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President's Report to Board of Trustees, 2004

Clemson University

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Dear Friends,

Four years ago, we had a “big idea” — to become a top-20 public university. We had a not-so-ulterior motive.

Our intention was, and still is, to improve the economy and quality of life in our state; to educate our students for the most promising career fields; and to be innovative in all things, from research to teaching to partnerships.

We mapped out a plan based on a series of big ideas, united our faculty and began looking for resources. Each was a huge undertaking and a lesson in itself, but taken together, these tasks helped us intensify our focus and determination.

Every object has a story to tell. What it’s made of. How it came to be. How the spark of an idea gathered energy, found a path and flowed to the rim of invention.

We learned to concentrate our energy and resources on areas in which we’re already strong, for which we’re passionate and that drive economic development.

We found three essential elements to measure by: economic impact, education and innovation.

Before committing to a project, we looked at its potential to create economic benefit for the state. Will it create quality jobs? Cultivate positive commerce? Bring in tax dollars? Encourage small businesses as well as large industries? In other words, will it drive the economy?
We also considered how it furthers our mission of providing the best and most pertinent education possible. We have just undertaken a bold new step in our undergraduate education — we’ve begun mandating a research experience for every student. This is the cornerstone for building our academic reputation and attracting top students, as well as providing a unique educational experience. Any new endeavor should provide opportunities for undergraduate research and critical thinking.

And, finally, a major project must be highly innovative. Clemson is a leader in a variety of fields because of our strong research background and our willingness to approach problems with a fresh mindset of solutions. We want to build on that inquisitive, competitive and creative method of operation in all new endeavors.

In those first few years, we stuck to our main goal of becoming a top-20 public university, made adjustments when necessary and found resounding successes along the way.

I'd like to share with you three of the major initiatives — or big ideas — we’ve since undertaken. We’re especially enthusiastic and committed to these areas because they measure up. They’re all strong in the essential elements of economic impact, education and innovation. And they all bear the Clemson imprint.

James F. Barker, FAIA
President
Clemson University International Center for Automotive Research
Center for Optical Materials Science and Engineering Technologies and Other Advanced Materials Research
Biosystems Research Complex
In November 2003, we broke ground on the 400-acre Clemson University International Center for Automotive Research (Clemson-ICAR). The center is located in Greenville along I-85, halfway between Atlanta and Charlotte.

The project has already generated more than $115 million in private and public support, and many of the world's top corporations — including BMW, IBM, Michelin and Microsoft — have signed on as corporate partners.

This unique partnership between the state and private business aims to put South Carolina at the hub of the nation's automotive and motorsports industries. The state already has 200 automotive-related businesses and 117 automotive industry suppliers. Another 1,000 automotive assemblers and suppliers are within a 500-mile radius of the center.

With Clemson's strength in mechanical engineering, both at the graduate and undergraduate levels, and the state's potential for growth, the center is a natural fit.

Backing from our state Legislature has been crucial to making the Clemson vision possible. Two bills approved in 2002 by the S.C. General Assembly are providing key support — the Research Centers of Excellence Act and the State General Obligation Economic Development Bond Act. Another bill was passed in 2004 that offers research universities regulatory relief and funding for research infrastructure.
Strength in threes — researchers, students and industry

The center will have three primary anchors.

**Its academic anchor will be the graduate engineering center, where programs will focus on systems integration.** Through the graduate engineering center and related research labs, Clemson faculty and students will find ways to integrate the scores of different systems in automotive development and manufacturing. The center's faculty and graduate students are expected to generate $5 million a year in external research support.

Graduates of the program will be prepared to meet the engineering and management challenges of designing and building a highly complex automobile in which mechanical, electrical and digital technologies work together.

**Supporting the automotive engineering component will be an 84,000-square-foot information technology research center** that focuses on improving automotive software systems and software/hardware compatibility for BMW products. The $15 million facility will be owned by Clemson and occupied by BMW and other allied companies.

**The motorsports component is expected to include unique research and testing facilities,** such as an automotive electronics systems lab, crash-worthiness lab and fuels lab with an emphasis in hydrogen-based research. It's to be anchored by a proposed wind tunnel testing facility, which will be unique in the nation. The research campus's location, midway in a corridor that's home to two-thirds of the nation's motorsports racing teams, is ideal for economic development.

The three components will put researchers, students and industry scientists in close working contact at a center that's driven by research for a knowledge-based economy.
The automotive research campus will build on our existing strengths. Here's a sampling of recent and current research.

