



Research article

Interfacing triple bottom line sustainability and metropolitan governance: An empirical exploration of stakeholder value co-creation and conflict

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ABSTRACT

The importance of metropolitan governance and stakeholder collaboration in sustainable urban development (SUD) is well recognized. However, collaboration among stakeholders is dynamic, and the relationship between metropolitan governance and stakeholder dynamics, including value co-creation and conflict, remains underexplored. This study aims to address this gap by examining the causal relationships among metropolitan governance, stakeholder value co-creation and conflict through the lens of the triple bottom line (TBL) of sustainability. Using a questionnaire survey, this study collected 467 valid responses through a combination of probability and quota sampling and analyzed the data using Structural Equation Modeling. The results indicated that stakeholder value co-creation is positively influenced by TBL dimensions and metropolitan governance, thereby simultaneously promoting SUD and generating potential conflicts that constrain SUD. The study further evaluated the effectiveness of stakeholder value co-creation as a mediating variable and found that it has a unique suppressing effect on the relationship between environmental sustainability and conflict. The findings suggested that environmental sustainability-driven governance initiatives are crucial to containing conflict and fostering value co-creation among stakeholders. Theoretically, this study enriches the discourse on SUD literature by quantifying the interactions between TBL, metropolitan governance and stakeholder dynamics. Practically, it provides certain implications for relevant practitioners by proposing an argument that governance initiatives can be aligned with the shifting priorities toward environmental sustainability.

1. Introduction

In recent decades, the concept of sustainable urban development (SUD) has catalyzed extensive discourse and research in urban studies [1]. SUD is perceived as a holistic approach to urban progress [2], aiming to harmonize economic growth, social inclusivity, and environmental preservation, guided by the triple bottom line (TBL) theory, which emphasizes balancing these three dimensions to meet the needs of both present and future generations effectively [3,4].

With urban areas expanding, the spatial and functional interrelations between cities, their surrounding rural areas, and neighboring cities have increased, extending beyond administrative and political boundaries and gradually giving rise to a metropolitan scale [5].

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In this complex context, the correlation between metropolitan governance and SUD has increasingly captured public and academic attention [5,6]. Several studies argue that metropolitan governance, characterized by cross-jurisdictional coordination and inclusive policy-making, is instrumental in realizing SUD goals, as it involves managing and aligning resources, strategies, and actions across various urban sectors and geographies, ensuring an integrated approach to urban challenges [7,8].

Nevertheless, holistic SUD requires more than policy adjustments or governance enhancements; it necessitates the collaboration of diverse stakeholders to co-create value for urban sustainability [9–11]. Stakeholder value co-creation is a construct derived from stakeholder theory, in urban studies, it reflects the synergy among urban stakeholders and their satisfaction with the strategic objectives and actions of urban governance and management [12]. However, studies in the governance field have pointed out that stakeholder collaboration is dynamic and can lead to conflict when stakeholders diverge due to different priorities regarding resource allocation, decision-making processes, and the distribution of benefits and burdens, often exacerbated in a metropolitan setting [5,13]. Consequently, stakeholder dynamics in the context of SUD have been a focal point of scholarly debate, particularly concerning metropolitan governance issues [14–16].

Understanding the intricate interplay among these elements is critical for achieving SUD. Despite similar research outcomes reported worldwide, they do not explicitly reveal causal links or tell the whole story. Specifically, there are three research gaps: first, few studies simultaneously examine the relationship between metropolitan governance and stakeholder dynamics in promoting or inhibiting SUD; second, the mechanisms by which stakeholder value co-creation is influenced by economic, social, and environmental sustainability (i.e., TBL) towards SUD are underexplored; and third, the impacts of conflict as a product or byproduct of these interactive processes on sustainability outcomes are insufficiently examined.

According to these gaps, the present study, using the TBL, intends to investigate the causal relationships among metropolitan governance and stakeholder dynamics, including value co-creation and conflict through empirical investigation, thereby addressing the research question: How do metropolitan governance, stakeholder value co-creation and conflict, interact within the TBL framework to influence SUD? To achieve this, we propose three sub-objectives: 1) quantify the connections between metropolitan governance and stakeholder dynamics, including value co-creation and conflict, 2) clarify the role of TBL in shaping stakeholder value co-creation, and 3) identify the impact of conflict on SUD.

Furthermore, Structural Equation Modeling (SEM) was employed to capture the interactions between these elements and their impact on SUD. Its causal-predictive nature makes SEM particularly useful for performing in-depth predictive correlation assessments and the effectiveness of this approach in the SUD field has been confirmed by a series of previous studies [17–20]. Thus, SEM is a valuable method for substantiating the direct and indirect effects of these elements, offering a deeper understanding of the pathways or mechanisms that contribute to achieving SUD.

This study makes theoretical contributions in four ways. First, it integrates metropolitan governance and stakeholder dynamics into the TBL, revealing that environmental sustainability is a dominant factor in stakeholder value co-creation, thereby challenging the conventional equal weighting of TBL dimensions. This provides valuable implications for rethinking TBL by the fluctuating influence of each dimension based on specific SUD contexts. Second, this study redefines metropolitan governance as a crucial facilitator of stakeholder collaboration, emphasizing the comprehensive benefits of governance for stakeholder value co-creation, thereby advancing the theoretical discourse on multi-stakeholder governance. Third, the present study offers an insight into the dual-edged nature of stakeholders by exploring the value co-creation and conflict of stakeholders, challenging the predominant view within the existing literature that stakeholder value co-creation is an inherently positive phenomenon, thereby enriching discussions concerning the complexities of stakeholder interactions in metropolitan development. Fourth, the study offers a causal network that drives or hinders SUD by quantifying the interactions between TBL, metropolitan governance, stakeholder value co-creation, and conflict, contributing to providing theoretical insights for more effective and context-sensitive research on SUD mechanisms.

The structure of this paper is as follows: Section 2 presents the theoretical framework and associated research hypotheses. Section 3 details the data collection procedures and analytical approach. Sections 4 and 5 provided study findings and discussed the similarities and differences between our findings and those of prior studies point by point. Finally, the paper concludes with a discussion of the study's implications.

2. Literature review

2.1. Sustainable urban development and triple bottom line

Urban development and its links with sustainability have been discussed since the early 1990s in response to the impacts and challenges of rapid urbanization [2]. In this process, several theories have been developed to address these challenges, each offering

Table 1
Comparison of theories.

Theory	Dimensions		
	Social	Economic	Environmental
Urban Resilience	✓		✓
Smart Growth		✓	✓
Urban Regeneration	✓	✓	
Triple Bottom Line	✓	✓	✓

unique insights into SUD, and prominent among these are the Urban Resilience theory [21], Smart Growth theory [22], Urban Regeneration theory [23], and TBL theory [4]. As a comparison, Table 1 summarizes the applicable dimensions of these four theories.

Urban Resilience emphasizes the ability of urban systems to withstand and adapt to environmental and social changes [21]. This theory is advantageous for shaping urban policies that prioritize adaptability in the face of climate change and other environmental challenges [24]. However, it has been criticized for occasionally having a narrow focus that may neglect the broader economic dimensions of sustainability [25]. Smart Growth theory offers another perspective by focusing on efficient land use and promoting compact, transit-oriented urban development [22]. Its strength lies in reducing environmental impacts through efficient land use, but it often overlooks the socio-cultural dimensions of urban spaces, leading to challenges in inclusivity and equity [26]. In contrast, Urban Regeneration theory focuses on revitalizing urban areas for economic growth and improved quality of life. It often involves redeveloping underutilized or derelict spaces and integrating new urban functions [23]. While this approach can stimulate economic development and enhance urban aesthetics, it may lead to gentrification, potentially displacing existing communities [27]. Additionally, urban regeneration can sometimes prioritize economic goals over environmental sustainability, leading to unbalanced urban development [28].

