Iterative Development of Dynamic Student Project Team Interventions

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ABSTRACT

The development of teamwork skills in project management is becoming increasingly important as the future of work requires increasingly complex team organization and coordination. Professionals of highly technical backgrounds face challenges working in collaborative environments involving communication, management, conflict resolution, and challenging behaviors. To help improve construction engineering students' collaborative skill development in and via project team assignments, this paper presents an iterative development process of dynamic project team interventions. An intervention module was designed after a comprehensive literature review, which was later tested in a pilot study and revised as the final version. The module focuses on planning, management, coordination, conflict resolution, and communication aspects of project teamwork, and includes a dynamic charter, a training module, and reminders driven by teams' use of the project charter. Insights into training and intervention modules for the future of work in higher education are discussed, and directions for future research are presented.

KEYWORDS
project teams; online meeting; student engagement

INTRODUCTION

Teams are at the core of project performance and improve productivity and decision making by leveraging on the diverse perspectives, knowledge, and expertise (Katzenbach & Smith, 2015). However, teams are unable deliver unless they work effectively. This becomes a bigger concern in highly technical inter-organizational projects—such as construction projects—due to higher demand of coordination and interdependence (Jones & Lichtenstein, 2008). Modern day construction with themes such as sustainability add further to the complexity of teams by introducing multiple new specialized roles (Shafique & Mollaoglu, 2022). Moreover, the post-pandemic dynamics of virtuality and uncertainty has introduced new coordination challenges.

Considering the context above, employers in the construction industry have always stressed upon the development of interpersonal and teamwork skills such as communication, problem solving, critical thinking and leadership in college graduates (Bhattacharjee, Ghosh, Young-Corbett, & Fiori, 2013). Construction engineering programs across the country develop team-based assignments and capstone projects that help the students learn to communicate more effectively, provide leadership, organize, and plan tasks, and finally meet their goals (Stanford, Sloan, Pocock, & Russell, 2020). However, research shows that student teams lack a baseline relating to coordination and interactions for sharing deep knowledge (Weeks and Kelsey, 2007; Galbraith and Webb, 2013). This paper aims at adding further value to project teamwork skills fundamental for the future of work by developing a dynamic project team intervention module that includes interventions or activities to improve coordination and grow collaborative teamwork skills in construction engineering students. These interventions are dynamic charter that is updated by the team periodically, a training module, and reminders driven by teams' use of the project charter.

LITERATURE REVIEW

The literature review below draws from collaborative partnering, which is a well-known set of methods to help project teams work more effectively through various interventions. Also, the concept of progress loops is investigated for its feedback-based iteration model, and communication behaviours are studied to optimize team communication.

Collaborative Partnering

Collaborative partnering is a voluntary practice that involves following certain strategies to integrate a project team, whether formally or informally, to achieve consistent project outcomes and performance results (Lahdenperä 2012). International Partnering Institute (IPI) (2017) describes the collaborative partnering as a three-step process (Figure 1) as described below.

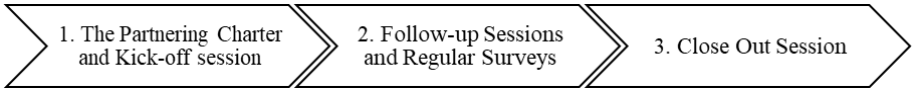

Figure 1 Sessions included in the Collaborate Partnering Process (adopted from IPI, 2017)

1. The Partnering Charter is a fundamental document for any project team engaging in collaborative partnering. It enables the team to collaboratively establish objectives and commit to fulfilling those goals, thus promoting a sense of team ownership. The Charter is a dynamic document that is created with the help of a facilitator during the initial Partnering Session and

continuously updated throughout the project's duration. The Charter typically encompasses several essential components including project goals, follow-up plan, issue resolution process and team commitment statement. Charters are widely used in the construction industry (Mollaoglu et al., 2021; Sparkling et al., 2017), as well as student teams (Sverdrup et al., 2017; Aaron et al., 2014; Hunsaker et al., 2011; Mathieu & Rapp, 2009).

