TENNESSEE STATE UNIVERSITY

R E S E A R C H H O R I Z O N S

2008 Annual Report

RESEARCH HORIZONS 2008

ANNUAL REPORT

RESEARCH HORIZONS

TSU Publication Number TSU-09-0032(B)-11-61010

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TENNESSEE STATE UNIVERSITY
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From the Vice President

The academic and scientific communities face a demographic challenge of historical proportions: the looming retirement of a generation of accomplished senior researchers. The Baby Boomer Generation consists of persons who were born between 1946 and 1964, and the U.S. Census Bureau estimates that there are about 80 million baby boomers. These seasoned workers represent an enormous resource of education, skill, and knowledge – which factors constitute the intellectual working capital of continuing discovery and innovation.

Our challenge then is to educate, train, and mentor a new generation of researchers. The Division of Research and Sponsored Programs (RSP) of Tennessee State University (TSU) is a national and international leader in supporting research and other scholarly activities so that these emerging minds may begin to build upon the professional legacy of these veteran researchers.

Fiscal year 2008 witnessed many projects for both faculty and student researchers which provided the necessary collaborative opportunities. This report details the SCORE program - which has provided general support for faculty members commencing research careers - and also outlines a sample of specific research endeavors.

In the areas of agricultural science, cancer study, environmental protection, and military technology, TSU researchers continue to maintain and increase the stellar academic reputation of the University within the global research community. For example, TSU Agricultural and Environmental Research Assistant Professors Dr. Samuel Ochieng and Dr. Jason Oliver engage in research at the TSU Nursery Research Center in McMinnville, Tennessee to master techniques to deter the destruction imposed upon nursery crops by the imported fire ant. Pamela Hull, Associate Director of the TSU Center for Health Research, provides continuing leadership in cancer research to identify and eliminate the factors that create a racial disparity in oncology health services within metropolitan Nashville and Davidson County. TSU Civil and Environmental Engineering students illuminate practical knowledge for improving the management of solid waste. TSU Electrical and Computer Engineering faculty and students innovate toward the development of intelligent, self-healing engines for fighter aircraft.

This report also showcases the TSU Pilot Center for Academic Excellence in Intelligence Studies (PCAEIS) which prepares and mentors students to be Intelligence professionals for national service and security.

The 2008 Annual Report thus provides valuable information to our partners and stakeholders concerning a sample of projects that will assist in providing the next generation with the education, skill, knowledge, and opportunity to achieve ascending levels of accomplishment.

Sincerely,

Maria Thompson, Ph.D.
Interim Vice President
Research and Sponsored Programs
Tennessee State University

THE IMPORTED

Otis L. Floyd Nursery Research Center, McMinnville, Tennessee

Did you know that Tennessee State University is an active participant in one of the fastest growing industries in the US economy? Or that Tennessee State University (TSU) maintains a multi-million dollar facility that has been actively supporting a green, renewable Tennessee industry for over ten years? This is what is happening at the TSU Otis Floyd Nursery Research Center in McMinnville, Tennessee.

With the annual production value of U.S. nursery crops approaching $14 billion, and an average annual growth rate of about 4%, ornamental crop production is presently the fastest growing segment of the U.S. and Tennessee agriculture. According to the Tennessee Nursery and Landscape Association, the nursery industry in Tennessee has an annual economic impact to our state of over $600 million.

Located about 80 miles southeast of Nashville on the edge of the Cumberland Plateau, the TSU Otis L. Floyd Nursery Research Center is a facility dedicated to the improvement of the Tennessee nursery crop industry. It is operated through a cooperative effort between the TSU School of Agriculture and Consumer Sciences and the United States Department of Agriculture/ Agricultural Research Service (ARS). The mission of the Nursery Research Center is to provide leadership in the strengthening and expansion of the regional nursery industry through research in the areas of pathology, entomology, genetics, horticulture and related sciences.

Dr. Jason Oliver, research assistant professor at the center, is engaged in research to manage invasive and destructive pests like the imported fire ant. Research has focused on an integrated pest management approach that includes chemical, biological, and cultural control strategies. Evaluation of fire ant treatments of nursery stock has shown that rotating the root ball of the tree during pesticide application significantly improves efficacy against fire ants and can lower grower costs by reducing the total number of consecutive applications from six (the current requirement) to two applications.

Research has also identified several biopesticides with potential to control imported fire ants while offering favorable environmental profiles and lower worker exposure risks.

Biological control research at TSU is being performed in cooperation with scientists at the USDA-APHIS, USDA-ARS, the Tennessee Department of Agriculture, and the University of Tennessee. Current projects are seeking to establish new parasitoids of the imported fire ant in Tennessee. To date, multiple releases of small fruit-fly sized insects (called phorid-decapitating flies) which parasitize the worker fire ants, have been made throughout middle Tennessee. These flies derive their name from their unusual habit of developing inside the head of the fire ant, eventually decapitating the ant. It is hoped the establishment of a complex of phorid fly species in the U.S. will suppress fire ant populations in

Testing treatment application methods.

