

Collegiate Wind Competition: Site Team

Team Post Mortem Analysis

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The Collegiate Wind Competition (CWC) Site Team has completed the first semester of capstone with some progress towards designing a wind farm within Eastern Colorado. The competition is set to take place after graduation at the beginning of June. So far, the team has been consistent with the quality and timeliness of assignments for the capstone class. The Site Team's competition submissions follow this second semester's schedule.

Furthermore, the purpose of the site team is to develop a model of a wind farm within Eastern Colorado for the Collegiate Wind Competition. The formation of the Site Team and its participation in CWC provides the team members an opportunity to research, learn, and gain experience working with wind turbines. The goal of CWC is to prepare students for entering the wind energy workforce since the industry is expected to grow in the near future. The U.S. Department of Energy (DOE) has estimated that wind energy could supply 20% of the nation's electricity by 2030 and 35% by 2035 [1].

The stakeholders are David Willy, the DOE, the National Renewable Energy Laboratory (NREL), and the citizens of the United States. David Willy is a stakeholder because he is our faculty advisor and is passionate about the competition as well as the future of the wind energy industry. The DOE and NREL are the creators of the competition and did so to educate students of different disciplines about wind farms. So, their expectations are after the competition students will be ready and willing to work in the wind energy industry. The citizens of the U.S. are stakeholders as well because they will enjoy the benefits of clean energy production for the future.

In all, the team will continue to work towards their goal and fulfill capstone's requirements per the Team Charter's ground rules and coping methods. Problems that both hinder the performance of the team and halt the progress of the project have been discovered, and measures are being taken to prevent further issues. This postmortem report details the challenges and successes the CWC site encountered during the first semester. With improvements, the team will take past experiences to continue forward.

At the beginning of the first semester, the entirety of the CWC Team (turbine and site team) collaborated to outline the goals and purposes set and graded at the competition. Many of these goals, such as the dedication for the highest grade possible and the distribution of workload amongst members, are satisfied on a regular basis. However, the team had prioritized the completion of work by those who are most skilled at the task rather than who could learn the most from the experience. This allotment is a recognized issue that will be addressed in future.

Following the goals set by the Department of Energy, the CWC team established rules and coping strategies. The team created a set time on Wednesdays, which allowed Professor Willy to meet with both teams and ensured communication flowed every week. Every member was required to attend the weekly meeting or give notice of their absence/delay 24 hours ahead of time. Last semester, the site team member's attendance to meetings was decent. During the meetings, the members of the site team followed the ground rule of respecting the viewpoints of others, which allowed team members to be open with one another and for ideas to flow. During the last semester, the team's client would have difficulty meeting the Turbine Team in tandem with the Site Team during the Wednesday meetings. To make sure the Site Team has an opportunity to receive feedback, the team has scheduled their own meeting time with Professor Willy. This remedied the time constraints made by concurrent meetings.

One of the coping strategies listed in the Team Charter involved whether EEs would be on the CWC Team. Their involvement does not pertain to the Site Team activities. The other coping strategy requires constant and open communication with all members to address any issues, assignments, and meeting times. This coping strategy worked for the Site Team which used the GroupMe app, email, Google Drive, and Microsoft Teams for all communication and team assignments.

One positive project performance aspect of the site team last semester was the team's communication between members. Members developed a centralized Google Drive for documents they worked on together and incorporated Microsoft Teams for final reports. The site team created quality

work and update each other through proper communication at meetings and through the GroupMe app.

Another positive performance aspect of the Site Team was the ability to utilize teamwork to its fullest by assigning specific project sub-assignments to the member most qualified to complete it. Distributions of sub-assignments required team members to have open communication and depend on one another. Having open communication allowed all members to share their ideas and perspectives on all sub-assignments, which lead to better quality submissions. The team was also able to build trust by depending on each other to complete their sub-assignment on their own in a timely manner at an expected level of quality that incorporated their expert knowledge and the input they received from the rest of the team.

