

SENSORS

Sensor Industry in Oklahoma

SENSORS is produced by the Office of the Vice President for Research and Technology Transfer at Oklahoma State University.

Contact information:

Kelly Green
Research Communications
203 Whitehurst
Stillwater, OK 74078
405-744-6501
kelly.green@okstate.edu
vpr.okstate.edu

Oklahoma State University in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, sex, age, religion, disability, or status as a veteran in any of its policies, practices or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services. Title IX of the Education Amendments and Oklahoma State University policy prohibit discrimination in the provision of services of benefits offered by the University based on gender. Any person (student, faculty or staff) who believes that discriminatory practices have been engaged in based upon gender may discuss their concerns and file informal or formal complaints of possible violations of Title IX with the OSU Title IX Coordinator, Dr. Carolyn Hernandez, Director of Affirmative Action, 408 Whitehurst, Oklahoma State University, Stillwater, OK 74078, (405)744-5371 or (405)744-5576(fax).



“Stillwater, Okla., at first glance, might not sound like it would be home to a cluster of companies in the homeland security industry. Thanks to Oklahoma State University, however, a cluster has grown in that community.”

- Expansion Magazine, August 2004 issue

Though you may not know it, the sensor industry is flourishing right here in Oklahoma. The growth exists not only through sensor research and development coming out of OSU in Stillwater, but also across the state where numerous sensor design, development and certification companies are well-established and thriving. Much of the research and many of the technologies are deployed around the globe to aid in the nation’s war on terror. Others are used to detect diseases, solve infrastructure problems and assist in the production of food crops.

In the following articles, you will read about this research and these companies. You’ll also discover the size and scope of the global sensor industry and just what Oklahoma stands to gain from its commitment to research and innovation in this area. The potential is huge, and with a strong base already in place, Oklahoma’s sensor future will be exciting.

CONTENTS

4 / SENSORS IN THE U.S. AND IN OKLAHOMA

Dr. Stephen McKeever, vice president for research and technology transfer at OSU, discusses the impact of the industry.

6 / OSU SENSOR RESEARCH

OSU innovations inspire new technologies, products and companies.

8 / UNIVERSITY MULTISPECTRAL LABORATORIES

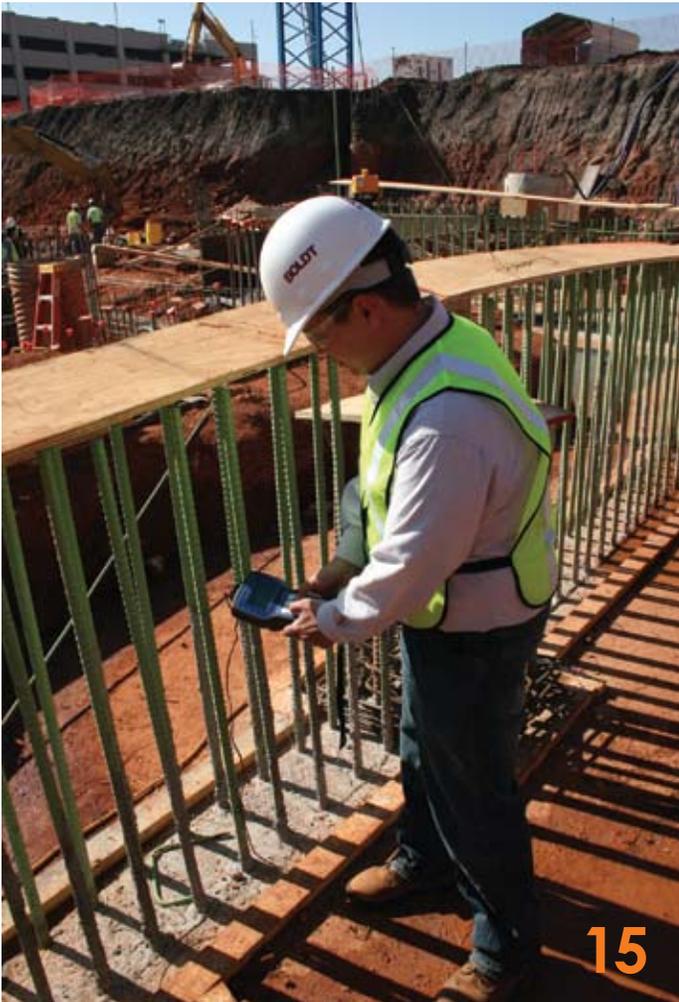
Oklahoma’s newest sensor development lab serves the military and first responders.

11 / ICX NOMADICS

International sensor development company specializes in explosives detection technologies developed in Stillwater.

12 / EKIPS TECHNOLOGIES

OU spin-out company uses exhaled breath to detect diseases.



13 / GEOPHYSICAL RESEARCH COMPANY

Tulsa-based firm makes highly sensitive gauges for oil wells.

14 / LANDAUER

Leading provider of occupational radiation detectors uses method developed by OSU researchers.

15 / ENGIUS

Stillwater-based company develops sensor that adds precious time to the construction process.

16 / NTECH INDUSTRIES

Sensor-based agricultural nutrient and herbicide delivery systems maximize output, minimize impact.

17 / QUAL-TRON, INC.

Systems produced in Tulsa secure and monitor military holdings around the world.

18 / SCIPERIO

Oklahoma City firm makes unique, adaptable antennas for soldiers and government agencies.

19 / SENSORCORR

OSU spin-out company produces sensors to detect corrosion on highways, pipelines and airplanes – a \$300 billion annual problem.

20 / TRITON SCIENTIFIC

Oklahoma firm manages the OSU-UML, a national resource for homeland security technologies.

21 / OKLAHOMA TECHNOLOGY & RESEARCH PARK

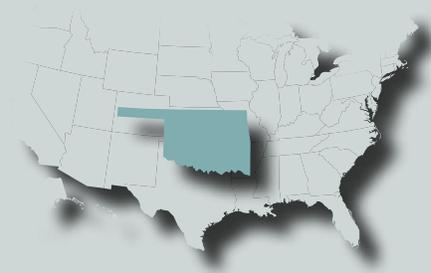
Partnership gives high-tech innovations room to grow.

