

Governance Responsibility in Fragmented Small-Lot Urban Regeneration: Evidence from Taipei

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Abstract

Small-lot urban regeneration in high-density cities is often constrained by fragmented governance structures that create systemic responsibility gaps across institutional, financial, professional, and spatial domains. Using Taipei as an empirical case, this study examines how scale-biased redevelopment frameworks produce discontinuities that hinder small-lot regeneration despite extensive aging building stock and strong underlying demand. Adopting the DPSIR (Driving Forces–Pressures–States–Impacts–Responses) framework, the research integrates semi-structured interviews across six governance dimensions with spatial evidence on pre-1974 building distribution and self-designated renewal units to identify structural bottlenecks and map their causal interactions. The findings show that stagnation is not driven by insufficient incentives, but by misaligned responsibility distribution embedded in regulatory thresholds, risk-averse financial systems, fragmented coordination, unstable trust relations, and market-selective redevelopment patterns. These conditions generate governance breakpoints where no single actor is positioned to ensure process continuity, leaving many aging buildings outside effective renewal pathways. To address this, the study proposes a governance repair framework comprising institutional, financial, systemic process, and impact-based interventions that collectively restore causal flow. Intermediary actors emerge as critical integrators in reconstructing shared responsibility across fragmented systems. The study contributes to urban regeneration and land-use governance debates by conceptualizing small-lot redevelopment as a spatialized responsibility problem, where sustainability outcomes depend on the alignment and reconfiguration of distributed governance roles.

1. Introduction

Urban regeneration in high-density metropolitan regions is increasingly shaped by structural fragmentation, cadastral subdivision, and institutional thresholds that continue to privilege large-scale redevelopment. For decades, urban renewal in Taipei has relied primarily on medium- and large-scale integrated redevelopment for land consolidation, infrastructure upgrading, and economic revitalization. Similar models have been widely adopted in high-density cities worldwide, supported by strong state coordination and large development actors (Newton et al., 2021; Neugebauer, 2021). However, mounting systemic constraints—including net-zero transition requirements, tightening financial regulations, escalating construction costs, prolonged land assembly, and rising social resistance—have exposed vulnerabilities within large-scale redevelopment regimes (Levine & Yavo Ayalon, 2024; Shach-Pinsly, 2021). These pressures have intensified governance discontinuities, particularly in contexts where redevelopment systems are calibrated toward scale and capital concentration. In small-lot regeneration, such discontinuities are not merely procedural obstacles but reflect fragmented responsibility across institutional, financial, professional, and spatial domains, making governance coordination central to the renewal of aging urban housing.

Simultaneously, many mature high-density cities are characterized by small-parcel urban fabrics. In Taipei, alley-based housing on parcels often under 500 square meters constitutes a substantial share of the aging building stock and retains significant spatial, social, and cultural value. Figure 1 illustrates the spatial mismatch between the widespread distribution of pre-1974 buildings and the selective concentration of approved or self-designated renewal units. While aging buildings are broadly dispersed across the urban fabric, renewal cases appear as fragmented and unevenly distributed pockets, suggesting that micro-scale

regeneration does not simply follow building age or physical deterioration but is shaped by regulatory feasibility, land assembly conditions, and market operability. Comparable patterns are observed in Seoul and major Chinese metropolitan regions, where redevelopment processes have become increasingly fragmented and localized (Hwang, 2021; Xiang et al., 2025). As large developers retreat from low-yield projects, micro-scale regeneration has emerged as a critical yet under-institutionalized domain of urban governance (Stryjakiewicz and Jaroszewska, 2016; Acri, Dobričić and Debevec, 2021; Newton et al., 2021; Ahn, 2024; Gonçalves and Freitas, 2025; Aigwi et al., 2026). This condition reveals a scale bias embedded within redevelopment frameworks: regulatory, financial, and coordination systems designed for larger assemblages often fail to accommodate small-lot regeneration, producing stalled renewal despite evident demand.

In response, recent policy instruments in Taipei—most notably the Statute for Expediting Reconstruction of Urban Unsafe and Old Buildings (Republic of China [Taiwan], 2017)—have lowered formal entry barriers and encouraged landowner-led initiatives. While such instruments increase procedural flexibility, they also externalize coordination risks, intensify negotiation costs, and amplify governance gaps at the micro scale (Neugebauer, 2021; Shach-Pinsly, 2021). Similar dynamics are observed in small-scale regeneration contexts globally, where piecemeal interventions reshape cities without coherent strategic coordination (Şahin & Arslan Selçuk, 2025; Chiang, 2025). Rather than resolving structural fragmentation, these mechanisms often redistribute risk across actors, generating discontinuities between institutional design and implementation capacity.

Parallel to these institutional transformations, professional roles within urban regeneration have expanded. Architects increasingly operate beyond technical design, engaging in planning integration, stakeholder mediation, and governance facilitation (Chansomsak & Vale, 2009; Jamieson et al., 2011; Okeke, 2021; Owens, 2015). In contexts where public-sector steering is limited, intermediary governance actors emerge to align regulatory requirements, financial models, and multi-actor negotiations (Sedova & Celani, 2023; Yang et al., 2022; Chen et al., 2022). Unlike European and Japanese systems, where renewal coordination is institutionalized through public agencies and financial instruments, Taipei places substantial coordination and risk management within private or semi-private professional domains (Neugebauer, 2021; Hwang, 2021). This has produced a distinctive governance configuration in which intermediary actors compensate for fragmented institutional design.

While these challenges are often framed as governance inefficiencies, they can also be understood as systemic responsibility gaps distributed across institutional, financial, and professional domains. In fragmented urban regeneration systems, responsibility is dispersed without clear accountability, leading to discontinuities in implementation. These challenges can also be understood as systemic responsibility gaps distributed across institutional, financial, professional, and spatial domains. In fragmented land-use governance systems, responsibility is dispersed without clear accountability, leading to discontinuities in implementation. This perspective positions small-lot regeneration not simply as a redevelopment problem, but as a question of how land-use responsibilities are allocated, coordinated, and repaired across fragmented institutional and market systems.

Despite the growing prevalence of micro-scale regeneration, systematic governance analyses remain largely focused on large-scale or state-led redevelopment (Newton et al., 2021; Xiang et al., 2025). Limited attention

has been paid to how governance discontinuities emerge under scale-biased redevelopment systems, or how repair mechanisms operate within fragmented urban environments. To address this gap, this study applies the DPSIR (Driver–Pressure–State–Impact–Response) framework as an analytical operationalization tool to diagnose responsibility bottlenecks in small-lot urban regeneration in Taipei. By conceptualizing governance repair domains and examining the emergence of intermediary actors within scale-biased systems, the research contributes to debates on fragmented urbanism and governance adaptation in mature high-density metropolitan regions.

2. Methods

2.1. DPSIR-Based Analytical Framework for Governance Repair

This study develops a DPSIR-based semi-quantitative governance repair model to diagnose responsibility bottlenecks and transformation pathways in small-lot urban renewal. DPSIR (Driving Forces–Pressures–States–Impacts–Responses) was originally developed by the European Environment Agency (EEA) in the 1990s as an extension of the OECD’s (1993) Pressure–State–Response (PSR) model, providing a causal logic linking socio-economic drivers, implementation constraints, systemic conditions, socio-spatial consequences, and governance interventions.

In recent years, DPSIR has been widely applied to analyze complex urban and environmental governance dynamics, including urban resilience (Liang et al., 2024), climate governance (Yang et al., 2024; Kristiadi et al., 2022; Vannevel, 2018), and urban regeneration and sustainability assessment (Yussif et al., 2023; Liu et al., 2020; Spanò et al., 2017; Bai et al. 2024). These studies demonstrate the suitability of DPSIR as a diagnostic framework for tracing governance pathways from underlying structural drivers to systemic stagnation and policy responses (Tscherning et al., 2012).

To move beyond linear diagnosis and to enable Table 2’s semi-quantitative results, the study integrates: (1) qualitative multi-actor interviews and document/statistical review; (2) systematic coding of governance attributes across analytically defined dimensions; and (3) normalized attribute intensity measures and cross-case validation of repair activation.

Within the context of small-lot urban renewal in Taipei, DPSIR is operationalized to capture multi-actor governance processes shaping project initiation, stagnation, and recovery. The DPSIR components are defined as follows (Liang et al., 2024):

- Driving Forces (D): Motivations initiating renewal, including policy incentives, safety imperatives related to aging buildings, and disaster prevention awareness.
- Pressures (P): Institutional, financial, industrial, and social constraints arising during implementation, such as regulatory thresholds, conservative risk controls, fragmented coordination, and cognitive gaps.
- States (S): Conditions of systemic stagnation resulting from accumulated pressures, including institutional exclusion, procedural delays, and spatial infeasibility.

- Impacts (I): Social and urban consequences of stalled renewal, such as continued safety risks, trust erosion, and declining living quality.
- Responses (R): Governance interventions aimed at restoring causal flow through institutional reform, financial risk sharing, process integration, and trust reconstruction.

