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Arizona Optics Initiative

Option Year Four Annual Report

February 29, 2024

**Small Business Administration (SBA)
Regional Innovation Cluster (RIC) Program
Contract Number 73351019C0003**

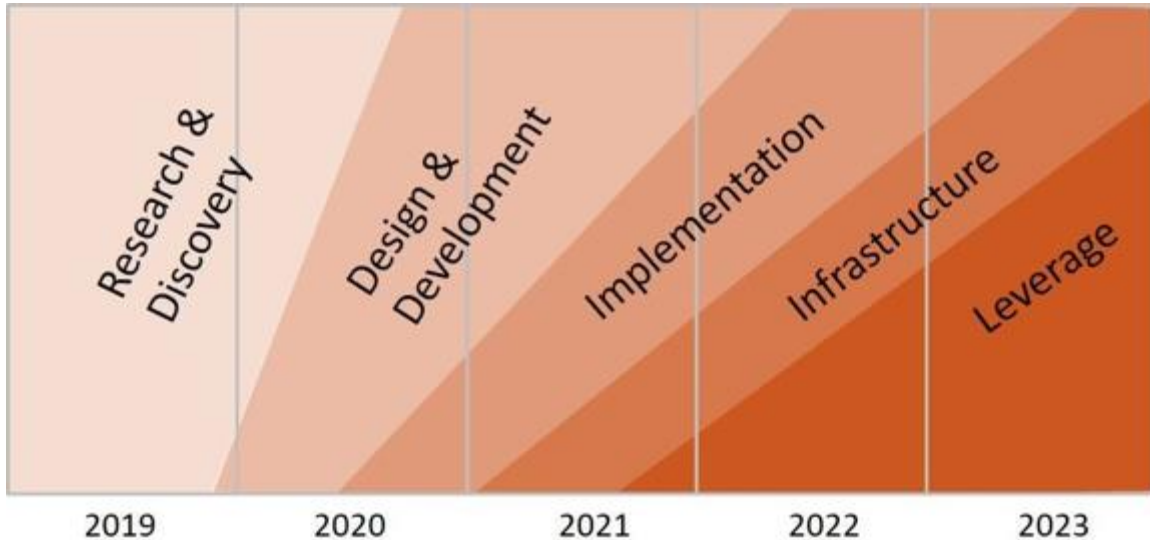


Arizona Optics Initiative 2023 Annual Report

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Introduction



Arizona Optics Initiative Program Overview

When this SBA contract was first awarded in 2019, the Arizona Optics Initiative (AOI) team conducted extensive interviews with southern Arizona optics companies, both formal cluster members and those outside. We also interviewed many of the local technology support organizations. Our overall findings were that while there were many optics companies in the region, there was nothing resembling an ecosystem of support. Some of the specific issues included:

- There was little communication among companies, much less cooperation or collaboration.
- Even though the cluster had operated continuously since 1992, few companies participated because they saw little or no values in doing so.
- While most companies wanted to grow, they had difficulty doing so because they could not hire skilled employees, and there were no formal support programs.
- There was lots of optics technology coming out of the UArizona Wyant College of Optical Sciences that spawned entrepreneurial companies. However, there was little support for developing business acumen to build and grow those companies.

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- Many of the small companies wanted to compete for larger contracts but were unable to do so because they did not have access to critical equipment.
- Within the worldwide optics technology community Tucson is a true center of gravity. However, within the local community-at-large, there was virtually no knowledge of this center of excellence.

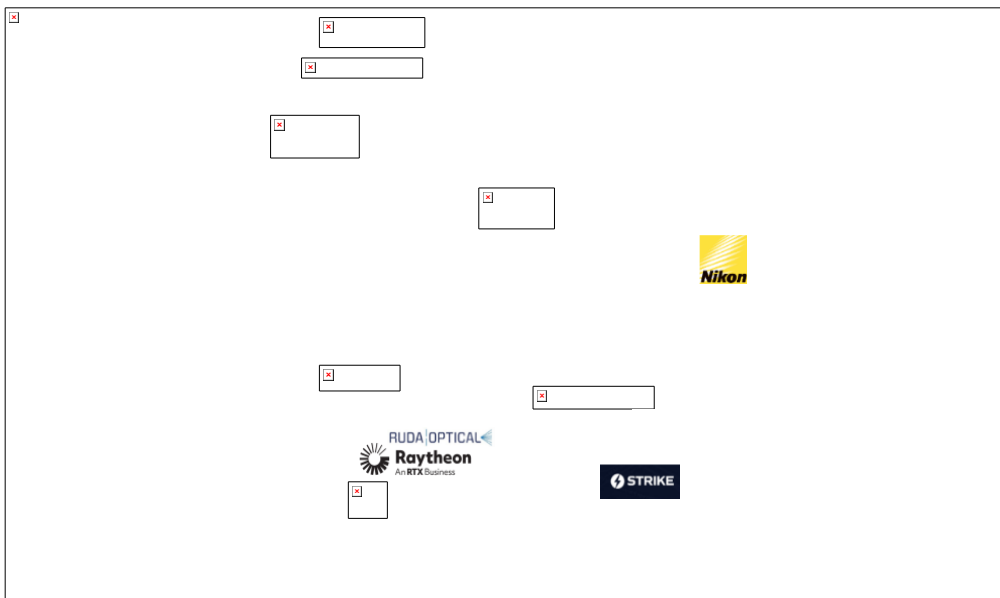
In short, there was no ecosystem.

To start to build an ecosystem, the first thing that the AOI team did was to build the graphic above to guide our actions through the coming years. That beacon has worked well for us, except that we were clearly delayed in 2020 – 2021 by the COVID-19 epidemic.

To implement specific activities, we developed three guiding initiatives:

- Help existing companies scale-up and grow (80% of money and effort).
- Facilitate the formation and development of entrepreneurial companies (10%).
- Enhance the visibility and community awareness of optics (10%).

The net result of the efforts applied to these initiatives is that Optics valley cluster membership has grown from less than 20 in 2019, to over 100 today. The members range from multibillion-dollar companies to very small businesses, some single practitioners.





To facilitate the growth of our existing companies, Optics Valley sponsors and participates in many industry events, including:

- Quarterly Optics Valley business meetings.
- Our flagship event, Arizona Photonics Days, held each January.
- SPIE Photonics West in February.
- SPIE Optics + Photonics in August.

In addition, ongoing support programs include:

- Monthly Tech Series Webinars
- Monthly Newsletter: *Optics Valley FOCUS*
- Creation of an online Resource Directory
- Supply Chain Working Group
- Community Lab Working Group
- Development of curricula for workforce development
- Continued development of the relationship with Raytheon

Throughout the year, we have continued to work with Pima Community to develop programs for optics technician training. The initial *Intro to optics* class was held in December 2023. That class will be repeated in the spring of 2024, and curriculum development for the full optics certificate program is in process.

It is important to note that as the ecosystem has begun to take shape, some of these programs are shifting from AOI driven activities to company led projects, with AOI in a support role. Some specific examples include:

- Workforce development curricula development
- Community Optics Lab workgroup
- Supply Chain Workgroup

Throughout this contract, AOI has worked with entrepreneurial companies to submit SBIR proposals. The success rate for these proposals is over 90%, with \$6.1 million contract value.

AOI has also begun to engage with the University of Arizona Center for Innovation (UACI). They have more than 80 nascent companies in their incubator program, 6 of which possess optics technology. Working with UACI leadership, we have begun to work with some of the optics companies in a pilot program using our VIA-Business assessment to help identify gaps and encourage development of better business acumen.



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To support our community visibility initiative, we had two major events in 2022:

- In May, we partnered with the UArizona Flandrau Planetarium and Science Center to celebrate the International Day of Light. This was a Sunday afternoon Family Affair open to the public, with programs for both the young and old.
- In October, Optics Valley was an exhibitor and sponsor for the Arizona Technology Council 10th Annual Tech + Biz Expo.
- In addition, we participated in several smaller events, including SheTech and the Tucson Festival of Books.

Details for many of these events and programs are included in the next two sections of this annual report.

While the AOI team is proud of our accomplishments in building a solid ecosystem, there is still much to do to expand and sustain that result. Some key areas for future emphasis include:

- Continued emphasis on Workforce Development for both STEM and technician training, and expansion to Maricopa County and the state universities.
- Direct interaction and inclusion in broader community organizations focused on economic development.
- Integration into the Arizona semiconductor initiative as a critical enabling technology.
- Expansion to defense Prime Contractors, other than just Raytheon, as a critical technology for defense and homeland security.

