detailed risk hazard analysis as a priority. Follow-on studies have been initiated to assess which buildings would be impacted by 100-year and 500-year river flood events. After the studies are completed, the financial impact of a flood event—both daily and overall recovery—will be calculated.

The university's long-term strategy for flood mitigation, the road realignment, offers multiple advantages from both a campus master plan and resilience perspective. A series of short-term actions, including the installation of pumps and the purchase of temporary flood barriers, was identified to protect the campus until the longer-term road realignment project can be implemented.

CONCLUSIONS

Given the increasing need to prepare for natural hazards and the near- and long-term effects of climate change, institutions would be well advised to integrate resilience strategies into their campus plans. Resilience planning can have a profound and long-term effect on institutional sustainability, allowing institutions to develop a realistic understanding of their risks and vulnerabilities and enhancing their ability to adapt to natural hazards and climate change. Resilience planning allows institutions to

- Reduce loss of life and property damage in the event of a disaster
- Limit "self-insured" losses from small and medium events to acceptable levels
- Get back to "business as usual" as quickly as possible after severe weather
- Minimize business interruption and financial losses from storm events and long-term climate change impacts
- Define expected post-disaster performance, recovery, and renewal time lines

As campus planners, it is important to engage the university community in a dialogue around resilience. The most effective way to do this is to start by doing your homework—research potential near- and long-term hazards and the specific physical, social, and financial vulnerabilities of your campus. Next, find partners across the institution whose needs or priorities coincide with yours. These may be in academic, student life, finance, or facilities departments. Together with your colleagues, expand the communication on this topic and engage a broad array of stakeholders so that the gaps and opportunities are well vetted and considered comprehensively. When approaching decision makers, speak in terms of their priority issues. These may be learning opportunities, financial risks or rewards such as insurance limitations or business continuity, or staff demands.

Incorporating resilience planning into the campus planning process provides an outstanding opportunity to leverage a familiar activity involving relevant key stakeholders to address a campus's vulnerabilities, align resilience-related investments with the broad campus vision, and ensure the long-term viability of the institution.

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Integrated planning is the linking of vision, priorities, people, and the physical institution in a flexible system of evaluation, decision-making and action. It shapes and guides the entire organization as it evolves over time and within its community.