

Thom Mason: partnerships spur economic development

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Carolyn Krause bring us another in her series on Oak Ridge National Laboratory Directors. This time she brings us insights into the current director, Thom Mason. She does this by interviewing him and letting him share with you readers some of the amazing scientific breakthroughs coming from the laboratory.

Enjoy the interview.

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The question science writers seek to answer for the public is "Why should we care about science and the scientific research that national labs do?" Thom Mason, who is in his eighth year as director of the Department of Energy's Oak Ridge National Laboratory, answers the question convincingly. He tells of ORNL's involvement as a research lab in revolutionary manufacturing of vehicle parts and revolutionary lighting of indoor sports arenas.

Mason, who became director in 2007 after leading the completion of the Spallation Neutron Source, is particularly pleased with the support ORNL receives from DOE, other federal agencies and the state of Tennessee. He is delighted by ORNL's successful interactions with the University of Tennessee, other universities and many industrial partners. "The regional business community is also interested in what we do," he added.

The ORNL highlight of public interest in the past year was the three-dimensional (3D) printing and public display of two cars with different designs. Jay Rogers, a former U.S. Marine, moved his company Local Motors from Phoenix, Ariz., to Knoxville in 2013 to use the 3D printing capabilities of ORNL's Manufacturing Demonstration Facility (MDF) in Knox County. Local Motors is now in Market Square in Knoxville.

ORNL has the most comprehensive materials and energy research portfolio in the United States, so it's not surprising Rogers was attracted to the area. In 2014 ORNL and Local Motors signed a cooperative research and development agreement to enable rapid design and manufacturing of vehicle prototypes through direct digital manufacturing.

At the North American Auto Show in Detroit last month, the 3D-printed Shelby Cobra was one of the stars of the show. It received considerable media attention. Rogers and the car were shown on national TV.

According to Mason, the ORNL video made of the revolutionary manufacturing process and shown at the auto show in Detroit holds an all-time record for ORNL videos, with more than 50,000 hits on YouTube on Jan. 16, 2015, when Mason was interviewed. On Jan. 9, President Obama spoke with Mason and saw the car when he spoke in Clinton.

The 3D-printed Shelby Cobra was the product of the MDF and four companies – and it took only six weeks to manufacture it. Making a prototype this way instead of building a clay model for a new car design is much faster, less expensive and more energy-efficient.

The companies are Local Motors, which selected the design from the many designs submitted to its website from all over the world; Techmer PM (Polymer Modifiers) in Clinton, which produced the carbon fiber-reinforced plastic for the Big Area Additive Manufacturing (BAAM) system at MDF, developed by machine tool manufacturer Cincinnati Inc. in partnership with ORNL, and Tru-Design of Knoxville, which developed a coating to give the car a smooth surface finish.

Mason said the Brookings Institute called this partnership "a great example of how national labs can contribute to economic development."

Last September ORNL's partner Local Motors used the BAAM machine to print a Strati car in about 44 hours at the International Manufacturing Technology Show in Chicago. After large-scale

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additive manufacturing produced the car body, it was fitted with a Renault electric drive train. It received the 2014 Popular Mechanics Breakthrough Award.

At ORNL, Mason said, 3D printing can involve using a supercomputer to accelerate the development of a digital design and trying out new lightweight, strong materials as the “ink” for BAAM. The programmed printer builds an object layer by layer so that the material precisely conforms to the complex digital design, saving energy, minimizing waste and reducing costs. Mason said that 3D printing will likely be used first for making prototypes rapidly for testing and for producing molds for use in high-speed manufacturing of products. ORNL uses the Local Motors platform for testing its technologies, such as wireless charging of the electric car’s battery.

Mason is pleased by President Obama’s Jan. 9 announcement at Techmer PM on the creation of the \$259 million Institute for Advanced Composites Manufacturing Innovation, which is led by UT. (ORNL is managed for DOE by UT-Battelle.)

A partner in IACMI, ORNL pulled together the successful proposal and team. “It has industrial partners along Interstate-75 in Kentucky, Ohio and Indiana,” Mason said. Another partner, he added, is DOE’s National Renewable Energy Laboratory in Colorado.