To extend DPSIR into a governance repair model that can be empirically assessed, the Response (R) component is disaggregated into four governance repair domains. Each repair domain corresponds to the structural dimension it seeks to address, and the abbreviations are derived from the initial letter of the targeted governance sphere:

- Institutional Repair (Rd) – where R denotes Response and the subscript d refers to institutional design and regulatory frameworks (derived from the “D” in Driving Forces, indicating the need to recalibrate enabling institutional conditions). Rd addresses regulatory exclusion, procedural rigidity, and the absence of small-lot-specific mechanisms.
- Financial Repair (Rp) – where R denotes Response and the subscript p refers to financial pressures (derived from the “P” in Pressures). Rp targets conservative lending models, insufficient guarantees, and capital access barriers that constrain regeneration viability.
- Systemic Process Repair (Rs) – where R denotes Response and the subscript s refers to systemic state conditions (derived from the “S” in States). Rs focuses on fragmented coordination, workflow misalignment, and construction feasibility bottlenecks that maintain stagnation.
- Impact Repair (Ri) – where R denotes Response and the subscript i refers to accumulated impacts (derived from the “I” in Impacts). Ri mitigates trust erosion, cognitive asymmetries, and social and safety risks that intensify governance breakdown.

By specifying Rd, Rp, Rs, and Ri as differentiated Response pathways linked analytically to D, P, S, and I, DPSIR is extended from a descriptive causal chain to a governance repair model. This structure clarifies how targeted interventions within the Response dimension can reactivate stalled regeneration processes by reconnecting governance flow from R back toward D. These repair domains are treated as embedded feedback mechanisms rather than isolated policy measures: institutional repair reshapes renewal inclusion structures, financial repair enables capital flow through risk-sharing mechanisms, systemic process repair converts operational friction into coordinated implementation pathways, and impact repair restores participation dynamics through trust rebuilding.

This operationalization also enables the interpretation of governance dynamics as distributed responsibility structures, allowing the identification of responsibility gaps and repair mechanisms across multi-actor systems.

2.2. Governance Dimensions and Interview Protocol Design

To operationalize DPSIR within a fragmented governance environment, the study adopts a multi-dimensional governance structure derived from theoretical literature and empirical urban renewal research. Urban renewal involves multiple public and private actors across institutional, financial, social, industrial, and spatial domains, which often operate with limited coordination and inconsistent regulatory logics. Drawing on governance fragmentation theory (Biermann et al., 2009; Zelli & van Asselt, 2013) and a synthesis of urban

renewal studies (Chao & Hsu, 2018; Xie et al., 2024), small-lot renewal is conceptualized as a system composed of interdependent but weakly integrated subsystems.

Based on recurring governance themes in the literature, six core governance dimensions were identified as central to renewal outcomes:

- Governmental and Institutional Systems: policy frameworks, regulatory thresholds, and administrative review processes;
- Industrial and Operational Environment: professional coordination, construction management, and implementation workflows;
- Financial Environment: lending practices, risk control models, credit mechanisms, and capital accessibility;
- Academic and Educational Dimensions: cross-disciplinary training, professional capacity building, and knowledge dissemination;
- Landowner Needs and Social Dimensions: stakeholder interests, cognition, trust relations, and collective action dynamics;
- Site Conditions and Physical Constraints: parcel fragmentation, alley accessibility, parking feasibility, and construction logistics.

These dimensions serve two methodological functions. First, they constitute the primary analytical categories for coding qualitative interview data, enabling systematic comparison of responsibility bottlenecks across domains. Second, they structure the semi-structured interview protocol to ensure comprehensive coverage of the multi-actor governance system shaping small-lot urban renewal processes. Semi-structured interviews were designed following established qualitative research guidance (Bengtsson, 2016; Schreier, 2012; Adeoye-Olatunde & Olenik, 2021; Bearman, 2019; Karatsareas, 2022).

Stakeholder selection ensured representation across all six governance dimensions. Interviewees included actors from governmental agencies, financial institutions, architectural and construction management sectors, urban renewal consultancies, real estate brokerage firms, and landowner-related organizations, enabling triangulation of perspectives and robust identification of responsibility bottlenecks within the DPSIR framework.

2.3. Study Area and Institutional Baseline

Taipei City is adopted as the empirical setting for examining governance fragmentation in small-lot urban renewal. As Taiwan's capital and most highly urbanized metropolis, Taipei is characterized by high-density development, extensive cadastral fragmentation, and a substantial stock of aging buildings—conditions representative of mature metropolitan contexts facing the limitations of large-scale, consolidation-oriented renewal models. As shown in Fig. 1, buildings constructed before 1974 are widely distributed across the urban fabric, whereas announced and approved renewal units and approved unsafe-and-old-building reconstruction cases appear as fragmented and selective pockets. This spatial mismatch suggests that renewal activation does not simply correspond to building age or physical deterioration, but is mediated by land assembly feasibility, regulatory pathways, and market operability.

Historically, Taipei's urban renewal mechanisms have prioritized medium- and large-scale redevelopment due to institutional preferences for land assembly efficiency, financial feasibility, and administrative manageability. In contrast, small-lot alley-based sites—particularly those under 500 square meters—remain structurally marginalized within formal renewal systems. Such parcels frequently fail to meet minimum area thresholds for Urban Renewal Unit designation and are redirected toward expedited reconstruction mechanisms requiring unanimous landowner consent, rendering projects highly vulnerable to stagnation. The selective concentration of renewal cases shown in Fig. 1 further indicates that small-lot regeneration tends to emerge where regulatory and market conditions are more operable, leaving many aging buildings outside effective renewal pathways.

To contextualize this scale-based governance exclusion, official statistics from the Taipei City Urban Renewal Office were analyzed. In 2024, 83.78% of approved urban renewal projects involved sites larger than 1,000 square meters, while only 16.22% were located on smaller parcels. Similarly, cumulative approvals from 1998 to 2024 show that 88.65% of projects exceeded 1,000 square meters, with small-scale sites accounting for only 11.35%. As illustrated in Fig. 2, small-lot projects ($< 1000 \text{ m}^2$) have increased modestly but remain a minority in both absolute number and proportional share, while medium- and large-scale developments continue to dominate approvals.

Despite the introduction of the Statute for Expediting Reconstruction of Urban Unsafe and Old Buildings, implementation outcomes reveal pronounced vulnerability among small-lot projects. By the end of 2024, approximately 14% of approved expedited reconstruction cases had lapsed without completion, of which nearly 69% involved sites smaller than 500 square meters. This pattern highlights structural barriers limiting inclusion and successful implementation of small-lot redevelopment within formal urban renewal mechanisms. Together, the statistical evidence and spatial distribution indicate that Taipei's small-lot renewal problem is not merely a shortage of policy incentives, but a spatialized governance mismatch between widespread aging-building demand and selectively activated redevelopment pathways.

2.4. Case Selection and Comparative Logic for Semi-Quantitative Mapping

To examine governance dynamics in depth and to support semi-quantitative mapping, a purposive case selection strategy was adopted. Rather than aiming for statistical representativeness, cases were selected for analytical relevance in revealing variation within Taipei's small-lot urban renewal practices. Drawing on extensive professional engagement in small-lot coordination processes, four empirical cases were identified that collectively reflect recurrent governance trajectories observed in practice.

The cases were selected to capture variation across key structural dimensions, including site scale, ownership fragmentation, regulatory pathway, financial arrangement, and coordination intensity (Table 1). Importantly, these cases do not constitute predefined typologies. Instead, they provide empirical anchors for subsequent DPSIR-oriented attribute coding and quantitative structural mapping. By examining governance processes across cases with divergent outcomes—including breakdown, prolonged stagnation, consensus instability, and eventual completion—the analysis seeks to identify recurring structural patterns through attribute-level quantification rather than through a priori classification.

Table 1

Case selection framework and governance trajectory variation in Taipei's small-lot urban renewal. This table presents four purposively selected cases representing variation in governance trajectories observed in Taipei's small-lot urban renewal practice. The cases differ in ownership complexity, institutional interaction, financial coordination, and outcome continuity. They serve as empirical anchors for subsequent DPSIR-oriented attribute coding and quantitative structural mapping.

Case	Site (Area)	Landowners	Observed Governance Trajectory	Analytical Function in Study
Case A	Da'an District (300 m ²)	8	Process breakdown following late-stage financial disagreement despite prior architectural coordination.	Provides empirical instance of renewal discontinuity under social and financial tension.
Case B	Zhongshan District (460 m ²)	21	Prolonged stagnation due to private road access disputes and regulatory–financial coordination challenges.	Illustrates coordination-intensive renewal process involving cross-domain interaction.
Case C	Zhongzheng District (500 m ²)	40	Initial consensus achieved but later dissolved due to relocation conflict and trust erosion among residents.	Demonstrates instability within complex ownership structures.
Case D	Da'an District (300 m ²)	7	Completed after extended mediation, stakeholder withdrawal, and sustained architectural coordination.	Provides contrasting case of governance continuity under structural constraints.

2.5. Data Collection

This study employs a multi-source qualitative data collection strategy integrating documentary analysis, statistical records, and semi-structured interviews to capture governance dynamics in small-lot urban renewal in Taipei. Combining institutional data with multi-actor perspectives enables systematic diagnosis of governance fragmentation across regulatory, financial, professional, social, and spatial domains.

Regulatory documents, policy instruments, and official statistical records related to urban renewal and the expedited reconstruction of unsafe and old buildings were compiled to establish an institutional and quantitative baseline. Statistical data from the Taipei City Urban Renewal Office were analyzed to assess project approvals by site scale, identify structural biases favoring large-scale redevelopment, and contextualize the marginalization of small-lot sites under 500 square meters. Policy texts and regulatory guidelines were further reviewed to map institutional thresholds, procedural requirements, and incentive structures across renewal pathways.

