THE UNIVERSITY OF ALABAMA

FEDERAL ACTION ITEMS
FY 2015
Facts and Figures About The University of Alabama System (UAS)

- UAS is comprised of three doctoral research universities: The University of Alabama, The University of Alabama at Birmingham, and The University of Alabama in Huntsville.
- With more than 57,000 students, UAS is Alabama's largest higher education enterprise.
- Total projected revenue for UAS for FY 2013 is $3.6 billion.
- Total state appropriations budgeted for UAS operations for FY 2013 are $442 million.
- UAS competed successfully for $611 million in research contracts and grants in FY 2012.

The University of Alabama (UA)

- U.S. News and World Report has consistently named UA one of the nation’s top 50 public universities.
- UA is regularly ranked among the top 100 public universities in Kiplinger’s annual list of colleges and universities that combine “great academics and affordable tuition.”
- Total enrollment at UA reached a record high of 34,852 for fall 2013.
- The 2013 freshman class is once more the largest and the most academically talented in UA’s 182 year history with 6,478 freshmen. Over 27% of the freshman class had a 4.0 or higher grade point average in high school and 27% scored 30 or higher on the ACT exam.
- This class includes 126 National Merit Scholars and 21 National Achievement Scholars. For the most recent national rankings available, fall 2011, UA ranked 6th in the nation among public universities in the enrollment of National Merit Scholars with 128.
- UA is #1 in the nation in enrollment of minority doctoral students under the Southern Regional Education Board’s Minority Doctoral Scholars Program. A total of 66 SREB fellows have completed their doctorates at UA, and 20 SREB doctoral fellows are currently enrolled in this program that encourages minority students to pursue doctoral degrees and become college-level professors.
- UA is recognized by the Carnegie Foundation for the Advancement of Teaching as a Community Engagement Institution. The designation recognizes UA as one of the nation’s premiere institutions in community outreach and scholarship, and it underscores UA’s commitment to apply its resource and expertise to address critical community needs.
- UA has a dramatic impact on the economy of Alabama, returning three dollars for every one dollar invested in UA by the State. UA each year contributes over $2 billion to the state’s economy. The UA economic impact on the three-county Tuscaloosa metro area in 2011-12 was $1.6 billion, with 10,609 jobs, and $28.5 million in local sales tax.
# CHARACTERISTICS

## HEADCOUNT ENROLLMENT BY LEVEL

*Fall 2013*

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<tr>
<th></th>
<th>UNDERGRADUATE</th>
<th>GRADUATE</th>
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## COMPLETIONS BY DEGREE-LEVEL

*2012/13*

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*Includes Post-bachelor's certificates  
** Includes Ed.S. degrees and Post-masters certificates

## FULL-TIME FACULTY & STAFF

*Fall 2013*

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* Preliminary staff figures (including 6,854 full-time hospital employees at UAB).

## GOVERNMENT CONTRACTS & GRANTS

*FY 2012*

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*Preliminary staff figures (including 6,854 full-time hospital employees at UAB).*
January 9, 2014

To the Alabama Congressional Delegation:

The University of Alabama recognizes the difficulty Congress faces in balancing budget reduction with the need to invest in areas most critical to our nation’s future—education, research and economic development.

Federal funding for infrastructure, research, and educational activities has allowed us to significantly enhance the educational experience we provide for our students. The University of Alabama has become an institution of choice for the best and brightest students, not only in Alabama, but across the nation. Our enrollment has grown from 19,633 students in fall 2002 to 34,852 in fall 2013. At the same time, the quality of our students has increased dramatically with 27% of our fall 2013 freshman class arriving with 4.0 high school GPAs.

This funding has also allowed the University to expand its research activities with a focus on research that advanced the economy of the state and nation. The last 3 years have provided record support for the institution with an average of almost $40 million annually in total research expenditures. UA researchers received an average of over 475 awards a year with many focusing on areas of pressing national need including energy sustainability, environmental quality, water resources, aging, rural health, and information technology. We continue to aggressively seek to commercialize the intellectual property created by this research. Over the past three years, UA received 114 invention disclosures, submitted 147 patent applications, and was awarded 9 U.S. and 27 foreign patents.

Since 2009, our state appropriations have been reduced by an aggregate $278 million (averaging $56 million each year from our 2008 allocation). This has forced us to dedicate a growing percentage of available funds to the general operation of the institution, reducing our ability to enhance our educational and research programs at the rate we have in the past.

Included in this booklet are a number of areas of high priority for the University. Future support for these areas will allow us to maintain the momentum we have built over the past eight years as we educate our graduates to be the innovators of the future and as our faculty and students perform cutting-edge research that will drive the economic competitiveness of the nation in a global marketplace.

Sincerely,

Judy Bonner
President
FY2015 Priorities

Research

Water and the Environment

The University of Alabama is nationally recognized for its research focusing on the protection and restoration of the nation’s water supply and natural environment. This research involves in-situ fixation of toxic metal contaminants in soil and groundwater; evaluation of zeolite-based treatment technologies for contaminated groundwater and industrial waste solutions; the effects of land use on sources; composition and reactivity of organic matters in headwater streams; biogeochemical cycles of carbon and nitrogen over the development and recovery of cultural eutrophication in large lakes, contaminant transport modeling; soil and groundwater restoration; environmental engineering; and soil remediation. Future interactions with federal initiatives including the NEON and IWRSS programs will enhance and expand UA’s water-related research.

Cyber and Information Technology

Cyber Security, Cyber Forensics and Information Technology (IT) have become vital concerns of the world’s infrastructure. Research carried out in a number of UA centers and departments concentrates on cyber and information technology. This includes work on cyber systems, IT hardware/software along with the development of applications to address issues related to public safety and security, business profitability, and geographic information systems.

Energy

UA has a long-standing tradition of excellence in energy research. Multidisciplinary research within eight units at UA encompasses a range of areas including alternative energy sources, biofuels, fuel cells, hybrid vehicles, solar power to power systems and for energy storage, and the optimization of existing and future fuels.

Materials Science & Engineering

UA researchers perform world-class research, educate students, and serve as a resource and communication channel for the information technology industry. Research programs range from the most fundamental studies on materials for data storage, energy storage and energy sensors to the application of this knowledge in information technology, energy, and other industries.

Aerospace Materials Engineering and Additive Manufacturing

UA has growing expertise in the aerospace arena from aerodynamics and composite materials to structural dynamics, thermal barrier coatings and propulsion. Additive manufacturing is an exciting new technology that will revolutionize the manufacturing industries. It will have tremendous impact on the supply chains for those industries, and allow nearly infinite customization of parts.

Health and Health Care

UA has a number of nationally recognized programs in the area of health care. The most prominent among these are the programs in mental health and aging, child development, and rural health.

Sustainable Civil Infrastructure

Improving the performance, resiliency, and sustainability of America’s infrastructure is a national funding priority area and is essential to supporting economic growth and prosperity. Infrastructure resiliency is critical to mitigating social vulnerability and accelerating economic recovery following any large-scale disaster, including major seismic or weather events.
Transportation

UA has a long-history of transportation research focusing largely on the activities of the University Transportation Center for Alabama (UTCA) and the Center for Advanced Vehicle Technologies (CAVT). The UTCA conducts transportation research, education and technology transfer activities using faculty members and students from UA, UAB and UAH. The CAVT was established to promote the development of efficient, safe, secure, economical, durable, comfortable, user-friendly and environmentally conscious vehicles to meet the transportation needs of America.

Infrastructure

Intermodal Facilities

The University of Alabama requires the construction of bus and parking facilities to serve campus residents, off-campus residents, local residents, and visitors. The facilities will be integrated with the Crimson Ride campus transit system which serves over 32,000 discreet users. The proposed intermodal facilities will expand existing parking and transit infrastructure and will positively affect efforts to minimize traffic congestion on campus. The continued transition to mass transit will also reduce fuel consumption and environmental pollutants.
University of Alabama Contacts

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Water and the Environment

The National Academy of Engineering identified access to clean water as one of the major challenges facing global civilization in the 21st century. Nearly a billion people around the world do not have adequate access to clean drinking water, and the impact on world health is staggering. The World Health Organization reports that waterborne diseases are the fifth leading cause of death in the world — the third leading cause in low-income countries. Water mismanagement and misuse are having horrendous impact on global biodiversity with potentially disastrous ecological impact. Ironically, having too much water may be even worse than having too little. Estimates of the global costs of flooding run into the trillions of dollars. It is also important to realize that only a small fraction of the world’s fresh water requirements are for drinking and sanitation. The majority is required for agriculture and industry, and major business decisions (e.g., manufacturing site selection) are frequently based on access to sufficient water.

