2024 INTERNSHIP REPORT

LOCKHEED MARTIN - MARIETTA

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Preface

This Lockheed Martin document is meant for internal and external purposes. It is to be submitted to Lockheed Martin coworkers and managers and any internal parties interested in the projects that I have been working on during this internship. Furthermore, it aims to cover an outsider's perspective on working at Lockheed Martin. Secondly, the intent of this document is to be shared with supervisors and professors at the Technical University of Denmark responsible for the special course created to facilitate this internship at Lockheed Martin. Furthermore, it is to be shared with Terma and their relevant employees. Lastly, the intent of this document is to be shared with patrons in Denmark who have contributed financially with scholarships to make this internship possible. This includes but is not limited to Thomas B. Thriges Fonden and Knud Højgaard Fonden.

This paper covers the progress made on the intern projects as well as outlines key takeaways related to technical, social, and business-related aspects experienced during an internship with Lockheed Martin through Terma in the F-35 program.

The internship took place during the spring semester of 2024 in Marietta, Georgia. Here Lockheed Martin (LM) manufactures the center wing for the F-35 which is the first 5th generation multipurpose stealth fighter jet with the aim of replacing several different fighter jets. Having one aircraft being able to carry out the roles of many different, makes for a more efficient and overall cheaper program. The F-35 comes in 3 different variants which enables the aircraft to be effective in different environmental settings. The A-model or Conventional Take-Off and Landing (CTOL) is the base model which requires a regular airfield to effectively operate. The B-model or Short Take-Off and Vertical Landing (STOVL) allows for smaller takeoff and landing areas such as smaller aircraft carriers and features a vertical fan right behind the cockpit. The C-model or Carrier Version (CV) is a model sold only to the US with reinforced landing features and larger foldable wings needed for the relatively harder landings on the short runways of carriers while not limiting its own capabilities with the vertical fan of the B-model.

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Project 1: Sealant AI

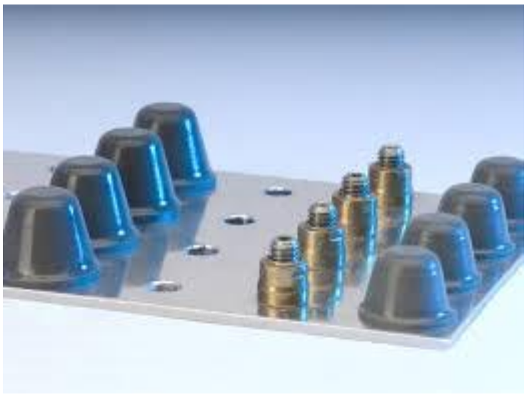

Figure 1: Sealant Cap Example
Source: https://www.ppgaerospace.com/getmedia/9a234ec3-1db9-48de-94f7-c212ac2ba705/customized_Sealant_solutionsTDS.pdf

Project Introduction

"Our brand means quality" is a statement often seen posted around on the production floor of Lockheed Martin (LM) in Marietta. This is the quality policy that LM have chosen to represent some of its core values. When producing aircraft it is vital that the quality is top notch. Any defects in the product could cost lives. With this mindset LM therefore does a lot of quality inspections throughout production. A lot of this is done by human visual inspections.

Fighter aircraft such as the F-35 are often limited to low amounts of fuel, due to their smaller size and need to carry a proportionally very large internal engine, weapon systems and auxiliary systems. Therefore the F-35 is designed such that any bay or void that doesn't need to be dry, is filled with fuel. To prevent fuel to leak into unwanted areas, all bolts and connections are sealed off with a special sealant.

This project seeks to automate the inspection process of the sealant caps that are applied to nuts and bolts in the wet bays. Through artificial intelligent image recognition software applied to a borescope mounted on a robotic arm it is sought out to make the inspection process more efficient.

Current Inspection Process

As stated previously, the status quo inspection is mostly done by the human eye. Here a quality inspector checks all relevant seal caps and fillets. The inspector uses a powerful flashlight when inspecting and a small mirror on an extendable stick to look at hard to reach places on the aircraft. If defects are found it is noted and depending on the severity of the defect it is fixed in different ways.

