ENGINEERING THE STEM PIPELINE

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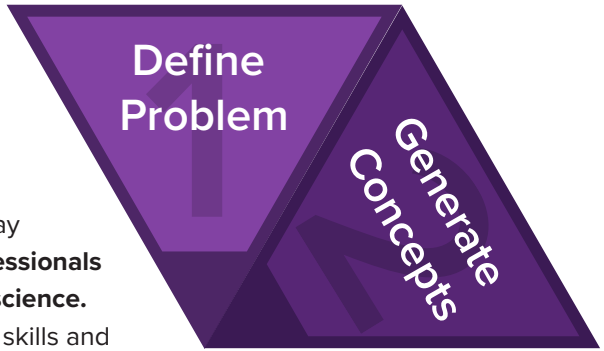
“It truly is a **million-dollar opportunity**.”

That’s how Kari Winter, Practicum Supervisor for the Arlington Independent School District (ISD), describes the **Lockheed Martin Aeronautics Internship in Fort Worth**, Texas. Other participating districts echo this sentiment regarding their appreciation for this student opportunity and how impactful it is in the lives of their students.

Define Problem & Generate Concepts



Lockheed Martin began partnering with Project Lead The Way (PLTW) in 2007 to address the nation’s **need for future professionals in science, technology, engineering, math, and computer science.** Additionally, this partnership aimed to provide students with skills and experiences that would set them up for **success in their future careers**. Lockheed Martin understands that there is a shortage of talent in STEM professions. To increase the talent pool for their organization, more students need to pursue degrees and employment in STEM fields. Neil DeVasher, a manager at Lockheed Martin, shared, “We had the vision that getting the right resources that Lockheed Martin looks for was going to be more challenging in the years ahead, so this gave us an opportunity to step into the pipeline.” The internship opportunity allows Lockheed Martin to **bring in talented students with an interest in engineering, and provide them with varied workplace experiences while building relationships** with these potential future full-time employees.

“I can’t think of anything more valuable for a student to engage in their senior year.”

- Kari Winter, Practicum Supervisor for Arlington ISD

Research has shown that **internship experiences affect students' choice of college major and career decisions** (Papadimitriou, 2014; Patel et al., 2021). Internship and work-based learning programs not only increase the likelihood a student will choose a major and career in a related field, but there are also broader implications for the lives of students. Carnevale et al. (2022) note that a hurdle to **economic independence** for many young people is the lack of access to work-based learning. "Well-designed work-based learning opportunities could both improve young people's life trajectories and remedy a competitive disadvantage resulting from our country's inefficient approach to human capital development" (Carnevale et al., 2022, p. 46). The decision by Lockheed Martin to create a high school internship program had the potential to not only **dramatically impact their talent pipeline, but also the lives of the participating students** – and that is exactly what has happened.

"...the most intensive forms of workplace learning – apprenticeship and sustained internships – are especially effective in meeting the developmental needs of young people. They provide a structure to support the transition from adolescence to adulthood lacking for a majority of young people in the U.S."

- Symonds et al., 2011, p. 20

Develop Solution, Construct, and Test

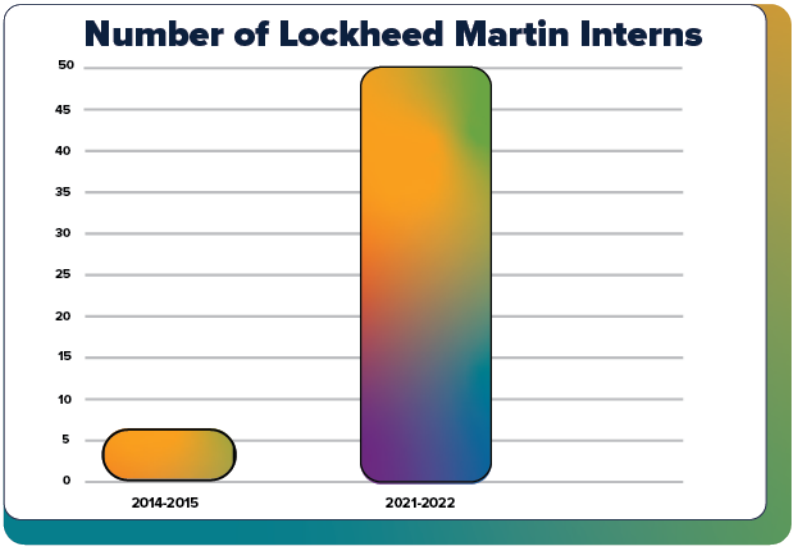
When designing the high school internship, Lockheed Martin knew it would take a **rigorous and relevant curriculum** to provide students with the transportable and technical skills needed in the workplace. Lockheed Martin also knew they needed to provide work-based learning opportunities that engage students in **applied real-world work experiences** supported by **strong business engagement.** These three components are core criteria for successful internship programs (Alfeld et al., 2013; Chapman et al., 2013). The intentionality of these three components is why this internship model has been successful allowing it to grow and scale. The Lockheed Martin Aeronautics internship in Fort Worth began in the 2014-15 school year with **five interns from one school district** and has expanded to **50 interns from four school districts** in 2021-22.

