BUILDING INTERDISCIPLINARY TEAMS THROUGH STUDENT DESIGN COMPETITIONS: A CASE STUDY

A THESIS

by

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ABSTRACT

The relationships between architecture, engineering, and construction (AEC) practitioners have grown increasingly complex, necessitating improvements to both design and construction procedures. This complexity has heightened the need for increased collaboration among all lean stakeholders. However, universities are often criticized for not developing essential, generic skills in their graduates—especially an ability to work collaboratively in teams. Attempting to better prepare students, academic institutions are creating vehicles to help their students acquire effective teamwork skills. Competitions, for example, have spread to almost every discipline, including the AEC-related ones, since they have much to offer students of the built environment. This research assessed participants' experience of an interdisciplinary design competition to determine if students were experiencing identified teamwork attributes. Additionally, this research aimed to identify areas where educators should prioritize their efforts to better prepare students for enhanced teamwork performance. In addition to highlighting that teams should be appropriately composed of members with critical, needed skill sets, results from a post-event survey of the case study competition also suggest there is a need to teach students how to develop clear and shared goals, develop clear and understandable roles, and communicate more effectively when working in teams.

Keywords: Teamwork, Collaboration, AEC (architecture engineering and construction), Interdisciplinary Competition, Lean Integrated Design Delivery

NOMENCLATURE

HA-ICU 2022	Harold L. Adams Interdisciplinary Charrette for Undergraduates Competition
TAMU	Texas A&M University
COA	College of Architecture
ARCH	Department of Architecture
COSC	Department of Construction Science
LAUP	Department of Landscape Architecture & Urban Planning
USAR	University Studies
VIZA	Department of Visualization

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1. INTRODUCTION

The architecture, engineering, and construction (AEC) industry is a project-based sector that requires the collaborative sharing of knowledge and expertise of individuals from various stakeholder disciplines. AEC practices have grown increasingly complex, necessitating improvements in both design and construction procedures as well as increased collaboration among all stakeholders. Being a fragmented sector, the construction industry relies on the skills of a wide range of experts to complete projects successfully (de Cresce El Debs et al. 2017). Several studies have suggested that it is challenging for students to function in teams (DeFranco and Neill 2014). When its students are confronted with the profoundly collaborative realities of today's AEC practice, this shortcoming in their educational preparation can be carried into practice. That said, academic competitions can prepare students as they transition into the "real world." In particular, interdisciplinary competitions in the AEC-related disciplines are one potential strategy to help expose students to the challenges associated with collaboration they will face following graduation.

This paper will describe results of a post-event survey conducted immediately following an interdisciplinary design competition at Texas A&M University – the Harold L. Adams Interdisciplinary Charrette for Undergraduates Competition – held during the weekend of February 25-27 of 2022. This research aims to assess the participant's experience in order to determine if interdisciplinary student competitions are capable of performing as a means to impart teamwork skills to future collaborative stakeholders of the built environment. This research also aims to identify areas where educators must prioritize to better prepare students for enhanced teamwork performance. For the fifth

year in a row, the Annual Harold L. Adams Interdisciplinary Charrette for Undergraduates (HA-ICU 2022) was funded by the Dean of the College of Architecture, each of the heads of the departments of Architecture, Landscape Architecture and Urban Planning, Construction Science, and Visualization, as well as a more open major entitled "University Studies." The competition was officially held at the College of Architecture at Texas A&M University to bring together first- and second-year undergraduate students from the different departments of the college, including the Department of Architecture (ARCH), Department of Construction Science (COSC), Department of Landscape Architecture & Urban Planning (LAUP), Department of Visualization (VIZA), and University Studies (USAR).

The Fifth Annual Harold L. Adams Interdisciplinary Charrette for Undergraduates (HA-ICU 2022) charrette was held from 5:00 pm Friday (2/25) until 02:00 pm Sunday (2/27), 2022. The College of Architecture students were recruited by paid student ambassadors (a student representative of the college's five programs, including ARCH, COSC, LAUP, USAR, VIZA) starting one month prior to the competition weekend. The recruited first- and second-year undergraduate students from ARCH, COSC, LAUP, USAR, VIZA programs united to collaborate as interdisciplinary teams in order to develop solutions to a pre-determined design prompt (Appendix A).

On Friday, February 25th, student participant were notified of their teammates. A total of 43 first- and second-year undergraduate students from the College of Architecture (18 from ARCH, 7 from COSC, 6 from LAUP, 5 from VIZA, and 7 from USAR) formed teams of up to five members per team. The HA-ICU 2022 organizers gave students the

task of developing a recreational space with the intent of uniting students of all disciplines within the College of Architecture in the enclosed space south of Langford C as well as the small grassy open space adjacent to the enclosed side-yard on the southeast side of the building (Appendix A). Before beginning their designs, the student participants were invited to engage in ice-breaker activities with the student ambassadors to enhance their collaboration process during the competition days (Figure 1). The student ambassadors hosted a "quiz show" style icebreaker where students were teams were invited to digitally respond to film trivia.

All teams were asked to complete and submit the required submission documents within approximately 36 hours.

