

Evaluation Report

September 2014-through May 2015

ASER-TEC

The SE Regional Center for Laser and Fiber Optics Education

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PART I

Introduction

LASER-TEC is a National Science Foundation Advanced Technological Education Center of Excellence in Lasers and Fiber Optics. It is an association of community and state colleges, universities, high schools and technical centers, trade associations, and laser and fiber optic (LFO) companies in the following eight southeast states: Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Florida. LASER-TEC started its operation in September 2013 based at Indian River State College in Florida, with the following principal partners: Central Carolina Community College - NC, Tri County Technical College – SC.

This report focuses on the performance of LASER-TEC from September 2014 to May 2015, the second out of a four year grant as a Regional Center.

The mission of LASER-TEC is to develop a sustainable pipeline of qualified laser and fiber optic technicians to meet industry needs in the Southeastern United States. To accomplish this mission the following goals were set:

1. Assist colleges with existing LFO programs by providing support, professional development, and equipment.
2. Assist colleges without LFO programs to create courses and programs by providing startup support.
3. Provide professional development for K-12 STEM teachers to bring LFO career awareness to students to create a high-school-to-college student pipeline.
4. Create awareness of LFO careers and a clear pathway for returning veterans to recruit them for participating regional college programs.
5. Develop, expand, and strengthen partnerships between LFO industries and all regional colleges.
6. Expand the membership of the Industrial Advisory Board (IAB), and monitor the supply, demand, and skill-set needed by LFO technicians in the Southeast region through a strong Industrial Advisory Board.

This report evaluates the progress, accomplishments, and challenges in achieving these goals.

In Part II of this report, we describe the evaluation model and methodology used for this project. We started working with LASER-TEC during the proposal development period and created the evaluation plan which we currently execute. Continuous formative evaluations have been done during the first two years of operation. This report represents the summative evaluation of year-2 of this Regional Center.

In Part III, we use the Kirkpatrick and Kirkpatrick evaluation model, with its four assessment levels. The Kirkpatrick and Kirkpatrick model measures the success of the learning process that occurs during faculty professional development, student workshops, or any other training setting.

In Part IV of this report, we make recommendations to LASER-TEC for the third year of this project.

In Part V, we present our conclusions for this evaluation.

Part II

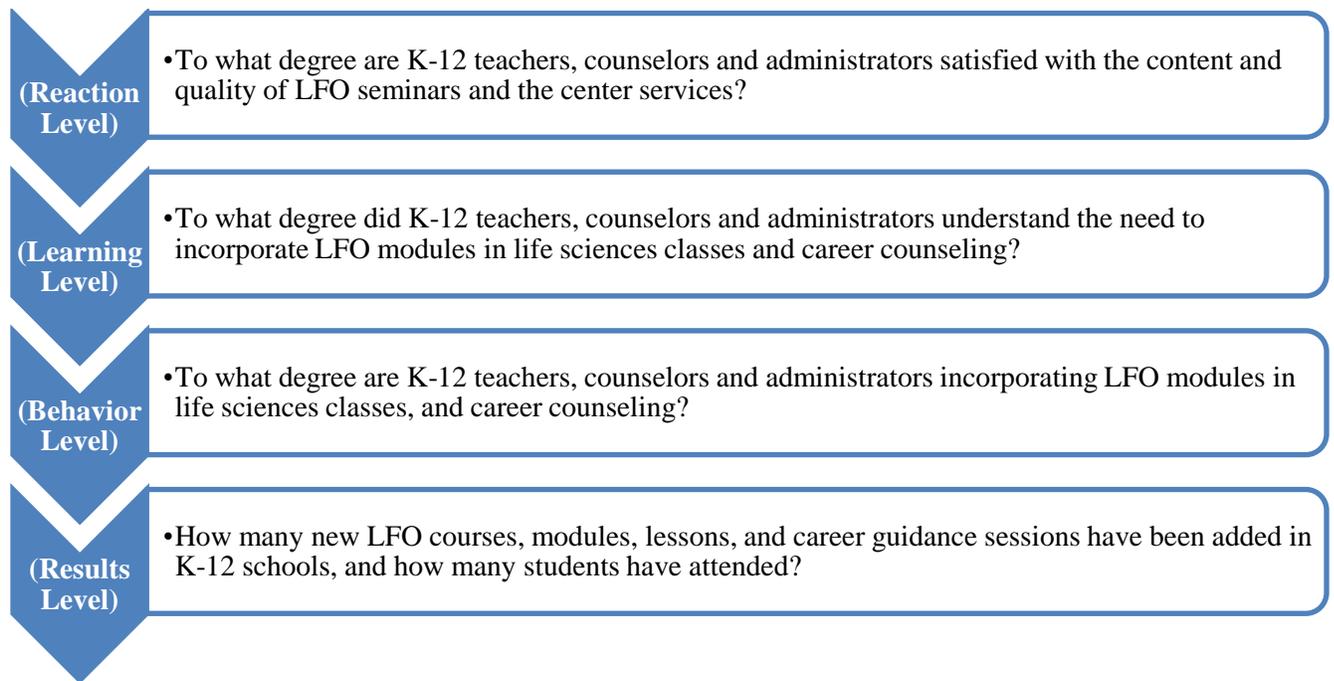
Evaluation Methodology

A broad scope of LASER-TEC objectives requires deployment of evaluation methodology that combines several methods. The Logic Model effective in organizational planning, design, implementation and analysis, together with the Kirkpatrick and Kirkpatrick method effective for training programs are used to evaluate performance of the Center.

The following questions were addressed during the evaluation:

- What was proposed to be done?
- How was it planned?
- Is it being done as planned?
- Is the program successful?

To evaluate K-12 professional development designed and conducted by LASER-TEC, Kirkpatrick and Kirkpatrick model is used. The evaluation was based on the 4 levels as follows:



The PI met with the evaluator on four occasions and outlined the goals, objectives and tasks of this project. An evaluation plan was drafted that include the collection of data for a continuous formative evaluation during each year of the project, and a summative evaluation at the end of every year of the project. Feedback from the formative evaluations was provided to the management team on a regular basis so that corrective actions are taken immediately for effective management. The evaluator was responsible for creating the evaluation instruments, scripts for telephone interviews, and other evaluation tools. The Center staff disseminated and collected the evaluation results from participants and delivers them to the evaluator for analysis and report preparation.

This report represents the formal summative evaluation for the second year of operation of LASER-TEC. It analyzes and assesses the progress of the project and suggests changes or realignment of goals and objectives for the following year as needed.

PART III

Evaluation Questions and Activities

What was proposed to be done?

1. Assist colleges with existing LFO programs by providing support, professional development, and equipment.
2. Assist colleges without LFO programs to create courses and programs by providing startup support.
3. Provide professional development for K-12 STEM teachers to bring LFO career awareness to students to create a high-school-to-college student pipeline.
4. Create awareness of LFO careers and a clear pathway for returning veterans to recruit them for participating regional college programs.
5. Develop, expand, and strengthen partnerships between LFO industries and all regional colleges.
6. Expand the membership of the Industrial Advisory Board (IAB), and monitor the supply, demand, and skill-set needed by LFO technicians in the Southeast region through a strong Industrial Advisory Board.

How was it planned?

Goal 1. Assist colleges with existing LFO programs by providing support, professional development, and equipment.

Objective A: Assist each college to create a quality training program that can be standardized and duplicated at any other partner college when needed.

Deliverables: i. Training program in a LFO specialty area.

Objective B: Create bill of materials, equipment and part vendor list.

Deliverables: i. Bill of materials needed for the LFO specialty course.
ii. List of vendors of materials and equipment needed.

Objective C: Deliver training to industry.

Deliverables: i. End of semester report on training delivered to industry.