Semi-structured interviews were conducted with stakeholders representing the six governance dimensions identified in Section 2.2, following established qualitative research practices (Bengtsson, 2016; Schreier, 2012; Adeoye-Olatunde & Olenik, 2021; Bearman, 2019; Karatsareas, 2022). Interview questions explored regulatory barriers, financial constraints, professional coordination challenges, landowner motivations and trust dynamics, educational capacity gaps, and site-specific feasibility issues. All interviews were transcribed in full for subsequent thematic coding and attribute intensity analysis.

A purposive multi-actor sampling strategy was adopted to capture key governance functions within the fragmented renewal system. Participants included representatives from governmental agencies, financial institutions, architectural practices, construction and project management firms, urban renewal organizations and consultancies, real estate brokerage companies, and development firms. Interviewees held senior professional roles, including bank branch managers, principal architects, urban renewal association leaders, consultancy executives, brokerage firm chairpersons, and project management professionals, with approximately 10 to 30 years of relevant experience. This multi-sectoral representation enabled triangulation of institutional, financial, professional, and social perspectives and supported robust identification of responsibility bottlenecks.

Data saturation was observed as recurring responsibility bottlenecks and repair mechanisms consistently emerged across interviews, indicating sufficient coverage of key causal dynamics. By integrating documentary evidence with multi-actor interview data, the study establishes a comprehensive empirical foundation for DPSIR causal mapping and the operationalization of governance repair domains in subsequent analytical stages.

2.6. Data Analysis

Following data collection, interview transcripts were analyzed using qualitative content analysis combined with word frequency analysis to capture responsibility bottlenecks across domains (Bengtsson, 2016; Schreier, 2012; Namey et al.; Paley, 2002). All transcripts were first coded according to the six governance dimensions identified in Section 2.2. Within each dimension, inductively derived sub-themes were developed to identify dominant governance attributes associated with institutional barriers, financial constraints, coordination challenges, social dynamics, and physical feasibility.

To ensure methodological transparency and strengthen comparability across governance domains, the analysis distinguishes between descriptive recurrence and normalized structural prominence. Word frequency analysis was applied to identify attributes mentioned five times or more across the corpus (N = 392 coded governance references). This threshold was adopted to filter incidental remarks while retaining attributes that reflect recurring governance constraints. Frequency is not interpreted as causal origin but as an empirical proxy for accumulated governance friction during implementation.

To reduce bias arising from variation in transcript length and thematic density, attribute intensity was operationalized as a normalized ratio defined as the Attribute Intensity Index (All). The All is calculated as:

$$\text{All}_i = \frac{f_i}{N} \times 100\%$$

where f_i represents the absolute frequency (i.e., the total number of coded occurrences) of attribute i identified across the full set of interview transcripts, and N denotes the total number of coded governance references across the dataset (392). Each occurrence was counted independently, including repeated mentions within the same interview, to capture the intensity of perceived governance constraints.

The All provides a relative measure of structural prominence and enables cross-dimensional comparison of bottleneck concentration. This normalization underpins the proportional shares and intensity rankings

presented in Table 2 and informs the vertical structural mapping in subsequent analysis.

Each identified attribute was subsequently aligned with the five DPSIR components—Driving Forces (D), Pressures (P), States (S), Impacts (I), and Responses (R)—according to their functional roles within the renewal process. Classification followed process-based criteria: Driving Forces represent exogenous policy incentives and safety imperatives initiating renewal; Pressures capture active constraints such as regulatory thresholds, financial risk controls, coordination gaps, landowner conflicts, and construction feasibility challenges; States refer to accumulated structural conditions including institutional exclusion and procedural delay; Impacts denote observable consequences such as trust erosion and stalled implementation; and Responses encompass institutional reforms, risk-sharing mechanisms, professional integration strategies, and trust-building interventions.

To enable structural comparison across governance attributes, each DPSIR stage was assigned a Structural Lock-in Score (SLS) representing its relative degree of institutional embedding within the renewal process. The SLS does not constitute a statistically derived coefficient; rather, it operationalizes the ordinal depth of structural entrenchment implied by the DPSIR causal sequence. The scoring logic is grounded in governance rigidity theory and path-dependence reasoning. Within small-lot urban renewal, D reflects exogenous policy or safety imperatives; R represents adaptive interventions aimed at mitigating bottlenecks and similarly retain institutional flexibility; I captures observable consequences of governance friction and indicate intermediate structural embedding; P corresponds to systemic constraints actively shaping implementation; S denotes accumulated institutionalized conditions. Based on this ordered structural logic, SLS values were assigned on a 0–1 scale (D = 0.20; R = 0.35; I = 0.50; P = 0.65; S = 0.85), preserving the causal hierarchy of increasing institutional embedding.

The spacing between values is not intended to imply equal metric intervals but to reflect progressive structural rigidity along the governance chain. This ordinal-continuous scaling enables comparative visualization and weighted centroid calculation while maintaining theoretical consistency with DPSIR causal sequencing. Sensitivity inspection confirms that moderate variation in scale spacing does not alter the relative clustering patterns observed in the results, indicating that the analytical conclusions are driven by structural ordering rather than specific numeric intervals.

Governance sector involvement was coded according to the primary institutional actor implicated in each attribute, including governmental agencies (GOV), renewal consultancies (CONS), architectural practices (ARC), construction firms (CON), developers (DEV), project/construction management firms (PCM), financial institutions (FIN), and landowner or brokerage stakeholders (SOC). Where attributes spanned multiple domains, multi-sector associations were recorded as relational indicators.

Within the Response stage, attributes were further reorganized into four governance repair domains—Institutional Repair (Rd), Financial Repair (Rp), Systemic Process Repair (Rs), and Impact Repair (Ri)—to examine recovery potential and enable cross-case comparison. To synthesize attribute-level coding at the project scale, case positioning was calculated using an attribute-weighted structural centroid approach, in which both SLS and All values were weighted by attribute frequency. This procedure ensures that higher-frequency attributes exert proportionally greater influence on case-level structural positioning and supports visualization of governance configurations under varying lock-in conditions. To enhance methodological

transparency and clarify the analytical workflow, Figure X summarizes the process linking qualitative coding, frequency aggregation, normalization, and structural mapping within the DPSIR-based framework.

3. Results

3.1. Six Governance Dimensions from Multi-Actor Interviews

Applying the coding, normalization, and DPSIR–SLS alignment procedures outlined in Section 2.6, the 392 coded governance references were consolidated into six governance dimensions (Table 2). By integrating raw frequency, the Attribute Intensity Index (All), and Structural Lock-in Level (SLS), the analysis reveals a stratified structural configuration of responsibility bottlenecks in small-lot urban renewal. Rather than a dispersed set of constraints, the empirical distribution indicates a concentrated institutional–spatial core in which regulatory entrenchment, cadastral fragmentation, and financial conservatism converge. This pattern is consistent with the spatial mismatch shown in Fig. 1, where pre-1974 buildings are widely distributed but renewal cases remain fragmented and selectively activated.

The Institutional System dimension accounts for the highest normalized intensity (All = 22.4%) and exhibits the deepest structural embedding (SLS = 0.85). Dominant attributes—including Institutionalization (53), Review (13), and Threshold (8)—align primarily with the State (S) stage of the DPSIR framework. Their concentration reflects not merely procedural complexity but institutionalized exclusion mechanisms embedded within regulatory thresholds and approval systems. This finding suggests that institutional responsibility gaps in small-lot renewal are structurally consolidated at the State level, where procedural rigidity transforms policy intent into practical exclusion.

Site Conditions and Physical Constraints rank second in intensity (All = 19.1%; SLS = 0.75), driven by attributes such as Small-lot (44), Parking (12), and Alleys (8). While these constraints are partially positioned within the Pressure stage, their structural effect reinforces State-level entrenchment by rendering regulatory compliance materially infeasible under prevailing parcel configurations. Spatial morphology thus operates not as a neutral background condition but as an active mechanism reinforcing institutional lock-in.

The Financial Environment (All = 19.1%; SLS = 0.65–0.85) reveals risk-averse lending regimes, stringent risk controls, and the absence of guarantee mechanisms as recurrent bottlenecks. Although formally categorized within Pressure, the empirical recurrence and institutionalized character of financial constraints indicate a transition toward structurally embedded conditions functionally equivalent to State-level barriers. Financial conservatism therefore operates as a quasi-institutional extension of regulatory rigidity.

The Industrial Environment (All = 18.6%; SLS = 0.65) is characterized by workflow fragmentation, professionalism gaps, and integration challenges. Situated primarily at the Pressure stage, these attributes act as intermediary bottlenecks linking institutional thresholds with implementation feasibility. In this sense, industrial fragmentation does not independently generate lock-in but amplifies institutional and financial rigidities through coordination failure.

The Landowner and Social Dimension (All = 15.3%; SLS = 0.50) aligns predominantly with the Impact stage. Attributes such as Landowner (29), Trust (10), and Consent rigidity reflect the cumulative consequences of

institutional and financial fragmentation. Rather than constituting primary drivers of lock-in, social trust erosion emerges as a downstream effect of structural exclusion and implementation uncertainty.

Finally, the Academic and Educational Dimension registers the lowest normalized intensity (All = 5.4%; SLS = 0.35) and is positioned within the Response stage. Attributes including Education, Talent, and Cross-disciplinary capacity reflect comparatively weak governance repair mechanisms. The low salience of this dimension indicates a systemic gap in cross-sectoral training and professional integration, reinforcing the asymmetry between structural rigidity and adaptive response.

