THE NATIONAL ACADEMIES

MEETING SUMMARY

REIMAGINING THE UNIVERSITY

Government-University-Industry Research Roundtable
October 9-10, 2012

Colleges and universities today face many challenges, among them decreases in state funding, reduced endowment performance, increasing demand for student services, and other financial hurdles. At the same time, new opportunities are emerging, including online education and new models for partnerships among academia, government, and industry. At this meeting of the Government-University-Industry-Research Roundtable (GUIRR), the decision makers in attendance examined these challenges and opportunities and explored the future landscape of higher education.

The meeting's keynote address on October 9, "Paying for College: Cost and Value," was given by **Ms. Sarah Ducich**, Senior Vice President for Public Policy at the financial services company Sallie Mae. Ms. Ducich spoke about student debt, how families and students view college education, and how they are paying for it given the recent recession.

One of the reasons student debt has gone up is that enrollment has grown dramatically – 41 percent from 2000 to 2010, Ms. Ducich said. This is in part because many adults are returning to school to get degrees. Over the past 15 years, Americans have spent $3.7 trillion on college. One-fourth of this expense has been paid for by loans, most of which are coming from the federal government.

Ms. Ducich cited a recent study by the University of Rochester based on interviews with young adults who had graduated from college during the years 2006 to 2011. One-quarter of them had already paid off at least half of their student loans, and another 45 percent had paid a quarter of their debt. While there are people who overvalue and borrow too much, most people are doing fairly well and are able to handle their debt, she said.

For each of the past five years Sallie Mae has interviewed students ages 18 to 24 who are preparing to go to college, as well as their families, said Ms. Ducich. The company surveys 800 students and 800 parents to find out their perceptions of the value of college and how they pay for it. The survey has been able to track their responses through rocky economic times.

Students and their families attach great value to higher education, especially as an investment in the future, and families are willing to stretch themselves to pay for it, said Ms. Ducich. Students' valuation of college has hardly changed at all over the past five years; 98 percent agree or strongly agree that it is an investment in their future, and they would rather borrow than not go. In parents, however, the survey reveals a weakening, not in the rate of agreement about the value of college, but in the strength of their feeling about it.

Parents are feeling the pressure of college costs; this year 7 out of 10 parents said that they considered cost at some point in the process of deciding on a college – the highest level since the survey started.

In the first full year after the recession started, families used more of their income and savings to pay for college, said Ms. Ducich, but in the last two years, that amount has declined. There has been a shift in choices over the last year, with an increase in enrollments at 2-year public institutions. There has also been a huge increase in students living at home, particularly among upper-income families. Two years ago, 24 percent of students in families making over $100,000 per year lived at home; last year it was 47 percent.

So families are still reaching and trying to pay for college, but they are changing the way they are going to college and the choices they are making, said Ms. Ducich. The portion of college funded by parents has declined in recent years, though they still fund most of college in an "average" family. Last year parents funded about 37 percent, either through income and savings or borrowing. Students funded another 30 percent through income and savings, work, or borrowing. Grants and scholarships provided 29 percent, and relatives and friends provided 4 percent (Figure 1).