Thirteen Months in Review (January 2023 – January 2024)

First Quarter 2023

In January 2023, the cluster achieved two major milestones. Founded in late 1992 as the world's first optics cluster, Optics Valley celebrated 30 years of continuous operation and has grown to over 100 members.

In January, Optics Valley hosted its 6th annual Arizona Photonics Days.

- 210 registrations
- 28 technical presentations
- 12 industry presentations
- 23 company pitches



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In San Francisco, Optics Valley hosted 25 member companies in the Arizona Pavilion at Photonics West 2023.



In March, Optics Valley held its quarterly Business Meeting with over 40 cluster members attending. The highlight of this meeting was a workshop to solicit member input on the needs for the Community Optics Lab that we are planning.



Optics Valley joined the National Photonics Initiative (NPI) for Congressional Visits Day in Washington, DC. We are excited to report Arizona Senator Mark Kelly's membership in the *Congressional Optics & Photonics Caucus*. The *Caucus* seeks to advance the use of light-based technologies through public and private investments and policies.

In addition to these industry activities, during the first quarter, Optics Valley sponsored three community events as part of our initiative to enhance visibility and community awareness of optics, photonics, and astronomy:

- SheTech, hosted by City of Tucson
- Tucson Festival of Books Science City
- UArizona Wyant College of Optical Sciences Laser Fun Day, a student hosted event

Second Quarter 2023

The Optics Valley highlight of this quarter was the celebration of the International Day of Light, presented in partnership with the UArizona Flandrau Planetarium and Science Center. This family event held two planetarium shows on Sunday afternoon, May 21, and both were filled to capacity with close to 300 attendees.



On June 7th we continued the Optics Valley Technical Series with a well-attended webinar on Laser-Induced Damage Threshold.





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Also in June, we held our quarterly Optics Valley member meeting, with over 40 attendees. The meeting featured a company overview by member company PowerPhotonic, an introduction to the services from SBDC, and a progress update on the project to establish a Community Optics Lab for companies to use. After the prior Business Meeting workshop, Optics Valley has formed a “community optics lab workgroup” to further develop the shared laboratory formation.

Led by one of the senior Optics Valley members, several of our companies attended and/or exhibited at the 25th Photonics North Conference in Montréal, Canada, followed by the International Optical Design Conference (IODC) in Quebec, Canada.

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Later in June, Optics Valley, in association with the Arizona Commerce Authority, hosted 8 member companies in the Arizona Pavilion at Laser World of Photonics 2023, a.k.a. Laser Munich, one of the world's largest optics events with over 1,300 exhibitors and over 40,000 attendees.

Optics Valley's delegation leader also supported several other member companies exhibiting in individual locations and interacted extensively with other cluster leaders in the Global Photonics Alliance and their exhibiting member companies.



Third Quarter 2023

This quarter was a quiet one. As is shown throughout this report, our overall AOI program is now well into the Implementation Phase.

The only in-person local event was our Optics Valley quarterly meeting in mid-September. It was attended by about 40 members. This meeting featured a presentation by Optical Support Inc. (OSI), which is a fast-growing local company providing mechanical subsystems for optical instruments and systems. The highlight of the meeting was a presentation by a local FBI agent on the protection of intellectual property. The discussion on this topic continued well into the hosted Happy Hour.

In August, a sizeable group of our corporate and institutional members, led by Katie Schertz of Edmund Optics as Optics Valley volunteer, participated in SPIE's Optics + Photonics Conference and Exhibition in San Diego as exhibitors, presenters/educators, and involved in the SPIE Annual General Meeting and committee meetings. This event was attended by all sizes of corporations from startups, small businesses, and large national/international enterprises.

In September, Mark Jepperson attended the annual SSTI Conference and made good connections and received valuable learning experiences to bring back to our cluster.

Also, in September, Jack Schumann attended the SPIE Photonics Industry Summit in Washington, DC. This one-day forum focused on the optics and photonics industry as an essential enabler of emerging technology. The full-day program hosted US government leaders and company executives discussing federal policy and funding important to the optics and photonics industry. Our collective goal in meeting is to raise the profile of the optics and photonics industry, while learning more about the priorities of the US government in this technology space. Six of our large company/prime contractor members attended,

The other key event for the quarter was the virtual presentation on *High Power and High Energy Fiber Lasers for Doppler LiDAR and Sensing*. It was attended by about 50 members.

Fourth Quarter 2023, including January 2024

From an events perspective, this is always our most active quarter, with three major events, plus our quarterly business meeting.

Arizona Technology Council Tech + Business Expo

We started in October with the annual Arizona Technology Council Tech + Business Expo. While this one-day conference and exhibition is not only focused on optics, it is an opportunity for our cluster members to demonstrate their capabilities to the broader Arizona technology community. This year we had 67 exhibitors and nearly 400 attendees. Program highlights included an expert panel on AI and an update on the OSIRIS-REX mission, which brought an asteroid sample back to earth. Aon optics company, Paramium Technologies was featured as the Innovation Leader of the year.



Optics Valley Business Meeting

In mid-December we held our quarterly member business meeting. As usual, it was attended by about 50 people. The highlights of the meeting included a company overview by Teledyne and a presentation on cybersecurity strategies. In addition, there were updates on three key programs: supply chain, workforce development, and the community optics lab.

7th Annual Arizona Photonics Days

The highlight of the quarter in January was our annual flagship program, Arizona Photonics Days. This was our seventh edition of this conference. This year it was 2.5 days long and featured five technology sessions:

- Biomedical Technology
- Astronomy
- Sensing and Metrology
- Laser Technology
- Quantum Information Science

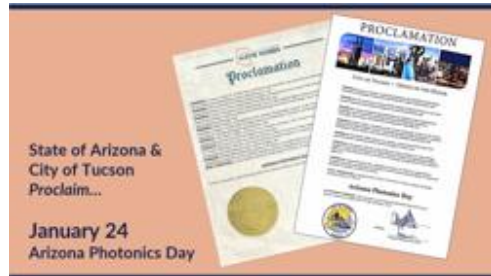
In addition, there were industry presentations, company pitches, and plenty of time for networking. In total, there were:

- 209 Registrations
- 28 Technical Presentations
- 14 Industry Presentations
- 24 company Pitches



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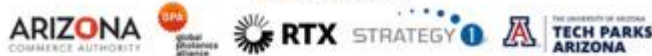
This year, we received formal proclamations of support from both the State of Arizona and the City of Tucson.



As always, we thank our Arizona Photonics Days sponsors:

We gratefully acknowledge these 7th Arizona Photonics Days sponsors:

GOLD SPONSORS



SILVER SPONSORS



BRONZE SPONSORS



Looking ahead:

SAVE THE DATE



Photonics West

Immediately following Arizona Photonics Days, we headed to San Francisco for Photonics West. This is an annual worldwide three-day major optics industry conference with about 20,000 attendees, 1,500 exhibitors and over 1,000 presentations. This year 10 of our members joined us as exhibitors in the Optics Valley Pavilion. In addition, there were over a dozen Arizona exhibitors throughout the exhibit halls.

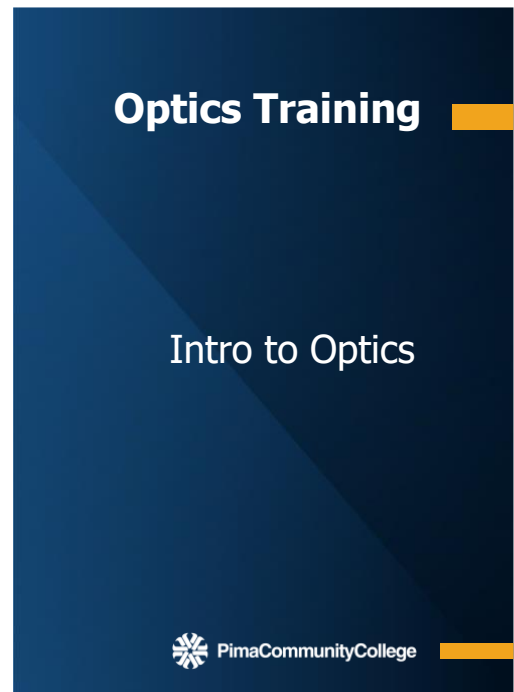


Program Progress and success.