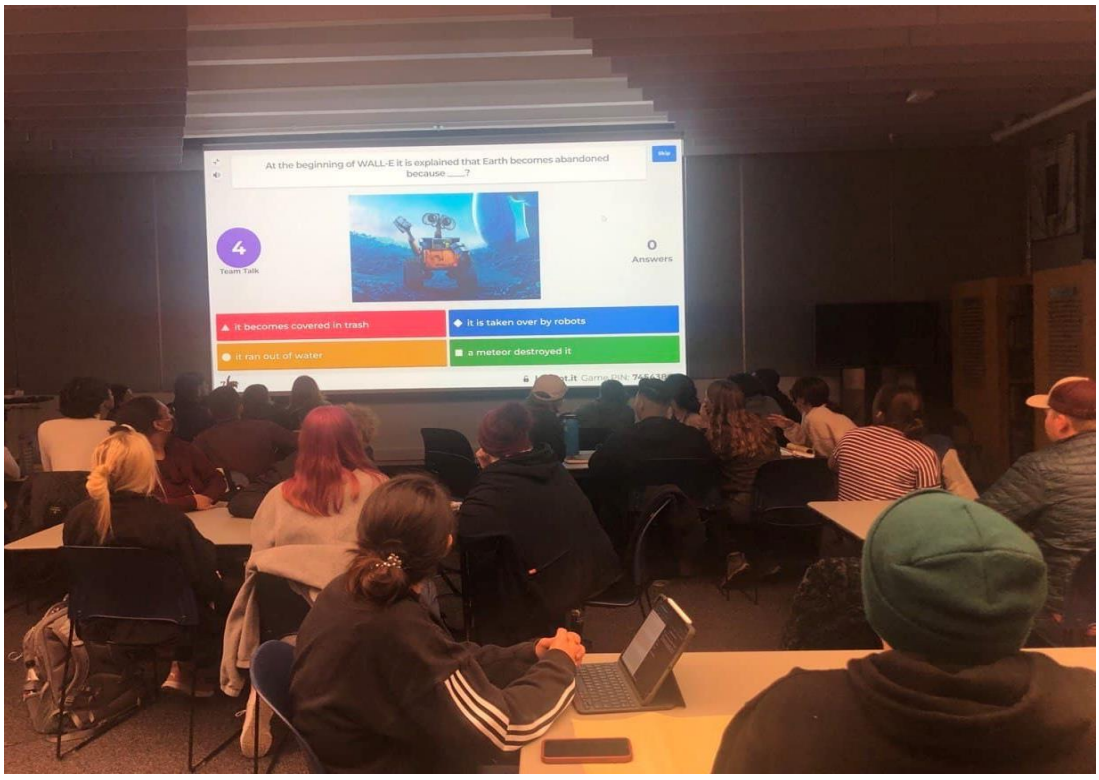

Figure 1. Ice-breaker activities on Friday, February 25th

2. LITERATURE REVIEW

2.1. COMPETITIONS AND THE AEC INDUSTRY

In the architecture, engineering, and construction (AEC) industries, interdisciplinary project delivery (IPD) contracts are becoming the norm. AEC educational approaches, however, have been slow to embrace the transition to a more collaborative project structure (Irizarry et al., 2010). Gusmao Brissi et al. (2019) argue that changes in the education of students in the AEC disciplines offer a way to enhance collaboration in the AEC industry. Arguably, students in these disciplines should be exposed to education that provides the type of collaborative mindset needed for their future careers. For example, in recent years, builders and building management companies have become increasingly interested in approaches to improve quality and to reduce project risk, conflict and waste, despite potentially high upfront costs (Nguyen and Akhavian 2019). A review of the literature suggests that Lean-Integrated Project Delivery (IPD) can be implemented as an effective approach by aligning the interests of key stakeholders involved in construction through mutually developed goals and shared decision-making as it involves key stakeholders at a very early stage in the project timeline. Lean-IPD aims to enhance project outcomes by aligning the incentives and goals of the team. It is therefore likely that teaching collaborative decision-making approaches can improve time, cost, quality, safety, and stakeholder morale on AEC projects (Kulkarni et al., 2012; Rybkowski et al., 2013).

In an effort to prepare students for the industry, educational institutions have been creating programs to help students acquire industry-related skills. Educational institutions strive to develop educational programs that teach students skills such as teamwork, collaborative decision-making, and communication. However, researchers have noted that the current approach appears insufficient to help students develop necessary skills for industry practices (MacLaren et al. 2017). Clevenger et al. (2016) argue that in order to impart collaborative student skills, new evidence-based teaching methods in construction and engineering programs are needed, or future professionals will lack the skills necessary to contribute to the building of future infrastructure. Furthermore, because of a growing concern that the traditional teaching methods cannot provide graduates with the required skills for their future career, architecture, engineering, and construction (AEC) academics have been considering the use of collaborative learning approaches (T.W. Chan and Sher 2014). One type of approach to expose students to collaborative learning is through a design competition.

Competition in academia has spread to almost every disciplinary field. Research has shown that competitions have much to offer to students and should be adopted by academia (Verhoeff, 1997). Guilherme (2014) argues that "competitions, in particular international competitions, test [an] architect's capacities beyond controlled systems of social relations, comfort zones, age, gender or even expertise, in a fast sublimation process, as well as induce a recognition and publicity that surpasses the investments in time, energy and financial resources..." (p. 433). Haupt et al. (2019) concluded that "teaching a design studio based on [an] architectural competition assignment shows that

entering a prestigious event is a great motivation for students to undertake more difficult tasks, as well as to bring them to a successful end" (p. 342).

It stands to reason then, that interdisciplinary competitions can offer a similar opportunity to jump-start AEC students' understanding of the need for collaborative skills, as well as respect for their partnering stakeholders on a project.

Existing peer-reviewed literature is somewhat limited regarding competitions in the AEC industry-related disciplines. Kovacic et al. (2014) conducted research that concentrated on the effect of team competition on design quality. Moreover, Gusmao Brissi et al. (2019) researched a design competition in three categories: teamwork, education and knowledge, and skills and abilities for AEC students. Results of this case study suggested that the design competition effectively cultivated interdisciplinary teamwork among participants, better preparing them for enhanced academic success and for their futures as professionals.

Furthermore, Bibbings et al. (2018) introduced a new model using real-life project competitions to enhance the learning of architectural technology students. They also discuss the outcomes of a developed module that used a real-life competition design project at its core. Moreover, Gusmao Brissi et al. (2019) argued that more research can help analyze some important issues that emerged in their study, such as "(1) the importance of student competitions that simulate real-word experiences for the AEC students; (2) the role of extracurricular activities promoted by universities in the preparation of future AEC professionals; and (3) changes in the academic AEC programs to enhance effective learning and interdisciplinary teamwork among students" (P.19).

2.2.TEAMWORK

Why are certain competition teams successful while others are not? What attributes are required for success? Research has indicated that the existence of some key attributes is vital to successful teamwork. Tarricone and Luca (2002) concluded that there is a strong correlation between adopting some key traits by team members and how successfully they perform in terms of collaboration and developing a quality product. Strong teams do not form by accident. Team building can improve team performance in a long-term, positive, and measurable way (Land, 2019). One of the most important characteristics of a team, according to the literature, is its emphasis on a single objective and a defined purpose. Furthermore, the three primary disciplines historically associated with architecture, engineering, and construction (AEC), have recently undergone significant adjustments to adapt to new processes and demands in the AEC industry. Because these professions should be working toward a shared objective of delivering a completed built structure, communication between architects, engineers, and construction managers is necessary (Gusmao Brissi et al., 2019). Several characteristics required for successful teamwork have been identified through a literature review. Many of these characteristics have been observed repeatedly. Table 1 summarizes the literature on elements essential for effective teamwork.

Table 1. Key Attributes for effective teamwork

Key Attributes	List of Reviewed Literature
Effective Communication	(Kline et al. 1996) (Holland et al. 2000) (Mickan and Rodger 2000) (Tarricone and Luca 2002) (Yusuf 2012) (Azmy 2012) (Bannister et al. 2014) (Szewc 2014)
Appropriate Team Composition	(Katzenbach and Smith 1993) (Holland et al. 2000) (Tarricone and Luca 2002) (Bannister et al. 2014) (Svalestuen et al. 2015)
Effective Leadership	(Kline et al. 1996) (Holland et al. 2000) (Mickan and Rodger 2000) (Azmy 2012) (Fapohunda 2013) (Sohmen 2013) (Szewc 2014) (Setiawan and Erdogan 2018)
Responsibility and Accountability	(Tarricone and Luca 2002) (Fapohunda 2013) (Bannister et al. 2014) (Setiawan and Erdogan 2018)
Clear and Understandable Roles	(Holland et al. 2000) (Mickan and Rodger 2000) (Azmy 2012) (Khoshtale and Mahdavi Adeli 2016)
Clear and Shared Goals	(Katzenbach and Smith 1993) (Kline et al. 1996) (Fisher et al. 1997) (Mickan and Rodger 2000) (Tarricone and Luca 2002) (Fapohunda 2013) (Bannister et al. 2014)
Interdependence	(Tarricone and Luca 2002) (Bannister et al. 2014)

In reality, each team is unique and faces its own challenges. Not all perform as successfully as planned, and of course, teams can also fail. Researchers have observed a variety of factors that can lead to unsuccessful teamwork: lack of clear purpose and goals, lack of effective leadership, lack of trust, poor communication, and unclear roles or insufficient skills (Parisi-Carew, 2015; Maldonado, 2015; Eckfeldt, 2017). While the list of characteristics that lead to failed teamwork appears to primarily represent an antithesis of attributes that lead to success, *trust* is one notable exception (Table 2).

Table 2. Key factors for ineffective teamwork

Key Factors	List of Reviewed Literature
Lack Of Clear Purpose & Goals	(Parisi-Carew 2015) (Maldonado 2015) (Eckfeldt 2017) (Wanamaker 2018) (Leonard 2019)
Lack of Effective Leadership	(Parisi-Carew 2015) (Wanamaker 2018) (Rajagopal 2021)
Lack of Trust	(Parisi-Carew 2015) (Maldonado 2015) (Wanamaker 2018)
Poor Communication	(Maldonado 2015) (Leonard 2019) (Scully 2019) (Rajagopal 2021)
Unclear Roles or Insufficient Skills	(Eckfeldt 2017) (Wanamaker 2018) (Leonard 2019) (Rajagopal 2021)

Studying participant experiences in student competitions is vital to assessing the impacts associated with them (Kaiser and Troxell 2005; Bigelow et al. 2013). Competitions have been shown to offer a variety of benefits to participants in various disciplines. Even

defeat can be of benefit since participants will learn from experienced realities, such as dealing with time constraints and failure (Bigelow et al. 2013). However, more in depth research about the value that competitions offer is needed (Bigelow et al. 2013).

