




# Bringing Metals Into the 21st Century

Joe Steele



**F**rom 3D printing and smart textiles to digital and photonic circuit manufacturing, a great deal of creative and innovative work is being done by the various National Network of Manufacturing Innovation (NNMI) institutes and their industry academic and research partners.

But what about a material that people have been using for tools, weapons and transportation for millennia? For centuries, people have been using various metals to form objects or tools they have needed.

What is it about metal manufacturing that is still so innovative in the 21st century? Can the idea of melting, shaping or casting metal be revolutionized to meet our current manufacturing and defense needs while we remain mindful of conserving both resources and energy?

That is the mission of LIFT—Lightweight Innovations for Tomorrow—operated by the American Lightweight Materials Manufacturing Innovation Institute.

Founded in 2014, LIFT is a Detroit-based, public-private partnership committed to developing and deploying advanced lightweight metal manufacturing technologies, and to implementing education and training initiatives to better prepare the metal manufacturing workforce today and in the future.

One of the founding institutes of the NNMI, LIFT is a member-based organization funded in part by the Department of Defense (DoD), with management through the Office of Naval

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Research to develop technologies to benefit the U.S. transportation, aerospace and defense markets.

“Our goals are twofold,” says Larry Brown, LIFT’s executive director. “The first is to accelerate development and application of innovative lightweight metal production and manufacturing technologies, and the second is to build a robust talent pipeline for the advanced metals manufacturing factories of tomorrow.”

In pursuit of these goals, LIFT partners with its members, including large corporations, small and medium enterprises, business startups, professional societies, colleges and universities, and other research institutions, to move lightweighting manufacturing technology concepts to the marketplace.

On education and workforce development, LIFT works with universities, community colleges, kindergarten through grade 12 schools, economic development corporations, workforce intermediaries, manufacturing extension partnerships, industry, and state and local government officials to improve education related to manufacturing and science, technology, engineering and mathematics (STEM) training.

“Our mission is a challenging one,” Brown says. “I tell our members that what we are attempting to do is not easy, because we are rethinking an industry that’s been around for thousands of years. It is exciting, but it’s not easy.”

Lightweight metals manufacturing does face challenges, both from a technology perspective, with lightweight metals being more expensive to purchase and process, and on the education and workforce development front, with many misconceptions about manufacturing jobs and careers being low skill, low wage, and vulnerable to offshoring. Despite those challenges, interest on the part of a wide array of stakeholders continues to grow in lightweighting and the research behind it.

Companies are looking to conserve the energy and reduce raw metals used in manufacturing. These significantly include the energy and the transportation sectors such as the aircraft industry and automakers. Cars must meet increasingly stringent fuel economy standards while adding more technology.

The LIFT mission is clear, and the partners are in place to develop new methods of lightweight metal manufacturing through improved technology and to create a talent pool of educated workers to support the jobs of the future.

**Lightweighting Through Technology**

The earliest forms of metallurgy, the science behind metal properties and production, date back to rudimentary tools and weapons created thousands of years ago. While the basics of using metal to create objects in different shapes and sizes have remained consistent, the metals used and processes in place have changed dramatically. “People have been heating, stretching, casting and beating metals for thousands of years,” says Alan Taub, LIFT chief technology officer. “But we are at the cusp of a revolution in terms of the way we are able to process and design them in far different ways than ever before.”

By focusing on specific process areas, and distinct themes that cut across all of them, LIFT is working with its industry, government, academic and research partners to bring metals to the market in a whole new way.

LIFT’s technology focuses on six “pillars,” including:

**Melt Processing.** Casting is just one well-known example of the manufacturing processes involving molten metal. At LIFT, many others are being re-examined and transformed by new technologies and lightweight metals.

**Powder Processing.** Generally squeezed, sintered and/or sprayed to form parts, sheet or plate, metal powders allow great control over the final composition of the end product and its properties and yield.

**Thermo-Mechanical Processing.** Advanced metal processing technique using heat and deformation and can be applied to forming operations, including forging, rolling and extrusion.

