# *Operationalizing team commitment in a project-based learning environment*

2022 IEEE Frontiers in Education Conference (FIE) | 978-1-6654-6244-0/22/$31.00 ©2022 IEEE | DOI: 10.1109/FIE56618.2022.9962577

Aparajita Jaiswal
*Department of Computer and Information Technology*
*Purdue University*
West Lafayette, IN
jaiswal2@purdue.edu

Tugba Karabiyik
*Purdue Systems Collaboratory*
*Purdue Univesity*
West Lafayette, IN
tugba@purdue.edu

Paul Thomas
*Department of Computer and Information Technology*
*Purdue University*
West Lafayette, IN
pjosekut@purdue.edu

Alejandra J. Magana
*Department of Computer and Information Technology*
*Purdue University*
West Lafayette, IN
admagana@purdue.edu

***Abstract*—Commitment is a multi-dimensional construct that has been extensively researched in the context of organizations. Organizational and professional commitment have been positively associated with technical performance, client service, attention to detail, and degree of involvement with one's job. However, there is a relative dearth of research in terms of team commitment, especially in educational settings. Teamwork is considered a 21st-century skill and higher education institutions are focusing on helping students to develop teamwork skills by applied projects in the coursework. But studies have demonstrated that creating a team is not enough to help students build teamwork skills. Literature supports the use of team contracts to bolster commitment, among team members. However, the relationship between team contracts and team commitment has not been formally operationalized.**

**This research category study presents a mixed-methods approach towards characterizing and operationalizing team commitment exhibited by students enrolled in a sophomore-level systems analysis and design course by analyzing team contracts and team retrospective reflections. The course covers concepts pertaining to information systems development and includes a semester-long team project where the students work together in four or five member teams to develop the project deliverables. The students have prior software development experiences through an introductory systems development course as well as multiple programming courses. The data for this study was collected through the team contracts signed by students belonging to one of the 23 teams of this course. The study aims to answer the following research question: How can team commitment be characterized in a sophomore-level system analysis and design course among the student teams?**

**A rubric was developed to quantify the team commitment levels of students based on their responses on the team contracts. Students were classified as high or low commitment based on the rubric scores. The emergent themes of high and low commitment teams were also presented. The results indicated that the high commitment teams were focused on setting goals, effective communication, and having mechanisms in place for timely feedback and improvement. On the other hand, low commitment teams did not articulate the goals of the project, they demonstrated a lack of dedication for attending team meetings regularly, working as a team, and had a lack of proper coordination while working together.**

***Keywords— team commitment, team contract, project based-learning***

## I. Introduction

Commitment is a construct that features several dimensions and is often classified along the lines of organizational commitment, professional commitment, and team commitment. [1]–[3]. Organizational and professional commitment has been extensively researched [3]. Organizational commitment is characterized as the extent of an employee's involvement in an organization and the strength of their identification with the same organization. It has been positively associated with the employee retention [4]. Commitment is an important aspect of teamwork. Team commitment is an intrinsic inclination of a team member toward their team [5]. Team Commitment has also been identified as one of the important scrum values. The concept of commitment has been studied widely in an organizational setting, but very few studies have been conducted in a higher education setting [6], [7]. Thus, this study intends to characterize the team commitment in sophomore-level system analysis and design course. The course follows a cooperative project-based learning approach. Student teams are trained on scrum principles, and they follow the scrum approach throughout the semester. The students must complete a semi-capstone project and deliver a prototype as the final course deliverable. Accordingly, the research question for this study is: How can team commitment be characterized in a sophomore-level system analysis and design course among the student teams? The manuscript is structured as follows: i) Section II

discussed the literature pertaining to project-based learning and team commitment; ii) Section III detailed the characteristics of the participants, data collection and analysis methods adopted; iii) Section IV provided the quantitative and qualitative results of the study; iv) Section V discussed the results in the context of literature, and v) Section VI concluded the manuscript while also detailing the limitations and future avenues of inquiry.

## II. Background

Project-based learning is a very effective method of instruction in which students explore real-world problems by solving them in an open-ended environment by working on a project [8]. It is a very effective teaching method, as shown in several studies, with the benefit of great engagement with the research literature and course content [9]. Working in teams within project-based learning environments is a crucial part of the instruction [10]. Team contracts are one of the very first steps for effective teamwork, goal setting, and team commitment to minimize conflicting situations [11], [12].