"The opportunity just felt a little too good to be true – that I could actually get hands-on work; I could get to bridge the gap between what is engineering in my classes and what is actual engineering in the real world."

- Erin Blasingame, former high school intern

Rigorous and Relevant Curriculum

PLTW's Engineering program provides the curricular foundation for future interns. These courses allow students opportunities to gain transportable and technical skills, as well as apply those with **hands-on problem solving**. Former intern Alexis Capitano shared the impact of **applied learning** in PLTW courses. "I think the aspects of the courses where you got to learn about certain concepts and then actually go and put your hands on something and apply them was really unique compared to my other courses."

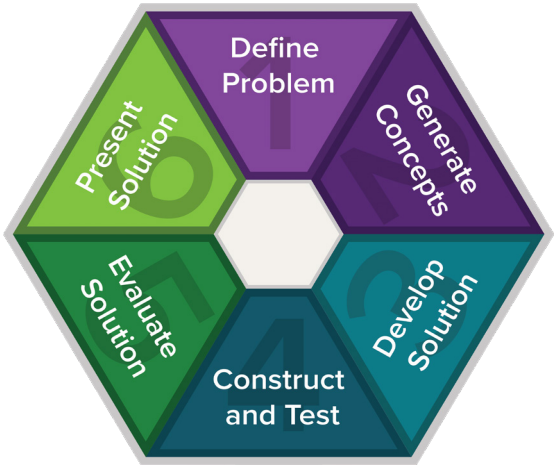


Internships are a bridge between the theory of the classroom and the world of practice. This helps classroom knowledge become clearer and more practically meaningful to the student, allowing for better transfer of classroom training into the workplace. "

- Maertz et al., 2014, p. 126

Former high school interns describe how their PLTW courses allowed them to develop transportable skills that helped them be **successful in the workplace.** The hands-on learning of technical skills in the PLTW Engineering pathway provided students **opportunities to think critically, problem solve, and collaborate with one another, as well as communicate their findings in oral and written formats.** The design process was often cited as particularly beneficial for the internship. Phoenix Saavedra, a former high school intern, shared, "Learning how every decision that you make is going to impact your result in the end is definitely one of the things I remember from those classes. Going through the process and realizing that the idea I had at the beginning may not work in the end because I didn't think the entire process through."

Interns at Lockheed Martin have widely varying internship experiences depending on the department they work in, which means the technical skills they use in their internship vary. Many former interns shared how the foundation of technical skills in their PLTW courses helped them **navigate the learning curve** of working in the engineering industry. Their experiences with CAD, C++, Python, and AutoDesk Inventor, as well as other equipment and software programs, provide a solid foundation upon which to build in the workplace. Additionally, the process of applying for the internship is a **rigorous learning experience in and of itself**.



"It's the way education should be done, honestly. It's hands-on experience, it's getting kids to partner and work in small groups. It's problem solving that helps them in all the other classes they take. They fail, but they learn how to deal with failure and overcome it."

- Keith Killebrew, CTE Coordinator for Keller ISD

Students applying for the Lockheed Martin internship must meet **certain prerequisites, submit materials** like a resume, and **complete interviews** with their district and then Lockheed Martin staff. To scaffold student development in these areas, school districts have put in place **learning opportunities and supports to position students to be more prepared and successful,** including writing sessions, mock interviews, elevator pitch preparation, and public speaking opportunities. Students cited the preparation from their schools and districts as critical to obtaining an internship.

