The Public Research University: Forces of Change

This year, we are celebrating the 150th Anniversary of the Morrill Act, which created a new partnership between government and the states to support higher education. The Morrill Act established the public land-grant university and brought a college education within reach for all Americans. For more than a century, land-grant institutions have fueled the groundbreaking research that has moved our country forward.

Since its founding in 1870, The Ohio State University has grown to become one of the nation’s premier research universities. This is a time to honor the history of our university and look towards the future.

This morning I will review the influences that created today’s public research university and explore the forces that will help shape its future. Along the way, I will highlight examples of Ohio State research that exemplifies how the university is gearing up to meet these future challenges.

First, I would like to give you a “snapshot” of our research enterprise at Ohio State.

1. Research expenditures for FY 12 reached $934 M, representing an increase of $102 M over the prior year.

2. Ohio State researchers have received numerous honors and awards:
   a. There are 189 fellows of the American Association for the Advancement of Science (AAAS). Twenty new members were elected this past year by their peers to the world’s largest professional organization.
   b. We have 12 National Academy of Sciences members. Election to the NAS is one of the most prestigious honors an American scholar can achieve.
      - Tina Henkin, from Arts and Sciences, and Yasuko Rikihisa, from Veterinary Medicine are the two newest members.
        - Henkin focuses on mechanisms enabling cells to sense changes in their environment and resulting gene expression. She is targeting these mechanisms to develop a new class of antibiotics to treat bacterial infections.
        - Rikihisa specializes in the study of tick-borne diseases that infect animals and humans. She focuses on how unique pathogens can cause potentially fatal and emerging infectious disease. She won the 2011 Innovator of the Year award.
   c. We have 17 American Academy of Arts and Sciences members, 7 Institute of Medicine members, and 12 members of the National Academy of Engineering.
d. Matthew Kahle from mathematics in Arts and Sciences received the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award for the next generation of researchers in defense-related disciplines.

- He conducts interdisciplinary research that involves the interaction of different fields of math – topology and geometry, probability, statistical mechanics, and combinatorics.
- His current focus – When exactly does a liquid change into a solid?

e. Scott Gaudi, from astronomy in Arts and Sciences received the 2012 Presidential Early CAREER Award for Scientists and Engineers (PECASE), the highest honor given by the U.S. government to science and engineering professionals in the early stages of their independent research careers.

- He is creating a new stellar map for exoplanets – those planets that lie beyond our solar system. He was directly involved in worldwide collaborations that discovered five of the eight planets using gravitational microlensing.
- Arts and Sciences faculty have received the PECASE for the last 3 years.

f. The number of students participating in the Denman Undergraduate Research Forum increases each year. This past May, more than 600 students took part.

- Their projects ranged from the mechanism of insulin resistance to dancing in the vertical plane.
- The Denman encourages all undergraduates to participate in research as a component of their education.

g. The Barry M. Goldwater Scholarship and Excellence in Education Program recognized four Ohio State students – Johnny Greco, Ronald Siebenaler, Grant Young, and Nicholas Jarjour. Each institution was allowed to submit 4 applications.

- The Goldwater Scholarship is the most prestigious award given to undergrads in science, math, and engineering.
- Since its inception in 1986, 44 OSU students have received scholarships.
Now I would like to shift my focus to today’s topic:

[Slides 10-18] HOW THE PUBLIC RESEARCH UNIVERSITY BECAME WHAT IT IS TODAY: CELEBRATING 150 YEARS OF PUBLIC HIGHER EDUCATION

With the introduction of the Morrill Act, emphasis on combined liberal arts and more practical endeavors gave rise to the comprehensive university model – such as Ohio State.

- Abraham Lincoln signed the Morrill Act into law in 1862.
- The Morrill Act made it possible for all citizens to aspire to the benefits of higher education.
- Each state received 10,000 acres of land to sell. The proceeds were used to create public universities.
- The original mission of the public university was “To teach agriculture, military tactics, and the mechanic arts (engineering), as well as classical studies so that members of the working or ‘industrial’ class could obtain a liberal, practical education with direct relevance to their daily lives.”
- Today, the phrase “teaching, research, and public service” has become synonymous with land-grant universities.
- Every state in the nation has at least one land grant university.

During World War II, research was needed to fuel the war effort. Federal funding for basic research escalated, leading to the establishment of federal agencies such as NSF and NIH. Events such as the Space Race and the Cold War further increased the emphasis on science, engineering, and defense and national security.

As federal funding continued to increase, industry funding for basic research began to show a decline. During this time, the extension model of university outreach and engagement grew to encompass “economic development.”

I would like to share with you examples of Ohio State research in the areas of agriculture, engineering, and medicine that exemplify our land grant mission.

[Slide 19] Let’s begin with research on the emerald ash borer, an exotic beetle discovered in southeastern Michigan in 2002.