22 / SENSOR CORRIDOR

Two agencies commit to the growth and development of a sensor industry cluster.

The Sensor Industry in the U.S. and in Oklahoma

By Stephen McKeever, Vice President for Research and Technology Transfer at Oklahoma State University



According to data from the Homeland Security Research Center (HSRC), the global homeland defense and homeland security industry is projected to outlay \$1.15 trillion from 2007 to 2015. In the United States, \$28.5 billion of homeland security products and services are predicted to be procured in the industry from 2007 to 2011 by the private sector alone. The U.S. government procurement market over the same period is projected to be \$123 billion. Striving to maintain a technology advantage in the battlefield – be it on land, sea or in the air – drives the creation and development of new innovations as nations, especially the U.S., strive to maintain their technology advantage.

Amid this burgeoning industry, some sectors are leading the market growth more than others. A report published by PR.com analyzes the growth of the defense and security market and states that innovations in surveillance, reconnaissance, robotics and sensor technologies are driving the military market at present. HomelandDefenseStocks.com (HDS), the source of the report, is a global investor and industry news portal for the homeland defense and security sector. These HDS findings are backed by research from the HSRC, which notes that the fastest growing military technology sectors (60%-400% growth from 2007-2011) are in radio frequency identification (RFID) sensors, nuclear detection technologies, biochemical detection, and communications - especially interoperability, information technology, and perimeter and border surveillance. Related sensor areas in biometrics and explosive detection are also projected to show remarkable growth.

The above are the main military markets only. According to Kipp Lynch at photonics.com, the non-military global sensor market is due to grow to \$50.6 billion annually by the year 2008.

In the U.S., Lynch says the sensor market will account for \$16 billion per year in all markets.

By anyone's measure, these are significant numbers. They represent potential markets that Oklahoma business cannot ignore and in which the state needs to compete.

In 2003 the state of Oklahoma assigned \$19 million to Oklahoma State University for research and development into sensor and sensor-related technology, particularly for applications in homeland defense and security. The result of this investment (to date) has been the generation of approximately \$80 million dollars in external funding to OSU in support of its research and development activities in this remarkable growth area.

OSU has spun-out seven start-up companies in the general field of sensors over the past eight years. OSU also currently enjoys almost \$1.2 million per year in royalties from licensed technology – most of which is based in the sensor and related technology fields.

The recent launch of the University Multispectral Laboratories (UML), a national sensor test and development facility headquartered in Ponca City, only expands the capabilities of Oklahoma's sensor industry. Providing services to government, industry and academia, the UML highlights Oklahoma as the 'go-to' state for sensor research and development.

Thanks to this progress, Oklahoma is quickly becoming known for its sensor research and development capabilities. It will take a continued commitment to this process to ensure the state maintains its piece of this very large sensor industry pie. With an emphasis on research as well as support for the sensor companies in Oklahoma, the state will continue its rise to national prominence in the global sensor industry.

Sensor Research at Oklahoma State University



Since 2002, sensors and sensor-related technologies have been identified and pursued as a major research focus at Oklahoma State University. Although already a research strength for OSU at the time, the receipt of \$19 million from the Oklahoma legislature through the Oklahoma State Regents for Higher Education in 2003 launched the program to even higher levels. The funding allowed for the expansion of several sensor-focused laboratories, including 13 new Biosafety Level 3 labs to support chemical and biological sensor research. OSU now maintains the highest concentration of biosafety labs in Oklahoma.

The funding also helped to upgrade and/or add faculty positions, which now total more 60, in the areas of physics, microbiology, electrical engineering, chemical engineering, and others that focus on the development of new sensor technology. Additionally, the OSRHE investment helped to purchase cutting-edge, multi-user equipment for research labs and facilities—equipment that has been essential to the acquisition of major grant funding from agencies like the National Science Foundation and the National Institutes of Health.

Since 2003, OSU has garnered an additional \$80 million in external funding to support its sensor research program.

“By choosing this as a key area of research at OSU we have leveraged existing core strengths and matched current national priorities,” said Stephen McKeever, vice president for research and technology transfer. “Evidence of our progress can be seen in the increase in licensed sensor technologies, the formation of start-up sensor companies, and the continued growth in support from external funding sources.”

OSU’s international collaboration of sensor researchers work on the creation of new science, technology, high-tech companies and jobs through projects with strong commercial potential. Sensor projects are represented throughout the various university departments and cover a range of sensor types. Some recent developments are:

Radiation Sensors

OSU has developed a method for remote detection of radiation using an optical fiber. The system is able to measure radiation in difficult-to-access areas like the sub-soil or in/on patients during radiation therapy.

Successful work continues at OSU’s Radiation Dosimetry Laboratory. Currently, the team of researchers is working to improve on personal radiation monitoring technology licensed to Landauer (see page 14) by adding elements for neutron sensitivity. The team is also investigating the potential of using luminescence techniques to estimate radiation exposure after an accident or terrorist attack. New technologies for measuring cosmic radiation are also being developed.

Chemical/Biological Sensors

OSU scientists are developing methods to detect chemical and biological agents of mass destruction. Chemical agents that can be detected include: nerve agents, cyanide, mustard agents, and numerous compounds classified as toxic industrial compounds. These chemical agents can be detected at less than 7 parts per trillion. The biological agent detector can identify more than 45 different toxins and disease-causing pathogens including influenza virus and cancer cell markers in real time (less than 1 second). The biological sensor can also distinguish between influenza (flu) virus and “Avian flu.”

Researchers in OSU's physics department have developed a micro-optical chemical sensor that is smaller than the period at the end of this sentence. The sensor consists of a glass sphere in contact with an optical fiber and uses light propagating down the fiber to detect trace amounts of various gases. The sensor can detect methane in the air or in an oil storage tank, for example. It could also detect the concentration of carbon monoxide in a home.

