If You Build It, They Will Come: Creating Ecosystems to produce the next generation of optics technicians

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ABSTRACT

Precision optics manufacturing companies across the U.S. are suffering from a critical shortage of technicians. This shortage impacts supply chain, delays shipments, and impedes the productivity of any industry reliant on optics. Further, it stifles innovation and requires engineers with advanced degrees to complete the work of technicians. Development of the current and next-generation optics manufacturing workforce is vital.

Monroe Community College (MCC) in Rochester, NY offered the nation's first Optical Systems Technology program. By collaborating with industry, community, and governmental partners, MCC grew the program over several decades to a record-high graduating class today. Unfortunately, MCC alone cannot meet the demand for optics technicians with 500 new graduates needed every year just in the Western NY region.

The U.S. Department of Defense sees this critical workforce shortage as a threat to national security and charged the American Center for Optics Manufacturing – AmeriCOM – to increase the number of optics technicians. Recognizing the success of connecting industry, community, and governmental partners with an optics-focused academic institution, AmeriCOM is replicating this "ecosystem" model in regions across the country.

The initiative has: 1) Extensively enhanced precision optics technician training with innovative approaches that meet the needs of the optics industry and students; 2) Increased the number and diversity of optics technicians nationwide; and 3) Established opportunities for student and faculty engagement with the optics industry. This paper describes the success of MCC's optics ecosystem model and illustrates why AmeriCOM is replicating it nationally to strengthen the nation's precision optics workforce.

Keywords: Optics technician, Training, Diversity, Workforce development, Industry partnerships, Optics ecosystem, Precision optics inoculate

INTRODUCTION

The U.S. military depends on precision optics for several applications including guidance systems, satellites, advanced weapons, night vision goggles, and more. Affordable, U.S.-manufactured, advanced optics are needed to meet the current and future demands of our military systems. The U.S. Department of Defense (DoD) recognizes the lack of skilled precision optics technicians, who help produce these advanced optics, as a matter of national security. The DoD charged AmeriCOM to significantly build and sustain the precision optics manufacturing base.

In addition to meeting the DoD's needs, a strengthened optics manufacturing workforce also drives innovation in countless other industries that rely on optics including healthcare, banking, transportation, communication, technology, and more. Unfortunately, a worldwide shortage of optics technicians is stifling growth. For every optics engineer focused on innovation, we need 10 optics technicians to bring that innovation to market. Currently, there are over 2,500 open positions nationwide in the optics and photonics fields [1], and 98% of optics technician jobs currently go unfilled.

AmeriCOM's Workforce Development (WFD) Initiative is addressing this challenge, in part, by creating regional industrial workforce development ecosystems in multiple strategic locations throughout the country. The ecosystems are based on the existing mature model for optics manufacturing training at Monroe Community College (MCC) in Rochester, NY. Established in 1963, the Optical Systems Technology program at MCC is the nation's first program to train students to work as technicians in the precision optics industry. AmeriCOM has established ecosystems at Front Range Community College (FRCC) in Boulder, CO; Sussex County Community College (SCCC) in Newton, NJ; and

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Valencia College in Orlando, FL. AmeriCOM continues to evaluate additional regions around the country for their capacity to establish ecosystems. MCC's work with AmeriCOM has helped raise awareness of optics careers, attract new students into optics programs, and helped better prepare students for meaningful optics careers.

METHODOLOGY

An ecosystem, by definition, is an interconnected network. MCC and AmeriCOM identified this network to include partners from the optics industry, nonprofit organizations, and government representatives on local, state, and federal levels, convening to support an academic institution training future technicians. Harnessing the ecosystem's collective resources helps provide curriculum models for optics training programs, guidance for setting up labs within the college's facilities, optics manufacturing equipment and supplies, and marketing resources. The ecosystem supports all segments of the continuum from identifying and recruiting potential students, to providing relevant training, to producing career-ready optics technicians. MCC established its ecosystem model by broadening and strengthening its community relationships. These relationships have helped secure funding, raise awareness, and train technicians—all key elements in strengthening the optics workforce.