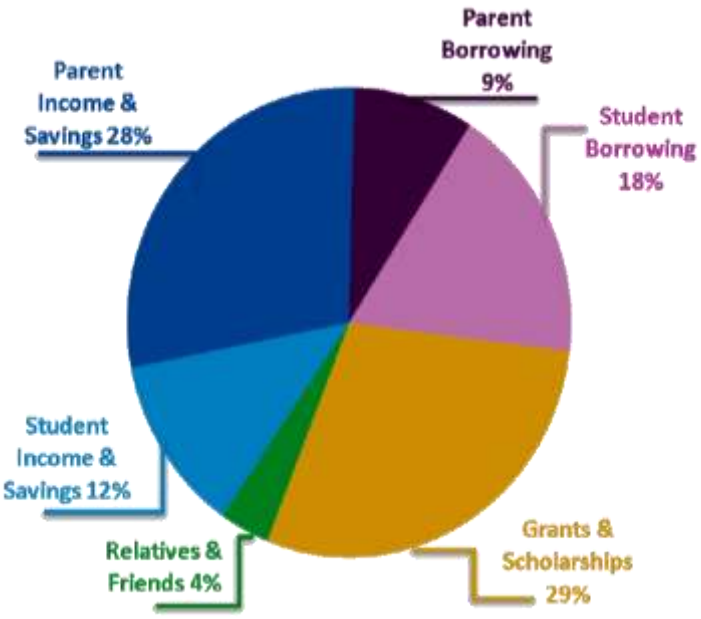

FIGURE 1 Funding Undergraduate Education
SOURCE: Sallie Mae, How America Pays for College, 2012

The changes in the last five years have been gradual, and there is elasticity, said Ms. Ducich. Families don't have the income or savings they had before, and thus parents are borrowing a little more. The challenge for higher education is to continue to deliver a high-quality education that families greatly value, and to do so in an increasingly cost-sensitive world.

In the opening presentation on October 10, "College Unbound: The Future of Higher Education," **Mr. Jeffrey Selingo,** Vice President and Editorial Director of *The Chronicle of Higher Education,* surveyed recent and coming trends in higher education, predicting a massive change in the near future.

Noting that a period of growth often precedes a major change, Mr. Selingo described the period 1999 to 2009 as a "decade of more." The number of students has increased by one-third since the late 1990s, and the number of academic programs has grown as well. Tuition climbed by huge amounts at all types of institutions. Colleges added facilities and amenities both to meet demand and to "keep up with the Joneses," to better meet the expectations of incoming students and their families, and to increase their prestige as a selective university. Institutions took on an enormous amount of debt, which now stands at $307 billion. Meanwhile, students seemed willing to go to any institution at any cost. All of this started to unravel in September 2008, when the economic collapse ended the "decade of more."

Turning to the future, Mr. Selingo outlined five disruptive forces that will shape higher education in the next decade:
1) **Low completion rates.** Nationwide, 56 percent of students at four-year public universities complete their degree within six years; in a majority of states, completion rates are below that average.
2) **Demographics.** The "student swirl" is under way, with one-third of students transferring at least once before getting their degree. Many of them "reverse transfer," starting at a four-year institution and then transferring to a two-year institution. Students are now less brand loyal; they want education on their terms, and if they don't get it, they move on.
3) **A sea of red ink.** In addition to the debt held by institutions, family ability to pay has decreased. Last year, students took out $110 billion in student loans – equivalent to the entire amount taken out during the period 1965 to 2000.
4) **Improved alternatives.** Students are already using courses from online providers such as the Kahn Academy, edX, the Open Learning Initiative, and Coursera.

5) **A focus on value.** As many forces leave students paying more out of pocket for their education, they will start asking more questions about what they are buying.

As Mr. Selingo traveled the country talking to parents and college-bound students doing research for his book, he kept hearing the same questions: How and what will I learn? Will I get a job? And will I make enough to pay off my debt? He mentioned that in the previous week the state of Virginia – the third state to do so – released a database that allows the public to look at graduates' first-year salaries by institution and by major. These are the kinds of measures students and parents want, he said.

Meanwhile, at higher education meetings he has attended in the last year, Mr. Selingo saw viewpoints similar to those of newspaper editors in the late 1990s: hubris about universities' role as a public trust, skepticism of anything new, and unwillingness to hear opposing views. Even when presented with evidence of changes under way, many people in higher education don't want to believe it, he said.

Mr. Selingo concluded by summarizing the aspects of higher education he sees as most at risk and least at risk from future trends. Among the most at risk are: 1) commodity courses, such as the large introductory courses often taught by adjuncts; 2) the bundled, one-size-fits-all experience, in which many colleges try to serve every single need of every single student; and 3) the credential, especially among graduate students who might pursue other alternatives. The aspects of higher education that he views as least at risk are: 1) the idea that colleges mature students; 2) the research function at big universities, which cannot be done online; and 3) the relationship between student and professor, which is still much stronger in person than online.