Goal 2. Assist colleges without LFO programs to create courses and programs by providing startup support.

Objective A: Create a campaign to inform all community colleges of the SE region about the Center and its purpose and invite them to join the center.

Deliverables: i. Create lists of community and technical colleges of the SE region and targeted contact persons.
ii. Create information flyers announcing the creation of the regional center.
iii. Send flyers out via email and regular US mail.
iv. Follow up with phone calls.

Objective B: Offer information sessions at existing partner colleges and invite new colleges to attend.

Deliverables: i. Design a model information session, including all the print materials, giveaway photonics kits, and lab tours for all partner colleges.
ii. Offer information sessions.
iii. Follow up with phone calls and surveys.

Objective C: Make presentations at regional and national conferences attended by colleges of the SE region.

Deliverables: i. Present at HI-TEC conference.
ii. Present at PI conference.
iii. Present at state technology conferences, forums, or similar events.

Objective D: Create a campaign to employers of the region and ask them to encourage the colleges close to them to start LFO courses or programs with the assistance of the SE LFO Center.

- Deliverables:
- i. Identify employers needing LFO training and located close to a community and technical college that has no LFO courses or programs.
 - ii. Contact employers and introduce the centers and its services to them.
 - iii. Ask employers to contact the colleges close to them and encourage them to start an LFO course or program.
 - iv. Follow up with employers and assist them in this process.

Objective E: Assist interested colleges with information on funding sources and grant writing.

- Deliverables:
- i. Provide a list of funding sources for LFO programs.
 - ii. Create and deliver a grant writing workshop to interested colleges.

Goal 3. Provide professional development for K-12 STEM teachers to bring LFO career awareness to students to create a high-school-to-college student pipeline.

Objective A: Create a one-day LFO seminar for educating middle and high school educators, counselors and administrators.

- Deliverables:
- i. Create the educational materials for the one-day LFO seminar.
 - ii. Purchase the LFO giveaway kits.
 - iii. Create agenda and promotional materials for the LFO seminar.
 - iv. Create promotional materials for attendees to take back to their schools to distribute to students.
 - v. Create a section of the center's website for K-12 personnel and students.

Objective B: Organize and offer the seminar once in the fall and once in the spring semesters.

- Deliverables:
- i. Create address lists of middle and high schools of each college's service area.
 - ii. Create a contact list consisting of principals, vice principals, deans, science teachers, and counselors of each school.
 - iii. Invite people on the contact list to attend an LFO seminar which includes a stipend.

Objective C: Create a newsletter to keep in touch with seminar attendees, and update them with LFO news, statistics, and why they should be encouraging students to study LFO.

- Deliverables:
- i. Create a semester LFO e-newsletter keeping the one-day seminar attendees updated on related events and developments.
 - ii. Send out occasional surveys to previous participants to keep them engaged and remind them of the regional center and its services.

Objective D: Inform attendees of online training, webinars and other free LFO training to seminar attendees over the school year.

- Deliverables:
- i. Send information to participants about upcoming free industrial seminars, shows, webinars etc.
 - ii. Organize industrial seminars or technical presentations at partner colleges and invite one-day seminar participants to attend.

Goal 4. Create awareness of LFO careers and a clear pathway for returning veterans to recruit them for participating regional college programs.

Objective A: Create paper and electronic LFO educational materials addressed specifically to returning veterans and minorities.

- Deliverables:
- i. Create a paper and web-based flyer for returning veterans.
 - ii. Create a paper and web-based flyer for women and minorities.

Objective B: Locate the veterans' transition, from military to civilian life, centers and make arrangements to either visit or send information packets about LFO educational opportunities.

- Deliverables:
- i. Make a list of locations where the veterans transition program is offered.

- ii. Contact and visit these locations and present the LFO options to veterans.

Objective C: Locate the transition centers for veterans with military LFO experience and inform them about possible award of college credit and accelerated degree completion.

- Deliverables:
- i. Make a list of the locations where veterans with LFO training are discharged.
 - ii. Contact these locations and offer information about transferring credits into LFO programs of the southeast region.

Objective D: Create a veterans newsletter and email it to every veterans office of every partner college and also to any veterans offices in the vicinity of the partner college.

- Deliverables:
- i. Create an electronic newsletter specifically for veterans.
 - ii. Send via email the newsletter to veterans offices of partner colleges and veterans offices in the service area of participating colleges.

Objective E: Work with the minority/diversity office of each college to create initiatives for increasing enrollment of minority groups in LFO programs.

- Deliverables:
- i. Create an electronic LFO flyer targeting females.
 - ii. Create an electronic LFO flyer targeting African Americans and Hispanics.
 - iii. Create a minority/diversity section on the center's website.
 - iv. Visit minority/diversity offices on college campuses, explain the LFO program and deliver flyers.

Objective F: Ensure that all print and electronic promotional material depicts diverse minority role models.

- Deliverables:
- i. All pictures with students in promotional materials should have 50% women according to IWITS recommendations.
 - ii. All pictures with students in promotional materials should have representatives of all the major races: White, Black, Hispanic, Asian, etc.

- Was the program successful?

Goal 5. Develop, expand, and strengthen partnerships between LFO industries and all regional colleges.

Objective A: Survey the training needs of the LFO industry and the preferred time for delivery.

- Deliverables:
- i. Create time lines for delivering the training to the different industrial partners.
 - ii. Obtain commitment from employers to the training content and schedule.

Objective B: Study the best and most effective delivery method for training. Consider face-to-face, online, or blending of the two methods.

- Deliverables:
- i. Catalog the preferred training delivery method by every stakeholder.

Objective C: Identify colleges with existing LFO programs and expertise in the geographical area where the need is.

- Deliverables:
- i. Conduct a survey of LFO employers and find out what their special training needs are.
 - ii. Conduct a survey to identify colleges with existing LFO training programs.
 - iii. Produce a gap analysis identifying where new programs need to be created to satisfy industry needs.

Objective D: Conduct LFO information sessions at colleges identified in objective A located close to LFO employers.

- Deliverables:
- i. Create an information seminar for identified colleges.
 - ii. Present the information seminar to the college stakeholders: instructors, department chairs, deans, and vice presidents.
 - iii. Follow up and assist in implementation of course or program.

Objective E: Prioritize delivery of the needed training based on the industry specific needs.

- Deliverables:
- i. Conduct a survey of LFO employers and find out what their timeline for the special training need is.
 - ii. Assist colleges with existing LFO training programs and local to the employers in delivering the training.

Objective F: Provide training to the college faculty closest to the industrial employer with the need.

- Deliverables:
- i. Conduct a survey to find if proximal to employers colleges have a need for professional development for their LFO instructors.
 - ii. Provide this training with the OP-TEC open-entry open-exit hybrid courses, or with Corning’s Fiber IQ program.

Goal 6. Expand the membership of the Industrial Advisory Board (IAB), and monitor the supply, demand, and skill-set needed by LFO technicians in the Southeast region through a strong Industrial Advisory Board.

Objectives A: Identify one faculty member and one IAB member from each partner college to serve on the regional center’s steering committee.

- Deliverables:
- i. Form the center’s steering committee.

Objective B: Create a vision for the future of the Regional Center.

- Deliverables:
- i. The steering committee creates a vision statement for the regional center.

Objective C: Compose a prioritized list of the annual goals of the Regional Center.

- Deliverables:
- i. Create a list of the annual goals of the regional center.
 - ii. Prioritize the list of annual goals.

Objective D: Distribute the tasks for achieving the above goals to the member colleges

- Deliverables:
- i. Assign tasks for achieving goals to member colleges.
 - ii. Create a timeline for completing assigned tasks.
 - iii. Create a reporting schedule for assigned tasks.

