

Optics Manufacturing Technician Apprenticeship

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Abstract

The Optics, Photonics, and Imaging industry is responsible for remarkable innovations that have revolutionized our world—and improve our lives, every single day. The industry is growing at an exponential rate and is suffering from a worldwide shortage of skilled optics technicians. For several decades, our society and education system have emphasized the value of a 4-year college education at the expense of workforce education, and our nation is suffering because of it. The registered Optics Manufacturing Technician apprenticeship is a structured “earn and learn” solution that combines on-the-job learning with related technical instruction, with benefits for employer and employee.

The Challenge

Innovations from the Optics, Photonics, and Imaging industry have affected every facet of our daily lives, from our smart phones to the vehicles we drive. The industry is growing at an exponential rate, with a compound annual growth rate of 4.2%. SPIE’s 2020 Optics and Photonics Industry Report valued the 2019 photonics-enabled marketplace at \$2.02 trillion—an increase of 34% over the seven-year period. Total worldwide employment was more than four million.¹

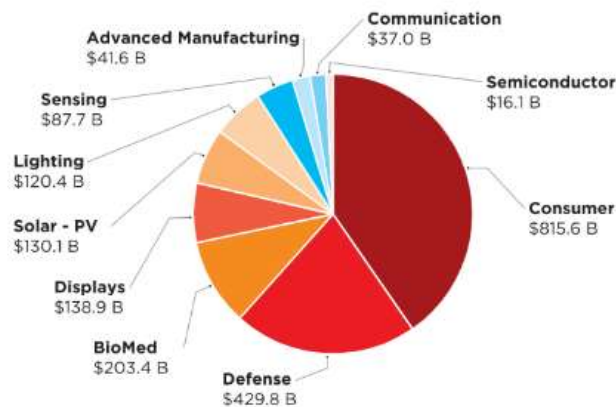


Figure 1: Enabled Markets Economic Impact 2019. Global Total \$2.02 Trillion

As consumer, medical, and defense demands for optics enabled technologies and products have grown, global markets have not been able to supply an adequate number of new engineers and technicians needed to produce and improve them. Furthermore, it is predicted that up to 30% of experienced optics technicians and engineers are approaching retirement, resulting in a severe worldwide shortage of skilled optics technicians. This lack of optics technicians is a national security threat. Without optics technicians we cannot safeguard our country or continue to innovate.

The History of Optics in Rochester, New York

Since the founding days of Kodak, Xerox, and Bausch + Lomb, Rochester, NY has been known across the country and, around the world, as a center for optics research, invention, and manufacturing. There are approximately 120 optics related companies in the Greater Rochester area. These companies rely heavily on three local educational institutions, The University of Rochester, Rochester Institute of Technology, and Monroe Community College, to provide them with a constant supply of optics engineers, technicians, and designers. MCC has a long history of

educating technicians for the workforce through its highly recognized Optical Systems Technology AAS degree program. The graduates of this program have often gone on to become leaders in the optics industry.

In 2006, MCC received funding from a Workforce Innovation in Regional Economic Development (WIRED) grant. These US Department of Labor grants were intended to fund new approaches to workforce and economic development.² Through the WIRED model, the Finger Lakes region integrated economic and workforce development activities for economic transformation. MCC used the WIRED funding to develop a “new” training approach for optics technicians. The new approach was the development of the Precision Optics Manufacturing Technician (POMT) apprenticeship. The POMT was designed by MCC, in partnership with Optimax Systems, Sydor Optics, JML Optical, and Rochester Precision Optics.

The New State Apprenticeship Council approved the POMT as an apprenticeable occupation in 2016, (ATP 45-560 (08/16), D.O.T. CODE 716.382-018) and Optimax Systems became the first registered sponsor in New York state. The three-year apprenticeship consists of 2000 hours per year of on-the-job learning along with a minimum of 144 hours per year of related technical instruction (RTI) per year. Presently, Optimax Systems, JML Optical, and Sydor Optics are registered sponsors in New York State. Rochester Technology and Manufacturing Association (RTMA) is an intermediary, or associate sponsor of the POMT, with OptiPro as one of its signatories.