In the next presentation, **Dr. Robert Martin,** Emeritus Boles Professor of Economics at Centre College, spoke about "H.R. Bowen's Rule." Much of what Bowen foresaw in his 1980 book *The Cost of Higher Education* has happened, Dr. Martin said, leaving us in a situation where the cost of higher education has become exorbitant and quality is declining. This is a serious social issue, because higher education is very close to becoming a bottleneck in upward economic mobility.

The basic formulation of Bowen's rule is that revenue drives cost. Colleges follow a balanced budget model for their operations, which means that revenues are the cap on the services provided. Colleges raise all the money they can and then spend that money on an unlimited list of things that might conceivably improve quality. And the more revenue there is, the less need there is to use resources efficiently.

Dr. Martin then introduced his own hypothesis: that in recent decades there has not been too little money flowing into higher education, but rather too much. Since costs are capped by revenue, it would not have been possible for college costs to increase so much if there had not been a corresponding rise in revenue. Colleges raise as much money as they can, then think about how to spend it all, and then they charge students accordingly.

As a percentage of GDP, the U.S. is spending more money on higher education than Europe, Dr. Martin said. The good news is that we could be doing a lot more and better things with the amount of money we have, improving quality at lower cost to students, he continued; the bad news is that a complete reset is needed before the good news can be realized.

Dr. Martin suggested that one problem of higher education is related to inefficient use of resources, inefficiencies that are characteristic of "bureaucratic entropy": the tendency of overhead staffing to grow faster than the number of people served, ensuring that costs must rise. While businesses fight this entropy by continually reorganizing themselves to get rid of dead weight functions and activities, higher education typically does not because the politics involved in doing so can be very difficult. If bureaucratic entropy goes unchecked, the complex overhead begins to interfere with productive activities, causing quality to decrease and costs to rise.

Institutions are trying to climb up the quality tier, Dr. Martin noted; and because the only rewards in higher education are research-driven, everyone wants to move up that ladder. However, teaching is the number one priority of taxpayers and parents. If we had better value-added metrics for teaching, suggests Dr. Martin, there would be an international market for senior master teachers, a market that currently does not exist.

One effort to improve efficiency in higher education is happening in the rapidly growing world of online education, and in particular through massive open online courses (MOOCs) – the subject of the meeting's next two speakers. In a presentation titled "Reinventing Education," **Dr. Anant Agarwal** of the Massachusetts Institute of Technology explained his work as president of edX, a nonprofit venture of MIT and Harvard that offers free online courses that enroll thousands of students worldwide. Education is being

reinvented, said Dr. Agarwal, giving an example of how a high school teacher in Mongolia used an edX course on circuits with his students, one of whom got a perfect 100 score in what is one of the hardest classes at MIT.

Dr. Agarwal explained that edX's two goals are to expand worldwide access to education through online learning and to work with universities to reinvent on-campus education through "blended" learning, which mixes online and classroom learning. He and his colleagues view online learning as a rising tide that will lift all boats – increasing access to learning worldwide and at the same time dramatically improving on-campus learning in quality, efficiency, and skill.

Online learning can make education more cost-effective, Dr. Agarwal said, describing the online circuits course taught at MIT. Over 154,000 people registered worldwide; 10,547 students made it to the mid-term; and 7,157 students passed the course and received a HarvardX or MITx certificate verifying that they did so. That online course, which reached thousands of people, was taught with the same staff resources as an on-campus class for 150 people.

Higher education should focus on efficiency – the ratio of quality over cost – rather than cost alone, said Dr. Agarwal, stressing the importance of improving quality. In edX's learning experience, the videos are lectures that are interleaved with exercises. Students get feedback immediately after trying an exercise; if they got the correct answer, a green checkmark appears on the screen (Figure 2).

This instant feedback dramatically improves the learning experience, he said. Dr. Agarwal also described a virtual game-like laboratory where students can build designs themselves, explaining that online courses have the potential to take learning to a new level – beyond analysis, to innovation and creativity.