Extant literature reveals that few studies had been conducted to identify a competition's full impact on AEC students participating in these competitions. Although some studies have been conducted regarding the importance of design competitions to the AEC disciplines, most existing research does not identify the attributes that are critical for teams to win—or lose—an AEC design competition. These elements are helpful to know because student design competitions can arguably serve as a proxy for AEC collaborations in the professional world. In addition, these attributes could help academic institutions to identify the areas in which they should focus efforts in order to prime a more sophisticated future workforce by offering appropriate training in their curricula. The success or failure of a project in the "real world" is likely built on collaborative skills that are formed when AEC professionals are still students at universities. The intent of this research is to analyze competitors' experiences immediately following participation in a university-level interdisciplinary design competition. The research will probe an interdisciplinary student competition as a case study to identify which teamwork skills are naturally in play and which skills need to be better transmitted to future collaborative stakeholders of the built environment.

3. PROBLEM STATEMENT

The importance of collaboratively sharing knowledge and expertise has long been recognized by the AEC industry. Despite this, the industry has a reputation for being adversarial.

The educational process of those studying to enter disciplines within the AEC industry plays a crucial role in preparing students for their professional lives. Although various approaches have been adopted to address the need for enhanced teamwork, there is concern that most existing approaches are insufficient to prepare the future workforce for the AEC industry's challenges.

Design competitions are sometimes used to help students develop teamwork skills. Despite their promise, there is a lack of empirical evidence that AEC competitions achieve this goal. Since competitions can serve as a proxy for teamwork on actual projects following graduation, it is important to see determine if interdisciplinary student competitions are capable of serving as a means to impart teamwork skills to future collaborative stakeholders of the built environment—and to identify areas where educators must prioritize to better prepare students for enhanced teamwork performance.

4. SIGNIFICANCE OF RESEARCH

The significance of this research is that it can help educators make decisions about the need to standardize the hosting of interdisciplinary student competitions, as well as to identify the skills needed to better prepare students for enhanced teamwork performance.

5. RESEARCH OBJECTIVE

This research investigates participant experiences during an interdisciplinary design competition with respect to teamwork attributes. The objective is to identify areas where teamwork attributes appear to already be in place, as well as areas where educators should prioritize efforts to better prepare students for enhanced teamwork performance. The ultimately goal is to determine if interdisciplinary student competitions can serve as a means to impart teamwork skills to future collaborative stakeholders of the built environment.

The author implemented a mixed method analysis (qualitative and quantitative) of the data collected from a post-event survey in this research. Particularly, the study posed the following questions:

- What attributes of team collaboration appear to be of paramount importance for first- and second-year students to attain most effective team-performance?
- What areas must be prioritized by educators to better prepare students for enhanced teamwork performance?

The research is predicated on an assumption that design competitions simulate real-life experiences for AEC students and can therefore play an effective role in preparing future AEC professionals.

6. METHODOLOGY

6.1. RESEARCH DESIGN

This case study assessed post-competition responses to an annual interdisciplinary design competition entitled the Annual Harold L. Adams Interdisciplinary Charrette for Undergraduates (HA-ICU 2022). The competition was held during the weekend of February 25-27 of 2022 in the College of Architecture at Texas A&M University. This college-wide design competition was designed and organized by five faculty and five hand-selected and paid student "ambassadors" (organizers) from the departments of architecture, construction science, landscape architecture and urban planning, and visualization, and the program of university studies. Competition participants were recruited from all five departments and programs by the student ambassadors. Although their professional skill sets were still in their infancy, first and second-year undergraduate students were recruited as competition team members as it has been observed by several COA faculty members that students from the AEC disciplines appear to be most open to learning from other disciplines during their early years of study, before disciplinary silos become hardened.

To conduct this study, a literature review was conducted to identify key attributes for effective teamwork. Based on findings from the literature review, a survey was administered to the student competitors following the competition (Appendix B). To streamline the survey process, the questions for this research were included as part of a multi-year survey that was being conducted by a separate researcher regarding participant knowledge growth during the competition.

6.2. STUDENT RECRUITMENT

The main organizational team of five interdisciplinary faculty—from the departments of architecture, construction science, landscape architecture and urban planning, and visualization, and the program of university studies—selected five representative student ambassador organizers to recruit students from their respective departments. The selected ambassadors were hired as student workers to collaborate closely with the faculty committee for a month prior to the competition to organize the annual HA-ICU 2022 competition, now in its fifth year. The student ambassadors took on different responsibilities, including poster design, advertising, participant recruitment, design prompt development, t-shirt design for participants, meal ordering and delivery for the weekend of the competition, etc. The ambassadors met weekly with the faculty committee for guidance to avoid potential problems.

The ambassadors designed a poster as well as announcement emails to recruit participants. To maximize recruitment effectiveness and build excitement among first- and second-year students, the recruitment process was done both virtually (by sending out emails from the College of Architecture as well as from the individual student ambassadors) and in-person (by make announcements in classes and through the posting of the posters). This multi-level recruitment strategy was adopted to increase the likelihood that email recipients would read the competition announcements.

6.3. DATA COLLECTION

To streamline the process, the survey questions for this study were added to the questions of an annual survey representing a different study that was being conducted by a separate researcher. The survey was primarily administered using Qualtrics–an online software service that provides tools for designing, distributing, and analyzing surveys. Online administration of the survey made the data collection and analysis more efficient compared to paper (i.e., the data collected thorough Qualtrics were later converted into Excel spreadsheet for data analysis). However, paper copies of the survey were also made available to students who did not have their laptops or cell phones available at the time of the survey or who preferred to respond by paper.

The competition took place from 5:00 pm Friday, February 25 until 2:00 pm on Sunday, February 27, 2022. To avoid potential bias, this study was conducted via a survey administered to student participants following their presentations to the competition jury, but before winners were announced. To maximize survey participation, participants were given approximately 30 minutes to complete the survey and were awarded with tickets upon completion which gave them access to enter the auditorium where the winners were to be announced.

6.4. STUDENT PARTICIPATION

Although the original goal was to recruit participation of 50 students (10 teams of 5 interdisciplinary students each), the fifth annual Harold L. Adams Interdisciplinary Charrette for Undergraduates competition hosted 43 students as some of the registered

students cancelled their registration due to conflicting work schedules and other personal matters. Ultimately seven teams of 5 students each, and two teams of 4 students each participated in the weekend-long competition. Table 3 lists the number of students registered from each department.

Table 3. Student participation

Departmental Affiliation	**Students** (nos.)
ARCH	18
COSC	7
LAUP	6
VIZA	5
USAR	7

6.5. RESEARCH METHODOLOGY

The research was guided by two primary questions based on a literature review about teamwork attributes. The intent of the literature review was to identify the key attributes leading to either effective or ineffective teamwork. The primary question asked were: *If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be?*

The investigation involved a post-charrette surveys. These surveys were designed so that they were available both virtually and physically. Although all participants were asked to bring their laptops to be able to participate in the virtual survey, paper copies of the survey were also made available if needed.

A link to the virtual version of the survey was disseminated among the participants at the end of event, specifically after all teams presented their submissions, but before the winners were announced (Appendix B). Participation in the survey served as a participant's entrance pass to the auditorium where the first, second, and third place winners were announced. This strategy was applied to maximize the number of survey respondents.

