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Project Team Bonding: Approaches, Activities, Analysis, and Advice

Hugh L. McManus & B. Kris Jaeger-Helton
Department of Mechanical and Industrial Engineering
Northeastern University
Boston, MA
h.mcmanus@northeastern.edu

***Abstract*—Capstone project teams of 4-5 students participated in informal team building activities, outside of class and not related to their project, at the beginning of a two-semester senior capstone sequence. Factors that students believed helped them form effective teams were surveyed at the end of the first semester. At the end of the second semester, students evaluated the contributions of their teammates and received an assessment of project success from their project advisor. This paper correlates team cohesion and project success with the intensity of team building activities and student assessments of their helpfulness. Team cohesion and project success are found to correlate with participating in team building activities and perceiving these activities to be helpful to team building. The effect of the team-building activities was confounded with many other factors, so the correlations were noisy, and more data is required to establish statistical significance. The intensity of the team building activity was found to be strongly affected by the emphasis placed on it by the faculty coordinators, suggesting a low-investment path to better capstone team performance.**

Keywords—capstone; team building; teamwork; performance

I. INTRODUCTION

A cohesive working team can be more productive and enjoy their work more than one that does not feel connected. It is conventional wisdom that a good way to help new teams become more cohesive is to have the team members participate in non-work-related activities. The thought is that this helps team members get to know each other as people and increases trust and communication. Bonding activities are only one of many factors that affect team cohesion and performance, and hence their effects will be difficult to measure. This has led to some doubt as to the general effectiveness of team building activities. In large-sample meta studies, the observed effect on subjective measures (e.g. team member opinions) is greater than the effect on objective measures of team performance. The later may be very small or even negative [1].

There is evidence that *active* participation in team building games or training are more effective than didactic training in teamwork concepts [2,3]. In the capstone context, it is difficult to isolate the effects of activities, and also difficult to conduct controlled experiments. Recent work by Godbole et al. correlated student-designed team-building activities with individual student performance. They classified the activities by location and type (including a "none" type for students who did not do an activity) and measured course performance on a standard rubric. Although the data was very noisy, statistically significant correlations were found between activity type and location and student performance. Taking part in off-campus, participatory activities (such as games, hiking, golf, etc.) positively correlated with performance [4].

In Northeastern University's Industrial Engineering senior capstone design sequence, teams of 4-5 students work over two semesters on complex open-ended projects. In Capstone 1, offered in summer and fall terms, teams form, define their problem, and plan their project. After a break, teams reunite in the spring term for Capstone 2, when the project is carried out [5]. This paper explores methods used to help bond new teams and associated outcomes.

Sixty nine students took Capstone 1 in the summer and fall terms of 2023. In the first few weeks of term, sixteen newly formed teams chose, planned and carried out a bonding activity and described it in their first progress memo. Teams engaged in activities ranging from nothing (students planned but did not carry out an activity) to golf, bowling and game room outings. At the end of Capstone 1, students were asked open-response questions on what helped their team bond. All teams took Capstone 2 in the spring of 2024. At the end of Capstone 2, students were asked to rate their teammates' contributions to project success, and project advisors were asked to rate both the contributions of individual students and the overall success of the project. The resulting data provide insight into the interactions among team bonding activities, student perceptions of what is helpful to team bonding, student and advisor perceptions of team cohesion, and project success. This paper focuses on this group, referred to as the 2024 cohort.

In the next academic year, slightly more emphasis was placed on the activities. Both the number and the intensity of the activities increased compared to the previous year. The data showed that students were also more likely to perceive activities as helpful to team bonding. This group, referred to as the 2025 cohort, has not completed the capstone sequence and hence no outcome data is available for them.

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II. ACTIVITIES

In the first week of Capstone 1, students are assigned to teams and given projects. The assignment is done by Capstone faculty, with student requests for both projects and teammates heavily considered. The result is a mix of teams requested by the students (who are usually friends or acquaintances) and thoughtfully assembled teams of various students interested in a particular project. After a short lecture on best practices in team behaviors, faculty suggest that the teams participate in a non-project-related 'bonding' activity together. The suggestion is in the form of a single slide; it mentions escape rooms as a possible activity on the intense side, and pizza as a less-intense experience. The students are asked to outline their planned activity in their first progress memo. Without prompting, most groups also reported on the completion of the activity in their second memo.

The first two memos were examined to extract the activities the students selected. Activities reported included pizza, lunch, a "wonderful brunch," evenings out, ice cream, and minigolf. Some groups did not complete their activity. The activities were rated for intensity on a 0-2 scale, with 0 indicating none, 1 pizza or lunch, and 2 more involved dynamic activities. This metric of the intensity of non-project-related team activity will be referred to for the rest of this paper as "Activity." In the 2024 cohort, 7 groups ultimately did not do an activity; 4 groups did a low-intensity activity, and 5 did a more elaborate one. All except one of the teams that participated in an activity mentioned food. Results for the 2025 cohort are discussed later in the paper.