Corrosion Sensors

OSU researchers have developed non-powered, wireless sensors able to detect corrosion on pipelines, highway infrastructure and airplanes. The technology is based on low-cost, passive radio frequency identification (RFID) tags like those used for inventory and theft prevention of consumer goods. Once attached to an object or structure, the sensor transmits a characteristic signal from the RFID tag. A technician is able to detect areas of corrosion by the loss of the characteristic signal using a wand-type RFID reader.

Explosives Sensors

OSU chemists have developed a reagent based on nanotechnology that can render explosives into non-explosive compounds. Since this reaction is accompanied by a dramatic color change, researchers are creating three products that use color change as the indicator for the presence of explosive materials. The first is simple test strips, towelettes and inks that can identify improvised explosives or their ingredients. The second is plastic bags with an inside "sensor spot" for screening of liquid products at airports. Travelers would use the bag to store their liquid products, and inspection would require only a brief glance at

the package. The third is tablets for solvent bottles that prevent build-up of explosive peroxides and indicate that the solvent is still safe to use.

Bio-Imaging Sensors

By using near-infrared light, OSU researchers have initiated a novel method for imaging and detecting prostate cancer. Near-infrared light is capable of penetrating deep into the body's soft tissue, interrogating it for the presence of cancerous tissue, which has specific and significant contrast.

Using near-infrared optical tomography and ultrasound, OSU researchers are further developing a multi-modality method for imaging prostate cancer. The ultrasound image is used to localize a lesion, and optical tomography is used to differentiate benign from malignant tissues. This method will ultimately be used for accurate guidance of prostate biopsy.

Chlorine Dioxide Sensor

Chlorine dioxide (ClO₂) is very useful for destruction of microorganisms, mold and odorants in buildings. The treatment of areas, however, requires that a desired concentration of ClO₂ gas be maintained for a specified period of time. OSU researchers have developed an optical sensor that detects ClO₂ gas concentrations during fumigation and transmits results to a remote location. The sensor ensures that ClO₂ levels are maintained long enough to destroy unhealthy materials.

For more information on OSU sensor research, visit sensors.okstate.edu.





UML

University Multispectral Laboratories

OKLAHOMA STATE UNIVERSITY

Based in Ponca City, the OSU University Multispectral Laboratories (UML) is a national center focused on the test, evaluation and implementation of defense, homeland security, energy, and intelligence systems. Wholly owned by OSU and operated by Triton Scientific, an Oklahoma business, the UML brings researchers together with government and industry to rapidly and efficiently advance new technologies and capabilities to the end user. The existence of the UML places Oklahoma at a considerable advantage compared to its neighbors, including the coastal states, in developing a dynamic and enviable sensor-based industry.

Established in 2006 with a \$2 million investment from the Ponca City Development Authority and a \$2 million gift from ConocoPhillips, the UML is an outgrowth of the increased sensor research and development underway at OSU. It is also an outgrowth of the national need in the defense and security markets to accelerate technologies from the bench to the marketplace in support of the nation's war on terror. Focused initially on the defense and homeland security sectors, the UML is designed to identify technology gaps and to work with the technology developers and the end user to refine the technologies into usable and reliable products of immediate use by the military and security agencies.

Currently, the UML has yearly revenue of over \$3 million.

The facility is unique in the United States and enjoys considerable support from the Department of Defense and the Department of Homeland Security. The UML has also forged relationships with universities and agencies throughout the country. Its partners include:

- Johns Hopkins Applied Physics Laboratory
- Penn State University Applied Research Laboratory
- Alcorn State University
- Jackson State University
- Western Kentucky University
- Memorial Institute for the Prevention of Terrorism
- U.S. Army Biometrics Fusion Center
- Livermore National Laboratory
- Los Alamos National Laboratory
- Quicksilver Analytics
- Electronic Warfare Association
- Republic Aero
- AT&T
- ConocoPhillips
- Chilocco Confederated Tribes
- Ponca City Development Authority

More information about the UML is available at www.okstate-uml.org.

UML Headquarters and Business Operations - Ponca City, Oklahoma



This secure 100,000-sq ft facility houses state-of-the-art chemical, biological, explosives, electronics, and radiological laboratories.

Facilities include:

- Sensor, Device, and Systems Testing
- Chemical Synthesis
- Materials Characterization
- Molecular and Microbiology (BSL-2+)
- Medical/Pharmaceutical Process Analytics
- Nuclear and Radiochemistry
- Systems Integration and Development
- Agricultural Development
- Environmental Chambers
- Secure Data Storage
- C4ISR Electronics and Engineering

UML successfully brings these disciplines together in one location to create single-source efficiencies.

Richmond Hill Research Center and Oklahoma State University (OSU) - Stillwater, Oklahoma

The Richmond Hill facility contains a rare co-location of an Anechoic Chamber (20 Mhz - 18 Ghz) and a Reverberation Chamber (80 Mhz - 18 Ghz) in addition to an enviable Chemical Assessment Laboratory.

At OSU, more than 60 faculty members with teaming efforts from academia and industrial partners, focus on the creation of new science and technology. Sensor technology includes:

- Chemical sensors
- Body Armor
- Smart textile & clothing
- Mobile robots for multi-vehicle control platforms
- Sensor-based modeling for improved manufacturing
- Biosensors
- Sensors for precision farming
- Neutron & Radiation Dosimetry applications
- Retinal imaging for non-invasive disease study
- Integrated target detection, tracking classification
- Learning dual-band infrared imagery



Chilocco- A Truly Unique Outdoor Technical and Tactical Training and Testing Facility

This vacant, secluded 5,000-acre facility, located 25 miles north of Ponca City, consists of an abandoned training school with 75 buildings, rolling terrain, small lakes, flat prairies, and a variety of creeks. Named "Chilocco," this four-season facility provides excellent opportunities for rural, urban, and aviation operational testing and support training in fast tracking, development, RDT&E, and certification for:

- CBRNE Sensors
- C4ISR Sensors & related technologies
- Biometrics
- PSYOP
- Threat-based Sensors
- Task-based Sensors
- Commercial/Government requirements
- RF Sensors and communications testing
- Realistic training of first responders, DoD personnel, UWAC, SWT, and LF



UAS Testing and Training Facility - Lawton, Oklahoma

Located adjacent to the unique Fort Sill Army ranges, our UAS range provides large areas of restricted airspace for safe UAS flights without the requirement of securing military COAs or civilian special airworthiness certificates. The newly installed 500' X 40' asphalt runway with adjacent office, hangar, and RV hookups provide cost-effective facilities for UAS development, testing, and training.