The Harold L. Adams Interdisciplinary Charrette for Undergraduates Competitions had been offered in the College of Architecture over the previous four years, and the organizational committee had already been conducting pre- and post-event surveys to evaluate the effectiveness of the interdisciplinary competition. This study took advantage of the existing surveys and the researchers decided to work closely with the HA-ICU 2022 organizational committee and add their own questions to the existing surveys for data collection. In the 2022 version of the post-charette survey, four additional questions were added based on the literature review conducted prior to the event. These included:

1. Do you think you will win one of the top three prizes in this competition?

   _____ Probably Yes
   _____ Probably No

   Why did you select the response you did?
   _____

2. For the following questions please rate how you think your team performed with respect to each attribute of teamwork. Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent.

	Poor							Excellent
Effective Communication	⓪	①	②	③	④	⑤	⑥	⑦
Appropriate Team Composition and Skillsets	⓪	①	②	③	④	⑤	⑥	⑦
Effective Leadership	⓪	①	②	③	④	⑤	⑥	⑦
Responsibility and Accountability	⓪	①	②	③	④	⑤	⑥	⑦
Clear and Understandable Roles	⓪	①	②	③	④	⑤	⑥	⑦
Clear and Shared Goals	⓪	①	②	③	④	⑤	⑥	⑦
Interdependence	⓪	①	②	③	④	⑤	⑥	⑦
Trust	⓪	①	②	③	④	⑤	⑥	⑦
Other (Please Explain)	⓪	①	②	③	④	⑤	⑥	⑦
Other (Please Explain)	⓪	①	②	③	④	⑤	⑥	⑦
Other (Please Explain)	⓪	①	②	③	④	⑤	⑥	⑦

_____

3. If the organizers were to offer training in advance of the workshop on team collaboration, where do you think their focus should be? (Pick only 3)

Effective Communication	☐
Appropriate Team Composition and Skillsets	☐
Effective Leadership	☐
Responsibility and Accountability	☐
Clear and Understandable Roles	☐
Clear and Shared Goals	☐
Interdependence	☐
Trust	☐
Other (Please Explain)	

Why did you recommend what you did?

_____

4. What is your Team ID? (This information will **not** be used to identify you)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

_____

5. Overall, was this a worthwhile experience?

_____ Yes
_____Somewhat
_____ No

7. FINDINGS

7.1. SATISFACTION WITH COMPETITION AND PERFORMANCE WITH RESPECT TO EACH ATTRIBUTE OF TEAMWORK

This section describes results obtained from the post-event survey conducted immediately following the competition to determine if interdisciplinary student competitions are capable of imparting teamwork skills to future collaborative stakeholders of the built environment, and to identify areas where educators should prioritize efforts to better prepare students for enhanced teamwork performance. After the weekend-long competition, student competitors were asked to rate how they felt their team performed with respect to each attribute of teamwork identified in the literature review. Participants were also asked to identify which of the attributes they felt should be given to participants before the competition to enhance their performance on teams.

The fifth annual HA-ICU 2022 competition united a total of 43 students from the departments of architecture, construction science, landscape architecture and urban planning, and visualization, as well as the undergraduate studies program. The post-event survey was conducted on Sunday, February 27, 2022, and 42 participants participated in the survey (one participant could not attend the winner announcement session due to a family emergency). The result of one of the survey questions demonstrated that a majority of participants (95.23%) found this competition worthwhile as a learning experience (Figure 2).

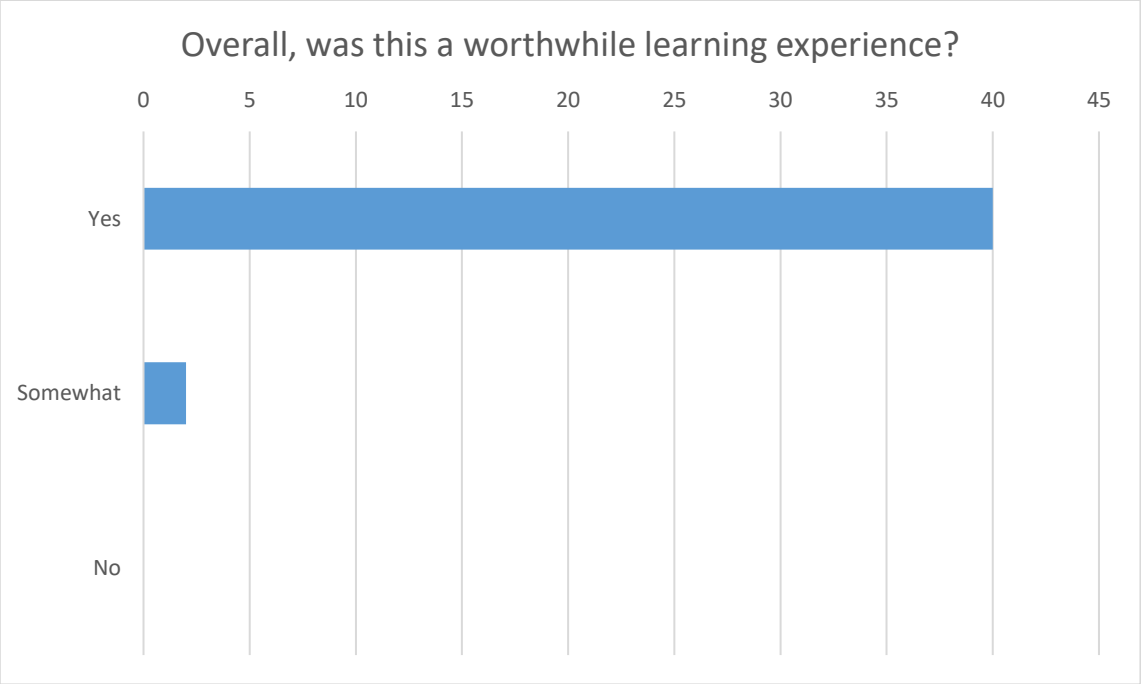

Figure 2: Participants' response to survey question "Overall, was this a worthwhile learning experience?" (Measurement is by number of respondents, n=42)

7.2. IDENTIFICATION OF ATTRIBUTE TRAINING NEEDED

Another core question that participants were asked in the post-event surveys was "If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be?" The attributes revealed by the literature were again listed for respondents, along with a follow-up question asking them to add any attribute that they think may be critical but that was not listed in the survey (ie. "other" (please explain)).

With respect to the listed attributes of teamwork (Question 2), participants indicated that trust (an average of 6.17 out of 7) and interdependence (an average of 6.17 out of 7) rated highest among all the teamwork attributes previously identified by the literature review

and listed in the survey. However, respondent results also showed appropriate team composition and skillsets (an average of 5.90 out of 7) and effective communication (an average of 5.98 out of 7) were rated the lowest by the participants, revealing that these areas were more problematic for teams to overcome during the competition. Figure 3 summarizes responses to this question.

Figure 3. Response to question 3: "Please rate how you think your team performed with respect to each attribute of teamwork." (according to Likert scale from 0 to 7, where 0 is lowest and 7 is highest), see Appendix C for standard deviation and Appendix D for individual teams responses.

Data collected for Question #3 of the survey revealed that appropriate team composition and skillsets (52.38%), clear and shared goals (47.61%), clear and understandable roles (45.23%), and effective communication (45.23%) were identified by most participants as areas that needed training prior to the competition (Figure 4).

Figure 4. Response to question 4: "If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be? (Pick only 3)" (according to the number of respondents, n=42), see Appendix D for individual teams responses.

As mentioned earlier, the participants were asked to suggest any other attribute they thought was important but not listed in the survey. However, the majority of them did not suggest any other attribute other than the ones listed, which concludes that the attributes were the most critical ones for team collaboration in HA-ICU 2022 participants' opinion. There were only two students suggesting workshops on software and programs to better prepare them to participate.

