CHAPTER 15

The Global and the Local: Constructing a Distinctive Role for Universities in Shaping the Future

David W. Leebron[1]

BACKGROUND OVERVIEW

The modern university traces its origin back to the founding of the University of Bologna in 1088. Universities quickly became the centres of scholarship and learning, and, while they grew significantly, they evolved slowly. In the early 19th century, the concept of the research university emerged in Germany. Universities became engines of technological progress. The German model was exported to the United States with the founding of Johns Hopkins in 1876, and both older (e.g., Ivy League) and newer universities (e.g., Rice and Carnegie Mellon) followed that model (Lucas, 1994; Britannica, 2019). This was accelerated further in the United States as the government relied on and funded universities for technological research for military purposes during the Second World War. Following the war, universities, most particularly Stanford, emerged as centres of entrepreneurial advancement and technological discovery for civilian purposes. Research funding expanded rapidly as the government launched major endeavours in space exploration, cancer and other health issues, and energy.

The social role of universities also changed. Most universities, even highly renowned ones, remained fairly regional in most respects even into the second half of the 20th century, when they became more national and international. Over time, the universities evolved from being bastions of privileged students (white, male and wealthy) to being increasingly diverse engines of opportunity.

Universities remain complex in both organization and differentiation. They tend to be balkanized into schools and departments focused on historical disciplinary ideas. Centres and institutes are often created to overcome such balkanization and build interdisciplinary endeavours to address complex problems that require not only the knowledge and tools of a variety of disciplines, but new knowledge and tools that result from intellectual endeavors across disciplines.

The vast majority of institutions of higher education and research that are denominated as universities pursue a three-fold mission: teaching, research and service. (This is also true of many four-year colleges in the United States, although the balance among the missions differs significantly.) The nature of the missions varies a great deal, depending on the overarching institutional identity, its scope and reach. In the United States these institutions are either public (created under the auspices of a state, not federal, government) or private. The private institutions are either non-profit secular, sectarian (church affiliated) or for-profit (although the latter are generally not significant participants in research). According to a recent count, there are 4,298 institutions of higher education in the United States, of which 1,626 are public, 1,687 private nonprofit and 985 for-profit. Depending on their size, funding source, history, affiliations and location, the universities might conceptualize their mission primarily in local, state, national or other (e.g. religious) terms. There are 328 doctoral universities in the United States, of which 115 are categorized as R1 or "very high research" (The Carnegie Classification, 2019). The very high research universities range in size from 2,200 students (Cal Tech) to over 71,000 (Arizona State). Although the mix of such institutions varies greatly from one country to another, most universities fit in this broad categorization.

THE FORMS OF UNIVERSITY CONTRIBUTIONS TO SUSTAINABILITY

In light of this complexity, it is difficult to generalize about the role of universities in sustainability, as those roles vary according to the nature of the institution and are internally fragmented within universities. Generally, the contributions universities make to sustainability fall into five categories:

basic research, applied research and technology development, educational programs, the university's own sustainability practices, and service to external people or organizations that will benefit from assistance in one form or another. These categories of course overlap and blend into each other. Each of these modalities may be pursued with local priority, state priority or with a global perspective.

Sustainability at universities begins with their own university community. Residential universities are essentially small cities, providing the full range of services including housing, dining, transportation, police and healthcare. Universities are significant purchasers of a variety of inputs, including food, water and energy, and engage in substantial amounts of construction. And because universities want to apply insights gained from research in areas such as sustainability, they are constantly updating their practices to reflect knowledge and values. We see strong efforts by universities to reduce their carbon footprint, to build in environmentally friendly and sustainable ways, and to encourage behaviours that are less costly in environmental terms, such as recycling and limiting food waste. LEED certified buildings and environmentally friendly transportation (in both technology and community usage) have proliferated on American campuses, and administrative personnel help determine and guide practices that promote sustainability.