2. Follow-up Sessions and Regular Surveys: An integral part of the partnering process are the follow-up sessions, which aid project teams in sustaining progress, enabling effective communication, and identifying and resolving issues. The frequency of team meetings is contingent on the level of effort required for each Partnering endeavour but should occur as often as necessary to achieve Charter objectives. Meanwhile, anonymous surveys of team's performance on charter goals offer a means for the team to uphold accountability and gain momentum as they fulfil their commitments throughout the project's timeline. In addition to follow-up sessions, deadline reminders assist in keeping the team members on track and increasing the overall team effectiveness (Siddiquei et al., 2022; Clark, 2008).

3. Closeout / Lessons Learned Partnering Session: Following the completion of project, a team survey is conducted to gather insights and lessons learned. During this session, the team will reflect on the aspects that were successful, as well as opportunities for improvement in future project endeavours (IPI, 2017).

Partnering is not a new concept in the construction industry (CII 1996), and its benefits including fewer claims, reduced cost, reduced time, improved safety, higher job satisfaction have been validated (Bennett, 2006). Since 1996, the partnering literature has expanded considerably, with focus on areas such as drivers during the delivery, team characteristics, project outcomes, organizational performance, and boundary conditions (Sparkling et al., 2017).

Progress Loops in Projects

The idea of progress loops was devised by Garcia et al. (2014), inspired from the team processes framework proposed by Marks et al. (2001). The generation of progress loops involves the period between the decision-making stage and the receipt of feedback on project outcomes. This enables an assessment of the quality of past decisions and the progress made. Progress loops comprise a series of transition-action-transition phases (Figure 2). In the first stage, planning decisions are made, followed by project team members performing tasks according to those decisions, thereby advancing project progress. Finally, feedback is obtained, allowing for an evaluation of both the adequacy of decisions made in the first stage and progress. Subsequently, construction project teams embark on a new progress loop. The duration of progress loops can vary as the time between decision-making and feedback reception can differ (Garcia et al., 2014).

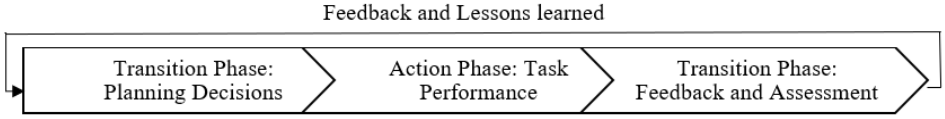

Figure 2 Progress Loops in Projects (Adopted from Garcia et al., 2014)

Communication Behaviours

Effective communication among team members is necessary for the success of construction projects (Chinowsky et al., 2008). However, it is challenging due to the inter-organizational

nature of the teams in construction, with different expertise and backgrounds in play. Multiple issues arise in construction team communication, such as missing information, misunderstanding messages, and confusion in responsibility distribution (Poole, 2011). Hence, there is a need for understanding communication and managing it for construction teams.

Sun et al. (2015) identified and described four communication behaviours in construction teams: monitoring, managing, challenging, and negotiating. ***Monitoring*** involves scrutinizing the internal and external environments of the team to identify any information or occurrences that could impact the project and highlight any issues that may arise. Examples include visual metrics, identification of issues, and feedback. ***Managing*** refers to reconciling differences, establishing communication with other groups, and making efforts to protect the project from external pressures. Examples include assigning tasks and responsibilities, deciding lines of action, and issue resolution. ***Challenging*** involves proposing innovative methods for completing tasks and contribute novel ideas. Examples include challenging standard ways of performing tasks and proposing value addition to in place methods. ***Negotiating*** involves deliberating on issues and utilizing trade-offs to develop practical solutions. Examples include discussing pros and cons, proposing compromises and reaching win-win situations.

Communication behaviours in teams are indicative of team performance. They help in successful project delivery (Paik et al., 2017), by mediate the relationship between goal alignment and project quality. More recently, Manata et al. (2021) found that communications behaviours are significantly related to teams' perception of good decision-making.

METHODOLOGY

This study aims at developing a project team intervention module consisting of a unique set of dynamic interventions for student project teams to address the need of collaboration skills in students. To achieve this aim, we followed an iterative process (Figure 3).

