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LOCKHEED MARTIN

Lockheed Martin Internship Report Quality Technology, spring 2022

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*Picture sources are found
on the final page of the report.*

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Introduction

Working at Lockheed Martin is a huge opportunity for a Danish student/graduate. In the case of the 2022 interns, the process of getting here has not been easy. The interviews and selection process in 2020 feel like an eternity ago, as the internship was postponed due to Covid. I remember the surrealistic feeling of actually standing in the U.S. late January. Just three days before leaving, I had defended my Master's thesis and spent those days taking care of the last preparations and seeing friends and family a final time before leaving Denmark for 5 months. Getting to the apartments and subsequently going to work the first day required me to take a step back mentally and realize that it was actually happening. I am going to work with a 5th generation fighter jet in Texas, USA for the next 4 months!

Naturally, getting to this point would not have been possible without the help of people both within and outside Lockheed Martin and Terma. Therefore, a special thanks goes to the following people:

Louise Daa Løfquist – for an incredible and intensive effort to enable us to go to the U.S. in a short period of time. You have been a major reason that we were able to partake in the internship through persistent work with the embassy, Lockheed Martin and other stakeholders of the internship program. Even during our stay you have been a massive support – thank you!

Nils Toudal – for partaking in arranging social events, answering questions about the internship and keeping the connection between Terma and the interns during changeover periods. Thanks for taking the time outside of your regular work tasks to arrange the internship for us!

Kelcey McKinley – for providing us with a continuous flow of information both prior to departure and during our stay, as well as your efforts to enable us to go to the U.S. Thanks for all the recommendations on both practicalities and social events and experiences. You have done an amazing job for your first group of interns!

Elyse Michniak – for the efforts during 2020 to try and make the internship happen during Covid. Although we didn't go then, we appreciate the efforts and believe that it subsequently led to the possibility of postponing the internship. Thanks for being available for questions about the program and other technicalities!

Bradley & Travis – for assistance with all of the essential practicalities and keeping us posted about local events whether that be art festivals, lacrosse games, plays at the opera or even tornado and other severe weather warnings! It is rare to see such unselfish actions as the two

of you have taken, helping interns for the past 15 years. Arranging accommodation and being points of contact in the U.S. during planning in Denmark has been invaluable. Likewise, the assistance with registering cars, getting local phone numbers, getting insurance among other things has been invaluable – thank you so much!

Donny Weaver – for being our Terma ally in the U.S. and welcoming us so warmly to the area. It has been great to have some informal days and evenings getting to know Terma NA as well as the relationship between Terma and Lockheed Martin.

Sam Bartholomew – for allowing us to work on interesting projects and enabling us to carry out our work. Thanks for the trust in getting our work done and being there whenever questions arise!

Alexander Tramm – for making sure we were always progressing on the exciting projects while simultaneously being a great colleague. Additional thanks for the assistance working with IT and for making work fun!

Jean-Pierre Njock II – for providing us with work during slow times and pushing boundaries to enable us to carry out our work. Also, thanks to both you and Alex for the social events we have attended together!

...and many, many others! A lot of people have engaged in making this once in a lifetime opportunity possible and at least as many have contributed to it being a great experience. Finally, I want to express my gratitude towards Thomas B. Thriges Fond for enabling us to pay for apartments, inventory, cars, repairs, flights and experiences through a generous scholarship.

This report aims to describe some of the many experiences I have gotten throughout my internship both at and outside of work. The report is divided into three main parts; “Lockheed Martin”, “Life outside of Lockheed Martin” and “Reflection”. The first part aims to provide some background information of the company I have spent the past four months working at, as well as describing the department, projects and classes I have been part of. The second part describes some of all of the experiences I have gotten outside of work on the long weekends and a one-week holiday. Finally, the third part provides some considerations on all of the experiences and how I can use the knowledge I have gained from the internship when returning to Denmark. Additionally, this part provides a few recommendations for future interns to hopefully ease their preparations and practical efforts during their internship.

Lockheed Martin

Employing 114.000 people in 54 countries across 395 facilities¹, Lockheed Martin is no small company. The history of the company goes back more than 100 years, where Glenn L. Martin and the Lockheed brothers founded the Glenn L. Martin Company and the Lockheed Aircraft Company, respectively². The businesses are divided into four sub-areas; “Aeronautics”, “Missiles and Fire Control”, “Rotary and Mission Systems” and “Space” – all contributing to the \$65.4 billion in net sales in 2020. Throughout my time here, I worked within the Aeronautics business area in Air Force Plant 4 in Fort Worth, Texas. This plant has been home to the production of both the F-16 Fighting Falcon and F-22 Raptor aircrafts but is now dedicated to the production of the 5th generation fighter, the F-35 Lightning II. The F-35 aircraft aims to be the most advanced multi-role fighter in the world³. To achieve this goal, the newest technology is being applied both in production and during inspections of the aircraft to both lower cost and improve quality. The latter is the purpose of the Quality Technology (QualTech) department, which I was a part of during the 4 months of internship. QualTech is a rather small department, consisting of 10 employees, including the manager, Sam Bartholomew. During our internship, the department was merged with Manufacturing Technology (ManTech) to form Operations Technology (OpsTech).



