Exploring the connection between transdisciplinary co-production and urban sustainability solutions: a case study at an urban stream management symposium

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Abstract
Urban sustainability challenges are complex, impacting a wide range of stakeholders. It is commonly accepted that sustainable solutions must integrate scientific knowledge from a variety of disciplines, coupled with community stakeholder ideas, norms, and practices in ways that link knowledge to decision-making and action. Jointly researching problems and co-designing solutions, known as co-production, requires working together in teams. Interestingly, the intersection of co-production and team science has been understudied. We address this gap by asking: Does team formation – specifically, single-, multi- or trans-disciplinary teams – impact the process and perceived efficacy of sustainability solutions? Using case study data collected at the 5th Symposium for Urbanization and Stream Ecology (SUSE5), held in February 2020, we explore the impact of bringing different types of teams together to generate solutions to real-world “wicked problems” surrounding urban streams in Austin, Texas. We found that the solutions generated by trans-disciplinary teams – i.e., teams that include multiple disciplines and community members – were on average rated higher by their peers than solutions from single- or multi-disciplinary teams. However, our findings suggest that some transdisciplinary teams found it difficult to get through the different stages of problem definition to solution design. The findings from this limited but novel and unique case study make two important contributions to the literature. First, co-production leads to more agreeable solutions to urban sustainability challenges. Second, co-production team dynamics are likely to be more complicated and variable than disciplinary or multidisciplinary teams. A better understanding of these opportunities and challenges can inform institutions and agencies employing a community-engaged process to solve urban sustainability challenges.

Keywords Urban sustainability · Co-production · Transdisciplinary research · Community engagement

Introduction
Urbanization is one of the most significant trends of the twenty-first century with nearly 68 percent of the world’s population expected to live in cities by 2050 (United Nations 2018). One projection suggests that, in the next decade alone, the population of world cities will increase by approximately 2.6 billion people (Bai et al. 2018a, b). The environmental implications of rapid urbanization are profound and far reaching, with the impacts often outpacing population growth. Cities are both a driver and main bearer of the most concerning social and environmental challenges – climate change, public health, resource availability – at local and regional and global scales (Grimm et al. 2008). Addressing these urban challenges necessitates balancing multiple, often conflicting, objectives with limited resources: equitable communities, economic development, sufficient food, water and energy, opportunities for recreation and renewal, and reduced risks to climate-related natural hazards (Bixler et al. 2019b; Keeler et al. 2019).

Yet, urbanization also brings about a window of opportunity for knowledge co-production and the implementation of innovative sustainability solutions. Urban areas are not only
the grounds of experimenting with new technologies, but also with new systems-level approaches towards livability, equity, sustainability and resilience (Bai et al. 2016). There is broad agreement that in order to solve contemporary urban challenges and build resilient communities, researchers, policy-makers, practitioners and other city stakeholders need to strengthen partnerships and jointly produce knowledge and solutions together (Bai et al. 2018a). Academic and non-academic partnerships and community engagement intersect at the idea of co-production. As a framework to address the complex nature of contemporary sustainability challenges, co-production emphasizes collaboration between scientists and stakeholders to create action-oriented knowledge that supports societal change (Wyborn et al. 2019; Jagannathan et al. 2020; Norström et al. 2020). The current concept – converged from public administration, science and technology studies, and sustainability studies – suggests that for knowledge to be actionable, the production of science should occur collaboratively to define important questions, identify relevant evidence, and co-create convincing forms of argument (Miller and Wyborn 2020).

Jointly researching problems and/or co-designing solutions – different modes of co-production (Chambers et al. 2021) – requires working together in teams. Interestingly, the intersection of co-production and team science has been understudied. Team science emerged from the necessity of solving complex problems by working together across disciplinary boundaries (Ledford 2015). More limited in scope than co-production research, team science focuses on understanding the dynamics of cross-disciplinary research collaboration. Frameworks from team science can inform co-production as they direct attention towards interpersonal processes of scientific collaboration (Milojević 2014; Nancarrow et al. 2013; Fiore 2008). Constructs such as trust, openness, communication, collaboration, conflict, and shared cognitive models are key variables studied as teams composed of different disciplines and perspectives move through the research process (National Research Council 2015; Cassidy and Stanley 2019; White et al. 2019; Delice et al. 2019; Nagy et al. 2020). These concepts apply equally to cross-disciplinary collaboration and co-production, as they both require complex social and cognitive processes.