8. DISCUSSION

Responses from a post-competition survey study revealed that most participants (95.23%) of the HA-ICU 2022 competition found the event to be a worthwhile learning experience. However, follow-up questions to members of the interdisciplinary student teams also revealed some potentially helpful information about how educators can better prepare first- and second-year undergraduates for more effective teamwork.

A data analysis of participants' responses to question #2 of the survey revealed that trust and interdependence rated highest (an average of 6.17 out of 7) among all attributes revealed through a literature review on teamwork attributes, indicating that team members believed they performed well in these areas. However, participant responses also revealed that appropriate team composition and necessary skillsets (an average of 5.90 out of 7) and effective communication (an average of 5.98 out of 7) were rated the lowest by the participants, revealing that these attributes were the areas that participants of this interdisciplinary competition struggled most to overcome.

Furthermore, data analysis of participants' responses to question #3 of the survey indicated that participants rated highest the need for appropriate team composition and skillsets (52.38%), clear and shared goals (47.61%), clear and understandable roles (45.23%), and effective communication (45.23%) among the attributes suggested by literature review. Additionally, nearly all members of four of the nine competition teams accurately predicted they would place in the competition and all members of the first-place winning team predicted they would win the competition (while the team that placed fourth technically did not win one of the top three awards, but there was very little

difference in the judges' score between the third and fourth placed teams). This confidence was not evident in the responses of the teams that placed five through nine in the competition. Perhaps not surprisingly, the first-place winning team exhibited the most advanced rendering skills of all nine teams (Appendix D).

In summary, results from this case study point to a recommendation that holding interdisciplinary competitions is worthwhile for AEC undergraduates as a learning experience and can be helpful for them to appreciate the importance of the attributes that play a role in team success. It is interesting that team members in this competition felt a sense of trust and interdependence among their team members since these attributes can help team members feel comfortable about opening up, exposing vulnerabilities, and collectively overcoming existing problems. However, it must be acknowledged that both these characteristics–trust and interdependency–can also be adversely affected by a lack of necessary skillsets, which apparently challenged some participants of this case study competition. While the need to better equip students with more polished skillsets might suggest the competition should instead comprise upper-level student participants rather than first- and second- year undergraduate students, it is worth investigating to see if the vulnerability these more junior students felt may actually motivate them to better equip themselves with the skills they need to become effective as professionals. A longitudinal study of the future performance of these students could offer some interesting insights.

Finally, and perhaps most importantly, results from the post-competition survey suggest that AEC students are calling for educators to teach them how to develop clear

and shared goals, develop clear and understandable roles, and communicate more effectively.

9. LIMITATIONS

Although this research is about teams, it explores the attributes of student teams in academia, which may differ from those of teams in firms/companies where an experienced individual is often placed in charge. Also, because this research represents a case study, generalization of the findings is limited.

10. DELIMITATIONS

The scope of this research was confined to a single, interdisciplinary, design competition comprising teams of first- and second-year students of the built environment and held at Texas A&M University during the Spring of 2022.

11. REFERENCES

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APPENDIX A

2022

Fifth Annual
Harold L. Adams
Interdisciplinary Charrette for Undergraduates Competition

DESIGN PROMPT

Dr. Harold L. Adams, College of Architecture
Dr. Zofia Rybkowski, Construction Science
Dr. Ahmed K. Ali, Environmental Design
Dr. Courtney Starrett, Visualization
Dr. Xinyue Ye, Landscape Architecture & Urban Planning
Dr. Shelley Holiday, College of Architecture
Dr. Katie Reed, College of Architecture

Student Ambassadors:
Robert Williams - Environmental Design
Atithi Shrestha - Construction Science
BreAnn McClanahan - University Studies Architecture
Jocylin Lopez - Visualization
Amy Ma - Landscape Architecture & Urban Planning

Fifth Annual
Harold L. Adams
Interdisciplinary Charrette for Undergraduates Competition

2022 DESIGN INFORMATION

The Interdisciplinary Charrette for Undergraduates Competition is a weekend-long charrette that brings undergraduate students in their 1st and 2nd years within the College of Architecture's 5 undergraduate programs together to generate unique design solutions. Students will work in teams of five consisting of one student from each department - Architecture, Construction Science, Landscape Architecture & Urban Planning, University Studies, and Visualization. Students will be competing to share cash prizes in the amount of $2,000 (1st place); $1,250 (2nd place); and $750 (3rd place), which will be awarded by an expert panel of judges.

The Task:

Develop a recreational space with the intent of uniting students of all disciplines within the College of Architecture. The proposal should consider human behaviors and social interaction, relating these themes to promote interaction between all students, staff, and visitors who enter the space. Consider how they will be pulled into the space, how they connect with each other, and how they interact with the space. Furthermore, the proposal should consider the history of the College of Architecture and celebrate the successes of each discipline. The proposal should include a form of structure / shade cover that should consider the relationship to the context, the volume of traffic throughout the area, and the microclimate factors. Design solutions must incorporate the College of Architecture's mission to address three environments: the **Natural**, the **Built**, and the **Virtual**.

The Prompt:

Introduction
This year's ICU project presents a unique interdisciplinary activity to design and ultimately construct an area that focuses on promoting social interaction between all the students within the college. As the year progresses, students and faculty may find themselves spending more time on campus than at home. Think about how to create a healthy space on campus where they can step out to get some fresh air, gather with friends, or even to take outdoor classes. Furthermore, since the pandemic started, people have found themselves spending more time with nature and gathering outdoors. A lot of the time, nature can have a healing effect on humans mentally, emotionally, and physically. Yet we as humans haven't done enough to preserve nature around us. Thus, revitalization of the space is the natural extension of this goal. Your team is tasked with connecting these themes to a space that both inspires and provides a functional destination to students.

Background

The site for this year's project is the densely vegetated area in the enclosed space south of Langford C as well as the small grassy open space adjacent to the enclosed space on the southeast side of the building. Currently, the enclosed space is underutilized due to a lack of seating and attractive features. Most of the time it's unclear if the space can be used due to the fact that it's isolated by brick walls, which may either be torn down or kept, and enclosed by a gate. On the other hand, the grassy open space on the southeast side of the building is highly exposed without functionality, shade, or seating.

Limitations

Since the project will be considered a permanent installation, it should be in compliance with the materiality designed in the Campus Master Plan. Additionally, there is a utility room and generator just outside, or southward, of the enclosed space that cannot be moved or taken away. If students choose to keep the brick wall, make sure to consider the noise level of the space they create as to not disturb the classes indoors, as well as to not block the sunlight going into the classrooms and building. Finally, make sure to address the change in elevation, as well as materials, used for the new design.

The Prizes: Prizes to be divided equally among all team members

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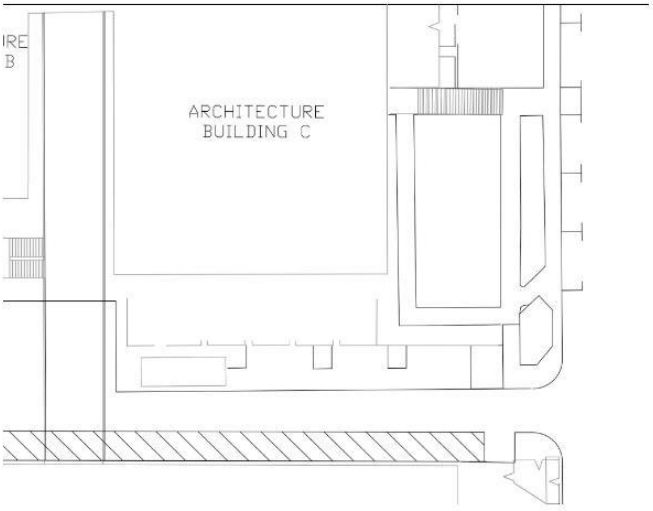
First Place - $2,000 *Second Place - $1,250* *Third Place - $750*

Budget:

There is no specified budget for this project (so let your creative solutions thrive). There are constraints on the existing context listed below, but be bold in how you look to provide a unique experience for the next generations of Aggies in this space. Your limit is only to work within known or emerging technologies, and of course the basic laws of physics.