This current method poses an extreme challenge for this project, but also a couple of opportunities. The inspectors are extremely quick. Most have a lot of experience and know what to look for. Competing with the speed of the inspectors is probably the biggest challenge for succeeding with this project. Furthermore some of the seal caps are in hard to reach places which would pose a challenge for a robotic arm.

However the Sealant AI project proposes a non-subjective and normalized inspection process. Today there is no clear definition on what is an acceptable seal cap, and suffers from subjectivity. A bad seal cap is easy to spot with either tails, voids or missing sealant, but what about those that are right on the verge of being acceptable? Another advantage that this project has is the fact that the robot would follow that same path and inspect every seal cap every time. Humans are prone to fall into habits and miss things every once in a while. It is not unreasonable to assume that the inspectors also tire their eyes out after looking at so and so many seal caps and fillet seals. The borescope and AI does not tire out and inspects the seal caps fairly every time. Furthermore it was noted that more than one quality inspector was checking the aircraft at the same time. This introduces inflexibility in terms of inspectors having to schedule time together to do the inspection. A robotic arm would have no delay in being deployed as soon as the product is ready for inspection. Another opportunity that this project has is an improvement in the communication between the inspection and the mechanics performing the fix. Today the mechanics sometimes raise some confusion as to which exact defect they are to fix and the instructions from the inspectors are not always clear.

Initial State of Project

The first stage of the project was a handheld borescope hooked up to a computer that an operator would point at all seal caps and the Sealant AI software would point out defects on the screen. This however proved to be an inefficient way for multiple reasons. Firstly the operator had to guide the borescope by hand while looking elsewhere to a screen. This proved difficult. Furthermore the framerate of the camera wasn't great which caused a lot of frustration with the operators using it, leading to many not wanting to use it. These headaches were sought out to be fixed in the second stage of this project with a UR10 robotic arm.

Sealant AI as a software was developed by Lockheed Martin Operations Technology in Fort Worth, Texas and was therefore a pretty much ready to use product when starting this second stage of the project. A borescope was fixed to a 3D printed end effector on a UR10 robotic arm. A coupon, or test article, was available to test the setup and software on.

Ultimate Project Goal

Automating and normalizing the inspection process of the F-35 is the ideal outcome of this project. That entails seal caps and seal fillets. However one could dream that it would also inspect for Foreign Objects and Debris/Damage, also denoted FOD, in the same run.

Robotic arms are normally extremely dangerous for humans to work around, since the robots don't stop if they hit something unexpected. Therefore most robotic arms require a safety cage around themselves, but the UR robots have inbuilt resistance sensors which mean they fault out in case they hit something unexpected. The goal of this project is therefore a robotic arm located on a cart that could be rolled up to the fixture of the aircraft. The cart would then be pinned in and the robotic arm would do an autonomous inspection leaving the operator free to do other tasks. Once the inspection is completed the software would generate an automatic report of seal caps with defects and their location with an image of the defect. This would convey to the mechanics where and what to fix in the case of defects.

Project Progression

Initial Setup

One of the first tasks of the project was getting the Sealant AI software to work on a different computer than the one used in the handheld configuration. When running the python code it was pretty easy to get the camera to run, just by adjusting the code to have the right input number to match the borescope and not the inbuilt camera in the computer. However it took a lot more troubleshooting to understand why the output from the program was only a fraction of what the camera recorded, just blown out of proportion on the computer screen. The output showed the overlaying mask that Sealant AI produces, but it was just distorted significantly. With the help of the Sealant AI developer from Fort Worth it was discovered that the aspect ratio was hardcoded to a fixed value. Fixing this issue resolved those problems and the code worked perfectly for sealant caps.