Dr. Agarwal described a survey that asked students who took the edX circuits class how it compared to an on-campus course. Sixty-three percent said the edX course was much better than a comparable on-campus class, 36 percent said it was about the same, and 1 percent said much worse. There is anecdotal evidence as well, he added, such as the message edX received from student in Pakistan who told them that "this course was the most rewarding experience of my life."

Next, **Dr. Daphne Koller,** Rajeev Motwani Professor in Stanford University's Computer Science

FIGURE 2 Example of an edX online course
SOURCE: Anant Agarwal, edX

Department and co-founder of online education provider Coursera, continued the exploration of online education with her presentation "Education for Everyone."

One of the things that motivated Dr. Koller and her colleague Andrew Ng to create Coursera was the tremendous need for higher education in many parts of the world. In South Africa, for example, large state universities can only admit about one of every eight qualified applicants, leaving the rest of the students without options. This led to a tragedy last January, when a mile-long line of students waited outside the University of Johannesburg to claim a few dozen slots left open after the standard admissions process had ended (Figure 3). When the gates opened there was a stampede in which 20 people were badly injured and one woman was killed. Higher education is also becoming out of reach for a large number of American families, Dr. Koller added, given that tuition and fees have increased by 559 percent since 1985.

When Coursera officially launched in April 2012 they had about 200,000 users, and by the first week of August they had 1 million users – a faster rate of growth than Facebook and a testament to the hunger for high-quality education, said Dr. Koller. Users have been growing steadily at about 60,000 to 70,000 students per week, and Coursera now has 33 university partners who offer courses through the service. Students have used certificates from the courses to help them get jobs at places like Twitter and Google.

FIGURE 3 University of Johannesburg
SOURCE: Daphne Koller, Coursera

Coursera's classes are broken into smaller learning modules that students can traverse at their own rate and in their own order. The courses include simple exercises embedded in the video and constant retrieval practice and assessment, which research has shown helps learning. In addition, there is real, graded homework, said Dr. Koller. How do you grade the work of 100,000 students? Short-answer and multiple choice questions, math expressions, and computer coding can be auto-graded without human intervention. For courses that have open-ended, critical-thinking work such as writing assignments, a sophisticated pipeline of peer grading is in place, said Dr. Koller, who noted that there is a strong correlation between peer grading and teacher grading.

Students interact with each other on message boards by posting questions, which other students then answer; the best questions and answers get voted up higher on the board. In addition, student study groups have grown up organically; there are 1,500 communities in 1,344 cities worldwide where people get together physically about once a week to study.

Online courses have the potential to change in-class learning as well. Maybe instead of subjecting students to lecture, we should use classroom time to talk with students, do problem-solving and engage students in active learning, said Dr. Koller. Studies have shown that active learning in the classroom provides better learning outcomes – in terms of attendance, engagement, and learning – than traditional lecture.

In the next presentation, **Dr. Robert Powell,** Chair of the Academic Senate of the University of California System and a professor at the University's Davis campus, spoke on "The University of California: Access, Affordability, and Excellence in an Environment of Rapid State Disinvestment." State funding for the University of California has been generally declining since the mid 1960s and currently makes up about 11 percent of the University's budget. Tuition, fees, and state funds – the backbone of the institution's budget – are supplemented by income from state contracts and grants, philanthropic support, the medical center and other services.

The state is often referred to as an "unreliable partner," said Dr. Powell, which means that there are intermittent bursts of funding – during the dot-com bubble, for example – and then decreases. The University has not had a stable funding landscape since at least the early 1990s, which means that tuition and fee increases for students have also been volatile. Even the tuition and fee increases, however, have only filled about 39 percent of the budget gap in recent years.

Among the effects of this unsteady funding has been a decrease in the number of faculty, even as more students are enrolling. This results in a greater workload for faculty and a higher student-to-teacher ratio. In 1965 the student-to-faculty ratio was 14.5 to 1. Today it's in the range of about 24 to 1. The drop in state support has also affected faculty salaries, which are currently about 12 to 15 percent lower than the University's comparison group of eight universities.