The fundamental problem is not that the world does not have enough fresh water; the problems are that it is not located (nor can it be easily moved to) where it is needed, that its cleanliness is not maintained, and that it is not managed effectively. Addressing these challenges requires expertise in the sciences, engineering, law, business, political science, and the social sciences and trans-disciplinary effort from all of these areas. UA is positioned to bring these components together in an environment that promotes long-term, effective solutions.

THE ENVIRONMENTAL INSTITUTE (EI)

Based on the multi-disciplinary nature of research today, the EI priority is to be a national leader in the research of environmental sustainability issues related to air, water, and land resources. The mission of the EI is to facilitate and support environmental research locally, regionally, nationally, and globally by enhancing resources available to individual researchers and through building and sustaining teams of interdisciplinary researchers within the University. The EI fosters study of basic concepts, methods, and practices involving environmental sustainability. Through these efforts, the EI positions researchers for leadership roles and participation in cross-disciplinary environmental research while promoting environmental stewardship. EI research has been sponsored by the US EPA, USDA, NSF, NOAA, and a number of state agencies and private corporations.

THE ATMOSPHERIC AND ENVIRONMENTAL RESEARCH OPERATIONS (AERO) PROGRAM

The AERO Program, housed in the Department of Civil, Environmental, and Construction Engineering, was established in 2004 to formalize, support and expand environmental research at the earth’s surface and lower atmosphere. Using a Small Environmental Research Aircraft (SERA), the program conducts air quality and environmental research by measuring gas and energy exchange between the earth's surface and the atmosphere. This serves to measure global climate change and determine greenhouse gas effects and to conduct studies to characterize wind structure of the “boundary layer” and work with remote sensing instruments that measure ground and ocean surface properties. The data collected are used to address current gaps in the understanding of gas exchange and the variability of this surface-atmosphere transfer on climate change. The AERO Program was initially funded by NOAA and has supported projects funded by NOAA and NSF.

THE CENTER FOR FRESHWATER STUDIES

The Center for Freshwater Studies (CFS) was established to bring together interests of UA faculty with expertise in different areas of freshwater studies and to provide a focus and organized structure for interdisciplinary research and education. Currently 38 faculty members from 4 colleges participate in the CFS and contribute expertise in biogeochemistry, biodiversity, conservation, ecology, geochemistry, geography, geology, hydrology, water policy/law, and water resources management. The CFS focuses its research on natural systems including many of the state’s major river systems which provide water to the majority of the state’s population.

More recently the CFS has played a significant role in the evolution of the National Ecological Observatory Network (NEON). NEON is a large facility project managed by NEON, Incorporated. Funded by the National Science Foundation, NEON contributes to global understanding and decisions in a changing environment using continental-scale ecology data obtained through integrated observations and experiments. NEON will create a
new national observatory network to collect ecological and climatic observations across the continental United States, including Alaska, Hawaii and Puerto Rico. The observatory network will be the first of its kind designed to detect and enable forecasting of ecological change at continental scales over multiple decades.

NEON has portioned the U.S. into 20 ecoclimatic domains, each of which represents different regions of vegetation, landforms, climate, and ecosystem performance. Data from strategically selected sites within each domain are synthesized into information products used to describe changes in the nation’s ecosystem through space and time. The data NEON collects and provides will focus on how land use, climate change and invasive species affect biodiversity, disease ecology, and ecosystem services. Because of the efforts of the CFS, 3 NEON sites that are a part of Domain 8 are located in Alabama; one within the Talladega National Forest southeast of Tuscaloosa, one along the Black Warrior River, and one along the lower Tombigbee River.

**The Center for Green Manufacturing**
The mission of the Center for Green Manufacturing (CGM) is to prevent pollution and save energy through the discovery and development of new knowledge that reduces and/or eliminates the use or generation of hazardous substances in the design, manufacture, and application of chemical products or processes. The Center focuses on utilization of ionic liquids and green chemistry for sustainable technology through innovation. Major research areas include development of advanced polymeric and composite materials from biorenewables; novel strategies for separation and purification of value added products from biomass; new lubricant technologies and selective separations; and elimination of waste during pharmaceutical production while delivering improved performance. CGM research has been funded by the Department of Defense, Department of Energy, NSF, and numerous industrial partners.

**Department of Geological Sciences**
UA has considerable expertise in surface and groundwater hydrology within the Departments of Geological Sciences, as well as the Department of Geography and the Department of Civil, Construction, and Environmental Engineering. Specific areas of focus include watershed processes and dynamics, water resources engineering, sustainability of groundwater resources, high-resolution, dynamic characterization of groundwater transport pathways, solute transport influenced by preferential flow paths, multifractal scaling of hydraulic conductivity distributions and the effect on plume-scale contaminant transport, and simulation-optimatization framework for groundwater resource management and remediation design optimization.

**NOAA National Water Center**
Construction of the NOAA National Water Center in Tuscaloosa will significantly enhance the focus on water resource issues not only in the State of Alabama, but across the country. The Center is being constructed to carry out the mission of NOAA’s Integrated Water Resources Science and Service plan and will draw on the expertise of water researchers at UA and other schools in the state and region to address water-related problems nationwide.

**Conclusion**
Environmental research at UA runs the gamut from the effects of land use on sources, composition and reactivity of nutrients and organic matter from headwater streams to the coast, biogeochemical cycles of carbon and nitrogen in rivers, and development and recovery of cultural eutrophication in large lakes, to contaminated groundwater and industrial waste solutions, contaminant transport modeling, soil and groundwater restoration, environmental engineering, and soil remediation. UA’s programs on water quantity and quality are recognized nationally and internationally. Research funding has come from the NSF, US EPA, NOAA, DOE, DOD, USDA, and numerous state agencies and private companies. Future interactions with federal initiatives; e.g., the NEON and IWRSS programs will enhance and expand UA’s water-related research.

**Points of Contact**
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Dr. Derek Williamson, Director, AERO Program (dwilliamson@eng.ua.edu)
Dr. Bennett Bearden, Director, Water Policy and Law Institute (bbearden@ua.edu)
Cyber Security, Cyber Forensics and Information Technology (IT) are subject areas in today’s world, at once providing solutions while simultaneously posing vexing problems that threaten us all. Research carried out in a number of UA programs focuses on these issues including work on cyber systems, IT hardware/software along with the development of applications to address issues related to public safety and security, business profitability, and geographic information systems. Networks are the fundamental focus of much of the security environment and our first line of defense. IT is the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware. IT is a critical element of the operation of virtually every business and organization in the United States and has become central to the day-to-day lives of most Americans. Similarly, UA has research directed at a range of cyber and cyber security issues like Big Data and the threat posed by trusted insiders.

UA has an evolving research emphasis on IT building on research being carried out in the Center for Materials for Information Technology (MINT), the Center for Advanced Public Safety (CAPS), the College of Engineering (Departments of Computer Science and Electrical and Computer Engineering), the College of Arts and Sciences (Departments of Criminal Justice, Geography, Mathematics), and the College of Commerce and Business Administration (Department of Information Systems, Statistics and Management Science).

**Center for Materials for Information Technology (MINT)**

MINT and its industrial partners focus on research in flexible media. Together, they broadened MINT’s research portfolio to include cutting edge research in Spintronics, in new concepts for magnetic media, in magnetic random access memory, and in other advanced information storage concepts. Operating since 1988, it has developed an international reputation for its work on information storage technology and is presently collaborating with a number of industrial sponsors around the world.

MINT also focuses on hardware applications. Specific areas of expertise include devices and materials for information data storage including hardware and software components of embedded systems for computing platforms. This research aims to improve energy efficiency, dynamic response and stability, and reduce cost.