Intermediaries provide services such as recruitment and screening, curriculum development, and classroom training for companies that do not have the internal staff to manage their own programs. It affords the companies the ability to use apprenticeship to grow their skilled workforce by providing the on-the-job learning. Technical organizations and community college are taking on the role of intermediaries for multiple trades. Most intermediaries charge a fee for their services.

Also in 2016, the US Department of Labor, Office of Apprenticeship (USDOL/OA) approved the Optics Manufacturing Technician (OMT) apprenticeship as a competency-based model (USDOL/OA Bulletin 2016-19, RAPIDS Code 2045CB). In a competency-based apprenticeship, the apprentices need to demonstrate mastery of list of competencies, along with completing 144 hours of related technical instruction per year.

Building upon this work, in 2019 MCC received a \$4.4 million grant from the Department of Defense in support of optics technician training. The vision for this grant from the Office of Naval Research is to strengthen and expand the national precision optics workforce to ensure technological superiority for the DOD, by expanding the apprenticeship program both locally and nationally.

Registered Apprenticeship as a Solution

Apprenticeship is a structured “earn and learn” training model that requires on-the-job learning along with related technical instruction. Apprenticeships can benefit both the employer and employee. The employer benefits with a more stable workforce, improved attendance, productivity and quality. The employee earns long-term career opportunities, workplace relevant skills, periodic wage progression, and industry recognized credentials.

Many industries, such as construction, electrical, and machining, successfully use apprenticeships to train skilled workers and technicians through their trade schools. Optics companies, however, have historically trained optics technicians in-house, which can negatively impact staffing, production capacity, and investments in innovation and research. Optics registered apprenticeships can provide a path towards rewarding careers in companies critically important to economic growth and national defense, as well as an academic certificate or degree. During their apprenticeship, apprentices rotate through all the elements of their employer’s manufacturing process. The optics apprentices will learn grinding, polishing, optical assembly, metrology, and coating. Some may learn about sales and engineering. When apprentices finish their apprenticeship and become journeyworkers, they are among the most knowledgeable employees within the company.

Three Modes

Apprenticeships can be conducted in one of three modes: time-based, competency-based, or hybrid.

In a time-based apprenticeship, the work process identifies the skill sets the apprentices need to learn and how many hours they will spend learning that skill set. The apprentice needs to complete a specified number of hours in each skill set. The apprentice has to keep a record of the hours worked in each skill set. New York and Maryland have registered time-based Precision Optics Manufacturing Technician apprenticeships.

Shaping and Finishing	Approximate Hours
<ol style="list-style-type: none"> 1. Manufacture optical components using conventional manual processes including loose abrasive grinding and pitch polishing. 2. Manufacture optical components using computer controlled automated equipment including CNC grinding and CNC polishing. 	3250

Competency based apprenticeships have a list of competencies and technical skills that apprentices have to master during their tenure as apprentices. The competencies follow the National Precision Optics Skill Standards For Technicians standards developed by OP-TEC in 2013.⁴

Critical Work Function		
Competencies	Date Completed	Initial
<ol style="list-style-type: none"> A. Assist and advise in the selection of fabrication processes and their sequencing. <ol style="list-style-type: none"> i. Accurately identify the shapes of various optical components and their use in an optical assembly/system. 		

Hybrid combines the competency with a range of hours for each competency.

Critical Work Function	Approximate Hours		
A. Identify standard operating and safety procedures of the optics shop and equipment required in the process.	20	-	30

On the Job Learning

Employers who sponsor apprentices are required to provide 2,000 hours per year of on-the-job learning (OJL). During on-the-job learning, the apprentice receives direction and guidance from a “journeyman.” The journeyman can be an apprentice graduate, an experienced optics technician, or a supervisor, who mentors the apprentice during their tenure. The journeyman assigned to an apprentice can vary from department to department within the company.

OJL in Time-based models: Each apprentice will receive approximately 6,000 hours of on-the-job learning based on the three-year, time-based, Precision Optics Manufacturing Technician apprenticeships approved in New York and Maryland.

OJL in Competency-based models: The USDOL/OA Optics Manufacturing Technician apprenticeship, which is a competency-based apprenticeship, is estimated will take the apprentice between two and three years to master all the competencies.