Is it being done as planned?

Action Plan and Timeline for Regional Center for Lasers and Fiber Optics

Legend: FL= fall, SP= spring, SM=summer, RC=Regional Center, PC=Partner College

ACTION ITEMS	TASKS	YEAR 1	YEAR 2	YEAR 3	YEAR 4
1. Organize the leadership team of the Regional Center and assign responsibilities to every member (Goals 1 and 6)	1A. All principal partners meet to identify work to-be-done, establish work priorities, and assign tasks to partners.	FL	FL	FL	FL
	1B. Publicize the formation of the center and its goals to educational institutions and industry.	FL SP SM	FL SP SM	FL SP SM	FL SP SM
	1C. Create a website for the RC.	FL			
2. Identify the specific area of focus of each principal partner college. (Goal 1)	2A. Each PC surveys its local employers to find out their special LFO training needs.	FL		FL	
	2B. PCs establish a training program to satisfy these needs.	FL		FL	
	2C. PCs purchase needed equipment and materials.	FL SP		FL SP	
	2D. PCs send instructor for professional development if needed.	FL SP		FL SP	

3. Expand the coalition of partner colleges and create new LFO programs. (Goal 2)	3A. RC identifies colleges located near photonics employers that need photonics training.	FL SP SM	FL SP SM	FL SP SM	FL SP SM
	3B. RC contacts these colleges and offers resources and support in creating photonics programs.	FL SP SM	FL SP SM	FL SP SM	FL SP SM
4. Create an outreach program for middle and high school science educators, counselors, and administrators. (Goal 3)	4A. Create a one-day LFO seminar for middle and high school educators, counselors, and administrators.	FL			
	4B. Each PC offers this seminar once in the fall and once in the spring.	FL SP	FL SP	FL SP	FL SP
5. Recruit and assist returning veterans. (Goal 4)	6A. RC investigates from where to recruit returning veterans.	FL			
	6B. Create paper and electronic materials introducing to veterans the LFO educational opportunities at PCs.	FL			
	6C. RC designs and executes a veteran information and recruitment campaign.	FL SP SM	FL SP SM	FL SP SM	FL SP SM

Goal 1. Assist colleges with existing LFO programs by providing support, professional development, and equipment.

All three partner colleges provided **professional development** for faculty in lasers and fiber optics, which included training on the latest FO equipment, attendance to conferences and supported 5 PD conferences, each involving 7 faculty members from 5 colleges. LASER-TEC also identified and distributed a series of webinars, with webinar notices being sent out to colleges on a monthly basis. The information and access to upcoming and archived webinars will be hosted on LASER-TEC and OP-TEC websites. LASER-TEC also facilitated training on latest fiber optics equipment and techniques for 7 IRSC students. LASER-TEC initiated the start-up of OSA and SPIE students' chapters at IRSC, with a trip to Photonics West, CA for CCCC SPIE Student Chapter members being organized. A newly initiated 'Makers Club' is open to all students at TCTC.

In terms of **recruitment and outreach**, LASER-TEC conducted and supported 75 outreach, recruitment, and informational events to increase public awareness of LASER AND FIBER OPTICS. 6,720 students participated, hired 3 part-time dedicated recruiters for CCCC and IRSC programs, hosted a student camp STEAMing along with the Arduino Controller at TCTC, and continued supporting the dual enrollment program in photonics at TCTC, with 'Intro to Photonics' course now being eligible for dual enrollment. LASER-TEC assisted the Baker College, MI with K-12 teacher workshops and recruitment strategies. A college recruiter visited LASER-TEC to learn about K-12 outreach best practices.

In terms of **course offerings**, Fiber Optics and Biomedical Electronics is a new course now being offered at IRSC. CCCC developed and launched a hybrid format of the core photonics courses, to enable a fast track employment option for the program graduates. In close collaboration with the industry, CCCC is developing a new course Photonics Applications. Based on the industry feedback, this course will include:

thermal-electric device fabrication and tests, material focusing lasers used for wafer cutting, spectroscopy, LED semiconductor processing, solid state crystal growth, fiber optics, and short pulse solid state laser design/manufacture.

The partner colleges continue to offer the following courses:

IRSC: Photonics, Geometrical Optics

CCCC: Lasers and Applications, Photonics Technology, Photonics Applications, FO, Photonics Applications Project

TCTC: Introduction to Photonics

The partner colleges continue to expand their inventory of **equipment and tools**. IRSC FO lab have recently acquired a fusion splicer, source-meter, and optical time domain reflectometer. PCS donated FO cable and equipment (\$2K value). CCCC have acquired equipment and supplies for operating the solid state laser, and continued development of a short pulse solid state laser using a pumping source and various crystals, grown at Synoptics. The laser system was successfully tested in April 2015. Furthermore, MegaWatt donated the laser (greater than \$20K value) to CCCC, and Synoptics donated the crystals to CCCC (greater than \$20K value). LASER-TEC is currently conducted research on equipment needs among college photonics programs.

Findings:

The following tables shows the increase of number of courses, course sessions, and program enrollment at the partner colleges during year 1 and year 2 of LASER-TEC operation.

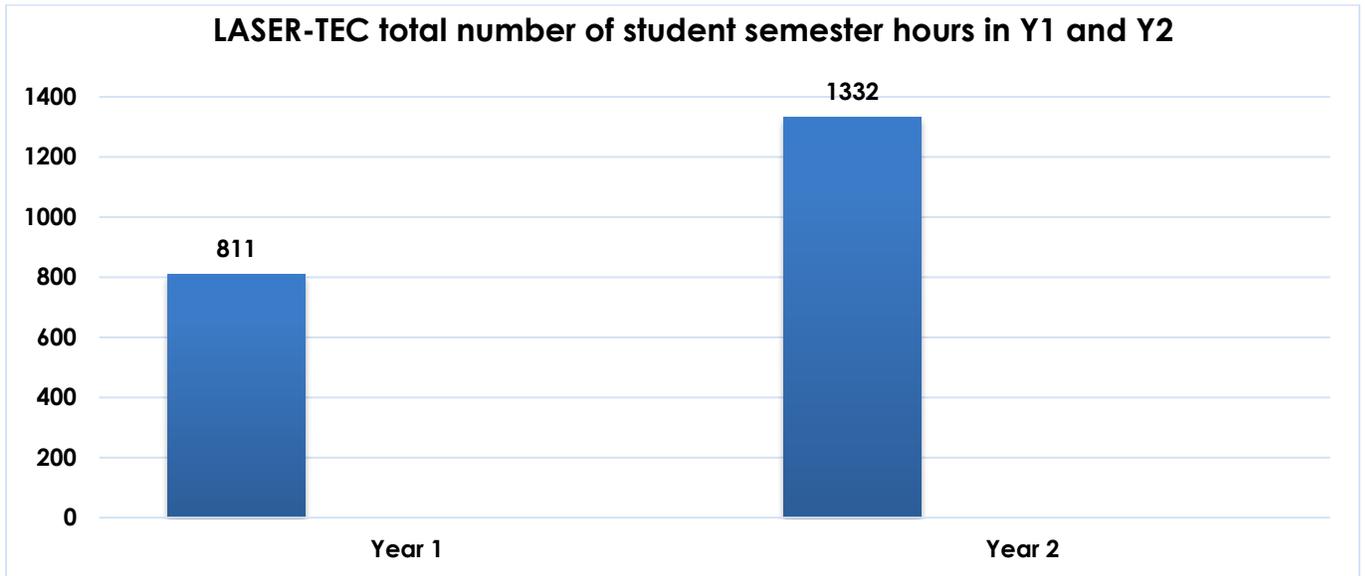
Year 2: 2014-2015	CCCC	TCTC	IRSC	Total:	Courses:
photronics courses	5	1	4	10	CCCC: LEO 111 Lasers & Applications (2 credit hours), LEO 212 Photonics Applications(4) , LEO 211 photonics Technology (7), LEO 222 Photonics Application Project (2), LEO 223 fiber Optics (4) IRSC: ETS 2210 Photonics, ETS 2215 Geometrical Optics, ETS 2424 Biomedical Electronics, ETS 2220 Fiber Optics TCTC: EET -175 Introduction to Photonics (4)
program enrollment	20	73	55	148	
Total credit hours	19	4	12	34	
Student semester hours	380	292	660	1332	
veterans	1	2	5	8	
Graduates	11	17	10	38	

The following table shows the 2013-14 (year 1) data of photonics courses and student enrollment at all partner colleges.