- Researchers in Clemson's computational fluid dynamics lab can predict and eventually control intricate fluid flows in everything from the interiors of engines to the exteriors of speeding cars.
- Using Clemson's supercomputing capabilities, researchers are developing complex aerodynamic modeling that may help eliminate time-consuming prototype testing.
- Computer-aided development of novel materials and processing technologies will lead to more efficient and environment-friendly vehicles, as well as electrical power generators.
- Research in enhanced thermal system management for automobiles for improved heat control and dissipation could lead to lighter, more fuel-efficient engines with reduced tailpipe emissions.
- Researchers are working on other efficiency measures including drive-by-wire technology for quicker response times in braking and maneuvering, aerodynamics testing and simulation, mechatronics applications and assessment of vehicle systems, such as ABS and four-wheel steering, in their impact on vehicle performance.
- Some safety-related projects include virtual-reality testing to assess driver attention under distraction, and pedestrian visibility and perceptions of visibility in nighttime driving.
Another initiative with great economic potential and educational opportunities is Clemson's advanced materials research—in particular, our Center for Optical Materials Science and Engineering Technologies (COMSET).

In October 2003, we announced plans to invest $70 million over five years to develop our advanced materials emphasis area. **The linchpin is a $21 million advanced materials research facility at the Clemson Research Park** in nearby Anderson. It's anchored by COMSET, one of the nation's top optical materials centers, coupled with a state-of-the-art electron microscopy facility.
This economic development initiative could make our Upstate a magnet for advanced materials-related industries, particularly in the emerging area of photonics. Advanced materials industries in South Carolina already employ 52,000 workers and generate $15 billion in revenues. In our state alone, there are 50 advanced materials companies needing R&D support.

Advanced materials researchers with Clemson’s COMSET have attracted approximately $20 million in sponsored research in the past few years. Faculty expertise ranges from materials science and chemistry to physics and entrepreneurial development. The team of outstanding faculty is led by an engineer who received both the 2004 Young Scientist Award from the American Ceramic Society and the 2004 Young Engineer Award from the National Institute of Ceramic Engineers.

COMSET put economic muscle in its research by pairing with the University’s Arthur M. Spiro Center for Entrepreneurial Leadership, turning the photonics materials research initiative into an economic development effort. The partnership has spun off companies that have generated more than $1.5 million through grants and startup investments.

Again, having our state Legislature on board has been critical. The S.C. Commission on Higher Education designated COMSET a state center in 2004 because of the tremendous opportunity it provides for South Carolina.
Also, the S.C. Research Centers of Economic Excellence Review Board gave the state’s stamp of approval by awarding $5 million for an endowed chair in photonic materials. The board manages the state’s endowed chairs program and is funded through revenues from the S.C. Education Lottery. The award must be matched with nonstate funds raised by Clemson and eventually lead to the hiring of a world-renowned scholar and two junior faculty members to complement COMSET’s existing faculty.

The national and international reputation of Clemson’s optical materials research has made its students highly marketable to companies and graduate schools. For example, recent graduates are employed by Cisco, Lucent Technologies, JDS Uniphase and other international optics companies. Students have a wide range of opportunities for research, both at the graduate and undergraduate level and across several disciplines.

Clemson has already joined with local technical colleges and North Carolina universities to create a coordinated educational system in support of the strong regional optics industry.

COMSET’s educational reach, however, actually begins before college. At the high school level, the center is working with Clemson’s Emerging Scholars summer program to enhance South Carolina’s economy by increasing the number of economically disadvantaged students who attend and graduate from college — a key factor in breaking the state’s poverty cycle.
Here are some other Clemson advanced materials projects.

- A new “smart blending” process could change the way plastics are made and improve their performance.
- Clemson researchers have found a way potentially to replace up to 50 percent of the chemicals that make regular plastics with polylactic acid, a byproduct of corn.
- Clemson photonics research could lead to fast, reliable and inexpensive sensors that detect chemical agents in order to combat their potential use as instruments of terror.
- Micro-optic research could cut Internet costs, double DVD storage capacity and lighten military aircraft.
- Nanotubes could assist with surgery and more effective drug delivery.

Because the automotive industry is closely tied to advanced materials through products such as fuel sensors, advanced braking sensors, LEDs and catalysts, many of our advanced materials projects are within our automotive-related research.

For example, Clemson researchers are working on smart materials and their use in automotive applications, the use of optical fibers to route information between a car’s electronics and on-board sensors, and tougher plastics for automotive uses including development of a plastic engine and “smarter” tires embedded with materials that can sense and respond to road conditions.
A third Clemson initiative is in biotechnology, a field expected to have a major impact on the world economy in the years to come. Clemson is building expertise and research resources that can help South Carolina claim a share of the expanding biotechnology industry.

