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CHME 391: Industrial Employment August 2016

Intel Corporation Fab 11X Summer Internship

My name is Joshua Gomez and I was born and raised in the west Texas City of El Paso. I graduated from Montwood High School, where I was a starting defensive end on the varsity football team and was a secretary for the ram ambassadors. In high school, chemistry, physics, and math were always my preferred subjects and as a result, I wanted to pursue a career as a chemist. My AP chemistry teacher was not happy with that. She suggested that my talents and interests would be better suited as a chemical engineer. I had never heard of chemical engineering before that and after doing more research I knew that chemical engineering would be a perfect fit for me. In high school, I was a prospect of many different universities that offered chemical engineering, but in the end I chose New Mexico State University because it was close to home and the American Institute of Chemical Engineers organization ultimately sealed my decision to pursue a chemical engineering degree with NMSU. Thus far in my degree, the highest chemical engineering course I have completed is CHME 441 (chemical kinetics and reactor engineering). I would be starting my senior year this fall, but I have been given the incredible opportunity of a co-operative position as an engineering intern at Intel in the Fab 11X Rio Rancho, NM site for the summer and the fall. Working as an intern at Intel has been the most incredible and fast paced learning experience of my collegiate career.

I started at Intel in the lithography department with the stand alone and dry tracks group where the main focus of my internship was to set up automated test wafer processes and internet of things (IOT) components to the tools of the factory. The purpose of these projects was to reduce tech time hours in order to focus time on more pressing tasks, but mainly to increase the quality of wafer production by increasing monitoring as well as reducing human error. The tools that develop the wafers run performance monitors periodically in order maintain and record the

health of each tool. Automating the performance monitors allow for less variability when measuring the health of a tool and less human error than being done manually. The internet of things is becoming a big part of Intel, where you can monitor processes with temperature, pressure, weight, etc. and have the data measured by these devices uploaded to a cloud where the data can be seen on a website. Putting IOT systems on processes that require redundant or extensive monitoring is very advantageous considering the time it would take to measure those processes would be saved and again human error is removed from the equation. Developing new methods to save time and reduce variability in processes is important to allocate more energy to more advanced technologies and higher production quality.

Maintaining the quality of the tools that process the wafers is imperative. The equipment that develops the wafers are expensive and having the equipment run optimally detours costly repairs and losses in production. Performance monitors are a method to determine the health of a tool that process wafers. Test wafers are used to during the performance monitors and after the test wafers have completed processing they are regenerated to be used again. A performance monitor is done by sending the wafers to a pre-measurement which, depending on the process that is being performed which consists of a property measurement. Once the wafers are pre-measured and pass defects, they will run on the desired tool exactly to how a normal production wafer would be done. After being processed on the tool, the wafers are then measured again for to determine how many more defects are added by running on the tool. A healthy tool will add none to very little defects to the wafers. These performance monitors take about an hour to run and have high variability when done manually. Most of the factory have their performance monitors automated, but for new processes, the performance monitors must be performed manually. I was in charge of developing the automated performance monitors for a process that has never been

automated. To automate the performance monitors the exact same procedure must be written into the program that initiates and tracks all of the automated monitors. The automated monitor that I worked on processes noncopper wafers on a tool that can process copper wafers. After the wafers finish on the tool, they must be post measured for defects with a tool that cannot accept copper wafers. An intermediate step must be programmed to run on a tool that can reprogram the lot to remove the copper label. Programming this step was challenging due to the fact that it has a different configuration to the other processes and there are few other departments that require this step. In order to develop the first automated monitor for this process, collaboration was key. Meeting with other engineers and learning how to use the programs allowed for several different possible solutions to be discussed. After completing the first configuration of this process it will be replicated for other processes and tools, creating an improvement in overall quality of the factory and time reduction.