In this research, we explore transdisciplinary co-production of urban stream sustainability solutions at the 5th Symposium of Urban Stream Ecology (SUSE5). SUSE5 was designed to examine real world urban stream problems and provide a unique opportunity to think about urban sustainability solutions that integrate scientific knowledge from multiple disciplines alongside community ideas, norms, and practices; i.e., the process of co-production (Norström et al. 2020). This design provided a unique opportunity to explore how team composition (e.g., disciplinary, multidisciplinary, or transdisciplinary) and problem complexity interact, enabling a wider consideration of the opportunities and challenges of co-production for sustainable urban ecosystems. Broadly, three predictions guided our work: (1) that disciplinary teams will exhibit the easiest work collaboration process, (2) transdisciplinary teams will achieve higher-rated solutions, and (3) that the quality of team working dynamics will be positively correlated with the rating of their solutions.

The structure of this article will proceed as follows. First, we’ll discuss the methodology and background on the SUSE5 conference, how the teams were formed, the structure and logic of the sessions, and the measurement strategies for the intra-team process and the solutions scores. We’ll revisit some of the high level predictions that guided our analysis and then present the results, followed by a discussion that integrates what we learned in the context of transdisciplinary co-production.

Methods

The SUSE5 conference – held in Austin, Texas in February of 2020 – was intentionally designed to compare the process and solutions among different compositions of teams. The goal of intentionally designing these teams was to document the potential differences between different team types by the quality of the process (e.g., How did teams vary in terms of communication, establishing trust, and exchanging information?) and the quality of the solutions (e.g., Did teams including community representatives produce concepts that were more community-centric than teams that lacked community representation?). The foundation for asking these questions was the team formation strategies.

Team formation

Each SUSE5 conference registrant was assigned to one of three teams with different compositions – disciplinary, multidisciplinary, or transdisciplinary. The size of the teams was determined by creating groups sufficiently small for effective interactions while allowing richness of perspectives and disciplines to be incorporated particularly for the transdisciplinary teams (Littlepage and Silbiger 1992). This led to teams of approximately 10–12 SUSE attendees per group. Teams were intentionally structured either as disciplinary (e.g., all biologists or all engineers), multidisciplinary (e.g., a combination of biologists, engineers, planners, etc.), or transdisciplinary (combination of different disciplines and community members). The teams were assigned one of four real world urban stream problem locations (sites hereafter). In total, there were 12 teams. Each of the four sites in Austin had a disciplinary, multidisciplinary, and transdisciplinary
team working to develop solutions for the urban stream problem specific to that site.

Given the nature of conference registration, team design was constrained by the disciplines of registration participants. The conference organizers sought to diversify the backgrounds of attendees by offering grants to non-traditional SUSE disciplines (planning, sociology) and by actively recruiting outside of engineering, biology, and ecology. Registration fees and small stipends were also offered to community members who attended and participated in SUSE5. As a result, each multidisciplinary team had three or four engineers, three or four biologists, and three or four representatives from social or planning sciences. Transdisciplinary teams included a minimum of 3 community members and a near balanced distribution of engineers, biologists, and disciplines other than engineering/biology.

Each team had two assigned facilitators, as well as one City of Austin staff that was familiar with the site. Facilitators and local experts were identified a priori by the symposium organizers as people who were familiar with urban streams science and known as good communicators with some facilitation experience. All group facilitators attended a two-hour training session that clarified facilitator strategies and goals.

Sessions

The symposium program was designed with four sessions where teams worked together to address the challenges and identify solutions for their assigned site. Each program session was structured around the primary functions of the research process: problem identification, problem analysis, and embeddedness of the results in context (Pohl and Hadorn 2007; Pohl 2008; Lang et al. 2012; Bixler et al. 2019a) and proceeded sequentially throughout the SUSE symposium. In this order, the conference facilitated work sessions and time allocated for each session, which included:

1. Team formation and problem identification (1.5 h)
2. Problem structuring, analysis of available GIS and other data, and identifying project objectives and associated values (2 h)
3. Visiting the site in a field trip (3.5 h) and
4. Revising initial thoughts and ideas, refining proposed solutions and preparing a presentation (2 h)

In addition to the work sessions designed around stages of the research process, the symposium program included plenary sessions on the concepts of wicked problems (Brown et al. 2010; Lönngren and van Poeck 2021) and structured decision making (Gregory et al. 2012; Runge 2020). These plenary sessions were designed by conference organizers to inform the works sessions. Each work session was assigned a stage number: work session 1 = stage 1; work session 2 and 3 = stage 2; and work session 4 = stage 3. Hereafter, we will refer to the “stages” rather than specific work sessions.