Our UAS testing, certification, and development facilities provide one-stop UAS development services. Electronic interference testing at Richmond Hill complements the real world flight development opportunities at Fort Sill and the system integration demonstrations at Chilocco.



SENSOR Companies in Oklahoma

Whether they are university spin-outs, have long-time ties to Oklahoma or simply located here to be close to sensor research, these companies are players in the global sensor industry. They are technology innovators, and their products and services meet needs.



ICx Nomadics

Stillwater, OK

ICx Technologies™ is an international sensor development company with more than 20 locations worldwide. The company manufactures, tests, and markets an extensive range of biological, chemical, radiation, nuclear and explosives detection systems. Founded in 2003, ICx went public in 2007 and now trades on NASDAQ under the ticker ICXT. Stillwater-based Nomadics was acquired by ICx in 2005, primarily because of its proficiency in the area of explosives detection.

“Acquiring Nomadics was strategic for ICx,” said Colin Cumming, chief technology officer and president of ICx Detection. “We wanted to augment our expertise in sensors by adding its explosives detection technology and the expertise that came along with it.”

Fido®, the explosives-detection technology first developed at Nomadics, is a portable system weighing less than three pounds. Able to identify even trace amounts of explosive materials, such as vapors, the system’s level of detection is comparable to that of a highly trained explosives-detection canine, hence its name. Fido has numerous explosives-detection applications.

Fido® OnBoard™ is a system that can not only detect but also disarm explosive devices using on-board, robotic capabilities. Because of these robotic capabilities, Fido OnBoard prevents humans and animals from having to examine objects or areas for explosive materials.

Fido® PaxPoint™ is a liquid-screening system that detects chemicals used to produce homemade explosive devices. With applications in transportation security, military screening operations and entry control points, the hand-held device provides real time results and was designed to quickly screen both passengers and baggage for a variety of so-called innocuous liquid threats.



Fido® OnBoard examines vehicle wreckage for explosive devices, vapors or particulates.

In addition to these and other explosives detection systems, ICx manufactures numerous sensors with chemical, nuclear, radiation and biological applications.

BioCapture® is a hand-held air sampler designed for first responders working in unfamiliar, challenging and dangerous environments. Large, single-button operation allows workers to quickly execute a sampling mission.

The BioBadge® is a portable personal air sampler about the size of a cell phone. It can be worn by an individual or placed discretely in an area of suspect contamination.

ICx Technologies’ products can be found working in areas around the globe to enhance safety and security. This includes events like Mardi Gras, the Super Bowl and at Washington’s National Mall during July 4 celebrations. ICx also has security solutions in locations like the Statue of Liberty, Hoover Dam, Iraq and Afghanistan.

A first responder uses BioCapture® to sample the air for threats such as anthrax, plague, smallpox and tularemia.



The BioBadge® portable personal air sampler is worn by an individual to monitor exposure to biological organisms.

Photos provided.

ICx Nomadics
1024 S. Innovation Way
Stillwater, OK 74074
405-372-9535
www.icxt.com



Ekips Technologies

Norman, OK

Ekips Technologies is a Norman-based company that develops lasers and laser-based sensor systems for the detection of specific gas-phase molecules. A spin-out of the University of Oklahoma, Ekips' laser spectrometers can detect gas-phase molecules in real time (less than one second) and can sense these molecules at high sensitivities (parts per billion). Ekips' Breathmeter is a specialized laser spectrometer that, using exhaled breath, detects certain biomarkers for conditions and/or diseases like asthma, diabetes, schizophrenia and cancer.

Since beginning operations in 2000, Ekips has built five different prototypes of the Breathmeter. The company recently used the device to test more than 2,000 people for the presence of gas-phase molecules that indicate asthma.

"The concept of using exhaled breath to detect disease is not new," Ekips President Patrick McCann said. "For several years reports have been published about a dog's ability to identify patients with cancer by sniffing urine or breath samples."

Currently, the Breathmeter is for research purposes only. McCann said Ekips' ultimate goal is to make an inexpensive, hand-held Breathmeter that people could use to monitor their individual gas-phase molecule levels. In the near future, however, McCann said Ekips will work on making the Breathmeter smaller and more affordable for researchers and clinics.

"Researchers need instruments like the Breathmeter so they can study the biochemistry of breath analysis," McCann said. "More work on the laser technology will help reduce the cost so an NIH-funded researcher could afford to purchase one to determine which molecules are biomarkers for certain diseases."



A nurse assists a child in providing a breath sample using the Breathmeter, a device that detects biomarkers for diseases/conditions like asthma, diabetes, schizophrenia and cancer.

Photos provided.

Ekips Technologies
710 Asp Avenue,
Suite 500
Norman, OK 73069
405-307-8803
www.ekipstech.com

GRC

Tulsa, OK

Geophysical Research Company is a Tulsa-based manufacturer of high-tech gauges that measure pressure and temperature in oil wells. Founded in 1925 by Amerada Petroleum Corporation, GRC began by investigating the possibility of applying geophysical methods to oil exploration. The products developed by GRC more than 80 years ago enabled engineers and geophysicists to determine reservoir capacity and performance.

Today, GRC serves the entire oil industry. The company maintains a long list of clients including some of the world's largest and most well known E&P and service companies, national oil companies, independents, majors, and smaller companies. "We work to make our customers successful by developing innovative technology that reliably and accurately measures pressure and temperature under strenuous conditions over long periods of time," said Suzanne Behr, vice president of engineering.

GRC incorporates three types of sensors in its product lines: quartz resonators, gap capacitance and piezoresistive. Although the sensors measure temperature and/or pressure in different ways, they are used in GRC gauges to provide highly sensitive data to engineers at the surface of a well. The engineers interpret these data to monitor the production of hydrocarbons. Even small increments in pressure could indicate a significant change in an oil well, so many of GRC's gauges have very high accuracies and resolutions.