Year 1: 2013-2014	CCCC	TCTC	IRSC	Total:	Courses:
photronics courses	5	1	1	7	CCCC: LEO 111 Lasers & Applications (2 credit hours), LEO 212 Photonics Applications(4) , LEO 211 photonics Technology (7), LEO 222 Photonics Application Project (2), LEO 223 Fiber Optics (4)
program enrollment	25	66	18	148	
Total credit hours	19	4	4	34	

Student semester hours	475	264	72	811	IRSC: ETS 2210 Photonics TCTC: EET -175 Introduction to Photonics (4)
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The chart below points to a favourable increase of combined student semester hours in the partner colleges:



The following table shows the 2014-15 data of the various forms of outreach events at all partner colleges.

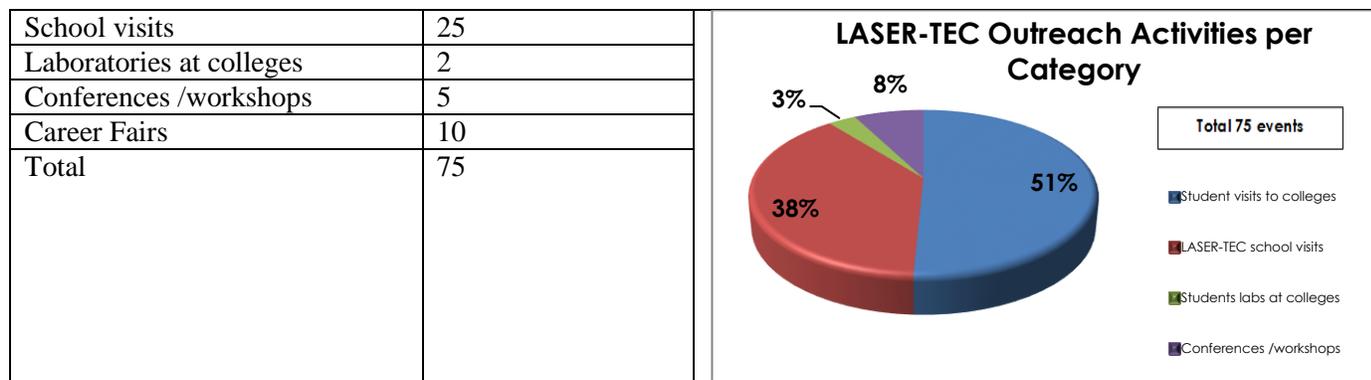
The following table shows the number of outreach events and the total number of students participated for year 1 and year 2.

	Year 1	Year 2
Outreach events	70	75
Student Impacted	6,580	6,720

Number of LASER-TEC Outreach Activities	
Year 1	70
Year 2	75

Number of Students Participated at LASER-TEC Outreach Activities	
Year 1	6,580
Year 2	6,720

Student camps and lab visits	33
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Goal 2. Assist colleges without LFO programs to create courses and programs by providing startup support.

LASER-TEC continues to succeed in meeting this goal. Informational e-mails and funding opportunities to start a course or programs in LASER AND FIBER OPTICS were sent out to 451 recipients in the 8 SE states.

LASER-TEC have collaborated with the Bishop State Community College in launching a fiber optics course, providing assistance in identifying fiber optics technician employers in the college area, development of a technician supply/demand survey, planning a teacher workshop, and training of a faculty member to conduct a workshop.

LASER-TEC have also assisted Minnesota Technical Community College in launching a photonics course, and the following colleges have expressed an interest in opening LASER AND FIBER OPTICS courses or programs:

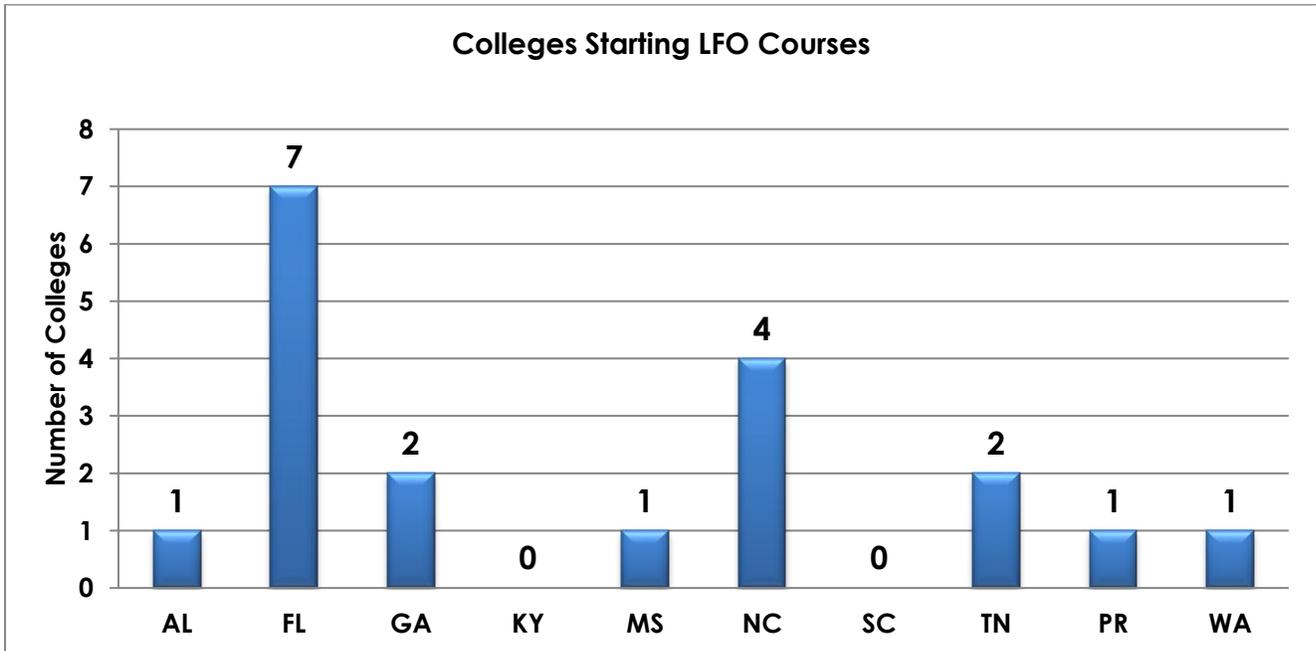
- Spokane Community College, WA
- Piedmont Community College, NC
- Miami Dade College, FL
- Catawba Valley Community College, NC

LASER-TEC developed a college level textbook on Fundamentals of Fiber Optics based on a public resource “Navy Electricity and Electronics Training Series: Module 24- Fiber Optics”, (CSCS), 2013”. This textbook is tailored for colleges and will be available at no cost for LASER-TEC partners, thereby sufficiently reducing the start-up and educational costs. The textbook consists of 7 chapters that explain the core principals of fiber optics and describes the latest developments and applications in the field. It is accompanied with student assessment tools and laboratories.