Measurement

At the end of each stage, conference participants were given a brief paper survey that used a seven-point Likert scale from strongly disagree to strongly agree to ask questions related to the process and quality of team interaction. Other seven-point Likert questions ranged from “never” to “every time”. The paper surveys were completed at the end of the work session and incentivized through symposium “meal tickets”, which encouraged a very high response rate (> 90% for each stage). Surveys were anonymous but participants were asked to provide their team number that was a unique identifier for their combination of site and team composition. Table 1 includes a summary of questions, item means, and standard deviation. Questions 1.1–1.4 were asked after stage 1; questions 2.1–2.6 were asked after stage 2; and questions 3.1–3.4 were asked after stage 3.

The team science literature was informative for the question design. Questions were mapped on to a conceptual framework that guided the inquiry related to effective team interaction and process (Fig. 1).

The paper surveys were collected by conference organizers and recorded into excel spreadsheets after the conference was concluded. One process rating score for each team at each stage was computed by taking an arithmetic mean of all team members answers to the survey questions. One cumulative team process score was computed by combining process ratings across all three stages for each team.

One of the last sessions of the SUSE symposium was designated for each team to present to the rest of the symposium attendees the outcomes they generated at the end of each work stage, as well as the proposed solutions for their case study site. During each of the 12 presentations, conference participants were asked to rate the solutions to the urban stream problem presented by other teams. Participants did not rate their own team solution(s). Each attendee scored other groups on a 5-point Likert scale from strongly disagree (1) to strongly agree (5) with a neutral option (see Table 2). The paper surveys were handed out prior to the symposium session and collected after the session. The data was recorded in an excel spreadsheet and each team received one solution rating score based on the arithmetic mean of all ratings received.

Guiding predictions

Our data analysis was guided by three broad predictions based on our understanding of the team science and co-production literature.
Prediction 1: Disciplinary teams will have an easier time working together and thus will have higher intra-team ratings than other team types.

Prediction 2: The solutions presented by the transdisciplinary teams will be rated higher by peers.

Prediction 3: Team working dynamics (intra-team process rating scores) will be correlated with solution ratings.

Given the design and data, we were able to explore these general relationships.

Data analysis

We used three data analysis techniques performed in R (Zamora Saiz et al. 2020): ANOVA, Pearsons correlation, and regression analysis (Delice et al. 2019). One-way
ANOVA, using R’s aov() function, was used to compare team types and process ratings (prediction 1) and team types and solution ratings (prediction 2). Pearson correlation (r) and linear regression were used to assess the relationship between process ratings, team composition and the solutions rating (dependent variable). Correlation test was done using the cor.test() function in R. Our linear regression model also used the solution ratings as the dependent variable and regressed that by each team’s cumulative (across all stages) average process rating and team composition type. We included each team’s site in the model as a control. The linear regression was conducted using R’s lm() function (Sheather 2009).

Results

Using our predictions to guide the analysis, we found that multidisciplinary teams, rather than disciplinary teams, reported working better together than other team types and that the solutions proposed and presented by transdisciplinary teams were rated the highest by non-team member peers. We also found a mixed relationship between intra-team ratings and solutions ratings. These results are discussed below.

The process (prediction 1)

We predicted that the process ratings would be internally rated higher by disciplinary team members than multidisciplinary teams or transdisciplinary teams. On average, we found that the multidisciplinary teams had the highest average intra-team process rating (5.67) and lowest variability (standard deviation of 0.06), followed by disciplinary teams (5.61), and then the transdisciplinary teams (5.60) (Table 1; Fig. 2). The one-way ANOVA test indicates that the differences between the mean ratings of the process by team type were not statistically significant ($F(2,9) = 0.0112, p = .881$). However, as Fig. 2 illustrates the variability of ratings was much higher in the transdisciplinary groups relative to other team types (a standard deviation of 0.33). A Bartlett test of homogeneity of variances (Arsham and Lovric 2011) resulted in a p-value of 0.039, less than the significance level of 0.05. This means that there is evidence to suggest that the variance in intra-team process ratings is statistically significant between the three team types.