Team commitment can be defined as the "…psychological attachment that the members feel toward the team" [5]. Effective team commitment will result in team members being able to identify with the goals and values of the team while wanting to continue within the same team to achieve long-term goals. For example, an empirical study was conducted among 625 members and their leaders, covering over 138 teams, to test the relationship between emotional carrying capacity and group innovation [13]. Effective team commitment was considered the mediating variable for this study. The researchers found a positive relationship between effective team commitment and group innovation and suggested that the teams who openly express their emotions contribute to reinforcing their affective attachment to the group. This, in turn, made them feel more involved and available to test and implement new ideas and procedures.

Team commitment is transactional in nature, with members often receiving something from the team, resulting in a commitment to the team. Despite the positive effects of team commitment, there is a dearth of research in the area [2], [14]. The gap is especially prevalent in educational contexts where team commitment and its effects have not been operationalized or studied extensively. We especially focus on exploring the importance of using team contracts as team commitment and its relationship with the team effectiveness in terms of goal setting, collaboration, providing feedback to each other, and communication.

## III. Methods

This study used a sequential mixed methods design to characterize commitment in the context of student teams.

### A. Participants

This study was centered around a sophomore-level semi–capstone systems and design course offered in the Fall 2019 semester with a total population of 113 students grouped into 23 teams. The course covered topics such as the systems development lifecycle, project management, unified modeling language, systems analysis and design, and systems implementation. Most students were in their second year of college education and were pursuing a Computer and Information Technology major or minor. All students enrolled in this course were required to complete an introductory systems development course as a prerequisite. The introductory course provided students with some experience in programming through coursework [15], [16]. These same students were required to take a design thinking in technology course in their first year, where they developed some experience working with teams. For the team project component of this course, students were expected to work in a team of four or five members. Students were randomly assigned to the teams. The project intended to help students to apply their conceptual knowledge to model requirements and develop a prototype. The project required student teams to analyze case studies that detail information systems. The teams would then iteratively develop the system requirements, software models, and a functional prototype through a series of milestones. For each milestone, the role of the Scrum Master – who was responsible for facilitating communication and conflict resolution - was rotated through the team members, with the rest of the team functioning as product owners – those responsible for maintaining the product backlog, or development team members – those responsible for software model and prototype development [17]. By the end of the project, the students would have developed a functional prototype in addition to a design document that described systems requirements and specified the system using Unified Modeling Language (UML).

Student teams were also trained on five core scrum principles of commitment, courage, focus, openness, and respect [18]. For this study, we focused on helping student teams to adhere and understand the first scrum principle of team commitment. Teams were also expected to retrospectively reflect on each milestone regarding what went well and what could be improved. Students utilized the class hours to work on the project and sought feedback on their deliverables from instructors and teaching assistants [17]. For this study, we investigated all twenty-three teams from the course. To ensure the privacy of the student teams, each team was assigned a pseudo team name.

### B. Data Collection

Data were collected in the form of team contracts and team reflections. At the beginning of the semester, once the teams were officially formed, each team was required to agree on specific terms of operation before the commencement of the project. The terms of operation were defined using a team contract as those have been identified as significant evidence of team commitment [19]. Thus, for this study, the team contracts served as the measure of team commitment. Class time was allocated for the teams to discuss and complete contracts. The team contracts contained a set of predefined terms and three essential questions that teams were required to decide and commit to criteria for planning and group expectations. Planning criteria comprised of team procedures which defined and described using the following seven criteria: Day, time, and place for regular meetings, preferred method of communication

(e.g., GroupMe, WhatsApp, etc.), case software tool (e.g., creately.com, draw.io, etc.), division of labor (e.g., Scrum Master for each milestone), internal deadlines for submitting individual contributions to the Scrum Master.

Group expectations comprised of the following criteria:

*Absence/Exclusion*: A group member who is absent from group meetings or to in-class time for milestone teamwork more than _____times, then their name will not be included in the submission. This will result in that team member getting a zero on that specific milestone.

*Dismissal*: A group member who doesn't contribute with the submission more than _____ times will be dismissed from the group.

The responses to the above three questions were explored to understand the level of commitment for all twenty-three teams. Furthermore, the formula for calculating the team commitment was created, and results were reported.

In addition, the retrospectives submitted by teams for each milestone were qualitatively analyzed to reveal themes and insights into how teams operated.

### C. Data Analysis

The team contracts were analyzed to address our research question, and the team responses toward team planning and decision-making were evaluated. The study used a mixed-method approach to analyze the data [20]. The prompts in the team contracts were grouped into two broad categories of planning and group expectations. Planning refers to the team procedures agreed on by the group members, including meeting dates and times, preferred communication methods, preferred software for the project, etc. Group expectations included group member absence and exclusion from submission. It also included terms pertaining to their dismissal from the group. Given the structure of the team contracts, equal weight was given to the categories of planning and group expectations. Group expectations were sub-divided into the absence/ exclusion and dismissal criteria. Therefore, we applied the weights as 50% of the planning, 25% of absence and exclusion, and 25% of dismissal to calculate the level of commitment out of 100.