But the larger role of universities comes from their impact beyond their own campuses, whether in their own surrounding community or across the globe. Both urban and rural universities typically undertake both scientific and policy studies aimed to understand and benefit their immediate surrounding areas. At Rice University, for example, our professors have played a critical role in understanding the sustainability challenges of a coastal city, particularly one that regularly faces severe tropical storms (hurricanes). One effort is the university's Severe Storm Prediction, Education & Evacuation from Disasters (SSPEED) Center, which aims "to be recognized as the Gulf Coast's top university-based resource for research and education related to protection strategies for severe storm flooding and hurricanes-related surge" ("SSPEED Center: Vision," n.d.). Locally, it is often only universities that can research deeply into such problems as sustainability and help formulate solutions, as local entities rarely have such research capabilities.

THE INTERNATIONAL CHARACTER OF UNIVERSITIES

The impact of research universities extends well beyond their own communities. While major universities all claim a global or international role and perspective, in reality they remain overwhelmingly domestic institutions where international relationships are, for the most part, bilateral and

transactional. They are significantly engaged in international trade of the services they produce through the mechanism of customers (students) travelling to the site of the enterprise to consume educational services. A few top research universities now enrol over 20% international students, and most are in the range of 10-20% of their undergraduate student bodies. (Institute for International Education, 2019.) The share of international graduate students, especially in STEM fields, is several times higher. There are a relatively minor number of foreign branch campuses of US universities and students studying at those campuses. Overall, it might be said that in terms of internationalization, higher education still resembles more of the 19th century model of transnational business rather than the 21st century global enterprise model.

However, a different story emerges if one looks not so much at the educational role as the research role. Faculty collaborations frequently span borders, although the vast majority of such international collaborations out of the United States are with researchers in other developed countries or in China. Deep collaborations with developing country universities and researchers, however, are rare. In addition, the faculties in the United States have a strongly international character. At Rice we looked at the fairly conservative measure that counts only faculty who received their first higher education degree (college BA or BS or similar) *outside* the United States. (Thus a student from another country who began his or her higher education at a US college would not count, even if they did so as a non-immigrant foreign student.) By that measure, about 31% of our faculty is international, and that is an important element of building the international research relationships and graduate student pipelines.

Equally important, the exchange of research information is global and frequently nearly instantaneous. Thus the exchange of ideas and results around much research, particularly fundamental research, has a strongly international quality. That has actually long been the case for universities. In the 19th century for example, the competition and intellectual exchange between the different schools of thought across national lines (particularly French, German and British) played a critical role in the successful development of the structural theory of organic chemistry (Hugill & Bachmann, 2005). Certainly the internationalization of science was a key part of the stunning developments in early 20th century quantum physics as well.

In sum, across the United States, we see a wide variety of international engagements, from professor-driven, two-person collaborations to the still quite limited establishment of foreign campuses or larger scale joint research enterprises. Each of these engagements reflects largely the structure of the home university, the benefits offered by particular foreign locations (hence a concentration in China, Singapore and wealthy Gulf states in the Middle

East), local demand and international accessibility. International teams in critical areas of sustainability (e.g. understanding climate change, creating sustainable technologies) are common. What remains comparatively rare are large scale and deeply rooted international research collaborations. Thus, while the international impact of research universities on sustainability is large, the primary channel for such impact is the effect of that research on similar challenges wherever they may be found.

UNIVERSITIES AND GRAND CHALLENGES

As universities are becoming increasingly international, they are also increasingly engaged in addressing concrete problems, often with funding from government research agencies, private foundations and individual charitable giving. A number of universities have explicitly decided in their strategic plans or other processes to identify "grand challenges" that they will focus on helping solve. In many instances, these challenges are locally formulated. For example, UCLA announced in 2013 the "Sustainable LA Grand Challenge" designed specifically to transition LA to a number of sustainable goals around water, energy and health. Its second selected grand challenge is "Depression", which it identifies as "a campus-wide initiative aimed at cutting the burden of depression in half by 2050" (Transforming Los Angeles, n.d.).