In addition to comparing the process ratings between team types, we analyze the process ratings over time, by each stage that conceptually correspond to the different stages of the process (team formation, problem identification and structuring, and problem analysis). Across all team composition types, the overall mean ratings of the process were higher after the problem identification and structuring (stage 2) than either stage 1 or stage 3 (Table 3). The one-way ANOVA test indicates that the differences between the mean ratings of the process by stage were statistically significant ($F(2,33) = 5.76, p = .007$). The Tukey HSD test provides statistical evidence that the mean ratings between stage 1 and stage 3 are not statistically significant ($p = .99$), but the difference between stage 1 and stage 2 ($p = .014$) and between stage 2 and stage 3 ($p = .017$) are statistically different.

Combining the analysis of team type by process rating with the team type by session (Fig. 3) we can observe a “process peak” in stage two for the disciplinary and multidisciplinary teams with significant variability across the stages for the transdisciplinary teams.

The solutions (prediction 2)

We predicted that the solutions presented by the transdisciplinary teams will be higher rated by peers than solutions developed by disciplinary and multidisciplinary teams. Our hypothesis was accurate, as transdisciplinary teams received higher solution ratings ($4.33 ± 0.23$) compared to the multidisciplinary ($3.97 ± 0.33$) and disciplinary ($3.84 ± 0.44$) teams (Table 3 and Fig. 4). The mean solution rating differences were statistically significant between the team types (ANOVA: $F(2,9) = 5.29, p = .03$). The Tukey HSD test provides statistical evidence that the mean difference between disciplinary and transdisciplinary team types of 0.445 is statistically different ($p = .027$).

Table 2 The “solution” survey questions. Conference participants rated the solutions of other teams using questions S.1-S.5

| Q No. | Question                                                                 | N  | Range | Mean  | SD  |
|-------|---------------------------------------------------------------------------|----|-------|-------|-----|
| S.1   | …realistic and feasible                                                  | 83 | 1–5   | 4.16  | 0.69|
| S.2   | …like it has benefits that would outweigh the costs                      | 83 | 2–5   | 4.04  | 0.70|
| S.3   | …like it could be sustainable over the long-term                         | 83 | 2–5   | 4.02  | 0.71|
| S.4   | …like it would be seen as a benefit by residents in nearby neighborhoods  | 83 | 1–5   | 4.19  | 0.78|
| S.5   | …innovative and creative                                                 | 83 | 1–5   | 4.00  | 0.85|
Correlation between process and solution (prediction 3)

We predicted that teams with a higher rated process scores (internal team ratings) will have higher rated solutions (peer ratings based on presentations). There was no association between the team process ratings and the solution ratings using a Pearson correlation test ($r (10) = -0.02$, $p = 0.9477$).

We further tested this relationship by use of linear regression using the solution rating score as the dependent variable. Table 4 shows the result of the linear regression and the team process rating coefficient of 0.24 has a non-statistically significant relationship with solution ratings. The results of the regression model confirm the positive relationship between being a transdisciplinary team and solution ratings. Based on the linear regression model, the effect of being a transdisciplinary team increased the solution rating score by 0.45 ($p < 0.05$) relative to the average of a disciplinary team solution score. For this model, we controlled for the differences to the process that may be introduced by different sites (by including site as a control variable).

Discussion

Although the promise of co-production to address urban environmental challenges is compelling and research in this area has grown tremendously, concerns and challenges abound. Scholars question the gap between co-produced knowledge and implementation in practice, how power is balanced and traditionally marginalized actors are empowered, and the applicability of co-production frameworks beyond the context in which they are implemented (Chambers et al. 2021; Jagannathan et al. 2020; Belcher