At the end of Capstone 1, individual students were surveyed on a variety of factors affecting their progress. One open response question was "What has helped you connect to one another, learn about each other, and feel like a team?" The answers for both cohorts were explored using thematic analysis, using key words and phrases to characterize helpful factors. The results are summarized in Fig. 1. The color coding designates interpersonal interaction factors (pink), non-project-related activities (blue), project related activities (green) and socializing around project related activities (brown).

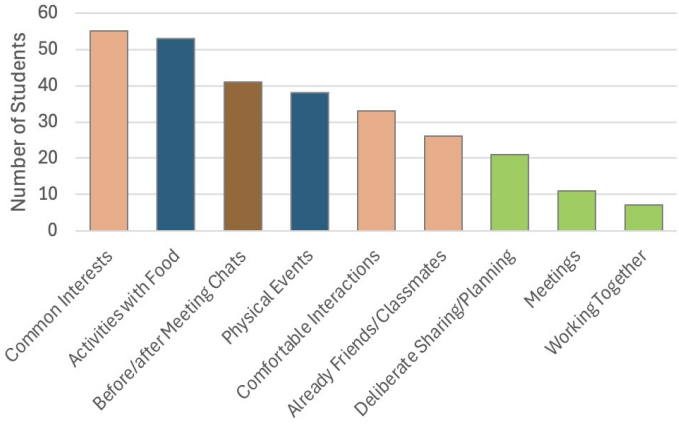

Fig. 1. Factors that students report help with Capstone team bonding.

A *team* metric was created by counting the number of students on each team who indicated that any of the above categories of non-project-related activities were helpful to them. The results were normalized by team size, creating a metric from 0 (no students on the team found activities helpful) to 4 (all students on the team did). This metric of number of students on the team who found non-project-related activities helpful to team bonding will be referred to as "Helpful." In the 2024 cohort, only 2 teams had no members who found these activities helpful. Six teams had one member, five had two members, one had three members, and two had four members who found these activities helpful. Teams with higher activity levels tended unsurprisingly to have more students who found the activities helpful in bonding them. The "Helpful" metric is correlated with the "Activity" metric for the 2024 cohort in Fig. 2. There was quite a bit of scatter in the correlation. The figure shows the high, average, and low Helpful metric for each level of Activity. The *average* Helpful metric correlated well with Activity, but due to the high variation we will treat these metrics separately in further analyses.

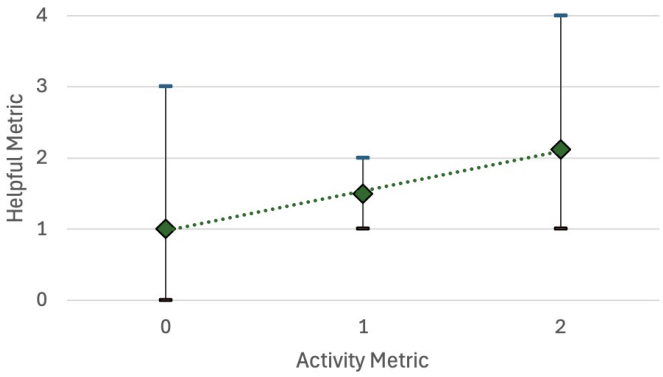

Fig. 2. Correlation between intensity of team activity and perception that the activity is helpful

III. OUTCOMES

A. Performance

At the end of Capstone 2, project advisors were asked to rate the overall success of the projects on a 0-100 scale using a multifactor rubric. This rating accounted for 45% of each student's grade in the capstone sequence. In the 2024 cohort, ratings ranged from 70-100. Here the rating is used without modification, and is referred to as "Performance."

B. Metric of Team Function (or Dysfunction)

At the end of Capstone 2, students were asked to assess their teammates' contributions to the project. The students also rated themselves. The rating scale shown in Table 1 was used. The ratings were converted to a number from 0-100 and an average was calculated for each student.

A metric of team cohesion was derived from the student ratings. The difference between the highest student average rating and the lowest was calculated for each team. Teams with low differences were assumed to be cohesive. Teams with larger differences were assumed (and indeed observed) to have team cohesion problems.

Teams with differences between students from 0 to 10 (equivalent to less than one step on the rating scale in Table 1) were assigned a score of 1. Teams with differences from 11 to 25 (equivalent to 1 or 2 steps on Table 1) were given a score of 2. Teams with differences greater than 25 were given a score of 3. This metric of lack of team cohesion will be referred to as "Dysfunction."