The Site Boundaries:



The Context:

Buildings - All current buildings are to remain intact, however, revised entries and light structures (canopies, stair access etc.) can be added to the Langford buildings. Additionally, new or revised entrances to all buildings can be recommended. *Please consult the campus master plan.

Trees - The trees by the enclosed space may be removed, as well as the trees in the planters on the south side of Langford C. Additionally, proposed trees can be added to the site

Site Features - All current site features including asphalt and concrete walks and parking, site walls, concrete planters, benches and pavers can all be modified or removed. The site DOES NOT include the main entrance that leads to the Langford buildings on the south side of the enclosed space. You may redesign the stairs, but may not relocate or resize them. Make sure to address the change in elevation and existing pipe features beneath the surface.

How Each Discipline Can Both Lead and Integrate

Each discipline brings great skills to the design problem of the HA-ICU Competition. This provides the opportunity for each team member to both grow in these skills and also to be able to teach peers about the ways you approach the built, natural and virtual environments. The following discipline-specific requirements should be led by the team member in that discipline, but the completion of the requirements should be taken on by the team.

Visualization elements to incorporate:

- Virtual environments into the built and natural environment -- for example, real-time visual display of network activity, weather, air quality, or other real-time data feeds or by presenting VR, visual artwork or animations. The virtual can also be a public artwork incorporating any of these or something else altogether.
- Visualization design that is both technically efficient and aesthetically pleasing.
- Research that supports the visualization designs such as the work of artists and designers who populate public spaces with works: see the Zachry Center art installations. Also see the work of the Center for Data Arts, The Allosphere, the Beall Center for Art and Technology, and Flowing Data.

Landscape Architecture & Urban Planning elements to incorporate:

- A clear arrangement of spaces and uses that include designed exterior space for humans.
- Study and assessment of existing and potential movements of people to, within and through the space/site.
- Clear integration of the relationships of structure(s) to the space/site/context

Construction Science elements to incorporate:
A Construction Plan that includes

- A schedule (bar/Gantt chart) showing sequence and durations of activities
- A construction site plan showing:
    - Diversion of foot and vehicular traffic during construction
    - Locations of site office, security fence, laydown areas, storage areas, and temporary sanitation and waste disposal
- A description of the time of year you will build this and why.
- A description of the primary project materials
- A description of equipment will you need
- A description of parts that will be prefabricated and what parts will be built on site.
- A listing of expected subcontractors/trade partners

Architecture elements to incorporate:

- Create a gathering place on campus that encourages social interaction.
- Consider creating outdoor classroom spaces, pavilions, study spaces, and conversational spaces.
- Use your knowledge of social and behavioral spaces in the built environment to be a magnet for people.
- Consider circulation around the area and designing in a way that maintains or improves the access to the surrounding existing context.
- All spaces should consider barrier-free access to be inclusive to everyone.
- Also, realize that in a few years robots will be utilized in the environment and they will require barrier-free access too.

The Process:

ICU 2022 Competition Schedule

Each team will need to follow the basic design process described here as a way to systematically approach a solution to the design problem. The Competition Schedule will reflect this process and faculty guides will also provide insight on navigating this process as a team.

1. Project goal setting, intent and initial design program generation
2. Site inventory and analysis
3. Bubble diagramming of uses and relationships among project elements and context
4. First conceptual design(s)
5. Final team design solution
6. Production of final graphics
7. Presentation of project

At each step of the process, utilize faculty guides for reviews and critiques to help your team move through each step. A schedule of faculty volunteers will be posted in the studio space

Project Deliverables

Folder Location

At the conclusion of the competition each team will display a digital presentation to be given by **ALL** team members in the Geren Auditorium. These basic products include the following:

- A 200-word project description that includes the project intent, users, and innovative solutions
- A hand or digitally rendered scaled site plan
- 4+ hand or digitally rendered perspectives
- 2+ hand or digitally rendered elevations, sections, or detail drawings / plans to express design effectively
- A 3D model (physical or digital)
- A graphic showing key recommended materials and plant palette
- A construction plan

Checkpoints:

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*At the time of every checkpoint**,** progress photos **must** be uploaded into the shared Google drive

Checkpoint1
Friday night - 10 pm - project goal setting

Checkpoint 2
Saturday morning - 10am - Site inventory and analysis, and Bubble Diagram

Checkpoint 3
Saturday Afternoon - 2pm - Site Plan

Checkpoint 4
Saturday Afternoon - 6pm - Orthographic / Perspective / Elevations Representations of Structures

Checkpoint 5
Saturday Evening - 10pm - Sections / Detail Drawings

Checkpoint 6
Sunday morning - 10am- **FINAL PROJECT DUE**

Final Presentation
Sunday morning - 10:30am - Final Presentation

Evaluation Criteria

On Sunday, February 27th, the judging process will happen in order to determine the first, second and third place of the 2022 ICU Competition. An expert Jury, made up of department heads and professionals in each field, will render the final decision on the competition results.

The five Student Ambassadors will check to make sure the required deliverables were turned in on time and were presented in their pre-recorded presentations. This will then be provided to the Jury as information for their deliberations.

The Jury will rank teams based on completeness of deliverables and overall design quality.

Additional Resources

Folder Location

Campus Master Plan
ICU 2022 Competition Schedule

APPENDIX B

Full post-event survey administered to student participants to demonstrate how these research questions were included as part of a larger research survey.

Harold Adams ICU Post-Event 2022

1. Please provide your favorite color, favorite animal, and the last 4 digits of your phone number. Please use the same information you did the first time so that we can link your responses from the pre-event survey. We will not use this information to identify you.

_____ _____ _____

Favorite Color Favorite Animal Last four digits of your phone no.

2. Do you think you will win one of the top three prizes in this competition?

____ Probably Yes

____ Probably No

Why did you select the response you did?

3. For the following questions please rate how you think your team performed with respect to each attribute of teamwork.

Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent.

	Poor							Excellent
Appropriate Team Composition and Skillsets	0	1	2	3	4	5	6	7
Clear and Shared Goals	0	1	2	3	4	5	6	7
Clear and Understandable Roles	0	1	2	3	4	5	6	7
Effective Communication	0	1	2	3	4	5	6	7
Effective Leadership	0	1	2	3	4	5	6	7
Interdependence	0	1	2	3	4	5	6	7
Responsibility and Accountability	0	1	2	3	4	5	6	7
Trust	0	1	2	3	4	5	6	7
Other (Please Explain)	0	1	2	3	4	5	6	7
Other (Please Explain)	0	1	2	3	4	5	6	7
Other (Please Explain)	0	1	2	3	4	5	6	7

4. If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be? (Pick only 3)

☐	Appropriate Team Composition and Skillsets
☐	Clear and Shared Goals
☐	Clear and Understandable Roles
☐	Effective Communication
☐	Effective Leadership
☐	Interdependence
☐	Responsibility and Accountability
☐	Trust
☐	Other (Please Explain) .....

Why do you recommend what you did?

5. What is your team ID? (This information will ***not*** be used to identify you.)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

6. Now that you have had a chance to work on this project, please identify a few skills or daily activities you imagine a professional from each of the disciplines below might use or do in their job.