FIRE ANT PROJECT

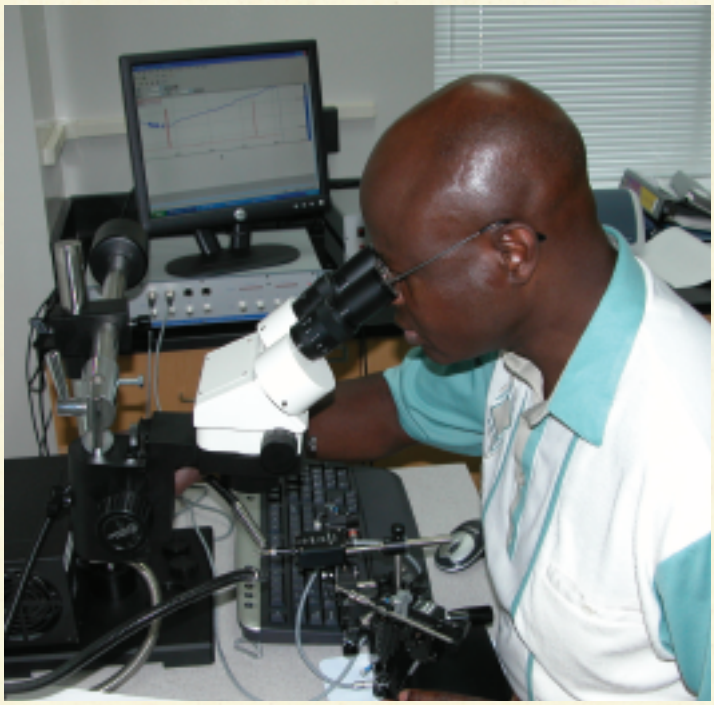
the southern U.S. TSU has participated in the release of phorid flies in Davidson, Franklin, Hamilton, and Williamson Counties. As a component of the phorid fly program, TSU just completed a statewide survey of imported fire ant species with funding and assistance from the Tennessee Department of Agriculture. The survey found a mixture of hybrid and black imported fire ants in middle and west Tennessee, hybrid fire ants almost exclusively in east Tennessee, and red imported fire ants near metropolitan areas and in some other isolated locations. The fire ant survey will be used to guide future releases of different phorid fly species that are species-specific to black, red, or hybrid imported fire ants. During the fire ant survey, the first detection of a new fire ant virus was documented in Tennessee, as well as the presence of multiple queen fire ant colonies (polygynes) in Williamson County.

Dr. Jason Oliver taking fire ant data

Dr. Samuel Ochieng, research assistant professor at the Nursery Research Center, conducts research in chemical ecology-- the study of how insects use chemicals to communicate. His program is looking to isolate and identify chemicals produced by plants and imported fire ants that can be used to attract foraging fire ants to insecticide-laden baits; he will then evaluate how safe the identified chemicals are to a range of beneficial insects such as phorid flies that prey upon imported fire ants.

Dr. Ochieng compared intra- and inter-species behavior of fire ants to the poison in Dufour's gland extracts. Imported fire ants use venoms stored in their poison glands to subdue their prey and for defense. Intra- and inter-species behavior showed that imported fire ants are capable of recognizing and differentiating their own venom gland extracts from extracts of other species. For example, red imported fire ant workers were only attracted by gland extracts from their species but repelled by extracts from black and hybrid species. It suggests, therefore, that red imported fire ants may be repelled from unwanted areas by incorporating gland extracts from black or hybrid fire ants into a repellent medium such as bait.

Dr. Ochieng's research also evaluated toxic effects of a biopesticide, Armorex, and a traditional pesticide, Talstar, and combinations of Armorex and Talstar. Armorex is exempt from EPA regulations and is approved for use on ornamental plants and ants in general, but its effects against imported fire ants in a nursery setting are unproven. His results showed there was no significant difference between Armorex, Talstar and control treatments when they were applied alone. However, a significant increase in mortality was observed when Armorex was used in combination with Talstar, suggesting a synergistic effect between the ingredients. Currently these treatments are being tested as mound applications for the ability to control imported fire ants in the field environment. Individual mound treatments are usually more environmentally and ecologically acceptable because less insecticide is used and treated areas are limited, resulting in less impact to non-target insects.



Dr. Samuel Ochieng prepares a Dufour's gland.

SOLID WA

Faculty members within the Department of Civil and Environmental Engineering at Tennessee State University have been involved in research that seeks to determine the quantities and composition of solid waste disposed in state landfills. This research, commissioned by the Tennessee Department of Environment and Conservation for the period March 2008-January 2009, provides valuable information about Tennessee waste characteristics, and assists waste management authorities in developing new programs for the reduction of waste and material recovery.

Dr. Roger Painter prepares for waste sorting at the Cedar Ridge Landfill in Lewisburg, TN.

RECYCLING FACTS

- In one year Americans throw away 28 billion recyclable glass bottles and jars
- Enough aluminum is thrown away each year to rebuild the entire U.S. commercial air fleet every three months
- The average U.S. office worker generates one pound of office waste paper every day

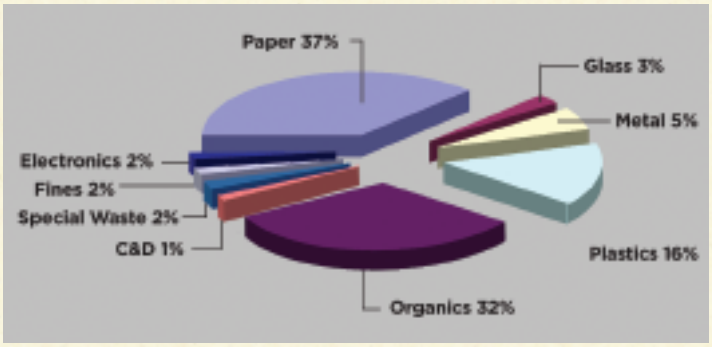
Under the direction of principle investigator Dr. Roger Painter and co-investigator Valetta Watson, TSU Civil and Environmental Engineering students carefully sorted, documented, and analyzed the composition of solid waste received at two facilities: The Bi-County Solid Waste Management landfill in Montgomery County, and the Cedar Ridge landfill in Marshall County. Waste samples were classified by point of origin and sorted into nine primary categories and sixty-four secondary categories. Statistical analysis was performed to extrapolate the data for the entire Tennessee waste stream.