- According to estimates, the emerald ash borer will cause $10-$20 B in losses to urban forests over the next decade.
- Dan Herms, in entomology, received a $1.4 million grant from the USDA to develop a new variety of tree able to withstand the emerald ash borer.
- He is leading an interdisciplinary team of entomologists, plant pathologists, biologists, and ecologists, from OSU, Wright State, Michigan State, and the U.S. Forest Service.

[Slide 20] Reducing the transmission of antimicrobial-resistant organisms by wildlife in the food supply is another area of ongoing research at the university.
According to estimates, the economic health-care burden caused by AMR bacteria is more than $4 billion annually.

Jeff LeJeune, professor in the Food Animal Health Research Program at OARDC, is leading a $1.8 million effort funded by the USDA to identify how AMR strains might be spread.

He and his team of researchers from Colorado State, British Columbia, and the U.S. Wildlife Protection Agency are taking a “one medicine approach” as they study all aspects of food safety – the animals, the people, and the environment.

October is national breast cancer awareness month. Barbara Andersen, professor of psychology, is improving the lives of cancer patients through her Breast Cancer Intervention Training program.

She received a $1.6 million grant from the National Cancer Institute to train more than 320 mental health care professionals – psychologists, social workers, and mental health clinical nurse specialists – in biobehavioral interventions to help cancer patients cope with the stresses of diagnosis and treatment.

Andersen and a group of collaborators developed the intervention, which culminates more than a decade of research evaluating the benefits of psychological counseling and support for cancer survivors.

In the area of deep energy research, David Cole, professor of earth sciences and Ohio Research Scholar in Subsurface Extraction and Carbon Sequestration, is leading a $1.5 million effort funded by the Sloan Foundation to create sustainable solutions to meet our energy needs.

Scientists from 7 countries are working in 5 synergistic themes linking the study of crustal and mantle carbon across enormous length and time scales, from global to bench scale to the atomic scale.

Globally, the university is participating in 4 of 9 Collaborative Research Support Programs (CRSPs), supported by the United States Agency for International Development. These International Programs in Agriculture are mechanisms for land-grant universities to combine forces and strengthen the agricultural sector in developing countries.

Sally Miller, professor of plant pathology, leads the International Plant Diagnostic Network – a network to improve plant disease and insect diagnostics in Africa, Asia, and Latin America.

Building a capacity for plant diagnostics in these countries should help reduce the risk of the accidental introduction of new pathogens into the U.S.

The land grant mission of the nation’s public research universities is evolving. While universities remain committed to their land-grant mission, the complex challenges we face today have made it more important than ever to find new ways to effectively promote access to higher education and collaborate to advance knowledge. Several major forces have the power to transform the public research university and their land-grant mission.

A forward-looking institution learns from the past, is not afraid to take risks, and is collectively visionary towards the future. Ohio State is a forward-looking institution.
So, what are the pressures shaping the direction of public research universities in the future?

[Slide 24] Today, I will talk about 6 forces shaping the public research university of the future. They are:

1. Changing Demographics
2. Multidisciplinarity
3. Partnerships
4. The Information Explosion
5. New Technology; and
6. Entrepreneurship

1. DEMOGRAPHICS

[Slide 25] I’ll begin with Demographics. The overall distribution of the population in the U.S. continues to shift – the population is becoming older and more diverse. The “graying” of college faculties is notable in many institutions.

So what demographic trends are we seeing in our faculty at Ohio State? Let’s compare demographics from 2002 and 2011.

[Slide 26] Age:

- In 2002, 35% of our faculty were 45 and younger. In 2011, 40% of faculty were age 45 and younger. The shift here is towards younger faculty.

[Slide 27] Gender:

- In 2002, 29% of faculty were female compared to 34% in 2011. The trend: We are hiring more women today than 10 years ago.

[Slide 28] Ethnicity:

- In 2002, 15% of faculty were identified as a minority, compared to 21% in 2011. We are moving towards a more diverse population.
As our faculty retire, a large contingent will be replaced by people who lived life in a very different way – with different educational and technological experiences.

For example, if you were a faculty member growing up in the 1950’s:

- You were probably the most popular kid on your block if you had a television in your home.

In the 1950’s:

- Fast food restaurants were just springing up.
- Coke was only sold in glass bottles.
- The patent for the first microchip/integrated circuit was applied for in 1959.
- The 1953 Corvette was the country’s first mass-produced fiberglass automobile with a sticker price of $3500. The only available options – an AM radio and heater.

In contrast, let’s take a look at our “up-and-coming researchers.”

Growing up in the 1980’s was far different than growing up in the 1950’s. For those of you who grew up in the 80’s:

- Personal computers (IBM PCs) were available, but not for widespread home use.
- Video games existed, but looked nothing like the do today.
- Cartoons were hand drawn.
- If you missed a show on TV, you had to wait months for the rerun.
- You had to order a pizza over the phone.
- Diet Coke was not introduced by Coca Cola until 1982.
- There were many more options available in the 1980 Corvette – cloth or leather upholstery (with no price differential), AM-FM radio with 8-track, and power door locks. The average price tag: $14,350.