**Center for Advancing Public Safety (CAPS)**

CAPS overall mission is to create innovative solutions through IT research and cutting-edge software development to enhance the public safety and security of our state and homeland. CAPS has performed research in information mining, algorithms and optimization, and also in public safety applications involving the more efficient allocation of law enforcement resources and more effective traffic safety countermeasures.

CAPS developed some of the most advanced law enforcement support software systems that exist. These include the Alabama Communications and Operations Portal (AlaCOP); a unique information system for law enforcement information within Alabama. The Electronic Citations Generation and Processing System (eCITE) is a complete system that fits within the Mobile Officer’s Virtual Environment (MOVE), enabling officers to easily generate citations, validate a defendant’s identity and view previous records, upload citations and electronically “swear” to the citations at District courts. SHARE, the Secure Homeland Access and Reporting Environment, is a web portal developed with support from the US Department of Homeland Security. The major goal of SHARE is to establish the critical missing link between State and Federal homeland security officials and field officers. While SHARE is strictly for interactions between law enforcement and the state’s Fusion Center, a companion portal called the Portal to Uphold a Secure Homeland (PUSH), was also developed as part of this project to support private sector security personnel who oversee critical infrastructure.

**Management Information Systems (MIS)**

The MIS program focuses its research efforts at the forefront of enhancing business value by leveraging IT capabilities. Specifically the core capability of the MIS faculty is to build, test, and disseminate theory that enables business success. The faculty prides itself on developing collaborative research programs that involve
multiple faculty and graduate students. The collaboration is reinforced through faculty-directed research labs, centers and institutes that the MIS faculty directs. The National Science Foundation, federal agencies, corporations and philanthropic organizations continue to support the faculty and their research. MIS research is heavily focused on some of most critical cyber issues related to deriving value and meaning from large data sets; i.e., the Big Data problem.

**Geographic Information Systems (GIS), Geospatial Information Technologies Facility (GITF)**

The Department of Geography and the CAPS Center lead UA research in the use of GIS to solve real world problems. Research using geographic information techniques includes the use of spatial modeling, remote sensing, GIS, and computer cartography. Recent projects include remote sensing of water quality, the modeling of nutrient dynamics, accessibility and transportation, and development of a number of atlases for Alabama. CAPS dedicated considerable resources to the development of GIS visualizations to support their other programs including distribution of traffic accidents or citations with on-screen time and day of the week specification. Another tool, PatrolSim, produces an optimized route for officers to cover on a given day to maximize the criminal hotspots encountered.

Because geospatial information is critical in addressing a number of research challenges, UA plans to renovate a portion of the old Biology Building to build a GITF. For many IT applications, spatial/locational information is a key element that facilitates the mapping, integration and analysis of data. GITF will address the need of geospatial information visualization, simulation and analysis in addition to providing training and support for the use of ArcGIS, a popular GIS software package that encompasses GPS and digital image processing for remotely sensed data. It will include broad spectrum capacity to handle diverse and high volume cross-disciplinary data in many fields from archeology and anthropology to natural resources management and conservation, urban planning and global studies.

**Conclusion**

Cyber and Information Technologies have become vital elements of the world’s infrastructure. UA has advanced research capacity including work on cyber security/forensics, IT hardware and software along with the development of applications to address issues related to public safety and security, business profitability, and geographic information systems.

- UA research has a strong and developing focus on Cyber and IT.
- While UA research covers most cyber and IT areas at some level, there is deep expertise in specific areas.
- Although UA programs are engaged in cutting-edge research, through CAPS, we have an innovative, proven capability for transforming research program results into innovative, practical solutions to address critical problems for government, academia and the private sector.
- UA’s MINT Center has evolved with the cyber revolution to become an international leader in advance data storage concepts and techniques—a critical enabler of exponential growth in IT and cyber.
- A particularly promising area is the work done in the area of Big Data and Predictive Analytics. This program will help unlock large data sets for government, the commercial world and academia.
- As technology converges, so too have our research programs, as much of our work at UA has a significant interdisciplinary dimension cross leveraging expertise providing practical solutions to today’s problems.
- Criminal Justice (CJ) is engaged in interdisciplinary research efforts with C&BA MIS, Engineering and Psychology on Insider Threat issues and with Engineering in research into the Deep Web.

**Points of Contact**

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UA has a long-standing tradition of excellence in energy research, from the Center for Sedimentary Basin Studies to the Center for Advanced Vehicle Technologies (CAVT) along with contributions from researchers in the MINT Center and the departments of Mechanical Engineering, Chemical and Biological Engineering, Electrical and Computer Engineering, and Chemistry.

**Materials Challenges and Combustion**

The automotive industry, which is currently a major force in Alabama’s manufacturing economy, has undergone a dramatic transformation over the last five years. Economic conditions led the industry to close older facilities and increase production capacity at newer, more efficient facilities primarily in the southeast. The result has been an influx of automotive subsystem manufacturers to the southeast — to Alabama in particular. The economic development these “original equipment manufacturers” are spawning will dwarf that of the auto manufacturers themselves. The UA CAVT focuses its efforts on the material and chemical challenges posed by on-board electro-chemical energy storage and processing. Of particular interest in the last few years has been work on fuel cells, hydrogen storage and batteries. This activity includes fundamental studies of fuel cell materials and catalytic chemistry.

However, another wave of change is on the horizon. Manufacturers realize that their “knowledge-base” supply chains are also overly stretched. They want and need to have their research, design, and engineering expertise closer to their manufacturing plants. They want the people who are designing vehicles and vehicle systems to be able to work with their vehicle assembly counterparts face-to-face and daily; in the current fast-paced industry, Michigan, California, Japan, and Germany are simply too far away. Therefore, they are beginning the process of establishing research, design, and engineering groups closer to their manufacturing plants. This will constitute the next wave of economic development from the automotive industry. In much the same way that locating assembly and manufacturing facilities in an area brought many automotive component suppliers to the area, companies moving substantial research, design, and engineering divisions to an area will result in an influx of professional design and engineering businesses. There are roughly 20 automotive manufacturers in the southeastern United States, and it is reasonable to expect that some area in the region will become the future hub of automotive engineering. Through strategic investment, UA can become this hub — both for producing the trained engineers the industry requires and for producing the cutting-edge research results that will define the future of the industry.

UA, serving as a hub of automotive engineering research and education, will also address a major threat facing the State of Alabama regarding retention of the automotive manufacturing industry. Labor considerations were the prime motivator bringing the industry to the State. However, the State’s success in recruiting manufacturing industries and the associated saturation of the labor market has reduced the State’s advantage. Absent other reasons to stay in Alabama, manufacturers will begin to move their facilities to lower-cost regions of the country and world; this threat is becoming very real as we are seeing planning for new assembly plants for Audi, Hyundai, and Mercedes in Mexico. Providing an advanced research and development capability, along with the associated influx of professional engineering talent and firms, will give the industry the incentives they need to stay in Alabama and ensure the viability of our manufacturing industry for the foreseeable future.

**Coal, Natural Gas and Carbon Sequestration**

The Center for Sedimentary Basin Studies (CSBS) focuses on maximizing the utilization of the state’s fossil fuel resources. The State of Alabama is blessed with abundant oil, gas, coal, and coal-bed methane. Researchers in the CSBS investigate the distribution, quantity, and quality of these resources within the state and ways these resources can be used in the most environmentally friendly manner.

Coal is one of Alabama’s most abundant natural resources. Much of the state’s coal is used for electric generation and is a source of carbon dioxide, a greenhouse gas that is a major contributor to climate change.
Electric companies are under pressure to reduce their production of carbon dioxide. Mitigation may involve reduction in emissions by burning fuels other than coal or collecting and storing the carbon dioxide where it is not in contact with the atmosphere. This collection and storage process is termed carbon dioxide sequestration and UA researchers are national leaders in the field.

**CONCLUSION**
Multidisciplinary research within eight units at UA encompasses a range of areas including alternative energy sources and energy storage, biofuels, fuel cells, the automotive industry and hybrid vehicles, solar power to energy systems, and the optimization of existing and future fuels.