Preliminary findings from the 2008 Tennessee Solid Waste Study suggest that significant reductions in landfill space consumption in Tennessee can be achieved by diverting a higher percentage of corrugated cardboard (paper) and certain organic wastes (organics) through implementation of material disposal bans. The preliminary data from the study for residential solid waste is depicted in the Residential Waste Chart at right.

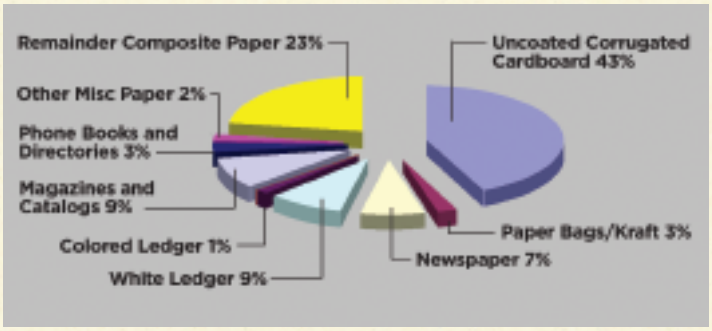
The largest fractions of the residential solid waste, paper and organics, are further broken down in the following figures on the Paper and Organics Charts.

STE CHARACTERIZATION STUDIES

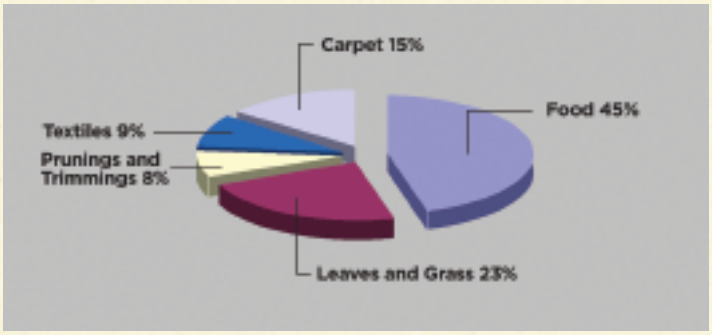
RESIDENTIAL WASTE



PAPER

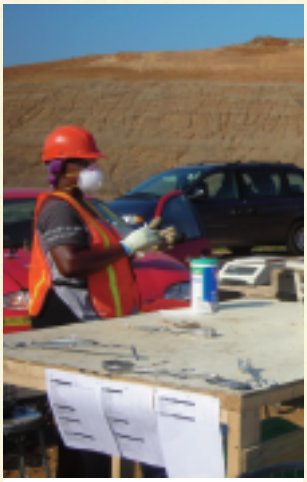


ORGANICS



Knowledge of the percentages of solid waste within individual waste category types is important information for planning solid waste management programs. Planning elements that may require an understanding of the percentages include (a) evaluation of the success, or lack thereof, of ongoing recycling programs, (b) quantification of the degree of success of bans to exclude specific materials from the waste stream, (c) characterization of the waste as feedstock to an incinerator, and (d) determination of quantities of organics in the waste stream which influence biogas production levels once the waste is landfilled.

Biogas production refers to the amount of methane produce by the decomposition of the organic portion of the solid waste. The amount of methane production is important for a couple reasons. First, the production of methane is an important parameter in landfill design since measures have to be taken to minimize explosion risks increased by the presence of methane. Second, methane is a valuable fuel and landfill biogas can be harnessed to as a heating/process fuel.



The refuse baler facility at the Bi-County Solid Waste Management landfill in Woodlawn, TN. ▲

◀ Valetta Watson prepares waste sorting at the Cedar Ridge Landfill

TSU Department of Civil and Environmental Engineering students Mahadi Almoula (left) and Wendy Leung (right) sort and categorize waste at the Bi-County landfill.

NEURAL-FUZZY PROBABILISTIC FOR MAXIMIZING TURBINE ENGINE

Since the 1980's, the U.S. has aggressively pursued the goal of doubling the propulsion capability of military aircraft through the Integrated High Performance Turbine Engine Technology program. The Department of Defense (DoD), using technology through a system-level approach (i.e., the turbine engine, airfoil designs, aircraft structure materials), has been providing new capabilities to the war-fighters. In particular, the Air Thrust of the Propulsion Directorate of the U.S. Air Force is conducting a comprehensive program to make current turbine engines even more capable by increasing performance while reducing overall costs of ownership. More specifically, the advanced turbine engine program of the Propulsion Directorate is introducing new applications related to advanced turbine engines. This includes supersonic cruise missiles (Mach 3.5 with a range twice that of the current missiles), supersonic strike aircraft (capable of Mach 2-4 cruise) and an advanced turbine accelerator engine (in excess of Mach 4 for lift-off).

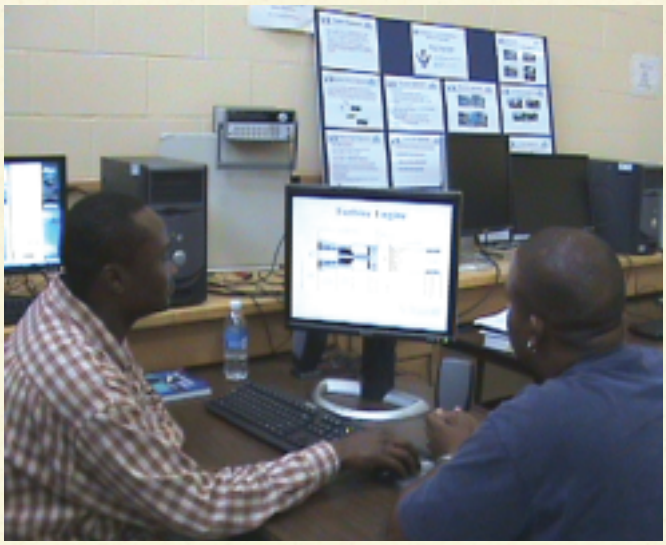


Figure 1. Research students work with the AFRL turbine engine model.