Through Chris Hutchens, associate professor of electrical engineering, OSU and GRC have recently entered into a grant relationship. Under the grant from GRC, an OSU postdoctoral graduate student will design a high temperature PBC board that can receive and record signals from a particular sensor. Behr said the OSU student and engineers from GRC will collectively share information, test designs and review results leading toward a successful final product.



Pictured above are various GRC gauges used to monitor pressure and temperature in oil wells.
Photos provided.



**Geophysical Research
Company**
6540 E. Apache
Tulsa, OK 74115
918-834-9600
www.grcamerada.com

LANDAUER®

Landauer

Stillwater, OK

Landauer is the world's leading provider of technical and analytical services and products to determine occupational and environmental radiation exposure. For more than 50 years, the company has provided complete radiation dosimetry services to hospitals, medical and dental offices, universities, national laboratories, and other industries in which radiation poses a potential threat to employees. Landauer's services include the manufacture of various types of radiation detection monitors (also known as radiation badges), the distribution and collection of the monitors to and from clients, and the analysis and reporting of exposure findings.

The company was founded in 1954 in the suburbs of Chicago by Bob Landauer. Today, Landauer has divisions and/or joint ventures in Japan, France, United Kingdom, Canada, Mexico, Australia, China and Brazil. The company manufactures, distributes, and processes around 13 million radiation badges every year. About 1.5 million people around the world receive radiation dosimetry service from the company.

The badges function based on a technique called Optically Stimulated Luminescence (OSL), which uses luminescence emitted from radiation-sensitive materials to measure radiation exposure. The OSL technique was developed by researchers at OSU and licensed to

Landauer in 1998. Since that time, Landauer had continued successful collaborations with OSU scientists.

“Our collaborative projects with OSU researchers Dr. Eduardo Yukihiro and Dr. Eric Benton are related to development of new radiation sensor technologies and benefit our society by having better tools for protection of people working with radiation as well as assuring precise delivery of radiation doses during radiotherapy procedures in oncology,” said Mark Akselrod, chief scientist and executive manager of Stillwater Crystal Growth Division of Landauer.

Aluminum oxide crystals and powders are key components in OSL technology. Stillwater Crystal Growth Division of Landauer produces and supplies all the aluminum oxide materials used by the company. The Stillwater division also conducts an active research program for the development of new products and applications of aluminum oxide crystals. The remaining part of the business that includes manufacturing and analysis of radiation badges is conducted at the company's main laboratories in Glenwood, Ill. and in subsidiaries around the globe.



(Top) These small squares are radiation detectors made from the crystal of luminescent aluminum oxide pictured above them.

(Above) Radiation badges made from aluminum oxide and OSL technology.

Photos provided.

Landauer
723 1/2 Eastgate
Stillwater, OK 74074
405-377-5161
www.launderc.com



OSL reader used for the automatic processing of 200 radiation badges.



Engius
Constructive Intelligence

Engius

Stillwater, OK

Stillwater-based Engius is a company that specializes in the development and distribution of high-tech construction instrumentation. A spin-out of ICx Nomadics, Engius' original product, IntelliRock, began as an internal project at Nomadics in 2002. In 2004, Engius LLC was formed to focus specifically on the needs of the construction industry.

Although Engius has developed several technologies in its short existence, Michael Fox, chief operating officer, says IntelliRock is the company's most widely used product. Using a microprocessor and temperature sensor embedded in a concrete structure, IntelliRock monitors the concrete curing process without the use of permanently affixed external instruments. When connected to a handheld device, the microprocessor and sensor (called a logger) transmit various readings about the structure's strength and moisture levels. A new wireless IntelliRock system can send readings directly to the contractor's computer.

Before IntelliRock, Fox said contractors relied on cylindrical test specimens to determine when to strip the forms from a concrete structure. However, since mass traps heat and the structures are comparably much larger than the test specimens, the structures would reach their target strength days sooner than the test specimens. For contractors, those days spent waiting for the test specimens to reach target strength translated into lost time and money.

intelliRockTM
concrete facts • superior results

"IntelliRock measures the actual in-place temperature when reporting concrete strength," Fox said. "The strength readings are available anytime with the press of a button, and are much more accurate than relying solely on traditional testing methods. The result is often a tremendous speed increase in concrete operations, which means time and money to the job."

IntelliRock assisted with the reconstruction of the I-40 bridge after it was hit by a barge and collapsed near Webbers Falls in May 2002. The system played a major role in the timely reopening of the bridge, and enabled the general contractor to receive a \$1.5 million bonus for completing the project 10 days ahead of schedule.

In addition to the I-40 reconstruction project, IntelliRock has been used in numerous construction projects throughout Oklahoma, the United States, and internationally. Examples include:

- Stadium expansions at both Oklahoma State University and University of Oklahoma
- Parking garage at Will Rogers World Airport
- San Francisco Bay Bridge
- New bridges around Hoover Dam
- Hatsfield Jackson Airport



Contractors use the IntelliRock to determine the maturity of new concrete structures.

Photos provided.

Engius
712 Eastgate
Stillwater, OK 74074
866-636-4487
www.engius.com



N-Tech Industries

Ukiah, CA

N-Tech Industries is a manufacturer of sensor-based agricultural nutrient and herbicide delivery systems. Its GreenSeeker and WeedSeeker products utilize optical sensing technologies to deliver precise amounts of nutrients, herbicides, pesticides and other inputs to a variety of crops, which maximize yield and minimize environmental impact.

Although N-Tech is located in California, its ties to Oklahoma go back to the mid-1990s. Since 1991, OSU agricultural researchers have worked on numerous methods for detecting/spraying weeds, applying precise amounts of fertilizer and increasing crop yield. After acquiring a company with several patents for optical sensing technologies, N-Tech CEO John Mayfield, a native Oklahoman, contacted OSU's plant and soil sciences department about similar research being conducted in Stillwater.

In 2001, OSU and N-Tech signed a master research and license agreement for optical sensing technologies. OSU receives royalties on any products sold that fall under the agreement—one of which is the GreenSeeker. "The OSU relationship and agreements are integral to N-Tech's business plan," Mayfield said.