Figure 4 further visualizes these dynamics at the attribute level by mapping normalized intensity (All) against structural embedding (SLS). The upper-right quadrant reveals a dual-anchor lock-in structure driven primarily by Institutionalization and Small-lot, indicating that regulatory entrenchment and cadastral fragmentation jointly produce the deepest structural rigidity. Financial attributes (Bank, Risk control, Lending) cluster near this core but do not dominate it, suggesting that financial conservatism operates as a reinforcing mechanism rather than an originating structural anchor. In contrast, response-oriented attributes (Education, Talent, Cross-disciplinary) remain concentrated in the lower-left quadrant, demonstrating that adaptive repair capacities are both weakly embedded and empirically marginal within the current governance configuration.

The quadrant distribution demonstrates that governance lock-in is concentrated within a high-intensity, high-embedding cluster dominated by institutional and spatial attributes. Financial and professional attributes reinforce this cluster, while response-oriented academic attributes remain structurally peripheral. The divergence between empirical salience and structural embedding underscores that frequently articulated concerns are not necessarily the deepest sources of rigidity; rather, lock-in consolidates where institutional embedding and spatial infeasibility intersect.

Taken together, Table 2, Fig. 1, and Fig. 4 substantiate a State-dominant structural configuration in which institutional thresholds, cadastral fragmentation, and financial conservatism converge to produce deep governance lock-in. The spatial distribution of renewal cases further indicates that these bottlenecks are not only institutional or procedural, but also spatialized through selective redevelopment pathways. This structural distribution establishes the empirical basis for examining governance repair activation and case-level process stabilization in the subsequent section.

Table 2
Cross-case Structural Bottlenecks, Normalized Intensity, and DPSIR Lock-in Position in Small-Lot Urban
Renewal (N = 392)

Governance Dimension	Primary DPSIR Position	Key Structural Bottlenecks	Core Attributes (Top Frequencies, selected)	Total Frequency (Σf_i)	Attribute Intensity Index (All, %)	Structural Lock-in Level (SLS)
Institutional System	State (S)	Regulatory thresholds; fragmented review; absence of small-lot instruments	Institutionalization (53); Review (13); Threshold (8)	88	22.4%	0.85
Site Conditions & Physical Constraints	State-reinforcing Pressure	Parcel fragmentation; narrow alleys; parking infeasibility	Small-lot (44); Parking (12); Alleys (8)	75	19.1%	0.75*
Financial Environment	Pressure → State transition	Risk-averse lending; absence of guarantees; corporate requirements	Bank (25); Risk control (13); Lending (12)	75	19.1%	0.65–0.85*
Industrial Environment	Pressure (P)	Workflow fragmentation; coordination gaps; construction uncertainty	Professionalism (25); Process (17); Integration (16)	73	18.6%	0.65
Landowner & Social Dimension	Impact (I)	Trust erosion; information asymmetry; unanimous consent rigidity	Landowner (29); Trust (10); Consent (10)	60	15.3%	0.50
Academic & Educational Dimension	Response Gap (R)	Lack of cross-disciplinary governance training	Education (10); Talent (6); Cross-disciplinary (5)	21	5.4%	0.35
Note:						

N = 392 represents the total number of coded governance references derived from qualitative interview data. Each attribute frequency (f_i) denotes the number of coded occurrences of a specific governance attribute across all transcripts, with repeated mentions counted independently. Total Frequency (Σf_i) represents the aggregated sum of attribute-level frequencies within each governance dimension. The Attribute Intensity Index ($All_i = f_i / N \times 100\%$) normalizes attribute frequency to enable cross-dimensional comparison of empirical salience. Structural Lock-in Level (SLS) represents analytically assigned levels of institutional embedding based on DPSIR positioning, supporting the structural mapping and quadrant visualization presented in Fig. 4.

3.2. Structural Dilemmas of Small-Lot Urban Renewal

Building on the structural distribution identified in Table 2, the dilemmas of small-lot urban renewal are not attributable to isolated governance failures but to a cumulative entrenchment of bottlenecks at the State (S) and Pressure (P) levels within the DPSIR framework. The dominance of institutional and spatial constraints indicates that renewal stagnation arises from a structural scale mismatch between regulatory thresholds, financial responsibility structures, professional coordination regimes, market-selective redevelopment patterns, and the morphological characteristics of small parcels.

Although regulatory frameworks formally provide renewal incentives such as floor area bonuses and tax exemptions, interview evidence indicates that most sites under 500 square meters fail to meet standardized renewal unit thresholds of approximately 1,000 square meters. Consequently, projects are frequently redirected toward expedited reconstruction mechanisms requiring unanimous landowner consent. This procedural shift does not resolve institutional exclusion but instead amplifies vulnerability to consent withdrawal, rendering implementation chains structurally fragile. Prolonged administrative review timelines and limited institutional flexibility further decouple regulatory processes from financial cycles, reinforcing the State-level rigidity identified in Section 3.1.

Within the financial and industrial dimensions, pressures accumulate through the application of large-scale development risk assessment frameworks to small-lot projects. Financial institutions, operating under conservative risk-control logics, require legally recognized development entities, stable pre-sale structures, and corporate guarantees that small-lot actors are structurally unable to provide. In the absence of institutionalized risk-sharing mechanisms, lending institutions respond by tightening credit conditions or withdrawing capital. Simultaneously, narrow construction interfaces, limited machinery access, and potential impacts on adjacent buildings intensify cost uncertainty and delay risk. These pressures converge toward quasi-State conditions, as recurrent financial conservatism becomes embedded in implementation expectations.

Professional fragmentation further reinforces structural lock-in. The absence of institutionalized coordination platforms linking architects, project managers, contractors, and financial institutions results in discontinuous workflows. Without integrative mechanisms, regulatory approval, financing, and construction sequencing operate in parallel rather than synchronously. This fragmentation inhibits the transformation of pressures into stabilized systemic process states.

Landowners function as pivotal yet structurally constrained actors within this configuration. While safety concerns and living quality improvements motivate renewal intentions, persistent information asymmetry generates cognitive uncertainty regarding cost structures, rights transformation mechanisms, and long-term risks. Unrealistic expectations—such as one-for-one exchange assumptions or anticipated future policy relaxation—reflect structural misalignment between institutional design and stakeholder cognition. As a result, consent chains become unstable, and implementation momentum dissipates before stabilization.

Physical constraints intensify this cumulative effect. Narrow alleys, parking infeasibility, limited setbacks, and constrained construction access frequently render technically compliant projects economically unviable. In such cases, regulatory approval does not translate into financial feasibility, illustrating how Pressure-level

attributes reinforce State-level entrenchment. Without spatial innovation strategies—such as block-level integration, off-site parking arrangements, or adaptive housing management models—small-lot renewal remains structurally constrained.

Taken together, institutional exclusion, financial lock-in, professional fragmentation, information asymmetry, and spatial infeasibility converge into a State-dominant governance configuration. Policy incentives and safety imperatives generate renewal drivers, yet these drivers repeatedly fail to overcome entrenched structural barriers. As indicated by the contrast between widespread pre-1974 buildings and selectively activated renewal cases, aging-building demand alone does not determine redevelopment outcomes. Instead, renewal tends to concentrate where land assembly, regulatory approval, financing, and market operation can be aligned. The result is a governance landscape characterized less by absence of intent than by systemic incapacity to transform pressures into stabilized implementation states.

3.3. Governance Repair Chain Continuity across Empirical Cases

To examine whether and how structural lock-in can be mitigated, the four empirical cases were analyzed through the DPSIR repair chain continuity framework. Rather than evaluating isolated interventions, the analysis focuses on whether governance repair mechanisms successfully transformed fragmented pressures into stabilized systemic process states (S), thereby restoring causal continuity.

Cases A and C demonstrate continuous repair chains ($D \rightarrow P \rightarrow S \rightarrow I \rightarrow R$) in which institutional, financial, procedural, and social repair domains (R_d, R_p, R_s, R_i) were activated in an integrated manner. In both cases, architect-led coordination aligned regulatory review with financing timelines, adapted design strategies to spatial constraints, and facilitated stakeholder negotiation. Crucially, Systemic Process Repair (R_s) stabilized workflow integration, enabling pressures to be converted into operationally coherent states. This stabilization allowed renewal drivers to translate into sustained implementation and ultimately successful completion.

Case B illustrates a broken chain ($D \rightarrow P \rightarrow S_x \rightarrow I \rightarrow R$). Although regulatory approval and partial financial negotiation were present, the failure of systemic process repair prevented the establishment of a stabilized State. Parking infeasibility and unresolved financing gaps remained unintegrated pressures, which translated directly into adverse impacts, including erosion of stakeholder trust and project collapse. The absence of integrative governance mechanisms demonstrates that repair activation in isolated domains is insufficient without process stabilization.

Case D represents a partially stabilized configuration ($D \rightarrow P \rightarrow S^{\sim} \rightarrow I \rightarrow R$). Institutional and financial repair mechanisms were initiated through negotiation and temporary capital access, yet systemic process repair remained incomplete and reliant on informal coordination. Persistent construction risks and workflow uncertainty prevented durable stabilization, resulting in fragile continuation characterized by fluctuating stakeholder confidence and elevated governance risk.