Workforce Development

Pima Community College

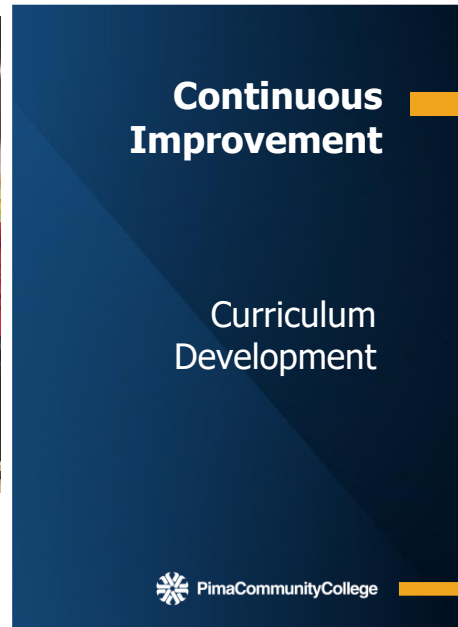
At long last, the optics technician training program launched on October 10, 2023, at Pima Community College (PCC) with the first class. This class includes appropriate hands-on laboratory exercises. The first class was attended by 10 students.



This initial class offering will run again in Spring of 2024 while the rest of the classes are under development.

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We also identified optics industry leaders to review and confirm the curriculum for the Pima Community College optics program. This group will act as the Optics Program Advisory Committee to the Dean of Advance Manufacturing at PCC. The advisory committee has been meeting at least three times per month and is developing the long list of outcomes it expects the curricula to deliver.





State of Arizona Office of Economic Opportunity

In October, we had a meeting with the leader of a newly created State of Arizona agency called Office of Economic Opportunity (OEO). The Governor has chartered this new agency to help drive workforce development and create economic opportunity.

At that meeting the new Director heard about many of the good things happening in technology in southern Arizona. Optics Valley and the Arizona Optics Initiative (AOI) had time to share what we are doing. In brief, we pitched the Optics Training Laboratory as part of the effort with PCC, and it was very well received. We were requested to write a proposal for that training lab, including justification rationale.

That proposal was written by AOI, submitted by Pima Community College (PCC), all in partnership with the Joint Technology Education District (high school level), the Center for the Future of Arizona, the McFletcher Corporation (for Workstyle Patterns™ inventories), and supported by Optics Valley.

The \$1.9 million dollar proposal has been well received. It is aligned with what OEO is chartered to do, supports the education track for Optics Technicians, is a connector for Job Path (a non-traditional and underserved workforce candidates), and leads to solving the workforce shortage in our industry for technicians. It is a game-changer for the optics ecosystem.

The most recent meeting with OEO was that they have accepted the proposal, but because it arrived just as they are forming their own agency internal processes, the funding will be delayed. PCC should have the funds in hand no later than March. In fact, we have now been asked if we can spend the money by June 30th.

Supply Chain Workgroup

Establish an active machining manufacturing, including precision fabrication, subgroup that meets monthly. To date results are as follows:

- Conducted 9 facility tours (see Edmund Optics highlight below).
- 24 Meetups
- 62 industry and supply participants
- Supported 2 people hired within the industry
- Supporting 1 new member seeking work
- Over 48 companies collaborating.
- 35 companies developing commercial relationships.
- 45 companies discovered new local solutions.
- 20 companies generated over \$750K in new business with each other.

Five supply companies have elected to participate in the Resource Directory.

The Supply Chain Workgroup added Electrical design and assembly companies along with the precision machining.

The meetings now start with a local company facility tour followed by a meetup at a local restaurant. 5 companies organized tours in their facilities during this quarter.

The Workgroup and Edmund Optics (EO), trained members on how to add their products to EO's Marketplace and catalog. EO has global market reach.

The Supply Chain Workgroup is scheduling a meeting and tour at the University of Arizona Richard F. Caris Mirror Lab as the scientists are working on the seventh and last segment of the Magellan telescope. This will continue to expose our supply chain to the strength and capabilities of our cluster.

The highlight of the fourth quarter was a workshop with Edmund Optics (EO) to introduce our members on how to add their products to EO's Marketplace and catalog. EO has global market reach. This workshop was followed by a tour of the new PCC Advanced Manufacturing Building, and then the usual meetup.

SUPPLY CHAIN WORKGROUP & **Edmund optics worldwide**

MARKETPLACE
One-stop shop for the best brands and products in optics and photonics

Learn How to Market Your Product Through the EO Catalog & Website

WHY AND HOW
Do you have a standard optics, imaging, or photonics component or device? Learn how to reach hundreds of thousands of potential customers through the Edmund Optics catalog and website. Gregg Fales, Director of Marketplace Products at Edmund Optics, will share:

- The Edmund Optics Value Proposition
- The Ideal Products for the Edmund Optics Channel
- Typical Terms and Requirements of our Suppliers

WHO SHOULD ATTEND
Optics and Photonics Marketing Teams, Product Managers, Merchandising, Supply Chain, Sales Management

WHEN
DECEMBER 6TH
STARTING AT 2:00 PM

LIST OF EVENTS

- 2:00 PRESENTATION OF EO MARKETPLACE AND YOU**
Starting at 2:00 pm at Pima Community College Advanced Manufacturing Building Room M110
- 3:15 TOUR OF ADVANCED MANUFACTURING BUILDING**
Starting at 3:15 pm at Pima Community College See page 2 for details
- 4:45 MEETUP**
Starting at 4:45 pm at Borderlands Brewing See page 3 for details

WHERE
PimaCommunityCollege
1255 N. Stone Ave. Tucson, AZ [See Page 2 for map](#)

SBIR Proposal Support

This table outlines the financial impact on Arizona through research and development (R&D) SBIR/STTR awards received by optics/photonics companies across various agencies. The financial distribution, number of awards, and success rates provide insights into Arizona's R&D landscape.

Company	Agency	Phase I	Phase II	Total Amount
ELE Optics	NSF	No award	No award	\$ -
Emagine Solutions	NSF	\$ 250,000.00	\$ 1,000,000.00	\$ 1,250,000.00
Hydronalix	USDA	\$ 175,000.00	Pending	\$ 175,000.00
Hydronalix	DOE	\$ 200,000.00	\$ 1,150,000.00	\$ 1,350,000.00
LightSense	DHA	\$ 100,000.00	No award	\$ 100,000.00
Paramium Technologies	NSF	\$ 250,000.00	\$ 1,000,000.00	\$ 1,250,000.00
Revolvate Robotics	Army Xtech	\$ 15,000.00	No award	\$ 15,000.00
Photonics Automation	NASA	\$ 117,000.00	No award	\$ 117,000.00
US Air Tech (USAT)	NSF	\$ 250,000.00	\$ 1,000,000.00	\$ 1,250,000.00
VaxSyna	NIH	\$ 430,000.00	Pending	\$ 430,000.00
Zenox DX (MSDX)	NSF	\$ 256,000.00	No award -	\$ 256,000.00
Totals		\$ 2,043,000.00	\$ 4,150,000.00	\$ 6,193,000.00
Success rate		91%	80%	

1. **Total R&D Funding Awarded:**

- The total R&D funding awarded to companies in Arizona amounts to **\$6,193,000.00**.

2. **Number of Awards:**

- The table lists a total of 14 awards distributed among different companies and Phases, 11 Phase Is and 4 Phase IIs.

3. **Results and Success Rates:**

- **Phase I Success Rate:** 91%
- **Phase II Success Rate:** 80%
- LightSense, Revolute Robotics, VaxSyna or Zenox DX did not request support from the AOI team on their Phase II applications.
- The AOI team supported Emagine, Hydronalix, Paramium Technologies, Photonics Automation and US Air Tech (USAT) on their Phase I and Phase II applications.
- These success rates indicate the overall effectiveness and viability of Arizona-based optics companies in progressing from Phase I to Phase II of R&D projects, reflecting the positive impact of the AOI team in providing coaching and mentorship to these companies.

4. **Financial Impact by Company:**

- Companies such as Emagine Solutions, Hydronalix, Paramium Technologies, and US Air Tech (USAT) have secured substantial funding, contributing significantly to Arizona's R&D optics ecosystem.
- Notable agencies supporting Arizona-based companies include NSF, USDA, DOE, DHA, Army, NASA, and NIH.

5. **Strategic Sectors and Innovation:**

- The distribution of awards across various agencies suggests a diverse range of R&D activities, encompassing the application of optics/photonics optics in robotics, automation, unmanned vehicles, environment, space, energy, and healthcare (NIH).

6. Potential Economic Growth:

- The financial injections into R&D projects are likely to stimulate innovation, foster technological advancements, and contribute to economic growth within the state.

7. Overall Win Rate:

- The overall win rate, considering the success rates in both Phase I and Phase II, reflects a positive trend in Arizona's ability to secure and advance in R&D projects.