Former intern Alexis Capitano shared, "I think one of the reasons I did well in the Lockheed Martin interview specifically was because as a high schooler, you don't have a lot of technical skills you can market in an interview. But through PLTW, I had all of these **trial-and-error moments** where I was working on a project and encountered a barrier and had to figure out how to work through it and work on a team. **I could communicate that I had developed a lot of those critical thinking skills, being able to work on a team.** And I was able to showcase the transferable [and] soft skills that I developed through engineering challenge environments." Lockheed Martin manager Neil DeVasher agreed with that sentiment as he shared that high school students will not have the most technical skills, so they're looking for students who have general knowledge along with the ability to communicate, problem solve, learn, and ask questions.

"Right now, in my job at Lockheed Martin I work on F-16 drawings, so I make changes to them and incorporate them. Through that incorporation I use something called CATIA and in my Intro to Engineering and Principals of Engineering courses we used AutoDesk Inventor – that software is super similar. When I got into CATIA, I was like, 'Oh, I know how to do this' and that was really cool."

- Phoenix Saavedra, former high school intern

Authentic Work Experience

The Lockheed Martin high school internship was designed around students engaging in **genuine applied work**. Students work on **'C-level projects,'** which are projects Lockheed Martin wants to see completed with more capacity in terms of time and resources, and projects that are low risk for interns but can have a **high impact for the organization**. Structuring the internship work in this way mirrors guidance for designing effective internships that will create organizational benefits (Cupps & Olmosk, 2008). Former high school interns describe working on projects such as data analysis, website creation, coding, maintenance planning, inventory management, updating workflows, facility audits, and more.

Keller ISD CTE Coordinator Keith Killebrew stated, "**Their experiences and the work they do is very real.** They are hands-on working on true projects that come to fruition for them, and they feel so empowered by it all." Similarly, rising college intern Erin Blasingame shared, "Everything I have done is real; it is the easy stuff, but it is real. That is something that I have appreciated because it is complex, real work."

> **"They gave us a lot of trust going in with the projects that seemed a little above our caliber, but I believe that was the point of it."**
>
> *- Yuliana Garcia, former high school intern*

For many students, their internship at Lockheed Martin is their first **professional work experience.** They shared there was a vast amount of learning that occurred in the workplace that wasn't directly related to engineering. They learned how to manage their time for projects, find new assignments or projects once theirs were complete, send professional emails, network with colleagues, and present to colleagues and managers in team meetings. They also reported learning about company culture and onboarding. This creates a well-rounded experience for students **setting them up for success** with their next endeavor.

Engaged Industry Partner

Creating opportunities for high school students to engage in work-based learning is simply the beginning of the pipeline. Lockheed Martin understands that having students engaged in engineering work provides them a chance to **'try out' that career**. The fact that students are engaging in true engineering allows them to see where their interests may or may not fall. Keith Killebrew shared that this internship "gets kids out there, to understand what it takes to be in a role, to be in a career path, to be an engineer."

"[The internship] gives them a real-world perspective with a real-world context not contrived in education. It helps them achieve at a different level, at a professional level."

- Tamara Albury, Principal of Young Women's Leadership Academy in Fort Worth ISD

One practicum supervisor shared that even within engineering, the internship experience can open a student's eyes – having seen students who want to pursue mechanical engineering, but their internship is in electrical engineering, that experience helped them have a **better sense of their interests and skills.** Additionally, students learn not only where their strengths are, but also which skills they will need to continue to hone throughout college and future work experience.

For some students the internship is confirmation of a career path in engineering and for others it is confirmation that their career will lie elsewhere. Interns shared how valuable the Lockheed Martin internship is because of the **ability to experience different types of work and areas in engineering.** Lockheed Martin managers work to ensure students have as much exposure as possible by having them work on different projects. Lockheed Martin gathers feedback from interns, which allows interns to share if they would like to move to another area. This shows interns that the organization is committed to helping them figure out where their interests and talents reside.

Erin Blasingame shared that it is a "huge opportunity to be able to try it and figure out whether or not this is something I want to do before I graduate." Students can **experience the workplace and build relationships.** Supportive managers within the organization, while welcoming their interns back to their department, will encourage interns to transition between departments. This helps broaden skill sets, align interest and skills with roles, and build relationships with employees.