**Coatings.** More than just paint, emerging coating processes are modifying the surface of metals to enhance their performance in exciting new ways.

**Joining and Assembly.** A key challenge for the application of lightweight metals to manufactured goods is joining them to other lightweight metals, traditional steel alloys, or nonmetallic metals.

**Agile Processing.** The pacing and cost of introducing new light metal components often are determined by the required tools and dies. New technologies, tool-making methods and



advanced machining can eliminate dies entirely and reduce cost and speed of deployment.

The LIFT technology focus also includes themes that cut across each of the technology pillars, including design, life-cycle analysis, validation/certification, cost modeling, supply chain, corrosion, ballistic blast, and integrated computational materials engineering (ICME).

Development of ICME and computer modeling is a game-changer for lightweight metal design and processing. It carries great promise in creating computer “super models” that combine a much wider array of property and processing information than previously possible without the expense of developing, testing and validating property and process relationships.

LIFT partners also have several projects under way—in the melt processing, coatings, joining and thermos-mechanical processing pillar areas, with more on the horizon for 2016.

Earlier this year, nearly 100 LIFT members gathered in Detroit to take part in a 2-day technology road-mapping session to determine the long-term direction of LIFT’s technology development, including new projects it might undertake based on the industry’s needs and future trends.

Several project teams were launched and are seeing progress with positive results from their work. In fact, preliminary results on one of the first melt processing projects have shown a nearly 40 percent weight reduction in the specific part being cast. “With the knowledge and ideas from our members, there can be no question that our current projects, and those we’ll pursue going forward, will result in dramatic changes to the metal and manufacturing industries,” Taub says.

### **Education and Workforce Development**

Commercializing innovation—or bringing “mind to market”—is only possible if educated talent is available to put new ideas and technologies to work. That means that the goal of making the United States the world leader in lightweight metals manufacturing requires training a skilled workforce that can develop and manage these new technologies and processes. With that in mind, LIFT is supporting initiatives to provide a competent and confident workforce for the advanced manufacturing jobs of the future.

“Developing a skilled workforce is mission critical to the future of manufacturing here in the U.S.,” said Emily Stover DeRocco, LIFT’s director of education and workforce development. “Our goals are to eliminate the current skills gap in order to sustain, grow and attract manufacturing jobs across the country, and to prepare a technology-savvy next generation workforce.”

To achieve that goal, the LIFT Education and Workforce Development roadmap was developed in coordination with education, workforce development, economic development and labor experts and includes 11 areas of strategic focus:


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- Understanding workforce demand-supply gaps
- Ensuring students gain STEM foundational skills for success in manufacturing careers
- Attracting students and workers to educational pathways for careers in manufacturing
- Deploying more on and off ramps from education to employment
- Helping disconnected youth and adults prepare for high-quality, middle skills jobs
- Linking and leveraging related incentives and resources on the ground today
- Teaching the teachers
- Adding lightweighting technologies to engineering design curricula
- Expanding work-and-learn activities
- Fast tracking military personnel and veterans to skills development for manufacturing careers
- Offering on-the-job training solutions to industry partners

Each of LIFT’s Education and Workforce Development investments strives to positively impact at least one of those focus areas. Recent examples include delivering machinist training for veterans in Indiana, providing metals science boot camps for teachers in Tennessee, familiarizing Kentucky educators with modern manufacturing workplaces, supporting work-and-learn opportunities in Ohio, and reaching out to disengaged and unemployed youths and adults in Michigan.

### **Innovating for the Future**

LIFT is one of nearly a dozen new manufacturing institutes that coalesce public- and private-sector talent to upgrade production capacities by using more advanced technologies. Most of the institutes are devoted to developing advanced technologies from scratch. LIFT is demonstrating that even something as old as forming, shaping, joining and casting metal can provide a fresh source of innovation for our economy and defense industry when we put our nation’s best minds to work.

For more information on LIFT, visit [www.lift.technology](http://www.lift.technology), follow LIFT on Twitter at @NewsFromLIFT, email [communications@lift.technology](mailto:communications@lift.technology) or call (313) 309-9003. 

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