Confidence Levels and AI Training

For this project it was important to have the correct balance between false positives and false negatives. In the industry which has a very high standard for quality it was very clear that one would much rather have a lot of falsely identified defective sealant caps than having defects sneaking through as false positives. Therefore an appropriate confidence level was chosen for the coupons which showed promising results. It was assumed that if the confidence level was appropriate for the coupons, it would be on the aircraft itself as well

The Sealant AI developer disclosed in a meeting that the AI was trained with a very large number of images of seal caps, some without and some with defects. Previous interns developed a very handy program that would use AI to train the AI. Upon our visit to Fort Worth we tried the training process for their in-development FOD AI which was an extremely boring and strenuous task despite the cleverly designed AI labeling tool. For FOD AI the training consisted of recording a video of FOD on an aircraft and then loading that video onto the computer in a lot of frames. For each frame the relevant FOD was then highlighted by an inbuilt AI that could detect shapes, a click by the user and then on to the next frame. In the matter of a couple of hours the user could train the AI with a thousand or two images. In order for the AI to work effectively it needed to be trained with a lot of images, and preferably a lot of diverse images as well.

Sealant Fillets

Sealant is not only applied to bolts and nuts, but along edges where parts meet up. At the point of implementation the AI was not trained to recognize flaws in fillet seals. Since the training of the AI was done in Fort Worth, it made sense that this would be out of the scope for the pilot of this project with a possibility for later implementation.

Robot Pathing on Coupons

To learn RoboDK, the software used to control the robot, it was implemented on a set of coupons given to LM Marietta by LM Fort Worth. Here path planning proved to be fairly easy as RoboDK is a very intuitive program with a relatively easy GUI. By placing targets for the robot to hit using the "Surface Target" button, it was a simple point and click task. However the question arose about which path would be most efficient in order to investigate the seal caps.

The initial path over all the caps was just directly vertically passing over the seal caps at a slow and steady pace. Sealant AI could surprisingly keep up to quite a high robot arm velocity, but would fail to see certain details when only getting the perspective of directly above the cap. Then an orbiting approach was utilized where the robotic arm would orbit each seal cap to enable the borescope to record the cap from multiple angles. This did give a higher accuracy, but at the expense of speed as the orbiting motion was extremely slow and added a lot of extra travel distance for the robots joints. A final path was decided where the borescope would pass sealant caps in a line from one angle, then change perspective and go back through the row of caps.

Applying Sealant AI to the F-35

In order to marry the UR arm with the borescope to the F-35, it was decided to design a method to fix the cart, which carried the robot, to the fixture holding the F-35. Since the aircraft is located in the same way on the fixture, it would mean that the robot would know exactly where the aircraft would be located with respect to the cart it. Thereby it could inspect the sealant caps on the aircraft "blindly" i.e. there was no need for an extra camera that would adjust the robots position according to the observations of the camera.

Importing the 3D model of the F-35 proved to be a bit more of a hassle than expected. The F-35 is obviously a large ship compared to the robot with lots of details and complex geometries. Therefore when trying to load the model onto a computer it was a huge mouthful for the computer. It was therefore necessary to remove the parts of the ship that were not built yet for the computer to handle it.

Conclusion & Discussion

As the project is not finished at the time that this report was written, it is difficult to determine the exact effectiveness of the project. However it shows a lot of promise when it comes to standardized and automated inspection tools. One could argue that seal caps are not the most pressing matter to inspect, but it was an easy start to an automated process. Subject matter experts told us that scratches were a way bigger cause for rework and repair than bad seal caps, and that we should have started with that instead. This feature is of course possible for future generations of the project, but since the Sealant AI was already developed, it was natural to start implementing that. Furthermore it would be interesting to implement the FOD AI in the same inspection process and perhaps investigate the possibility of implementing a 3D camera for a more efficient inspection process.

Project 2: AdMIRal Shim Delivery

Figure 2: Shim Example
Source: https://laminatedshim.com/standard-aircraft-shims/

Figure 3: MiR 500 stock image
Source: https://www.materialhandling247.com/product/mir500_mobile_robot

Project Introduction

The F-35 production line adheres to super tight tolerances. However sometimes these tolerances don't line up and a shim is needed to remedy this. When two parts are to be joined they sometimes leave a gap. Here Lockheed Martin in Marietta has an in-house custom machine shop which caters to the production floor and produces these thin metal sheets called shims. These shims are then transported from the machine shop dubbed 'shim cell' to the production floor where it is installed in between parts to fill out the gap.