In the last six years, the MCC Optical Systems Technology team has secured more than seven million dollars in grants and corporate support. This vital funding allowed MCC to purchase and install new advanced manufacturing equipment. Industry guidance helped inform which equipment would best prepare students to meet current and future optics demands, and enabled MCC to revise its curriculum to better align with the knowledge and skills employers sought.

Simultaneously, the Optical Systems Technology department launched marketing and outreach initiatives with community partners and created experiential learning opportunities for students and faculty with local employers. This included an Optics Advisory Board made up of industry representatives who helped facilitate tours for students and faculty at optics manufacturing companies, including virtual tours at companies around the country. These tours help attract students to optics careers while establishing relationships with employers. In addition, as MCC students find work with local optics employers, the ecosystem partners share those success stories to help recruit new technicians. AmeriCOM's Light Up Your Future With Optics campaign includes MCC graduates sharing their career journey to inspire others who may be interested in the optics field.

Outreach with ecosystem partners also led to the launch of a nationwide precision optics manufacturing apprenticeship program. This is a structured "earn and learn" program that combines on-the-job with related technical instruction. MCC also created an online curriculum to engage interested and eligible employees from around the world. The college has registered optics apprenticeship programs with Optimax, JML Optical, Sydor Optics, OptiPro Systems, LaCroix Precision Optics, Nu-Tek Precision Optical Corporation, Esco Optics, Applied Image, and Archer OpTx, and has engaged community partners to help launch youth apprenticeship programs for high school students.

As ecosystem partners provide MCC guidance and resources, the Optical Systems Technology department can recruit and better-train more students to help fill the demand for optics technicians—thus achieving the symbiotic nature of the ecosystem. AmeriCOM has used this model to nurture ecosystems in Boulder, CO; Newton, NJ; and Orlando, FL. The model drives sustained collaboration between educational programs and industry while creating hands-on experiences for students and workers entering and advancing a career in precision optics manufacturing. This results in career-ready workers with advanced practical knowledge and capabilities.

DATA

MCC's work to develop an optics ecosystem has directly led to an increase in the number of students and industry partners engaged with the program. The data show enrollment has increased, especially among previously underrepresented populations.

Table 1. Student enrollment in Monroe Community College's Optical Systems Technology program

Enrollment	2019	2020	2021	2022
Optics Students	46	79	101	114
Female Students	10 (22%)	20 (25%)	30 (30%)	28 (25%)
Students of Color	7 (15%)	17 (22%)	28 (28%)	34 (30%)

Enrollment from Fall 2019 to Fall 2020 increased 72%. As a comparison, the overall enrollment rate at MCC decreased 12% during that same time period. Further, the Spring 2021 enrollment in the Optical Systems program remained at 79 achieving a 100% retention rate while the overall retention rate for MCC was 69% for the spring semester. From Fall 2020 to Fall 2021, the number of students taking Optics classes increased another 28%. From Fall 2021 to Fall 2022, the number of students taking Optics classes increased another 13% to an all-time record high of 114 students.