These theories, while contributing valuable insights, are not fully suitable for SUD research involving stakeholder dynamics. This is because, in the urban development process, stakeholders choose to collaborate or diverge due to priorities, which are often influenced by multiple dimensions such as economic, social, and environmental [10,29,30]. Moreover, metropolitan governance, characterized by cross-jurisdictional coordination, also needs to consider urban development from a balanced perspective.

In this context, the TBL provides a more encompassing theoretical framework by expanding the focus beyond traditional economic measures to include social and environmental dimensions [4]. John Elkington [3] its originator, posited that these dimensions are intrinsically interlinked in urban development. Economic sustainability in the TBL theory implies practices that ensure long-term economic health and viability without negatively impacting social and environmental aspects. Social sustainability encompasses human rights, community engagement, and social justice, while environmental sustainability focuses on the impact of activities on the environment, ensuring the long-term health and quality of environmental resources [31]. Compared with the above theories, the TBL effectively integrates the economic, social, and environmental dimensions, advocating a comprehensive reconsideration of their interconnections in urban development to optimize its multi-dimensional trajectory with sustainability [1]. The last row of Table 1 highlights how the TBL differs from the other three theories.

While TBL is not without its limitations—such as its sometimes oversimplified application in complex urban settings—it provides a comprehensive foundation for analyzing urban development challenges [32]. The symbiosis between TBL and urban development has been cogently articulated in existing research [31,33,34]. Beatley [33] sharply criticizes urban developments that overlook the TBL, arguing that such myopic endeavors engender discord between human well-being and ecological prudence. This academic conversation is extended by Agyeman et al. [34], who introduce the concept of “Just Sustainabilities” to signify a form of urban development where social, economic and environmental dimensions coexist in a mutually beneficial nexus. Since TBL provides a more balanced perspective on urban development, it is an appropriate theoretical foundation for this study.

2.2. Metropolitan governance, stakeholder value Co-creation and conflict

Existing studies have posited that metropolitan regions have, in many respects, become practical testing grounds for strategies and programs, serving as crucibles for innovative approaches to urban development [30]. Within this surrounding, metropolitan governance has emerged as a critical field of study in the pursuit of SUD due to its capacity to foster adaptive governance [7,8]. Unlike traditional governance, which often operates within siloed jurisdictions, metropolitan governance refers to the institutional frameworks that regulate, manage, and govern sprawling urban regions, often transcending jurisdictional and administrative boundaries and formulating policies through a more heterogeneous, collaboration of stakeholders [29,35]. Such an approach is particularly relevant in polycentric urban areas, where administrative homogeneity is often impracticable. As the multi-stakeholder governance model proposed by Fougère and Solitander [36], posits that diverse stakeholder groups of decision-making can co-exist and cooperate, thereby enhancing governance efficiency.

In considering SUD and metropolitan governance, the contemporary definition of stakeholder is “who/which has the salience attributes of power, urgency, legitimacy, and proximity and simultaneously is affected or affects ... the goals of municipalities, (and) even the whole body of urban governance” [12, p.2]. According to Beck et al. [37], the range of urban stakeholders includes municipal bodies, local communities, non-governmental organizations, and citizens. Within this multi-stakeholder environment, the concept of “value co-creation” gains prominence. Ramaswamy and Ozcan [38] argue that value is not merely exchanged but co-created by multiple actors. This concept encapsulates the collective valuation estimates provided by each essential stakeholder group [39]. More specifically, stakeholder value co-creation occurs when organizational management and governance align with the needs and expectations of stakeholders, thereby fostering a synergistic relationship among them [37]. Consequently, stakeholder value co-creation denotes the synergy among urban stakeholders, emphasizing their satisfaction concerning the strategic objectives and actions of metropolitan governance and SUD [12].

However, as a public goal with broad impacts, SUD involves diverse stakeholder groups with different perceptions, bringing diverse value appeals and priorities to governance. Conflicts inevitably occur when stakeholder groups disagree over resource allocation, decision-making processes, and the distribution of benefits and burdens [40,41]. The ‘tragedy of the commons,’ a term coined by Hardin [42], elucidates the inherent conflict arising from shared resources, a problem often exacerbated in a metropolitan setting [5, 13]. Consequently, previous studies have debated stakeholder dynamics within the context of SUD, particularly regarding metropolitan governance. For instance, Ansell and Gash [14] argue that stakeholder value co-creation can heighten public trust and

streamline resource distribution, thereby reinforcing the bonds of metropolitan governance and promoting SUD. Conversely, Sørensen and Torfing [15] offer a counterargument, suggesting that stakeholder co-creation is fraught with tension, since the conflicts as a product or byproduct of stakeholder interaction processes can hinder collective initiatives and undermine governance, thereby constraining SUD.

2.3. Research hypotheses and conceptual framework

Several urban planning and governance studies acknowledge that the application of TBL contributes to enhanced stakeholder participation and achieves mutually beneficial outcomes, thereby promoting holistic sustainable development for urban [14,15,43].

According to Liashenko & Trushkina [44], adherence to economic sustainability facilitates optimal resource allocation and fosters public-private partnerships that contribute to sustained value creation [45]. By reconciling competing interests through aligning financial incentives (e.g., shared economic incentives) and community participation in a manner that transcends mere profit maximization [46], economic sustainability may be a drive of stakeholder co-creation.

Social sustainability, on the other hand, is instrumental in augmenting community participation and establishing more equitable urban frameworks [47]. Focusing on social imperatives helps foster a sense of community ownership, strengthening stakeholder relationships and collaborative initiatives [16]. The enhancement of social capital and trust among diverse stakeholders potentially facilitates value co-creation by promoting inclusivity, equitable access to resources, and participatory governance [48].

Furthermore, environmental sustainability encourages green practices and mitigating detrimental impacts on natural resources through initiatives such as green infrastructure, renewable energy implementation, and waste management optimization [49,50]. Such ecological initiatives are not merely acts of altruism, they propagate environmental stewardship as a shared responsibility and benefit, thereby potentially aligning stakeholder interests towards a common ecological value [49].

The above discussions underscore the potential for TBL to engender a multi-faceted, symbiotic relationship among stakeholders by harmonizing economic imperatives with social trust and environmental stewardship. Thus, based on the theoretical foundations and evidence presented in the literature, the present study proposes the following hypothesis.

- H1.** Economic sustainability has a positive influence on stakeholder value co-creation.
- H2.** Social sustainability has a positive influence on stakeholder value co-creation.
- H3.** Environmental sustainability has a positive influence on stakeholder value co-creation.

Through a systematic literature review, Nevens et al. [51] stated that the integrative and collaborative dimensions of metropolitan governance permit an array of stakeholders—including public bodies, private enterprises, and civil society organizations—to engage in dynamic dialogues, problem-solving, and resource pooling. The confluence of these factors engenders a form of "collaborative value" that surpasses what any single stakeholder could achieve in isolation [52]. Moreover, by providing a decentralized yet cohesive governance structure, metropolitan governance accommodates divergent perspectives and preferences, which contributes to fostering a culture of participatory decision-making and shared value creation [5,30]. On the other hand, the adoption of metropolitan governance is closely associated with socio-economic indicators, such as urban resilience, improved public services, and sustainability transitions [10,53,54], which potentially enhance stakeholder common value. Based on this synthesis of these contributions, the following hypotheses were formulated.

- H4.** Metropolitan governance has a positive influence on stakeholder value co-creation.