Findings:

The following table shows the number of colleges starting LFO courses in year 2.

Colleges starting LFO courses		
	Year 1	Year 2
AL	1	1
FL	6	7
GA	2	2
KY	0	0
MS	1	1
NC	2	4
SC	0	0
TN	2	2
PR	0	1
WA	0	1
Total	14	19



Goal 3. Provide professional development for K-12 STEM teachers to bring LFO career awareness to students to create a high-school-to-college student pipeline.

LASER-TEC conducted 5 Laser and Fiber optics professional development workshops for K-12 educators. Total of 64 STEM teachers from 37 schools attended. 5,888 students were impacted by teachers who participated in the LASER-TEC workshops. LASER-TEC understand that it is essential for STEM teachers to have sufficient technical knowledge about LASER AND FIBER OPTICS and the modern achievements and applications in lasers and fiber optics. To further assist teachers become familiar with the LASER AND FIBER

OPTICS fundamentals a new tool was designed, developed and assembled, known as the Light and Optics Exploration Kit, 120 of which were distributed to STEM teachers for free. 61 kits and 50 components were sold. Furthermore, LASER-TEC developed and published 15 lesson plans using the Light and Optics Exploration Kit. Post-event evaluation showed that 100% of responders found this PD workshop was beneficial and helpful.

LASER-TEC hosted a public event “Shedding Light on Laser and Infrared Technologies” celebrating the 2015 International Year of Light. 120 participants included general public, K-12 teachers, students and parents, faculty, and industry. The next free public event “Unlimited Power of Light” is scheduled in June 11, 2015. Industry and educational leaders will discuss the use of lasers in nuclear fusion, integrated photonics, and fiber optics.

LASER-TEC collaborated with the Pine School, FL, where a physics teacher participated at a LASER-TEC workshop and integrated topics in his AP Physics class, this resulted in 15 AP Physics students visited IRSC Photonics lab, practiced alignment of a laser system and performed advanced optical experiments. LASER-TEC donated 2 Light and Optics Exploration Kits.

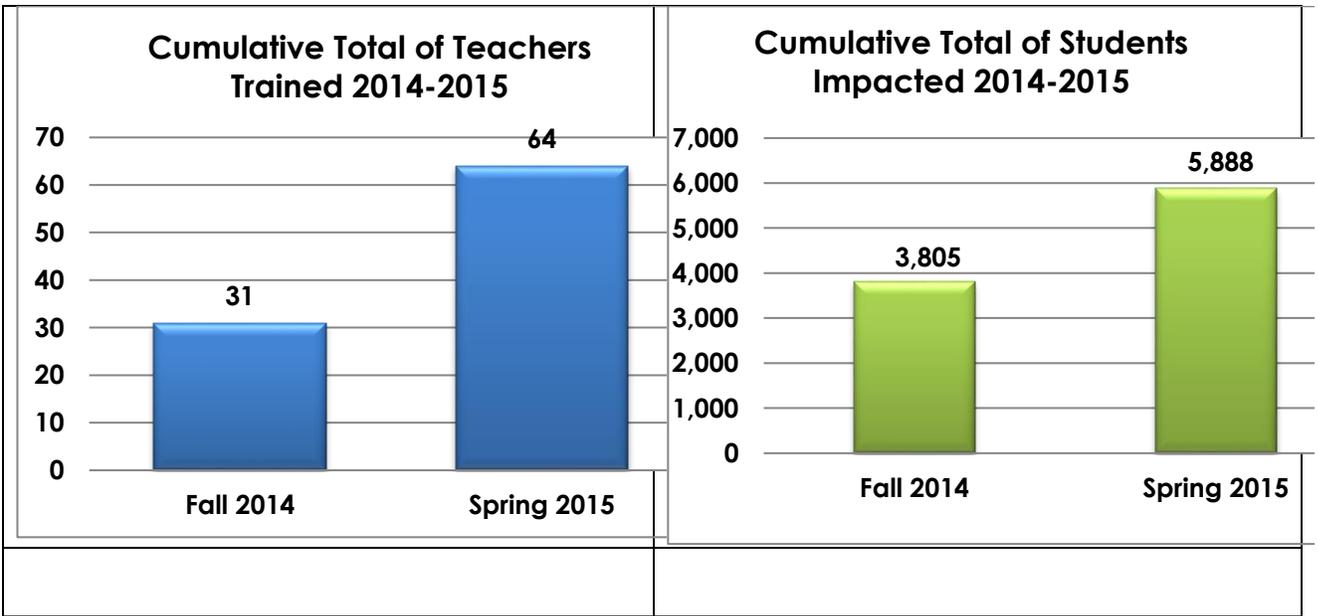
LASER-TEC collaborated with UCF on K-12 professional development, participated at a workshop hosted by UCF, exchanged best practices in conducting workshops, and planned joined future events. Opportunities were discussed to conduct a K-12 STEM workshop with the North Carolina Department of Public Instruction. LASER-TEC joined the AOP STEM Council in TCTC college area, and is working with council to create engaging and inexpensive activities to introduce students to LASER AND FIBER OPTICS.

LASER-TEC continued improving the content of the Light and Optics Exploration Kit. It supports 15 K-12 classroom demonstrations and is accompanied with detailed lesson plans. The lesson plans support inquisitive and cross disciplinary approach in teaching STEM. They consist of: learning objectives, theory overview, latest applications, a “hook”, step-by-step demonstration recommendations, tips, assessment, and literature reference. The Center has initiated development of short video demonstrations to assist teachers with the content integration. Over 120 kits were distributed to K-12 educators for free. 61 kits were sold. Total sales: \$6,520.

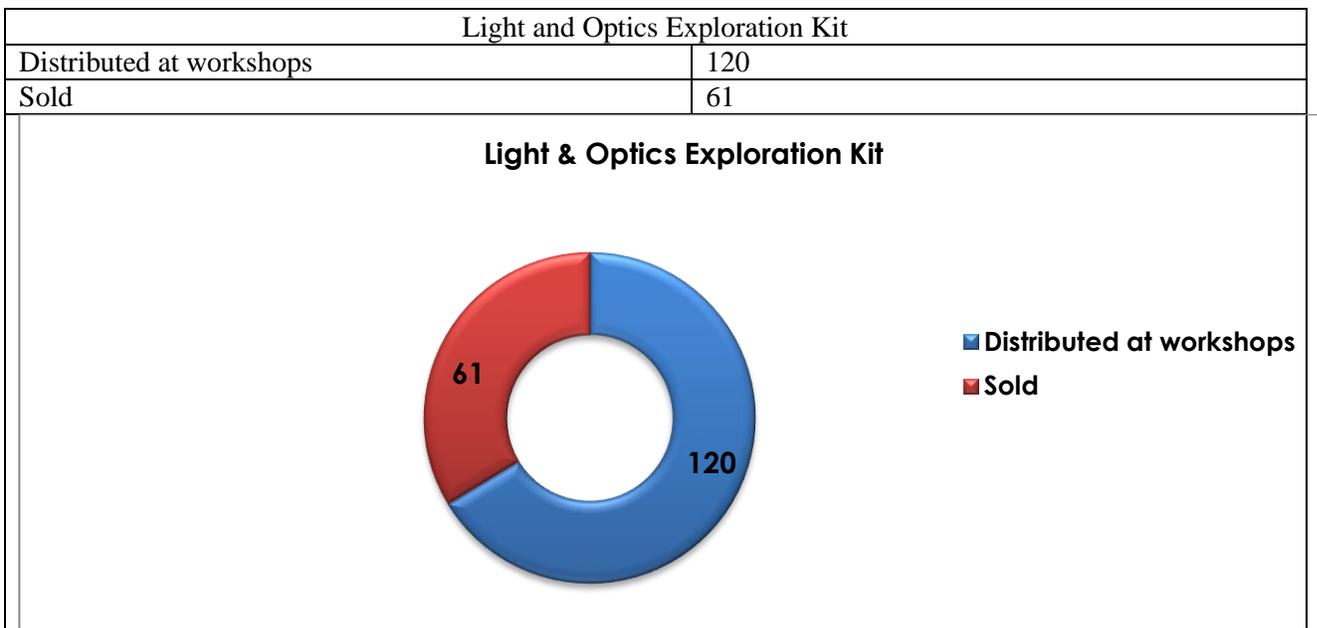
Findings:

The following table shows the number of K-12 professional development workshops and the total number of teachers trained and students impacted for year 2.