Such "Grand Challenges" vary in specificity and geography. At the University of Melbourne, for example, the three Grand Challenges are very broadly defined: Understanding our place and purpose; Fostering health and wellbeing; and Supporting sustainability and resilience (Research: The University of Melbourne, n.d.).

At Rice, our strategic plan didn't focus on grand challenges, but as part of our research aspirations it stated: "We should identify critical global challenges in areas such as health, education, cities of the future, and sustainability, energy and the environment to which Rice can make distinctive contributions, and work with partners locally and globally to achieve meaningful progress." Indiana University took a more specific approach that was also tailored to its role as the preeminent public university in the state of Indiana. Its three grand challenges chosen so far are: Precision Health Initiative, Prepared for Environmental Change, and Responding to the Addictions Crisis (Grand Challenges, n.d.).

A UCLA report in 2018 on "University-Led Grand Challenges" noted that "nearly 20 North American universities are leading Grand Challenge programs that are rallying research communities to contribute to solving a major societal challenge; attracting new investment and resources; demonstrating value of university research; and engaging students, partners, the

broader community, and the public" (Popwitz & Dorgelo, 2018). Its appen-
dix identified 12 examples of university-led grand challenges, all aimed at
setting important research and education priorities that will address critical
problems. A plurality of such Grand Challenges appears to focus on a range
of sustainability issues, and a clear majority address sustainability and health/
medicine.

These programs vary greatly in terms of mission, scope, specificity, fund-
ing and partnerships. Not surprisingly, these grand challenges tend to focus
largely on local jurisdictional benefits and to some extent the benefits to
the specific mission of the university, such as educating its students. What
drives them in many respects is a sense of high ambition, a desire to cap-
ture increasingly programmatic private funders, and seizing on governmental
funding opportunities, both local and national. For the most part, they seem
aimed at coalescing and coordinating existing strengths and programs and
supplementing them with additional resources and other forms of university
support. In sum, they appear to be more about prioritizing and coordinating
than truly doing things differently (although some might observe that for
many universities, prioritizing and coordinating is in fact doing things dif-
ferently). Thus, it's not clear that the identification of the grand challenges
implements a different role for the university in addressing the large scale
problems faced both locally and globally.

UNIVERSITIES AND SUSTAINABILITY IN GLOBAL SCALE

Universities have rightly become seen as substantial contributors both to
local economies and to the solution of national and local problems. But,
despite the proclamation of grand challenges, universities are notoriously
bad at formulating and sustaining highly focused efforts, and there are mul-
tiple reasons for this that are deeply embedded in university culture, historic
practice and values. In addition, their track record in working together to
create global approaches is limited. (Huge exceptions include the CERN
effort in particle physics and large scale telescopes.) Of course, virtually every
solution to a domestic problem has benefits for similar problems elsewhere
around the globe, even if significantly affected by local conditions. Thus
there is a trickle-down (or perhaps more appropriately, trickle-out) approach
for universities to achieve global impact.

A look at available information on higher education's role in achieving
the UN's sustainability goals is fairly discouraging. For example, the Higher
Education Sustainability Initiative (HESI) contains little that is concrete,
convincing or impactful. The emphasis seems to be primarily on membership
and conferences. Though HESI claims that it "provides higher education
institutions with a unique interface between higher education, science, and

policy making," the evidence of that seems limited (Higher Education, n.d.). However, one example presented at the HESI conference appears to be a good example of a collaborative international education initiative aimed at making contributions to sustainability, namely the Geneva Tsinghua Initiative for Sustainable Development Goals. This program appears to integrate efforts across institutions from a developed and developing country and build deep relationships among students and others. The educational approach is also broadly integrative across methodologies and purposes, from traditional educational environments to online modalities to entrepreneurial and maker spaces.