TABLE I. STUDENT ASSESSMENT OF TEAMMATE CONTRIBUTIONS

RATING	DESCRIPTION
Excellent	Consistently goes above and beyond, helps teammates, carries more than their fair share of the load
Very good	Consistently does what they are supposed to do, very well prepared and cooperative
Satisfactory	Usually does what they are supposed to do, acceptably prepared and cooperative
Ordinary	Often does what they are supposed to do, minimally prepared and cooperative
Marginal	Sometimes fails to show up or complete assignments, rarely prepared
Deficient	Often fails to show up or complete assignments, tends to be unprepared
Unsatisfactory	Consistently fails to show up or complete assignments, often unprepared
Superficial	Practically no participation
No Show	No participation at all

In the 2024 cohort, five teams were highly cohesive (Dysfunction score of 1). Seven teams had moderate cohesion (Dysfunction score of 2). These teams typically had one member who performed at a level slightly lower than the others. Four teams had more severe teamwork trouble (Dysfunction score of 3). These teams had one or two team members who significantly underperformed.

Each project advisor also provided information on the relative contributions of team members. This information was used as a reality check on the student assessments. The advisor assessments rarely disagreed with the student ones. For this reason they are not used as an independent metric in this work.

Fig. 3 shows the correlation between the two outcome metrics for the 2024 cohort, using the same high-average-low format as Fig. 2. Cohesive teams did well; less cohesive teams could do well, but were less likely to. Team dysfunction can be seen to correlate with a decrease in average performance, and a large increase in performance variability.

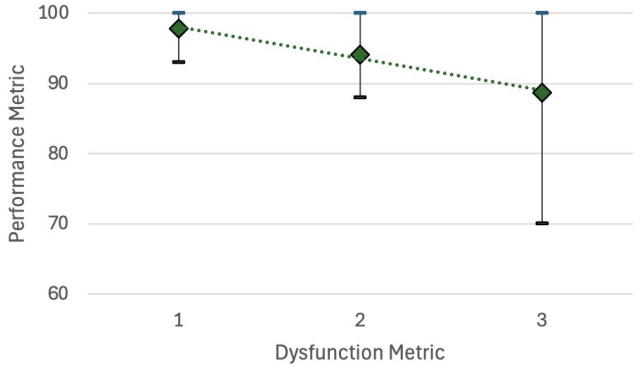

Fig. 3. Correlation between team dysfunction and performance

IV. ANALYSIS

Here we correlate the metrics of bonding activity and perceived helpfulness discussed in Section II with the metrics of team cohesion and performance from Section III. In all cases, the average of the outcome metric will be shown, with bars showing the full range of the metrics (high to low). Due to the low N and high dispersion in the data, no statistical significance will be claimed. However this level of variability is noteworthy as it emphasizes the effect of misaligned teams. A more thorough level of analysis in this area will be presented in follow-on work, after at least one more cohort of data has been collected.

Fig. 4 shows the correlation of Performance with Activity. Fig. 5 shows the correlation of Performance with the Helpful metric. Both correlations are positive, although not strong compared to the scatter in the data. At least one team with no recorded activity or members who thought activities were helpful was fully successful. On the other hand, no teams with average or high levels of activity and perceived helpfulness were seriously unsuccessful.

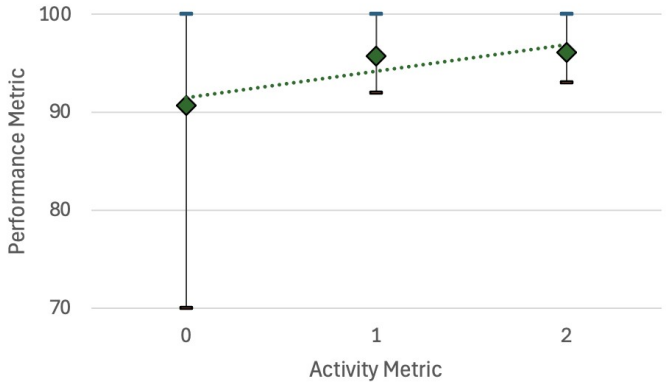

Fig. 4. Correlation of teambuilding activity to performance

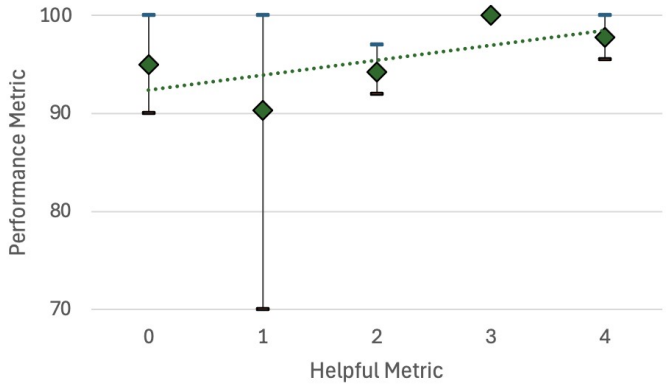

Fig. 5. Correlation of perception that activities are helpful with performance

Fig. 6 and Fig. 7 show correlations with the Dysfunction metric. The correlations are negative, and notably stronger and more consistent than the findings above. This is consistent with the literature, which notes that teambuilding activities have a stronger effect on the teams' perception of team cohesion than on subjective measures of performance [1].