Lockheed Martin **employees engage with their interns as their peers.** They ask for their opinions, thoughts, and questions. One practicum teacher shared that for many students this is “the first time they are interacting with adults who they realize are their peers as opposed to a student/teacher relationship or parent/child relationship. Even though there is a manager/employee relationship there, the way they are **considered part of the team** surprises a lot of the students because the employees do such a great job of welcoming them into the team and making them feel as equals.” Universally, former interns shared how welcoming and supportive their Lockheed Martin colleagues were.

Principal Tamara Albury shared, “They get really excited when they work with engineers on a project that they are being taken seriously; they are being consulted on things**. It gives them a sense of pride.”** This **sense of connection and relationship in the workplace** helps foster a sense of purpose and well-being for individuals, which can increase retention (Cross, 2019). In turn, this allows interns to stay engaged with Lockheed Martin and makes a positive impact on their talent pipeline.

Evaluate Solution

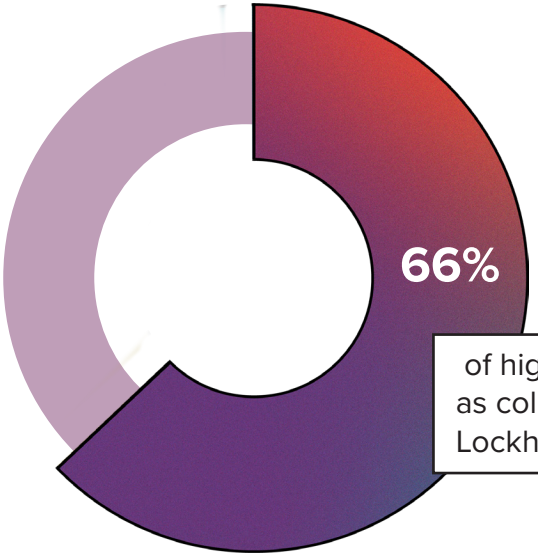
It's impossible to measure the impact this program has had for individual students, for the Fort Worth community, and for the global workforce.
For some students, this experience and the ability to earn money while in high school allows them to **afford college**. For others, the experience **confirms or refutes their area of focus** for college and career helping them learn which area and which type of role they are interested in having after college. For some students, that means **better access to internships or prestigious opportunities** during college. For others, it means **building their professional network** and connecting with individuals in the industry. For all, it is also a resume builder that will **open countless doors.**

The students are connected by this experience. They return to their schools to share about their involvement, talk about the importance of the curricular pathways, and encourage current high school students to apply for the internship opportunity. Their experience shapes them in a way that they want to **continue giving back and making a difference for other students.** Former intern Phoenix Saavedra shares how the year she was selected as an intern, just over a third of the interns from her school district were females. She was disappointed in those numbers and believed they would be discouraging to other high school girls. So, she worked within the Girls Engineering and Robotics Society (GEARS) organization where she was a leader to make a difference. They worked on preparing the girls applying for the internship with mock interviews and interview tips. Her hard work paid off, and the next round of interns from their district was almost two-thirds female.

"The students get real-world work experience with an incredible partner in Lockheed Martin. We didn't know going into the partnership all the things it would provide."

- Keith Killebrew, CTE Coordinator for Keller ISD

This internship opportunity does not necessarily end when a student graduates from high school. Successful interns are invited back to complete **summer internships throughout college.** Those summer internships can then develop into **full-time employment** with Lockheed Martin after college graduation. Students shared with us, as well as with their school leaders and teachers, how the PLTW coursework and the Lockheed Martin internship prepared them for their college experience – from a solid foundation in the content for their introductory engineering courses to having a competitive resume that helps them earn coveted spots in honors colleges or research fellowships. The National Association of Colleges and Employers (2016) found that students who had a paid internship had **higher median starting salary offers,** as well as **higher job offer rates** than students who did not. Students with a college degree and work-based learning earn more than those without (Carnevale et al, 2022). That seems to be just the beginning for the positive impacts of this internship program.



of high school interns are either working as college interns or working full time for Lockheed Martin

The Fort Worth community understands the value of this opportunity for students. Keith Killebrew in Keller ISD fields calls from elementary school parents wanting to ensure their child is prepared for the Lockheed Martin internship. Students are choosing to stay local for college or return after college graduation because of the **opportunities** they know are available in their local **community**.