Unfortunately, there have been some discrepancies among team members that have hindered the team's progress through the first semester. Under stressful conditions, many tasks were withheld until 48 hours of the deadline and required emergency team meetings to complete. The supplementary meetings created poorer quality deliverables and exhausted team members. This applies to the team's presentations as well. Most of the team's mock presentation meetings are typically held within 24 hours of graded execution. In the limited time to practice, mistakes such as poor transitions, uncomfortable silences, and poorly composed slides were common and negatively impacted the overall performance. In addition, unexcused tardiness among some members became a significant issue as it requires extra time to reiterate information to the group. This also distracts other team members from performing their tasks as well.

Although the team completed successful work during the first semester, there were also many challenges that came along the way. One important area of improvement the team must consider is working with Openwind, the main software performing most computations for the wind turbine placement. The Openwind software created huge problems for the team because these computations took a great amount of time, with 10-12 hours for a site. With great difficulty searching for a reliable computer that could handle the amount of computations running within Openwind, the team resorted to the internet cafe's computers. With many engineering students resorting to these computers as well, the team had to find a consistent time to meet and continue simulations. The result was a significant loss in time.

This semester, the team has consulted with the mechanical engineering research team, renewable energy lab, to use a few computers for computations to increase productivity. Using multiple computers at the same time will provide the team with additional time to research other topics needed for the competition such as, permits and regulations for wind farms. In addition, the team will consider implementing certain features within Openwind to create a better yet faster simulation to gather steady results. With these addition tasks and changes, the team believes they will create results that will improve their product and increase productivity time that can be spent elsewhere

Another challenge that has indirectly affected the project performance in a negative way was the project development costs. The current budget requires the team to innovate their progressional prototypes to varied levels of success. Most of the funding has been allotted to create promotional displays for the Collegiate Wind Competition event in Colorado. While the budget for creating these products is current unused, the team may require more to properly represent Northern Arizona University at the competition.

There are ways to solve the current problems hindering performance. One would be to reinforce the deadlines for the next meeting and requiring team members to complete tasks prior to a given date or before the next meeting. Meeting these softer deadlines will improve the pace of meetings and reduce the chance of emergency meetings to fulfill deliverables.

In addition, team members should spend time reviewing the previous meeting minutes. By reviewing the information from previous meetings would bring the team up to pace rather than simply storing the information. These meeting minutes should note brainstorm, ideas, and topics for the next

meeting as well. With this, the procession of meetings will move much more smoothly.

Furthermore, workloads that have been distributed based on skill level should be more equally spread amongst team members. By doing this, members will experience different aspects of the project and learn to accomplish these assignments. Less skill-based distribution also reduces the stress held by those who have historically performed more tasks, allowing them time to produce higher quality work. The problems that have been negatively affecting performance could be resolved with individuals improving their time management skills, taking better notes, and better handling of workloads related and unrelated to the project through the uses of phones, calendars and/or notebooks.

When provided directional assistance by the client, the team should meet with the client during a work-intensive day to directly communicate and confirm that the project is moving in the correct direction. This solves the issue of miscommunication due to separate meetings and ensures that the expectations held by the client are met.

Overall, the team has discovered many new aspects that go into the project development of a wind farm such as: how wind farm simulations are conducted, what can affect in losses of energy production and the environmental impacts. Learning to use the Openwind software was one of the largest milestones for the site team because it computes and compiles all of the computational data that is needed for the team to make decisions such as site location, the amount and type of turbine that should be used at the selected site. The team has also learned about the energy production losses that can happen due to factors such as wake and terrain. The teams have learned that such loss factors can be accounted for within Openwind. Lastly, the Site Team has learned of the endangered animal species that are within Eastern Colorado and what are some of the laws and repercussions that the team needs to plan for and address within the final report that will be submitted for the competition.

With these challenges and successes, the Site Team will continue to build their teamwork efforts and develop a solid project for the wind competition and represent NAU in a positive way.

References:

[1] U.S. Department of Energy Collegiate Wind Competition. 2019. [pdf] National Renewable Energy Laboratory. Available:

https://www.energy.gov/sites/prod/files/2019/01/f58/CWC%202019%20Rules%20and%20Requirements%20Manual_20190104_0.pdf [Accessed: 13-Sep-2019].