In addition to monitoring how well wafers run on tools, monitoring the peripherals of the tools is just as important. The internet of things allows for a different solution to monitors those peripherals around the clock where you can again remove human error. IOT systems consist of a Galileo or Arduino board that is programmed to process the data that is being measured by whatever measuring device it is hooked up to. The data is then sent to a gateway that then is connected to the internet where the data can be posted to cloud to be further documented and processed. On certain tools keeping things such as temperature and pressure constant are imperative and before IOT solutions were possible, someone would monitor hundreds of tools manually one by one. I am part of setting up IOT equipment on tools that need a scale to measure the weight of the bottle of resist used to coat the wafers and a thermometer on chemical bottles to prevent the chemicals in the bottle to form condensation. At the moment, this IOT system is

working on 50 percent of the tools and is set to be completed on the rest. Computer science solutions are becoming more prevalent as the cost of producing solutions like these decreases. Learning how gateways are programmed and setup to measure and post data is an invaluable skill to completing this project.

With each project that I took on, collaboration was the most important factor for completion. Collaboration allowed me to bounce back ideas with colleagues, learn new processes, techniques, and test new solutions. The culture at Intel is very open, where I can approach any engineer in any department and ask for their thoughts. This aspect of Intel impressed me the most because having the entire factory as a resource is truly valuable. Intel also offers a great deal of online resources that include documents, training, and specifications. These sources of information were especially useful when I was learning the automation process because mostly everything done with automation had been documented and published online. From what I have learned thus far in school, engineering problem solving has been crucial while working at Intel. Coming in, I was exposed to new processes that I have never learned or heard about and using the same procedure of problem-solving that I have learned in my engineering classes I was able to obtain more information, come up with a solution, and do tests of different configurations. Apart from problem solving, the communication skills I learned at NMSU allowed for me convey my ideas to colleagues clearly so that feedback was constructive and achieve solutions.

In terms of safety, Intel comes second to none. Intel provides extensive safety training to its employees depending on what area an employee will be working in. Not only does Intel take the safety of people seriously, but also their health and our impact on the environment is just as important. I took part in different factory evacuation tours, web-based safety training, and safety classes. The first part of my internship was for me to complete all of this training before I could

start working. The culture at Intel plays a big role in the overall safety of the factory. Correcting coworkers with unsafe procedures is common practice on a day to day basis. Intel calls it the good catch system. This system is especially useful when it comes to ergonomics. At Intel, the most common injuries are related to ergonomics such as carpal tunnels, sprained wrists, or strained backs. Ergonomic reviews of how an employee works at their desk are done periodically to confirm they are being safe. To assist further with ergonomic safety, each employee is required to have wellnomics installed on their computers. Wellnomics is a program that limits the daily use of a computer by requiring six-second breaks after 6 minutes of continuous use, 6 minute break after 55 minutes, and locking the computer after 6 hours of continuous computer use. This program helps prevent employees from being at a desk all day and increasing their chance for an injury. Each employee is not only responsible for their own health and safety, but the health and safety of the employees around them. Intel requires that each employee is observant for safety infractions, signs, and required PPE in every area.

Communication was the most important skill that I employed to achieve success at Intel. Every employee is open and more than willing to give you feedback. At Intel, each engineer is given access to email, instant messaging, a mobile phone, and a laptop. I used email and instant messaging to create a first contact with other employees. I then used email and instant messaging to create formal documentation of meetings, conversations, and events. Intel also has an open door policy, so it is welcome to approach the office of other engineers to ask for their feedback. Due to this policy, every engineer and employee is easily approachable so that I may set up meetings in scheduled rooms which is valuable in creating an environment where collaboration and constructive ideas can be created.

Thus far, this internship has allowed for me to experience the actual engineering that is behind what we learn in textbooks and for any engineering student that kind of exposure is crucial to achieve success. With Intel, I felt that there was no equivalent to what I have learned. Along with the positive and open work environment that Intel offers, what I learned and achieved was that much easier and rewarding. Each day I was focused and knew that expectations were high, but never did I feel pressured or anxious to complete work. I would recommend Intel to any engineering student who seeks to gain experience that is valuable and unique to any other internship.

F11X Engineering Interns at St. Felix food pantry community service event. July 2016.