A number of universities explicitly aim to develop exportable or scalable technologies to address sustainability and other challenges. But, in fact, such technologies often turn out not to be exportable to lower resource environments, at least in the near term, for a variety of reasons. These include cost, maintenance issues, lack of local materials and manufacturing capacity, inadequate educational training and capacity, lack of cultural fit and other unanticipated collateral costs and obstacles. To give just one example, a low-cost diagnostic test that took several days to produce results might not work in an environment in which a patient had to travel for a day to a clinic or hospital from her village, and couldn't afford to wait or to make another trip.

Many of the grand challenges involve health issues, such as curing cancer. And while ultimately the knowledge gained will benefit communities around the globe, the process will be slow and often require years of adjustment to local resources and conditions. The spread of solutions can be further hampered by the creation of intellectual property, the deployment of which is determined largely on the basis of financial return.

INTEGRATIVE EXAMPLES FROM THE RICE EXPERIENCE

There are two efforts led by Rice University faculty that suggest comprehensive solutions-oriented research approaches that span institutions are possible, and some of the essential elements for success.

Neo-natal Care: Nest 360

In 2018 the MacArthur Foundation set about the process of identifying the recipient of a $100 million one-time grant for a project that "promises real and measurable progress in solving a critical problem of our time." In the words of the foundation, the essential requirement was that "the proposal describe the urgent problem worth solving, and [that] the solution have a transformative impact." The solution was required to be evidence-based, feasible and durable (100 and Change, n.d.).

In many ways, the results of this competition revealed that universities were not, at least in the judgment of the foundation judges and board, the entities best positioned to address such problems at scale and with urgency. Only one of the eight semi-finalists was primarily a university entity. Four of the projects addressed human health issues directly, one food supply and health, two education broadly and one social welfare programs.

The only university-affiliated semi-finalist was a project organized by Rice professor Rebecca Richards-Kortum and others, called Nest 360, to solve the challenge of over one million babies who die each year in sub-Saharan Africa largely from preventable causes. While technologies existed in developed countries to prevent these deaths, such technologies were not sustainable in developing countries both because the cost was too high and they could not be manufactured or maintained locally. Much equipment ended up in "equipment graveyards" as a result. Rice 360 (the entity within Rice out of which this project emerged) integrated a set of 17 technologies that if implemented as part of a neo-natal suite developed by Rice would prevent at least half of such deaths. But technology development, which universities can excel at, was only part of the problem. Rice 360 identified four "gaps" and corresponding work streams: innovation (including manufacturing), education, implementation and market shaping that would generate demand and create a distribution channel.

In short, a sustainable solution in health care required the creation of a complete ecosystem that addressed all aspects of a solution and provided an adequate feedback loop for the continuous evolution of the solution. To address this, Rice 360 expanded a complex set of collaborations aimed to bring expertise to diverse tasks and build local capacity where needed. The partners included two key local university partners, namely the University of Malawi College of Medicine and Malawi Polytechnic, as well as a local hospital, the Queen Elizabeth Central Hospital in Blantyre. One specialized international higher education partner, the London School of Hygiene and Tropical Medicine, was also part of the consortium, as was a domestic partner chosen to bring business and logistics expertise, the Kellogg School of Management at Northwestern University. Finally, since the project involved the production of physical equipment, a design and manufacturing company was added, 3rd Stone Design, which emphasized the integration of "user needs, environmental constraints, technological capabilities and economic realities to create convincing solutions to difficult problems." (The presentation to the MacArthur Foundation judges can be seen online [Macfound, 2017]). As the project has expanded beyond Malawi, additional partners have been added, including the Ifakara Health Institute in Tanzania, the Dar es Salaam Institute of Technology, the University of Lagos, the University of Ibadan and Kenya Pediatrics Association.

Although Rice 360 did not win the competition for the $100 million, they received a $15 million award from the MacArthur Foundation that has launched them on the path of achieving grants from multiple foundations that will enable them to complete the first phase of the project in Africa.