Innes and Booher [55] proposed a concept of "collaborative rationality" according to stakeholder co-creation, an advanced form of participatory governance that involves a diverse of stakeholders to form a collective intelligence and enhance by integrating different knowledge bases, values, and resources, thereby implementing more effective urban sustainability interventions [10,12,56]. Moreover, investigations by Ogu [9] and Li et al. [57] emphasize the role of stakeholder co-creation in infrastructural projects, noting that stakeholder involvement mitigates project risks and amplifies public trust. Therefore, stakeholder value co-creation may improve the effectiveness of SUD initiatives by fostering adaptive and localized solutions.

Nevertheless, the process of stakeholder value co-creation may give rise to conflicts due to differences in priorities, goals, and expectations among the various stakeholder groups [5,13]. For instance, in the context of SUD, urban space construction typically involves substantial initial costs for infrastructure development, as well as ongoing expenses for maintenance and upgrades [58]. These costs may strain the public budgets of municipal bodies and lead to conflicts over priorities and resource allocation [59]. In light of these controversial views, the present study formulates the following hypothesis.

- H5.** Stakeholder value co-creation has a positive influence on sustainable urban development.
- H6.** Stakeholder value co-creation is positively related to conflict.

Through empirical study, Sørensen and Torfing [15] acknowledged that conflict is a significant factor influencing the success of sustainable initiatives. Haoyu [59] further pointed out that conflict complicates economic sustainability by breeding uncertainty, inhibiting investment, and reducing collaborative opportunities integral to economic revitalization and innovation. Moreover, conflicts not only impose barriers to attaining consensus but also attenuate the efficacy of participatory governance mechanisms designed to coalesce disparate interests toward shared goals [13,60]. Within the field of sustainable construction, conflicts engender both material and immaterial costs, such as delays in project implementation and loss of public trust, respectively [57,61], thereby

potentially undermining social sustainability. Hence, the hypothesis was as follows.

H7. Conflict has a negative influence on sustainable urban development.

Researchers have posited that when stakeholders perceive the value generated from SUD initiatives and governance, they may be more inclined to collaborate and seek consensus [62,63], as stakeholders become more aware of the benefits associated with sustainable developments and their alignment with shared goals [59,64]. In this context, the function of stakeholder value co-creation may be as a mediator, transforming the positive impacts of TBL which encompasses economic, social and environmental sustainability, as well as metropolitan governance into collaborative efforts to promote the successful advancement of sustainable urban development.

However, prior studies have also underscored the potential for conflicts when stakeholders fail to co-create value due to differing objectives and perspectives [5,13]. More precisely, stakeholders including municipal bodies, local communities, and non-governmental organizations may not align with their objectives and priorities. These can relate to technology usage, resource distribution, and overarching aims of sustainable urban development [59,61,65]. These diverging goals among stakeholders may obstruct the successful execution of sustainable initiatives and governance, culminating in outcomes that are subpar in the context of sustainable urban development. Accordingly, the present study proposes the following hypothesis.

H8. Stakeholder value co-creation plays a mediating role between economic (a), social (b), and environmental (c) sustainability, metropolitan governance (d), and sustainable urban development.

H9. Stakeholder value co-creation plays a mediating role between economic (a), social (b), and environmental (c) sustainability, metropolitan governance (d), and conflict.

According to the discussions above, the conceptual framework that summarizes the hypothesized relationships has been developed, as shown in Fig. 1.

3. Materials and methods

3.1. Study area

Situated in Huangpu District, Shanghai, China serves as the empirical location for this investigation. Encompassing a geographical expanse of 20.43 square kilometers (7.89 sq mi) and 678,670 inhabitants, the Huangpu district stands as a paradigm within the

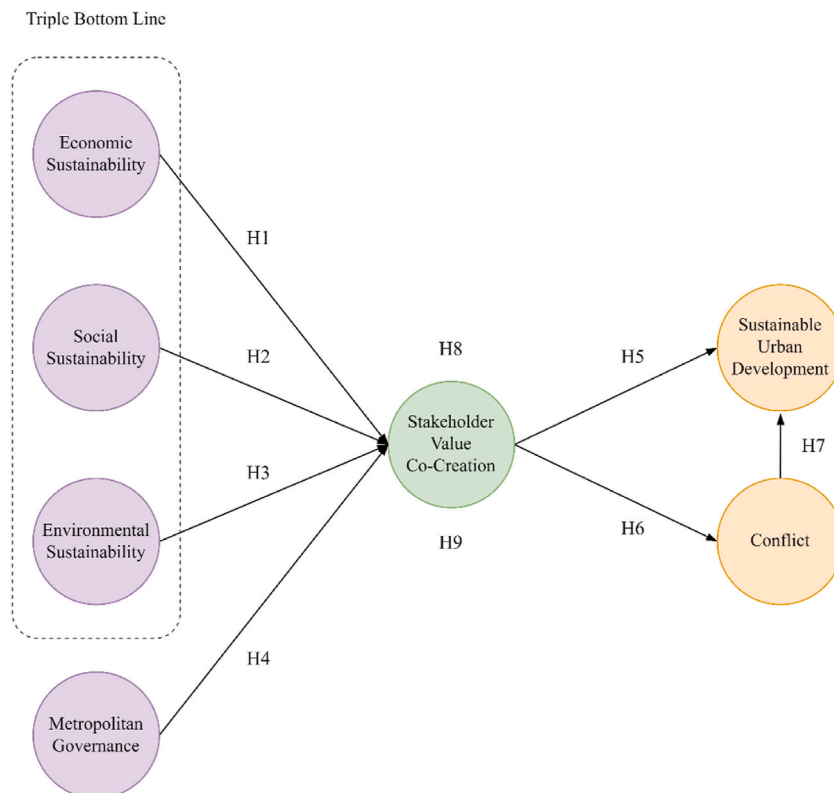


Fig. 1. Conceptual framework.

metropolis of Shanghai [66]. However, the district faces sustainable development challenges due to its growing transient population and aging demographic, resulting in a strain on urban spaces and infrastructure. In response, the Shanghai Government has instituted a multifaceted strategy for urban sustainability and governance in the Huangpu district, which manifests in 1) the spatial reconfiguration and optimization of extant micro-spaces and the metamorphosis of previously unapproachable urban fringes into accessible pocket parks; 2) infrastructural enhancements and aesthetic refinements; and 3) the edification of a shared administrative nexus that integrates municipal bodies from adjacent districts and engages the citizenry [67]. This series of sustainable initiatives covering metropolitan governance is a model development not only in Shanghai but across China, offering a compelling case for this study. Fig. 2 shows the location of the Huangpu District of Shanghai, China.

3.2. Measurement

This investigation employs a structured questionnaire as the data collection instrument, integrating a list of measurement items that match the crucial variables. Each item was derived from empirically validated scales present within the existing literature, ensuring reliability and relevance to the study's context. The details and information of the questionnaire are presented in the following.

- 1) *Economic sustainability*: Measured using Apak & Gürbüz's 4-item scale [68]. This scale assesses aspects related to the economic impact and efficiency of urban development initiatives, with items focusing on local employment opportunities, economic growth rate, income distribution equity, and investment in sustainable technologies. These items were chosen as they comprehensively represent key aspects of economic sustainability in an urban context [68].
- 2) *Social sustainability*: It is measured through items evaluating accessibility and effectiveness of education, community cohesion, healthcare affordability, and safety. These measurements were derived from Shen et al. [69], with slight modifications for context-specific relevance.
- 3) *Environmental sustainability*: This variable draws from the works of Apak & Gürbüz [68] and Shen et al. [69], with minor alterations for applicability to the current study. The measurements cover areas like carbon footprint reduction, water and air quality standards, and the effectiveness of renewable energy use and waste management, reflecting a comprehensive approach to environmental sustainability.
- 4) *Metropolitan governance*: Drawing from Borongan & NaRanong's scales [70], and evaluated in terms of public transportation efficiency, urban planning effectiveness, public involvement in governance, and transparency in governmental processes, highlighting key governance aspects that influence urban sustainability.
- 5) *Stakeholder value co-creation*: Measured with Asiedu & Iddris's 5-item scale [11], this variable captures stakeholder involvement in development projects, the effectiveness of public-private partnerships, community participation in decision-making, innovation in sustainability practices, and stakeholder satisfaction.
- 6) *Conflict*: Assessed using a modified 5-item scale from Park et al. [61], subject to slight modifications. This scale examines the nature, intensity, and implications of conflicts among stakeholders within urban development and governance, which encompasses the frequency and prevalence of land use, social inequality, environmental, governance, and resource allocation conflicts.
- 7) *SUD*: Measured based on Cohen's works [71] with minor modifications, which encompasses urban density optimization, infrastructure resilience, energy-efficient design, inclusiveness of social and economic policies, economic diversification, and effectiveness of environmental conservation initiatives. These items collectively provide a holistic view of SUD.