Profession	**Work-related skills or daily activities**
Architecture	
Construction Science	
Landscape Architecture	
Urban Planning	
Visualization	

7. Describe one challenge your group encountered this weekend and explain how you overcame it.

8. How would your design solution have been different if you didn't have teammates from the other departments? Would it have been better or worse? Why?

9. What was the most surprising thing you learned this weekend that you did not expect?

10. Overall, was this a worthwhile learning experience?

____ Yes

____ Somewhat

____ No

11. If you were a juror for this competition, which teams would you give prizes to?

First Place: Team _____

Second Place: Team _____

Third Place: Team _____

Thank you for participating in the Harold Adams Interdisciplinary Charrette for Undergraduates!

APPENDIX C

Likert scale averages and their standard deviation for post-event survey question to participants: “Please rate how you feel your team performed with respect to each attribute of teamwork. Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent.”

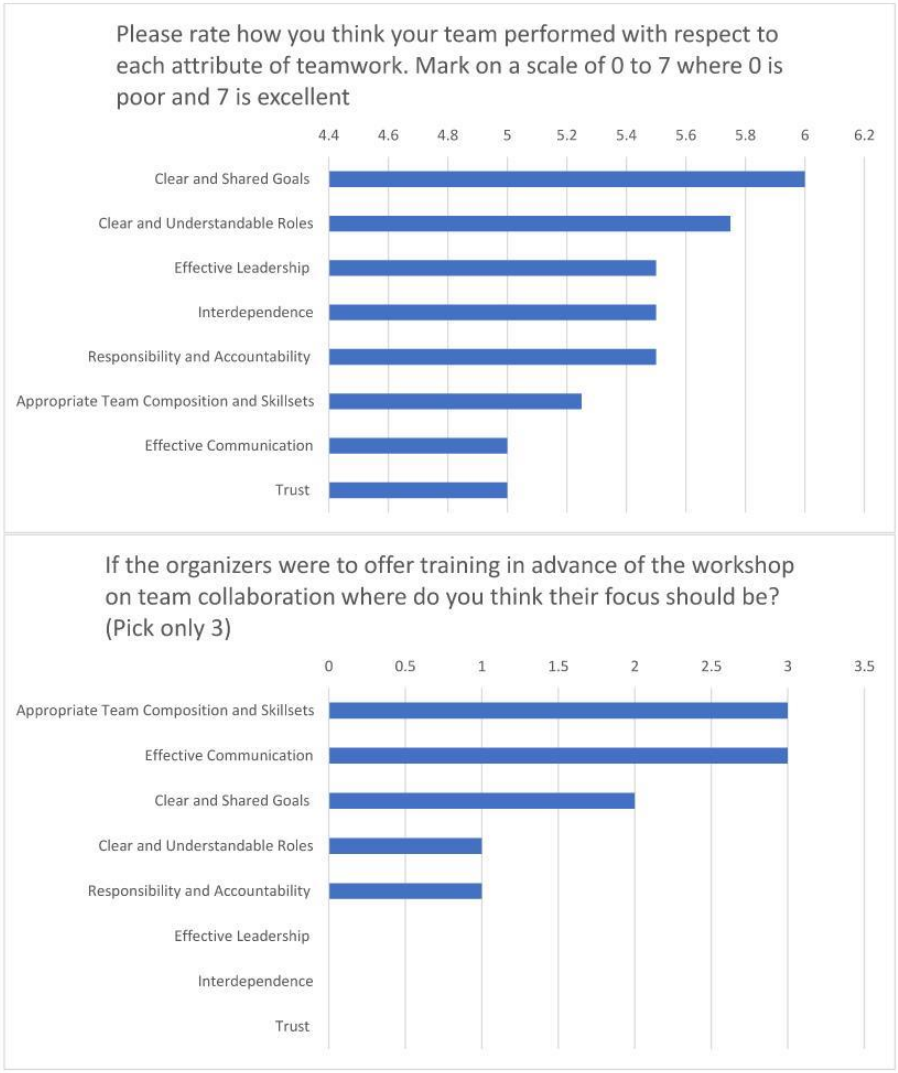
Teamwork Attribute	Average	Standard Deviation
Appropriate Team Composition and Skillsets	5.90	1.21
Effective Communication	5.98	1.17
Clear and Understandable Roles	6.10	1.1
Effective Leadership	6.10	1.14
Clear and Shared Goals	6.12	1.05
Responsibility and Accountability	6.12	1.01
Interdependence	6.17	1.21
Trust	6.17	1.06

APPENDIX D

Responses to survey by team

Team 1

Team 2



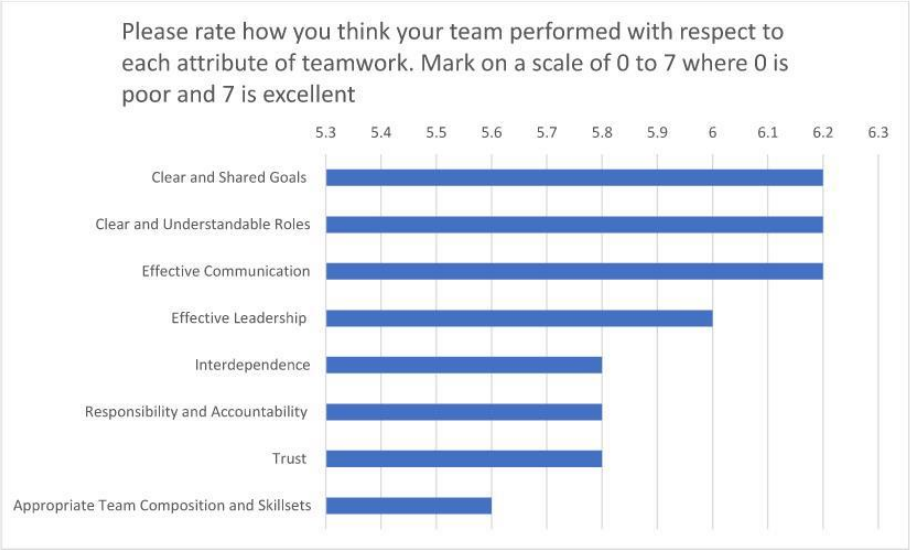
Note: Team 2 won second place in the completion

Team 3


Please rate how you think your team performed with respect to each attribute of teamwork. Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent
5.8
6
6.2
6.4
6.6
6.8
7
7.2
Responsibility and Accountability
Trust
Clear and Understandable Roles
Effective Communication
Interdependence
Clear and Shared Goals
Effective Leadership
Appropriate Team Composition and Skillsets