These researchers came to the university with a very different skill set and very different life experiences. They came with new ways of thinking about challenges and brought with them novel methods for achieving results. Their research pursuits reflect their upbringing as well as the changing demographics.

For example, Terrell Strayhorn, associate professor in the College of Education and Human Ecology, was named a “Research Rising Star” by the publication *Diverse: Issues in Higher Education*.

- With support from an NSF CAREER award, Terrell studies the identification and removal of roadblocks for the retention of minority students.
- In particular, he is looking at the importance of a students’ sense of belonging in school and the barriers to academic and career success. He and his team are examining access and achievement, equity and diversity, and broadening the participation of women and minorities in STEM fields.
R. Kelly Garrett, also an NSF CAREER Award recipient, is using the phenomena of social networking as a way to communicate.

- He studies the ways social networks influence U.S. political misperceptions.
- He is trying to answer the question “Can the web undermine democracy by misinforming or polarizing voters?”
- During the 2008 election, the Internet did indeed become a giant rumor mill. New technologies were being used in ways that challenged our notions about how people handled controversial or difficult issues.

And then there are our students. Through the land-grant university heritage, millions of students are able to experience a multitude of academic disciplines and explore fields of inquiry far beyond the scope envisioned in the original land-grant mission. As the demographics of our faculty changes, so do the characteristics of our students. They are gaining a variety of experiences beyond the classroom and are becoming increasingly involved in hands-on research.

- Today’s students have never before been so technologically savvy and interconnected – they are able to receive their education anytime, anywhere.

So who are today’s students? According to Beloit College’s Mindset List, which provides a look at the cultural touchstones that shape the lives of students entering college, the class of 2016:

- Were born into cyberspace.
- Have measured their output in the fundamental particles of life: bits, bytes, and bauds.
- Have come to political consciousness during a time of increasing doubts about America’s future.

During their lifetimes:

- Women have always piloted war planes and space shuttles.
- Genomes of living things have always been sequenced.
- There have always been blue M&Ms, but no tan ones.
- If they wanted to buy a 2012 Corvette, the base model would set them back $50,000 – depending on the options selected – such as an MP3 player, Bluetooth, a navigation system, and stability control.

Today’s students have the opportunity to conduct research from the moment they set foot on campus. For example, Ronald Siebenaler, a biomedical science major and winner of the Goldwater Scholarship, has been conducting research throughout his educational experience at Ohio State.

- He is testing novel therapies for patients with acute myeloid leukemia (AML) to discover a more personalized therapy that will provide less toxic and more effective treatment for AML patients.
- He plans to obtain an MD and a PhD, before he pursues a career in experimental cancer therapeutics.
Our students have the opportunity to work in teams – to communicate and engage effectively with team members and work collaboratively to solve problems. One such student led team – the Buckeye Electric Motorcycle team – is based out of the Center for Automotive Research.

- The team was launched in 2010 to enhance the development of clean, electric powered motorcycle technology.
- They set the East Coast Timing Association (ECTA) record for electric motorcycles at the Ohio Mile Track in Wilmington. They achieved 144 mph, an increase of 30 mph over their 2011 record.
- Jennifer Holt, a grad student and professional motorcycle driver, steered the team to victory.
- What’s next? The team wants to build a motorcycle that can reach 150 mph – something few professional teams have been able to accomplish.

2. MULTIDISCIPLINARITY

The second force that must shape the research university of the future is Multidisciplinarity. We are facing significant challenges today, some of which may impact our very survival.

- According to a report published by Exxon Mobil, the demand for global energy will increase about 30 percent in 2040 compared to 2010.
- 1.1 billion people in developing countries have inadequate access to water, and 2.6 billion people lack basic sanitation.
- According to the United Nations, 925 million people were undernourished in 2010. Even in the U.S., one out of eight children under the age of 12 goes to bed hungry every night.
- One billion people lack access to health care systems. According to the World Health Organization, there were more than 139,000 measles deaths globally in 2010 even though a safe and cost effective vaccine is available.
- By 2050, the world’s population is expected to grow by 2.2 billion.

The problems that we face now and will face in the future are becoming increasingly complex. Our resources for addressing them are becoming more and more limited. Meeting society’s challenges will require an approach that is problem-based, multidisciplinary, and global. Solutions to these problems will not be found in individual disciplines. Multidisciplinary research will be an essential driver for innovation.

Here are some great examples of problem-based multidisciplinary research going on at OSU today.

Steven Lower, from Arts and Sciences, is someone whose work spans a range of disciplines – molecular science, biophysics, microbiology, and mineralogy.
• He studies the physical forces that enable bacteria to stick to surfaces, infectious biofilms on medical implants, and biomineralization of magnetic particles.