In conclusion, the table illustrates the positive financial impact of R&D awards on Arizona, showcasing the state's success in securing funding and advancing projects through different phases. The diversity of awarded projects and high success rates underscore Arizona's growing prominence in the realm of research and development.

Community Optics Lab Workgroup

As noted in our previous quarterly report, the initiative to create a shared community lab to support our small companies has shifted from an AOI led activity to one that is driven by the companies themselves, supported by AOI. That effort will continue even though this SBA contract has now ended.

The three phases of this lab were designed to facilitate growth: 1) Virtual lab that identified small service task and access to specific equipment to the company offering that service [the task moves], 2) Lending library lab that identified small equipment at existing businesses that could be loaned out [the equipment moves], and 3) Physical lab with a formation of a non- or not-for-profit company that could receive donations and grants to facilitate the access to high-cost optics equipment without the capital costs.

We are happy to report that we have moved past wire-frame designs and this group of company leaders are now starting to build a website that addresses phase 1 and can be expanded to future phases.

For additional information about the development of the Community Optics Lab, please see Appendix 1.



Entrepreneurial Company Development Support

VIA-Business and VIA-ITAB are two products that measure business maturity and readiness to apply for SBIR/STTR funding, respectively. They have been developed by Vector Reports who is part of the AOI Team. AOI uses these assessments to guide mentoring and coaching services to our optics and photonics entrepreneurial companies; they have been successful in identifying business process vulnerabilities and highlighted actions to reduce those risks.

VIA-Business has been used by UArizona Tech Launch Arizona (TLA) and the University of Arizona Center for Innovation (UACI) but on a sporadic basis. AOI and Vector Reports continue to work with both TLA and UACI to develop a consistent program.

VIA-ITAB has been applied by AOI team members to the optics companies pursuing SBIR funding where we have achieved an overall application success rate of over 90% and over \$6 million of SBIR contract value.

Both VIA-Business and VIA-ITAB have been in pilot development throughout this SBA contract, and the working relationship between AOI and Vector Reports has been mutually beneficial. It is our current understanding that these assessments will become available to the public in 2024. We look forward to including them as a key part of our program offerings in future contracts.

For additional information on the VIA-Business assessment, please see Appendix 2.

Raytheon Relationship

We are happy to report that the optics industry's relationship with Raytheon continues to be solid. As an example of that they were a GOLD sponsor of the Arizona Photonics Days optics conference run by Optics Valley. They have also donated used, but in good condition, optics tables and other small equipment to the training lab at PCC (planned for shared use with the future business optics lab).

As a brief update to the initial 16 companies that went through our development process here are some facts: All of them are in the Raytheon preferred supplier network, 14 companies have already received new business (they refused to share the number but indicated it was in the single digit million-dollar range), and larger contracts are coming their way. Raytheon has also indicated that they have begun to add other optics companies to their supplier system.

For additional information on the development of the Raytheon relationship, please see Appendix 3.

Appendix 1 - Development of Shared Equipment Laboratory

2019

When the *Arizona Optics Initiative* RIC contract began, we researched and surveyed those few companies that were participating. That data collected revealed a lot of information and a few themes.

- One theme was the challenges very small business have starting up or growing their business given the high cost of optics and photonics equipment.
- Another theme was the challenge to support the workforce development needs for optics and photonics technicians.

One solution proposed early on in this year was a shared equipment laboratory where companies could come and utilize, perhaps even rent, high-cost equipment and then return it to the lab without the capital expenditure or ongoing overhead costs. While this was generally accepted as a good idea and companies said they would use such an asset or capability if it existed, no one or two companies had the financial bandwidth to support the creation of it.

This industry is generally the opposite of a high-volume industry and is better represented by the “one-off” or “research version” or as a “low volume” production to meet high-technology or defense needs. And when you talk to these companies or the Department of Defense, the topic often moves to a “must have” technology or capability that enables other industries. So, the traditional route to justify capital spending simply didn’t have the volume for a timely payback period.

This laboratory became a “*nice to do*” item on the action list for the *Arizona Optics Initiative* if we found a way to obtain the needed capital equipment.

We knew Raytheon had many pieces of high-tech equipment that was “*collecting dust*”, and the technology lead agreed with that, but there were significant paper clearances needed to give program, company, or government owned equipment to this worthy cause.

At the end of the year, it became a good idea waiting for the right time.

2020

Then, unexpectedly, the Covid-19 hit the United States in full force. Everyone is familiar with the effects of that—in essence a shutdown of economy, the redesign of work, masking rules, distance rules, Zoom meetings and more.

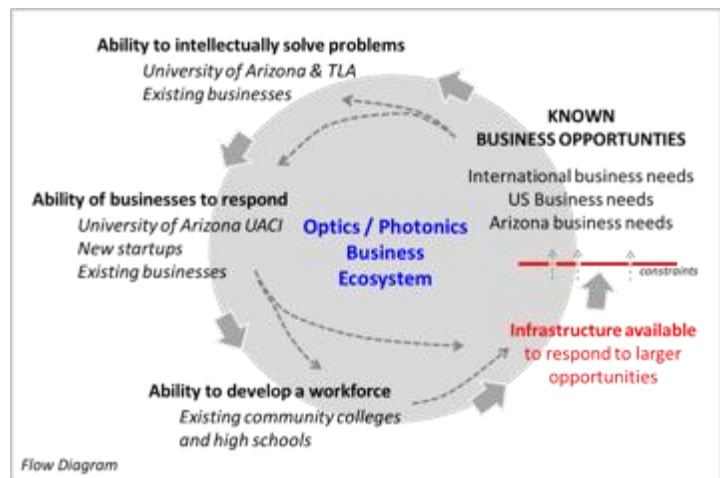
Raytheon simply said, “Not now.” Optics Valley, had to adjust. The RIC team had to adjust. Everything shifted to survival, and efforts to thrive and grow were simply put on the back-burner, so-to-speak. And the RIC team focused on business survival efforts for our cluster companies.

As for technicians, the shortage was so great that companies began to “steal away” technicians from each other with higher pay. That approach only solved the problem for the well-funded companies and did not solve the problem for the industry ecosystem.

2021

The idea remained as a good one. But it morphed to another use of a shared equipment laboratory.

We helped on the pursuit of EDA funding, Build Back Better and other initiatives. While we made good contacts and built relationships with the Joint Technical Education District (JTED) a CTE high school system in the state, Pima Community College, the Center for the Future of Arizona (a non-profit funding organization for the education and development of Arizona workforce, and the University of Arizona, but we were late to the game and our ask was quite small in comparison of the scale of the other entity “asks.” We failed to get included in any of those proposals.



2022

As a part of a completely different effort on the other side of the country the Department of Defense funded an optics manufacturing defense industry business consortium called AmeriCOM. They saw the need for optics technicians, were funding curricula development, but mostly around glass and not all the other parts of the optics and photonics technologies.

The RIC team believed, as the aphorism states, “Two birds could be hit with one stone,” if we could combine a dual use of training equipment and actual business use of that equipment during off hours. Starting in October, we spent a significant amount of time to compile a technician workforce demand in Arizona that would justify funding for curricula and equipment locally. In December a market analysis of future business, and training needs forecast was delivered to AmeriCOM.

We won't go into the politics around the use of funds, where they should go, and how they should be spent, but we can say Arizona was not included in any of those fund and curricula was withheld from us.

We began looking for other approaches to make the lab happen, as well as sought other sources of funding for local curricula, the training lab equipment, and a future business lab.

2023

Early this year our *Arizona Optics Initiative* team (Mark) met with the key business leaders who were supporting this business lab idea / endeavor. A critical conversation was held on *who was leading this effort*. In short, that meeting flipped the leadership from the AOI team to three local business leaders that would receive AOI support.

Those meetings, and a broad Optics Valley lab yellow stickie information collection session, led to the design of a three phased approach. Three forms of collaborative processes were identified:

1. The “**virtual laboratory**” exchange akin to “*borrowing a cup of sugar from a neighbor*” where companies with equipment and available time on that equipment can support a small short-term need from another company (allow use of the equipment and have a preset labor cost). In other cases, who performs the work and value exchanges can be discussed at the time of the engagement.

In essence, the *task moves* to the loaning company.

2. The “**lending equipment laboratory**” exchange akin to “*borrowing a book from a public library*” where companies with both available equipment and time windows for that equipment can support the loan out of that equipment for a fee. In other cases, who performs the work and value exchanges can be discussed at the time of the engagement.

In essence, the *equipment moves* to the task the borrowing company.

3. The “**physical equipment laboratory**” exchange akin to “*renting time on equipment from a rental company*” where a non-profit company could be formed (perhaps a cooperative) with available equipment and time windows for that equipment for use for a fee.