Table 3 Mean ratings and standard deviations by group and by stage

| Team Type          | Stage 1 (problem definition) | Stage 2 (problem structuring) | Stage 3 (analysis) | Combined process ratings (mean of three stages) | Mean solution ratings |
|--------------------|------------------------------|-----------------------------|--------------------|-------------------------------------------------|----------------------|
| Disciplinary       | 5.52 (0.17)                  | 5.96 (0.09)                 | 5.36 (0.25)        | 5.61 (0.13)                                     | 3.84 (0.44)          |
| Multidisciplinary  | 5.49 (0.05)                  | 5.90 (0.16)                 | 5.63 (0.14)        | 5.67 (0.06)                                     | 3.97 (0.33)          |
| Transdisciplinary  | 5.55 (0.36)                  | 5.67 (0.55)                 | 5.59 (0.36)        | 5.60 (0.33)                                     | 4.33 (0.23)          |
| All team types     | 5.52 (0.21)                  | 5.84 (0.33)                 | 5.552              | (0.23)                                          |                      |
et al. 2019; Wyborn et al. 2019; Lemos et al. 2018). Broad conversations exist regarding evaluation of co-production processes (Wall et al. 2017) and, somewhat uncritically, the literature suggests that co-production will lead to positive outcomes (Lemos et al. 2018) but few long-term assessments of scientific and societal impacts exist.

SUSE5 intentionally designed many of the key inputs for successful co-production (as discussed by Wall et al. 2017; Norström et al. 2020): The research teams included the necessary scientific disciplines, time explicitly set aside for collaborative team work, participation by targeted community members with site specific local knowledge integrated at the start of the process, and goal-oriented and context-based processes. Thus, SUSE5 provided a novel context and unique research design to consider how transdisciplinary teams work to solve urban sustainability challenges and how that compares to other team types. The “solution output” that co-production SUSE teams developed (transdisciplinary) were rated higher than their multidisciplinary and disciplinary team peers (Fig. 4). One possible explanation is that, in comparison to the disciplinary and multidisciplinary teams, solutions that came from the transdisciplinary co-production teams were broader in scope and included social marketing (“brand the creek”), environmental justice (suggestions that the watershed protection department could fund the equity office to be included in projects), and community engagement (and using projects to build neighborhood cohesion) considerations. Contrasted with disciplinary and multi-disciplinary teams, the transdisciplinary solutions presented merged “ideas, norms, practices, and discourses” and “united ways of knowing and acting” (Wyborn et al. 2019) in ways that combined engineering and biological

Fig. 3 Average ratings of the process by team type and by stage

Fig. 4 Average peer rating of group solutions by team composition type
perspectives with equity and community. In this context, the transdisciplinary teams demonstrated the promise of co-production of integrated solutions to complex problems.

It is difficult to know if the solutions generated by transdisciplinary co-production teams were “better” by more traditional economic (cost–benefit), ecological health, or engineering standards. However, on average, the transdisciplinary team generated solutions were subjectively rated as better solutions to the different urban stream problems considered. This aligns with existing theory and literature that suggests co-production processes lead to pragmatic, tangible, and proximate solutions that have broader public support since they include those affected by resulting recommendations in the process (Chambers et al. 2021; Jagannathan et al. 2020; Wyborn et al. 2019). We hypothesize a “social placebo effect” where community co-produced solutions, regardless of their technical feasibility, are perceived to be beneficial.

This idea of social placebo effect is important since in most cases, a disciplinary solution, such as one primarily engineering or biological, should work in the sense that technical performance can meet the criteria as determined through a specified plan. However, all too often, municipal design exercises consider the operating environment out of context. Ultimately, the intervention is placed in a community and low levels of community support can result in project failure because a community may lack the institutional knowledge, workforce available, or motivation to operate and maintain the engineering intervention as anticipated during planning and design phases. On the contrary, when solutions are co-produced, early alignment of local values and preferences with technical needs are considered in the intervention, allowing the solution to be more widely adopted and sustainably fit within the fabric of community—i.e., the operating environment. The co-produced solutions are likely deemed more appropriate, since these considerations are built into the solution, creating a tailored alternative that meets the engineering and natural system needs while aligning with the community vision.

However, the intra-team assessment of the process within the transdisciplinary teams was quite variable (Fig. 2). There was higher variability in all stages of the process rated by the transdisciplinary teams (Table 3 and Fig. 3). This is consistent with team science literature that emphasizes effective teamwork and collaboration is based on three influencing conditions: composition, culture, and context (Salas et al. 2015). Differences in knowledge, skills, and attitudes (composition), situational characteristics that influence the meaning of behavior (context), and assumptions about an individual’s values, beliefs, norms, etc. (culture) are known barriers to team interaction (Delice et al. 2019). Each of these barriers impact openness, trust, communication, information sharing, etc. (conceptual model, Fig. 1) that are important for team dynamics throughout the research process. Dynamics that take time to develop were significantly compressed into the timeframe of the SUSE5 symposium.