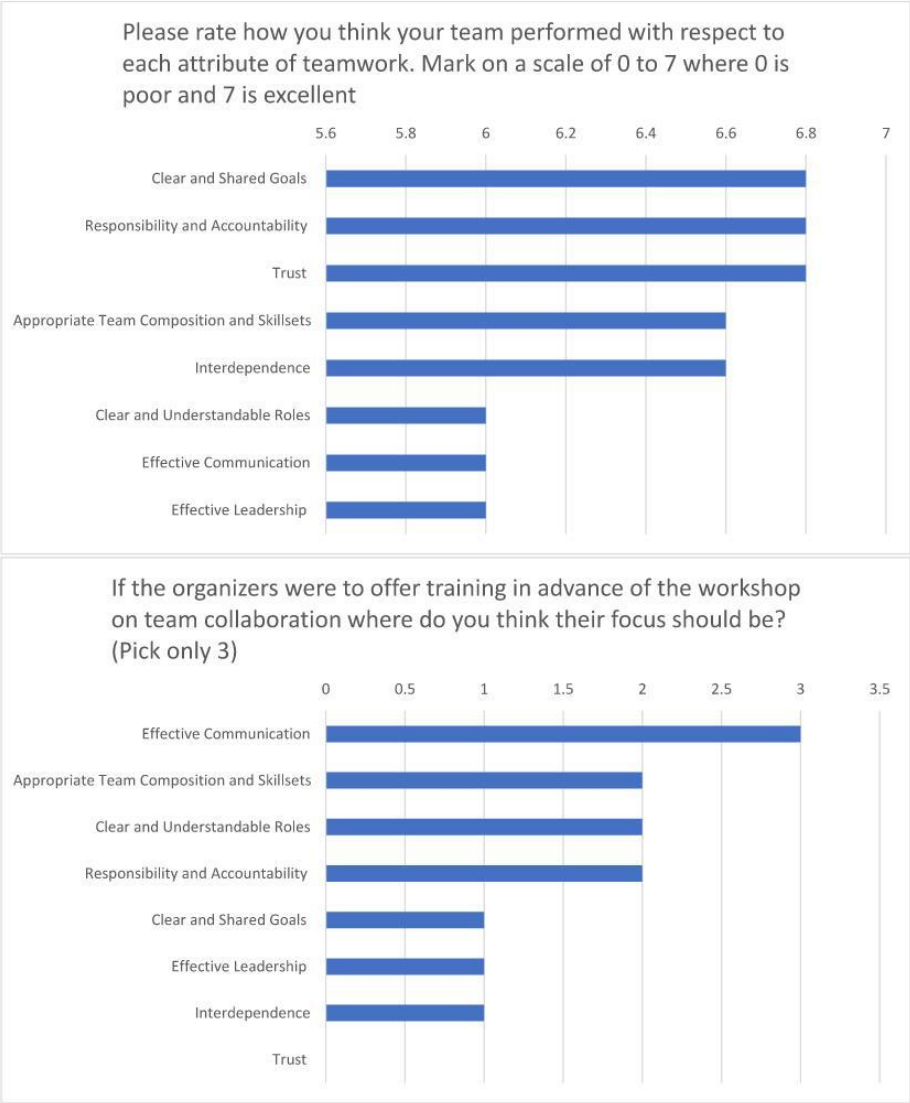

If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be? (Pick only 3)
0
0.5
1
1.5
2
2.5
3
3.5
Appropriate Team Composition and Skillsets
Clear and Shared Goals
Clear and Understandable Roles
Interdependence
Responsibility and Accountability
Effective Communication
Effective Leadership
Trust

Team 4


Please rate how you think your team performed with respect to each attribute of teamwork. Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent
5.3
5.4
5.5
5.6
5.7
5.8
5.9
6
6.1
6.2
6.3
Clear and Shared Goals
Clear and Understandable Roles
Effective Communication
Effective Leadership
Interdependence
Responsibility and Accountability
Trust
Appropriate Team Composition and Skillsets

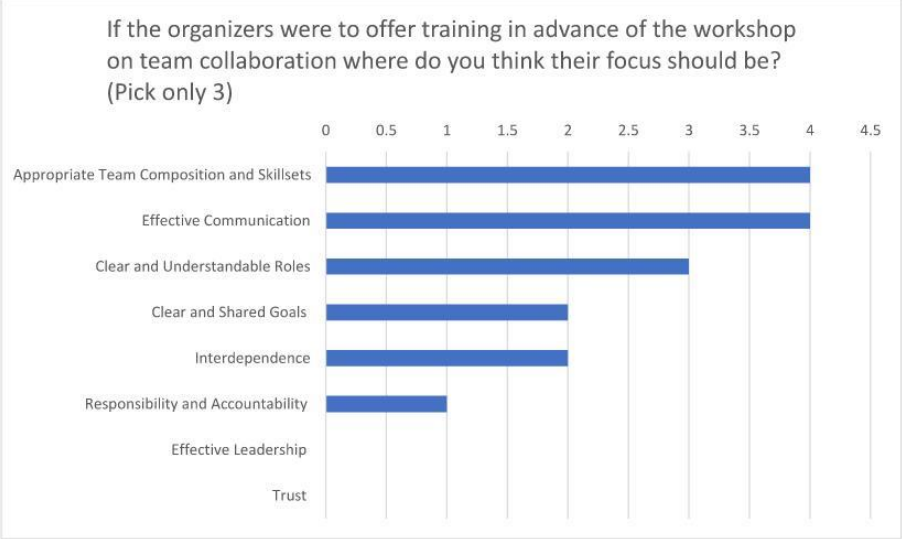

If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be? (Pick only 3)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Clear and Shared Goals
Appropriate Team Composition and Skillsets
Clear and Understandable Roles
Effective Communication
Effective Leadership
Interdependence
Responsibility and Accountability
Trust

Team 5



Note: Team 5 won third place in the completion

Team 6



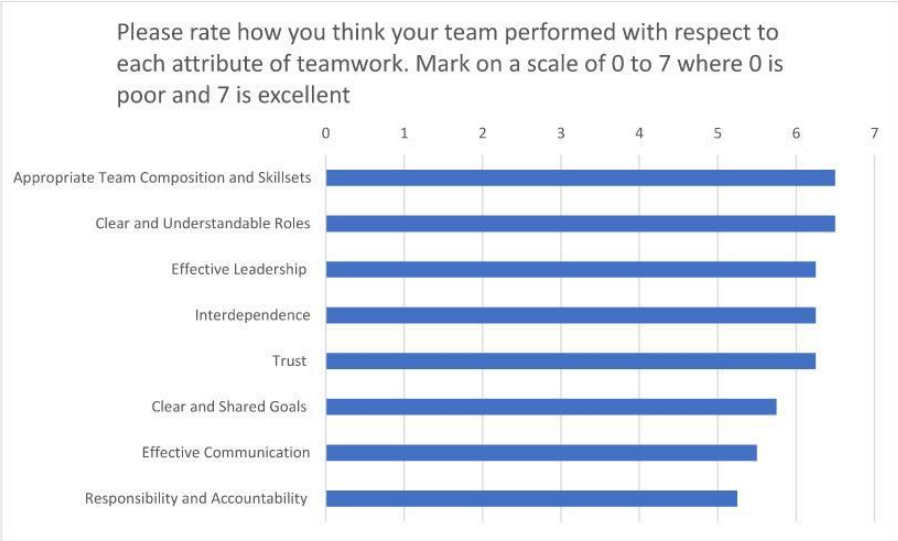
Note: Team 6 won first place in the completion

Team 7


Please rate how you think your team performed with respect to each attribute of teamwork. Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent
5
5.2
5.4
5.6
5.8
6
6.2
6.4
Clear and Understandable Roles
Interdependence
Effective Communication
Effective Leadership
Responsibility and Accountability
Trust
Clear and Shared Goals
Appropriate Team Composition and Skillsets


If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be? (Pick only 3)
0
0.5
1
1.5
2
2.5
3
3.5
Appropriate Team Composition and Skillsets
Clear and Shared Goals
Clear and Understandable Roles
Effective Communication
Effective Leadership
Interdependence
Responsibility and Accountability
Trust

Team 8



Note: While Team 8 did not receive an award, it ranked in fourth place in the competition.

Team 9


Please rate how you think your team performed with respect to each attribute of teamwork. Mark on a scale of 0 to 7 where 0 is poor and 7 is excellent
0
1
2
3
4
5
6
7
8
Effective Leadership
Responsibility and Accountability
Clear and Shared Goals
Interdependence
Trust
Effective Communication
Appropriate Team Composition and Skillsets
Clear and Understandable Roles


If the organizers were to offer training in advance of the workshop on team collaboration where do you think their focus should be? (Pick only 3)
0
0.5
1
1.5
2
2.5
Effective Communication
Responsibility and Accountability
Appropriate Team Composition and Skillsets
Clear and Shared Goals
Clear and Understandable Roles
Effective Leadership
Interdependence
Trust