In April 2004, we dedicated a $27 million Biosystems Research Complex, our newest campus laboratory facility. The complex serves as a focal point for biotechnology research — biology, genomics, biochemistry and bioengineering — to create new products and processes in agriculture, health and the environment.

The complex, constructed with the support of the S.C. Legislature, includes state-of-the-art laboratories; computerized, climate-controlled greenhouses; and a greenhouse support facility. The flexible laboratory space houses a wide variety of researchers to encourage multidisciplinary cooperation.
Great genes for world-class research

Biotechnology research at Clemson began in the 1980s with plant genetics. Today, the Clemson University Genomics Institute, in the new complex, has developed an international reputation as a leading research and training center for discovering and analyzing genes important to agriculture, human health and the environment. In fact, it has one of the largest collections of genetic materials in the world.

As a result, Clemson has the world's leading laboratory of fruit tree genomics. This research is particularly important to our state's fruit industry, especially when you consider that South Carolina is second only to California in peach production.

Genomics research at Clemson has generated patents, a spinoff company and millions of dollars in federal and private-sector grants for South Carolina. Its extensive plant-based research has also resulted in a prestigious endowed chair.
In the biotechnology field, Clemson offers undergraduate and graduate degree programs that span agriculture, biological sciences, medicine and human genetics.

These programs draw strength from partnerships with other research institutions, including the Greenwood Genetic Center and the Greenville Hospital System, giving students opportunities and experiences beyond the main campus.

Other partnerships focus on developing a skilled work force for the biotech industry. One program links the University with the state's technical college system; another collaborates with high schools to provide biotechnology workshops for students and teachers.

Clemson is also partnering with industry organizations, as well as with biotechnology, biomedical and nutraceutical companies, to develop commercial applications through research and technology transfer programs.
The University is positioned to play a leading role at a time when advances in genetics, biochemistry and life sciences will lead to breakthroughs in health, agriculture and bio-based industries.

While this research has great economic potential, its benefit to the health and quality of life may be immeasurable. For example:

- Clemson researchers are collaborating with NASA in a molecular study of bone loss from prolonged space flight to find a treatment for osteoporosis.
- Scientists are studying the process of DNA repair at the molecular and cellular level for new approaches in the prevention and treatment of cancer.
- A potential new treatment for breast cancer based on the study of the hormone prolactin is awaiting approval to begin clinical trials.
- Another Clemson scientist is developing an injectable tissue implant that could provide patients a viable reconstructive surgical solution for damage from lumpectomies and other invasive procedures.
- Researchers are using electrochemical methods to develop new analytical techniques to detect and identify DNA, such as a hand-held analyzer for rapid disease diagnosis.
- A molecule called Ap4A is being studied in an effort to characterize its role in regulating blood pressure, particularly in stressful situations.
- Clemson scientists are seeking to improve production efficiencies and reduce the cost of biofuels by testing new strains of yeast for the fermentation process.
These three initiatives — automotive and transportation technology, advanced materials, and biotechnology and biomedical sciences — are our three most advanced areas in a larger group of "big ideas."

When we committed to the vision of becoming a top-20 public university, we established eight emphasis areas on which to build the Clemson Academic Plan.

We chose the following areas that provide interdisciplinary research and service venues, unique platforms for enhanced scholarship, increased opportunities for graduate and undergraduate students, and economic development prospects for our state.

- Automotive and transportation technology
- Advanced materials
- Biotechnology and biomedical sciences
- Leadership and entrepreneurship
- Information and communication technology
- General education
- Family and community living
- Sustainable environment

Progress has been especially visible within the first three. While these areas are getting the headlines now, our faculty, staff and students are building momentum in the other five areas as well.

We believe that with the support of our state and the private sector, Clemson has the intellectual resources to drive the future of South Carolina. And just as we know our students will soon be driving that future themselves, we also know that education will be the key to the next big idea.
Clemson made advances in a variety of areas during the past academic year — in disciplines as varied as architecture, bioengineering, communication and laptop connections. Here are several that were ranked in the top 20 or were otherwise outstanding.

**Architecture ranked second in South, 20th in nation**
Clemson's School of Architecture is highly regarded nationally and regionally in a poll by leading architecture firms and the editors of *Design Intelligence*, a monthly newsletter published by the Design Futures Council.