The above applications and their challenges have led the Propulsion Directorate to set a goal to increase affordability of these applications ten fold. This has led to the concept of intelligent engine design which integrates technologies that provide durable, adaptable, damage tolerant engine health and life management features into the engine itself. The advanced turbine engine will automatically reconfigure itself to accommodate deterioration and damage to deliver the best possible performance while in a degraded or damaged state.

TECHNICAL BACKGROUND

Turbine engine maintenance in particular has significantly improved over the past several decades. Recent maintenance practices are being replaced with more sophisticated diagnostics and prognostic systems. A diagnostic system can be defined as a system that makes an assessment about the current (and past) health of a system based on observed symptoms. A prognostic system makes an assessment about the future health of the system. Future turbine engine maintenance is expected to include automatic diagnosis, prognosis, and adaptation/reconfiguration of the engine in delivering performance based on its operating conditions. This leads to damage-tolerant control of the engine as well as an integrated health management system, which consists of both diagnostic and prognostic systems.

Typically, sophisticated engine integrated health-management systems deal with information provided by multiple sensors located throughout the engine. Processing information provided by multiple sensors can understandably lead to conflict in the decisions made by the engine integrated health-management system. A way for dealing with such conflict in the decision-making is to employ decision-fusion and reasoning software. Fuzzy-logic technology (types I and II) has been used to develop effective decision-fusion and reasoning software. The problem associated with using ordinary or type-I fuzzy-logic is its

PERFORMANCE

PROJECT PI: Dr. Saleh Zein-Sabatto, Department of Electrical and Computer Engineering, College of Engineering, Technology and Computer Science. Project period: September 2007-September 2011

inability to associate confidence-level or degree of belief in the decision made in the engine integrated health-management system about failures that have occurred in the engine. Type-I fuzzy-logic does not take into account that the sensor(s) could be malfunctioning and the information being provided to make a decision is inaccurate. Type-II fuzzy-logic provides reasoning and associates degree of confidence (belief) in the decision made based on uncertainty in information provided by each sensor used for the engine health-management system. Type-II fuzzy-logic does take into account that the sensor(s) could be malfunctioning and the information being provided to make a decision is inaccurate. This research is using type-II fuzzy-logic technology to develop the turbine engine integrated health-management systems to automatically sort out conflicting messages of engine performance and internal maintenance.

THE RESEARCH GOAL AND OBJECTIVES

The intent of the three-year research is to initiate and establish a plan in which Tennessee State University (TSU) provides a long-term and sustainable research effort to assist the Propulsion Directorate of the U.S. Air Force at Wright Patterson Research Laboratory (AFWPRL) in achieving its goal in advanced future turbine engine research. The goal of the proposed multiphase (three years) research is to conduct basic and applied research in regards to turbine engines related to: (1) fault detection: determining that a fault has occurred in the operation of the engine; (2) isolation: determining where in the engine the fault has occurred; (3) accommodation/reconfiguration of turbine engine adaptive control: development of a control strategy to continue operation although a fault may have occurred and (4) integrated health-management systems: including diagnostics and prognostic systems. This leads to intelligent turbine engines with damage-tolerant control, health and life management system.

RESEARCH TECHNICAL APPROACH

The project involves developing and testing an integrated health-management system that controls the health and life management of turbine engines by utilizing artificial neural networks and fuzzy-logic (type-II) technologies. A neural model will be developed and used to group and identify performance defects or faults. A fuzzy logic model will be developed and used for resolving conflict in the decision-making process to maximize the performance of the integrated health-management system. A fuzzy sensor fusion center will be developed to integrate information generated by different neural networks and produce a unified decision about the health of the monitored turbine engine.

TSU has received software for an advanced turbine engine model from AFRL which has been used to test the developed technologies and integrated health-management system. In Figures 1 and 2 graduate students, along with the PI, work on the software engine model.

To date, the research has involved one undergraduate and two graduate students. The undergraduate student demonstrated how other industries such as the automobile industry, can benefit from the developed technology under this research. She applied diagnostic technology to design an onboard diagnostic device for online health monitoring of automobile engines. If implemented, this device is expected to save drivers of future automobiles time and unnecessary maintenance cost. The two graduate students are still actively involved the DoD research project.

Figure 2. Students and PI discuss research challenges in integrated health-management systems for turbine engines.

THE MBRS SCORE PROGRAM

An analysis from 1965-1968 (included in a "Minority Programs Update" by the National Institute of General Medical Sciences/NIGMS, Spring/Summer 2002), indicated that minority institutions were underrepresented in biomedical and behavioral research. Minority institutions were defined as having a student enrollment of 50% or higher from primarily African American, Hispanic American and Native American groups. These institutions received less than $2 million in research grants from NIH and 80% of this grant support went to Howard University in Washington, DC and Meharry Medical College in Nashville. Approximately 1 out of every 400 NIH grants was awarded to minority institutions.