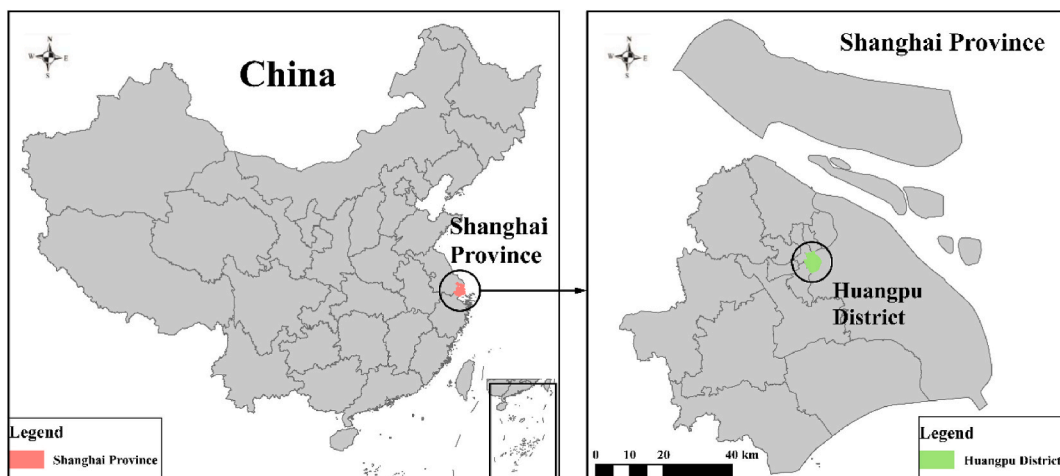


Fig. 2. Location of the Huangpu District, Shanghai, China.

All adopted scales were unidimensional and employed a 5 Likert format, with 1–5 indicating, respectively, "strong disagreement" to "strong agreement" with a positive statement. Complementary to these scales, respondents were prompted to provide fundamental sociodemographic details, inclusive of gender, age, educational level, and general attitude toward SUD.

3.3. Data collection procedures

To determine an appropriate sample size, we consulted several established guidelines. Hair et al. [72] recommend a ratio of 10:1 for sample size to measurement items. Given that this study involves 33 measurement items, requiring a sample size of over 330. Stevens [73] recommends a minimum sample size of 400 to ensure SEM sufficient statistical power and accuracy, reducing the likelihood of model specification errors. Additionally, we accounted for the potential need to moderately adjust the sample size according to model complexity and the number of measurement items per variable [74,75]. Taking these comments into account, we determined that a sample size range from 400 to 500 would be optimal for the purposes of this study.

The target population primarily comprises individuals residing or employed within the Huangpu district, as they are the largest stakeholder group for the Shanghai Government to implement urban sustainability initiatives in Huangpu District. Meanwhile, they are also in a position to assess the ultimate performance of governance. Still, we preferred to investigate people who participated in decision-making in metropolitan governance as citizens. The study employed quota sampling with probability sampling to achieve effective and secure data collecting. Probability sampling was utilized to provide equal opportunities for selecting SUD comments from stakeholders with diverse demographic backgrounds [72], whereas quota sampling was employed to ensure both security and effectiveness when collecting data [20]. Prior to data collection, the study received approval from the Academic Integrity and Research Ethics Committee of Guilin University of Technology (approval number: GLUTYS-2023-34).

This study employed a cross-sectional design for data collection. To ensure that the sampling process is probabilistic, we conducted random interviews with the public across various locations in the Huangpu District at different times between June 20 and July 26, 2023. Given the potential demographic differences between weekdays and weekends, our survey included responses from both periods to accurately reflect the diverse public population. The primary approach for completing the questionnaire involved digital submissions enabled via QR code scanning. To accommodate participants less familiar with digital platforms, in-person data collection was also provided. Participation was entirely voluntary and responses were collected anonymously. Each questionnaire was accompanied by an introductory letter to ensure respondents fully understood the terms used. A total of 500 questionnaires were distributed. During the data screening phase, 18 responses were excluded due to evident disinterest in the subject, indicated by completion times under 15 s as recorded by the online survey platform. Additionally, 15 responses were discarded due to incomplete data sets, resulting in a final count of 467 valid questionnaires.

3.4. Data analysis

In the data analysis phase, SEM was utilized to test the hypothesis. SEM is a variable-oriented technique based on causal inference primarily utilized for the construction of conceptual frameworks during exploratory research, alongside validating or refuting associated theories [72]. It conceptualizes independent variables as competitors vying to elucidate the variation inherent in the dependent variables, thereby providing an explanation of the interrelations among a series of variables [74,75]. Consequently, its deployment was deemed apt for the analytical requisites of this study. The SEM analysis was executed following Anderson & Gerbing's recommended two-step approach [76], encompassing the measurement model and the structural model steps.

The measurement model is dedicated to scrutinizing the relationship between measurement items and variables. This step involved conducting Confirmatory Factor Analysis (CFA) to assess the validity and fit of the proposed measurement model, ensuring that the measurement items accurately reflect the variables they are intended to measure. The assessment process includes convergent validity, discriminant validity, and goodness of fit [74–76].

The structural model is concerned with examining the causal link between the variables themselves. In this study, path analysis within the structural model was performed to test H1 through H7, exploring the direct relationships between variables such as TBL, metropolitan governance, stakeholder value co-creation, conflict, and SUD. This involved examining the standardized path coefficients to determine the strength and significance of the relationships among variables.

On the other hand, Bootstrapping was employed to conduct indirect or mediating effect analysis to test H8 and H9. Bootstrapping is a non-parametric resampling technique, that is usually used in structural models within the SEM since this approach provides a more accurate confidence interval and significance test for mediating effects in SEM [72]. In the structural model, the independent variable affects the mediator, which, in turn, affects the dependent variable. The mediation effect can be classified into full mediation, partial mediation, or no mediation, depending on the relationships among these three variables [76,77]. This step is crucial in understanding stakeholder dynamics and providing insights into the underlying mechanisms of SUD.

Furthermore, SEM was executed utilizing AMOS 28.0, meanwhile, SPSS 27.0 was applied to conduct descriptive statistics.

4. Results

4.1. Sample overview

The sample comprised a marginally higher proportion of males (51.4%) compared to females (48.6%). Regarding age distribution, the largest groups were individuals aged 26–35 (28.1%) and those aged 46–55 (26.6%), with the 36–45 age group following at 22.3

% . These figures indicate that the sample's gender and age distribution was balanced and stable. Table 2 presents the detailed respondents' demographic information.

