

Team Postmortem Analysis of ME 476C



Biomechatronic Hip Exoskeleton Team19F13(BHET)

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Section information: We 5:30PM - 8:00PM, Engineering, Rm 321

Introduction

The Biomechatronic Hip Exoskeleton Team (BHET) has successfully completed the Mechanical Engineering Design I course (ME 476C) during the fall 2019 semester at Northern Arizona University. This marks the midpoint of the senior capstone project, which will continue through spring 2020. The second half of the course begins with a team assessment of ME 476C performance. The following report summarizes the results of the teams' discussion, beginning with contributors to project success, followed by opportunities for improvement. The report also contains what changes will be implemented to address the established issues.

Contributors to Project Success

Which aspects of project performance (time management, product quality, manuf. Cost, etc.) were most positive?

Overall, the team worked very well on the project last semester. As a team we were cohesive and worked efficiently. Regarding time management, the team was proactive about looking over the schedule. Each member was looking ahead, so none of the assignments took us by surprise. For the specific assignments the team was great at splitting the tasks evenly. Making sure no one was overworked was our priority, even though sometimes it did not work out, which will be discussed in the below sections. A specific assignment the team worked great on that stands out would have to be prototyping. The team picked a time and date, and the day was used efficiently. Each member tried to help wherever they could, and as a result we completed ahead of schedule.

Which tools, methodologies and practices contributed to positive (or negative) aspects of performance?

There were a handful of tools, methodologies, and practices that contributed to the positive aspects of the team's performance. Key of these was Microsoft Teams, which acted as the team's main workspace throughout the semester. Microsoft Teams was where all remote group discussions were conducted, where meetings were planned, and where all documents were collectively stored and worked on. Keeping all of this within a single ecosystem was critical for the team's performance and organization. Last semester the team also regularly met two to three times a week and tried to meet with our client as often as possible. Regular meetings and staying in constant contact with our client allowed the team to stay on track and ensure that the result of the first semester stratified the client's requirements.

What specific technical lessons did you learn?

The team performed extensive research to become familiar with the current state of wearable robotic devices. There is a great deal of work being done to analyze human walking dynamics, which has resulted in more accurate modeling. Design of an exoskeleton is a very difficult challenge due to a variety of factors like the compliance of soft tissue, difficulty aligning mechanical joints with those of the wearer, and the soft interface between the mechanical system and the wearer. The project benefited greatly from the published work of similar projects [1] [2] [3].

Opportunities/areas for Improvement

Did the team complete the Purpose and Goals stated in the Team Charter?

The team charter has clearly mentioned the purpose and goals the team has been trying to achieve. It is clearly mentioned in the team charter that the major purpose behind this project is to provide a new hip exoskeleton for the NAU biomechatronics lab. The stakeholders for the project are identified within the purpose. This includes children with walking impairments and the NAU biomechatronics lab. The project's aim is to develop a hip exoskeleton that can help children with walking issues. This can be achieved by having a complete and in-depth study of the human hip. The project's purpose is to minimize the metabolic cost of walking in children using the new hip exoskeleton.

This project has clearly set its objectives that include focusing on the quality of work, teamwork, and interactions with the stakeholders. It has been mentioned clearly that the entire team has focused on generating a design of high quality which will fit on the stakeholders' needs. The team is also required to present itself well for the stakeholders and other professionals with whom they will be interacting.

Were the Ground Rules and Coping Strategies stated in the Team Charter followed? What worked and what did not?

The Ground rules are well aligned and mentioned in the charter as the major focus is on right strategies for team management where effective communication, respect and expression of opinion among the team members is important. Accountability of team members and effective decision-making process are other important rules that have been set in the charter. All of which will provide the team members with an effective level of accountability and interest within the work. These rules have been set forth to provide a clear strategic work environment. The coping Strategies are well identified in the charter which include communication and decision-making focus. Effective time management is also well focused on in the coping strategies.

The things that worked well in the team include the right way of decision making in the team and managing the team members. The team has made sure that all the members are given key emphasis in the decision-making process and each of the team members is given key importance in the process of making effective decisions. The stakeholders' needs were met effectively, and the entire project was focused on providing the right level of quality and improvements during project development. Additionally, since our team had a meeting with the client every week, we were on track with the requirements to satisfy our customers' needs.

Which aspects of project performance were most negative?

As mentioned in the last section, the team worked well on the project. Although, there are always things that can be improved. Specifically, our preliminary report was not effectively planned out. When assigning tasks, the team splits the sections evenly amongst the members, but we did not consider that some sections were larger than others. In that assignment there was a section regarding 'back of the envelope' calculations which were a large portion of the paper. At the end, that section ended up not being of good quality. Also, the strengths of our team were in planning the process of doing the assignments, but in the end finalizing things felt rushed at times because of time constraints.

What problems did the team encounter?

Despite last semester being successful for the team, there were a few problems that were encountered. As discussed earlier, most of the problems encountered had to do with time-management. This was most apparent in meeting agendas and leaving enough time to conduct final edits on some assignments.

What specific organizational actions can be taken to improve performance?

The planning and preparation for team meetings was frequently neglected over the course of the fall semester. This issue was discussed by the team during their review of the team charter. This issue causes the team to spend portions of meetings discussing the agenda and further time searching for relevant materials once the topic is decided on. This can also lead to the team spending too much time on one topic, neglecting or forgetting to address other relevant topics. To correct this issue, the team has decided to create templates for meeting agendas and minutes. Team members will now be expected to review the agenda prior to each meeting, so they can be properly prepared to execute the agenda when the meeting begins.

Conclusion

Last semester was very productive. The team worked well together, and communication was strong. The Team Charter was followed closely, apart from the 24-hour completion rule and the coffee rule, but the purpose and goals were achieved. There weren't any major issues regarding the design process or prototyping, and there were certain assignments where the team had great efficiency. Though there were also times where our planning effected our assignments negatively, the team has refocused its goal to plan assigned sections more effectively, give more time for final edits, and to better organize meetings with an agenda.

References

- [1] A. T. Asbeck, K. Schmidt and C. J. Walsh, "Soft exosuit for hip assistance," *Elsevier - Robotics and Autonomous Systems*, vol. 73, pp. 102-110, 2015.
- [2] M. O. Bair, "The Design and Testing of a Powered Exoskeleton to Reduce Metabolic Cost Of Walking in Individuals with Cerebral Palsy," Northern Arizona University, Flagstaff, 2018.
- [3] Q. Wu, X. Wang, F. Du and X. Zhang, "Design and Control of a Powered Hip Exoskeleton for Walking Assistance," *International Journal of Advances Robotic Systems*, vol. 12, no. 3, 2015.