Phase I: Develop LIFT Welding Technician curriculum- Weld-Ed
1.1 Gather task list of lightweight welder
1.2 Validation by industry advisory board of LIFT
1.3 Develop competency models for lightweight welding
Phase II: Develop a Lightweighting Welding Technologies Credential- AWS
Activity 2.1 Convene educator panel to transform the competency models to student learning outcomes
Activity 2.2 Crosswalk Industry input against available AWS certified welder programs to identify appropriate certifications
Activity 2.3 Revise and finalize certifications for lightweight welder
Phase III: Pilot the Lightweighting Welding Technician Curriculum- LIFT
Activity 3.1 Pilot lightweight welding curriculum at LIFT Learning Lab
Activity 3.2 Ensure sustainability of the program through national adoption.

Welding technician positions are notoriously difficult to fill, especially in areas with a high concentration of manufacturing jobs where competition is fierce. The shortage of available talent is only expected to grow in the coming years, with Bureau of Labor Statistics’ forecasts showing that demand for welding occupations is expected to increase by 6% by 2026\(^1\). This number is likely even higher considering, like much of the manufacturing workforce, a large portion of the welding workforce will be set to retire within the next ten years. These factors, when combined, push the number of projected openings (job growth plus attrition) to 427,300 over the next seven years\(^2\).

At the same time demand for welders is set to grow, the skills required to be successful in welding occupations are increasing as well. Both technological advances and changes in business climates will require that welders secure more advanced knowledge to do their jobs. Advances in welding technologies will introduce new types of materials being welded as well as the introduction of more complex processes, many utilizing robotics or computer-controlled equipment. These new processes not only result in cost reduction, but also increase safety, reduce risk, and decrease incidences of equipment or weld failure in mission-critical operations. However, these shifts also will require the more advanced skill sets that define a ‘welding technician’ – a certified welder who is equipped with knowledge, skills, and abilities to use these cutting-edge new processes.

Lightweight Innovations for Tomorrow (LIFT) is currently driving three projects in its technology innovation portfolio that exemplify these types of welding and materials joining process advancements. While these projects are still underway, they are expected to dramatically impact welding-related production processes as early as 2019. These innovations include:

- **Distortion Control**- the elimination of factors that produce distortion in the product, materials, or process in manufacturing applications.
- **Refill friction-stir spot welding (RFSSW)**- a developing technology that builds on the traditional friction stir welding (FSW) process to join metals without changing their surface geometry. FSW is a metal joining process that uses a tool “to join two facing workpieces without melting the workpiece metal.”

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\(^1\)2016 U.S. Bureau of Labor Statistics, Employment Projections
• **Joining Dissimilar Materials** - the ability to join dissimilar materials, such as titanium and steel, to lower production cost, achieve high performance and cost-efficiency.

Each of these technology advancements will require that welding technicians secure new competencies that currently are not taught in traditional welding programs. LIFT has already commissioned an Expert Educator Team (EET) to review these, and eight additional, technology projects to determine what new competencies will be required of future welding technicians. The EET found that existing curricula will not adequately address the competencies needed to understand and implement these new technological advancements, and new modular curriculum needs to be developed. Specifically, the EET found the following to be critical competencies for welding technicians at the 2-year level (a complete report is available at [Lift.Technology/EET](http://Lift.Technology/EET)):

  o **Distortion Control Critical Competencies** - Employ Rules-Based Shop Floor Procedures; Analyze Distortion Control in Joining & Assembly; Employ Process Mapping & Planning Tools to Identify & Mitigate Waste; Practice Joining Processes; Data Acquisition, Standard Operating Procedures (SOPs) & Document Work
  
  o **Refill Friction Stir Pot Welding Critical Competencies** - Recommend Solid-State Joining & Assembly Processes for Dissimilar Metals; Demonstrate Ability to Operate Welding Equipment; Apply Spot & Friction-Stir Welding Techniques; Relate Assembly & Process Variations to Distortion Control in Manufacturing
  
  o **Joining Titanium to Steel Critical Competencies** - Describe & Apply Joining Methods for Dissimilar Materials; Describe & Apply Testing Procedures for the Quality of Multi-Material Welds; Describe & Analyze the Physical Properties of Welds

The National Center for Welding Education and Training (d.b.a.–Weld-Ed) is a national partnership between the welding and materials joining industry and the nation’s community and technical colleges and universities that is dedicated to expanding the role and pipeline of welding technicians in industry. Weld-Ed has been continuously funded since 2007 as an Advanced Technological Education National/Resource Center by the National Science Foundation. Weld-Ed’s accomplishments in curriculum and program development include:

- One new **Welding Technician Associate Degree** program at Yuba College; seven revised Welding Technician Associate Degree programs; nine new Welding Technician - AAS Certificates programs; 16 new **Welding Technician Courses** – Credit; 94 new Welding Technician Courses – Non Credit; 76 **Articulation Agreements** (2+2+2); articulation agreement between Hobart Institute of Welding Technology and Lorain County Community College; four articulation agreements from two-year to four-year schools; and 19 programs aligned with AWS certificate/credentials.

- **Competency models** developed for Welder, Welding Technician, and Welding Engineer using the U.S. Department of Labor competency model and validated by industry.

- A **national curriculum guide** featuring Student Learning Outcomes for welding technicians identified from the validated competency model for Welding Technician.
• A new state-of-industry welding lab at Lorain County Community College that can deliver demonstrations, instructions, and distance learning applications to all Weld-Ed Regional Centers.