The status quo presents an opportunity to implement automation to the Marietta production floor. Having a workforce very skeptical towards automation and potential prospects of losing their job to robots, this inefficiency presented a way to get a foot in the door for autonomous robots. Here it was elected to utilize the MiR500 created by Mobile Industrial Robots (MiR) wherefrom the project nickname "AdMIRal" comes from.

Current Shimming Process

The way the production runs currently starts with a mechanic at his workstation starting work on the aircraft. When the parts are assembled onto the aircraft it is then noted that the gap is not in tolerance and needs a shim. Then a custom order is sent to the shim cell and they start producing the shim. Upon completion it is then picked up by the internal transport and logistics department and transported to the appropriate work station for installation.

In this process a couple of clear inefficiencies come forward, that this project aims to improve. Firstly it seems there is no clear responsibility in terms of who the owner of the delivery task is. While working on this project the phrase "it's nobody's job" has been uttered many times. Having an autonomous robot move around the factory floor would allow for that job to be carried out with the robot having the responsibility. Furthermore this eases out the whole struggle of people being afraid that it would replace them at their job, since the robot is literally taking nobody's job. It also has the benefit of acclimatizing people to the future of the Fort Worth Marietta plant of autonomous robots.

Another room for improvement is the timing aspect of the delivery. Currently there are only vague guidelines in place for the transportation department stating that they should swing by shim cell about every half hour to check if there is a pickup ready for them. This leads to the transportation team sometimes making the trip in vain and sometimes long waiting times for the workers at the aircraft. A solution was previously implemented with a light that would signal when a shim was ready for pickup, but the solution was never really effective since shim cell machinists forgot to utilize the light and the light not being very visible anywhere relevant.

Initial State of Project

Previous interns left the project almost complete. There was an already built drop-off rack where bins could be placed on with shims in the bins. A similar rack was built on top of the MiR which allowed the MiR to dock to the drop-off fixture and a docking mechanism would allow the empty bins to slide onto the MiR and the bins filled with shims would slide onto the drop-off rack. A demo map was already created and ready to be showcased.

Ultimate Project Goal

The ultimate aim of the project would be a fully automated delivery system. However due to constraints in time and equipment the scope of the project was limited to an almost fully automated system.

The scope of the project was limited to a tablet mounted to the MiR with an extremely simple UI. When a machinist would complete a shim, he would simply put the shim in one of the baskets and press the "Deliver shim" button on the tablet. The MiR would then transport the shims to the drop-off location, dock to the drop-off rack and the basket with the shim would slide onto the drop-off rack. The empty baskets from the drop-off rack would then slide onto the MiR. Then after a small delay the MiR would return to the shim cell for a new pickup.

Due to the previously mentioned constraints, the project is limited to the human input of pressing the tablet to deliver shims and also the human input of moving the baskets between the upper and lower deck. Another major limit is the fact that there is only one drop-off rack meaning that the MiR cannot drop off the shims directly to the respective workstation which would have been preferable. Instead it will drop-off the shims to one central location wherefrom mechanics can collect their shim from.

Project Progression

Initial Escorting Issue

During the initial part of the internship it was extremely difficult to work on the MiR project, as none of us had badges and had to be escorted everywhere. Since both UR robots were in the same room, it was prioritized to work on the Sandy and the Sealant AI projects. However once badges were acquired and escorting was no longer required we got to work on the MiR.

MiR UI

Firstly a familiarization of the MiR's UI was done as well as how to connect to the MiR. Then a mapping process was started, where an attempt to map out the main route between shim cell and the drop-off location was made. Here it was sought out to also give the MiR additional options in terms of routes if a path was blocked.

Mapping

The MiR uses SLAM (Simultaneous Localization and Mapping) to create maps. Here it simultaneously records its environment with its inbuilt scanners and locates itself in space according to what it records. This is an extremely easy way to record a map, but does come with some downsides. Mapping a too large section leads to errors, especially long straight corridors. When the MiR records large areas, it tends to warp the environment and the map becomes crooked. However error is also introduced when mapping a lot of small areas and stitching the maps together to form a holistic map. Therefore a balanced approach was chosen to map out the production floor.