• His research could have far-reaching applications:
  – Bacteria could potentially aid in environmental clean ups and doctors could better target antibiotic use on patients who receive implants or design bacteria-resistant implant materials.

Regenerative medicine is a relatively new area of research recognized by NIH. This is a truly interdisciplinary field that brings together nearly every field in science to deliver innovative health solutions.

• The Center for Regenerative Medicine and Cell-Based Therapies, led by Chandan Sen (College of Medicine), is a collaboration of 7 colleges plus Nationwide Children’s Hospital and Battelle.

• Within the Center, researchers are working together to create living, functional tissues to repair or replace tissue or organ function lost due to age, disease, or congenital defects.

• The field of regenerative medicine possesses opportunities for immediate product development. The global market for replacement tissue is estimated to reach as high as $5 billion by 2014.

Over 80 faculty members representing a variety of disciplines from pharmacology to bioinformatics are part of the Center for Microbial Interface Biology. This Center is led by Larry Schlesinger from the College of Medicine. The Center is creating the next generation of therapies and vaccines against infectious disease.

• There are about 57 million deaths in the world each year, 25% of which are directly related to infectious diseases. The most common infections are due to tuberculosis, HIV, and malaria. The worry is that many of these pathogens are resistant to current antimicrobial drugs.

• Within the Center, there is a focus on biofilms, which enable bacteria to adhere to body surfaces and gain a foothold, the host response to tuberculosis, HIV treatment trials, as well as protection against agents of bioterrorism.

Every problem that confronts us as researchers has important ethical dimensions. The Center for Ethics and Human Values, led by Donald Hubin, professor and chair of the Department of Philosophy, brings together diverse disciplines to explore the foundations of moral judgment.

• Solving these problems requires not only new technologies but, often, new ways of thinking.

• The Center just led a year-long conversation on immigration. The Immigration Project was the prototype for a program called “Conversations on Morality, Politics, and Society” (COMPAS), which brings together researchers from diverse disciplines to address complex social problems that have a significant moral dimension.

The Institute for Population Research, directed by John Casterline from sociology, is a multidisciplinary center established in 2000 with the goal of building excellence at Ohio State in population and health research.
In 2009, IPR received a $2.2 million award from NIH, establishing IPR as a premier population research center with signature strengths in the study of family demography, health and health disparities, and population distribution, including immigration.

IPR brings together behavioral and health scientists from 7 colleges to better understand the health and family outcomes of children, adults, and communities.

Honda R&D Americas and Ohio State have developed a unique collaborative research initiative called the Honda/OSU Mobility Innovation eXchange (MIX).

Honda scientists and engineers work side-by-side with Ohio State faculty and students, both in Scott Laboratory on the OSU campus and at the Honda R&D Americas campus in Raymond, Ohio.

They are working on cutting-edge research on a variety of topics related to automotive materials and technologies.

The Advanced Degree Program (ADP) makes it possible for Honda R&D employees to earn a master’s degree at Ohio State while continuing full-time employment at Honda. At the end of a 16-month program, they return to Honda with technical experience in their particular field of study.

Marcelo Dapino, professor of mechanical and aerospace engineering, and Lara Minor, senior director of technology outreach at Honda R&D Americas, serve as MIX directors.

3. PARTNERSHIPS

Federal funding for research is likely to decline in light of the U.S. spiraling deficit. We have seen at least seven years of flat or declining support for federal science programs at the national level and state legislatures have slashed educational spending across the country.

Universities, working on their own, will not be able to provide solutions to the world’s most pressing challenges.

Funding in the future will depend on three-way partnerships between universities, industry, and government in order to develop new technologies and a skilled workforce to keep our nation competitive.

Building partnerships has been a priority at the university. Through the work of the Industry Liaison Office, over 500 new or renewed company contacts have been made, representing $200 billion in global sales. We now have representatives from the ILO out in the colleges – in engineering, agriculture, the arts and sciences, public health, nursing, and medicine.

With $3 million from the Ohio Third Frontier Innovation Platform, a state-funded program, Ohio State is collaborating with Philips Healthcare and Cardinal Health to develop a PET/MRI, a next-generation multimodal molecular imaging technology platform.
• This collaboration will focus on the development of new radiopharmaceuticals and imaging technology to improve the detection and diagnosis of diseases in cancer, neurology, and cardiovascular patients.
• The effort is led by Michael Knopp, professor of radiology and director of the Wright Center of Innovation in Biomedical Imaging.

[Slide 48] The U.S. Department of Energy recently invested $2.7 million in an Ohio State, General Motors, and Meridian Lightweight Technologies collaboration to improve the manufacturing of automobile components.