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UA has a longstanding history of excellence in materials research. This research involves activities of faculty and staff from UA’s Center for Materials for Information Technology (MINT) along with the work of faculty members from the Departments of Metallurgical and Materials Engineering, Mechanical Engineering, Electrical and Computer Engineering, Chemical and Biological Engineering, Chemistry, and Physics and Astronomy.

**THE MINT CENTER**

The mission of the MINT Center is to perform world-class research, educate students, and serve as a resource and communication channel for the information technology industry. Research programs range from fundamental studies on materials for data storage, energy storage and energy sensors to application of this knowledge in information technology, energy, and other industries. Internationally recognized for the quality and innovation of its research activities, the Center was founded in 1988, and designated as a Materials Science Research and Engineering Center by the National Science Foundation from 2002 to 2008. MINT continues its role in the development of materials in support of the information technology industry, and is expanding its research efforts to include research in energy storage and energy sensors.

MINT’s ability to use basic scientific discoveries to solve real life problems in the information storage industry has led to cooperative arrangements with a number of companies including Seagate, TDK, and Showa-Denko. MINT faculty members are also working with Grandis, Inc. on a large project funded by DARPA.

**MATERIALS PROCESSING AND CHARACTERIZATION**

Faculty members in the Department of Metallurgical and Materials Engineering are involved in research in the areas of materials processing and materials characterization. Materials processing research includes advanced materials processing which utilizes reaction kinetics, thermodynamics, electromagnetic phenomena, heat transfer and fluid flow to address issues in advanced processing techniques such as laser processing and plasma processing. Research efforts focus on manufacturing nanocomposites and metal matrix composites and processing intermetallics, as well as materials joining which involves welding metallurgy and characterization of high temperature materials. Metal casting and solidification research activities involve sand, die investment, and centrifugal casting of metals and alloys.

The department also has a significant effort focused on nanomaterials processing. This research focuses on developing innovative nanofabrication techniques to enable large scale synthesis of multi-component and functional nanomaterials including carbon nanotubes, graphene, and oxide nanowires.

**BIOTECHNOLOGY AND ELECTRONIC MATERIALS**

The Department of Chemical and Biological Engineering is performing materials research in the general areas of biotechnology. The use of magnetic materials for biological applications can aid in detection of diseased tissue, serve to treat cancerous tissue, and can be used to trigger drug release external to the body. The goal of this research is to create novel therapies and diagnostics. Nanobiotechnology research activities consist of preparation of nanomaterials using biological scaffolds, development of improved drug systems, biological and biomedical detection and diagnostic systems using nanomaterials, and investigation of environmental effects of nanomaterials. Bioprocessing research focuses on micro and nanoreactors designed for new diagnostic techniques and producing pharmaceuticals with continuous processing.

Electronic Materials/Thin Films research addresses the fundamental understanding of atomic scale processes occurring during the synthesis of electronic materials. Special emphasis is given to deducing the chemical reactions, thermodynamic driving forces and physical phenomena that govern the material’s physical, optical
and electronic properties. Strategies are developed to produce innovative, high performance materials for use in next-generation electronic devices. The synthesis of electronic materials research effort focuses on the controlled synthesis and assembly of nanomaterials and nanostructures.

A key component to materials research is our Central Analytical Facility (CAF) with its ability to characterize materials at a variety of scales. The CAF has state-of-the art materials characterization instruments that allow researchers to elucidate both the physical and functional structure of a wide variety of materials. Of particular note is the CAF’s impressive suite of analytical microscopy tools including multiple transmission and scanning electron microscopes as well as tools for atom probe tomography.

**POINTS OF CONTACT**
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Dr. David Nikles, Director, Central Analytical Facility (dnikles@mint.ua.edu)
Dr. John Wiest, Associate Dean, College of Engineering (jwiest@eng.ua.edu)
**SUMMARY**

The aerospace industry has held an important place in Alabama for over 75 years — dating back to the rapid expansion of Redstone Arsenal after World War II. Historically, most of the emphasis has been on spacecraft, missiles, and rotocraft, and the industry has traditionally been driven by federal programs (e.g., NASA and the US Army’s Aviation and Missile Command). However, a major change occurred recently when Airbus announced their plans to establish a commercial aviation manufacturing facility in the State to assemble A320 passenger aircraft. This healthy diversification of the State’s industry presents many opportunities and challenges, some of which can only be addressed by university-based research.

In popular usage, the term “aerospace grade” material has come to mean a material of the highest quality. This is a consequence of the extreme strength, weight, and reliability properties such materials must have. Even small increases in strength to weight ratios can have tremendous impact on both the flight worthiness and fuel economy of aircraft. Furthermore, the extreme range of conditions that aircraft must endure, from high temperature and humidity environments on the ground to extremely low temperature environments at altitude, makes aerospace materials design and selection extremely challenging.

UA has a long history of excellence in fundamental materials science and engineering research and education. We are one of only nine universities in the nation offering undergraduate degrees in metallurgical engineering and one of only three nationwide that offer undergraduate degrees in both metallurgical engineering and aerospace engineering. Along with these undergraduate degree offerings, we have extremely strong graduate and research programs involving both metallic and composite materials. Furthermore, UA is exceptionally well equipped for materials fabrication and characterization research through the comprehensive suite of instruments in our Central Analytical Facility as well as dedicated composite materials, mechanical testing, precision machining, and welding and joining labs. The University will be able to serve as the catalyst for bringing together a combination of federally and industrially funded research for definition of coming generations of commercial aircraft.

It is important to note that, in addition to providing the highly trained workforce the commercial aerospace industry requires, UA’s efforts in aerospace materials research will have a major economic impact. At its genesis in Alabama, the automotive industry consisted of just assembly plants; parts were simply shipped to Alabama from all over the world and assembled into finished vehicles here. That industry has now matured locally to the point where many of the vehicle components are now manufactured in the State. It is reasonable to hope that a similar trend will be experienced as a consequence of the decision by Airbus to build an assembly facility in the State. However, the commercial aviation industry is quite different from the automobile industry, and Airbus is an outlier even in aviation. The supply chains for Airbus are truly global, and there are multiple assembly points world-wide for airplane subassemblies (e.g., the forward fuselage is assembled in France, wings are assembled in Great Britain, horizontal tail planes are assembled in Spain). Only final assembly of the completed aircraft from these subassemblies will be done in Alabama. Hence, in order for Alabama to experience an economic impact similar to that enabled by the automotive industry, UA involvement will be essential. Convenient shipping and available workforce provided the inducement for locating an assembly facility in the State, but the State’s research universities must provide the professional skills and technological innovation necessary to lure other elements of the aircraft supply chain to the region.

**ADDITIVE MANUFACTURING**

Rapid prototyping (also known as 3D printing) is a technology that allows fast production of one-of-a-kind items. It was originally developed for production of models and prototypes, but it is evolving to the point where it is ready to enter the manufacturing sector. The convergence of rapid prototyping and mass production, often
called “additive manufacturing,” will have a larger effect on the manufacturing industries than robotics has had in recent years. It will revolutionize traditional manufacturing by making it possible to produce parts at their point of assembly in the manufactured product – thereby shrinking supply chains to a matter of feet and allowing nearly infinite customization in a mass production environment.

The influence of additive manufacturing will first be felt in industries that have large demand for customized products, with the initial impact being on low-volume, high-value product manufacturing industries such as aerospace. It will then move into higher-volume, high-value product industries such as automotive. Finally, it will move into lower-value product industries. As the new hub of both aerospace and automotive manufacturing in the US, Alabama can lead the nation and world in this exciting revolution. Furthermore, UA is well positioned to serve as the State’s hub for R&D efforts in additive manufacturing, because of its world-class facilities and programs in materials science and engineering, operations management, automotive engineering, and aerospace engineering. The College of Engineering has established laboratories dedicated to additive manufacturing, with existing faculty strengths as well as three new faculty positions on track to strengthen our position in this exciting new technology.