The GreenSeeker works by utilizing optical sensors to assess the vigor and health of crop plants as an application rig moves across a field. These data are then used in real time to drive variable-rate applications of nitrogen fertilizer or other crop production inputs.

The WeedSeeker uses advanced optics and computer circuitry to sense if a weed is present. When a weed enters the 12"-wide field of view of the sensor, it signals a spray nozzle to deliver a precise amount of herbicide. The WeedSeeker® will spray only weeds, not bare ground.

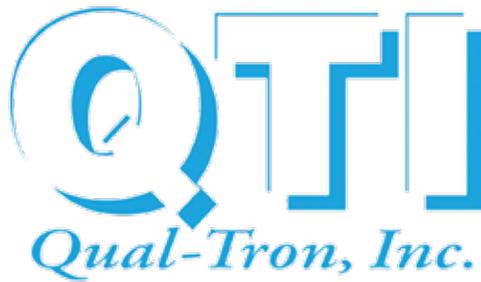
N-Tech's clients include: farmers, researchers, city/county governments, state departments of transportation, U.S. military, airports, railroads and contract sprayers.

N-Tech Industries
740 S. State St.
Ukiah, CA 95482
707-467-3747
www.ntechindustries.com

(Top) An application rig prepares to treat a vineyard using the WeedSeeker.

(Above) The GreenSeeker sensor attached to an application rig ready to fertilize crop plants.

Photos provided.



Qual-Tron Inc.

Tulsa, OK

Qual-Tron Inc. is a Tulsa-based company that manufactures a full range of unattended ground sensors and intrusion detection equipment used by U.S. and foreign militaries, government agencies and law enforcement agencies. Its products have applications and meet requirements for force protection, perimeter security and surveillance operations. In addition, the company designs, develops and tests new products needed by these various agencies.

Founded in 1978, Qual-Tron entered the sensor industry in the mid-1980s. The company worked with Sandia National Laboratories to develop its first products—a Mini Intrusion Detection System (MIDS) and standard magnetic, seismic and passive infrared sensors. The MIDS is a single channel fixed frequency system capable of monitoring up to 32 sensors and equipped with a built-in sensor fault alarm. A modified version of the original MIDS is capable of monitoring up to 999 sensors and includes additional data messages.

Qual-Tron's systems are portable battery operated equipment using standard 9-volt DC alkaline batteries, and have a battery life of 9-12 months. A full range of sensors is used to detect various targets on the ground, in the air, and in the water. When activity is detected, they transmit wireless, digitally encoded alarms using VHF or Satcom communications to provide worldwide sensor monitoring. Since most of the systems are deployed in covert operations, it is unlikely the general public will ever actually see the products at work. What can be seen, however, are the products' positive results.

“Our sensors are used all over the world,” said Dan Chambers, Qual-Tron's vice president for sales and marketing. “If deployed correctly, the bad guys never know they are there.”

Although the transmission range depends on line of sight from the sensor to the monitor, with no obstructions Chambers says the systems have achieved transmission ranges of over 15 miles. If obstructions are present, relays can be used to transmit messages from the sensor to the monitoring site.



Soldiers employ a Qual-Tron perimeter security system.

Photos provided.



Military officers examine one of Qual-Tron's unattended ground sensors deployed in the field.

Qual-Tron, Inc.
9409 E. 55th Pl. S.
Tulsa, OK 74145
918-622-7052
www.qual-tron.com



(Top) Rendering of Sciperio's Future Force Warrior personal antenna system, which enables soldiers to be data-linked as part of the U.S. Army's "Digital Soldier" initiative.

(Above) An unmanned aerial vehicle carries a rope wrapped with a Sciperio antenna.

Photos provided.

Sciperio
6421 S. Air Depot
Blvd., Suite B
Oklahoma City, OK
73135
405-622-9200
www.sciperio.com

Sciperio

Oklahoma City, OK

Founded in 1996, Oklahoma City-based Sciperio designs and builds unique antennas for the U.S. military, government agencies and defense prime contractors. Sciperio builds its antennas to match customer requirements with emphasis on small physical size, conforming antennas to fit on other objects, and integrating them to form part of other objects the customer already owns. Examples include:

- A near-weightless, near-zero, drag surface-applied antenna for a small, pilotless aircraft enabling it to perform intelligence functions, which previously required a larger manned aircraft.
- An antenna that conforms to the casing of an aircraft transmitter pod. This antenna enabled the customer to forgo an expensive, heavy and maintenance-intensive trailing wire antenna.
- Radically shrunken and more power-efficient radio frequency ID (RFID) tags, which allow this powerful tagging and tracking technology to extend to a greater variety of goods and applications.
- Soldier-worn antennas enabling individual soldiers to be data-linked as part of the "Digital Soldier" initiative under the U.S. Army's Future Force Warrior program.
- Various radically miniaturized antennas enabling communication between devices that otherwise are too small to be networked.

All of Sciperio's antennas are produced using in-house machining and assembly facilities, and are tested in the company's fully instrumented anechoic chamber. Although Sciperio's antenna work is currently integrated into military and other government electronic systems, John Felkner, director of business development, says the company is exploring consumer markets for specialty antennas.

"As consumer electronics are, in general, viciously cost-competitive, we find mass marketed wireless devices a difficult market to crack," Felkner said. "We anticipate serving specialized consumer segments where the users are aware of opportunities to improve the radio performance of their devices and are willing to install specialized antennas in order to see improved performance. We are targeting the advanced radio-controlled model hobbyist, aviation radio user, and professional mobile computing user markets."

In addition to the development of small scale antennas, Sciperio also operates in a think tank capacity for research and pre-production work in the science and engineering disciplines. The company designs and builds working prototypes of products, often in partnership with other similarly-sized companies.

Water purification systems are a current focus of the company's think tank work. Just as many families see a portable electric generator as an essential emergency preparedness item, Sciperio hopes to be able to provide liquid-fueled, reverse-osmosis water purifiers capable of providing ample water for a family's comfortable survival given access to a small amount of fuel and presumably contaminated feedwater. This system would also have applications for individual soldiers who need to purify their own water.