• The team, led by Jerald Brevick, integrated systems engineering, and Glenn Daehn, materials science and engineering and faculty liaison for the Ohio Manufacturing Institute, will develop a high-pressure casting process for manufacturing automotive structural parts.
• In particular, they will evaluate new magnesium alloys and further develop the die casting process.
• By substituting magnesium for the steel used in inner door panels, car doors could weigh 60% less, resulting in significant fuel economy improvements and carbon emission savings.
• Ohio State is proud to be one of GM’s 12 academic partners.

[Slide 49] The National Highway Traffic Safety Administration (NHTSA) is expected to release new guidelines soon to ensure that drivers don’t become too distracted by entertainment and navigation systems in their vehicles. The guidelines are expected to cover visual as well as manual distraction.

On October 18, the new Driving Simulation Laboratory will open.

• With funding from Honda R&D Americas, Ohio State, the Honda-OSU Partnership, and the Ohio Board of Regents, the lab will operate as a consortium with Wright State and Ohio University.
• The state-of-the-art 5,800 square-foot facility is located on OSU’s west campus in the research park.

4. THE INFORMATION EXPLOSION

[Slide 50] The Information Explosion is the fourth force at work.

The amount and availability of information is growing at an unprecedented rate as we digitize, collect, and create information from more and more sources. The amount of digital information available is increasing tenfold every five years. Moore’s Law, based on an observation by Intel co-founder Gordon Moore in 1965, states that the number of transistors per square inch on integrated circuits has doubled every year since their invention. This trend is expected to continue into the foreseeable future.

[Slide 51] When the Sloan Digital Sky Survey started work in 2000, its telescope in New Mexico collected more data in its first few weeks than had been amassed in the entire history of astronomy. Now, a
decade later, its archive contains 40 terabytes of information. A successor, the Large Synoptic Survey Telescope, due to achieve first light in Chile in 2016, will acquire that quantity of data every five days.

The Sloan Digital Sky Survey III reached a new milestone in August, with the release of the largest-ever 3D map of the known universe. David Weinberg, professor of astronomy and Distinguished Professor of Mathematical and Physical Sciences, is the Project Scientist for SDSS-III.

As the amount of available data grows, information management will become increasingly difficult. Despite the abundance of tools available to capture, process, and share the information – such as sensors, computers, mobile phones, etc. – available storage space has already been exceeded. Moreover, ensuring data security and protecting privacy is becoming harder as information is shared more widely around the world.

What are Ohio State and Ohio doing to keep up with this pace?

[Slide 52] The state of Ohio is investing $10 million to harness technology and boost the state’s broadband network speeds 10-fold.

- Ohio’s current broadband infrastructure will increase from 10 Gigabits per second to 100 Gbps, making Ohio the only state with this level of connectivity.
- What does this mean in terms of speed? Ohio’s 1.8 million enrolled K-12 students could download an e-Book simultaneously in just over 2 minutes.
- By the end of November, 10 Ohio cities will be connected to the northern and southern connection points of Internet2, a nationwide advanced networking consortium spanning U.S. and international institutions who are leaders in the worlds of research, academia, industry, and government.

New developments in biomedical informatics are changing the way data and services are exchanged across multidisciplinary fields.

[Slide 53] Cloud computing is making it easier to access and share a pool of resources (including applications, servers, storage, and networks) because the cloud acts like a virtual supercomputer.

- Using the cloud model as inspiration, and with funding from NIH, Ohio State researchers created the Translational Research Informatics and Data Management Grid (TRIAD) so scientists around the world can access and analyze biomedical data at an unprecedented rate.
- TRIAD is led by Philip Payne, chair of the Department of Biomedical Informatics, and Rebecca Jackson, principal investigator of the Clinical and Translational Science Award.

[Slide 54] Ohio State is home to the Clinical and Translational Informatics Training Program (CTRIP), one of only 14 elite academic training programs across the country applying innovative biomedical informatics theories and methods to improve overall health outcomes of patients. Philip Payne and Peter Embi, vice chair, Department of Biomedical Informatics, are co-directors.

- The award is from the U.S. National Library of Medicine.
• This prestigious, highly-competitive training award will enable the university to recruit and teach the next generation of biomedical informatics professionals and enhance the novel, cutting-edge research being conducted in today’s “living laboratories.”

• Ohio State was chosen for this grant because of the comprehensive nature of the health sciences campus as well as the interdisciplinary environment.

The educational landscape on college campuses is changing and will continue to change.

• [Slide 55] Ohio State recently launched Digital First, a collaboration with Apple that will transform teaching, learning, and research through mobile access and technology and make the university a global leader in the delivery of 21st century higher education.

• Undergraduate students in city and regional planning, armed with an iPad and a supplemental Bluetooth receiver, are developing a facilities master plan for the College of Engineering. Instead of a giant spreadsheet, the students are using a custom web application. This is the first time mobile technology has been used as part of the curriculum.

• This initiative will truly change the way we teach and conduct research.

The Internet has sped the pace of scientific discovery, but the necessary firewalls that protect institutions from malicious online activity often hinder data sharing among research partners.