This project exemplifies the impact that universities can have with the right partners in addressing sustainability challenges. The first element is a core group of researchers and staff driven to have an impact on the world. While the university provided smaller, strategic support at early phases, the bulk of the funding has been external. Careful development of long-term relationships with universities and other institutions on the ground was critical, as were partnerships with universities in developed countries that could provide critical expertise. In sum, the entire chain from innovation to implementation needed to be enabled and sustained by personal, institutional and funding commitments.

Solving Global Water Problems: NEWT

A somewhat more traditional example of large scale sustainability impact emerging out of Rice is Nanotechnology Enabled Water Treatment (NEWT). In the words of its website, "NEWT is an interdisciplinary, multi-institution nanosystems-engineering research center (headquartered at Rice University) whose goal is to facilitate access to clean water almost anywhere in the world by developing affordable and efficient modular water treatment systems that are easy to deploy, and that can tap unconventional sources to provide humanitarian water or emergency response" (NEWT, n.d.).

This is an effort led by Rice Professor Pedro Alvarez in collaboration with researchers at a diverse set of four universities: Rice, Yale, Arizona State and University of Texas El Paso. That collaboration of four universities enabled NEWT to receive an initial five year renewable NSF grant of $18.5 million to establish an Engineering Research Center "to develop compact, mobile, off-grid water-treatment systems" (Boyd, 2015). In addition, universities in China and Brazil have also been engaged, in part to provide on-the-ground expertise, testing and partnership in locations in need of such technology. In both cases, available national resources drove part of these collaborative efforts. NEWT leaders also recognized that sustainable success would depend on industry partners, and engaged nearly 20 such partners across the potential value chain from manufacturers of materials and equipment to service providers and end users.

Such collaboration was helped by a limited emphasis on the exploitation of intellectual property, but a tough-minded approach to practicality. Alvarez subscribes to an adapted version of the NABC value creation method suggested by Curt Carlson, a leading thinker on innovation (Denning, 2015):

starting with the identification of **N**eeds, adopt an **A**pproach that is appropriate and distinctive, and consider the **B**enefits in relation to the project's costs, as well as the **C**ompetition and alternative solutions. While the research being undertaken is of a kind universities typically engage in, the approach, mission and partnerships help assure broader and larger scale implementation.

These examples still stand in many ways as exceptions. Effective comprehensive partnerships that can address sustainability issues across the developmental spectrum are few. As Inside Higher Education reported just last fall, "it is striking that partnerships between the poorest nations and the world's research elite form a very small slice of international collaboration" (Baker, 2018). According to the inside higher education analysis, among the top 10 universities "less than 3% of cross-border research featured a partner from nations categorized … as the world's least developed. At four of the universities, the share was lower than 1%" (Baker, 2018). The largest share of such collaboration was medical research.

Equally, one can look at student flows and see similar shortcomings, although not quite as bad. According to the IIE's Open Door studies, over 60% of American students studying abroad do so in developed countries.

The barriers to the kinds of collaboration that might make deeper and faster progress on global sustainability questions are entrenched. First and foremost are the nationally directed funding sources. At least in the United States, the major research funding agencies have limited willingness to fund efforts outside the country. USAID has a good track record of working closely with universities to support efforts with impact on developing countries, but some reports suggest that willingness has been reduced in recent years. One example is the Higher Education Solutions Network, "a partnership between USAID and seven top universities" aimed at fostering innovation to address development challenges (H.E.S.N, 2018). Similarly, the Partnerships for Enhanced Engagement in Research (PEER) help foster partnerships between developing country scientists and those in the United States. International funding agencies, such as the World Bank, seem to play a very limited role in supporting the contributions that universities could make to large scale sustainability efforts.

One notable US university-based effort that represents at least a partial integration of researchers from around the globe to address a congeries of sustainability issues is the Global Resilience Research Network, organized by the Global Resilience Institute at Northeastern University. The GRRN "is a membership network of leading universities, institutes, non-profit organizations, and companies engaged in resilience research that informs the development of novel tools and applications". (Global Resilience Institute, n.d.) Its membership includes entities from every continent, although it is largely

focused on the developed world and the Caribbean. The website, however, provides little clear indication of activity other than an annual summit and some facilitation of collaborative research.