"Our 'think tank' practice specializes in applying interdisciplinary thinking to arrive at beyond-evolutionary novel solutions to problems in electronics, mechanical systems, and applied physics which have resisted solution," Felkner said. "We look for opportunities to remove process steps and energy conversions that produce losses inherent in existing solutions, thus enabling developmental leaps rather than incremental improvements in efficiency."

SensorCorr

SensorCorr

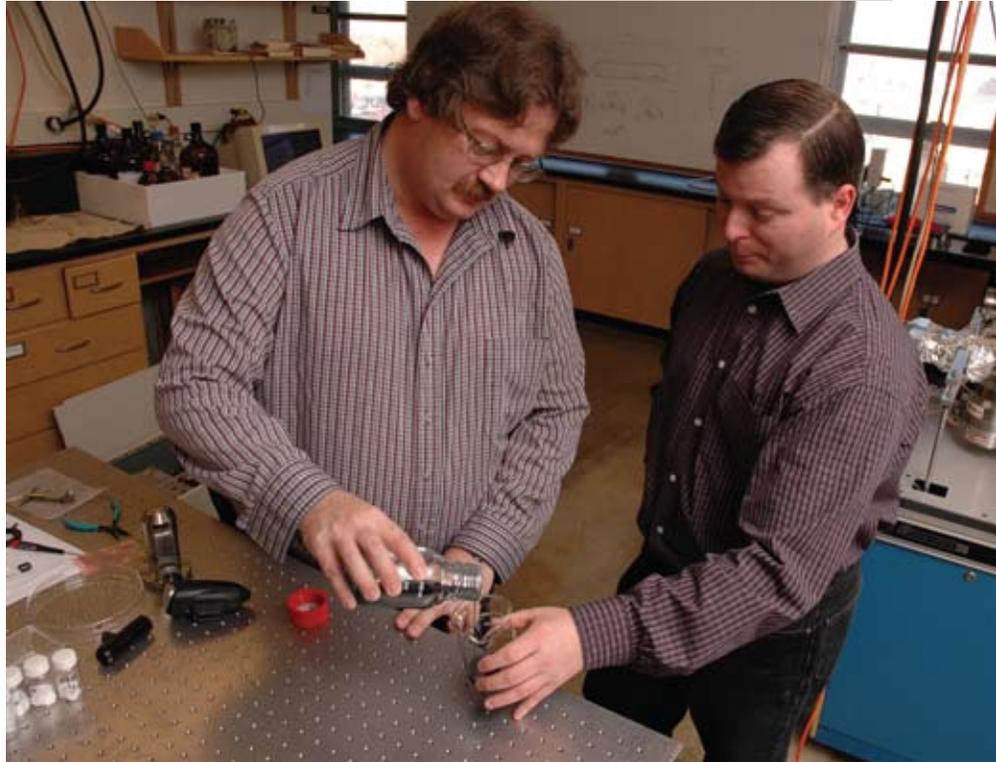
Stillwater, OK

SensorCorr is an OSU spin-out company formed in 2005 to focus on the commercialization of non-powered, wireless corrosion sensors developed by OSU researchers Allan Apblett and Nick Materer. The sensors are designed to detect corrosion on pipelines, highway infrastructure and airplanes.

“Corrosion is an over \$300 billion annual problem in the United States,” Apblett said. “From plane crashes, to bridge failure, to the catastrophic loss of 75 percent of the Alaskan pipeline, corrosion, and the failure to adequately detect its presence, represents a significant problem. The insidious nature of corrosion means it can remain undetected until catastrophe strikes.”

The technology is based on low-cost, passive radio frequency identification (RFID) tags like those used for inventory and theft prevention of consumer goods. Once attached to an object or structure, the sensor transmits a characteristic signal from its RFID tag. It is the loss of this characteristic signal that indicates the presence of corrosion. A technician is able to detect the signal, or the loss of it, using a wand-type RFID reader. The sensor can also be deployed in the open air of an internal space to measure the corrosivity of the environment.

Due to the wide availability of RFID tags and the packaged inventory control software that goes with them, Apblett said these systems are inexpensive to make and easy to use. These advantages allow the sensors to be easily placed at many locations and give them a greater utility over more complex sensor systems that report degrees of corrosion at fewer locations. In addition, low manufacturing cost allows the use of multiple sensors with different trigger levels. These may be utilized to indicate a range of conditions from the point where preventive maintenance is required to the point where imminent structure failure is at hand.



SensorCorr founders, Drs. Apblett and Materer, work in their lab in Stillwater.

Photo credit: Oklahoma State University

Apblett said the development of the sensors for pipeline monitoring and highway infrastructure is proceeding rapidly with funding from the Oklahoma Center for the Advancement of Science and Technology and the Oklahoma Transportation Center. Aerospace applications constitute a third lucrative avenue for this research that Apblett says they also plan to pursue.

SensorCorr
allen.apblett@
okstate.edu
nicholas.materer@
okstate.edu



Triton Scientific

Ponca City, OK

Triton Scientific is a sensor test, evaluation and certification company that began operations in September 2007. In January 2008, Triton assumed responsibilities for the management and operation of the OSU University Multispectral Laboratories (UML) in Ponca City.

As manager and operator of the UML, Triton provides the leadership, management, and scientific and engineering staff required to execute a broad variety of programs. The principal role of its staff is the research, test, evaluation, verification, validation, certification and implementation of sensor technologies and systems. Free from organizational conflicts of interest with government, industry, academia, manufacturers, other stakeholders, and/or any other entity, Triton serves as a trusted agent to technology researchers, developers, manufacturers, government agencies, and end users.

The primary systems assessed by Triton include: chemical, biological, radiological, nuclear, explosive (CBRNE); command, control, communications, and computing for intelligence, surveillance, and reconnaissance (C4ISR); unmanned aerial systems (UAS); petrochemical; biofuels; biometrics; psychological operations (PSYOP); medical; and pharmaceutical.