• [Slide 56] A $1 million grant from the National Science Foundation will fund the construction of a unique computer network at Ohio State devoted to helping scientists collaborate over the Internet with minimal interference from security measures.

• Dubbed the “Science DMZ” – a play on the term “demilitarized zone,” partners in the project will identify the software, hardware, methods, and protocols that will allow scientists to securely move data past local firewalls, creating a safe and resilient network architecture to encourage research and collaboration across regional, national, and international networks.

• The research team comprised of Ohio State, the University of Missouri, and the Ohio Technology Consortium’s Research and Innovation Center, will involve participation by scientists from numerous academic disciplines.
5. TECHNOLOGY

The fifth force shaping our future is Technology.

Technology has opened the door to change. It has changed almost every aspect of our lives – the way we socialize, the way we search for information, the way we study, and the way we work. Just look around and you’ll see how wired we are. The Internet, social media, videoconferencing, mobile phones, and Wi-Fi have enabled us to be a workforce on the go. The rate at which content is generated, consumed, and then disregarded is staggering.

One of the most dramatic changes technology has brought over the last 20 years is the opportunity to share in new ways and create communities based on common interests – without geography getting in the way. To quote Dr. Gee, “Ohio State will no longer be the “university of the state.” Ohio State will become the “land-grant university to the world.”

Ohio State research has greatly impacted the “technology revolution.”

On campus, Charles Csuri, known world-wide as the “father of computer art” and Ohio State’s pioneer in computer animation, was instrumental in establishing the Advanced Computing Center for the Arts and Design (ACCAD) – a leading center on the integration of emerging arts technologies.

- Csuri’s work has been applied to flight simulators, computer-aided design, architecture, magnetic resonance imaging, visualization of scientific phenomena, and special effects for television and film.
- How did he become a computer graphics pioneer?
  - [Slide 60] The following excerpt is taken from a 1985 Commencement address that he delivered: “I discovered a small project in computers and pattern recognition in the Department of Electrical Engineering that absolutely fascinated me. The idea that one could program computers to create pictures soon became an obsession to me. I sensed the potential of an entirely new universe, a new way of thinking about art. An entirely new field was emerging. There was no tradition and there were no rules and I was in a position to invent the technology for computers and art.”
  - [Slide 61] He went on to say that “I know that technical knowledge alone for both the artist and the scientist is not enough for innovation. A capacity to be creative and to deal with higher levels of abstraction is essential.”

[Slide 62] Today, technology is creating new ways to teach. A team, led by Christine Ballengee Morris of art education, has developed a user-friendly game to teach 4th graders about a piece of Ohio history not found in textbooks.

- A National Endowment for the Humanities grant is funding the creation of a flash-based game for children – one that includes animation, video, and interactivity to web pages – to help them learn about Native American Mounds in Newark.
• Children will be able to explore the mounds, find clues, and answer questions such as “How were the mounds built?” and “Why were they built?”
• Additional collaborators on the project include ACCAD, the Newark Earthworks Center, and a Shawnee group.

[Slide 63] The university has taken a virtual leap into the future of medical education – “Medicine meets virtual reality.”

• Simulation exercises are playing a greater role in the training and testing of surgeons.
• As the technology becomes more sophisticated and affordable – simulation centers are springing up across the country.
• In March, the university unveiled the Renovated Clinical Skills Education and Assessment Center in the Health Sciences, a $13.1 million expansion dedicated to training healthcare professionals of the future.
• The Center houses some of the most advanced technology, equipment, and simulators in the country.

[Slide 64] At Ohio State, the Temporal Bone Project uses real-time, interactive computer simulations to teach the delicate surgical techniques needed for temporal bone surgery in the human skull.

• The Virtual Temporal Bone simulator creates true-to-life experiences encountered in ear surgery to treat hearing loss, vertigo, tumors, etc.
• A binocular viewer replicates the view a surgeon would see through a microscope. A force-feedback device creates the pressure and resistance experienced during surgery. Drilling sounds are modulated based upon the pressures and area of bone being removed.
• Gregory Wiet, from otolaryngology, and Don Stredney, from the Ohio Supercomputer Center, are conducting a national, multi-institution validation study to determine how medical students trained with the simulator compare to those trained using traditional methodology.

[Slide 65] A very recent application of high technology is SCARLET, one of the world’s most powerful lasers outside of a national lab. Five years in the making, more than a dozen graduate students and two dozen undergrads in the High Energy Density Physics Lab worked to make SCARLET a reality.