The variability is still very high in these correlations. Fig. 6 shows that teams could be cohesive without doing teambuilding activities, but no team that did a higher-level team building activity was severely dysfunctional. Fig. 7 shows the strongest correlation of all of the data. Teams that had no members who thought teambuilding activities were helpful were notably less cohesive. Teams in which a majority of the members found teambuilding activities to be useful at the *beginning* of capstone *finished* capstone with strong team cohesion.

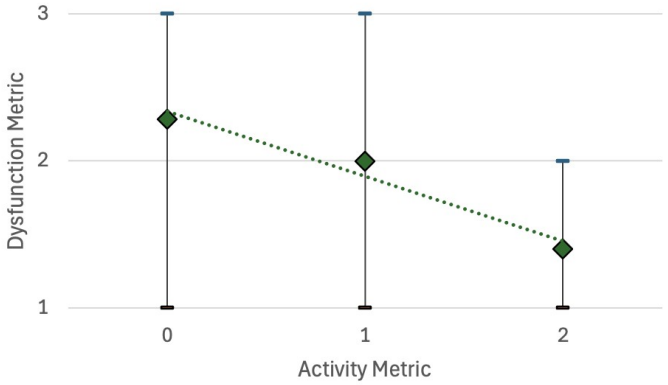

Fig. 6. Correlation of team dysfunction with teambuilding activities

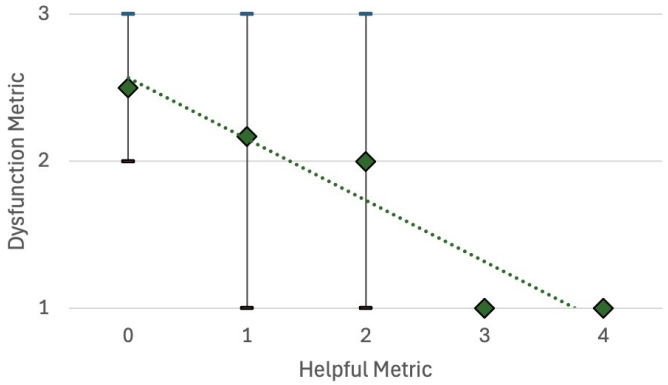

Fig. 7. Correlation of dysfunction with perception that activities are helpful

V. Follow Up

Based on the encouraging results presented here for the 2024 cohort, emphasis on Capstone team-building activities was increased in the following cohort's Capstone 1 classes. The lecture content (one slide) stayed the same, but more time was spent discussing options and emphasizing the positive effects of good team bonding activities. The requirement for the activity was made explicit in memo assignments. Missing activity discussions on the first memo were flagged for follow-up. As a consequence, only 3 teams failed to report any activity this time around. Four teams reported competitive (although not serious) gaming activity such as bowling or playing pool, known to be a good way to bond [2].

The survey results also showed more students in this cohort considering non-project-related activities to be helpful to their bonding and team performance. Fig. 8 compares the average Activity metric and average Helpful metric for the two cohorts. Nominal extra effort by the faculty resulted in a noticeable increase in team-building activity. Results of this activity will be reported in later work.

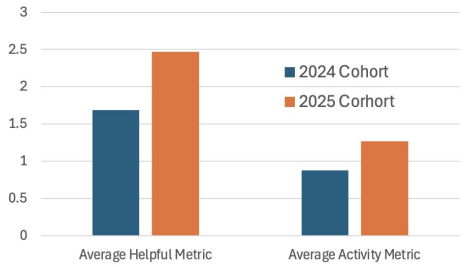

Fig. 8. Increase in team-building activity effects from 2024 to 2025 cohorts

VI. Conclusions

A simple and low effort (for the faculty) teambuilding activity 'assignment' was introduced into a two-term senior capstone course. At the beginning of the sequence, students selected activities and reported on them as part of pre-existing memo assignments. A survey captured the perceptions that these activities were helpful.

At the end of the sequence, metrics of team performance and cohesion were captured as part of the assessment and grading of the class. They were positively correlated with the both the levels of bonding activities and student perceptions that the activities were helpful in fostering team connection. Many factors besides the team-building activities affected team behavior, so it is not surprising that the correlations were noisy and not always strong. Even so, the authors would recommend formalizing a team bonding mission at the outset of the capstone 1 project launch. Further work will provide more data and insights, with the hope of helping with the difficult problem of team connection and cohesion in capstone projects.

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