The formula is detailed below.

*Level of commitment* = Normalized Planning/2+Normalized Absence & Exclusion/4+Normalized Dismissal/4

where,

*Normalized Planning*= Planned Procedures/ (Total number of procedures) *100%

*Normalized Absence & Exclusion* = [(Maximum number of times allowed to be absent among all teams - Number of times allowed to be absent by the team)] – [(Maximum number of times allowed to be absent among all teams- Minimum number of times allowed to be absent among all teams)] *100%

*Normalized Dismissal* = [(Maximum number of times cause dismissal among all teams - Number of times allowed to be absent by the team)] – [(Maximum number of times cause dismissal among all teams- Minimum number of times cause dismissal among all teams)] *100%

The median was calculated based on the commitment scores received by each team, and teams were divided into two categories, high and low commitment teams, based on the median value. The final commitment score was the total mean value of team planning and decision-making. The median was calculated for the final level of commitment score to categorize the teams into high commitment and low commitment teams.

Once the commitment scores were calculated, we then proceeded to group teams into high commitment and low commitment groups. Moreover, student reflections for high and low commitment teams were analyzed using inductive thematic analysis [21] to identify prominent themes for high and low commitment teams. Further, to ensure the trustworthiness of the thematic analysis first, the data was coded independently by two researchers. In the next steps, peer debriefing was conducted to discuss and reconcile differences, and it helped arrive at mutual agreement [22].

## IV. Results

The team commitment scores were calculated using the formula mentioned above to measure the level of commitment. The analysis intended to identify the team commitment levels, and teams were subsequently classified into high and low commitment categories. Table I represents the median value of team commitment level and team names in each category. Table I shows that based on the median commitment level score, 11 teams fall into the low commitment criteria, and 12 teams fall under the high commitment criteria.

TABLE I. Categories for teams' commitment levels and teams in each level

| Commitment Level | Median Scores | Teams |
|---|---|---|
| Low | <63.57 | A, B, C, D, E, F, G, O, P, T, U |
| High | >=63.57 | H, I, J, K, L, M, N, Q, R, S, V, W |

The results of the thematic analysis are reported in Tables II and III. The themes and quotes for the low commitment team are reported in Table II. The results indicated that teams were less committed to setting goals, team members lacked dedication, and demonstrated a lack of coordination among the team members.

TABLE II. Themes for Low Commitment teams

| Themes | Student Quote |
|---|---|
| Goals not well articulated | The work that could be split was split evenly the rest was worked on as a group. |
| Lack of dedication | [Team member 1] ended up leaving and we are not sure |

| | |
|---|---|
| | if she is still part of the project with us. We have not been able to contact her by the due date of this milestone, so we left her part out. |
| Lack of proper coordination | There was much less teamwork in this case, if you notice that it was submitted 2 hours late |

Table III represents the themes and quotes for high commitment teams. The thematic analysis revealed that teams were competent in setting goals. They also demonstrated good collaboration and communication and provided feedback to their members. They also made room for future improvement.

TABLE III. THEMES FOR HIGH COMMITMENT TEAMS

| Themes | Student Quote |
|---|---|
| Effective Goal setting | For this milestone, we decided to split the work so that each member was in charge of several deliverables. Internally set deadlines were completed on time; some were completed earlier than expected. However, we did have to complete the work more remotely than expected. Members put special effort to complete their designated work that would have been completed within the in-person meeting. This modified how the team reviewed drafts of documents. In regard to the individual completion of work, like the last milestone, individual completion of work was done at a high quality. |
| Promoted Collaboration | Each team member was responsible for completing his own document, but we made it clear that inter-team collaboration was encouraged and expected. |
| Provided feedback | We had each team member have his work checked by another team member. At the minimum, this included complete read thoughts by at least one other team member. Those who contributed to the updated product backlog, use-case diagram and use-case narratives added them to this milestone. |
| Focus on Communication and Quality of work | Communication throughout this milestone was fairly constant, which is a positive attitude. The only exception to this is the two days before the due date. During this period of time, communication spiked so that we could review the documents one last time before submission. |
| Room for improvement | Many aspects of the team's performance can be improved. However, fo[r] the next milestone, we should focus on one in particular- making team meetings a higher priority. In the future, we will not only discuss clear deadlines at the start of each project but clear meeting times as well. The most effective way to do this is to compare schedules, which change week to week and select the safest times. We will also set an agenda for each planned meeting, further placing emphasis on the necessity to attend them. We set very clear deadlines, and this was completed with a high degree of success, which made it much easier to achieve success, and these need to continue to be executed in future milestones. |