• New course in welding robotics and automation in the Weber State University Welding Engineering Technology degree.

The American Welding Society (AWS) is a nonprofit organization with a global mission to advance the science, technology and application of welding and allied joining and cutting processes, including brazing, soldering and thermal spraying. AWS strives to move the industry forward in both thought and action, as well as inspire new generations to see the exciting career opportunities available today. AWS offers a number of industry-recognized certification programs that recognize and document expertise and knowledge in specific welding-related disciplines including, welders, inspectors, supervisors, educators, radiographic interpreters, welding engineers and fabricators. AWS is the source for qualification and certification of welding personnel. The Certified Welder program is a performance-based program that tests welders to procedures used in the structural steel, petroleum pipelines, sheet metal, and chemical refinery welding industries and provides a transferrable, and industry-recognized credential.

There is a logical partnership between LIFT, Weld-Ed, and the American Welding Society (AWS) to develop curriculum to address emerging technology advancements in welding as well as standards-based, nationally portable, industry-recognized credentials related to these lightweighting welding technologies. The proposed partnership between LIFT, AWS, and Weld-Ed brings representation from industry, research, and academia together to address a significant workforce challenge that impacts advanced manufacturing and many tertiary industries. LIFT represents both industry and research; AWS brings standards-based, industry-recognized credentialing; and Weld-Ed adds expertise in the development of education and training programs.

To this end, LIFT, Weld-Ed, and the AWS propose to form a Project Team to implement a threefold effort to proactively address this major workforce challenge set to impact welding-related sectors. Together, the Project Team will:

1) Build on high-quality AWS SENSE Welding curriculum to develop a competency-based, modular, Lightweighting Welding Technician curriculum that will prepare welders for lightweighting-related technology advancements in welding.

2) Utilize the AWS Certified Welder program to identify the appropriate standards-based, nationally portable, industry-recognized credential for lightweighting welding processes.

3) Pilot the Lightweighting Welding Technician curriculum in the LIFT Learning Lab to serve as a basis of an Industry Recognized Apprenticeship Program (IRAP).

Each of these components is described in further detail below.

**Phase I: Develop LIFT Welding Technician curriculum**

The Lightweighting Welding Technician curriculum will be modular and competency-based and will build off the newly designed AWS SENSE welding curriculum, to be released in Summer 2019, as well as existing Weld-Ed Welding Technician curriculum. It will incorporate both virtual
and hands-on learning to train highly skilled welding technicians capable of working in multiple industries. The Lightweighting Welding Technician curriculum would also leverage proven models like Right Skills Now, developed by The Manufacturing Institute, and will be designed with the intent to lead to nationally portable, industry-recognized certifications.

Through the partnership with LIFT, this training program will incorporate skills relevant to emerging technologies in lightweight metals and materials joining stemming from LIFT’s technology project portfolio outlined in the previous section. Additionally, a DACUM or similar job task analysis for a Lightweighting Welding Technician will be conducted. The curriculum development would initially focus on those three technology areas; however, the Project Team will also ensure due diligence to incorporate other emerging technologies as appropriate.

Weld-Ed will lead the Project Team in this component of the project.

**Phase II: Develop a Lightweighting Welding Technologies Credential**

AWS credentials are among the most recognized and relied-upon standards-based, nationally portable, industry-recognized credentials in the labor market. The Project Team will convene appropriate industry representatives to examine the curriculum and learning outcomes developed as Phase I of this initiative for alignment to industry standards and skill needs. Utilizing this critical industry input, the Project Team will cross-walk against the combinations available within the AWS Certified Welder program to identify the appropriate certification(s) that match the attainment of skills and learning outcomes from the new curriculum developed in Phase I.

AWS will lead the Project Team in this component of the project.

**Phase III: Pilot the Lightweighting Welding Technician Curriculum**

Once developed, LIFT will pilot the Lightweighting Welding Technician curriculum developed in Phase I in its Learning Lab. The LIFT Learning Lab, located within the LIFT innovation lab in Detroit, is an interactive learning facility for LIFT’s industry members, partners, students, and teachers across the nation to engage in hands-on learning experiences centered around lightweight metals and materials manufacturing. The Learning Lab will feature a world-class Welding Technician Training Center, which will host the pilot and will include both virtual and hands-on welding training resources that are being entrusted by Miller Electric, a leading welding equipment manufacturer.

The pilot would target training 25 individuals with a focus on training guardsmen and guardswomen through a partnership with the Michigan National Guard, transitioning workers, and opportunity youth.

Once the Lightweighting Welding Technician curriculum is developed and successfully piloted, the Project Team will work to encourage its adoption nationally. While the curriculum would be designed with LIFT as a core partner, the Lightweighting Welding Technician curriculum would have applicability to several of the Manufacturing USA Institutes. As part of expansion efforts, the Project Team will work with the Education and Workforce Development Directors across the
Manufacturing USA Institutes to encourage adoption by their educational partners. Likewise, AWS and Weld-Ed will leverage their significant reach to education and industry partners to disseminate the program to other relevant training providers and industry.

The Project Team also sees the potential to use the Lightweighting Welding Technician curriculum as a foundation for an Industry Recognized Apprenticeship Program (IRAP) in a future phase of the project. The Project Team members are aware of federal efforts to promote IRAP and will plan to position the Lightweighting Welding Technician curriculum to be eligible for additional resources to support Welding Technician Apprenticeships, leveraging the Lightweighting Welding Technician curriculum, in future funding opportunities.

LIFT will lead the Project Team in this component of the project.