The University of California has managed to maintain its three pillars – access, affordability, and quality – despite these challenges, Dr. Powell said. The University is obliged to enroll the top 12.5 percent of graduating seniors in the state; enrollment has increased, and all eligible students have been offered a seat at one of the UC campuses they chose. The University has also managed to stay affordable; over 50 percent of California undergraduates pay no tuition or fees. Students do have debt, but it's nearly $7,500 less than the national average, and half of the 2010-2011 graduating class had no student loan debt.

According to Dr. Powell, the University's future funding will depend heavily on whether a tax revenue initiative on the ballot this November known as Proposition 30 passes or fails. If it fails, California State University and the University of California will each face $250 million in cuts, leaving the University of California with a budget of $2.14 billion. If it passes, the University of California's budget for 2013-2014 could go up to $2.84 billion – a funding level that, if it lasted for four to six years, would put the

institution back where it historically expects to be in terms of state funding, said Dr. Powell.[1]

The next two presentations examined high-impact research and educational partnerships that are intended to meet grand challenges. In his talk on "Cornell Tech and New York City's Applied Sciences Initiative," **Dr. Kent Fuchs,** provost of Cornell University, spoke about a new partnership Cornell is working on with the City of New York. The project will create a new campus in the city focused on developing technological capacity.

New York City has reinvented its economy over and over throughout its history – from major trading port to major manufacturing center to a city of services, such as financial services – but its leaders are concerned about the future and want to build the ability to drive technology, said Dr. Fuchs. However, the city's current workforce is not strong in applied science or engineering talent. So in December 2010 New York City Mayor Michael Bloomberg announced a worldwide competition for a university or partnership to come to New York City and create a new applied sciences campus – a "modern day land grant institution."

The city offered 12+ acres on one of four possible sites, as well as $100 million for site development and construction.

In December 2011, Cornell Tech and its partner in the venture, Technion, the Israel Institute of Technology, were announced as the winners. Cornell has a 25-year set of deliverables, including the task of setting up $2 billion in physical infrastructure on the new campus, which will be located on Roosevelt Island. For the next five years until the campus is ready, the school will be located in the Google building in southwest Manhattan.

The campus will be different from anything Cornell has had in the past, said Dr. Fuchs. There will be 2,500 graduate students and over 200 full-time faculty, as well as many people from industry and venture capital. The vision for the institution is to focus on three elements – academic leadership, commercial intent, and societal benefit. There will be no academic departments; in terms of courses and research, the school will be structured around three interdisciplinary hubs tied to the real world: healthier life, connective media, and the built environment (Figure 4).

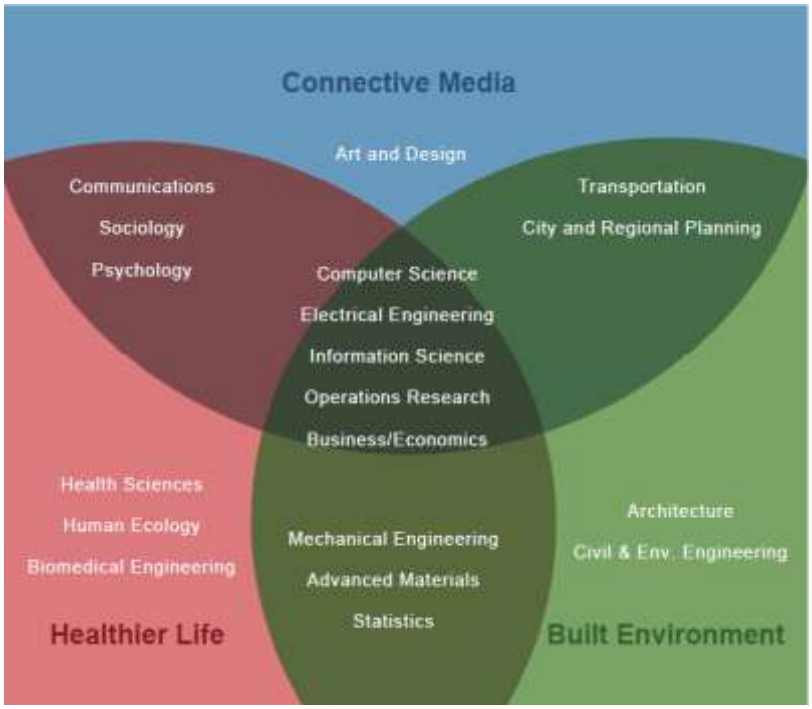

FIGURE 4 Elements of the Applied Sciences Initiative
SOURCE: Kent Fuchs, Cornell University

[1] Proposition 30 passed on Tuesday, November 6, 2012.