## V. DISCUSSION

The study intended to characterize the team commitment in a sophomore a level system analysis and design class. Student teams were categorized into low commitment and high commitment based on the median scores calculated from their team contracts. Thematic analysis was then performed on the team retrospectives to understand the characteristics of low commitment and high commitment teams. The thematic analysis results indicated that teams that demonstrated low commitment exhibited an inability to articulate goals, a lack of team member commitment, and a lack of proper coordination. A model proposed by Lencioni [23] identifies lack of commitment as one of the critical reasons for team failure. The model asserts that if the team members are not committed to the team goal, they will fail to meet the deadlines and complete the deliverables.

The themes associated with low commitment teams align with the assertions from Lencioni's model. This is in stark contrast to the teams that demonstrated high commitment right from signing the contract. The themes that emerged for high commitment teams were effective goal setting, promoting collaboration, providing feedback, focusing on communication and work quality, and room for improvement. Katzenbach and Smith [24] model proposes that commitment can only be achieved when the goal is well-defined. This was evident with the most committed teams proficient at setting goals.

Mahembe & Engelbrecht [25], have argued that teams exhibiting high commitment demonstrate an affective commitment, meaning that team members are intrinsically and emotionally attached to the team. On the contrary, the teams exhibiting low commitment demonstrate normative commitment meaning that they perceive working in a team as a requirement or an obligation. Studies [24], [26] have also revealed that high commitment teams demonstrate a higher level of interpersonal skills, goal setting skills, positive criticism, and constant communication that may lead to a higher

level of team performance. Our study also revealed that teams that demonstrated a higher level of commitment were competent in setting goals, developing interpersonal relations, and communication, and they also identified room for constant improvement. On the other hand, teams that exhibited low commitment demonstrated a lack of cohesion and purpose among the team members.

In addition, the findings of this study show that the teams demonstrating low commitment lacked the dedication to meet and coordinate with their team members on the progress of the projects. On the other hand, among the 12 high committed teams, there was an overarching theme of promoted collaboration where team members were more responsible for completing the project. As such, the team members of these teams were more focused on communication and quality of work as compared to the teams exhibiting low commitment.

## VI. Conclusions, Limitations, and Future Work

One of the overarching goals of the course detailed in section III is to develop scrum values among the students. Team commitment is a core scrum value. It can be inferred from the results of the study that high-quality specification of goals facilitated team members being more committed. Setting accurate and achievable goals serve as a driver for team commitment, as it makes team members accountable and responsible for their contribution in a team setting. This study identified that teams exhibiting low commitment failed to set their goals, whereas teams exhibiting high commitment articulated their goals well. Based on the results, we recommend that instructors guide student teams through the process of effectively setting goals to maximize team commitment while also setting mechanisms to hold team members accountable for their individual contributions.

This study is subject to the limitation that the team retrospectives did not necessarily capture or represent the reflections of each team member. In addition, the study did not explore the relationship between team commitment and project performance in terms of milestone scores. The results of this study were drawn based on data collected from second-year students pursuing a computer and information and technology major or minor and, as such, may not be applicable to students in other majors. Future work could evaluate the effectiveness of the learning intervention in terms of developing all the different scrum values, not just team commitment, in students. This could be facilitated through utilizing surveys and interviews in addition to retrospective reflections.

## Acknowledgment

This research was supported in part by the National Science Foundation under the award number IIS #2113991. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

## References

[1] J. W. Bishop and K. D. Scott, “An examination of organizational and team commitment in a self-directed team environment.,” *J. Appl. Psychol.*, vol. 85, no. 3, p. 439, 2000.

[2] A. Singh and B. Gupta, “Job involvement, organizational commitment, professional commitment, and team commitment,” *Benchmarking Int. J.*, 2015.

[3] A. Neininger, N. Lehmann-Willenbrock, S. Kauffeld, and A. Henschel, “Effects of team and organizational commitment–A longitudinal study,” *J. Vocat. Behav.*, vol. 76, no. 3, pp. 567–579, 2010.

[4] C. M. Mabaso and B. I. Dlamini, “Total rewards and its effects on organisational commitment in higher education institutions,” *SA J. Hum. Resour. Manag.*, vol. 16, no. 1, pp. 1–8, 2018.