4.2. Measurement model and CFA

The measurement model, encompassing all scales, was evaluated using CFA. To assess construct reliability, both Cronbach's α ($C\alpha$) and Composite Reliability (C.R) metrics were applied. Concurrently, convergent and discriminant validity were examined through factor loadings and Average Variance Extracted (AVE). The reliability analysis showed that Cronbach's α for all constructs was above 0.8, and C.R values also exceeded 0.8, indicating excellent reliability for the constructs [72,73]. The analysis of convergent validity demonstrated that factor loadings surpassed 0.7, while AVE values were above the established threshold of 0.5 [74,75], thus confirming robust convergent validity (see Table 3). Furthermore, the square roots of the AVE for each construct were higher than the correlations with other constructs, which further established their discriminant validity [74–76] (see Table 4).

The model fit can be evaluated using the following indices: Chi-square, degrees of freedom (df), Chi-square/ df , Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Tucker–Lewis Index (TLI), and Comparative Fit Index (CFI) [74–76]. As presented in Table 5, both the measurement model and structural model in this study exhibited an acceptable overall fit.

4.3. Structural model and hypothesis testing

4.3.1. Direct path analysis

Through the addition of hypothetical connections between the constructs, the measurement model was transformed into the structural model. The direct path analysis results of hypothesis testing are displayed in Table 6.

Results illustrated that ES had a positive influence on SVCC, with a path coefficient of 0.103 ($p < 0.05$). This implies that economic sustainability significantly contributes to stakeholder value co-creation, thus validating H1. Similarly, SS was positively related to SVCC with a coefficient of 0.102 ($p < 0.05$), confirming that social sustainability has a positive impact on stakeholder value co-creation, hence, H2 is accepted. Moreover, ENS exhibited the strongest effect on SVCC ($\beta = 0.497$, $p < 0.001$), indicating that environmental sustainability plays a substantial role in enhancing stakeholder value co-creation, reinforcing H3. MG also significantly contributed to SVCC ($\beta = 0.207$, $p < 0.001$), confirming H4, i.e., metropolitan governance has a positive influence on stakeholder value co-creation. Further analysis revealed that SVCC strongly influenced SUD ($\beta = 0.693$, $p < 0.001$), while also contributing to increased C ($\beta = 0.105$, $p < 0.05$), indicating that stakeholder value co-creation is positively related to both sustainable urban development and conflict; hence, both H5 and H6 are supported. In turn, C was shown to be negatively related to SUD ($\beta = -0.251$, $p < 0.001$). This implies that conflict has a significant negative impact on sustainable urban development, thereby confirming H7.

4.3.2. Mediating effects analysis

This study employs stakeholder value co-creation as a mediating variable. Utilizing the Bootstrap method, 5000 random resampled were executed on the dataset to test the mediating influence of stakeholder value co-creation on divergent pathways toward sustainable urban development and conflict (H8 and H9 respectively). The 95 % bootstrapped confidence interval (95 % Boot CI) for the estimated mediating effect was subsequently determined, with the results displayed in Table 7.

In the path from ES to SVCC to SUD, the indirect effect value of SVCC on SUD was 0.020, the 95 % Boot CI does not include 0,

Table 2
Overview of respondents' demographics (N=467).

Demographics	Frequency	Percentage (%)
Gender		
Male	240	51.4
Female	227	48.6
Age		
18–25 years	59	12.6
26–35 years	131	28.1
36–45 years	104	22.3
46–55 years	124	26.6
56 years and above	49	10.5
Education level		
Under Junior high school	62	13.3
High school	107	22.9
Bachelor's degree	110	23.6
Master's degree	138	29.6
PhD and above	50	10.7
What are your thoughts on sustainable urban development?		
Very Pessimistic	54	11.6
Pessimistic	121	25.9
Fair	138	29.6
Optimistic	116	24.8
Very optimistic	38	8.1

Table 3
Results of convergent validity and reliability.

Construct	Measurement Item	Factor loading	AVE	C.R	C α
Economic Sustainability (ES)	ES1. The local economy successfully generates ample employment opportunities.	0.886	0.633	0.873	0.870
	ES2. The annual economic growth rate in the area is satisfactory.	0.764			
	ES3. The distribution of income among different social strata is equitable.	0.764			
	ES4. Significant investment is made in sustainable technologies and practices.	0.759			
Social Sustainability (SS)	SS1. The educational system in the community is both accessible and effective.	0.855	0.678	0.894	0.893
	SS2. There exists a strong sense of community and social belonging.	0.812			
	SS3. Healthcare services are both accessible and affordable.	0.805			
	SS4. The community is generally safe and has a low crime rate.	0.820			
Environmental Sustainability (ENS)	ENS1. The community actively engages in efforts to reduce its carbon footprint.	0.839	0.598	0.881	0.880
	ENS2. The quality of water in the area meets or exceeds standards.	0.795			
	ENS3. The air quality in the area is satisfactory and poses no health risks.	0.711			
	ENS4. Renewable energy sources are prevalently used in the community.	0.738			
	ENS5. Waste management and recycling programs are effective.	0.776			
Metropolitan Governance (MG)	MG1. The public transportation system is both efficient and reliable.	0.910	0.591	0.851	0.845
	MG2. Urban planning and zoning regulations effectively manage growth and development.	0.707			
	MG3. Public opinions are regularly considered in governance decisions.	0.693			
	MG4. Governmental processes and decisions are transparent and accountable.	0.746			
Stakeholder Value Co-Creation (SVCC)	SVCC1. Stakeholders are actively involved in urban development projects.	0.878	0.623	0.892	0.890
	SVCC2. Public-private partnerships effectively contribute to achieving sustainable goals.	0.777			
	SVCC3. The community has a significant say in local governance and decision-making.	0.745			
	SVCC4. Sustainability practices in the community are innovative.	0.780			
	SVCC5. Stakeholders are generally satisfied with the outcomes of urban development projects.	0.759			
Conflict (C)	C1. Conflicts related to land use and zoning are infrequent.	0.882	0.600	0.882	0.881
	C2. Conflicts arising from social inequalities are not prevalent.	0.749			
	C3. Conflicts due to environmental degradation are rare.	0.757			
	C4. Conflicts related to governance and policy-making are uncommon.	0.761			
	C5. Conflicts over the allocation of resources are seldom observed.	0.715			
Sustainable Urban Development (SUD)	SUD1. The urban density is optimized for sustainability.	0.845	0.580	0.892	0.891
	SUD2. The infrastructure is resilient to natural calamities.	0.741			
	SUD3. Buildings and public spaces are designed to be energy-efficient.	0.736			
	SUD4. Social and economic policies are inclusive.	0.745			
	SUD5. The local economy is diversified.	0.730			
	SUD6. Environmental conservation initiatives are effective.	0.766			

Table 4
Results of discriminant validity.

Construct	ES	MG	ENS	SS	SVCC	C	SUD
ES	0.795						
MG	0.102	0.769					
ENS	0.201	0.334	0.773				
SS	0.047	0.210	0.254	0.823			
SVCC	0.205	0.374	0.522	0.248	0.789		
C	0.045	-0.017	-0.025	0.132	0.098	0.775	
SUD	0.245	0.406	0.656	0.267	0.561	-0.168	0.762

Table 5
The models' fit.

	Chi-Square	df	Chi-Square/df	SRMR	RMSEA	TLI	CFI
Benchmark value	/	/	<3	<0.10	<0.10	>0.9	>0.9
Measurement model	494.224	474	1.043	0.032	0.010	0.997	0.998
Structural model	646.666	482	1.342	0.065	0.027	0.979	0.980

suggesting that stakeholder value co-creation has a significant mediating effect when economic sustainability affects sustainable urban development. Furthermore, the direct effect was significant, indicating that the mediating effect is partial mediating, thereby H8a was supported. The path from ENS to SVCC to SUD. The indirect effect value was 0.091, and the 95 % Boot CI does not include 0. These

Table 6
Direct path analysis results (H1-H7).