In essence, the *task moves* to the task the shared equipment laboratory company.

It was believed that we could start now with the first step. Efforts were made to identify needed equipment and a wireframe design for a website were created that would, in time, support all three phases of this cluster endeavor.

As of December, of this year we are in the process of getting quotes from programmers to build this website.



STRATEGY 1

While the above “business lab” was being worked on, the State of Arizona began a reorganization of the Arizona Commerce Authority. That reorganization pulled out the Office of Economic Opportunity as a separate entity with its own funding source. The new leader was doing an introductory and discovery tour of Southern Arizona when the Arizona Technology Council (Karla) arranged for them to meet the *Arizona Optics Initiative* team.

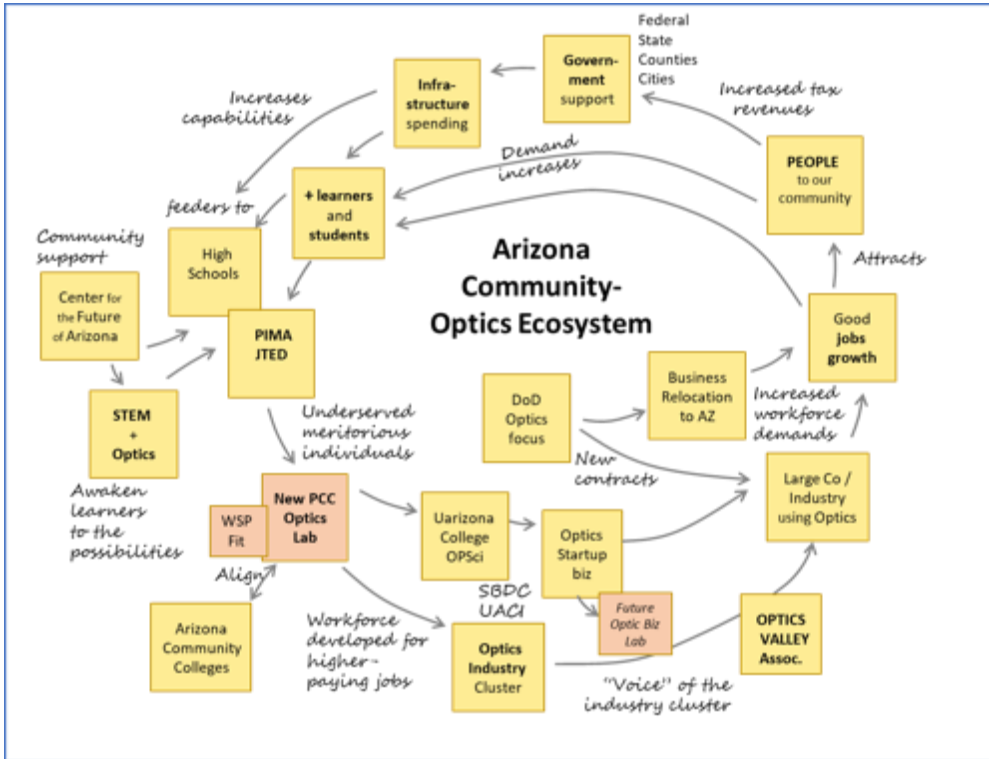
At that meeting, we simply and boldly informed them of our efforts and asked for their help to find money from whatever organization was out there for the laboratory (either type)—not knowing they had funding for this type of work.

The result of what we thought was a sunk cost to learn about and build relationships with the Joint Technical Education District (JTED) a CTE high school system in the state, Pima Community College and their newly constructed advanced manufacturing center, the Center for the Future of Arizona (a non-profit funding organization for the education and development of Arizona workforce, and the University of Arizona, Job Path (a track for non-traditional students) suddenly became relevant.

The new Office of Economic Opportunity asked for a proposal to them for the training lab endeavor. We had a shovel ready project with all members in the ecosystem already on board. That proposal was pre-cleared with them in November, and we received encouraging news that this kind of project is what they were looking for.

In the last week of December Pima Community College submitted a proposal for \$1.9 million dollars (mostly for state-of-the-art optics and photonics training equipment) to go into their existing, but somewhat empty new advanced manufacturing center. It was a pure example of a system working together in an aligned way, as shown in the Flywheel Map below.

Optics Industry Ecosystem *Flywheel* Map



Should this project be funded it will create a new pathway for people to higher paying jobs in the State of Arizona for an industry that needs them.

Please note, there is the “Future Optics Business Lab” identified in that diagram. It is needed and we are still looking to make that happen one way or another.

In conclusion, we hope the take-away from this story (to the SBA, to the United States Congress) is that it takes time, patience, and persistence to build trust and new relationships. It takes time to build value propositions among entities that did not know each other before. It takes time to build an aligned system of shared interests in an ecosystem.

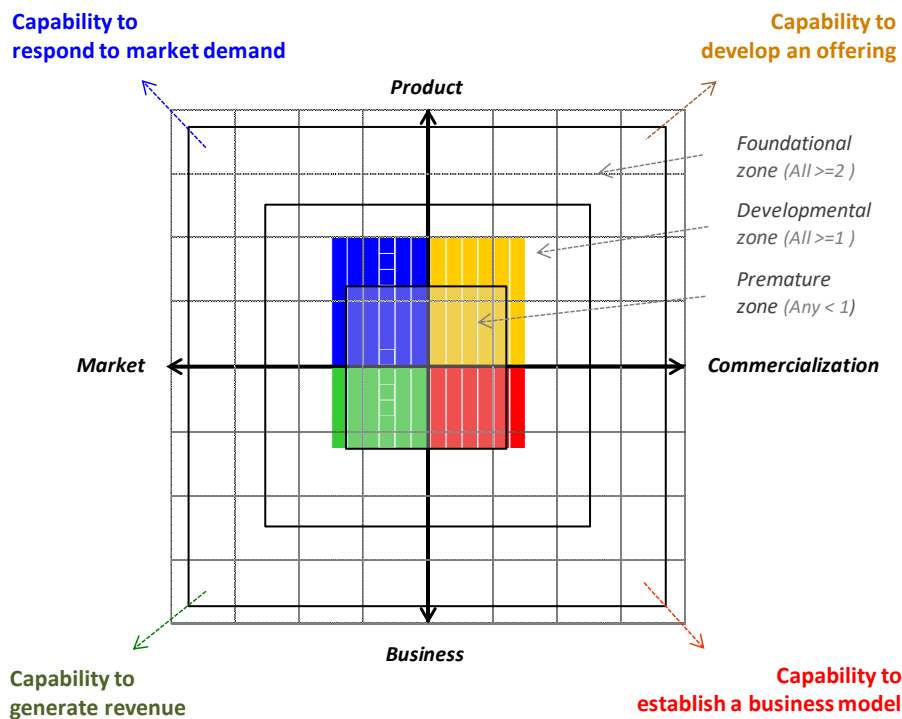
In summary, the RIC funding for the Arizona Optics Initiative has paid that investment back, and more. It worked!

Appendix 2 – VIA-Business Assessment

Our effort to support entrepreneurial companies was focused on individual company coaching and mentoring. Those activities were primarily around general company development, as well as SBIR/STTR support.

To promote company development, we built our program around the Very Small Business Assessment (VIA-Business) from Vector Reports. The VIA-Business takes less than an hour to complete and measures a company’s maturity and significant vulnerabilities in four areas as shown in the graphic below.