Implementing Safety Features

A major setback for the project progression was the introduction of essential additional safety features. In case of emergency it was required to have an easily accessible emergency stop and brake release button and switch. Thereby the MiR could be pushed out of the way if necessary. However the emergency stop buttons are located very inconveniently near the ground, and the brake release even worse hidden behind a panel also very near the floor. To change this it was necessary to rewire the MiR. Upon successfully rewiring the brake release it came at the expense of the MiR not turning back on correctly. This caused a major delay, as the MiR was not able to be used for mapping a long time while troubleshooting and contacting MiR support.

Conclusion & Discussion

The AdMiRal project is a simple project in its basic principle, but has a greater underlying agenda. Using an extremely expensive MiR 500 robot to transport simple sheets of metal might seem like using a bulldozer for knocking down a house of cards. However this project is perhaps more a stepping stone towards introducing automation to the production floor. This was therefore a perfect initiation of a new era of production at the Lockheed Martin Marietta production facility.

At the time of submitting this report, the MiR was still out of service and no actual runs had been done on the production floor. However it is estimated that it would be a relatively simple task to get this started, once a fully functional MiR was available with all the necessary safety features implemented.

Project 3: Travelled Work Metric Tool

Project Introduction

During the production of the F-35 aircraft, the ship itself moves from workstation to workstation throughout the production floor. Here it is sometimes the case that work from one workstation is delayed and the ship is moved on to the next workstation. This is called travelled work. During most of production this is not considered critical, as sometimes work gets held up and the continual flow of products is more important. Sometimes there are delays on parts or something has to get reworked or replaced due to damage. The travelled work does however turn critical towards the end of the production line, as the product is about to be complete and should be sold and shipped off on time. Since there is no current program to determine exactly in which workstation a ship is located, a tool was needed to be able to locate the ship in production.

Current Process

Today supervisors have to manually walk the floor and note down the exact location of each ship. From there it is possible for supervisors to compute how much work has travelled from one workstation to the next. This is however a lot of manual labor and can easily be a source of error and overlooked details – if even investigated at all.

Initial State of Project

A super complex excel document was already developed by previous interns, but unfortunately stopped working for some unknown reason. According to the manager it located aircraft by identifying how many open OP-cards each work station has on an aircraft. From this it would be able to guess where the aircraft was located to a high degree of accuracy.

Ultimate Project Goal

The project aims to deliver a tool to production. Here supervisors on the production floor would be able to hit a button and get valuable data regarding traveled work that they would need to assign resources and staff to in order to catch up. It would also include a filter option so that the supervisor could see the specific traveled work for each ship in order to correctly assign the extra resources when or if the work would be achievable. This tool would also be available for upper management such that they would get an overview of how production is going. Hopefully this tool would provide an easier way of managing these details of production.

Project Progression

At the point of writing this report, the project was still in its infancy and not much progress had been made. However it was made clear that a ship could easily be located by investigating open op cards which were furthest down the production line. If work is started in workstation X, then the aircraft is no longer in workstation Y which was where it was previously located.

Conclusion & Discussion

With this tool it would be easier for managers and supervisors to keep track of products approaching the end of the production line. That way it would be easier to manage the schedule regarding deliveries of fully finished products. However providing people with a tool and people actually utilizing said tool are two different things. Feedback from supervisors regarding previous excel sheets provided to them was that they were often too complex. For this to be an effective tool it would have to be extremely simple to use and come with a lot of clear benefits for the supervisors on the production floor.

Additional Smaller Projects

Printers on Flowline

A side project done with an Operations Excellence (OpEx) employee was the implementation of label printers on the production floor. Here it aimed to save a lot of money for the production through optimising the usage of Click bond. A lot of money is wasted on a yearly basis by throwing out the epoxy adhesive that was otherwise not expired and good for use.