Hypotheses	Path	Standardized Coefficient	SE	Unstandardized Coefficient	t	p	Result
H1	ES →SVCC	0.103	0.040	0.097	2.440	0.015	Accepted
H2	SS →SVCC	0.102	0.044	0.103	2.346	0.019	Accepted
H3	ENS →SVCC	0.497	0.054	0.524	9.775	0.000	Accepted
H4	MG →SVCC	0.207	0.044	0.200	4.524	0.000	Accepted
H5	SVCC → SUD	0.693	0.044	0.649	14.611	0.000	Accepted
H6	SVCC →C	0.105	0.051	0.104	2.046	0.041	Accepted
H7	C →SUD	-0.251	0.039	-0.237	-6.085	0.000	Accepted

indicate that stakeholder value co-creation has a significant mediating effect when environmental sustainability affects sustainable urban development. This is partial mediating as the direct effect was significant, thus H8b was accepted. In the path from SS to SVCC to SUD, the indirect effect of SVCC was 0.019, with 95 % Boot CI not including 0, but the direct effect was not significant, which indicates that stakeholder value co-creation has a significant full mediating effect when from social sustainability to sustainable urban development, H8c was accepted. In the path from MG to SVCC to SUD, the indirect effect was 0.047, and the 95 % Boot CI does not include 0, with the direct effect being significant, indicating that stakeholder value co-creation has a partial mediating effect when metropolitan governance affects sustainable urban development, hence H8d was supported.

On the other hand, in the path from ES to SVCC to C, the indirect effect value was 0.013, and the 95 % Boot CI does not include 0, indicating that stakeholder value co-creation has a significant mediating effect when economic sustainability causes conflict. Nevertheless, the direct effect was not significant, which suggests that the mediating effect is fully mediating, H9a was accepted. The path from ENS to SVCC to C. The indirect effect value was 0.058, with the 95 % Boot CI does not include 0, and the direct effect was significant. However, the direct effect and indirect effect have different signs, with the latter being counter to the direction of the former. That is the direct effect was significant but negative (-0.121), while the indirect effect was positive (0.058). According to MacKinnon et al. [77] research findings, the nature of the indirect effect, in this case, is not a "mediating effect", but a "suppressing effect". This aberration necessitated the rejection of H9b. In the path from SS to SVCC to C, the 95 % Boot CI does not include 0, and the direct effect was significant, indicating that stakeholder value co-creation has a significant partial mediating effect when social sustainability causes conflict, thereby H9c was supported. Whereas in the path from MG to SVCC to C, the 95 % Boot CI does not include 0, and the direct effect was not significant, suggesting that stakeholder value co-creation has a significant full mediating effect when metropolitan governance causes conflict, hence H9d was accepted.

Fig. 3 summarizes the results of the hypothesized relationships.

5. Discussion

This study explores the causal relationship between TBL dimensions, metropolitan governance, stakeholder value co-creation, and conflict in the context of SUD. Among the 9 proposed hypotheses, 8 were supported, with only one being rejected. The following sections discuss the SEM findings and provide a comparison with outcomes from prior studies in this domain.

5.1. Triple bottom line

The findings confirm the positive impact of economic sustainability on stakeholder value co-creation (H1), aligning with Liashenko & Trushkina [44] and Marx [45], highlighting the role of economic factors such as local employment opportunities and income distribution equity, in fostering public-private partnerships and value creation. However, the relatively low path weight ($\beta = 0.103$) in our study contrasts with Chen et al. [46] that suggested a more substantial link between both. This divergence may be attributed to variations in the economic landscapes of the studied regions, differing stakeholder priorities, or the specific aspects of economic sustainability considered in each study, such as the distribution of economic benefits or the inclusivity of economic policies. This

Table 7
Mediating effects analysis results (H8-H9).

Hypotheses	Path	Indirect effect	SE	95 % Boot CI		Direct effect	Status	Result
				Lower	Upper			
H8a	ES→SVCC→SUD	0.020**	0.010	0.005	~ 0.044	0.075**	Partial mediating effect	Accepted
H8b	ENS→SVCC→SUD	0.091**	0.022	0.058	~ 0.144	0.417**	Partial mediating effect	Accepted
H8c	SS→SVCC→SUD	0.019*	0.010	0.006	~ 0.043	0.048	Full mediating effect	Accepted
H8d	MG→SVCC→SUD	0.047**	0.015	0.025	~ 0.081	0.138**	Partial mediating effect	Accepted
H9a	ES→SVCC→C	0.013*	0.008	0.001	~ 0.031	0.037	Full mediating effect	Accepted
H9b	ENS→SVCC→C	0.058*	0.025	0.010	~ 0.109	-0.121*	Suppressing effect	Rejected
H9c	SS→SVCC→C	0.012*	0.008	0.001	~ 0.032	0.122**	Partial mediating effect	Accepted
H9d	MG→SVCC→C	0.030**	0.013	0.005	~ 0.055	-0.065	Full mediating effect	Accepted

Note: *p < 0.05; **p < 0.01.

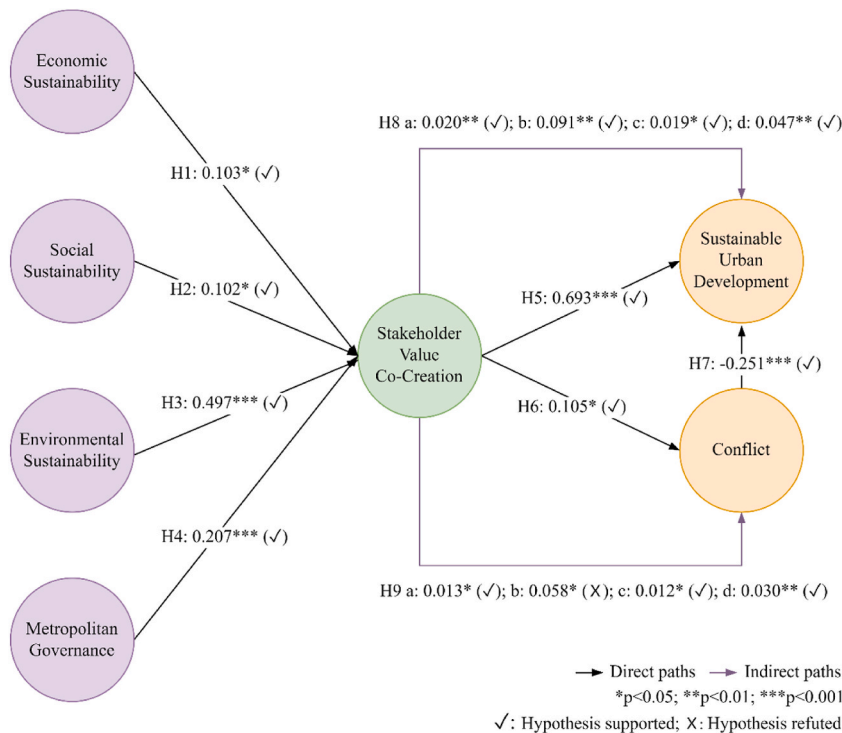


Fig. 3. Results of hypothetical connections.

finding reflects the need for a more nuanced approach in economic policy and planning that accounts for the diverse needs and priorities of stakeholders in urban development projects.

Similarly, social sustainability also showed significant positive influences on stakeholder value co-creation (H2), highlighting robust social cohesion is more probable to facilitate stakeholder collaboration and participation in urban development projects. This resonates with the perspectives of Cuthill [47] and Hovardas [16], Nonetheless, the strength of this relationship in this study ($\beta = 0.102$) was relatively modest compared to studies like Leino & Puumala [48]. This situation is similar to economic sustainability, suggesting that the interplay between social factors and stakeholder cooperation might be influenced by economic factors. This finding supports the assertion proposed by TBL that the dimensions are intrinsically interlinked [3]. This indicates that while social sustainability influences stakeholder value co-creation, the extent of its impact can vary depending on specific contextual factors such as the diversity of stakeholders involved, or regional socio-economic conditions.