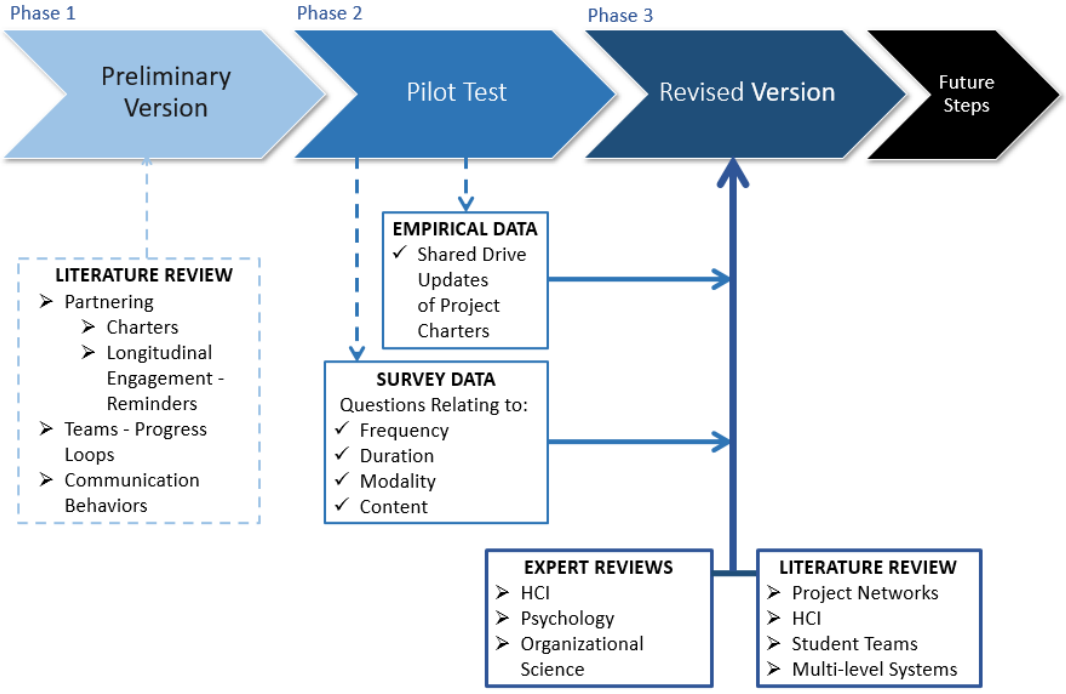

Figure 3 Methodology

The first phase of the study involved conducting a literature review on partnering, communication behaviours, and progress loops in project teams to understand the intervention needs of student projects teams in construction engineering domain. This review identified (a) charters as a tool widely used in project partnering (Mathieu and Rapp, 2009; Mollaoglu et al., 2021; Sparkling et al., 2017; Sverdrup et al., 2017; Aaron et al., 2014; Hunsaker et al., 2011) along with (b) longitudinal tools such as reminders/surveys/follow up sessions (Siddiquei et al., 2022; Clark, 2008) to keep teams engaged throughout project delivery in an integrated manner, and (c) effective communication behaviours for teams (Manata et al, 2021; Paik et al., 2017; Sun et al., 2015). Additionally, project teams' literature highlighted importance of the cyclical nature of projects and the importance of progress loops to ensure that the project stays on track. The literature review helped in identifying and bringing together all the right features and characteristics to develop a robust intervention module that can facilitate and sustain effective teamwork. The charter was included because of its impact on team collaboration and goal alignment, and a training module was specially designed to guide the students on how to develop the charter together. The progress loops were built into the module and the reminders were introduced periodically to facilitate effective communication.

The second phase of the study consisted of pilot testing the intervention module developed in phase 1. During this phase, empirical data was collected from two sections of a civil engineering undergraduate course in Fall 2021 semester at Michigan State University where 108 participating students in 21 teams (five or six members in each team) were engaged in an eight-week long construction engineering project. The assignment design focused on students' ability to use tools such as life cycle assessment, industrial ecology and multi-criteria decision analysis to real world problems in civil and environmental systems engineering. Participating teams in our study were provided with a shared drive (to which all team members and our research team had access to) that included a blank project charter and a video training module on how to fill out the charter. The charter required students to insert key milestones for their project as a team, which then informed timing and content of the reminders. These reminders were sent to the project teams by the research team throughout project delivery. Online surveys were employed during the research to collect data from participants on their perceptions regarding the component of the intervention module, namely, video training, project charter, and reminders. The survey included items to collect feedback of respondents on a Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) regarding the different components of the module. For example, "The video training helped my team understand principles of project management" and "My team revisited our project charter at regular intervals".