[5] C. L. Pearce and P. A. Herbik, “Citizenship behavior at the team level of analysis: The effects of team leadership, team commitment, perceived team support, and team size,” *J. Soc. Psychol.*, vol. 144, no. 3, pp. 293–310, 2004.

[6] R. Lozano *et al.*, “A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey,” *J. Clean. Prod.*, vol. 108, pp. 1–18, 2015.

[7] P. Vijayaratnam, “Developing higher order thinking skills and team commitment via group problem solving: A bridge to the real world,” *Procedia-Soc. Behav. Sci.*, vol. 66, pp. 53–63, 2012.

[8] E. de Graaff, “History of problem-based and project-based learning in E. de Graaff and A. Kolmos (eds), Management of change, implementation of problem-based and project-based leaning in engineering.” Sense Publishers, Rotterdam and Taipei, 2007.

[9] J. C. Nwokeji and P. S. T. Frezza, “Cross-course project-based learning in requirements engineering: An eight-year retrospective,” in *2017 IEEE Frontiers in Education Conference (FIE)*, 2017, pp. 1–9.

[10] A. C. Alves, D. Mesquita, F. Moreira, and S. Fernandes, “Teamwork in Project-Based Learning: engineering students’ perceptions of strengths and weaknesses,” 2012.

[11] M. L. Pertegal-Felices, A. Fuster-Guilló, M. L. Rico-Soliveres, J. Azorín-López, and A. Jimeno-Morenilla, “Practical method of improving the teamwork of engineering students using team contracts to minimize conflict situations,” *IEEE Access*, vol. 7, pp. 65083–65092, 2019.

[12] K. L. Towry, “Control in a teamwork environment—The impact of social ties on the effectiveness of mutual monitoring contracts,” *Account. Rev.*, vol. 78, no. 4, pp. 1069–1095, 2003.

[13] R. Damasceno, I. D. Dimas, P. R. Lourenço, T. Rebelo, and M. P. Alves, “Building Innovative Teams:

Exploring the Positive Contribute of Emotions Expression and Affective Commitment," *Front. Psychol.*, vol. 12, 2021.
[14] M. Riketta and R. Van Dick, "Foci of attachment in organizations: A meta-analytic comparison of the strength and correlates of workgroup versus organizational identification and commitment," *J. Vocat. Behav.*, vol. 67, no. 3, pp. 490–510, 2005.
[15] A. Jaiswal, T. Karabiyik, P. Thomas, and A. J. Magana, "Characterizing Team Orientations and Academic Performance in Cooperative Project-Based Learning Environments," *Educ. Sci.*, vol. 11, no. 9, Art. no. 9, Sep. 2021, doi: 10.3390/educsci11090520.
[16] T. Karabiyik, A. Jaiswal, P. Thomas, and A. J Magana, "Understanding the Interactions between the Scrum Master and the Development Team: A Game-Theoretic Approach," *Mathematics*, vol. 8, no. 9, p. 1553, 2020.
[17] A. J. Magana, Y. Y. Seah, and P. Thomas, "Fostering cooperative learning with Scrum in a semi-capstone systems analysis and design course," *J. Inf. Syst. Educ.*, vol. 29, no. 2, pp. 75–92, 2018.
[18] N. B. Moe and T. Dingsøyr, "Scrum and team effectiveness: Theory and practice," in *International conference on agile processes and extreme programming in software engineering*, 2008, pp. 11–20.
[19] D. Andolfatto and E. Nosal, "Optimal team contracts," *Can. J. Econ.*, pp. 385–396, 1997.
[20] J. W. Creswell and J. D. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications, 2017.
[21] V. Braun and V. Clarke, "Conceptual and design thinking for thematic analysis.," *Qual. Psychol.*, 2021.
[22] Y. S. Lincoln and E. G. Guba, "Naturalist inquiry." Beverly Hills, CA: Sage, 1985.
[23] P. Lencioni, *The five dysfunctions of a team*. John Wiley & Sons, 2006.
[24] J. R. Katzenbach and D. K. Smith, *The wisdom of teams: Creating the high-performance organization*. Harvard Business Review Press, 2015.
[25] B. Mahembe and A. S. Engelbrecht, "The relationship between servant leadership, affective team commitment and team effectiveness," *SA J. Hum. Resour. Manag.*, vol. 11, no. 1, pp. 1–10, 2013.
[26] B. Jackson and S. R. Madsen, "Common Factors of High Performance Teams.," *Online Submiss.*, 2005.