• SCARLET’s output exceeds 400 trillion watts – over 300 times the output of the U.S. power grid – concentrated in a tiny fraction of a second.
• The computer code controlling the laser was written by students.
• The facility is cleaner than an operating room – students cleaned the entire lab by hand to remove traces of dust that could get caught in the laser beam.
• SCARLET will be used to study proton beams for cancer therapy, extreme states of matter for learning about interiors of gas planets, and antimatter. SCARLET could have important implications for national security.
• Douglass Schumacher is the associate director of the SCARLET Laser Facility.
All of these technological capabilities build on Ohio State’s international connections and encourage the rise of global universities to support research, teaching, student exchange, and alumni engagement.

- We are committed to becoming a preeminent global university – one that prepares students and faculty to participate actively in knowledge-based collaborations around the world.
- Several Global Gateways have opened or will open in key parts of the world. Gateways opened in Shanghai in February 2010 and Mumbai in March 2012. A Gateway will open in São Paulo, Brazil in 2014.
  - The university is exploring Turkey, sub-Saharan Africa, and Europe as possible Global Gateways.
- To date, more than 85 faculty connections, 17 study abroad programs, 66 Memoranda of Agreement/Student Exchange Agreements have been made.

### 6. ENTREPRENEURSHIP

Finally, Entrepreneurship is the sixth force that must shape the research university of the future.

Innovation – generating new ideas and putting them into practice – is the foundation of economic growth. The future of our economy depends on a new generation of entrepreneurs coming up with novel ideas, resolving to make them a reality, and having the vision to foster economic development and create jobs.

10x is a venture accelerator program launched in 2011 by Fisher College of Business’ Center for Entrepreneurship. It was designed to attract and retain the best and brightest talent in Ohio to support the state’s future economic development.

- 17 talented entrepreneurial teams have competed in the first two rounds of this 11-week intensive program.
- The program has received national attention, spurring interest from other accelerators looking to launch similar boot camps.
- Total state, donor, and matching fund support for the program has reached $1.1 million and teams have received nearly $3 million in follow-on investment.
- Round three is gearing up for action with $200,000 in additional funding.
- One success story is Acceptd, a web-based management tool for college applications, co-founded by two University of Cincinnati marketing and entrepreneurship grads. Acceptd enables users to screen video applications used in performing arts programs or athletic programs. The developers garnered $600,000 in investments after participating in 10x.

Nanofiber Solutions, co-founded by Ohio State graduate Jed Johnson, spins microscopically thin fibers of plastic into three-dimensional structures that mimic human connective tissues, such as a windpipe or bowel, providing a more realistic environment for growing cells quickly.
Nanofiber Solutions, BioOhio, Ohio State and several additional collaborators have teamed up on a $4.8 million Third Frontier Innovation Platform Program.

The “OH-Alive Innovator Platform” will advance Ohio as one of the leading regions for stem cell therapy in the country by establishing a facility to provide expertise in determining optimized conditions for producing stem cells for therapeutic purposes.

As entrepreneurship spreads across campus, the work of our faculty continues to shine. At the 2012 TechColumbus Innovation Awards:

- Thomas D. Schmittgen from pharmacy received the Innovator of the Year award for research on noncoding RNA towards the early detection, pathogenesis, and treatment of cancer.
- M. Monica Giusti from FAES received the Outstanding Woman in Technology award for research on understanding the compounds in fruits and vegetables responsible for lowering the incidence of chronic disease.
- The Center for Automotive Research, directed by Giorgio Rizzoni of engineering, won the Outstanding Technology Team award for interdisciplinary research that examines electric propulsion and storage, alternative fuels, and noise and vibrations.
- The Wright Center of Innovation in Biomedical Imaging, under the direction of Michael Knopp of Medicine, received the Innovation in Non-Profit Service Delivery award, and
- Health Care Data Works, an Ohio State spin-off company led by Herb Smaltz, former CIO of the Wexner Medical Center, received the Outstanding Start-Up Business award.

CONCLUSION

The six forces that I’ve presented today – changing demographics, multidisciplinarity, partnerships, the information explosion, technology, and entrepreneurship – have already had an impact on how research is conducted at public research universities. These forces will lead us to think about how we do research as well as how we teach and what we teach.

These trends will continue to shape our future and present new challenges in our mission to make breakthrough discoveries and solve the world’s biggest challenges. Ohio State’s future will be defined and driven by the university’s move from excellence to eminence and the desire to contribute meaningfully to solving the world’s most pressing problems. The university’s path will be founded on three discovery themes – health and wellness, food production and food security, and energy and the environment. These themes are based on societal need, as well as broad and deep expertise across the university. Through these discovery themes, Ohio State will focus its resources and activities on finding durable solutions to issues of regional as well as global importance.

And now it’s time for Ohio State to honor our most innovative and entrepreneurial faculty.
2012 INNOVATORS OF THE YEAR

As Ohio State expands its role in the commercialization of research, it is important that we continue to create an environment that facilitates and rewards research creativity and entrepreneurship. The Office of Research launched the Innovator of the Year awards in 2010 to do just that.