Contrastingly, environmental sustainability demonstrated a more robust relationship with stakeholder value co-creation ($\beta = 0.497$) (H3). This finding is in line with the emphasis on ecological initiatives and stewardship in urban development, as discussed in previous studies [49,50], suggesting the role of environmental sustainability protocol in bolstering environmental stewardship. Our results extend this narrative by suggesting that environmental sustainability is a critical component of the SUD, potentially more influential than its economic and social factors. This finding suggests a broader acceptance and prioritization of environmental issues among stakeholders, possibly reflecting a global shift towards environmental consciousness.

The findings of economic, social, and environmental sustainability (i.e., H1, 2 and 3 were supported) lend empirical credence to the positive influence of TBL on stakeholder value co-creation. Nonetheless, the relatively low weightage of social and economic indicates that the context of SUD presents unique dynamics. This is a concern area and means that in certain urban development projects, environmental concerns are prioritized over social and economic aspects, this variation may be attributed to differences in power dynamics, social objectives, and the varying priorities among stakeholders involved in urban development projects, meanwhile, the pandemic may have further influenced the orientation of urban development. This finding potentially reflects that in the post-pandemic era, urban development strategies adapt to shifting priorities towards environmental sustainability, focusing on resilient and adaptable urban development that meets evolving societal needs.

5.2. Metropolitan governance

In examining the relationship between metropolitan governance and stakeholder value co-creation, our study identified a significant positive influence (H4) specifies that the importance of integrated and collaborative governance in enhancing stakeholder engagement in shared value creation. This finding aligns with the insights of previous studies [5,30,51,52]. Similarly, our results resonate with existing literature [53,54] that highlights the role of robust governance frameworks in facilitating sustainable

development initiatives. However, our study extends these findings by quantifying the value of stakeholder collaboration, since existing literature [53,54] primarily focused on the impact of governance on SUD, while our study provides empirical evidence of the quantitative impact of metropolitan governance on value co-creation. This distinction is crucial as it underscores the comprehensive benefits of effective governance in urban development contexts, suggesting that well-crafted policies could potentially mitigate tensions among stakeholders, and encourage stakeholder value co-creation towards SUD.

5.3. Stakeholder duality

The significant role of stakeholder value co-creation in fostering SUD (H5) corroborates the perspectives of existing literature [10, 12,15,55]. Contextually, the greater the effectiveness of stakeholder collaboration, the higher the benefits of SUD initiatives. However, this finding offers new insights into the extent of its influence in diverse urban contexts. Unlike the findings of Ogu [9] and Li et al. [57] that were specific to infrastructural projects, the relatively high path weight ($\beta = 0.693$) in our study suggests a more direct and substantial link between stakeholder value co-creation and SUD. This divergence may be attributed to variations in the specific aspects of urban sustainability considered in each study or the impact of metropolitan governance such as the nature of the urban development project and the deployment of collaborative governance structures. This finding broadens the applicability of stakeholder value co-creation across various facets of SUD.

However, study findings concurrently reveal that stakeholder value co-creation is positively related to conflict (H6). This supports the assertions of previous studies [40,41], and reinforces the notion that the process of stakeholder value co-creation gives rise to conflicts due to differences in priorities, goals, and expectations among the various stakeholder groups. The dual-edged nature of stakeholder value co-creation is highlighted here, indicating the complexity inherent in balancing diverse stakeholder interests and objectives. This dualistic phenomenon serves to echo the articulation of the stakeholder dynamics concept [5,13]. These findings suggest that while stakeholder collaboration is critical for sustainable development, it also brings the potential for conflict, necessitating judicious stakeholder governance strategies aimed at augmenting value co-creation synergies whilst attenuating conflict.

Conflict

As existing literature [13,15,59,61] demonstrates, conflict can hinder SUD project progress. Our findings confirm the negative impact of conflict on SUD (H7), indicating that the more conflicts there are, the less likely the successful implementation of SUD initiatives will be. However, the strength of this relationship in this study ($\beta = 0.105$, $p < 0.05$) was relatively modest compared to previous studies [5,13] that indicated that conflict can significantly impede SUD. This divergence may be attributed to the interaction between metropolitan governance, economic and social sustainability in this study. More specifically, the conflict has the characteristics of similarity to economic and social sustainability in this study, i.e., lower path weight coefficients, which are different from previous studies that were not the primary focus on metropolitan governance [13,59,61]. Instead, in the field of governance, several studies [10,53,54] have emphasized the notion that the adoption of metropolitan governance is closely associated with enhanced socio-economic indicators, which potentially enhance stakeholder common value towards SUD. Therefore, this study's lower coefficient indicates that the conflict is dynamic and may be affected by effective metropolitan governance initiatives. This finding implies that effective policies and governance frameworks are crucial for harmonizing stakeholder conflicts and advancing sustainable development goals.

5.4. Mediating and suppressing effect

In this study, the effectiveness of stakeholder value co-creation as a mediator variable was also assessed and it was found that stakeholder value co-creation partially mediates metropolitan governance, economic and environmental sustainability (H8a, b and d), indicating that stakeholders who were aware of the benefits of governance and sustainable initiatives, such as effective urban planning, employment opportunities, and air quality improved, may be more inclined to co-create towards SUD. This finding is supported by previous studies [59,62–64]. However, the full mediating effect in the path from social sustainability (H8c) potentially reflects that social stability including safety, cohesion, and affordability are prerequisites for stakeholder collaboration, which can subsequently promote value co-creation for SUD through aligned goals. This resonates with the essential concept of value co-creation [37–39], which is that stakeholder value co-creation arises when organizational management aligns with the needs and expectations of stakeholders.

In contrast, the paths involving conflict displayed more complexity. Based on the result, stakeholder value co-creation mediates metropolitan governance, social and economic sustainability (H9a, c and d), suggesting that most conflicts in the SUD context are attributed to disagreements among stakeholder groups regarding resource allocation, decision-making processes, and distribution of benefits and burdens. This finding is in line with the perspectives of Jin et al. [40] and Wei et al. [41]. Surprisingly, the path from environmental sustainability to stakeholder value co-creation to conflict demonstrated a suppressing effect (H9b), which is completely counter-intuitive. Theoretically, one would assume that higher levels of environmental sustainability would result in lower levels of conflict, as stakeholders tend to align towards shared environmental goals [62]. However, the analysis revealed the opposite, which indicates that while environmental sustainability initiatives typically aim to reduce conflicts by addressing shared environmental concerns, their actual implementation in practice may not always be smooth and straightforward. This study speculates that there may be three potential reasons for this suppressing effect.

- 1) *Diverging stakeholder interests*: Environmental sustainability is often associated with a broad spectrum of approaches, strategies, and goals, not all of which are mutually compatible. For instance, one stakeholder group may prioritize biodiversity conservation [29] while another might be more focused on reducing emissions or waste [50]. When all these stakeholders are engaged in the process of value co-creation, the complexity and potential for conflict can indeed increase. In this context, stakeholder value co-creation might serve as an arena where these conflicting interests are surfaced and negotiated, potentially intensifying conflict rather than mitigating it.
- 2) *Resource allocation*: The decision-making process involved in allocating resources for environmental sustainability initiatives can be complex, involving trade-offs between various environmental, economic, and social objectives. As stakeholders increase, these trade-offs may become more pronounced, leading to disagreements among stakeholders about where resources should be channeled.
- 3) *Environmental equity*: When stakeholders co-create value, they inevitably consider issues of fairness and equity. This might surface conflicts regarding who benefits from environmental sustainability initiatives and who bears the brunt of their costs. For example, low-income communities often suffer the most from environmental degradation but have the least resources to invest in solutions. On the other hand, wealthier communities might be able to invest more in environmental sustainability but are less impacted by its consequences [13]. These discrepancies can become a significant source of conflict, especially as stakeholder value co-creation brings these issues to the forefront.