“Sensors are ubiquitous in our society and can be found in homes, workplaces, cars and public transportation,” said Web Keogh, president of Triton and lab director at the UML. “If people look around they will find sensors similar to one’s we test and evaluate in the hands of their police and first responder force, at public transportation venues, at airports, and at theme parks.”

Triton serves academic, government and commercial clients from the defense, security, energy and intelligence communities. Of note are its clients from the United States Special Operations Command, Naval Air Systems Command, Space and Naval Warfare Systems Center, Defense Threat Reduction Agency, and the Department of Homeland Security.



(Top) Brett Waller, an engineer at the UML, inspects equipment at facility in Ponca City.

(Above) A completely renovated biological laboratory at the UML.

Photo credit: Gary Lawson



The staff of Triton Scientific at the UML grand opening on June 3, 2008.

Triton Scientific
500 W. South Ave.
Ponca City, OK 74601
580-767-8865
www.okstate-uml.org



Sensor innovations have room to grow at

Oklahoma Technology and Research Park

Through a partnership designed to enhance and enable high-tech innovations, the City of Stillwater, Meridian Technology Center and Oklahoma State University are giving Oklahoma's sensor industry another big boost. The Oklahoma Technology and Research Park is a 170-acre site master planned for one million square feet of lab, office and support space. Organized as a cluster, campus-style environment, the OTRP brings researchers from OSU together with emerging high-tech companies to facilitate interactions.

Sensors are a technology focus at the OTRP, and Venture I, the first of three multi-tenant facilities planned for the Park, currently houses some of OSU's leading sensor research programs. These include the Radiation Dosimetry Laboratory, Molecular Diagnostics and Biosensor Technology Laboratory, and Corrosion Prevention Laboratory. Other current OTRP tenants include ICx Nomadics, Lucas Newman Science and Technologies, and ERIL Research.

The benefits for sensor companies housed at the OTRP extend beyond access to high-quality, Class A laboratory and/or office space. OTRP offers tenants a long list of business and economic development advantages as well. Those desiring to re-locate to

the Stillwater area are eligible for a one-time, \$1,000 relocation incentive for each full-time employee courtesy of the Stillwater Chamber of Commerce's "Forward Stillwater" program.

OSU offers OTRP tenants a "Tech-Partner" status with the university, which includes pro-bono patent assistance from OSU's patent counsel, use of the OSU Electron Microscopy Lab, an OSU Wellness Center membership, access to OSU campus and community bus transportation system, full university bookstore privileges and full university library privileges.

Through Meridian Technology Center, OTRP tenants have access to Meridian's Center for Business Development, grant writing assistance, customized business training, cafeteria and catering services, and conference and meeting room space.

Through the OTRP board, tenants are also eligible for the OTRP Small Grants Program, which provides financial assistance for relocation and business development. The OTRP board will also assist tenants in gaining access to various state incentive packages that aid in the development of new technology companies.

For more information on OTRP, visit www.oktechpark.com.



OKLAHOMA SENSOR CORRIDOR

**Oklahoma
Sensor Corridor
further enhances
growing sensor
industry**

In March 2008,

trustees from the Ponca City Development Authority signed a memorandum of understanding with OSU's Center for Innovation and Economic Development to formally establish the Oklahoma Sensor Corridor. The goal of the corridor is to develop an industry cluster around the sensor industry and comes in response to the growing success of sensor research and development at the University Multispectral Laboratories and at OSU. The corridor runs along U.S. highway 177 between Stillwater and Ponca City and includes the counties of Kay, Noble and Payne, an area with a combined population of approximately 130,000 residents and home to 24 sensor companies.

“People usually think of an industry cluster as an area with a strong base of companies in a particular industry,” said David Myers, PCDA executive director. “We are adding to that notion by consciously developing the workforce resources and the business infrastructure to create a great place for an industry to thrive.”

The Oklahoma Sensor Corridor is being spearheaded by the OSU Center for Innovation and Economic Development. Glenn Freedman, CIED's vice president for research and programs, serves as the chair of the newly formed Sensor Corridor Steering Committee. Other members include private businesses involved in the industry, PCDA, Pioneer Technology Center, Meridian Technology Center, Stillwater Chamber of Commerce, the Stillwater Industrial Foundation, the Perry Chamber of Commerce and Stephen McKeever, OSU's vice president for research and technology transfer.

Among the steering committee's initial tasks have been the identification of existing companies in the area that are involved in the research or deployment of sensors as well as the development of a list of potential targets for recruitment to the area to take advantage of what the corridor has to offer. The committee has also submitted two grant proposals to the U.S. Department of Agriculture's Rural Development Program to provide the initial funding necessary to support the workforce and meet the needs of the sensor companies.

“The formation of the Oklahoma Sensor Corridor is a big step in the right direction for Oklahoma's sensor industry,” said Freedman. “The steering committee, responding to company needs, will establish the infrastructure necessary to support the continued growth of the sensor industry in this area. It's a big market, and with OSU and the UML anchoring the corridor we're sure to stay on the forefront of research and development with technology that serves all sectors of the sensor industry.”

HIGH-IMPACT INVOLVEMENT



Joe Alexander (center) presents a check to Kirk Jewell (left), president of the OSU Foundation, and Burns Hargis (right), president of Oklahoma State University.

A recent \$500,000 gift from the OSU Center for Innovation and Economic Development creates OSU's first endowed chair in sensor technology. Once fully matched dollar-for-dollar by T. Boone Pickens' \$100 million chair match commitment, as well as the Oklahoma State Regents for Higher Education, the gift will provide a \$2 million impact on OSU's sensor research program.

"We sought to find the biggest impact on research that would spur the greatest economic development - not only for Stillwater - but for the entire state, and we think that opportunity lies here," said Joe Alexander, CIED president. "People are our most important asset, and we believe this chair program is going to bring the highest-quality researchers and academics to study at OSU."



*create / innovate / educate / **Go STATE***

Oklahoma State University
Office of Vice President for Research and Technology Transfer
203 Whitehurst
Stillwater, OK 74078-1020

Non-Profit
U.S. Postage
PAID
Stillwater, OK
Permit #191