Table 3
Systemic Process Stabilization and DPSIR Repair Continuity across Empirical Cases

Case	DPSIR Configuration & Repair Activation (R: Rd / Rp / Rs / Ri)	Systemic Process State (S) Condition	Governance Outcome
A	$D \rightarrow P \rightarrow S \rightarrow I \rightarrow$ R (Rd + Rp + Rs + Ri activated)	S fully stabilized through integrated regulatory, financial, and construction coordination (Rs effective)	Stable and completed renewal
B	$D \rightarrow P \rightarrow S_x \rightarrow I \rightarrow$ R (Rd + Rp + Ri activated; Rs failed)	S not established due to unresolved financing gaps and parking infeasibility	Project collapse
C	$D \rightarrow P \rightarrow S \rightarrow I \rightarrow$ R (Rd + Rp + Rs + Ri activated)	S stabilized via design adaptation and phased process integration (Rs effective)	Successful renewal with sustained stabilization
D	$D \rightarrow P \rightarrow S_{\sim} \rightarrow I \rightarrow$ R (Rd + Rp + Ri activated; Rs weak)	S partially stabilized but structurally fragile due to incomplete workflow integration	Fragile continuation with elevated governance risk
Note: Rd = Institutional Repair; Rp = Financial Repair; Rs = Systemic Process Repair; Ri = Impact Repair;			
S = stabilized and continuous process state; S _x = systemic state not established; S ~ = partially stabilized but structurally fragile			

Across cases, outcomes were not determined solely by the magnitude of pressures nor by the number of repair domains activated. Instead, success depended on whether Systemic Process Repair (Rs) effectively transformed fragmented pressures into stabilized systemic states. This transformation required integrative governance coordination capable of synchronizing regulatory, financial, technical, and social dimensions. Empirical evidence indicates that architects frequently assumed this intermediary integrative role, functioning as boundary-spanning actors within fragmented governance systems.

The governance repair dynamics synthesized across cases are presented in Table 3 and visualized in Fig. 5, which conceptualizes governance repair as the restoration of causal continuity within a structurally entrenched DPSIR configuration. The model highlights that renewal stabilization in small-lot contexts depends not merely on policy incentives but on the capacity to reconfigure State-level rigidity through coordinated repair mechanisms.

4. Discussions

From a land-use governance perspective, the observed governance fragmentation reflects a systemic failure in aligning distributed responsibilities across actors. Rather than a lack of intervention, the findings indicate that institutions, financial systems, and professional actors operate within bounded rationalities that collectively produce exclusionary outcomes. This suggests that urban regeneration should be understood as a multi-actor

responsibility system, where sustainability depends on the reconstruction of accountability and coordination across fragmented domains.

This study contributes to urban regeneration scholarship by demonstrating that governance breakdown in small-lot redevelopment is not primarily a function of pressure intensity, but of causal discontinuity within fragmented urban systems. While prior research frequently identifies institutional fragmentation, financial constraints, and stakeholder conflict as discrete obstacles, the DPSIR-based analysis reveals that such pressures are structurally embedded in dense metropolitan environments. These pressures are not exceptional conditions; rather, they constitute the normal operating context of mature high-density cities. What differentiates stalled from progressing renewal trajectories is therefore not the elimination of pressures, but the capacity to re-establish continuity across disrupted governance chains.

The findings suggest that small-lot regeneration exposes a scale bias embedded within redevelopment regimes calibrated for large-scale land assembly and capital concentration. Regulatory thresholds, risk-averse financial instruments, and segmented coordination structures collectively privilege scale, rendering micro-parcel renewal structurally misaligned with prevailing institutional design. In this context, governance failure manifests less as policy absence than as systemic miscalibration between cadastral reality and redevelopment frameworks. Governance repair, therefore, should be conceptualized as a mechanism of causal reconstruction—restoring functional alignment between institutional rules, financial models, process coordination, and localized implementation conditions.

Empirical evidence from Taipei indicates that intermediary governance actors emerge where institutional steering is insufficient to bridge such misalignments. Architects, in this case, operate not merely as technical designers but as integrative nodes within fragmented governance environments. Their role encompasses regulatory translation, financial alignment, technical adaptation, and stakeholder mediation, enabling stalled processes to regain operational coherence. Importantly, this intermediary function should not be interpreted as professional exceptionalism, but as a structural response to governance fragmentation in scale-biased redevelopment systems.

By extending DPSIR from a diagnostic model to a recursive governance repair framework—where Response mechanisms reconnect stalled chains back toward Driving Forces—this study offers a conceptual lens for understanding how fragmented regeneration systems can regain continuity. The implications extend beyond Taipei. Mature high-density metropolitan regions characterized by small cadastral parcels, aging housing stock, and constrained public-sector coordination may face similar discontinuities. In such contexts, governance repair is less about introducing new policy instruments than about reconstructing causal integration across fragmented urban systems.

4.1. From Fragmented Pressures to Governance Breakpoints: A DPSIR Interpretation

By aligning thematic coding results with the DPSIR framework, this study demonstrates that responsibility bottlenecks in small-lot regeneration emerge not from singular policy failures, but from cumulative cross-dimensional interactions within fragmented urban systems. Driving Forces such as policy incentives and safety concerns associated with aging building stock initially activate renewal processes. However, within

scale-biased redevelopment regimes, these forces are rapidly converted into intensified Pressures. Conservative financial risk controls, segmented professional coordination, physical construction constraints, market-selective redevelopment logics, and cognitive asymmetries among stakeholders collectively amplify systemic strain.

As pressures accumulate, they crystallize into structural States of stagnation. These states are marked by institutional exclusion of micro-parcel sites, procedural delays misaligned with financial timelines, and spatial infeasibility rooted in cadastral fragmentation. Importantly, such stagnation is not episodic; it reflects the structural miscalibration between redevelopment frameworks and fine-grained urban fabric. The spatial mismatch between broadly distributed aging buildings and selectively activated renewal cases further indicates that governance stagnation is unevenly distributed across the city. The resulting Impacts—including persistent safety vulnerabilities, erosion of social trust, and declining neighborhood liveability—represent the visible surface of deeper governance discontinuities.

The concept of governance breakpoints emerges at this juncture. Breakpoints occur where compounded pressures stabilize into self-reinforcing stagnation, severing causal continuity within renewal systems. Rather than viewing impacts as the outcome of discrete regulatory or financial deficiencies, the DPSIR interpretation reveals them as symptoms of subsystem misalignment across regulatory, financial, industrial, social, and spatial domains. In small-lot regeneration, these breakpoints are also spatialized: aging buildings may remain outside effective renewal pathways when regulatory feasibility, financial acceptance, land assembly conditions, and market operability cannot be aligned. Effective Responses must therefore operate across interconnected causal linkages, addressing institutional rigidity, financial risk governance, process fragmentation, and trust erosion in an integrated manner.

Reframed through this lens, small-lot regeneration challenges are not primarily technical or regulatory scale problems, but manifestations of governance continuity breakdown under fragmented metropolitan conditions. The emergence of intermediary governance actors can thus be understood as a structural adaptation to these breakpoints. In contexts where formal coordination mechanisms are insufficient, integrative actors reconstruct causal chains capable of transforming dispersed pressures into coordinated renewal trajectories.

4.2. Repair Domains and the Restoration of DPSIR Causal Flow

Integrating governance fragmentation analysis with the DPSIR-based framework, this study conceptualizes governance repair as a systemic process of restoring causal continuity within fragmented urban regeneration systems. Rather than addressing isolated bottlenecks, effective repair requires coordinated interventions across institutional, financial, procedural, spatial, and social domains, where discontinuities are embedded in the interactions between actors rather than within single policy instruments.

Within the DPSIR structure, governance stagnation emerges when accumulated Pressures are not successfully transformed into stabilized States, resulting in systemic breakpoints that disrupt renewal trajectories. These breakpoints reflect not only operational inefficiencies but also misalignments in the distribution of responsibilities across governance domains. Institutional thresholds, financial risk controls, fragmented professional coordination, site constraints, and trust instability collectively contribute to

conditions in which no single actor is positioned to ensure continuity of implementation. As a result, many aging buildings remain outside effective renewal pathways despite formal policy incentives.

To address these conditions, the study identifies four interrelated governance repair domains: Institutional Repair (Rd), Financial Repair (Rp), Systemic Process Repair (Rs), and Impact Repair (Ri). These domains function as coordinated response mechanisms that collectively re-establish causal flow within the DPSIR framework. Institutional repair recalibrates regulatory thresholds and procedural frameworks to reduce exclusionary effects; financial repair introduces risk-sharing and credit mechanisms that enable capital accessibility; systemic process repair integrates fragmented workflows across actors, project stages, and spatial constraints; and impact repair restores stakeholder trust and stabilizes participation dynamics.

Importantly, these repair domains operate not as independent interventions but as interdependent mechanisms that reconstruct governance continuity through alignment. The effectiveness of repair therefore depends on whether these domains are activated in a coordinated manner capable of transforming dispersed pressures into stabilized implementation states. In this sense, governance repair can be understood as a process of reconfiguring distributed responsibilities across fragmented systems, rather than merely introducing new policy instruments. For small-lot regeneration, such repair also requires reconnecting widespread aging-building demand with selectively activated redevelopment pathways.

4.3. Intermediary Actors and the Reconstruction of Governance Responsibility

While the previous section conceptualizes governance repair as a systemic mechanism, this section examines the actor-level configuration through which such repair is operationalized. In fragmented urban regeneration systems, intermediary governance actors emerge as critical agents that bridge institutional, financial, and social domains where formal coordination mechanisms are insufficient.