The epoxy used on the aircraft is taken by the mechanics from a supply and once opened, it is labelled with an expiration date. The labelling was done by a marker by hand which meant a lot of work and often writing that was unreadable. Then a swivel straw is placed at the top of the Click bond wherein the epoxy is mixed. This means that only the epoxy in the swivel straw is mixed and that the epoxy still in the tube is technically not mixed and therefore still good for storage. Therefore the project aimed at making it easier for mechanics to label the products with an expiration date, such that the mixed epoxy in the swivel straw could be thrown out and not the rest of the entire tube. Here small label printers were configured to print out the current date and time and the expiration date based upon the type of product. A pilot project was implemented on part of the production floor to gather data and feedback to improve the proposed printer solution.

Mini-audits were done where we would walk the production floor and note down chemicals that were labelled by the printer and those that were done by hand. It was also noted whether the labelled chemical was within its working life or not. The data collected showed an overwhelming positivity towards the project and a lot of chemicals labelled with the printers. An important takeaway from the pilot was that many mechanics had very concrete feedback to the project and ideas to improve the printer setup. Most of those suggestions were implement and corrected for, showing the importance of a pilot project.

This evidence collected would support the project in rolling out the pilot to the rest of the production floor and provide additional traction towards changing the current aero-code towards allowing mechanics not to throw out perfectly good (and expensive) chemical leftovers. This would both mean time savings for mechanics in the labelling process and huge potential money savings for the company by using more of the chemicals bought.

Creating a CAD Model for a FOD AI Tablet Holder

During the internship we went on a visit to the Lockheed Martin production plant in Fort Worth. Here we met with our fellow Terma colleagues and got a tour of the Fort Worth facility. Our colleagues were trying to roll out their pilot project trying to fight FOD. Their FOD AI project utilized a borescope hooked up to a tablet. They needed a custom 3D printed case for their tablet which would enclose all their electronics and wires. During the few days in Fort Worth I created a CAD model in Catia for them to 3D print.

Internship Soft-Learnings

The following section outlines key takeaways related to technical, social, and business-related aspects experienced during the internship at Lockheed Martin. These softer skills developed and lessons learned are valuable experiences to carry for future employment.

Technical Experiences

Confidentiality, Proprietary Information, and Security

When it comes to the defense industry one must also mention security. The industry is by nature very concerned with information leaks of any kind. Almost everything encountered at LM has been marked with the abbreviation LMPI, Lockheed Martin Proprietary Information. As the majority of the western world's aerial defense is entrusted to LM it makes a lot of sense to protect any information from spies or attacks. This however meant a very tedious process to get into the internship.

Complexity and Tolerances of the F-35

Upon the first floor walk, it was extremely impressive just to see the size of the massive production floor from the inside. Taking a closer look at the center wings being produced it became apparent that these were no simple aircraft. The impressive complex curves of the F-35 made up by multiple types of material each coated with their own type of paint or low observable material. The enormous amounts of holes having to be drilled at the exact locations that they needed to be drilled in. Fasteners torqued to their specification. Surfaces fitted to be flush with each other. Super tight tolerances of hole diameters and shapes. The list goes on.

Flow through the Manufacturing Floor

In manufacturing terms, it is a very powerful tool to investigate the flow through a production plant. Making sure that the product is always in progress and moving along a manufacturing line in harmony with the speed of production for other parts. In the Marietta flowline of the F-35 center wing there was an overall structure of production line 1 and 2 working in parallel, then being joined and then pushed out to line 3. During the internship line 1 and 2 were not perfectly synced up meaning the joining of the two flow lines got delayed and thus delayed line 3 since they could not start working on the product on time. As expected, when processes upstream are delayed, downstream processes are too. Here a lack of mechanics trained in multiple roles became an apparent flaw in the system. One could advocate for a system of multirole mechanics where a mechanic would help the struggling flow lines when out of work at their own workstation.

"If you ain't sure, you're wrong!"

