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Individual JPL Reflection

The engineering process that my JPL group took was similar to the actual engineering process except we skipped or didn't put enough time into a couple key steps.

First, we started by defining the JPL problem and understanding the objective of the competition. Sammy made a stand to hold the mason jar up and we started brainstorming ideas for our machine. Our group had many ideas but the team captain's had their heart set on air power so we decided to investigate that possibility.

Our first idea for the JPL project was to create an air tube with our air compressor and send the ping pong balls through PVC pipes. Nick G. made a rough sketch of our project on the whiteboard so that we could all get an idea of the layout of our device. During this phase, we were also able to locate a "Craftsman" air compressor that was in the storage room so we were quite optimistic that this idea would work.

Next, we started researching air properties and how much PSI the PVC tubes could handle. However, looking back with the

benefit of hindsight, we should have looked at the competition specifications before spending time researching air physics. JPL required that all air compressors had an ASME “U-Stamp” which ensures that the compressor is safe and is up to date on safety requirements. Our air compressor (Craftsman) was not "U-Stamped" and this forced us to go back to the brainstorming phase and create a new design.

With Dr. Mingori’s help, our group came up with the final concept for our project. We decided to completely scrap air power and go with a medieval trebuchet. The trebuchet would include a large wheel to provide torque for the launch arm. In addition, we made a full blueprint with dimensions so that we know exactly how to build the trebuchet. Our next phase was an intense period of supply gathering and construction because our group was a couple of weeks behind.

This would relate to the develop and prototype solution phase of the engineering process. Sammy’s mom got lumber for the whole frame of our trebuchet and we started work by creating the huge wooden wheel. Gus and I spent around 6 hours cutting out the wheel from a piece of plywood, sanding it down, and sawing a slit for the rope. Once the wheel was done, we started making the huge base out of 2by4 wood pieces. We made sure that the

base was rigid because it would have to hold 10-15 pounds. We ran into an obstacle when we attached the wheel's axle in between the two supports because the ball bearing would wobble back and forth which would affect the entire wheel's stabilization. Gus was able to find a tight metal coil that could kind of secure the bearing in place. After this was secure, we constructed an arm to launch the ping pong balls and used a cone as a funnel for the balls.

Once we had a completely finished prototype, the issue was that we didn't have much time to change our design and test our machine's accuracy. The review step is a crucial step because we hadn't done any testing along the way of our design process.

We had a very limited time window to test our device because we completed our device within a week of the JPL qualifier. This meant that we couldn't make major changes to our trebuchet and were for the most part stuck with what we had. A part of our test runs consisted of me, Sarah, and Nick practicing the intricate reload process of our trebuchet and trying to get it as quickly as possible. The other part of testing was trying to get the device as accurate as possible. We would do this by changing the angle of the funnel, pipe, and/or trebuchet. Even though we could clearly see how the balls were

missing the jar, the balls bounced inside of the funnel, which caused the way the balls exited to change every time we tested the device.

The final part of our design process was admitting that our device did not meet requirements and communicating results at the qualifier.

Comparing with the real engineering design process, our group fell short in three steps: ‘specify requirements’, ‘test solution’, and ‘based on results and data, make design changes, prototype, and review new product.’ In specify requirements, we should have looked at the dimension requirements for our machine more carefully because we didn’t respect the rule that the device must remain within dimensional constraints during the whole objective. This affected us because when the arm was raised it went out of the machine area and this error ultimately got us disqualified. The second error in specify requirements is that we should have realized that our air compressor was an issue earlier into the design process.

In the test solution step, we didn’t have enough time to test our solution so this step was mostly omitted in our engineering process which proved to be fatal.

Finally, in the based on results step, we were not able to make huge changes to our device based on data because we didn't have much data, and we didn't have enough time to completely modify our design.

For the Capstone Project, I'm going to follow the engineering process closely and understand design constraints before building anything. In addition, I will aim to leave myself an ample amount of time to test my device.