Comparative Analysis of the Engineering Design Process at LOCKHEED MARTIN

TEAM #17505B

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Why **Lockheed Martin?**

Lockheed Martin, founded by Glenn L. Martin, became the forefront of American fighter aircraft during World War II, ranking tenth among US corporations in the value of wartime contracts. However, the notoriety of Lockheed Martin did not stop during World War II, and its wartime production only propelled the company to the forefront of the aircraft industry, where its presence remains large and ubiquitous. Yet, to become such a successful company, there lies an equally successful engineering process that has led Lockheed Martin to where it is now.

To gain more information on Lockheed Martin, I interviewed a **prior Lockheed Martin employee, Dr. Yawn**, with 20 years of experience in the company.

> **"The process is very structured, specifications written for everything, meaning there are very precise processes for how everything is done… Everything is written down, documented, and followed… So that, in a sense, is a very constraining and cohesive process." - Dr. Yawn, video interview**

Lockheed Martin Aeronautics Scientist

Based on the interview and several articles, we were able to provide a comparison of both engineering processes and how each functions differently but is essentially working towards the same goal of producing a successful project.

LOCKHEED MARTIN'S ENGINEERING DESIGN PROCESS

1: Predesign

1. This process includes vigorous checks of layouts and design solutions that fit within the constraints proposed and are in compliance with applicable codes and FES standards; also, determining any upgrades to existing facilities and utility systems.

2: Schematic Design Phase

2. Develop alternate layouts with a design team and provide deliverables per design standards for each design.

3: Design Development Team

3. Develop design solutions and design-build vendors, while still exploring other possible design solutions through meetings. Review a selection of equipment, collaborate with the equipment manufacturer to identify special circumstances, etc.

4: Construction Documentation Phase

4. Provide complete documentation.

5: Design Completion Phase

5. Submit completed documents for approval.

PREDESIGN AND SCHEMATIC DESIGN PHASE

As mentioned beforehand, the design process is very bureaucratic, and the pre-design phase is typically the most strenuous. The schematic design phase takes all of the needed information into consideration to make a “rough draft” of possible solutions. On a particular project, Dr. Yawn remembers having difficulties with upgrade to a machine.

“Long story short, we started developing a system that utilized lasers instead of water to get ultrasound into the material and detect it... However, there were multiple issues such as generating the ultrasound and detecting it. There was a great amount of teamwork that went into the process.”- Dr. Yawn, video interview

We faced similar issues with deciding how the catapult system would be built, based on the specifications given to us by VEX robotics and financial constraints. However, as Dr. Yawn said, there goes a great deal of teamwork into the process, and collaborating during class and after school united us on a set catapult system.

F-22 Raptor, one of the many aircraft Dr. Yawn worked on

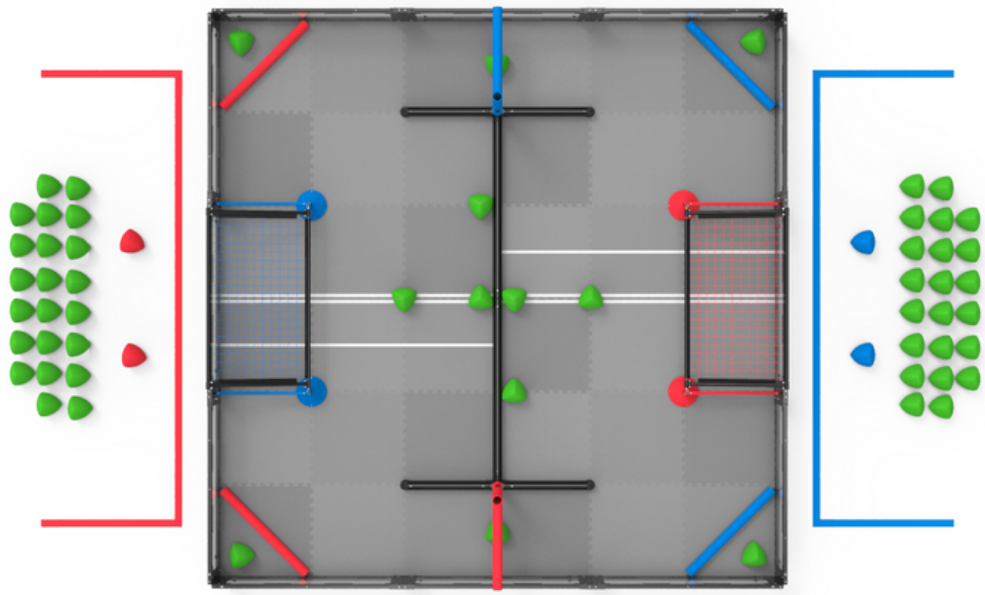
DESIGN DEVELOPMENT PHASE AND CONSTRUCTION DOCUMENTATION PHASE

In these phases, Lockheed Martin engineers must work on furnishing the design to be the most effective, and practical, and adhere to policies. In these phases, the design requirements are also fully fleshed out to prevent any type of miscommunication. Such explicit documentation is kept securely and revealed only to those who worked on the project and who have the security clearance to view it.

F-35 Lightning II reached a number of 156 produced in the year 2023. Documentation of aircraft like the F-35 is kept meticulous, but secure, to keep up with the demand.

Similarly, we keep a detailed engineering notebook with thorough notes and documentation. We also had a set of restrictions and goals, the most important being the ones set forth by VEX. Our goal for this season was to create a hang, improve our chassis system, and redesign the catapult system to accommodate pneumatics.

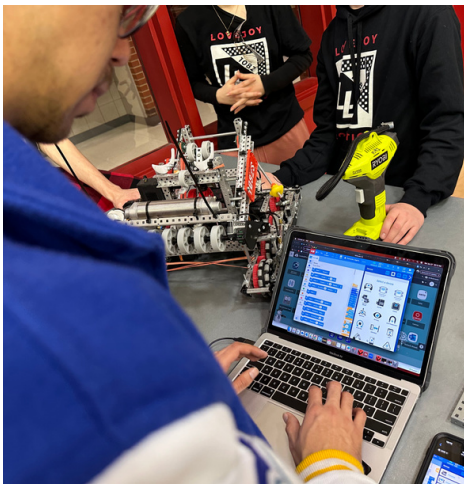
DESIGN COMPLETION PHASE



-VEX Robotics, *"field overview"*

In this phase, all of the completed documents are submitted for final approval. While Lockheed typically tests early to check on the properties of the materials, our VEX robotics team will test late in the engineering design process. We test late to confirm the sturdiness of our robot, and how efficient the new addition truly is.

For example, the autonomous code is carefully created by our programmers, and then tested by our driver to see if the code is working at 100% efficacy. If not, then the mistake is noted in our notebook, and the engineering design process is repeated.



HOW VEX PREPARES US FOR OUR FUTURE CAREER

Despite differences in the end goal of the project, both engineering design processes have striking similarities. This is because VEX robotics lays down the foundation for STEM skills, forcing students to work together. Building a robot requires people of different skill sets ie., programming and building skills, who can only work together successfully if there is communication. Not to mention, the restrictions put forth by VEX forces students to think critically and imagine a robot that can not only be built within those restrictions but also succeed on the field; such demanding challenges require good time management skills. The engineering design process itself and the iterative nature of it allow students to look for errors, correct them, and ensure that they are in harmony with the other parts of the robot. Thus, VEX robotics allows for the development of skills important to those working in STEM, and fully translates over to the workplace when needed.

Team Members following specifications according to our engineering notebook for new design plan.

Works Cited

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