Through its materials science labs and its Carbon Fiber Technology Facility, ORNL conducts research on producing quality carbon fiber at as low a cost as possible. The two DOE labs will be working with industrial partners to make exceedingly strong, lightweight, carbon-fiber composites for the manufacture of auto parts, wind turbine blades and tanks for storing compressed natural gas for use as fuel in industry and large trucks.

Mason said that CFTF has developed a process for producing a lower-cost carbon fiber composite that meets the auto industry’s performance requirements for strength and stiffness. The composite is lighter than steel, so cars made of the composite would use less fuel per mile. The fiber is made of textile PAN, or polyacrylonitrile, an organic polymer resin that’s a byproduct of petroleum. Textile PAN is used to make expensive carbon fibers for about 25 percent of Boeing and Airbus wide-body airframes.

One way to bring down the cost of carbon fiber to meet the auto industry’s requirements, Mason said, is to use a lower-cost feedstock like lignin from paper mills and biofuels production facilities, where ethanol is made from corn for later addition to gasoline.

ORNL’s Bioenergy Sciences Center (BESC), the SNS and the Oak Ridge Leadership Computing Facility provide data for computer models of lignin to determine its structure, properties and potential for making carbon anodes for lithium batteries in electric cars.

ORNL technology is embedded in the light-emitting diode (LED) lights manufactured by Oak Ridge-based LED North America. When fans attended the UT men’s basketball game against Vanderbilt a year ago, many noticed that part of the basketball court in the Thompson Boling Arena was brighter than the rest.

That was the first day the arena was partially illuminated with Oak Ridge LEDs that are smaller, brighter, longer lasting and up to 85 percent more efficient than the metal halide lights UT has since replaced. The LED gains were enabled by James Klett’s carbon foam cooling technology that was licensed to LED North America. Laced with air pockets, ORNL’s graphite foam conducts heat better, weighs less, costs less and is easier to machine than the metal blade-like fins in heat sinks commonly used to cool LEDs. LED North America is installing the same lights in the basketball arena of Virginia Tech.

Another exciting development, Mason said, was the CRADA-based partnership between General Electric and ORNL that led to the invention of the award-winning, energy-saving GeoSpring heat

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pump water heater, which you can buy at Home Depot or from Amazon. The multinational corporation opened GE Appliance's GeoSpring Hybrid Water Heater manufacturing facility at Appliance Park in Louisville, Ky., creating 1,000 new jobs.

As a result of research on superhydrophobic coatings led by ORNL's John Simpson, Mason said, you can buy Rust Oleum Never Wet products. They repel water and other liquids, protecting against corrosion and wear from exposure to moisture. Never Wet products can be used in or on paints, boots, goggles, lenses, windshield wipers and solar panels, which are less efficient when covered with snow or rainwater.

ORNL continues to show that partnerships among national labs, industrial firms and universities can benefit the public.

NEXT: Thom Mason talks about nuclear energy, clean energy goals, and climate change.

Thanks Carolyn! We in Oak Ridge are fortunate to have the Oak Ridge National Laboratory in our city. We are also fortunate to have Thom Mason as its director. Expect even more amazing discoveries in Carolyn's next installment.



At Techmer PM in Clinton, ORNL's Lonnie Love explains to President Obama and Vice President Biden how 3D printing was used to make the Shelby Cobra in six weeks. *Photo by Randy Sartin Photography*

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UT-Battelle managers surrounding the 3D-printed Shelby Cobra car at the ORNL Cafeteria include ORNL Director Thom Mason, ORNL Deputy Director Jeff Smith and Jeff Wadsworth, former ORNL director and president and CEO of the Battelle Memorial Institute in Columbus, Ohio. *Photo by Jason Richards*



Before Thompson Boling.jpg and After LED Thompson Boling.jpg: Before and after images showing the effect of replacing 110 1100-watt metal halide lamps at the Thompson Boling Arena with 90 400-watt Supersport LED lamps cooled by ORNL's carbon foam.