Group	11/18/2021
Assessor: Assessor	

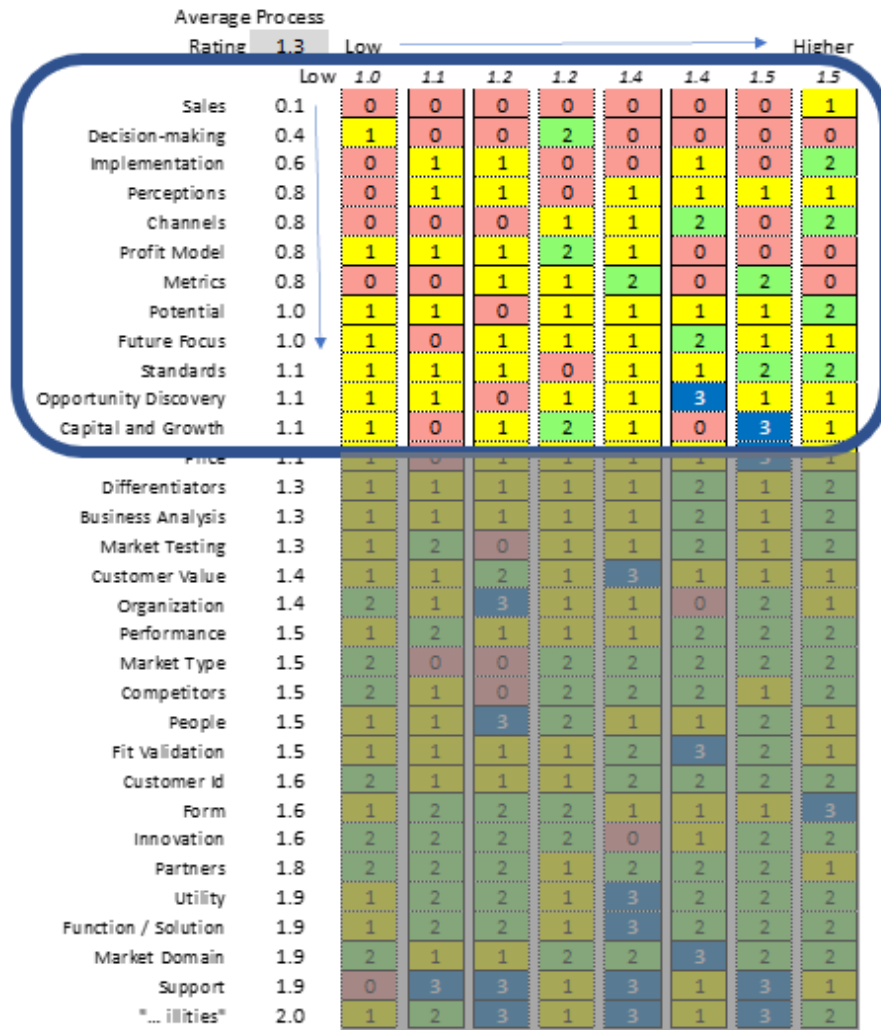


VIA-Business then generates a self-rated report that gives specific guidance to the company for actions to take to improve in specific areas. It is then the responsibility of company management and their AOI coach to develop a prioritized implementation plan for those actions.

STRATEGY 1

In all, we successfully completed VIA-Business with 12 companies. Of those 12 companies, we engaged 5 companies in a coaching/mentoring activity designed to utilize VIA-Business results to improve over time the company's longer-term positioning to become more valuable partners to prime defense contractors such as Raytheon. Additional companies have expressed an interest in engaging in coaching/mentoring at such time as a future RIC contract were awarded to the Arizona Optics Cluster.

In addition to developing coaching/mentoring relationships with our entrepreneurial companies, VIA-Business gave us the opportunity to gain insights into commonly shared strengths and vulnerabilities. The chart below shows an early summary of common vulnerabilities that were identified among the companies. These common vulnerabilities were also supported by VSBA's conducted with additional companies.





It is clear from this analysis that entrepreneurial company weaknesses are not around product development, but rather around developing business acumen.

The key value in this vulnerability analysis is that we can identify where we can develop and deliver high value-added education and training to all our entrepreneurial companies when we engage in a follow up RIC contract.

Appendix 3 – Development of Raytheon Relationship

2019

The relationship between this very large defense company and the local optics / photonics companies was in complete disrepair (to say it mildly). One of our associates, retired from Raytheon, who understood that work culture, took on the challenge to build bridges and connections. Nearly every effort to reconnect failed. Negative perceptions abounded, which rippled out from only one or two bad experiences from nearly 10 years earlier. And neither Raytheon nor any of our small companies were willing to spend the time to repair those relationships. It was simply easier to blame.

It became very clear that none of the organizations really knew each other and the strengths that could be leveraged and were even less likely to spend any energy whatsoever to repair and connect. We, as cluster developers, saw the potential, and our job was simple—try, try and try again to connect and build relationships before work agreements are sought.

Eventually, our associate connected with a friend who still worked at Raytheon and was now in a role that could connect the team to corporate supply chain. That led to a critical meeting with attendees from Strategic Sourcing, Supply Chain, Engineering Optics Technology leader (Paul), and our RIC leader (John Dennis) and our associate (Mark a Raytheon retiree) on the cluster team. The vision was shared and discussed. It was agreed we all ought to work to connect the dots. Assignments were made and follow-up meetings set.

Then, unexpectedly, the Raytheon and United Technologies merger was announced.

That put our work on hold, but we kept knocking on the door. About six months later, when merger activities had settled with new people put into roles, we began work again. The Director of Engineering Optics Technology and the RIC team started making plans.

2020

Then, unexpectedly, the Covid-19 hit the United States in full force. Everyone is familiar with the effects of that—in essence a shutdown of economy, the redesign of work, masking rules, distance rules, Zoom meetings and more. Raytheon simply said, “Not now.”

Optics Valley, also had to adjust. The RIC team had to adjust. Everything shifted to survival, and efforts to thrive and grow were simply put on the back-burner, so-to-speak.

The Director of Engineering Optics Technology, while supportive, did not have the connections to make things happen in Raytheon. So, we shifted our efforts to research and analysis—which, interestingly, made what resulted later in the future, better. He spent time figuring out where Raytheon was going and what technologies were needed. The RIC team focused on business survival efforts for our cluster companies.

2021

In a chance meeting in a pharmacy, a connection was made between our RIC team and an influential leader in the exact right role in Raytheon Supply Chain. Both knew each other by reputation, and both were change agents. The RIC Team was introduced to the Directory of Strategic Sourcing (Tim), who was a strategic thinker himself. And that led to the internal Raytheon connection between the technology leader and supply chain and our RIC Team (Mark and John)—things began again!

43 of the optics cluster companies were identified who had important technologies needed by Raytheon. And that led to a large open Zoom meeting where the 43 and any cluster company could attend. Our RIC team conducted the meeting as an “interview” with Raytheon to discuss a change in approach, technology needs, and to present an invitation to participate. That meeting led to a subset of companies who responded with “an interest” to participate to the team.

2022

With the pandemic restrictions being reduced, and face-to-face meetings becoming possible again, a supplier team from Raytheon formed to interview and enter those company candidates into their supplier database. The RIC team participated in most of those company interviews to help bridge the communication gap, work culture gap, and facilitate a new understanding among all.

While that was occurring a design to prepare Raytheon and our cluster companies was being built. Tim needed to scan all programs at Raytheon that utilized optics and photonics technologies to sift out the near-term and future technology needs that might fit our companies’ capabilities. And Mark found a company that could conduct a workshop to explain and teach business concepts to small technology companies and had a game that modeled the behaviors needed to succeed.

Those earlier face-to-face company visits led to a down select of an initial set of 16 companies.

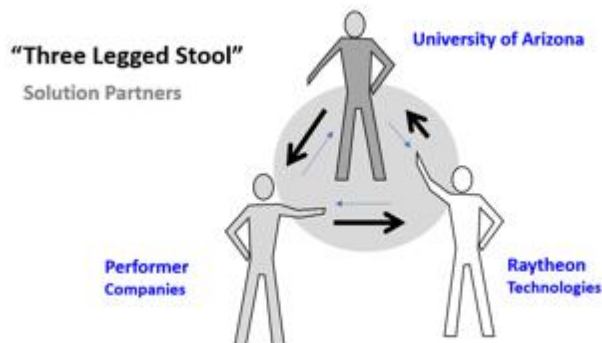
Two workshops were held.

- A preparation workshop for the optics and photonics companies that were selected to prepare those companies on several topics: Understanding the big defense company work culture and norms, better understand the process of connecting need to solution, business growth models, being bold and clear, empowering their voice to connect or say “... *no, but what if ...*” and more.

STRATEGY 1

They were taught to begin to work together to respond to opportunities larger than their own company. Some insights and outcomes included:

- *Complimentary*: Looking for technologies, skills, resources that augment each other.
 - *Synergies between capabilities*: Looking for ways to assist, support or update the capabilities of others.
 - *Openness*: Allows for one to help another without the stigma of hurting oneself.
 - *Shared goals*: System supports rewards for helping each other deliver.
 - *Synergies between goals*: Approach supports overall systemic growth of the association of companies.
 - *Special rules*: May need to address *rule-breakers* (e.g. Win All You Can Game”).
- A large introduction workshop at the Raytheon site, to introduce dozens of engineers facing technology challenges, supply chain process people, their internal SBIR representative, to our 16 companies that held technologies Raytheon indicated they may need; and to introduce our 16 companies to all those Raytheon engineers.



The effort was to begin the development of a mini ecosystem.

Business cards were exchanged. Contacts made. Instructions on how to take the next steps were offered ... and so much more.

And then, unexpectedly, Raytheon reorganized again. A pause on the process occurred. And our key technology leader at Raytheon retired.