K-12 Professional Development	
Number of workshops	5
Number of teachers	64
Number of students impacted	5,888



The following table shows the number of Light and Optics Exploration Kits distributed or sold at K-12 professional development workshops.



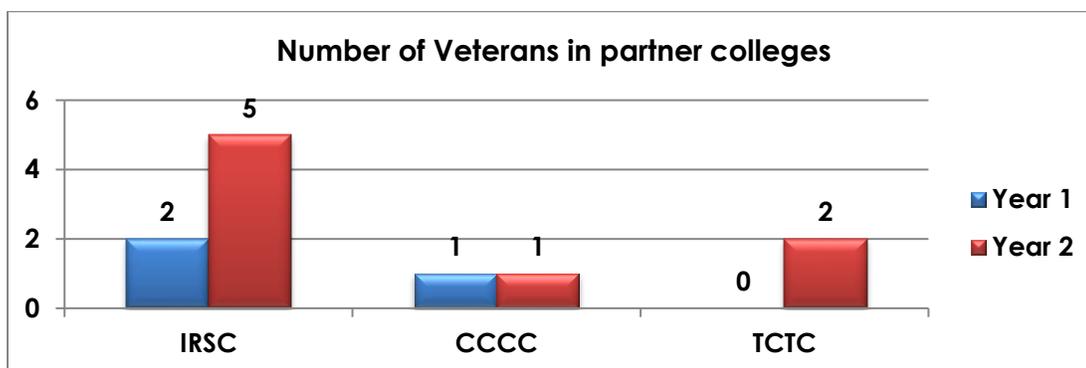
Goal 4. Create awareness of LFO careers and a clear pathway for returning veterans to recruit them for participating regional college programs.

LASER-TEC continue to examine ways to provide information on photonics employment and training opportunities to returning veterans. This has involved reaching out to 873rd QM Company Army Reserve Unit, participating at a session on veteran recruiting strategies at ATE PI with Dr. Rory Cooper with the University of Pittsburg, informing the local veteran community about EET courses, providing informational materials to

CCCC and IRSC Veteran’s offices, developing information for Veterans on AdvisorNet, and communicating with veterans on ACP Advisor Net about finding technical consulting work.

Findings:

	CCCC	IRSC	TCTC	Total
Veterans, year 2	1	2	11	



Goal 5. Develop, expand, and strengthen partnerships between LFO industries and all regional colleges.

LASER-TEC has a strong industrial network with estimated industry contributions reaching \$120,000 in assets and \$10,000 in-kind support. They have supported the fiber optics incumbent workforce by providing training, hosting workshops and facilitating job placements, i.e. hosted 4 workshops: Fundamentals Of FO, Future Flex AirBlown Fiber, FO in IP-Connected Enterprise, and Inside Plant Installation; trained 43 incumbent workers from 30 companies and educational institutions; workshops were supported by the industry partners: Corning Optical Communications, Anixter, Precision Contracting Services, Sumitomo Electric Lightwave, Axis Communications, and Transition Networks; facilitated on-line training for 6 Synoptics incumbent technicians in Fundamentals of Light and Lasers; Conducted onsite training at CCCC photonics lab; placed graduates at Laser Components, FL, Boomerang, FL, SW Florida Waste Water Management, FL, Watsatch Photonics, NC, MegaWatt Lasers, Synoptics, NC, Aqueti, NC, Photonics, NC, Lawrence Livermore National Laboratory, CA, DISCO USA, NC, Bosch, SC, and BMW, SC; modified the 2 year core photonics courses at CCCC to a hybrid format to accommodate the industry immediate hiring needs; solicited in-kind and financial support from PCS.

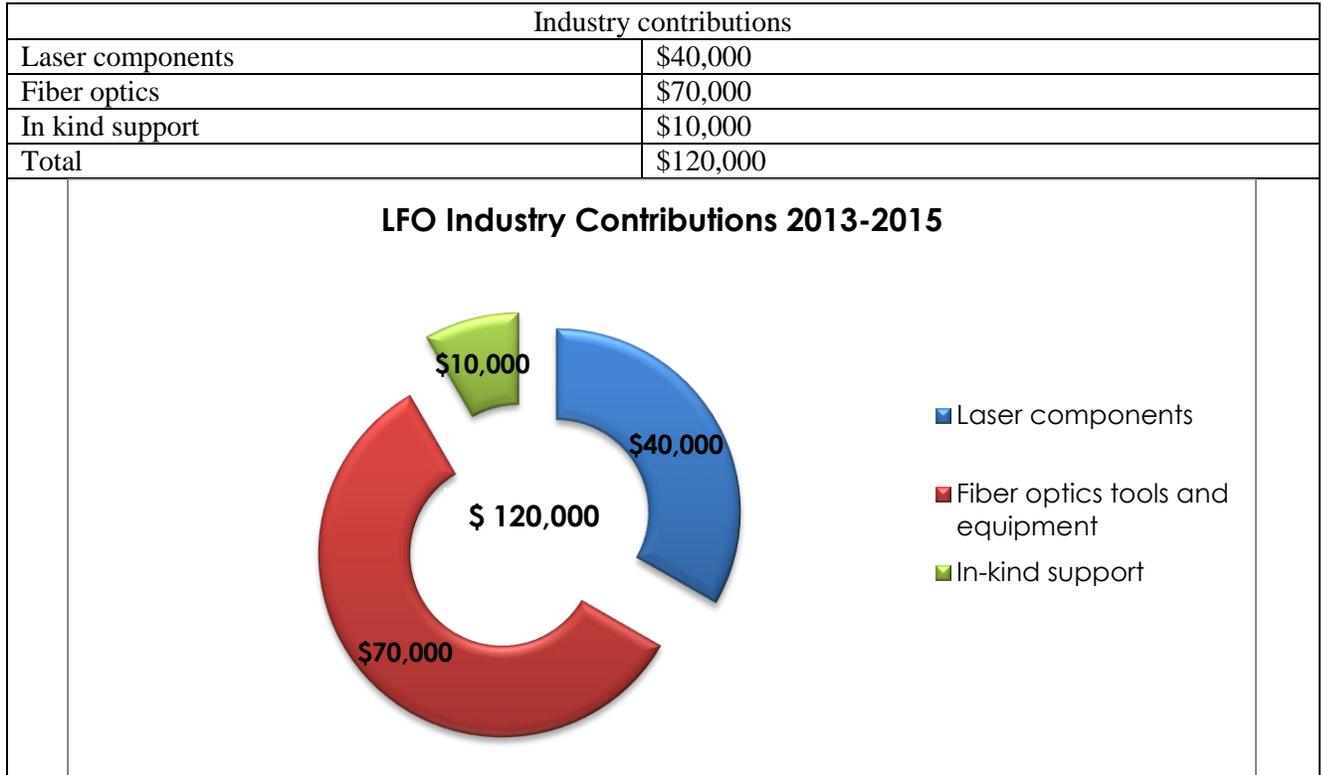
Furthermore LASER-TEC have developed a list of photonics companies nearby Bishop State Community College, AL.; linked a local FO company with the program; and facilitated access to discounted pricing for FO equipment through Corning Fiber IQ program for 12 faculty.