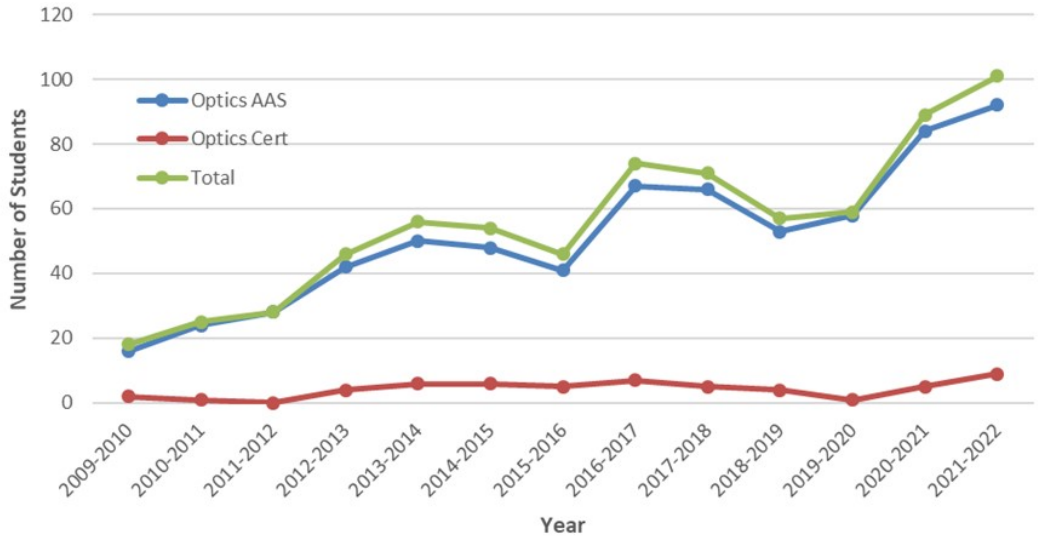

Figure 1. Student enrollment in Monroe Community College's Optical Systems Program

Interest in optics courses among students enrolled in other MCC programs and majors reached historically high levels. More than 300 students took an optics course during the 2020-2021 academic year, compared to 55 during the prior year. This was largely attributed to non-matriculated students who registered for classes because of an extensive Optical Systems Technology marketing campaign, both internal to the college and externally. The table below shows the academic programs for students taking optics courses outside of the major.

Table 2. Programs of Non-Optics Students Taking Optics Courses (2020-2021)

Program	Students
Non-Matriculated	277
Mechanical Technology (A.A.S.)	19
Liberal Arts (A.S.)	4
Business Administration (A.S.)	1
Construction Technology (A.A.S.)	1
Precision Machining (A.A.S.)	1
Precision Machining (Cert.)	1
Apprentice Training: Machine Trades (A.A.S.)	1
Visual Communication Technology – Photo/TV (A.A.S)	1
Total	**306**

RESULTS

Beyond enrollment growth, MCC's efforts to strengthen its optics ecosystem helped to grow the number of program graduates. Industry professionals who serve as adjunct faculty not only teach students, but advise and mentor them to help ensure they stay on track in their courses. The addition of a community liaison to the optics program staff, a position funded through MCC's DoD-funded Defense Engineering Education Program in Optics (DEEP OPS) initiative, has provided students with navigation services to ensure they have the resources they need to stay in school. As a result, MCC saw an historic number of students completing a certificate or AAS degree in Optical Systems Technology.

Table 3. MCC Optics Graduates.

Academic Year	Number of Graduates
2018-2019	13
2019-2020	20
2020-2021	41
2021-2022	47

The 47 total graduates (21 Associates degrees and 26 certificates) marked a record high for the Optical Systems Technology program. Meanwhile, efforts to engage industry and community partners have led to students participating in paid internships at companies like Corning, Lockheed Martin, MIT Lincoln Laboratories, Optimax, and Sydor over the last six years. And more than 2,000 high school students have participated in optics dual enrollment courses at their respective high schools.

The optics industry has proven to be a reliable career pathway that offers tremendous growth opportunities to the best and brightest optics technicians. Interest in MCC's optics program is at an all-time high and is reflected in its extraordinary enrollment growth. The transition to hybrid course delivery with lectures given online and laboratories offered in-person is attractive to students and incumbent workers who want to work while pursuing their degree. The construction of a fourth optics lab with more than $1.5 million in state-of-the-art optics equipment and the implementation of a comprehensive digital marketing campaign have generated an unprecedented amount of energy and excitement in the program. The program has extended its reach nationally and is developing apprenticeship opportunities with optics companies across the U.S. to drive additional enrollment growth.

CONCLUSION

MCC successfully deployed an optics ecosystem, engaging industry, community, and governmental partners, to strengthen the precision optics manufacturing workforce. The ecosystem has enhanced precision optics technician training with innovative approaches that meet the needs of the optics industry and students, increased the number and diversity of optics technicians, and established opportunities for student and faculty engagement with the optics industry. Building the ecosystem directly leads to an increase in well-trained precision optics technicians. To meet the national demand of precision optics technicians, MCC will work with AmeriCOM to nurture ecosystems in strategic geographic regions across the country.

REFERENCES

[1] "Training of Skilled Technicians for the Defense Industrial Base" (Briefing to the Senate Arms Services Committee, September 2021)