In either model, each skill set has a competency level or required number of hours that the apprentice has to reach in order to complete the apprenticeship. The apprentices will rotate through the company’s various manufacturing processes: materials, components, conventional methods & CNC fabrication, metrology, coating, and assemblies to gain the required skill level. Their work is periodically evaluated against a set of employer standards that includes quality, quantity, attitude, and aptitude.

Related Technical Instruction

Registered Apprentices are required to complete a minimum of 144 hours per year of related technical instruction (RTI), this is in addition to the 2,000 hours of on-the-job learning annually. The RTI can be taught at a community college for credit towards a certificate or degree, or it can be conducted in-house by qualified internal instructors. The in-house RTI usually are safety requirements such as personnel protective equipment, first aid, sexual harassment prevention, and safety sheets, or for company specific processes.

One of the barriers to expanding the Optics Manufacturing Technician apprenticeship across the country is the lack of community colleges with appropriate optics courses. Monroe Community College has the curriculum and hands-on-lab equipment to offer the Optical System Technology Certificate and AAS degree.

To expand optics registered apprenticeships nationally, the related technical instruction has to be delivered differently. One of MCC Optical Systems Technology's innovative training approaches has been to develop online and hybrid credit-bearing courses. The COVID 19 pandemic forced the college to switch to online instruction for all courses in spring 2020. With online and hybrid courses, MCC is able to train optics technicians outside of the Rochester, NY area. This is significant for the development of the optics manufacturing apprenticeship. Prior to the development of the MCC online courses, there was not sufficient related technical instruction for an optics manufacturing apprenticeship.

The online curriculum overcame the distance barrier to expanding the OMT apprenticeship. The apprentices can attend the lecture for the classes online from anywhere in the country. For the hands-on lab portion, the apprentices have a couple of options. One option is to complete a two-week lab session at MCC during the summer and winter breaks. The other option is for the apprentices to complete the lab work at their facilities under the guidance of an in-house instructor, given they have equipment availability. The apprentice will complete similar exercises and reports on results.

Expanding Locations

Monroe Community College has a complete optics fabrication capacity. The MCC labs include conventional fabrication with generators, grinding pots, and spindle polishers, to computerized OptiPro 80 grind and polishing equipment, and Moore Nanotech diamond turning lathe. The American Center of Optics Manufacturing (AmeriCOM)³ is providing guidance and funding for additional community colleges to institute optics curriculum and lab equipment at their facilities. Among the colleges are Sussex County Community College (Newton, NJ), Valencia College (Orlando, FL), and Front Range Community College (Boulder, CO). This will assist in expanding apprenticeship opportunities to a greater number of employers

Governance

Apprenticeships are monitored either by the US Department of Labor, Office of Apprenticeship (USDOL OA), or by individual states with a State Apprenticeship Agency (SAA). Each state can choose how to conduct its apprenticeship programs. Twenty-three states are monitored by the USDOL OA. Each state has a State Apprenticeship Director and staff members who are federal employees. All the USDOL OA states register programs and sponsors through standard documentation. Once the Optical Manufacturing Technician Apprenticeship was approved, it became available to all the companies in the USDOL OA states.⁵