**Conclusion**

UA has growing expertise in the aerospace arena. This includes expertise in aerodynamics, composite materials, structural dynamics, structural durability and fatigue, surface science, thermal barrier coatings, boundary layer measurements, propulsion, and astronomy. UA is also pursuing work with UAH, UAB, Auburn University NASA’s Marshall Space Flight Center, the U.S. Army AMCOM/AMRDEC, and private contractors in the state to develop the collaborative Aerospace Research Alliance in order to address more complex, larger-scale problems. Recent efforts at additive manufacturing put UA in a position to lead this exciting new technology that will provide new opportunities to rethink supply chain management and manufacturing practices.

**Points of Contact**

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The University of Alabama has a number of nationally recognized programs in areas of health and health care. The most prominent among these are programs in mental health and aging, child development and rural health.

**Mental Health and Aging**

In the United States, the number of persons who are 65 years of age and older is expected to double by the year 2030. At that rate, this group will comprise 20 percent of the total population while utilizing 50 percent of the nation's health care resources. The anticipation of this tremendous increase has led to increased focus on aging related research, and UA has emerged as one of the nation's leaders in this area.

UA’s research efforts on aging are focused primarily in The Center for Mental Health and Aging (CMHA). The CMHA is comprised of faculty and students from the College of Arts and Sciences, the School of Social Work, the Capstone College of Nursing, the Culverhouse College of Commerce and Business Administration, the College of Engineering, the College of Human Environmental Sciences, and the College of Community Health Sciences.

The mission of the CMHA is to develop new knowledge, test new interventions, and disseminate information related to mental health and aging. Through applied interdisciplinary research, the CMHA promotes improved quality of life for older adults. Research in the Center addresses four major focus areas: elder caregiving, mental health of rural elders, quality of care in institutional settings, and palliative care and end of life issues.

In the area of Elder Caregiving projects have focused on the development of interventions to alleviate stress and burden among Alzheimer's disease caregivers, understanding Grandparents as caregivers, and the development of interventions to help aging parents who have adult children with severe mental illness just to name a few. Research involving the mental health of rural elders has addressed such issues as cognitive quality of life, developing methods to assist rural caregivers with dementia patients, home, telemedicine, and the internet delivered mental health services and sources of information and assistance and barriers to older women seeking help for domestic abuse. Nursing homes, assisted living facilities, and other institutional settings have also been an area of concentration for the CMHA with activities investigating pain assessment for cognitively impaired elders, issues related to staff assignment and turnover as well as quality of life and quality of care in such facilities. The Center has also been a leader in addressing research and policies related to palliative care and end of life issues by investigating end-of-life care choices of prisoners, family involvement in evaluating functional capacity to consent to end-of-life treatments, hospice utilization, and Adult Protective Service workers preparedness to work with end-of-life situations.

All of these focus areas are or have been funded by the National Institutes of Health (NIH), including the National Institute on Aging and the National Institute of Nursing Research; the Agency of Healthcare Research and Quality; the United States Department of Defense; as well as the Retirement Research Foundation, the Alzheimer’s Association of America, and the John A. Hartford Foundation.

**Point of Contact**

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**Child Development**

The early years of a child’s life are very important for his or her cognitive, social, and emotional development and concomitantly to their immediate and long term health. Tragically, over 500,000 children in this country are diagnosed each year with some form of developmental disability. The research being conducted at UA seeks to develop interventions that will provide all children the opportunity to reach their full potential.

This important work is being done by individual divisions (e.g., the Department of Psychology, the School of Social Work, and the Human Development and Family Studies Department) and by collaborating Centers such as the Child Development Research Center (CDRC), the Brewer Porch Children’s Center, the Autism Spectrum Disorders Research Clinic (ASDRC), and the Center for the Prevention of Youth Behavior Problems (CPYBP).

Individual divisions like the Departments of Psychology and Human Development and Family Studies, are investigating intellectual disability (e.g., mental retardation), autism, and learning disabilities. These efforts focus on typical and atypical aspects of social, cognitive, and language development in the context of the cultural and family dynamics in which it takes place. The School of Social Work has developed a solid research portfolio with emphasis on child development from a social work perspective. One of the most prolific areas has been the investigation of access to mental healthcare services for children, youth, and families and mental health service best practices. The access to services has also been investigated within the Juvenile Justice System and within public schools. Additional investigations involve homeless-, runaway-, and street-youth, abused children, and child substance abuse.

The interdisciplinary centers like the Brewer-Porch Children’s Center, which was established by the Alabama Legislature in 1970 to provide a model treatment program for Alabama’s special needs children, adolescents, and their families, currently develop best practices in providing individual services which are directed by an interdisciplinary program treatment team of professionals from psychology, education, nursing, psychiatry, social work, and family counseling. Research efforts at Brewer-Porch seek to improve the understanding and treatment of emotional disorders, autism, and mental illnesses. Ongoing interdisciplinary research in the ASDRC is being conducted to improve understanding of the cognitive strengths and weaknesses of persons with ASD and underlying brain differences. The clinic also implements a transition program for college students with ASD. The CDRC supports interdisciplinary research projects focusing on children and families. Projects include: parental guidance of children, olfactory development, the reactions of infants and toddlers to the integration of a new infant into a group, social behavior interactions of preschool children, parental influences on bullying, social-emotional processing in young children, and learning in the absence of caregiver-child joint attention. As a result the CDRC is a hub for research, drawing investigators with funded projects involving children and families from throughout Alabama, the region, and the nation. In the CPYBP, their highly experienced investigators are national leaders in research and policy development regarding prevention of youth violence and antisocial behavior. Research in this Center has identified risk markers for youth with aggressive, violent developmental trajectories and the processes within the child and within their social environs which contribute to the development of problematic risky behaviors and antisocial problems. These efforts have been undertaken in an effort to develop effective early prevention activities which can be implemented at the school and community levels.

These efforts in Child development research and best practice development have been funded by the NIH, including the National Institute of Child Health & Human Development and the National Institute on Drug Abuse, and various state agencies such as the Alabama Department of Youth Services.

**Points of Contact**

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**Rural Health**

In the United States, rural communities represent approximately 20% of the population. These rural residents suffer from higher rates of morbidity and mortality than their urban counterparts. With less than 10% of physicians, and even fewer dentists, nurses, social workers and other healthcare professionals, practicing in rural communities, it can be hard to get care and identified health problems are typically more serious by the time they are diagnosed than their urban counterparts.

UA has had a long-term commitment to enhancing the health and health care available to the residents of rural Alabama. While the state has some of the finest medical facilities in the nation, the facilities are typically not accessible to residents of rural Alabama. Through the Institute for Rural Health Research (IRHR), the Rural Medical Scholars Program (R MSP), and the Capstone College of Nursing (CCN), UA is working to improve the health of, and bring high quality health care to the residents of rural areas of the state.

Those affiliated with IRHR work to bring the highest standard of health to rural citizens. The goal is to produce research that is useful to communities, policymakers and health care providers as they work to improve the availability, accessibility and quality of health care for rural and underserved citizens. Current activities include a community based participatory research project designed to address obesity and obesity related diseases in the Black Belt of Alabama, programs to improve rural Emergency Medical Services, a project to better understanding stigma related to HIV/AIDS in rural areas, and use of telemedicine, electronic health records and other electronic resources in the delivery of health care in rural areas.

As previously indicated, one of the most significant deterrents to quality healthcare in rural Alabama is the limited number of primary care physicians who practice in these areas; the RMSP has proven successful in producing such physicians. This program seeks to work with health professional schools in or close to the Black Belt to produce an interdisciplinary course of study that admits and nurtures local students through the entire health professional pipeline.

The CCN has, in an effort to address the quality of healthcare in rural Alabama, established the Capstone Rural Health Center (CRHC), a Federally Qualified Health Center, in the town of Parrish in Walker County. Walker County is federally designated as a Medically Underserved Area and a Health Professional Shortage Area. The CRHC is a nurse-managed program for the delivery of family-centered quality primary health care services by nurse practitioners, faculty and students. The services provided also include health promotion, disease prevention, case management, support groups, health education, home visits, and community-based health programming. Additionally, the CCN is working to implement an innovative chronic healthcare demonstration project, the Capstone Outreach Patient Enlistment Program which is designed to create a better chronic health infrastructure in rural Alabama by using nurse case managers and patient navigators (outreach workers) to better manage chronic disease among poor rural residents, many of whom are uninsured or underinsured and face many barriers to accessing quality care.