Clemson's graduate program in architecture was ranked second among the 36 schools in the 14-state Southern region that stretches from Texas to Virginia. Employers were asked to name schools that they believe best prepare students for the profession. Clemson was outranked only by Georgia Tech.

When *Design Intelligence* judged the schools nationally by factoring in other criteria such as selectivity, learning environment and technology/library resources, Clemson was ranked 20th in the nation in a list that begins with Yale at No. 1 and Harvard at No. 2.

Department chair Jose Caban believes Clemson's architecture students are well prepared because of the intensity of the thesis studio. "Those who teach the thesis studio concentrate only on that," says Caban. "They don't teach other courses, and they are not responsible for other research. They are like their students — they are entirely focused on the thesis studio, and as a result the outcomes are superb."

**Bioengineering shows unprecedented growth**
Clemson's Department of Bioengineering celebrated its 40th anniversary during a time of unprecedented growth in faculty, facilities and program development. During the past two years, eight new faculty members joined the department. Their research interests range from developing new treatments...
for osteoporosis to cardiac and vascular tissue engineering, gene therapy and the development of better joint replacement materials.

Major contributions from the National Institutes of Health through the S.C. Biomedical Infrastructure Network and the National Science Foundation EPSCoR program have allowed Clemson to expand its bioengineering research infrastructure and personnel.

An M.D./Ph.D. program in bioengineering and clinical sciences was recently established. This program was made possible through a joint education and research effort between Clemson and the Medical University of South Carolina designed to promote clinically based bioengineering research focused on cardiovascular biomaterials and bioimaging.

Clemson University’s bioengineering program is one of the oldest in the world and is widely recognized to have pioneered the field of biomaterials.

**Environmental engineering ranked 19th**

By combining science and engineering, Clemson’s School of the Environment approaches challenges with a broad perspective.

"The combination of the two," says Alan W. Elzerman, school director, "helps us look at the big picture and solve complex problems. The science helps us understand why something is happening — why there are contaminants in ground water or why PCBs are taking longer than expected to disappear naturally from a lake. The engineering helps us solve those problems."

Ranked 19th by *U.S. News & World Report*, Clemson's Environmental Engineering and Science program is complemented by the geology and hydrogeology programs in the school. The program is perhaps most unusual for its inclusion of a focus on nuclear waste and radioactive material. But Elzerman says that the department’s commitment to teaching excellence is what he is proudest of.

"We teach the fundamentals and the ability to adapt to change," he says. "Most of our graduate students are in their 20s, and they will likely be working in the profession for another 45 to 50 years. We cannot possibly anticipate all the challenges they will face. The best way we can prepare them is to make sure they have a solid foundation and they know how to be creative and adapt to different types of problems."
Communication program among the best
Clemson's Communication Across the Curriculum (CAC) program is a teaching method that encourages students to become not only better writers and better speakers but also better thinkers and problem-solvers.

Because of it, *U.S. News & World Report* ranked Clemson among the 16 colleges and universities best at promoting "writing in the disciplines" and ones that represent "outstanding examples of academic programs that lead to student success."

CAC integrates oral, written, visual and electronic communication in all disciplines. Professors are encouraged to discard long lectures and multiple-choice tests and focus instead on providing students with real-life challenges that require them to think and communicate effectively.

A unique and recent addition to the CAC program is the Class of 1941 Studio for Student Communication. The studio offers students the opportunity to work directly with communication experts and to have access to tools they need to create portfolios, team research reports, posters, fact sheets, PowerPoint presentations and other material.

At Clemson, CAC has become a standard teaching method used in nearly every department — from mechanical engineering to nursing to history. It's such an effective teaching initiative that *TIME* magazine chose Clemson University as its 2001 Public College of the Year for "being on the cutting edge of the communication-across-the-curriculum movement."

Most wired/unwired campus
Clemson is consistently regarded as one of the country's most "wired" and "unwired" universities. To prepare for Clemson's requirement that all students own and use a laptop, Clemson's Division of Computing and Information Technology began in 2000 to ensure wireless access across campus. Today nearly every campus building, except student dormitories, has wireless access.

"We installed wired access in the dorms, because the bandwidth is much greater with wire," says David Bullard, interim vice provost. "But even without wireless in the dorms, the access is very robust. For every bed in every dorm, we have a 100 MB network port — which means students never have to wait to go online."

In 2003, *The Princeton Review* named Clemson "among the top most wired college and university campuses in the country." A year later, Clemson was ranked 31st among the country's top 100 schools for wireless computing access in Intel's *Most Unwired College Campuses*. 
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