Figure 1 - First Danish F-35 being moved through the factory

Security

As much of the work and information within Lockheed Martin, and especially the facility, is highly confidential, security is an important matter within the organization. Hence, several measures were taken to ensure confidentiality. Much information within Lockheed Martin is proprietary and needs explicit clearance to be released to foreign nationals – such as Danish interns. Documents, e-mails

¹ <https://www.lockheedmartin.com/content/dam/lockheed-martin/eo/documents/lockheed-martin-fact-sheet.pdf>

² <https://www.lockheedmartin.com/en-us/news/features/history.html>

³ <https://www.lockheedmartin.com/en-us/products/f-35.html>

and other written information are classified into different levels of confidentiality to guarantee that the recipient is allowed to look through the material. To further ensure security, foreign nationals are assigned to a closed network, which caused some IT challenges during the internship, as accesses were limited.

Courses/training

During periods where the workload was low, we had time to take some courses within Lockheed Martin. First, we took some self-paced training in the CAD-drawing software, Catia, to be able to 3D-print models to be used in prototyping during our projects. As I had never worked with programming, I spent some time learning Python and MATLAB, which I utilized during my internship. Furthermore, we were enrolled in a Foreign Object Debris (FOD) prevention course. FOD is the existence of objects within the aircraft that do not belong and thereby pose the risk of damaging the aircraft. FOD is given utmost priority, as damages can be extremely costly and worst case be fatally dangerous for the pilot. The course focused on how to detect and prevent FOD through correct tool handling, cleaning procedures and inspections. To avoid FOD, the production floor is divided into three areas: FOD Awareness, FOD Control and FOD Critical, each with their unique signage. Additionally, we were enrolled in a 16 hour course in geometric dimensioning and tolerances. This course provided us with knowledge of the American standard of dimensioning and tolerances on technical drawings used in production. Finally, as the use of cameras within the facility is a threat to security, a certification to use cameras is needed. Therefore, through a self-learning session and briefing, we were certified to use cameras to be able to complete some work tasks.

Projects

Rather early in our internship, we were presented to the overall project we would be working on throughout the four months. There had been a wish from elsewhere in the organization to automate the detection of defects on applied sealant in the fuel tank of the aircraft. These defects can be e.g. holes and excess or lack of sealant. To fulfill this wish, QualTech was to develop an AI solution capable of detecting these defects. Within such a project, several steps are needed to be taken. Initially, we defined the requirements in collaboration with Quality Engineers, inspectors, etc. This seemed not to be a priority to the department at first, but with the involvement of other stakeholders on the project, it got higher priority. From this point, the three of us got different tasks to complete the overall objective of developing the sealant inspection AI. I focused mainly on making the process of gathering and labeling data (i.e. taking pictures and identifying flaws on those pictures) easier. This was achieved through

improvement of an already implemented technology. Thereby, future AI projects can be carried out and implemented faster. Other areas of work on the project included designing and producing samples that could be used to generate data, developing user interface among many other things. The entire project was managed through the Scrum framework, working in two week sprints.

In addition to the above, several minor projects were also carried out over shorter periods of time. The mix of one long-term project with specific weekly work tasks and some ad hoc tasks worked really well. The beginning of the internship was rather slow in terms of workload. However, when the project was more clearly defined, we always had things to do and progressed well from week to week and even from day to day.

It has been really exciting for me to work on this type of project, as I have never worked on anything similar to this. I have been thrown into tasks that I had never done before, but could always get assistance if needed. The work we have done is clearly usable in practice and therefore not only pseudo-work as one could fear during an internship in a large company. The colleagues at Lockheed Martin always listened to our inputs and we had huge influence on the direction we wanted to go with the project.

Life outside of Lockheed Martin

Luckily, the 5 month internship in the U.S. does not only include work – there is also time to experience the local and even national areas in and around Dallas / Fort Worth (DFW). The following presents a few of the trips and events we have experienced throughout our time here.

Within the DFW area there are a lot of things to do and experience. One of the first things we experienced was the Pro Rodeo Show in Dickies arena – a classic Texan event which included bull riding, barrel racing, tie-down roping and many other competitions. Staying in the cowboy category, we paid a visit to the Fort Worth Stockyards to catch the Western feeling and seeing the cattle drive. We also went to see a lacrosse game, the Super Bowl (at a bar) and a monster truck show. We visited Dallas on the occasion of St. Patrick's Day, but apart from that, didn't find the city particularly interesting. Finally, we went to see a play at the Bass Performance Hall, which was a great experience.

Outside of DFW, we took some road trips during the 3 day long weekends. One of these road trips had Austin as the destination. We quickly found Austin to be a much more modern and almost European city, compared to those we had visited this far. However, the area offers both

nature and urban experiences with Lake Travis and the Colorado River as well as the buzzing nightlife and many skyscrapers. Some of us took a daytrip to a small town called Fredericksburg and stopped on the way home by a state park called Enchanted Rock, which is a 550 meter tall granite mountain.