The third phase of the study incorporated phase 2 results and guided intervention revision relating to frequency of reminders, optimal project duration for effective interventions, and modality and content of reminders. The research team conducted additional literature reviews on networks, student teams, and Human Computer Interaction (HCI) at this stage (integrated in phase 3 results) and involved HCI experts in the process to provide input on the content of reminders. Accordingly, the intervention module was revised.

RESULTS

Phase1: The literature review helped in development of an intervention module consisting of Preliminary version components (Figure 4). In chronological order, the module began with the students developing a charter assisted by a video training. The charter included project and

team introductions, project vision, project timeline and milestones, team communication, and conflict resolution procedure. Afterwards, the module introduced two reminders before each of the milestones identified by the team. The first reminder was regarding milestone, urging the team to complete their tasks, while the second reminder was regarding the completion/revision of team charter. This module was revised and detailed contents for the final module are introduced in phase 3 findings.

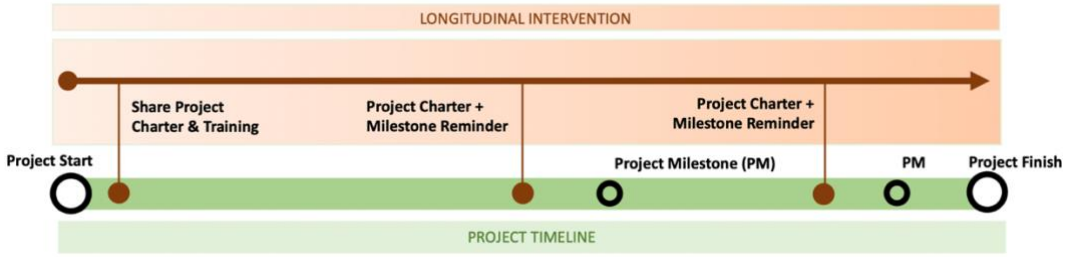

Figure 4 Initial Timeline for Intervention Module (before revision – Phase 1)

Phase 2: The pilot study participants (N = 108) were 54% male and 46% female. In terms of race, the distribution was as follows: White (81%), Black or African American (6%), Middle Eastern (5%), Hispanic or Latino (2%) and Biracial/Multi-racial (1%). Out of 21 total teams, 19 teams (90%) made changes to the milestones or revisited the project charter. The number of students in each team that actively worked on the charter ranged from three to four members out of the five or six in each team. Observations and examples of the student feedback received via surveys and findings based on our review of the updates on team charters via shared drives and student/ project outcomes are as follows:

- Team charters are helpful in developing project understanding: "*...The charter was certainly helpful to get to know the project and how we could manage it over a period...*"
- It is ideal that the teams go through the charter two times at the beginning of the project as team' understanding of the project requirements and planning practices evolve drastically early in the project timeline.
- Assigning roles can be easier with pre-determined suggestions in the charter: *"...We struggled with assigning the roles, but I think roles typically are important for projects."*
- Reminder design is to be re-evaluated for improved impact: *"...I think the reminder that was sent out on Nov 20th was too wordy & we didn't talk about it as a group."*

Phase 3: A final version of intervention module was developed based on the results of Phase 2, expert reviews, and additional reflections from the literature. Two HCI experts provided input on the content of the reminders utilized in Phase 2. We also sought the expertise of a professional in networks and organizational sciences to examine the feedback received from participants. Accordingly, the following revisions were made to the intervention modules:

Project Duration: Four to six weeks is the minimum timeline to establish systematic work procedures in a small project team, while keeping the balance between coordination (first two week in a two to four week-long project) and deep knowledge-sharing episodes (remainder of the project duration) (Garcia et al., 2021; Marks et al., 2001). Accordingly, adoption of this module should be considered for projects that will go on for at least four weeks.

Modality of Reminder Delivery: Using the milestones teams report in project charters, the automated e-mail reminders will be sent through a centralized system. Messages will be in the main body of the email, encouraging in tone, graphically appealing, considerate for individuals with different needs, and optimized for viewing through different mediums (e.g., phone, computer) (Lee and Benbasat, 2003).