2023

A restart of the process occurred when a replacement for the optics technology leader at Raytheon was made. Raytheon apologized in writing to the 16 companies for the delay (which is something Mark had never witnessed the company doing in over 30 years working there).

Raytheon reached out to each of them ... and more.

Our RIC efforts help make connections and defuse the impact of the delayed efforts.

In November of this year, we asked Raytheon to provide us numbers or data or something about the impact of the RIC effort to put into this final report. Please know that sharing this kind of information is **not** something Raytheon does—it keeps its work and supplier work quiet—as is appropriate for that industry. That said, we were provided the following:

- All 16 companies were entered into their Qualified Supplier network listings.
- 9 companies have already received contracts for work and support.
- 5 companies are expanding their businesses to support the new work.
- 2 of the 16 companies have refused to participate further saying “... *the paperwork burden is too great for their small size.*”
- The contract value is in the single digit millions so far.
- Big contracts are in work now and are coming down the pipeline to these companies.
- Raytheon has added more companies than our original 16 candidates.
- Raytheon is now an active member of Optics Valley.
- Raytheon is now supporting and has donated good value optics equipment to our local educational institutions.

We hope the take-away from this story (to the SBA, to the United States Congress) is that it takes time, patience, and persistence to build trust and new relationships. It takes time to build value propositions among entities that did not know each other before.

In summary, the RIC funding for the Arizona Optics Initiative has paid that investment back, and more. It worked!

Appendix 4 - 2023 Objectives and Results

Activity focus: 80% toward business growth and workforce development for member companies; 10% each toward entrepreneurial company development, and community events and enhanced visibility for optics, photonics, and astronomy.

Initiative 1: Help Existing Companies Scale Up and Grow

- **Raytheon and Other A&D Companies**

- Raytheon has integrated the first 16 optics companies into the RTX supply chain. 14 of them have received contracts, with the promise of more to come. The new optics technology lead at Raytheon has been very active with the industry community.
- Raytheon will delay the next group of companies to be incorporated into their contractual / supplier system to later in th2024, so they can complete their current efforts to establish contractual relationships with the first 16 companies.
- Raytheon has donated optics lab equipment for Community Optics Lab. It was delivered to Pima Community College in January 2024.

- **Workforce Development**

- The first session of *Intro to Optics* was held the Fourth Quarter 2023 with 10 students.
- We also identified optics industry leaders to review and confirm the curriculum for the Pima Community College optics program. This group is actively developing that curriculum.

- **Supply Chain**

Establish an active machining manufacturing, including precision fabrication, subgroup that meets monthly. To date results are as follows:

- Over 48 companies collaborating.
- 35 companies developing commercial relationships.
- 45 companies discovered new local solutions.
- 20 companies generated over \$750K in new business with each other.

- **Resource Directory**

- Complete transition to Optics Valley website: Done
- Over 70 companies are now included in the Resource Directory

- **Community Optics Lab**

- The community optics lab has moved from an Arizona Optics Initiative (AOI) led effort to the optics business community carrying the effort forward with AOI support.
- Raytheon has donated equipment for the lab.
- We have surveyed our members to validate the priorities of instruments and equipment needed for the Community Lab and built that priority list.



Initiative 2: Facilitate Formation and Development of Entrepreneurial Companies

VIA-Business and VIA-ITAB are two products that measure business maturity and readiness to apply for SBIR/STTR funding, respectively. They have been developed by Vector Reports who is part of the AOI Team. AOI uses these assessments to guide mentoring and coaching services to our optics and photonics entrepreneurial companies; they have been successful in identifying business process vulnerabilities and highlighted actions to reduce those risks.

VIA-Business has been used by UArizona Tech Launch Arizona (TLA) and the University of Arizona Center for Innovation (UACI) but on a sporadic basis. AOI and Vector Reports continue to work with both TLA and UACI to develop a consistent program.

VIA-ITAB has been applied by AOI team members to the optics companies pursuing SBIR funding where we have achieved an overall application success rate of over 90% and over \$6 millions of SBIR contract value.

Both VIA-Business and VIA-ITAB have been in pilot development throughout this SBA contract, and the working relationship between AOI and Vector Reports has been mutually beneficial. It is our current understanding that these assessments will become available to the public in 2024. We look forward to including them as a key part of our program offerings in future contracts.

Initiative 3: Enhance Visibility and Community Awareness

The only community event in the fourth quarter was the Arizona Technology Council Tech + Business Expo, described above.

Planning is now under way for Optics Valley participation in SheTech and the Tucson Festival of Books Science City in March 2024.

Our premier community event, the *International Day of light*, which celebrates the invention of the laser, will be held in May 2024. As always, it will be a family affair.

As reported previously, we completed a major upgrade to the Optics Valley website: In addition, our one-minute video continues to be very popular:

<https://www.aztechcouncil.org/optics-valley-arizona/>

This is already leading to increased usage of the site.

In addition, this video continues to be very popular:

<https://www.youtube.com/watch?v=NXiD1qPKTWw>

Appendix 5 – Optics Valley Strategic Impact Plan



**Strategic Impact Plan
2021 – 2024**



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Vision 2024	3
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Optics Valley Strategic Impact Plan (2021 – 2024)

Introduction

In October 1992, the Arizona Optics Industry Association (AOIA) was formed as the first optics industry cluster in the world. At the end of December 2016, AOIA was dissolved as an independent organization, and its work continues as Optics Valley, a Committee of the Arizona Technology Council (AZTC). Today, Optics Valley is recognized as a world-renowned industry cluster representing the optics, photonics, and astronomy communities in Arizona.

Mission (This is today and for the foreseeable future.)

The mission of Optics Valley is to catalyze, convene and connect optics, photonics, astronomy, and supporting business interests throughout Arizona.

Vision 2024 (This is what we strive to be at the end of 2023 when the SBA contract is complete.)

In 2024, with over 200 members throughout Arizona, Optics Valley is widely recognized as one of the leading global clusters for optics, photonics, and astronomy. Our members have a strong sense of community and a culture of cooperation and collaboration to foster continued industry growth. We are undisputedly the most active Committee in the Arizona Technology Council (AZTC), and our members participate actively in other AZTC programs and benefits.

It is important to note that our members come from the broadest sense of the optics industry. We include not only companies with a direct focus on technology improvements, but we also embrace application and end user companies who implement these creative innovations. In addition, we actively solicit supply chain and other support organizations. Additionally, we have a wide variety of individual and student members.

We have quarterly business meetings in both Tucson and Phoenix. Member participation has matured to where there are active subgroups focused on specific end-user industries and opportunities, including medicine, aerospace and defense, and Quantum Information Science (QIS).



Ongoing support programs include the on-line Member Directory, the bi-weekly FOCUS newsletter, monthly networking, and subgroup meetings, as well as Tech Series webinars, which are promoted and broadcast worldwide. In addition, our dynamic website is always current and filled with valuable information, including a company job board. Finally, Optics Valley sponsors an Other Transaction Opportunities (OTA) consortium to assist companies to respond to Federal opportunities including SBIR/STTR.

We maintain worldwide strategic collaborations and partnerships including membership in SPIE, OSA and IEEE. Annually, there is an Optics Valley “pavilion” in many key worldwide conferences and exhibitions. We continue to play a leadership role in the Global Photonics Alliance (GPA), a group of over 50 optics and photonics clusters. In addition, we maintain close relationships with UArizona, especially the Wyant College of Optical Sciences, as well as the Arizona Tech Parks.

Our flagship event continues to be Arizona Photonics Days (APD), held annually in Tucson, just prior to Photonics West. We attract over 250 attendees to this event where there is an active exchange of both company and technical information, as well as lots of networking time to build our worldwide collaborative relationships.

To support our industry growth, Optics Valley is heavily involved in workforce development. Our Advisory Committee has helped build optics training at Pima Community College (PCC) into a complete independent program that is a model for other similar programs. In addition, we serve as a hub for apprentice/internship programs for both university and high school students.

To develop the pipeline for tomorrow’s workforce, we are active in optics education in K-12 programs. We work closely with the AZTC SciTech Institute to promote the inclusion of optics curriculum in STEM programs throughout the state. We also work with Pima JTED and high schools throughout our region to expand the optics content to more locations in their programs.

Our members are active in the entrepreneurial community, many providing coaching and mentoring to fledgling companies in support of UArizona and community incubator and accelerator programs. There is a monthly informal get together to help young companies get to know each other. We have a focused sub-group within the Desert Angels to provide a vehicle for investment opportunities.