These and other activities have received funding from NIH, the Health Resources Services Administration, The Centers for Disease Control and Prevention, The Department of Agriculture, The Delta Regional Authority, The Alabama Department of Public Health, The Robert Wood Johnson Foundation, Verizon, and many others.

**Points of Contact**

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Improving the performance, resiliency, and sustainability of America’s infrastructure is a national funding priority area and is essential to supporting economic growth and prosperity. UA’s College of Engineering is well positioned, considering recent investments in new research facilities and the hiring of several new faculty as an internationally recognized leader in developing new solutions to improve performance, resiliency, and sustainability of infrastructure systems and to reduce the vulnerability of Alabama’s, the nation’s, and the world’s infrastructure to the compounding effects of multiple hazard risks. Infrastructure resiliency is critical to mitigating social vulnerability and accelerating economic recovery following any large-scale disaster, including major seismic or weather events.

States adjoining the Gulf of Mexico are especially vulnerable to hurricane and tornado destruction because of their topographical makeup and heavy population concentrations. The areas along the Gulf and Atlantic coasts, where most of the U.S. hurricane-related impacts have occurred, are also experiencing the country’s most significant growth in population. Often overlooked, the Southeastern U.S., including north Alabama, is also subject to a high seismic risk owing to the New Madrid Fault centered in east Tennessee.

Developing new materials, technologies, and systems to improve the performance and resiliency of our infrastructure will have a direct and positive impact on society and the economy. Social vulnerability is generally considered a deterrent to residential, commercial, and industrial development because it may significantly elevate the risk environment for both the public and private sectors of the state’s economy. It is strategically imperative that the State identify vulnerabilities and appropriate mitigation strategies for critical infrastructure including transportation, water supply and distribution, industrial manufacturing, electrical power generation and distribution, single and multi-family housing, healthcare facilities, and emergency and support services.

The State of Alabama is home to several leading construction firms that specialize in large-scale infrastructure and industrial construction. Additionally, the State is also a major producer of the three primary infrastructure construction materials – concrete, steel, and timber. The College of Engineering has very strong relationships with most of the major construction companies and material producers in the State and region. In partnership with these companies, research results are being developed and deployed, providing Alabama with improved infrastructure and Alabama-based companies with a competitive advantage supporting economic growth and expansion.

The College of Engineering’s new Center for Sustainable Infrastructure (CSI) was created by UA to coordinate infrastructure related research activities. The new Large Scale Structures Laboratory (LSSL) enables an expanded research potential for conducting nationally relevant experimental research to address critical needs and improve the performance of Alabama’s and the nation’s infrastructure. In addition to the LSSL, a series of new materials research and mechanical testing laboratories are available to develop new materials, systems, and monitoring technologies, and to scale from the prototype level up to full-scale systems, quite literally moving from “nano-to-ninety” (that is, nano-scale materials engineering to ninety-foot-plus structural testing). These new facilities have allowed the College to quickly develop new research partnerships and network UA’s unique laboratory capabilities with many leading research facilities in the country and around the world.

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TRANSPORTATION

UA has a long-history of transportation research focusing largely on the activities of the University Transportation Center for Alabama (UTCA) and the Center for Advanced Vehicle Technologies (CAVT). The UTCA conducts transportation education, research, and technology transfer activities using faculty members and students from UA, UAB, and UAH. The CAVT was established to promote the development of efficient, safe, secure, economical, durable, comfortable, user-friendly and environmentally conscious vehicles to meet the transportation needs of America.

**University Transportation Center for Alabama (UTCA)**

The Center’s mission is to advance technology and expertise in multiple disciplines that comprise transportation through the mechanisms of education, research, and technology transfer while serving as a university-based center of excellence. The goals of the Center are (1) to conduct a multidisciplinary program of coursework and experiential learning that reinforces the theme of transportation management and prepares the transportation workforce of the future, (2) conduct an ongoing program of basic and applied research, with the products that are judged by peers or expert review, and (3) ensure the availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied.

UTCA research has focused on transportation safety, management, and public transit projects. Recent projects include a pilot study of school bus seat belts funded by the Alabama State Department of Education. The project assessed the impact of installing lap/shoulder seat belts on Alabama school buses. A second project is a joint effort of UTCA and the Center for Transportation Policy Studies at the University of North Carolina-Charlotte that focuses on improving hurricane evacuation procedures for Mobile, AL and Wilmington, NC. The center is also working on a project to develop a primer that elected officials, planners, and transportation agencies may use to visualize, design, and implement transit-oriented development patterns in Alabama.

The UTCA provided a 180% return on investment from its inception in 1999 through 2009. It received $9 million of federal University Transportation Center (UTC) funding and more than $17 million in additional federal, state, and local project funding from sources including the Federal Transit Administration, Alabama Department of Transportation, Alabama State Department of Education, and Birmingham Regional Planning Commission.

**Center for Advanced Technologies (CAVT)**

The U.S. Department of Transportation has established a strategic plan to provide “fast, safe, efficient, and convenient transportation at the lowest cost.” Advancing transit technology through the development of advanced hybrid-electric and fuel cell vehicles will contribute substantially to the realization of DOT’s goals of safety, reduced congestion, global connectivity, environmental stewardship, and security preparedness and response. The CAVT studies, advanced composite and lightweight materials, and improved manufacturing methods for hybrid-electric and fuel cell vehicles will lead to more crash-resistant vehicles. Onboard sensors can minimize accidents by detecting and taking preventative action in case of imminent collisions, incipient rollover, and vehicle steering and braking problems. Improved vehicle-to-transportation-network communication technologies will enable more rapid and comprehensive response to accidents. Advances in communication of vehicles with road and information networks can yield dramatic improvements in congestion mitigation on existing roadways. Global connectivity will be accelerated through the development of improved vehicle-to-network communications, thereby improving multimodal transfer and transport of passengers through airports and commuter rail and bus stations.

From the viewpoint of environmental stewardship, transportation based on hybrid-electric (including plug-in hybrid) and fuel cell vehicles will improve the sustainability and livability of communities, and reduce the adverse effects of transportation on ecosystems, the human environment and the natural environment. To meet the challenge of extreme volatility and potentially astronomical fuel prices, hybrid-electric vehicles offer high
fuel efficiency, and their relatively steady engine operating conditions coupled with greater electrification of vehicular sub-systems can drastically cut emissions of toxic pollutants and greenhouse gases. Depending on fuel used, fuel cell vehicles offer the potential of continuous zero-emissions operation. By reducing conventional fuel consumption and substituting alternative fuels, these advanced propulsion technologies will greatly reduce transportation-related dependence on foreign oil. The proposed research program will improve the U.S. international competitive position in transportation goods and services, and improve the capacity of the transportation technical workforce. Finally, improved vehicular communications with the information network will greatly enhance the security preparedness and response of our transit system.

The CAVT, due to its past history of success and the resources available at UA, is well positioned to continue its record of research excellence. The inclusion of a state-of-the-art engine test facility in the new South Engineering Research Center building will greatly enhance the Center’s research capabilities. The facility will include four test cells with engine and chassis dynamometers and a dilution tunnel. These facilities are unique in the Southeast and position the Center at the cutting edge of advanced vehicle research. The Center has been involved in over 40 research projects and received more than $16 million in direct external funding to support its research activities. Another source of external funding is follow-on, investigator-driven projects that resulted from earlier “seed” research funded by the CAVT. For example, UA fuel cell researchers, initially funded by the CAVT, have since received more than $3 million in funding from external agencies including the Department of Energy, National Science Foundation, and the U.S. Consumer Product Safety Commission.

The Center for Advanced Vehicle Technologies is committed to continuing its research activities focusing on providing “fast, safe, efficient, and convenient transportation at the lowest cost.”