Principal Tamara Albury said, “For Fort Worth, the partnership has been amazing. You are building your **home-grown leaders of tomorrow** because they are here the whole senior year that they have their internship. In the summertime they come back. It also helps ensure that our intellectual resources are staying here in Fort Worth and not leaving and going somewhere else. They may go somewhere else for college, but they are going to come back here and **give back to the community.**”

Former intern Yuliana Garcia said, “By making these connections and networking, whether it be with the students or the people at Lockheed Martin, it really does make you want to give back, achieve something, so that you can contribute your own different part to it. It does encourage me to get my degree and then return to contribute more.”

School districts shared how the Lockheed Martin internship provided a vehicle for **expanded student opportunities**. Keller ISD illustrated to another industry partner how a high school internship was possible by sharing their Lockheed Martin experience. That has allowed them to expand the organizations that their students can complete internships with – allowing even more students to have an important work-based learning experience. Sergio Flores at the Young Women’s Leadership Academy in Fort Worth shared that when they asked employees from local engineering firms to help with the student mock interviews, those organizations saw the potential in their students and now they have six other local organizations hiring interns from their school.

“This is going to change my family.”

- Intern to Kari Winter

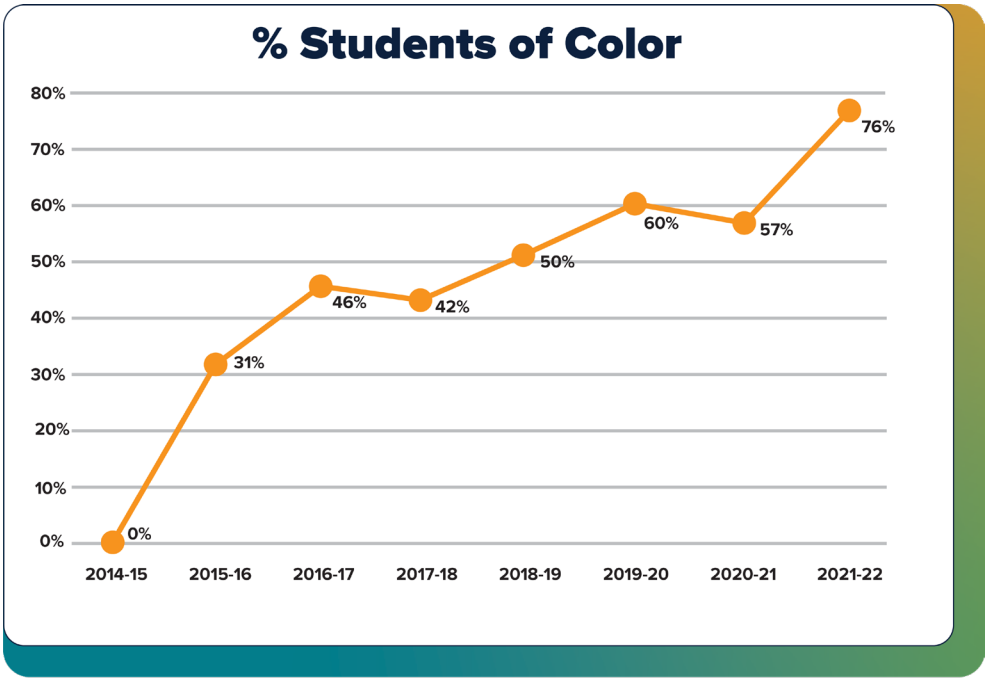
Present Solution

Lockheed Martin Aeronautics Fort Worth has seen a **return on investment** with the high school internship program. **Just shy of two-thirds of high school interns are either still interning or are working full time at Lockheed Martin.** Additionally, students of color make up just about half of these former high school interns that are still working at Lockheed Martin.

Our students are anywhere from singularly to triply marginalized. For a lot of our students, this is a game changer. For our first-generation students, whether high school or college, it is providing their families an opportunity to get out of poverty."

-Tamara Albury, Principal of Young Women's Leadership Academy in Fort Worth ISD

The former interns who begin full-time employment have been able to hit the ground running with a much smaller learning curve thanks to the numerous experiences their internships provided. Lockheed Martin has leveraged the success of the Fort Worth Aeronautics internship by **replicating the program at other facilities.** The internship program has now grown to Rotary and Mission Systems in Fort Worth, Missiles and Fire Control in Grand Prairie, Texas, as well as a summer internship in Stratford, Connecticut at Rotary and Mission Systems. The high school internship program is paying dividends for Lockheed Martin by improving and increasing their talent pipeline while also **forever changing the lives** of the students who participate.



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