Figure 2 - One of the three cars - an old police interceptor, Ford Crown Victoria, outside one of the huge gas stations called Buc-ee's on the way to Austin



Figure 3 - Five out of six 2022 interns at Mount Bonnell, Austin, TX

I was lucky enough to have some visitors from Denmark, including my girlfriend and two friends. Due to the flexibility at Lockheed Martin, I was able to take some days off work to enjoy some time with them. They were here for about a week where we took a road trip to Big Bend National Park which was a huge experience. On the way there, we had an overnight stay in a small town called Odessa. Although it was in the middle of nowhere and there was nothing much to see, it was fun experiencing that area of Texas also.



Figure 4 - View from the highest point in Big Bend National Park - Emory Peak (2385 meter AMSL)

At the time of writing this report we have only been outside of Texas twice – once to visit the largest casino in the U.S. in Thackerville, Oklahoma and once to go to New Orleans, Louisiana. The former was an impulsive afternoon-evening trip and the latter was Friday-Sunday to experience the seafood and nightlife of New Orleans.

As our visas allow us to stay in the U.S. for up to a month after the end date of our internship, we are planning to see some more of the states for a few weeks then. As for right now, the goal is to see the Rocky Mountains in Colorado, experience the nature in Yellowstone National Park, spend a day (and some money) in Las Vegas, and see Zion National Park and a lot else on the roads in between. The weeks post the internship allow us to take a longer trip to see some more of the U.S. than “just” Texas.

Reflection

All in all, the experience of not only living in the U.S. but also working for an American manufacturer of military aircraft as a foreigner has been unforgettable. I have explored the American culture – both in terms of work but also in general. Simple things such as seeing everything being bigger – the stores, cars, roads, meal sizes, distances – has been a huge experience. The flexibility of Lockheed Martin in terms of hours has been amazing and allowed me to take a full week off to go on a longer road trip. The work environment and culture has also been very interesting to experience. Although it is difficult to pinpoint specific areas where the American work culture is different from the Danish, it is obvious that the two are not the same. However, one area that is notably different is the work schedule. During our internship we worked 10 hours a day, 4 days a week. This also provided us with the possibility of working Fridays to build up some extra hours and use those to leave early some Thursdays or taking some days completely off. Another thing I found interesting was the hierarchical structure of a company such as Lockheed Martin. Although it may be partly a general American thing, I believe that any company that has the American Department of Defense as their customer would need such a structure. Every decision, change and technological implementation needs to be validated and accepted through multiple stages of the organization to be part of the daily activities in production. As it is essential to keep the level of quality high within the company, this structure is obviously needed – although it sometimes seems silly.

I am leaving the U.S. with a backpack full of new knowledge and experiences. As the first (to the best of my knowledge) group of interns having already completed their Master's theses, most of us are going to start our careers shortly after returning to Denmark. I am sure that the internship has provided me with knowledge, insights and personal and professional developments that I will be able to use in my future career. I will be bringing home some specific skills such as programming and working in an agile project environment. In addition to this, I am sure I will be able to refer to events or experiences from my time at Lockheed Martin when faced with challenges and projects at coming positions.

I have found that the internship is beneficial for many parties – not only the student but also for Terma and especially Lockheed Martin, since both the department we have been placed in and management listen to the ideas and solutions that are generated throughout the program. It creates a motivational element to know that you essentially have an influence on how the fighter jet will be manufactured and can assist in cost reductions and quality improvements.

Based on my experience working at Lockheed Martin for the past 4 months, I wouldn't hesitate to recommend future students to apply for the program. It is an amazing opportunity to see an entirely different industry from the inside, while simultaneously being able to experience living in – and traveling – the U.S. To make life somewhat easier both prior to departure and during the first few days, there is a so-called “Newbie Guide” which will be updated with tips and tricks from this year's interns. Recommendations on insurance, electric company, internet and phone service provider among many others things will be found in this guide.

I hope whoever reads this will be inspired to consider applying for the internship at Lockheed Martin through Terma and gain as many great experiences as I have during my time in the U.S!



Figure 5 - All six Danish interns at a birthday event for Zenait (middle)

Figure 6 - Myself in front of a Texas-sized truck

Picture references

- Front page: F35 SmugMug <https://www.smugmug.com/gallery/n-WFRWTg/i-wv7mQcd>
- Figure 1: F35 SmugMug <https://www.smugmug.com/gallery/n-mzJpLp/i-Whdhcph>
- Figure 2: Personal picture (Photo by Johan Hilsøe)
- Figure 3: Personal picture (Photo courtesy of Johan Hilsøe)
- Figure 4: Personal picture (Photo by Johan Hilsøe)
- Figure 5: Personal picture (Photo courtesy of Zenait Lopez)
- Figure 6: Personal picture (Photo by Nikolai Raben)