The above quote was said from a fellow coworker when describing how work in the aviation industry is carried out. When it comes to aviation and especially the military sector one spends the extra 30 seconds to do it right the first time around. An incredibly inspiring and valuable takeaway from this internship is being thorough and making sure that what you deliver is of great quality. In some contexts of engineering, it is of course the nature of the game to be unsure. For example, in research and development the outcome is never known, and one cannot be sure of how to best achieve a goal or measure it accurately the first time around. At the same time one can make sure to document the progress thoroughly and make sure to explain why something did or did not work.

However, when it comes to repeating tasks like in production, it certainly pays off to be certain. Something that was repeated a couple of times during the internship was that LM is building aircraft which <u>cannot</u> be allowed to fail. On the shop floor one might be subject to think that the work done on the floor is simply drilling a hole or installing a fastener and it doesn't make a big difference whether it is done perfectly or not. However, the reality is that down the line whether a hole is drilled to spec or not could mean a pilot coming home to their families or not. A critical mission carried out to perfection or failing miserably with the plane crashing. Keeping this in mind when producing aircraft keeps your eye on the mission of the whole production floor and shows the greater picture of the program.

Another reason to make sure what you are doing is right the first time around is when looking at when something is not done correctly, and the incredible amount of work needed correct it through the SRR process.

Social Experiences

Weekly Briefing Meetings

In the weekly meetings in the team, it was extremely common to end with the phrase "Do you need anything from me this week?" being passed around the office. This incredibly inspiring way of sitting in front of each other and organizing and planning a week seemed a lot more efficient than emailing back and forth trying to figure out each other's schedules as one is quickly prone to in the corporate world. In these meetings it would be quickly and efficient shared what each member of the team was doing and which types of struggles they were facing. Here people would chime in on solution ideas and perspectives they had which were used to great effect.

After Work Fun and Socializing

During the internship it was a big deal for the team to socialize outside work. Despite being foreigners who only had a brief stay in the US, the team made a big deal to welcome the new hires. Activities included multiple invitations to restaurants and bars. Skydiving, go-karting, top-golfing and even attending a 5K charity run where the boss of the team played in his band.

Business Experiences

Troubleshooting and Brainstorming as a Team

In one of the weekly meetings it was proposed to do a team collaborative effort to create the best possible arguments and counterarguments for a meeting regarding the Click bond issue. Here the guy in charge presented the present regulation and the concerns raised by upper management. In this collaborative effort the team investigated different concerns and possibilities regarding this, which was a very productive way of approaching such a great project facing adversity.

Action Items

An amazing takeaway from the internship was the clear delegation of responsibilities and tasks after a meeting. When working with the Operations Technology department it was always made clear which actions were the next steps and who was responsible for them. This was done on a weekly basis and with a 6-week outlook. This way the bigger goals of the projects were always kept in mind, and the work was split into doable subtasks. It seemed like a very efficient way of delegating work.

A Manager's Open-Door Policy

Coming from a different company where the manager was always behind a closed door without time for their employees it was a nice change of pace that the manager of Operations Excellence almost always kept his door open. We learned during a training course for new leaders and managers at LM, that compensation only drives engagement of employees 29% of the time. However engagement is driven by a competent supervisor 80% of the time and an approachable supervisor drives engagement 88% of the time. This was a clear priority from the manager at Operations Excellence and yielded a fantastic work environment for the team.

Feedback works both ways

One of the core values that the manager of Operation Excellence showed was that feedback was a two-way street. He showed genuine attention when presenting projects and offered clear and constructive feedback. At the same time, he was willing to also receive feedback and adapt to it. Despite having a very laissez-faire management style he was quite engaged in the personal and professional growth of his employees which was a very inspiring way of leading a team.

Final Remarks

I am incredibly thankful for the experiences I have had during my internship at Lockheed Martin Marietta and look forward to the rest of the internship. Seeing such a complicated and extraordinary aircraft being put together with such precision in such a large scale is truly staggering. Furthermore it has been an absolute blast getting to experience the US and all its glorious activities, nature and people. Skydiving, monster trucking, alligator watching, shooting, goldmining, hiking, Nascar, baseball and rodeo. The list goes on. Here listed a few of the many crazy adventures we have been on outside of work. All in all this internship has been an extremely enriching experience professionally and personally.