This variability among the process ratings of the transdisciplinary teams might be explained by the differences in values and priorities that arise when co-designing solutions with communities and engaging in participatory processes. It could be that trust was slow or didn’t develop well in the transdisciplinary groups, or that alignment of the problem/solution never occurred. Compared to transdisciplinary teams, disciplinary and multidisciplinary teams likely had more initial convergence around technical knowledge content and the relationship between individual knowledge components, an important factor or team success (Cassidy and Stanley 2019).

Another possibility is that a common vocabulary, understanding of the task at hand, and the mechanics of the exercise may take longer to develop in transdisciplinary teams. Known challenges around power, value conflicts, and conflicting worldviews are all considerations that may have made the process of transdisciplinary solution generating difficult. Generally, co-production aspires to empower traditionally marginalized actors and democratize expertise, although more attention has recently been given to the role of power in shaping process and outcomes (Turnhout et al. 2020).

Interestingly, we found no relationship between the average process scores (intra-team) and solution ratings (as rated by peers not part of team). This is likely an artifact of the

| Table 4 SUSE Solution Rating, Team Composition, and Team Process | Dependent variable: Solution Rating Score Coefficient (standard error) |
|---------------------------------------------------------------|-----------------------------------------------------------------|
| Team Process Rating                                           | 0.24 (0.42)                                                     |
| Multidisciplinary                                             | 0.13 (0.15)                                                     |
| Transdisciplinary                                             | 0.45** (0.14)                                                   |
| Site 2                                                        | -0.12 (0.17)                                                    |
| Site 3                                                        | 0.17 (0.18)                                                     |
| Site 4                                                        | 0.14 (0.22)                                                     |
| Constant                                                      | 2.62 (2.45)                                                     |
| Observations                                                  | 12                                                             |
| R2                                                           | 0.73                                                           |
| Adjusted R2                                                   | 0.40                                                           |

*p; **p; ***p < 0.01
research design, but warrants more investigation and emphasizes a broader need to better understand the connection between a quality of process and effectiveness of outcomes (Chambers et al. 2021).

Limitations and conclusions

Our findings, while interesting and insightful, are constrained by limitations of our data and design. First, our framing of co-production is limited to what Jagannathan et al. (2020) refer to as scope 1 outcomes that relate to understanding, utilization, action, and community. Our framing of co-production did not include considerations of broader transformative or radical changes to the science-society relationship (scope 2 outcomes in Jagannathan et al. 2020). Second, although each type of team worked on each site, there is variability in the complexity of the problem at each site that may have been an influence on the process and/or solution rating (although site is controlled for in the regression model in Table 4 and has no statistically significant effect). It may be that the complexity of the site or other exogenous variables help explain the variation in process ratings of the transdisciplinary co-production teams. Third, although the configuration of teams in disciplinary and multidisciplinary teams attempted to group participants given their self-reported background, the reality is that many do have multidisciplinary backgrounds and may wear ‘more than one disciplinary hat’ when examining problems and ideating solutions. Therefore, the separation of ‘disciplinary’ and ‘multidisciplinary’ may not be as clear as desired. Fourth, the different facilitation and/or leadership styles that emerged in the teams may have significantly shaped process outcomes (and differences in facilitation was not a factor we controlled for in our analysis). Lastly, the ‘controlled’ environment of SUSE is not how co-production and community-engaged processes play out in actual urban planning projects.

The ideas generated from the meeting have been shared with City staff, who have followed up with community representatives, conducted staff interviews, etc. to continue the evaluation of potential solutions within the City’s project development structure. Our case study of transdisciplinary co-production at SUSE5 demonstrates the potential to counter the traditional model where decisions proceed from goals provided by elected officials, followed by the rational and empirical formulation of plans by experts, then by city staff implementing the plans (Innes and Booher 2010). By contrast, this work shows that – although the process may be more complicated – co-producing assessments and solutions in transdisciplinary teams can likely generate legitimate and socially acceptable plans that can advance urban sustainability.

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Availability of data and material (data transparency) Available upon request.

Code availability Available upon request.

Declarations

Ethics approval The University of Texas Institutional Review Board was consulted prior to this project. The project was deemed a case study and not applicable for IRB review.

Consent to participate Not applicable given case study status.

Consent for publication Not applicable.

Conflicts of interest/competing interests No conflict of interest to report.

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