6. Conclusion and implications

This study aims to explore the causal relationships between TBL dimensions, metropolitan governance, and stakeholder dynamics in the context of SUD. The results indicated that TBL dimensions and metropolitan governance were found to directly influence stakeholder value co-creation, in which environmental sustainability plays a dominant role. While stakeholder value co-creation supports SUD, also positively related to conflict that constrains SUD. We further find that conflict may be influenced by metropolitan governance. Therefore, these findings support the argument that environmental sustainability-driven governance initiatives are crucial to contain conflict and promote value co-creation among stakeholders, contributing to the effective construction of SUD. These findings have both theoretical and managerial implications.

6.1. Theoretical implications

This study offers several contributions to the SUD, metropolitan governance, and stakeholder literature.

The present study, first, extends TBL by incorporating metropolitan governance and stakeholder dynamics, demonstrating that while each dimension of TBL contributes to stakeholder value co-creation, environmental sustainability emerges as a more dominant force, suggesting a potential shift in stakeholder priorities toward environmental concerns in urban development. The findings challenge the conventional equal weighting of TBL dimensions, thereby urging a rethinking of TBL by the fluctuating influence of each dimension based on specific urban developmental contexts. The extension of TBL enriches the discourse on SUD by highlighting the dynamic and context-dependent nature of sustainability priorities.

Second, the study expands the understanding of metropolitan governance from a mere administrative or organizational structure to a critical facilitator of stakeholder engagement and collaborative value creation. This aligns with, yet advances, the multi-stakeholder governance model proposed by previous research [36], emphasizing the comprehensive benefits of effective governance for stakeholder collaboration in a metropolitan development context. This perspective enhances the theoretical discourse on metropolitan governance, positioning it as a dynamic and interactive process that is central to achieving sustainable urban outcomes.

Third, the study provides a perspective on the dual-edged nature of stakeholders, challenging the predominantly positive view of stakeholder value co-creation in the literature. It illustrates that while stakeholder collaboration is essential for SUD, it inherently brings the potential for conflict. Conflict is not just a challenge to be mitigated but an inherent aspect of stakeholder collaboration that needs to be managed and understood. By acknowledging the dual nature of stakeholder interactions, the study adds depth to the theoretical understanding of stakeholder relationships, thereby enriching discussions on the complexities of stakeholder interactions in metropolitan development.

Fourth, by empirical investigation, this study quantifies and identifies the interactions between TBL dimensions, metropolitan governance, stakeholder value co-creation, and conflict, as well as their impact on SUD. It demonstrates a causal network that stakeholder value co-creation is influenced by TBL dimensions and metropolitan governance, thereby simultaneously promoting SUD and generating potential conflicts that constrain SUD; as well as presenting the argument that environmental sustainability-driven governance initiatives are critical for stakeholder value co-creation. These findings offer an actionable understanding of the factors that drive or hinder sustainable urban outcomes, contribute to providing a theoretical basis for more effective and context-sensitive research on SUD mechanisms.

6.2. Managerial implications

The findings are of practical significance to urban planners, policymakers, and other stakeholders involved in urban development.

First, given the dominance of environmental sustainability in stakeholder value co-creation, urban planners and policymakers should focus on urban environmental sustainability initiatives such as green space development, green infrastructure development and energy-efficient urban design within urban environments. Meanwhile, our findings indicate a broader acceptance and prioritization of

environmental issues among stakeholders, and therefore, these initiatives need to be implemented taking into account stakeholder priorities. This may involve establishing stakeholder participation forums and aligning different interests toward common sustainability goals. These measures contribute to addressing urban environmental issues and improving social cohesion. However, our findings recognize the dual role of stakeholder value co-creation, particularly the suppressing effect on environmental sustainability, suggesting that urban planners and policymakers need to acknowledge and prepare for potential conflicts in stakeholder collaborations. This can involve implementing training programs for urban planners and policymakers to enhance their capabilities in managing stakeholder participation and conflict, and advocating for a more proactive and conflict-sensitive approach, such as establishing clear communication channels and conflict resolution plans. Furthermore, given that metropolitan governance has a positive impact on stakeholder value co-creation while potentially constraining conflict, urban planners and policymakers should consider the synergy of metropolitan governance and environmental sustainability initiatives to reduce conflict and promote SUD. This can involve adapting governance structures and designing an environmental sustainability-centered governance framework, which focuses on the governance of conflicts in interest diverge, resource allocation, and environmental equity. Measures could include creating mechanisms that allow for transparent decision-making processes, inclusive policy formulation, and cross-sector collaboration. Implementing strategies to foster stakeholder dialogue, and ensuring diverse perspectives are considered in the urban planning process, such as providing stakeholder dialogue platforms and fostering a conducive environment for collaboration.

Implementing these recommendations may face various challenges, including bureaucratic inertia, limited resources, and the need to reconcile conflicting stakeholder interests. Urban planners and policymakers must anticipate resistance from different stakeholder groups, particularly when suggesting substantial modifications to current urban landscapes or governance structures. The successful implementation of these strategies hinges on securing adequate resources, fostering stakeholder buy-in, and ensuring continuous adaptation to feedback and changing urban dynamics.

From a broader perspective, the findings of this study may offer useful insights for SDG 11. Overall, by prioritizing environmental sustainability, enhancing metropolitan governance, and effectively managing stakeholder dynamics, urban development strategies can be more aligned with the shifting priorities towards environmental sustainability, ensuring that urban projects are not only economically viable but also socially equitable and environmentally sustainable, thereby laying the foundation for cities inclusive, safe, resilient, and sustainable.

6.3. Limitations and future research

The study limitations should be acknowledged to suggest future research directions.

First, while this study offers valuable insights from the Huangpu District of Shanghai, its reliance on a sample of respondents from China limits the generalizability and transferability of the findings, especially the suppressing effect observed in the path from environmental sustainability to stakeholder value co-creation to conflict. This outcome raises questions about the interplay of these variables and whether this effect is an artifact of the specific study area or a more widespread phenomenon in different urban configurations. Future research should therefore conduct cross-contextual examinations in varied urban environments to ascertain whether these findings are the consistent patterns or varies according to specific urban and environmental contexts, providing a more comprehensive understanding of how these dynamics manifest in different global contexts.

Second, this study adopted a cross-sectional design with SEM, capturing data at a single point in time. Such research design may limit the ability to infer causality and changes over time. This constraint highlights the need for future research to incorporate longitudinal studies and non-line analyses, to gain a deeper understanding of stakeholder psychology, behaviors, and the underlying motivations driving their actions and responses in different urban development contexts.

Additionally, while this study provides a foundational understanding of several elements within SUD, it represents just an initial foray into a complex and multi-faceted urban field. Future studies could broaden the analytical framework to encompass additional variables such as stakeholder trust, risk perception, and institutional capacity. Investigating these variables would deepen the comprehension of the intricate mechanisms driving sustainable urban development and the efficacy of metropolitan governance.

Ethics statement

This study has been approved by the Academic Integrity and Research Ethics Committee of Guilin University of Technology under approval number GLUTYS-2023-34. Informed consent of each respondent was received. They were fully briefed on the study's objectives and the intended use of the data. The procedures adhered to the ethical guidelines outlined in the Declaration of Helsinki concerning research involving human participants.

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Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Shaohan Chen: Writing – original draft, Methodology, Investigation. **Khairul Manami Kamarudin:** Writing – review & editing, Validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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