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Sandia National Labs Summer Internship

Albuquerque, NM

Monty Bruckman II

Submitted to Professor James Helbling

College of Engineering

Embry-Riddle Aeronautical University

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I am working for Sandia National Laboratories in Albuquerque, New Mexico in the Summer Product Realization Institute for Nuclear Weapons (NW SPRINT). NW SPRINT focused on increasing agility and facilitating the development of novel concepts and ideas on a compressed schedule. The program focuses on using advanced manufacturing technologies to innovate and revolutionize the products that Sandia National Laboratories delivers. The program is a design challenge incorporating knowledge from various engineering fields to design and implement a working product. Multiple teams from different departments compete to develop and iterate the best design. I am working on a team of five with individual disciplines including Mechanical, Aerospace, and Electrical Engineering. The team is advised by two mentors Josh Kuhn and Karl Walczak, and further supervised by Audrey Morris-Eckart (Manager 2616).

During my first few days at Sandia I thought about my position, what I would be doing, and what I would like to take away from this opportunity. I developed a list of learning objectives which correlate to my job responsibilities but I expanded my objectives to force me to think outside of the box and learn more than required. I am primarily interested in the design process for product realization including: CAD design, component and assembly analysis, and physical assembly and testing. In addition to my individual work, the team immediately started collaborating and getting to know each other. We developed a team name based on our department and assigned it the acronym AIM, for Accelerating Integrated Mechanisms.

The subsequent few days and initial weeks were spent attending orientation and setting up our workspace. Orientation consisted of many in-person meetings with mentors, directors, and technical staff, to familiarize ourselves with the history and policies of Sandia Labs. In addition to the meetings, online classes were taken to further familiarize ourselves with standard procedures and policy. Setting up my workspace and computer was the next big step in preparing for the competition. I installed many typical software's such as SolidWorks, ANSYS, MATLAB, and Creo to design and analyze components and

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assemblies. After completing orientation and preparing my computer, I was ready for the competition to start.

The SPRINT kick-off meeting revealed the design project and defined the requirements. Different technical engineering disciplines presented to the interns regarding the competition and what the teams will need to accomplish the goal. After the meeting our team immediately began brainstorming and designing to provide the best product.

I am extremely intrigued with the engineering design process because as Wallace Morris says, "requirements drive design." I am learning that the first step in designing a product is really understanding the requirements from the customer and designing to fulfill them. Extra amenities are great for innovation and showing off a product, but the base design must fulfill the requirements completely. Brainstorming is key for illuminating new or old ideas to implement into a design. Many ideas, narrow or far-fetched, are preferred to allow any idea to be developed and not cut off short. The down selection process narrows the design to provide the perfect fit the customer.

Initial physics and math calculations are performed to weed out obviously bad designs. CAD modeling and simulations are used to visualize and further down select to a more unique and workable product. Many different CAD software's are used throughout industry for pros and cons associated with each software, and Sandia uses Creo. SolidWorks was the first program I learned in college but I didn't even scratch the surface of how to design. I proceeded to learn CATIA and I am well versed in many workbenches in the program. Sandia uses Creo for all professional applications and I was determined to learn the program. Diving into SolidWorks and Creo at the same time at Sandia was difficult because the languages are slightly different and very easy to confuse. I stuck to the main ideas of 3D design and learned the basics of both programs. I am now very confident in my skills to design parts and assemblies in either program by breaking down parts into simple shapes, designing the component, and adding on more complex features.

Once components and assemblies are designed, they are analyzed using computer simulations following the provided design criteria. Individual components are tested first through a variety of test conditions, and then assembled to analyze how the system will work through the same test conditions. If simulation results indicate a poor design or reveal a situation not accounted for, the design is changed to yield a superior product. Simulation is performed on two main platforms, Creo and ANSYS, to verify results.

Typically, one design is selected, built, tested, and iterated to improve performance. In AIM's case, we design, build, and test, many designs in a short time frame, utilizing teamwork, effective communication, and advanced manufacturing. The primary form of advanced manufacturing utilized is additive manufacturing or 3D printing to achieve higher performing designs and to push the limits on technical capabilities. AIM utilizes additive manufacturing to rapid prototype individual parts, and assemblies. A MakerBot Replicator+ with standard PLA filament is used, but Tough PLA is implemented for stronger designs. Luckily the printer is in our office and we have full access to design and print anytime.

Like any mechanical assembly with moving parts, there are always problems. In fact, the MakerBot is prone to faulting or generating failed parts. The biggest issue the team encounters is the part not sticking to the build plate which leads to warping on large parts. Small parts print well but larger parts require glue on the build plate for the melted plastic to stick to. Research and troubleshooting is a natural part of physical manufacturing and we actively do this to maintain print quality.

Components are individually printed and placed together to verify a correct fit. I am inadvertently learning GD&T through trial and error of printing parts. Tolerancing and component and mounting placement is key to successfully assemble parts. Hardware is used for the final assembly and locked down for testing. The assembly is prepared and run through the various test profiles given. Data is collected throughout the tests and post processed to extract meaningful results.

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The facilities at Sandia are incredible. Any tool or piece of hardware I need is readily available in a marked tool box available at any time. The labs are fairly busy but accessing any larger machinery or getting help is extremely easy and people always have a positive attitude about work. Everyone is extremely generous and willing to help with the simple or complex issues. Everyone follows the Sandia motto to provide "exceptional service in the national interest."

Unrelated to work, I am enjoying the Sandia atmosphere and everything available on site. Sandia sponsors many events to engage interns to network and learn more about the company. Social and professional events such as an Intern Welcome or Intern Career Fair are highly supported to ensure interns have a great experience and are introduced to new opportunities.

Sandia offers work/home benefits such as a 9/80 schedule where employees work a 9-day work week while maintaining a full 80-hour schedule. This allows employees to take every other Friday off. I typically use my day off to work at my other job, but many individuals go camping, hiking, exploring Albuquerque or New Mexico, or for most interns, the opportunity to sleep in. Overall, I am having an amazing experience and would like to continue working for Sandia Labs in the future.

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