LASER-TEC advanced skills of incumbent LASER AND FIBER OPTICS technicians by offering continuing education opportunities. With the fiber optics industry collaboration LASER-TEC hosted 4 workshops. A total of 49 technicians and managers from LASER AND FIBER OPTICS companies advanced their technical knowledge and hands-on skills on the latest fiber optic technologies. All workshops were eligible for continuing education credits required for professional (re)certification. By providing the training opportunities in the local area, LASER-TEC helped local companies substantially minimize expenses associated with long distance

(re)certification requirements. LASER-TEC facilitated an online training of 6 incumbent laser technicians at Synoptics, and hosted on-site lab activities at Central Carolina Community College.

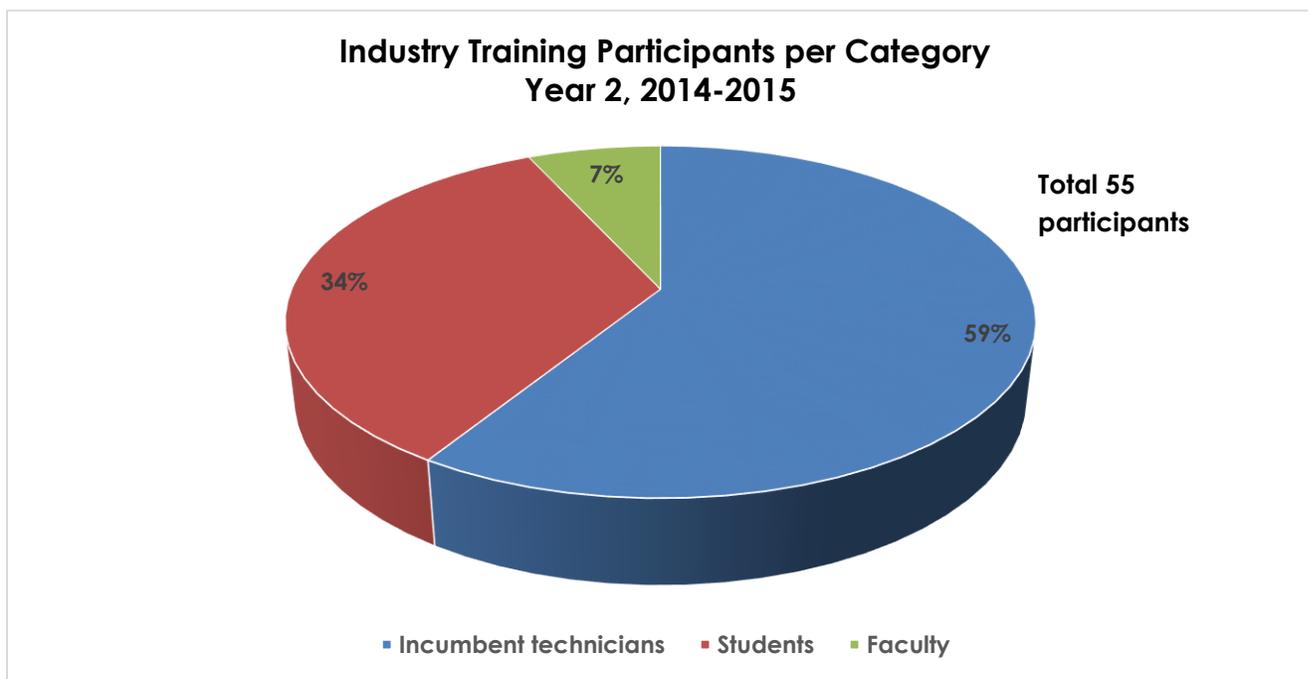
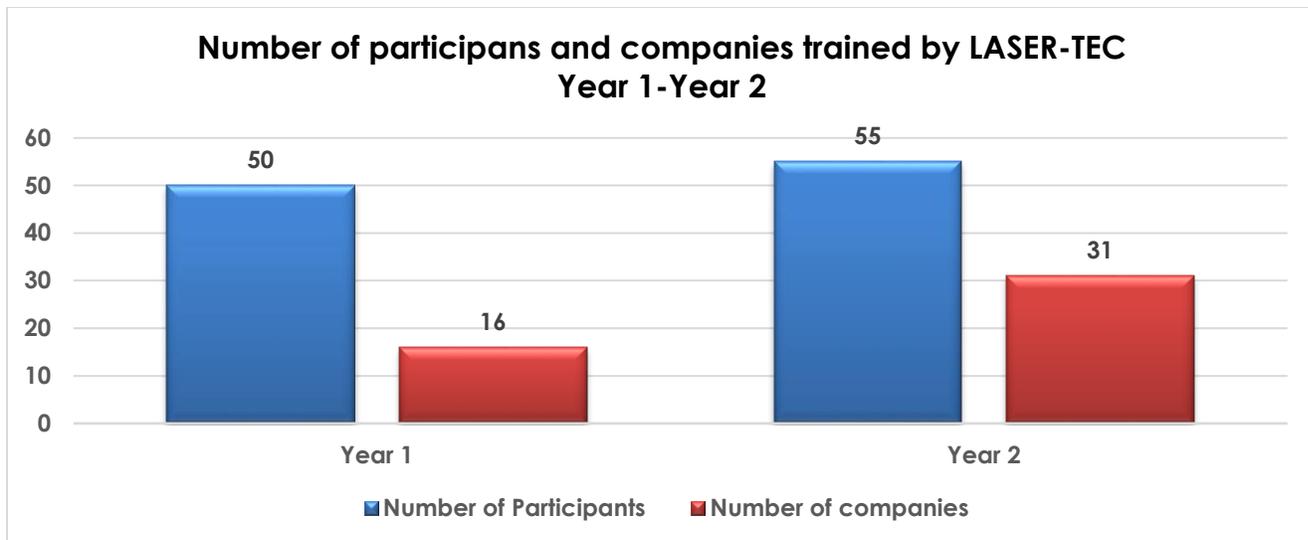
Findings:

The following table shows the LFO components, tools, equipment and financial contributions from the industry partners during year 2.



The following table shows the number of industry training workshops, together with a breakdown for the number of incumbent workers, students, faculty members, and industry participants during year 1 and year 2.

	Year 1	Year 2
Number of workshop/trainings	3	5
Number of incumbent workers	38	43
Students	6	7
Faculty	6	5
Total number of all participants	50	55
Number of companies	16	31



Goal 6. Expand the membership of the Industrial Advisory Board (IAB), and monitor the supply, demand, and skill-set needed by LFO technicians in the Southeast region through a strong Industrial Advisory Board.

This year, LASER-TEC formed and conducted the first meeting of the Industry Advisory Board (IAB) Members. Nine representatives from photonics industry leaders such as: Northrop Grumman Laser Systems, AFL, Brightview Technologies, DuPont Electronics and Communications, Gooch and Housego, Gulf Photonics, Inc. and Gulf Fiber Optics, LDX Optronics, Micron Optics, PFG Precision Optics and Florida Photonics Cluster discussed the current state of the LASER AND FIBER OPTICS technicians’ workforce. The mission of LASER-TEC Industrial Advisory Board is to monitor the supply, demand and skill-set of LASER AND FIBER OPTICS technicians in the Southeast.

LASER-TEC developed and conducted 2 industry surveys (the first in early 2014, the second in early 2015) to determine the current skill sets needed for photonics technicians. This survey is in the first of several surveys that are needed to accomplish the objectives of the NSF-ATE Laser & Fiber Optics Regional Center, LASER-TEC. The data will be used as a key input to the work of the LASER-TEC project to guide further development of photonics technician education training programs within the Florida and also the southeast US region addressed by LASER-TEC.