Pictured left to right: ReEtta Catlin, Armah Rashad Bell, and Dr. Margaret Whelan

Dr. Geraldine Woods

In 1970, Dr. Geraldine Woods, who had been appointed in 1964 to the Advisory Council of the NIGMS, presented her findings that minority institutions were eager to (1) improve their research facilities, (2) increase student and faculty research training capabilities, (3) enhance science curricula, and (4) provide for faculty development. In February 1971, President Richard Nixon, in a message to Congress, included "Special Help for Black Institutions," and the Senate Committee on Appropriations of the 92nd Congress recommended that $2 million be used to launch the Minority Biomedical Research Support (MBRS) program in 1972. In June 1972, thirty-eight (38) "charter" minority institutions were awarded grants of which Tennessee State University (TSU) was one of the recipients and Dr. Richard Hogg was the first TSU Program Director. In 1978, Dr. Edward Rigsby became the PD, and Dr. Jim Adams became the PD in 1986. Dr. Robert Newkirk took this role in 1988 and served as PD for 15 years. TSU has continuously won MBRS awards for 36 years. This accomplishment speaks to the stability and leadership of the program since its inception at TSU. Dr. Terrance Johnson became interim PD in 2004-05. In April 2007, Dr. Johnson received a competing renewal award and on May 1, 2007 became the current Director of the TSU MBRS/ SCORE (Support of Continuous Research Excellence) program.

Dr. Terrance Johnson

The SCORE program is a developmental program that seeks to increase the research competitiveness of investigators at minority-serving institutions and to increase the research capabilities of these institutions. To achieve these objectives, the SCORE program of today (the "New" SCORE) has separate funding opportunities for individual investigators and a stand-alone institutional award. These opportunities include the SC1, SC2, and SC3 awards which are discussed later.

E PROGRAM

TSU was awarded $2.5 million for the five-year period May 1, 2007-April 30, 2011. This award provides support for two research subprojects and SCORE program administration. Principal Investigators of thesubprojects are Dr. Mary Ann Asson-Batres, Professor of Biology and Dr. Margaret Whalen, Associate Professor of Chemistry. Dr. Asson-Batres' subproject focuses on understanding the role of retinoic acid (oxidized vitamin A) receptors (proteins embedded in the membrane of cells to which retinoic acid adheres) in neurogenesis (birth of new nerve cells) of postnatal olfactory epithelium (after birth nasal tissue). Dr. Whalen's project studies the effects of butylins (compounds used in a variety of industrial processes) on human natural killer cells (cells of the immune system that play a major role in rejection of tumors and virus infected cells). Both PIs are meeting the overall goal of the MBRS by publishing a number of articles and by providing research training opportunities for undergraduate and graduate level students.

The new MBRS/SCORE program raised the bar with respect to the competitiveness of winning grant awards. The program now includes an additional goal of developing biomedical research programs at minority institutions to be competitive with those at research-extensive institutions that have R01-funded investigators. The NIH R01 granting mechanism is the oldest used by the NIH. It is a competitive award given to a research investigator in an area of the researcher's expertise, based on the mission of the NIH. Many biomedical scientists consider this award as a premier step in research career development.

Through the new MBRS/SCORE program, the SC1, SC2, and SC3 funding mechanisms were initiated for investigator-initiated projects. The SC1 mechanism is a research advancement award for investigators who aim to transition to non-SCORE support such as the R01. The SC2 mechanism is a pilot project award for new investigators or investigators at the beginning stages of a research career. And the SC3 mechanism is a research continuance award for investigators who have been engaged in scholarly research and seek to continue to engage in research of limited scope. The tri-purpose goal of the current TSU SCORE program is to increase: (1) the number of faculty-funded biomedical research projects; (2) the research competitiveness of biomedical research faculty; and (3) the number of faculty and student peer-reviewed publications in the biomedical sciences. The TSU plan of the currently funded program is ambitious and will assist faculty in the following ways:

1. Provide biomedical research informational seminars/ sessions during department faculty meetings in the departments of biology and chemistry. These sessions will be presented by the Co-PDs of the proposed program.
2. Require all PIs who indicate an interest in developing an ongoing biomedical research program to complete the TSU Research and Sponsored Programs Academy course/workshop sequence.
3. Require PIs who complete the Academy course/workshop sequence to complete the University of Kentucky NIGMS Grant Writing Program.
4. Assist PIs in proposal development via provision of an internal review of the proposal, which will be conducted by the Co-PDs, selected University faculty with expertise in the proposed research area, and selected members of the program's Advisory Board.
5. Assist PIs in getting an external review of their proposal.
6. Assist PIs in routing their proposal through the University approval system for submission to the NIH.

Many of the plan's initiatives have already been sought and utilized by faculty beginning their research careers and also by intermediate and established researchers at TSU. In 1998, TSU began training graduate students seeking the Ph.D. degree in biological sciences. Within a ten-year period, this program has grown to 24 matriculating students. Eighty-five percent of graduates are from groups underrepresented in the biomedical sciences.

MBRS/SCORE is alive and well on TSU's campus. Our efforts will build on the University's tradition of conducting research and training undergraduate and graduate students to develop research expertise and professional careers, contributing not only to the research enterprise at Tennessee State University but taking expertise to industry, corporate/government/professional organizations, and to community neighborhood development beyond the University setting.

Pictured left to right: Antony Springfield, William Smith, Dr. Asson-Batres, LaTausha Gaskin, and James Asfour.

TSU PARTNERS WITH MEHARRY AND VANDERBILT

CANCER O

Tennessee State University Center for Health Research is collaborating with Meharry Medical College and Vanderbilt-Ingram Cancer Center (VICC) to develop community outreach and research aimed at reducing cancer disparities among minorities in the Middle Tennessee region.