Content of Reminders: Messages will be concise and specific to the stage of the project for any given team to improve team member engagement with multimodal content (Argyris et al., 2021). Charter reminders are designed for the project coordination phase: a team-level reminder includes a nudge to revisit the unfilled charter sections, and an individual-level reminder triggers users to sign the charter and celebrates action. Milestone reminders are designed for the deep knowledge-sharing phase and follow self-reported milestones in team charters. These aim to sensitize members towards upcoming milestones, provide tactics (i.e., relating to team communication, coordination, and goal setting (Clark, 2008) to prepare for and optimize team meetings, and are customized for team leader(s) and others.

Timing and Frequency of Component Exposure: Charter introduction and reminders target the project coordination phase (i.e., the first two weeks of a project), while milestone reminders are for the deep knowledge-sharing phase and timed for delivery three days before self-reported milestones in team charters.

The revised and final timeline of team intervention module developed by this study is presented in Figure 5, while the team charter, training video, and reminder can be found on the research team website (https://iopt4.msu.edu/research/index.html) under 'Dynamic Student Project Teams Intervention Modules.'

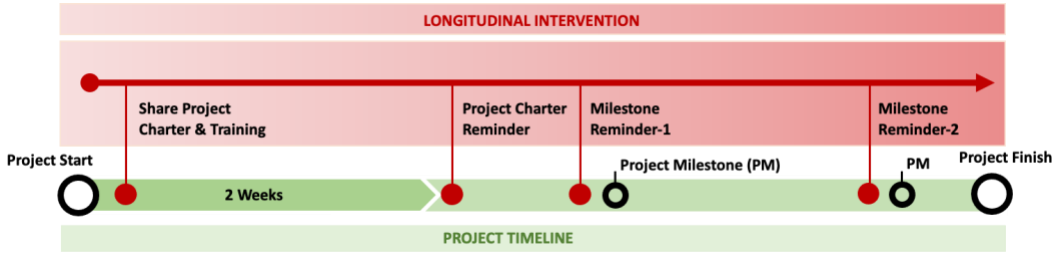

Figure 5 Final Timeline for Team Intervention Module

CONCLUSION and DISCUSSIONS

Student teams are important in construction engineering education to prepare for the collaboration required in technically complex inter-organizational project environments. To achieve the most out of the student team experience, this study uses current knowledge in multiple fields related to projects and teams to develop a dynamic intervention module for student project teams. The study utilized the literature in partnering, progress loops and communication behaviours to devise a module that included a charter, training session, and follow up reminders. Module elements were tested through a field study. Expert reviews and additional reflections from the literature helped revise and finalize the module.

In student team literature, team charters have been used repeatedly (Sverdrup et al., 2017; Aaron et al., 2014; Hunsaker et al., 2011; Mathieu & Rapp, 2009). However, none of the charters developed for student teams is dynamic in nature. The student teams, unlike industry teams, lack a baseline relating to coordination and interactions for sharing deep knowledge

(Weeks and Kelsey, 2007; Galbraith and Webb, 2013). Therefore, the intervention module developed by this study allows the teams to reflect and revise charters in the beginning, during the coordination phase of the project (two weeks). Moreover, as instructions help in more effective development of charter (Aaron et al., 2014), a training video is developed to guide the students through charter development. Another integral part of the module is the reminder protocol. Deadline reminders are effective in improving schedule performance (Clark, 2008). The module uses learnings from business literature to create the most appealing, easy to understand reminder content (Lee and Benbasat, 2003). Also, the multilevel, multirole nature of teams is considered by creating team as well as individual level reminders for teams, individuals and team leaders respectively (Kozlowski and Klein, 2000). In terms of practical implications, the module is a ready to use tool for student project teams in various fields. The module will help students improve their team effectiveness, task cohesion and participation, and add to student satisfaction with group work (Hunsaker et al., 2011). The industry can also benefit from these new features of intervention, especially with newly formed teams still to mature their coordination protocols.

Future studies should use the intervention module in various settings, within and outside the construction industry, to verify the effectiveness and adaptability of the tool. Also, with growing diversity in teams, the modules need to become more flexible to support the requirements of different groups. Recently, Feuer & Wolfe (2023) have proposed a new model of team charter development, that makes charters more flexible, acknowledge competing priorities, evidence greater planning, and articulate processes that could accommodate individual goals, values, and constraints. Using a flexible charter can help improve team behaviors and performance.

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