Economic impacts of ORNL's commercial successes

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This Historically Speaking column is written by Carolyn Krause.

The Oak Ridge National Laboratory's innovations have had significant economic impacts, said Jim Roberto in a recent talk to the Rotary Club of Oak Ridge. The lab's associate director for science and technology partnerships presented the "billion-dollar" impacts of ORNL inventions. Now that the Cold War is over, he added, the lab's missions include inventing technologies that could have a beneficial impact on the U.S. economy.

ORNL's first major technology transfer event, Roberto said, was the production of radioisotopes at the Graphite Reactor and their distribution, starting with the transport of a carbon radioisotope in 1946 to a St. Louis hospital for cancer treatment. By the 1960s ORNL was making 100,000 shipments of radioisotopes annually for medicine, industry and research; then the private sector took over most radioisotope production and distribution.

ORNL's High Flux Isotope Reactor, built in the 1960s, produces radioisotopes that only a world-class reactor can provide. Today the production and delivery of radioisotopes annually for more than 10 million therapeutic procedures and 100 million diagnostic tests constitute a multibillion-dollar industry.

In the 1940s ORNL developed a procedure for separating plutonium from irradiated uranium reactor fuel; today the lab's PUREX method is the basis for France's nuclear reprocessing industry, another billion-dollar impact.

One of ORNL's chemical separations innovations will be used in a $1.6 billion waste processing facility being built at Savannah River National Laboratory. The technology will separate highly radioactive cesium from defense materials that are otherwise low-level radioactive waste; the plant is projected to save the government $10 billion in disposal costs over its lifetime.

ORNL researchers also made the calculations that have allowed the extension of the lifetimes of American nuclear power plants from 40 years to 60 years, avoiding an expenditure of $20 billion to build new plants. These reactors provide almost one-fifth of the nation's electricity. ORNL trained people to become reactor engineers, including students from MIT who later founded MIT's nuclear engineering department.

The centrifuge technology developed in Oak Ridge has been used to purify polio vaccines. Today ORNL is managing DOE's centrifuge-based uranium enrichment R&D to prepare for meeting the nation's future national security needs.

ORTEC, an ORNL spinoff in the 1960s that manufactured and sold nuclear instrumentation, was later sold to EG&G. Terry Douglas, formerly of ORNL and later ORTEC, founded CTI in Knoxville, where positron emission tomography (PET) machines used for brain scans were further developed and commercialized. In 2005, Siemens purchased CTI for $1 billion; today it is a market leader in PET scanning devices.

ORNL is dedicated to improving the performance of materials to make energy production more efficient with less loss of heat. Hastelloy N was developed for the molten-salt reactor, an ORNL innovation that is making a comeback because it has drawn international interest. The ASME P91 steel, which was developed at ORNL in the 1980s for fast breeder reactors, is now used worldwide for pressure vessels; sales have totaled more than $400 million. ORNL research with

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General Electric on silicon carbide–silicon ceramic composites helped enable the development of new materials for the latest GE aircraft engine; GE has $1 billion in preorders for this engine.

Carbon foam, developed in 1987, is a lightweight material that efficiently wicks away heat from light-emitting diodes (LEDs) to keep them cool. LED lights with carbon foam are not as heavy as LEDs with aluminum heat sinks, so LED North America in Oak Ridge produced the bright, high-power, carbon foam–cooled LEDs that hang from the Thompson-Boling basketball arena's ceiling, which is not designed to hold heavy lights.

Thin-film batteries developed in the late 1980s at ORNL were licensed to five companies, later acquired by Apple Computer, for use in microelectronics devices and sensors. In the 1960s when integrated circuit technology was being developed, the best way to test thousands of ion implantations to see if the contacts would work was to use the calutrons at Y-12. Later ion implantation at ORNL resulted in hardened, longer-lasting artificial hips and knees. In the 1990s tens of thousands of hip and knee replacements used ORNL's ion-implanted material.

In high-temperature superconductivity research, ORNL made longer wires of superconducting material and licensed the technology to American Superconductor, which is the largest supplier of superconducting wire in the world. In 1987 the lab on a chip was invented by Mike Ramsey, who founded Caliper Technology in 1997 to create and sell lab-on-a-chip devices. He sold Caliper for $600 million to Perkin Elmer. His technology performs biomedical analysis quickly using smaller samples while producing less waste, reducing costs.

Landscan, the world's foremost global population database developed in the 1990s at ORNL, is used for agricultural and economic planning, disaster relief (by identifying where people were following the Indian Ocean tsunami in 2004), and location of rural populations that need medical services. With funding by the Bill and Melinda Gates Foundation, Landscan developers are locating children in West Africa who need polio vaccinations. Hundreds of copies of Landscan are in use worldwide.

Technology deployment, Roberto said, is a key priority for national labs. He noted that ORNL inventions going to market as new products are water-repelling, "superhydrophobic" coatings that can be used in windshield wipers; a smart smoke detector that minimizes false alarms and a hand-held mass spectrometer for monitoring changes in the environment. One new ORNL approach is a high-technology cluster that is hard to move and is based on ORNL strengths in carbon fiber and additive manufacturing (3D printing) to make cars that are lighter and, therefore, more fuel efficient.

Thanks Carolyn! Oak Ridge is one of a small group of cities where there is a national laboratory that can produce such remarkable accomplishments.

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Jim Roberto, Associate Laboratory Director for Science and Technology Partnerships (photo by Charles Samuels)