Three university wide-awards will be presented today. The Innovator of the Year and Early Career Innovator of the Year awards recognize researchers who are working actively to promote commercialization of university intellectual property, through invention disclosures filed, patents applied for and/or received, technologies licensed, or spinoff companies formed. The Student Innovator of the Year award recognizes innovation and entrepreneurship among students that has contributed to the development or commercialization of a new technology.

The college deans put forward many outstanding nominees for each category. Our selection committee, comprised of both internal and external members, had a difficult time narrowing down the list – all of the nominees have made significant contributions in their respective fields.

I would now like to invite Brian Cummings, vice president for technology commercialization, to join me onstage in the presentation of the awards.

Let’s begin with the Student Innovator of the Year.

I would like to recognize the outstanding students who were nominated in this category.

- Qussai Marashdeh
- Kinshuk Mitra
- Kunal Parikh

This group truly exemplifies our innovators of the future.

Our Student Innovator has revolutionized the field of capacitance tomography – an innovative imaging technique that has the potential to revolutionize the energy, aerospace, chemical, and healthcare industries.

The 2012 Innovator of the Year is Qussai Marashdeh from the Department of Chemical and Biomolecular Engineering. Qussai received an MS and PhD in Electrical Engineering. In 2012, he received his Master of Business Administration (MBA).

Qussai was involved in every stage of the development and commercialization of Electrical Capacitance Volume Tomography. Applications for ECVT include power-plant operations, combustion imaging, and multi-phase flow systems.

He is co-founder, president, and CEO of Tech4Imaging LLC, an Ohio State spin-off company. He holds two patents, both of which have been licensed to Tech4Imaging. With funding from the U.S.
Department of Energy, Tech4Imaging developed and installed an ECVT system at the National Energy Technology Laboratory. The company’s first sale was to an Australian university.

**Early Career Innovator of the Year**

I would like to introduce the nominees for the 2012 Early Career Innovator of the Year award.

- Robert Baiocchi
- Jianrong Li
- Jessica Winter
- Ronald Xu

This group truly exemplifies our up-and-coming innovators.

The 2012 Early Career Innovator of the Year is **Jessica Winter**, associate professor, Department of Chemical and Biomolecular Engineering and the Department of Biomedical Engineering. Since joining Ohio State in 2006, Jessica has authored seven invention disclosures, three provisional patents, one full U.S. patent, and over 30 peer-reviewed journal articles, proceedings, and book chapters.

She is the founder of Core Quantum Technologies (CQT). CQT won first place in the 2012 Ohio State University Business Plan Competition in the Fisher College of Business. Jessica was awarded a National Science Foundation’s highly competitive Innovation Corps (I-Corps) grant to translate CQT technology from the bench to commercialization. The I-Corps program broadens the impact of NSF-funded basic-research projects and provides classroom instruction on the formation of start-up companies and guidance from established entrepreneurs. She also received funding from the Ohio Third Frontier Technology Innovation Start-up Program.

The technology upon which CQT is based groups nanoparticles together in self-assembled structures known as micelles. The initial focus of her research was applied to semiconductor nanoparticle quantum dots to yield a platform technology known as the MultiDot. MultiDot provides increased brightness and stability compared to the quantum dots currently available and could enable multiple breakthrough technologies in personal health test kits, solar cells, LED bulbs, and medical diagnostics. The technology is in production at the lab scale. Many companies have already expressed an interest in licensing the technology, and early adopters are in line to make first purchases.

**Innovator of the Year**

The nominees are:

- Liang-Shih Fan
- Harold Keener
- Zhong-lin Lu
- Susan Olesik
- Subha Raman
- Ali Rezai
Each of these researchers has demonstrated the spirit of innovation by creating products, services, or programs that benefit society.

Our 2012 Innovator of the Year is Liang-Shih (L.S.) Fan, Distinguished University Professor and the C. John Easton Professor of Engineering, Department of Chemical and Biomolecular Engineering. L.S. holds 34 patents, has significant IP licensing activity, and has received nearly $20 million in funding from governmental agencies and the private sector to demonstrate and commercialize his technologies. He has developed alternative energy conversion technologies from the concept stage to successful demonstration in pilot scale units and commercialization.

He is a leading international authority in particle technology and its application for fossil energy conversion. A panel of experts assembled by the U.S. Department of Energy considers his technologies to be “transformational.” His chemical looping process is the only one being developed that is able to directly perform both combustion and gasification. Shell, Air Products and Chemicals, Babcock and Wilcox, and CONSOL Energy have teamed up with his research group to commercialize his chemical looping technologies for synthetic liquid fuels, H₂, and electricity production.

L.S. is currently researching the chemical looping process for natural gas conversion to syngas or liquid fuels with Bio2Electric and the potential of solar chemical looping – a renewable process – with DOE’s National Renewable Laboratory and the University of Colorado. His ultimate goal is to license and develop American-born technologies to spur economic growth, energy independence, and clean energy.

Thank you.

Contact information.