Evidence from the four cases indicates that design-centered professional practice alone is insufficient for overcoming structural constraints embedded in small-lot regeneration. Instead, architects increasingly operate as cross-sectoral governance nodes linking landowners, public agencies, financial institutions, and implementation actors. Their expanded functions include institutional coordination, rights negotiation, risk interface management, interest alignment, and sustained trust-building—activities that collectively address governance discontinuities rather than isolated technical deficiencies.

This transformation resonates with emerging scholarship on governance-oriented architectural practice (Chansomsak & Vale, 2009; Jamieson et al., 2011; Okeke, 2021; Owens, 2015; Ng et al., 2022), as well as recent observations highlighting coordination-intensive and trust-based professional evolution (Lai, 2025). However, the present analysis situates this evolution within a broader structural logic: intermediary roles emerge where formal institutional steering mechanisms are insufficient to reconnect fragmented redevelopment systems.

Within this configuration, intermediary actors can be analytically differentiated into four functional modalities. As coordinators, they orchestrate regulatory compliance, rights distribution, and construction feasibility through multi-actor negotiation. As translators, they convert technical, financial, and regulatory information into accessible knowledge, thereby reducing cognitive asymmetries among stakeholders. As trust

intermediaries, they sustain engagement processes and stabilize consent chains under conditions of uncertainty. As problem integrators, they synthesize design, regulation, finance, and construction constraints to bridge institutional–market discontinuities.

These roles collectively demonstrate that intermediary actors function not merely as technical professionals but as responsibility integrators within fragmented governance systems. By aligning distributed responsibilities and reconstructing accountability across domains, they enable the activation of governance repair mechanisms identified in Section 4.2. In this sense, the effectiveness of governance repair depends not only on the presence of policy instruments, but on the capacity of intermediary actors to reconfigure fragmented responsibility structures into coordinated implementation processes.

4.4. A Collaborative DPSIR Governance Repair Model

Building upon DPSIR attribute mapping and the identified intermediary functions, this study proposes a Collaborative DPSIR Governance Repair Model for small-lot urban regeneration. Rather than conceptualizing DPSIR as a linear causal chain, the model reframes it as a dynamic and recursive governance system in which repair mechanisms restore continuity within fragmented redevelopment environments.

At its foundation lies landowner trust and consent stabilization, which function as enabling conditions for mobilizing institutional incentives and financial resources in micro-parcel projects. Within this configuration, intermediary governance actors operate as cross-domain coordination pivots linking institutional systems, financial environments, professional networks, landowner interests, and site-specific constraints. Through mediation, translation, and integrative problem-solving, these actors align fragmented subsystems and mitigate structural contradictions embedded in scale-biased redevelopment regimes.

Within the outer DPSIR loop, renewal drivers are frequently undermined by institutional rigidity, threshold effects, and distorted expectations. These conditions generate pressures through administrative constraints, opaque construction processes, and conservative banking practices. Accumulated pressures crystallize into stagnant states characterized by coordination fragmentation and financing deadlock, producing impacts such as governance disconnection, trust erosion, and persistent safety vulnerabilities. Coordinated response mechanisms—including small-lot regulatory tracks, integrative project coordination management (PCM) systems, credit guarantees, and spatial adaptation strategies—function as repair pathways that restore causal continuity and reactivate stalled renewal trajectories.

By repositioning DPSIR as a recursive governance repair mechanism, the model explains how fragmented regeneration systems can transition from structural stagnation toward coordinated recovery. The collaborative configuration identified here does not rely on singular professional dominance, but on the structural necessity of intermediary coordination within high-density metropolitan contexts characterized by cadastral fragmentation and institutional misalignment.

5. Conclusions

This study applies the DPSIR framework to micro-scale urban regeneration and demonstrates that stagnation in small-lot renewal stems less from insufficient redevelopment motivation than from structural scale mismatch embedded within fragmented governance systems. In high-density metropolitan contexts,

institutional thresholds, financial risk regimes, professional segmentation, site constraints, and trust instability collectively disrupt causal continuity, preventing renewal drivers from translating into sustained implementation.

Governance breakpoints emerge where compounded pressures crystallize into systemic stagnation. Among these, conservative financial risk controls and persistent trust erosion function as particularly critical discontinuities, severing restorative feedback loops within the DPSIR structure. Stagnation is thus not episodic but structurally reproduced under scale-biased redevelopment regimes.

By extending DPSIR beyond linear diagnosis, this study conceptualizes governance repair as a recursive process in which targeted Response mechanisms restore causal alignment across fragmented subsystems. The repair-domain framework provides an analytical lens for understanding how renewal systems transition from lock-in toward coordinated recovery. Within this configuration, intermediary governance actors emerge as structurally adaptive connectors capable of reactivating stalled processes through cross-domain integration, translation, and trust stabilization.

Theoretical contributions of the study lie in three areas. First, it extends DPSIR to micro-urban regeneration contexts characterized by cadastral fragmentation and institutional miscalibration. Second, it operationalizes governance fragmentation through attribute-based causal intensity mapping, enabling the identification of governance breakpoints within complex urban systems. Third, it situates intermediary governance roles as systemic responses to scale bias rather than as profession-specific innovations.

The implications extend beyond the Taipei case. Mature metropolitan regions with fine-grained parcel structures, aging building stock, and constrained public-sector coordination may encounter similar governance discontinuities in small-scale regeneration. In such contexts, effective renewal requires not merely new policy instruments, but mechanisms capable of reconstructing causal integration across institutional, financial, and social domains.

Future research may incorporate quantitative modeling to further test causal interactions and undertake cross-contextual comparisons to evaluate the transferability of the governance repair framework across diverse institutional environments. This study reframes small-lot urban regeneration as a land-use governance challenge, highlighting that sustainable outcomes depend on the alignment and reconstruction of distributed responsibilities within fragmented redevelopment systems.

Declarations

Author Contribution

Shih-Wei Huang contributed to data collection and prepared the original manuscript draft. Yi-Chang Chiang conceptualized the study, conducted the analysis, prepared the figures and tables, revised and edited the manuscript, supervised the research, and managed the submission process. Both authors reviewed and approved the final manuscript.

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Figures

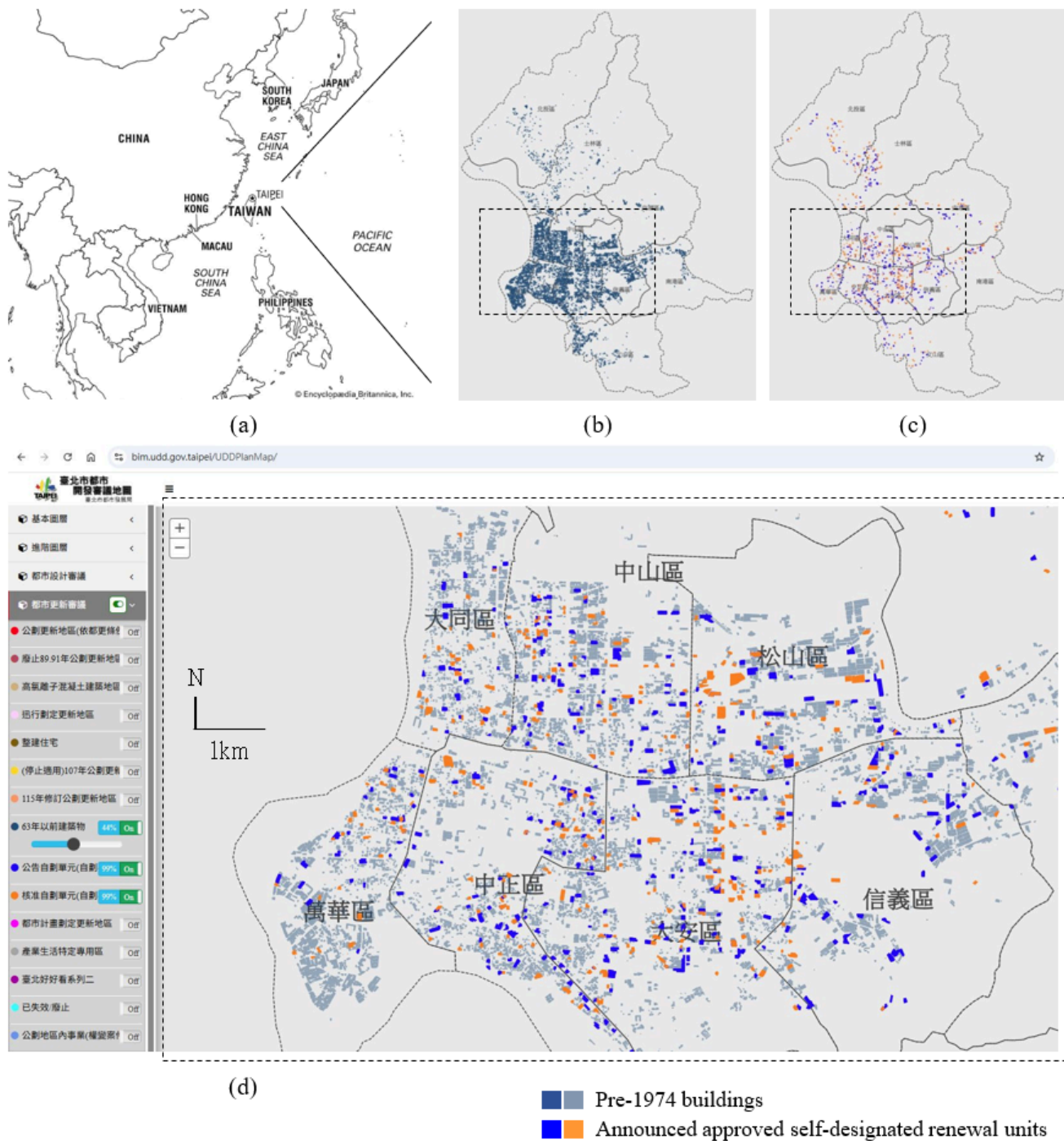


Figure 1

Spatial mismatch between pre-1974 buildings and self-designated urban renewal units in Taipei. (a) Location of Taipei in East Asia and Taiwan. (b) Citywide distribution of pre-1974 buildings, showing the broad spatial extent of aging building stock. (c) Citywide distribution of existing and potential self-designated urban renewal units, distinguishing announced units from approved units. (d) Detailed view of Taipei's core urban districts, illustrating the fragmented and selective concentration of self-designated renewal units within areas containing extensive pre-1974 buildings. Pale blue indicates pre-1974 buildings, and pale magenta indicates approved unsafe-and-old-building reconstruction cases; both are shown as contextual background layers. Blue indicates announced self-designated urban renewal units, while orange indicates approved self-designated

urban renewal units. The contrast between broadly distributed aging-building stock and unevenly activated self-designated renewal units suggests that small-lot regeneration follows land assembly feasibility, regulatory pathways, and market operability rather than building age alone. Source: Adapted from Taipei City Government (2026) and Encyclopaedia Britannica (n.d.).