**Points of Contact**

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INFRASTRUCTURE:
INTERMODAL FACILITIES

SUMMARY
Over the past 12 years, student enrollment at UA has increased from 19,636 students to 34,852 in the fall of 2013; increasing by over 78%. Construction programing is underway on a new South Campus Parking Deck to accommodate faculty, staff and residential students located on the south side of campus. UA is in the preliminary stages of evaluating an additional intermodal facility containing parking in the eastern portion of campus near the Bryant Conference Center (BCC) and Moody Music area. This intermodal facility would allow for daily visitor parking, conference parking as well as student/faculty/staff parking. Currently the parking infrastructure in this area does not meet current or envisioned (with BCC and sporting venue expansion) needs.

UA proposes construction of bus and parking facilities to serve campus/off-campus/local residents, and visitors. The proposed facilities will be integrated with the Crimson Ride campus transit system which currently serves over 40,000 users. The proposed intermodal facilities will expand existing parking and transit infrastructure and will positively affect efforts to minimize traffic congestion around the intermodal facility as well as the entire campus. The utilization of mass transit also reduces fuel consumption and environmental pollutants. Two years ago, UA partnered with the City of Tuscaloosa to provide a connecting route from the city’s intermodal facility to outlying area of campus and campus. This connectivity has allowed movement of passengers not only to and from the City of Tuscaloosa and but also to other destinations.

This transition is part of a larger system of projects. In August 2007, UA illustrated its commitment to a green environment and the development of a pedestrian campus, by reconfiguring streets and parking services, and implementing a campus-wide transportation system. The fleet operates 17 on campus and 5 off campus buses during peak hours, and through the fall 2013 semester, Crimson Ride has served over 8.35 million riders and maintained an average yearly ridership of 1.85 million users. Intermodal facilities and the transit system on campus have allowed UA to have a global connectivity by providing transportation to and from the Birmingham International Airport.

In addition, UA added several bike paths and lanes around the campus in accordance with the Campus Master Plan to further meet the shift to a pedestrian campus. Due to the influx of bicycles on campus, 75 bike racks were added, bringing the total to over 350 on campus. Bike repair stations were also added in strategic locations in other intermodal facilities on campus to assist with simple bike repairs. The addition of these bike racks allow students to easily access the transit system.

CONCLUSION
The project accommodates rapid growth of the student population and the employees placed in jobs created to support this growth. The cost to construct the intermodal components and the parking to accommodate 3,125 vehicles between the two facilities is $50,000,000.

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ACCOMPLISHMENTS MADE POSSIBLE BY CONGRESSIONALLY DIRECTED FUNDS

WEST ALABAMA AUTISM OUTREACH PROGRAM PHASE I

The Health Services and Resources Administration (HRSA) funded the West Alabama Autism Outreach Program (WAAOP) in September of 2009. The goal of WAAOP was to meet needs of individuals with Autism Spectrum Disorder (ASD) and their communities by increasing access to interdisciplinary ASD services in West Alabama, especially diagnostic services and consultation. To date following project activities were completed:

<table>
<thead>
<tr>
<th>Activities</th>
<th>County or Referral Source</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children and adults evaluated and/or treated at the ASD Clinic</td>
<td>Multiple</td>
<td>254</td>
</tr>
<tr>
<td>Students trained from Psychology, Communicative Disorders, Psychiatry and Pediatrics</td>
<td></td>
<td>Approximately 100</td>
</tr>
<tr>
<td>Community Group Meetings</td>
<td>Demopolis City, Marengo, Choctaw, Sumter, Hale, Greene</td>
<td>2</td>
</tr>
<tr>
<td>Evaluations for ASD in rural counties</td>
<td>Demopolis City Schools, Hale, Early Intervention, parents</td>
<td>15</td>
</tr>
<tr>
<td>School Consults</td>
<td>Choctaw, Greene, Demopolis City Schools</td>
<td>10</td>
</tr>
<tr>
<td>IEP Meetings</td>
<td>Greene</td>
<td>1</td>
</tr>
<tr>
<td>Inservice Trainings</td>
<td>Hale</td>
<td>1</td>
</tr>
<tr>
<td>Parent/Teacher meetings</td>
<td>Demopolis City Schools</td>
<td>1</td>
</tr>
</tbody>
</table>

- A full-time clinical psychologist, a speech-language pathologist, and a clinic coordinator were hired to expand the interdisciplinary diagnostic clinic at UA. Further, a pediatrician at the University Medical Center consults on cases and contributes to the diagnostic team.
- The ASD Clinic expanded from one to five days per week, dramatically increasing the number of individuals seen for diagnostic and intervention services.
- We collaborated with Community Service Programs of West Alabama to develop an early intervention assessment clinic for children under three years of age.
- All school systems were offered free consultations to meet their individual needs.
- A clinical research database was created which contains demographic information and diagnostic assessment results. The database serves as a registry for families who are interested in future research participation. Currently, 144 families are included in the database.

WEST ALABAMA AUTISM OUTREACH PROGRAM PHASE II

The Administration of Children and Families funded Phase 2 of the West Alabama Autism Outreach Program, which was created to provide autism trainings to physicians across the state, to establish early screening practices in local and rural physician offices, and to train early intervention providers on an autism-specific evidenced-based intervention, the Early Start Denver Model (ESDM; Rogers & Dawson, 2010). ESDM is a cutting edge intervention model included in Time Magazine’s 2012 Top 10 Medical Breakthroughs for normalizing brain functions responsible for social interactions in young children with ASD. The following outline summarizes project activities.

**Physician training:**
- In collaboration with the Alabama Academy of Pediatrics (AAP), a physician training for local and regional pediatricians and medical students was completed October 26, 2011, which included specific focus on early red flags for autism.
• Autism-specific training was completed in Monroeville, Carrollton, and Tuscaloosa, AL. Training focused on early red flags of autism, surveillance and screening procedures suggested by the AAP.
• **Physician training will directly contribute to earlier identification and intervention for young children with autism living in Alabama.**

**Early Screening:**
• 131/506 invited families completed the screening study, which offered two developmental screeners. Screeners were scored and results were shared with family and physicians. Lack of interest, cancelled appointments, and language barriers as the primary reasons families declined to participate.
• Of the 131 children screened, 41 failed the ESAC, (the autism-specific measure), and 22 failed at least one domain of the ASQ (the developmental screener). *These children were referred for early intervention earlier, which enhances their communication, social, and academic outcomes.*
• Physician concerns were not correlated with total ESAC scores. That is, physicians did not observe the red flags of autism that parents reported on the ESAC.

**Early Intervention Training:**
• Eight local early intervention providers received two ESDM trainings.
• Monthly meetings were held between the UA ASD team and the early intervention providers to provide supervision and feedback.
• Collaborations with community service providers will continue and all providers reported that they will continue to implement components of the ESDM into their intervention plans.
• Eight months following the completion of this project, providers completed a survey regarding their experiences using the ESDM. Providers reported that it was important to integrate evidence-based intervention in their practice; however, they identified many barriers to implementation in their daily practice due to time and resource constraints. Most of them continue to use aspects of the ESDM with young children suspected to have ASD.

**EXPANDING THE ALABAMA ENTREPRENEURIAL RESEARCH NETWORK**
The purpose of the SBAHQ-09-I-0133 was to upgrade and enhance the resources available to existing Alabama Entrepreneurial Research Network (AERN) partners in 15 rural distressed Alabama counties by encouraging rural entrepreneurship and bring prosperity to economically disadvantaged communities. These goals were met by training Chamber of Commerce directors in these areas to assist business owners in writing business plans, conducting research, and seeking financing for entrepreneurial endeavors. Grant funds were used to put resources (computer equipment, business resource books and computer software) in the offices of AERN partner agencies to access this specialized knowledge and make informed business decisions.

AERN partners reported 372 jobs retained or created during an initial three year funding period—through training workshops, one-on-one consultations with entrepreneurs and engagement by UA professional staff and faculty. The grant support impacted economic prosperity in the distressed rural counties. The AERN also extended its reach by adding four more counties to the network in 2012 to a total of 19 counties. By extending the AERN presence, this grant has addressed some needs in Alabama counties severely affected by industry downsizing and departures due to off-shoring and outsourcing. AERN partners responded enthusiastically to this training; using it to develop capacities and capabilities within their respective communities. This development of entrepreneurship added value to the economy and improved the quality of life in small rural areas.