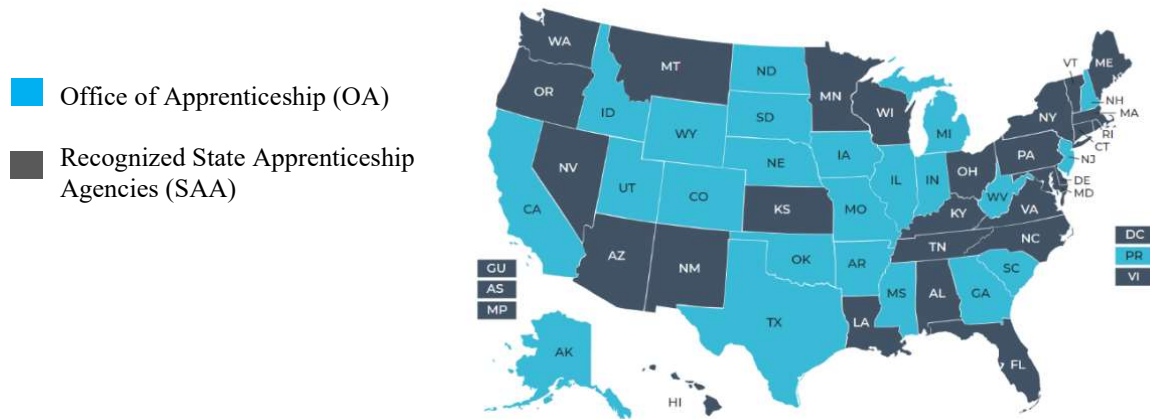


Figure 2: Map of OA and SAA States

US DOL OA States: Companies in USDOL/OA states complete a form known as Appendix A, which contains the work process, related technical instruction providers, wage scale progression, and apprentice selection process. Each company can modify the work process to align with their manufacturing process and choose the RTI providers and courses. The companies also complete the Registered Apprenticeship Standards, which contain the apprenticeship standards that the company has to adhere to be an approved registered sponsor. They will receive an identification code for the Registered Apprenticeship Partners Information Data System (RAPIDS) system for registration, oversight, and tracking of apprentice progress and apprenticeship compliance.

SAA States: Each SAA state has its own State Director and Apprenticeship Council, which is made up of members of the registered apprenticeship community. Council members represent SAA staff who are state employees, public, employers and employee organizations. SAA states approve their own apprenticeable occupations, and may utilize the standard federal paperwork and documentation, or may use documentation specific to that state. Each SAA state has different procedures for approving registered sponsors, and maintaining their own database.

Summary

Registered Apprenticeship has evolved into a long-term solution that will allow optics manufacturers to strengthen their workforces to meet attrition and production growth. Apprenticeships should be integrated into existing Training and Human Resources development strategies. They are a valuable recruitment tool for students coming out of high school.

There are numerous state and federal apprenticeship grant funding opportunities. In July 2022, the USDOL announced the award of more than \$121 million in Apprenticeship Building America (ABA) grants to strengthen and modernize Registered Apprenticeship programs and enable workers to find a reliable pathway to the middle class. The department awarded more than \$58 million of the total funding to grantees focusing on equity partnerships and pre-apprenticeship activities.⁶ Many states also provide tax credits for employers who sponsor a Registered Apprenticeship program.

This Optics Manufacturing Technician and Precision Optics Manufacturing Technician apprenticeships will incorporate newer technologies and processes that reflect today's modern optics/photonics enterprises and training delivery systems.

To learn more about the Optics Manufacturing Technician apprenticeship, contact Ross Micali at rmicali@monroecc.edu, (585) 292-2678, or Alexis Vogt, PhD, avogt4@monroecc.edu, (585) 292-2685.

Additional information about the Optics Manufacturing Technician Registered Apprenticeship can be obtained by calling your SAA or USDOL OA State Director, and searching the Internet for your state's apprenticeship website which will contain valuable information about contacts, application forms, and regulations.

References

- (1) SPIE (2020). 2020 Optics and Photonics Industry Report (Fall Update). <https://spie.org/news/2020-optics-and-photonics-industry-report>.
- (2) Wikipedia (2022). Workforce Innovation in Regional Economic Development. https://en.wikipedia.org/wiki/Workforce_Innovation_in_Regional_Economic_Development.
- (3) American Center for Optics Manufacturing (2022). Website. <https://americom.org/>
- (4) OP-TEC/UCF. (2013). The National Precision Optics Skill Standards for Technicians, 2nd Edition. <https://laser-tec.org/product/the-national-precision-optics-skill-standards-for-technicians-2nd-edition/>.
- (5) U.S. Department of Labor (2022). Apprenticeship System Webpage. <https://www.apprenticeship.gov/about-us/apprenticeship-system>.
- (6) U.S. Department of Labor (2022). News Release: US Department of Labor Awards \$121M in Apprenticeship Building America Grants to Expand, Diversify, Modernize Registered Apprenticeship Programs. <https://www.dol.gov/newsroom/releases/eta/eta20220707-0>.