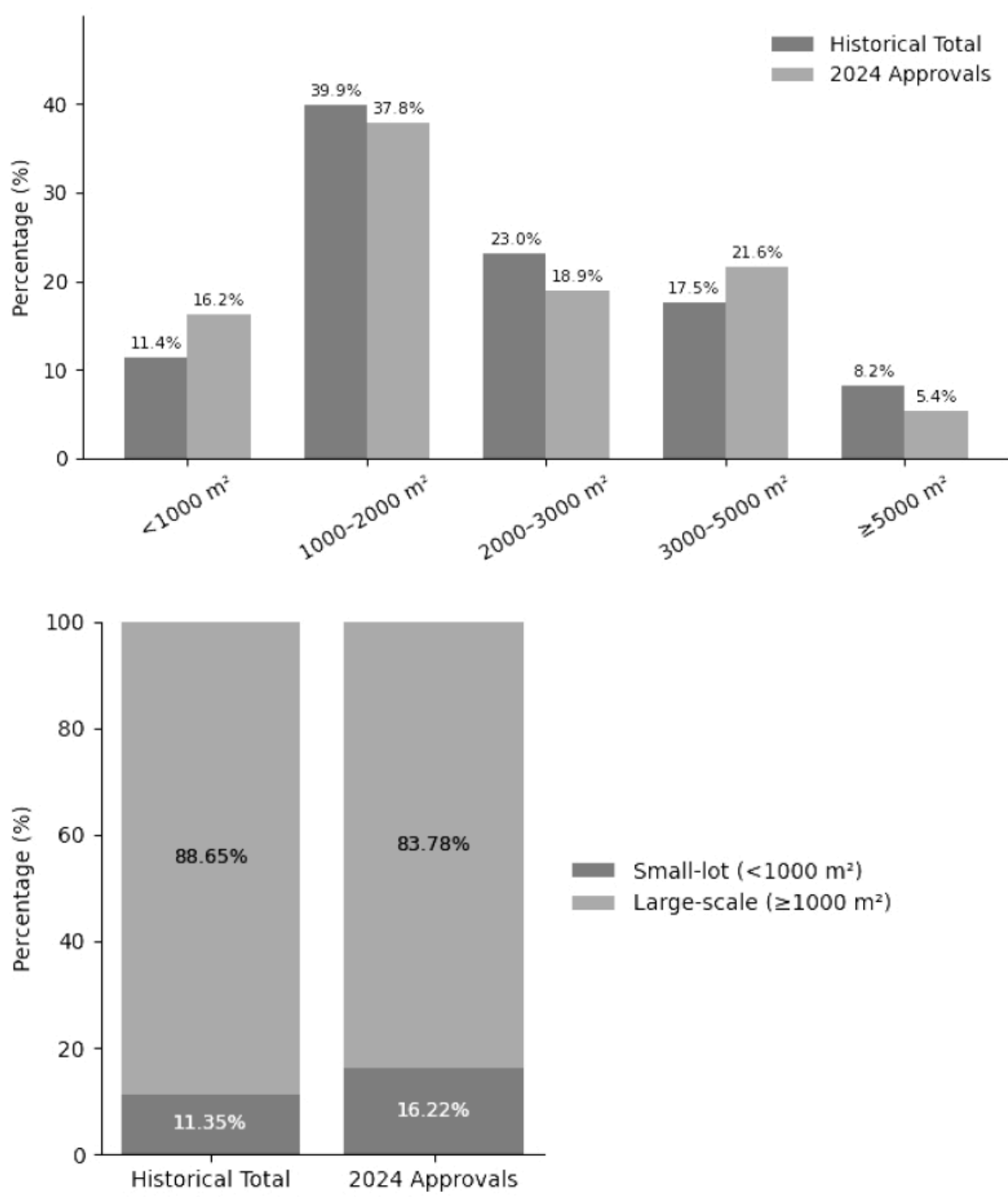


Figure 2

Site-size distribution and proportional representation of approved urban renewal projects in Taipei.

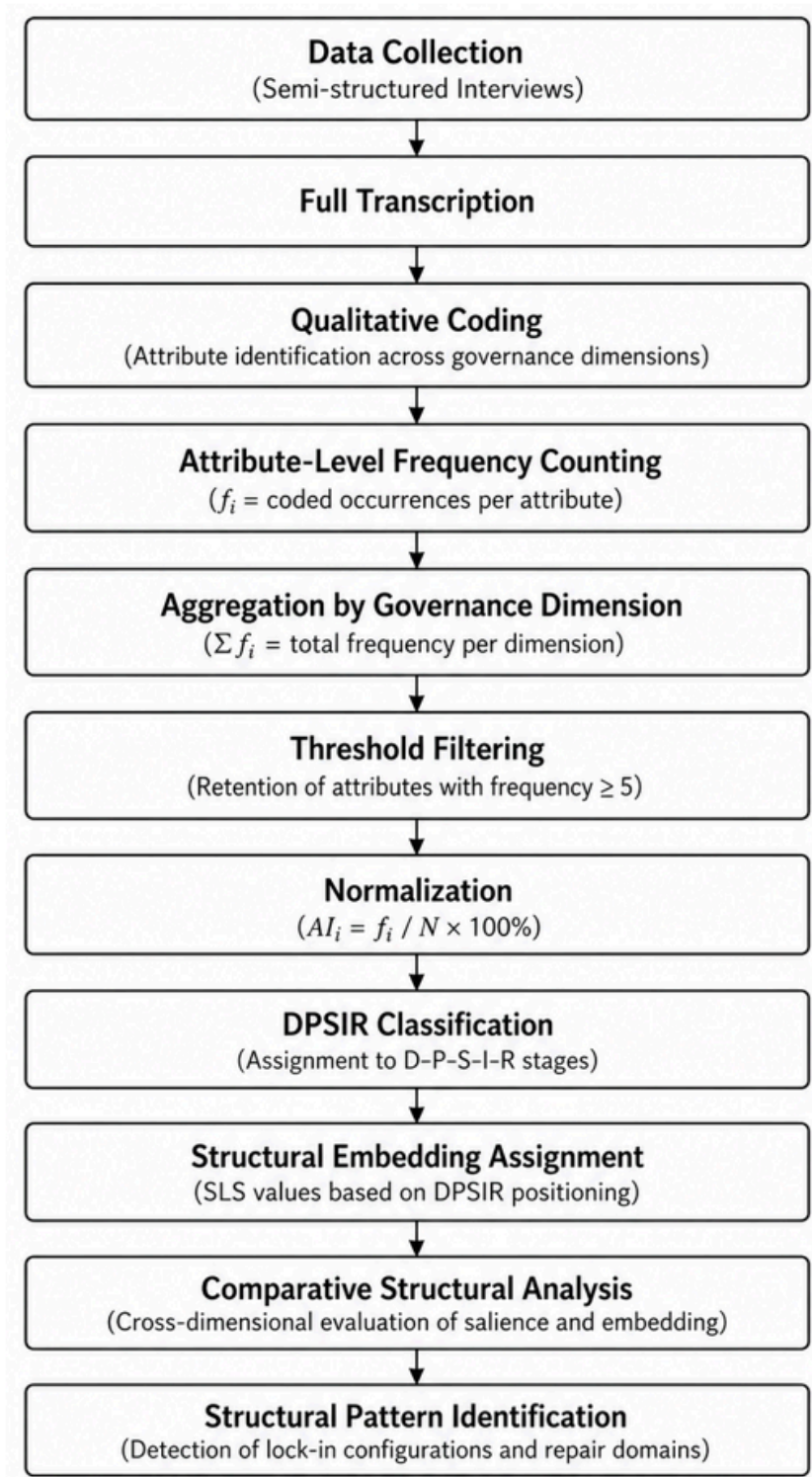


Figure 3

Analytical workflow for DPSIR-based governance repair modeling and semi-quantitative attribute mapping. This figure illustrates the analytical workflow linking qualitative interview coding to semi-quantitative structural analysis. Attribute-level frequencies (f_i) are aggregated ($\sum f_i$), normalized using the Attribute Intensity Index (AI), and structurally classified through DPSIR stages and Structural Lock-in Scores (SLS), enabling cross-dimensional comparison and identification of governance patterns.