The Meharry-Vanderbilt Cancer Partnership was funded by the National Cancer Institute in 2000, and in 2006 was awarded $14 million for a second 5-year cycle. TSU entered in the second cycle of the grant, co-leading a new cancer outreach component, the Cancer Outreach Core (COC), to provide a means for members of the local community and interested organizations to partner actively with Meharry,VICC, and TSU on cancer disparities research and outreach initiatives. The focus is on African American and Hispanic communities in Davidson County. With an explicit commitment to community engagement, the COC strives to build on community assets and to alter the unequal power dynamics of traditional research. Community partner-identified needs, interests, and priority areas guide the outreach activities, capacity-building activities with partners and researchers, and new research projects.

Pamela Hull, Associate Director of the Center for Health Research, says, "African Americans in Davidson County have higher rates of getting and dying from colorectal cancer, cervical cancer, and prostate cancer compared to Whites. While African American women have a lower rate of getting breast cancer, they are more likely to die from breast cancer compared to White women. These results point to the importance of African American women to get regular mammograms to detect breast cancer in its early stages when it is most curable."

The goal of the Partnership is to contribute to the elimination of disparities in cancer incidence and mortality among racial and ethnic minorities and economically disadvantaged groups. Specifically, the Partnership aims to improve the effectiveness of research, training and career development, cancer education and cancer outreach activities designed to benefit minority populations in the Middle Tennessee region.

Health-related data on Hispanics in Nashville are very scarce. The partnership conducted the "Hispanic Health Survey in Nashville 2007," as a participatory research project with Progreso Community Center.

ON CANCER DISPARITIES RESEARCH

OUTREACH CORE

Hispanic Survey Interviewers

Hispanic Cancer Info Fair, April 2008, Progreso Community Center

Cancer Disparities Symposium August 2007, Gilda's Club

The survey of 500 Hispanic adults in the Nashville area identified cancer-related needs among the Hispanic community. Cancer was identified as the top health concern in the Nashville Hispanic community. A great deal of interest was expressed in obtaining information related to cancer, particularly prevention and early detection. A high level of support was expressed for cancer clinical trials and for the new cervical cancer vaccine. "The results are guiding the planning of new collaborative outreach and research initiatives for the Cancer Partnership with Progreso Community Center and the Nashville Latino Health Coalition that focus on community-identified priorities," said Hull.

The partnership also coordinates United Nashville Partners Against Cancer (UN-PAC), a resource network for sharing information and resources related to eliminating cancer disparities, including the UN-PAC email listserv. List subscribers may also post questions or requests for information related to cancer and disadvantaged groups. Interested persons may subscribe to the list by sending an email to majordomo@tnstate.edu, with the following typed in the body of the message: subscribe unpac.

Researchers and community members can join this effort to reduce cancer disparities by contacting Dr. Pamela Hull at 615-320-3005 or pamhull@tnstate.edu.

PILOT CENTER FOR ACADEMIC EXCELLENCE IN INTELLI

PCAEIS

The Tennessee State University Pilot Center for Academic Excellence in Intelligence Studies (PCAEIS) was created in 2005 to assist the U.S. Intelligence Community in expanding and diversifying its pool of quality candidates for professional careers. PCAEIS is one of the ten Centers of Academic Excellence (CAE) nationwide selected to help students prepare for entry-level careers at one of the nation's 16 federal intelligence agencies. Through PCAEIS programs, students and educators at TSU and in the Nashville community have the opportunity to learn from top U.S. intelligence professionals about exciting internships and career opportunities in the federal agencies that constitute the U.S. Intelligence Community.

June 2008, 31 top high school students are well into the content of their week-long introduction to intelligence skills and topics on the TSU campus.

The national program has four focus areas: (1) curriculum development; (2) faculty and student development; (3) outreach; and (4) strategic partnership efforts. Each focus area allows program participants to enhance their understanding of U.S. intelligence and to strengthen their economic, cultural, and political awareness of the world around them.

CURRICULUM DEVELOPMENT

The Center assists professors and high school teachers with incorporating intelligence knowledge and skills content into students' curriculum to improve their abilities in critical thinking and understanding the impact of globalization. There is emphasis on languages and cultures outside the United States. Educators attend colloquia and workshops that discuss the role of intelligence in national security and offer ideas for curriculum-related activities for the classroom.

Curriculum development is a collaborative effort among faculty at TSU. Since the initiation of PCAEIS, TSU faculty members have developed seven new intelligence studies courses and modified three existing courses to include intelligence core competencies such as logic and critical thinking, cartography, data mining, geospacial issues in environmental security and multinational finance.

Tennessee State University's Intelligence Studies Minor Program places primary emphasis on enhancing students' understanding of national security and the critical role intelligence plays in helping ensure the nation's long-term security. Students take courses within the College of Arts and Sciences and the College of Business to gain a comprehensive understanding of the intelligence studies field and prepare for successful careers in the intelligence community.

I. Four Required Core Courses: 12 Credit Hours

- ECON 2010 Macroeconomics or POLI 2010 American National Government
- PHIL 2500 Logic and Critical Thinking
- POLI 2700 Introduction to Intelligence Studies
- BISI 3500 Data Mining

II. Electives: Six Credit Hours

- Business: ECON 4600 Business Intelligence
  FINA 4100 Multinational Finance
- Geography: GEOG 3100 Cartography
  GEOG 3200 GIS Applications to Intelligence Studies
  GEOG 4650 Geospatial Issues in Environmental Security
- History and Political Science:
  HIST 3050 History of Intelligence
  POLI 4700 U.S. National Security Policy

FACULTY AND STUDENT DEVELOPMENT

PCAEIS hosts fall and spring colloquia and a summer professional development workshop for high school teachers on TSU's campus. The sessions are led by nationally recognized intelligence scholars, professionals and experts. For example, at the summer workshop, June 23-26, 2008, guest speakers were representatives from the International Spy Museum in Washington, D.C. and the

GENCE STUDIES

Central Intelligence Center, two of many agency partners in the PCAEIS program. Fifty-two (52) high school educators completed this professional development workshop where presentations included topics ranging from "The Secret History of History" to case study explorations and how-to tips for successfully integrating intelligence studies into the classroom.