Part of the campus will be the Technion-Cornell Innovation Institute, a 50:50 partnership focused on a dual master's degree; students in the two-year program will receive one degree from each university. The program will be taught half by Technion faculty, half by Cornell faculty. Faculty will also collaborate in research. In addition, the school will be offering one-year discipline-based master's degree programs in traditional tech fields such as computer science, information science, information engineering, electrical and computer engineering. And Cornell's business school will offer an accelerated one-year MBA focused on the technology environment. Academic programs will include hands-on apprenticeship-style learning, with Fridays reserved for hands-on practicums; in addition, every student will have both an industry mentor and an academic adviser.

The next presentation gave an overview of another new collaborative effort, the National Center for Advancing Translational Science (NCATS), a National Institutes of Health (NIH) center established in 2011 by an Act of Congress. **Ms. Lili Portilla,** Acting Director of the Office of Policy, Communications and Strategic Alliances at NCATS, explained that the center's mission is to learn about the drug discovery process, identify bottlenecks, share information on how to overcome those bottlenecks, and develop technologies that can be used in the drug discovery process. NCATS will collaborate not only with our academic partners but also with the pharmaceutical and biotech industries, small businesses, and nonprofit advocacy organizations, as well as other parts of NIH, she said.

Ms. Portilla focused her talk on one part of NCATS, the Division of Pre-Clinical Innovation. The development of new therapeutics is slow and very expensive, and potential drugs drop out along the drug development pipeline. The division will look at that process and failures that occur and try to learn about them and share that information. The division has over 300 active collaborations with investigators across the U.S. and around the world, and about 80 percent of the employees have come from the pharmaceutical or biotech industry and have outside business experience, so they come in with a different attitude about managing projects: if something is not working, they're going to move on and initiate another project which is a refreshing approach, said Ms. Portilla.

One program within the division, the Bridging Interventional Gaps (BrIDGs) program, is intended to make therapy development projects less risky for academics and small businesses and help them move forward. The program is very milestone-driven; if a project does not meet its milestones, it does not proceed, and resources are no longer applied to it. So far, there have been 180 applications submitted since 2005, of which 34 were approved and 19 completed; five agents have been licensed to third parties.

Another program, Therapeutics for Rare and Neglected Diseases (TRND), is a collaboration that is run more like a pharmaceutical development team, with a biologist, a statistician, and a medicinal chemist all in one team, looking at potential therapies and making a plan for how each small molecule or biologic will proceed through the development process. The program's goal is to help for-profit partners or academic medical centers move potential therapies for rare or neglected diseases to a stage where it is possible to attract third-party funding or a partnership with a pharmaceutical company. Since 2009, TRND has taken in 14 projects and 3 investigational drugs that are now in clinical trials.

Ms. Portilla concluded by highlighting new projects NCATS is undertaking, including the Drug Rescue and Repurposing Program, which tries to find other uses for drugs that have clinical data but have failed for the purpose for which they were originally intended. Another program, the Tissue Chip for Drug Screening program, aims to develop tissue chips that mimic human physiology that can be used to screen for safe, effective drugs.

DISCLAIMER: This meeting summary has been prepared by Sara Frueh as a factual summary of what occurred at the meeting. The committee's role was limited to planning the meeting. The statements made are those of the author or individual meeting participants and do not necessarily represent the views of all meeting participants, the planning committee, GUIRR, or the National Academies. For additional information regarding the meeting, go to www.nas.edu/guirr.

The summary was reviewed in draft form by Howard Grimes, Washington State University, to ensure that it meets institutional standards for quality and objectivity. The review comments and draft manuscript remain confidential to protect the integrity of the process.

GUIRR

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