Copies of publications made possible through this grant as well as success stories on businesses that AERN helped can be found at [http://aern.cba.ua.edu](http://aern.cba.ua.edu). We will pursue additional opportunities to increase the effectiveness of AERN partner agencies and leverage UA-based knowledge and expertise so that rural distressed communities can connect with the digital age and compete in a global market.

**PREPARING THE WORKFORCE OF THE FUTURE**
This project provided workforce information and insight that is enabling the State of Alabama to prepare its workforce to meet future higher-wage higher-skill job demands of businesses and other employers and thereby raise household income and reduce poverty. Relative to the nation’s poverty and per capita income, the state’s
poverty rate is nearly 4% higher and its per capita income is around 84%. It is estimated that by preparing workers for high-wage high-skill high-demand jobs, Alabama’s total personal income can increase by $2 billion annually; an average of $4,000 for about 500,000 underemployed workers. The higher personal income would generate about $142 million in state and local income and sales taxes.

The goals of the project were to (a) develop comprehensive county and regional labor profiles that provide relevant insight into labor supply and demand as well as the implications for workforce and economic development, and (b) take this information to workforce and economic development officials at the local/regional and state levels where development efforts and decisions are made. The objectives are to show (i) the critical occupations and skills to train workers for and (ii) how to identify and make use of human capital, including underemployed- and non-workers, for maximum economic development impact with focus on high-wage, high-skill, fast-growing, and high-demand jobs. The set of deliverables comprised:

- 11 workforce reports (one each for the state and its 10 workforce development regions).
- 67 comprehensive county labor profiles along the lines of the workforce reports except for sections for which individual county data are not available.
- 11 results dissemination meetings; one each for the state and its 10 workforce development regions.

Project team/tasks
Dr. Samuel Addy (PI), eight CBER staff, one graduate student, two Capstone Poll staff and about 20 interviewers for surveys, and two UA staff for results dissemination. Two workforce surveys, demographic and socioeconomic data collection and analysis, population projections and economic forecasts, analysis of survey results, workforce reports preparation, results dissemination, and export sector workforce analysis.

Deliverables
Two surveys and first set of workforce reports completed and distributed to SBA and Alabama project partners; Alabama Department of Economic and Community Affairs, Alabama Department of Labor (formerly Alabama Department of Industrial Relations), Alabama Department of Postsecondary Education, Alabama Industrial Development Training (AIDT), and Alabama Power Company. Statewide results were disseminated at regional meetings of workforce development boards. Two project partners posted workforce reports on their websites.

MINIATURE ANTENNAS FOR UNMANNED AERIAL VEHICLES

Unmanned aerial vehicles (UAVs) require long-distance telecommunication capability. High gain miniature antennas are required for UAV applications. A helical antenna radiates electromagnetic (EM) waves from a copper radiator (ribbon). Depending on the geometry of the antenna and frequency of the power applied to the antenna, the antenna can be designed to operate in one of the two main radiation modes: normal or axial-mode. In order to improve video transmission quality from a long distance in a balloon unmanned aerial vehicle (UAV), a hexaferrite-glass composite core was used that is effective in tailoring EM wavelength to reduce antenna size from the dielectric core. We have designed a highly directional axial-mode ferrite antenna using a high-frequency structure simulator (HFSS), which gives a relatively large forward radiation gain. The hexaferrite axial-mode helical antenna was most advantageous with a size reduction of 68% as compared to an air-core axial-mode antenna. Work is ongoing to further reduce the helical antenna size, to increase antenna radiation efficiency and to prepare an array of helical antennas for characterization of antenna performance. A final report on this work was recently submitted to NASA (December, 2013).

MINIATURE FERRITE CHIP ANTENNAS FOR UNMANNED AERIAL VEHICLES

Z-type hexaferrite antennas were fabricated based on computer simulation results and characterized with a network analyzer for antenna performance. Antenna size and weight were dramatically reduced by Gen-5 and Gen-5-1 designs. Mechanical instability, cross polarization, and isolation issues were also addressed. A fabricated planar dual-polarized ferrite antenna has a small volume and light weight. The fabricated antenna showed a good impedance matching, good isolation, broad fractional bandwidth, and relatively high radiation efficiency. Moreover, measured 2D radiations showed good dual-polarization characteristic of the fabricated antenna. Accordingly, transmitted video image quality can be improved. Therefore, the planar dual-polarized ferrite antenna is suitable for advanced UAV video communication systems. The developed dual-polarized hexaferrite
antenna is currently under UAV video communication test. Based on the promising results obtained thus far, a provisional patent application was recently filed.

**INSTITUTE FOR SUSTAINABLE ENERGY**

Alternate fuels offer unique challenges and opportunities as energy source for power generation, vehicular transportation, and industrial applications. Institute for Sustainable Energy (ISE) at UA conducts innovative research to utilize the complex mix of domestically-produced alternate fuels to achieve low-emissions, high energy-efficiency, and fuel-flexibility. ISE also provides educational and advancement opportunities to students and researchers in the energy field. Basic research probing the physics and chemistry of alternative fuels has generated practical concepts investigated in a burner and engine test platforms. Major accomplishments during 09/01/2011-11/30/2013 are summarized below.

**Task A: Research on Utilization of Alternative Fuels:** Clean combustion of liquid biofuels was achieved (e.g., biodiesel and straight vegetable oil) by utilizing a novel fuel-injection concept relying upon aerodynamically created two-phase mixing near the injector tip. The concept consists of a fuel tube and an exit orifice separated by a small gap. The atomizing air mixes with fuel upstream of the fuel-tube tip to create a two-phase flow. Through the injector orifice, the two-phase flow is subjected to a rapid pressure drop, leading to expansion and breakup air bubbles and yielding spray with fine droplets. Emissions measurements in an atmospheric-pressure, swirl-stabilized, combustor reveal minor differences when operated with diverse fuels such as diesel, biodiesel, vegetable oil, and industrial byproducts including glycerol. This fuel injector concept offers the intriguing prospect of cleanly combusting relatively crude liquid biofuels for power generation and automotive applications. Thus, fuel processing steps required to convert biomass into liquid biofuels with precisely controlled physical and chemical properties can be greatly simplified to reduce the overall cost and emissions.

For automotive applications, we have developed a novel combustion approach to shift the paradigm by dividing the complex engine flow and chemical processes into two steps: (1) an external step involving injection, atomization, and vaporization of liquid fuel(s), mixing of fuel and oxidizer, and subsequently, fuel reformation or partial oxidation to produce syngas fuel outside the engine cylinder, and (2) an internal step involving injection of syngas fuel into the engine cylinder containing ingested air, followed by low temperature combustion (LTC) based on homogeneously-charged compression ignition (HCCI) concept. The external step is carried out as batch or continuous flow process at an elevated pressure by recirculating combustion products from the engine cylinder. Greater control of flow and chemical processes is feasible in the external device (fuel reformer) without the time constraints of typical reciprocating engines. Moreover, the in-cylinder ignition and combustion processes are greatly simplified since the fuel has already been partially oxidized. Research has been conducted to develop and characterize key aspects of this concept including a fuel-flexible fuel reformer, a combustion-system flexible two-stroke research engine test platform, and procedures to isolate and coat catalysts on a porous bed for use inside the engine and fuel reformer to selectively increase the chemical activity. Concepts were developed using advanced computational and experimental methods.

**Task B: Seminar Series and Technical Workshop:** For outreach and education, a seminar series was organized in Spring 2013 with distinguished speakers in the energy field. A technical workshop will be held in Spring 2014.

**Summary of Progress:** Project team consists of three engineering faculty members: Profs. A. Agrawal, A. Lane, and P. Puzinauskas. One post-doctoral researcher, three graduate students, and two undergraduate students were involved with the project. Major equipment has been purchased, experimental hardware has been designed, built and tested, and detailed computational and experimental results were obtained. The project has resulted in seven conference papers, one doctoral dissertation, one MS thesis and three undergraduate honors research projects. Research has led to four external research proposals. The outreach programs developed a focused group of energy researchers on the UA Campus.