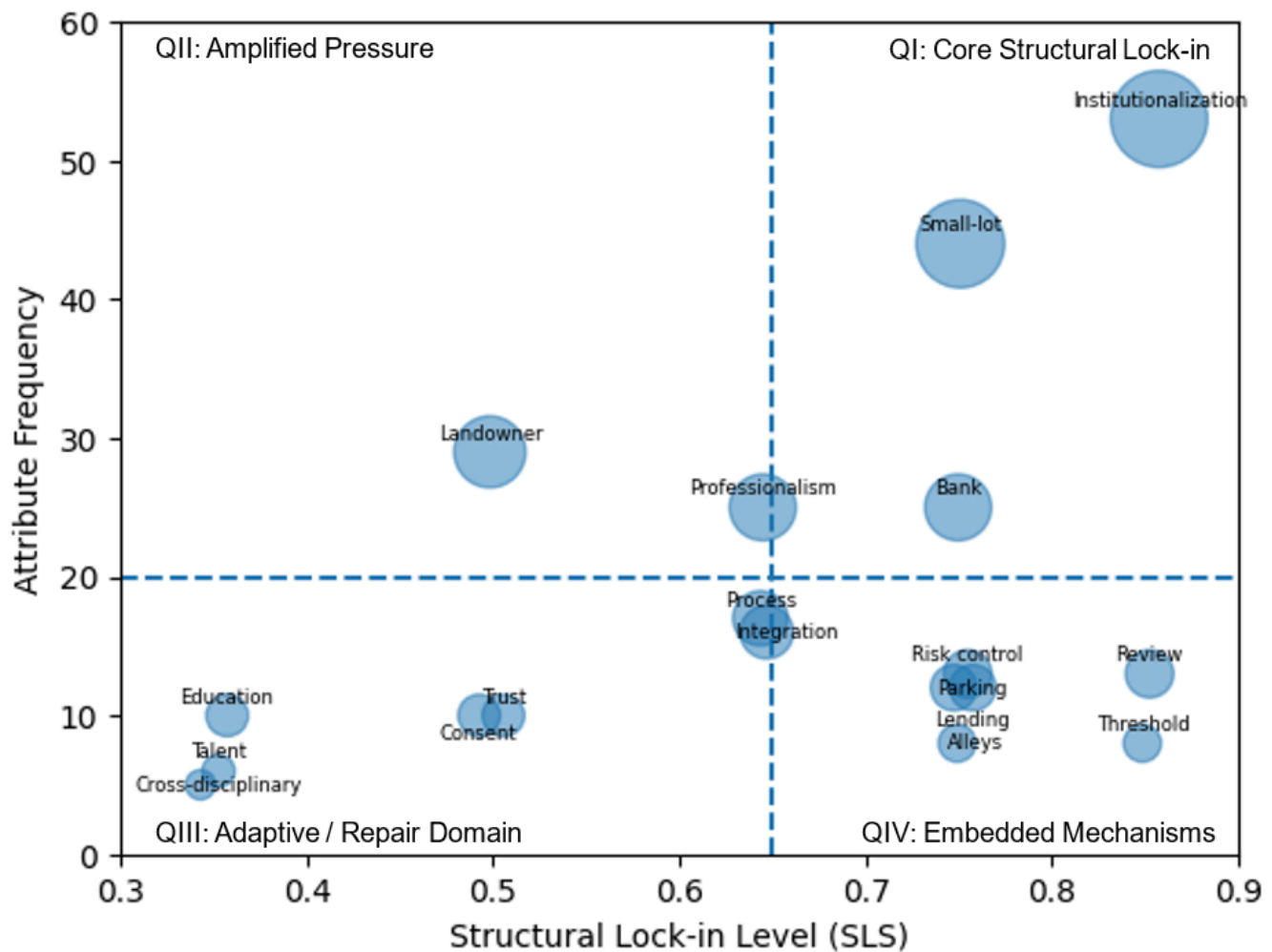


Figure 4

Attribute-Level Structural Lock-in Distribution across Governance Dimensions. This quadrant-based bubble map visualizes governance attributes derived from coded interview data. Each bubble represents an attribute, where position is determined by Structural Lock-in Level (SLS) and Attribute Intensity Index (All), and bubble size reflects raw frequency (f_{ij}). The vertical dashed line (SLS = 0.65) separates lower from higher institutional embedding, while the horizontal dashed line (All threshold $\approx 5\%$) distinguishes lower from higher empirical salience (corresponding approximately to a frequency threshold of 20 out of $N = 392$). The upper-right quadrant (QI: Core Structural Lock-in) indicates attributes that are both structurally embedded and empirically dominant, while the lower-left quadrant (QIII: Adaptive / Repair Domain) represents weakly embedded and low-intensity attributes associated with governance response potential.

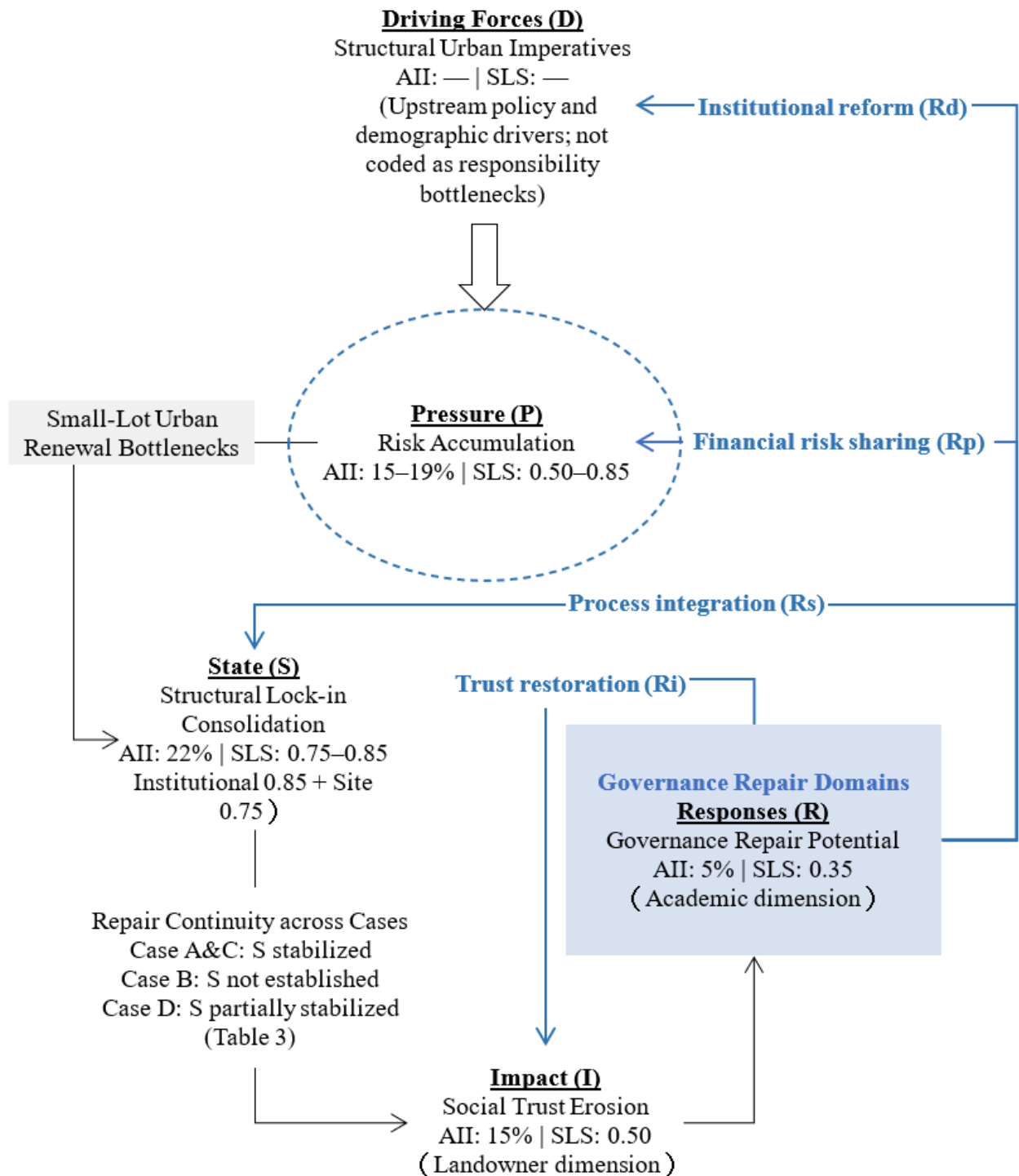


Figure 5

DPSIR-Based Governance Repair Model and Structural Lock-in Configuration in Small-Lot Urban Renewal. This figure synthesizes the empirical findings by integrating DPSIR components with Structural Lock-in Levels (SLS), Attribute Intensity Index (AII), and repair domains (Rd, Rp, Rs, Ri). The model illustrates a State-dominant structural configuration in which institutional embedding and spatial fragmentation consolidate governance lock-in. Financial and industrial pressures reinforce this consolidation, while social impacts emerge downstream. Governance repair mechanisms—Institutional reform (Rd), Financial risk sharing (Rp), Process integration (Rs), and Trust restoration (Ri)—are positioned as intermediary interventions that vary in

effectiveness across cases (Table 3). The model highlights that repair continuity depends on whether State-level consolidation can be structurally stabilized through coordinated regulatory, financial, and procedural integration.