Students benefit from sponsored study-abroad programs and intelligence community internships. PCAEIS has facilitated study-abroad opportunities for 52 students during the past three years. Students have experienced the language and culture of China, Australia, Europe, South Africa, and India. PCAEIS provides continuing assistance to students interested in pursuing scholarships, internships, and co-ops with one of the 16 intelligence agencies. In June 2008, nine TSU students and two faculty members completed the study abroad program at Tianjin Polytechnic University in Tianjin, China. Also four students traveled abroad with the International Laureate Program.

Team building activities at the Adventure Guild in Chattanooga during the week June 13-20, 2008.

OUTREACH

For the past three years, Tennessee State University (TSU) & PCAEIS have hosted a one week Academic Excellence in Government Intelligence Studies Summer Camp (AEGIS) for 95 high school juniors and seniors. Top students who demonstrate academic excellence, character, and leadership are selected from local area high schools.

During the week June 13-20, 2008, thirty-one (31) top high school students lived on the TSU campus. They were exposed to lectures, demonstrations and simulations on topics such as: logical & critical thinking, problem-solving, ethics, briefing skills, history of the Middle East, geospatial technology, history of cryptology, terrorism, foreign policy, and understanding Islam. Students participated in leadership and teambuilding exercises at the Adventure Guild in Chattanooga, Tennessee. The AEGIS summer camp allowed students to meet intelligence community experts and distinguished professors from TSU and area universities. PCAEIS web site now has application information for the 2009 summer camp.

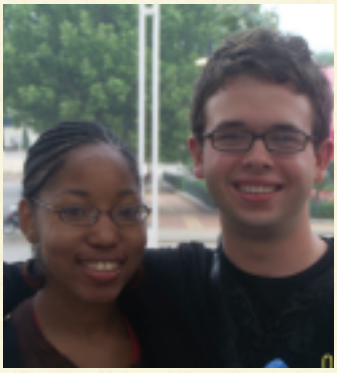
STRATEGIC PARTNERSHIPS

PCAEIS has developed several strategic alliances to create a network for students to enhance their skills and train for U.S. intelligence careers. Partnerships are created with intelligence community agencies, major research universities, national laboratories, homeland security agencies, and public and private national security research organizations. Representation from an array of agencies has been established to support and enhance PCAEIS activities, such as the following:

- Air Force Intelligence
- Army Intelligence
- Central Intelligence Agency
- Coast Guard Intelligence
- Defense Intelligence Agency
- Department of Energy
- Department of Homeland Security
- Department of State
- Department of the Treasury
- Drug Enforcement Administration
- Federal Bureau of Investigation
- Marine Corps Intelligence
- National Geospatial-Intelligence Agency
- National Reconnaissance Office
- National Security Agency
- Navy Intelligence
- Office of the Director of National Intelligence

2008 Tianjin Polytechnic University Study Abroad students: L-R, Mack Cox, Brittany Dean, Rashaun Davis, Taycia Hale, Philip Stoecklein, Yadira Satana Torres, Joshua Phelan, and Diana Henry

"One World– One Dream" advertisement on The Great Wall of China for Summer Olympics 2008



Life-changing adventure for Taycia Hale and Joshua Phelan

Please refer to the PCAEIS website at: www.tnstate.edu/PCAEIS for program information and upcoming events.

FISCAL YEAR 2008 ANNUAL

By Center/College/School

SUBMISSIONS

Agriculture and Consumer Sciences	$ 415,908
Arts and Sciences	4,813,857
Athletics	5,000
Business	114,905
Center for Health Research	146,939
Center of Excellence- ISEM	1,604,934
Center of Excellence- LS	6,986,940
Cooperative Extension Program	8,292,554
Education	419,303
Engineering, Technology, and Computer Science	8,913,754
Health Sciences	948,244
Institute of Agricultural and Environmental Research	4,674,198
Massie Chair of Excellence in Environmental Engineering	4,017,822
Nursing	1,669,906
Research and Sponsored Programs	3,431,498
Student Affairs	317,492
Total	**$ 43,463,858**

AWARDS

Academic Affairs	$ 426,100
Arts and Sciences	1,934,718
Business	379,924
Business and Finance	47,300
Center of Excellence - ISEM	1,407,072
Center of Excellence - LS	6,605,034
Center for Health Research	649,620
Cooperative Extension Program	2,586,359
Education	2,535,000
Engineering, Technology, & Computer Science	1,544,042
Health Sciences	1,334,003
Institute of Agricultural & Environmental Research	4,520,385
Massie Chair of Excellence in Environmental Engineering	686,017
Nursing	21,752
Student Affairs	869,426
Research and Sponsored Programs	1,134,855
Technology and Administration Services	127,818
Title III	6,942,349
Service Learning and Civic Engagement	670,869
Graduate Studies	38,600
Office of the President	11,610
Total	**$ 34,472,853**