SOME CONCLUSIONS

As Einstein famously said and is so frequently quoted: "The world that we have made as a result of the level of thinking we have done thus far creates problems that we cannot solve at the same level as the level we created them." One might argue there is a corollary to this quote: "The world that we have made with the institutional structures we have had thus far creates problems we cannot solve with the same institutional structures that created them."

On the optimistic side, we have already seen a major change in how universities contribute to fundamental solutions. There is greater production of intellectual property and greater collaboration with industry. There are more programs, institutes and focused collaborative research endeavours that aim to solve identifiable problems. More of our research enterprise is driven by increasingly massive amounts of data. Collaborations across universities are commonplace.

What are the special strengths universities bring, and what are the weaknesses, as we seek sustainability solutions that are both local and global? Compared to the private sector, universities are mission driven to achieve human welfare even when that doesn't translate into monetary return. They are good at developing fundamental knowledge and application strategies, and at their best able to use a range of available talent that includes undergraduate and graduate students as well as post-doctoral researchers, talented administrators and brilliant professors. Universities are far better positioned than most actors to integrate knowledge across disciplines, enabling them to simultaneously address, for example, engineering questions and cultural barriers to adopting solutions.

But, for the most part, universities are not good at focusing on a few projects or delivering fully integrated solutions to problems. The effective application of knowledge, and integrating knowledge into practical frameworks, is typically not their strength. Despite claiming global perspectives, a variety of pressures drives them to more locally oriented projects. Perhaps most frustratingly, problems are urgent and solutions are not. Universities tend to be too slow, and other actors often attempt to be too fast.

Large, globally oriented foundations are playing an increasing role in funding the solution of grand challenges that are not necessarily centred in the developed countries. In the US these mega-foundations include Gates (currently $50 billion), Ford ($12 billion) and MacArthur ($7 billion). On

the other hand, foundations have a tendency to want to invest only for limited periods rather than the long run required, as well as to fund at wholly inadequate levels the infrastructure (overhead) required to make the project funding approach truly sustainable. Nonetheless, the emergence of major foundations explicitly committed to "strategic philanthropy" to address major challenges, including sustainability issues, is changing the landscape of what is possible. These foundations increasingly have both the resources and organizational expertise to help motivate and coordinate critical actors.

Universities on their own are generally not in a position on their own to discover, design and implement large scale sustainable solutions to major problems. Here are some practices and solutions that could enhance both the role of universities and their effectiveness:

1. Universities in developed countries must partner in long term, sustainable and respectful ways with universities and other partners in developing countries.
2. These partnerships must be funded in a sustainable way that doesn't put the burden on low income developing country partners.
3. A key part of these partnerships must consist in building capacity in developing country institutions and people.
4. All university partners must be involved in all aspects of the relationship, and exchanges and other aspects must be mutual, including opportunities for shared experiences and cultural immersion.
5. Ownership, learning and decision processes must be shared, and especially located in the country where challenges are being addressed. Planning and implementation must take into account local cultures and governance.
6. Processes must involve all necessary disciplines and processes must provide for the engagement of those disciplines from planning through execution.
7. Partners must be identified and engaged across the entire learn-advocate-design-build-distribute-manage-maintain-evaluate ecosystem. Such partners should virtually always include, along with universities, non-profit enterprises, for-profit businesses and responsible government entities at the appropriate levels.

Building effective partnerships characterized by trust and a shared mission is challenging, especially since 1) typically the effort will be only a part, and often a small part, of each partner's mission and 2) each partner's and individual's mission and incentives will be different. This will affect views on everything from how learning should take place to which tools will be viewed as most effective (i.e., "if all you have is a hammer, every problem looks like a nail") to the time horizons that are employed.

But as we have seen at Rice and elsewhere, new approaches to building partnerships, designed for deep and sustained collaboration and impact, can leverage the strengths of universities to truly address the world's most salient issues of sustainability and health.

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