To collect the most accurate information about the LFO technician skillset and knowledge base, both surveys included open-ended questions. While more challenging to analyze, the collected data reflected unique requirements of LFO industry. The following knowledge and hands-on skills were identified by the responders.

Knowledge:

- Knowledge of electromagnetics, lasers, basic geometric & wave optics including interference & diffraction, thin lens equation, basics of light propagation
- Ability to read and understand detailed technical instructions
- Strong math and science fundamentals such as physics, algebra, trigonometry, geometry as well applied fields such as electronics and geometric and ray optics. Some knowledge of calculus is desirable although not required.
- Competence in optics and physics that provides understanding of technical goals, performance metrics, and trouble-shooting/problem-solving skills.
- Understand the function of various optical components for assembly into laser systems or test set-ups.
- Understanding of different types of lasers
- Problem solving
- Diligence in documenting procedures, measurements results, methods taken, and equipment/fixture layouts and locations. Documentation skills must be adequate for the tech or other team members to reproduce results and performance metrics.
- People skills, including good communication skills, written and verbal in English in order to communicate well with engineers.
- Just enough software skills to work with the EE and software engineers when developing and performing automated testing
- Responsibility in understanding risks and hazards, especially eye safety practices for lasers including laser classes, nominal hazard zones, and protective eyewear.
- Ability to use related computer tools such as MatLab, LabView, Excel and C++ or VB.

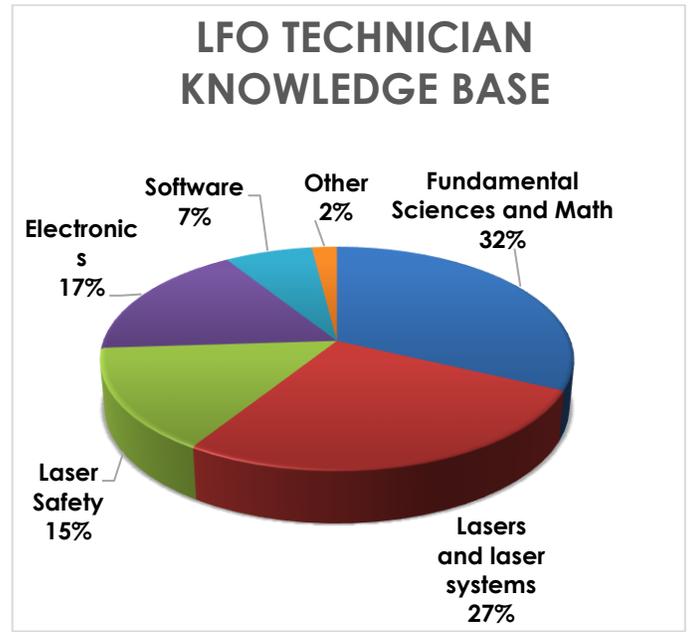
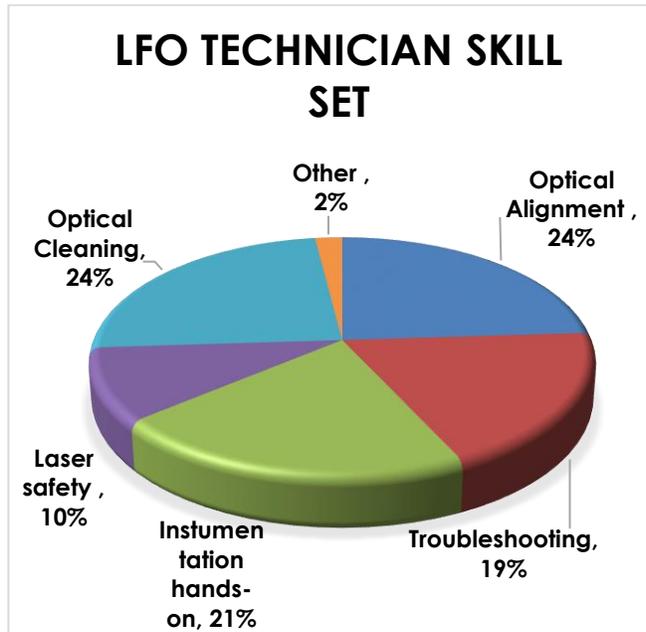
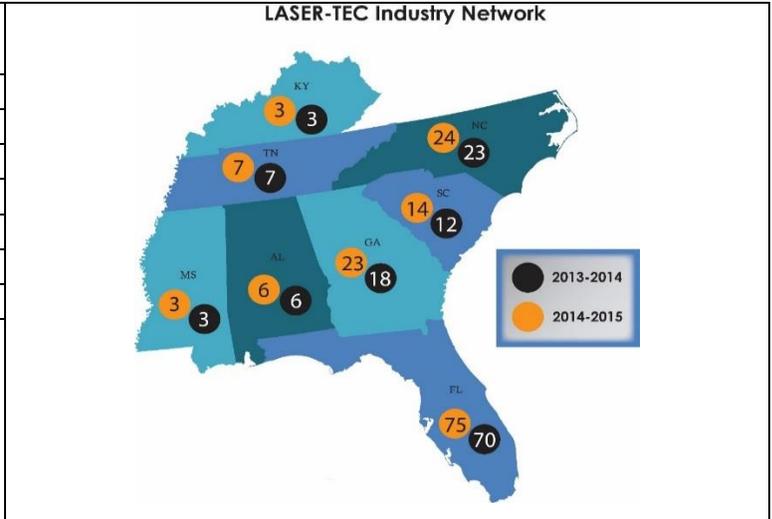
Hands-On Skills

- Opto-mechanical alignment experience; mounting and laser centering of optical elements; interferometer experience. Ability to align optical components/stations to required accuracies using not only simple alignment aids, but also optical metrology equipment and fixtures. The tech should be capable of understanding alignment techniques for both the visible and non-visible portions of the optical spectrum. Good eye-hand coordination and experience aligning optics to design fixtures and procedures would be a significant advantage.
- Basic trouble shooting skills
- Clean, handle and inspect optical surfaces without damaging them.
- Electrical and optical skills, including troubleshooting skills.
- Hands-on experience with lab instrumentation such as digital current sources, oscilloscopes, power meters, photometers and spectrometers.
- Electronics experienced, particularly with laser diode and solid state laser drivers

- Familiarity with operation of optical test equipment and hands-on experience with lasers and fiber optic assembly and test equipment
- Mechanical Skills

Findings:

Industrial Advisory Network in Year 2	
FL	75
NC	24
GA	23
SC	14
TN	7
AL	6
KY	3
MS	3
Total:	155 companies



Part IV

Is the program successful?

Conclusion

LASER-TEC continues to succeed in accomplishing the primary mission it set out to perform. They continue to assist the colleges with both existing and non-existing laser and fiber-optic (LFO) programs with support and programs and acquisition of new lab equipment. They held professional development workshops to aid K-12 STEM teachers improve their knowledge in optics, lasers, fiber optics, and bring awareness of LFO career opportunities. In the second year of the LASER-TEC program, the number of teachers and students impacted by the professional development workshops has doubled.

LASER-TEC helped recruit returning veterans with presentations, email campaigns, newspaper articles, with information about LFO career education. The colleges built and strengthened existing partnerships with local LFO industries and regional colleges while setting up expanded member Industrial Advisory Boards.

It is recommended LASER-TEC continue to expand the number of teachers they train and students that they impact through the professional development workshops, foster productive partnerships with their industrial partners using their Industrial Advisory Boards for contacts and advice. Successful strategies for attracting the returning veterans to train as LFO technicians should be pursued by exploring other avenues of contacting them before they transition to civilian life.