By Agency/Corporations/Foundations

SUBMISSIONS

Corporations	$ 597,075
Foundations	52,320
Tennessee State Agencies	2,364,447
Corporation for National Service	122,102
National Aeronautics and Space Administration	5,187,102
National Science Foundation	8,018,040
U.S. Air Force Research Lab/OSR	1,453,642
U.S. Department of Agriculture	13,307,892
U.S. Department of the Army	747,766
U.S. Department of Defense/MDA	1,527,741
U.S. Department of Education	508,643
U.S. Department of Energy	402,336
U.S. Department of Health and Human Services/NIH	8,792,143
U.S. Department of Homeland Security and Technology Directorate	382,609
Total	**$ 43,463,858**

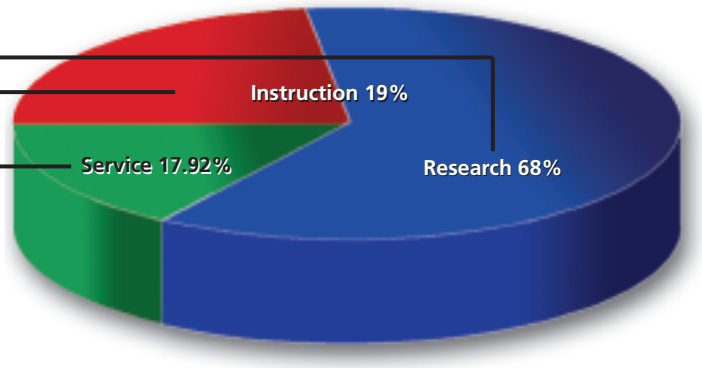
AWARDS

Corporations	$ 618,938
Foundations	33,300
Tennessee Agencies	3,389,127
National Aeronautics and Space Administration	499,478
National Science Foundation	1,123,654
National Geospatial-Intelligence Agency	750,000
Corporation for National and Community Service	19,250
U.S. Department of Agriculture	7,024,440
U.S. Department of Defense	1,954,226
U.S. Department of Education	9,115,643
U.S. Department of Energy	642,100
U.S. Department of Health and Human Services	8,196,380
U.S. Department of Housing and Urban Development	651,590
U.S. Small Business Administration	150,495
U.S. Department of Transportation	304,232
Total	**$ 34,472,853**

REPORT

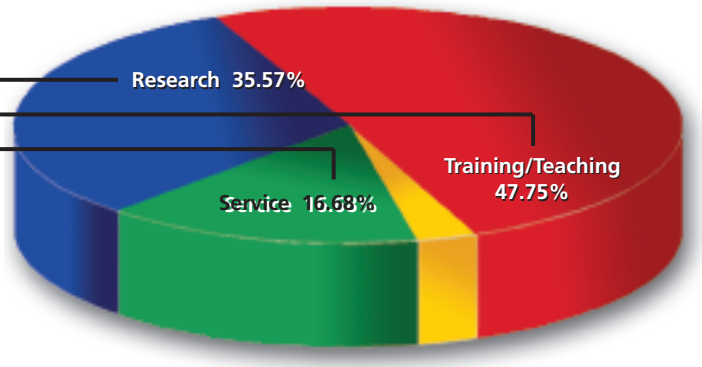
SUBMISSIONS BY PROJECT TYPE

Research $29,633,859 (80)
Instruction $8,316,850 (26)
Service $5,513,149 (14)
TOTAL $43,463,858 (120)



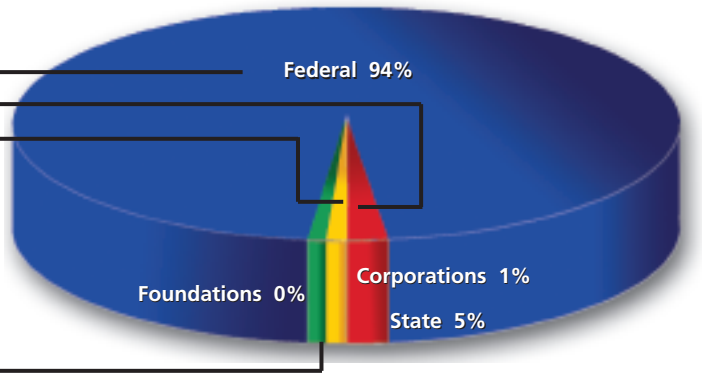
Awards By Project Type

Research $11,705,303 (40)
Training/Teaching $15,715,458 (63)
Service $5,491,242 (13)
TOTAL $32,912,003 (116)



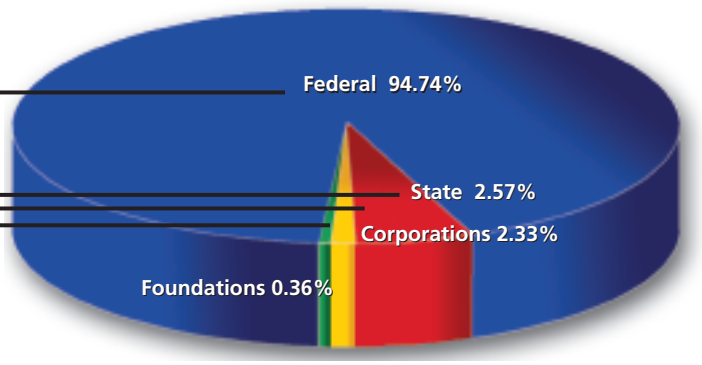
SUBMISSIONS BY SOURCE

Federal $40,450,016 (89)
State $2,364,447 (18)
Industry/Corporate $597,075 (12)
Private Foundations $53,320 (1)
TOTAL $43,463,858 (120)



Awards By Source

Federal $31,180,375 (103)
State $847,106 (5)
Corporations $776,214 (4)
Private Foundations $118,308 (4)
TOTAL $32,912,003 (116)



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TSU Publication Number: TSU-09-0032(B)-11-61010

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