We are active in the community to enhance visibility and awareness of our important enabling industry. This is highlighted by the annual celebration of the International Day of Light on May 16th. In addition, we participate and sponsor



many events throughout the year in both Tucson and Phoenix. We have also produced informational videos for both the community and corporate attraction.

In the area of public policy, we cooperate with and support the National Photonics Initiative (NPI) and the Congressional Photonics Caucus. We have a close relationship with the Arizona Governor's Office, the Arizona Commerce Authority, and county/city administrations throughout the State of Arizona.

Finally, Optics Valley is financially and organizationally stable. We have an elected Advisory Board, made up of member volunteer leaders, which provides guidance and direction to our full time paid Executive Director, who is an employee of AZTC. He/she is supported by other AZTC employees who share joint duties. Optics Valley finances are provided by sponsorships and event fees as well as dedicated endowments.



Appendix 6 – Optics Valley References

In late 2021, we completed a major upgrade to the Optics Valley website:

<https://www.aztechcouncil.org/optics-valley-arizona/>

This has now led to significantly to increased usage of the site.

On addition, our one-minute video continues to be very popular:

<https://www.youtube.com/watch?v=NXiD1qPKTWw>

Appendix 7 – Program Support

Arizona Optics Initiative (AOI) Program Partners

Formal in Proposal

Key Contact(s)

- Arizona Technology Council Steve Zylstra, CEO; Karla Morales, VP
- Pima Community College Ian Roark, VP; Greg Wilson, Dean
- UArizona Tech Launch Doug Hockstad, AVP
- UArizona Tech Parks Carol Stewart, VP; Eric Smith, Exec Dir

Informal

- Wyant College of Optical Sciences Tom Koch, Dean
- Arizona Commerce Authority Caleb Rhodes, VP
- AZ Office of Economic Opportunity Krista McGarvey, VP
- City of Tucson Barbra Coffee, Director Economic Initiatives
- Pima County Heath Vescovi-Chiordi, Director
- Startup Tucson Liz Pocock, CEO
- Pima JTED Kathy Prather, Superintendent
- And many more...

Strategy1 AOI Team

Focus/Expertise

- John Dennis Program Manager
- Mary Breeding Administration and Support
- Mark Jepperson Entrepreneurial Ecosystem/Building Change
- Peter Mantas Mentoring Entrepreneurial Companies
- Don Orton Growing Companies
- Jack Schumann Optics Industry
- Sonia Vohnout Federal Funding

Appendix 8 – SBA Requested Metrics

Preamble

Our understanding, as presented by the SBA in 2019, was that this is a “research” contract and we are to investigate, learn, and act for the unique needs for this cluster, in our case, the optics industry in Arizona.

While our optics and photonics companies were filled with potential, they were also quite vulnerable. We learned that most of these very small technology companies basically lacked business savvy and were mostly dependent upon one main customer, or luck, for their business endeavors.

Our task quickly became one to stabilize the cluster, develop a collaborative cluster identity, create a sense of belonging that would facilitate networking, and work to demonstrate how business development works, so they could learn to do that on their own. During the COVID-19 lockdowns, we worked with cluster companies to rationalize operations, costs, PPP, alternative funding to prevent failures. We set goals to develop our ecosystem, and our key metric became growth in membership in Optics Valley, and participation in cluster activities. This would be a parametric of real growth because individuals tend to “vote with their feet” and if we could not provide value they would not participate.

As shown in the information throughout this report, we believe that we have achieved these goals.

Requested Metrics:

- 1. Growth in number of small businesses participating in cluster partnerships and Industries (report quarterly)** When this contract started in 2019, Optics Valley had less than 20 members. Today, there are over 100. We believe that this dramatic growth in membership demonstrates that companies find value in the programs that we provide.
- 2. Number of small businesses receiving counseling, training, mentoring, or other technical assistance (report quarterly)** The AOI team has provided help to our member through a variety of programs and events. Some of these include:
 - Our flagship Arizona Photonics Days conference has grown to over 200 registrants annually. This year it included 28 Technical Presentations, 24 Company Pitches, and 14 Industry Presentations.
 - Quarterly meetings always include a company profile and a business presentation. These are typically attended by 40-50 people. It is important to note that there is often informal coaching during the Happy Hour after the meeting.
 - The online virtual Tech Series typically has 50 participants.



STRATEGY 1

- The Supply Chain Workgroup meets monthly, and now has almost 60 participants.
- The Community Optics Lab Workgroup meets bi-weekly with about 15 participants.
- As part of our development of the Raytheon relationship, AOI held extensive training sessions with our small companies to help them understand how to be part of the Supply Chain of a Prime Contractor. This included virtual ZOOM sessions and a two-day workshop at Raytheon. As a result, 16 new companies were added to the formal Raytheon Supply Chain.
- The AOI team typically does direct assessments, coaching, and mentoring with 4-6 small companies each quarter.
- Our AOI Team has supported numerous companies for SBIR proposals that have resulted in 14 awards and over \$6million in contracts

3. Number of small businesses participating in other activities and services provided by the cluster, including showcasing events, networking events, matchmaking opportunities, and other convening activities (report quarterly)

Frankly, it is difficult to differentiate our coaching and training events from “other activities,” since we make a conscious effort to include training and social aspects in almost everything we do. Since people “vote with their feet,” here are a few examples of the value that we provide:

- Cluster membership has grown from less than 20 to over 100.
- Arizona Photonics Days registrations has grown from less than 75 to over 200 annually.
- The Supply Chain Workgroup now has nearly 50 participants.

4. Number of new jobs, summary of growth, in employer small businesses (report at least annually)

Over the life of this contract the primary source of new jobs has come from additional companies joining the Optics Valley cluster. The actual number of new employees has been modest, especially in our small companies. We believe that there are two contributing factors to this. First, small companies are always reluctant to add employees until the absolute last minute. Even if they are growing, they want to stretch existing employees to the limit before adding the additional expense commitment. Second, and perhaps more important, is the lack of a skilled labor pool. While larger companies can afford the investment in internal training programs, small companies have neither the financial nor management resources to do so. The recent restart of the PCC Technician training classes will certainly help over time. In that regard, it is interesting to note that in the first Optics 101 class, all students were upskilling of existing employees. There were no new jobs added.

5. Number of new small businesses started/founded (report at least annually)

We see about 8-10 new businesses started annually. Many of them are simply sideline activities of UArizona Wyant College of Optical Sciences faculty. The challenge is to get those faculty members to realize that building a business is not a part time job. On the flip side, we do see optics companies relocating to Arizona, especially due to the strength of UArizona in optical sciences.

6. **Growth in new products, services, or business lines (report at least annually)** The majority of our small companies are founded by an individual technologist. As a result, those companies are focused on a single product area or service. While they may have variations to that capability, based on a specific project, it does not constitute a true new product line or area of effort. They very much tend to stay within their area of expertise.

7. **Number of patents obtained and /or applied for by small business participants in the cluster, as well as number of new technologies licensed (report at least annually)** The UArizona Wyant College of Optical Science is a worldwide recognized leader in optical research. That is clearly the major source of patentable ideas; there are well over 1,000 items available for license in their portfolio. However, the majority of that license activity is with large companies. Our small companies have neither the financial nor legal strength to deal with the UArizona requirements. When our companies, whether large or small, do develop patents they always treat them as company proprietary assets and do not share them publicly.

8. **Technical Assistance Needs (report quarterly)** Our cluster has been built by technology people. The UArizona Wyant College of Optical Sciences provides a plethora of new technology. To continue to build and sustain the cluster, there are two critical needs:
 - There is a need for technician training. We have the creative engineers and scientists to design new products, but we need people to manufacture them. This is a worldwide need, not just Arizona. Now that Pima Community College has restarted their Optics 101 class, it is a start. However, that needs to be expanded into a full certificate. In addition there needs to start a high school program to help fill the pipeline.
 - There needs to be a strong increase of business acumen. We have the technologists to conceptualize the ideas, but we lack a strong business bench to commercialize those ideas. The AOI Team continues to work with Tech Launch Arizona and the UArizona Center for Innovation to support their programs, but there needs to be an enhanced collaborative effort in the future.

9. **Success Stories (report quarterly)** This has been a strong quarter for success as we have continued to build the ecosystem for the optics industry in Arizona:
 - Growth in Arizona Photonics Days to over 200 registrations.
 - Completion of the first PCC *Intro to Optics* class.
 - Arizona Office of Economic Opportunity proposal.
 - Development of the community Optics Lab website
 - Edmund Optics offer to include Supply Chain company products in their catalog.
 - Raytheon donation of equipment to the Community Optics Lab

All these accomplishments are described in sections above.