Sustainable Urban Rehabilitation in Vulnerable Historic Contexts

Evaluating Alternative Intervention Strategies for Walkability, Safety, and Environmental Quality in Callao's Historic Center

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María del Rosario Rodríguez Zegarra

Bachelor of Science in Sustainable Built Environments Degree

College of Architecture, Planning & Landscape Architecture

The University of Arizona
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With the supervision and guidance of Sandra Bernal, Ph.D.

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Abstract

The Historic Center of Callao, Peru, faces physical deterioration, high crime rates, and decades of failed rehabilitation attempts, creating urgent need for effective intervention strategies. This research evaluates three rehabilitation strategies to identify which approach optimally balances urban impact with implementation feasibility in this politically unstable, resource-constrained context. Literature shows that political discontinuity and insufficient funding have caused previous rehabilitation attempts to fail. Currently, the PDM Callao 2040 (Metropolitan Development Plan) includes planning provisions for this zone. However, researchers have not adequately examined intermediate strategies that balance viability and transformative impact.

This study employs methodological triangulation, combining semi-structured stakeholder interviews (n=10), focus group discussion (n=6), and weighted scorecard analysis across four dimensions: Walkability, Safety, Environmental Quality, and Viability. The research evaluates three strategies: A1 (Tactical), A2 (Intermediate combining pedestrianization, pocket parks, lighting, and façade rehabilitation), and A3 (Comprehensive transformation).

Findings demonstrate that alternative urban rehabilitation strategies in the Historic Center of Callao differ in perceived effectiveness for two main, interdependent reasons. The first is the capacity to address security, which is the community's primary concern. The second is the perceived credibility of interventions within existing institutional constraints.

This research contributes the strategic implementation zone concept and provides evidence-based guidance for municipalities navigating viability-impact trade-offs, with broader applicability to Latin American historic centers.

Keywords

Urban rehabilitation, perceived feasibility, Vulnerable Historic Contexts, Callao.

1. Introduction

Callao is a port city located in the Constitutional Province of Callao on the central-western coast of Peru, along the central stretch of the national littoral (Figure 1).

Although contiguous with Lima, it maintains a distinctive territorial identity and considerable development potential as a metropolitan centrality (Metropolitan Planning Institute, 2020).

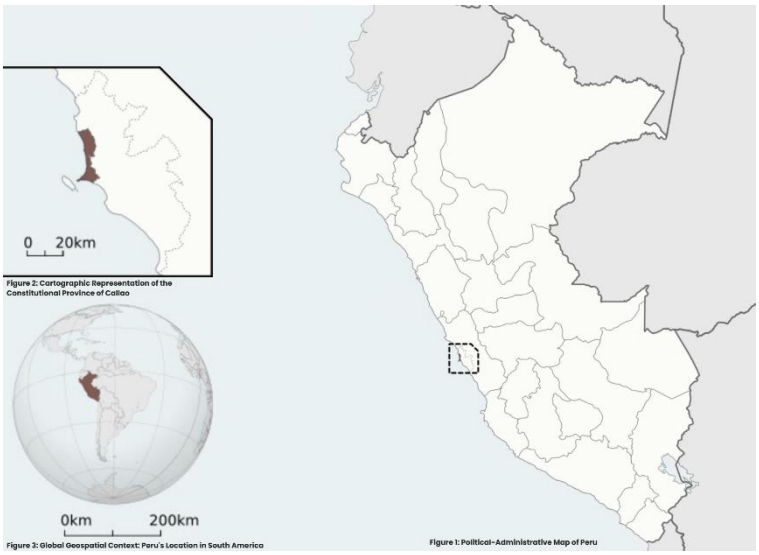


Figure 1: Geographical Location of Callao *Source: Wikipedia (2009) Peru-Callao, Constitutional Province of Callao*

Historically significant as the country's maritime gateway, Callao concentrates heritage assets, mixed-use urban fabric, and strategic logistics infrastructure that anchor national commerce and regional mobility (Figure 2).

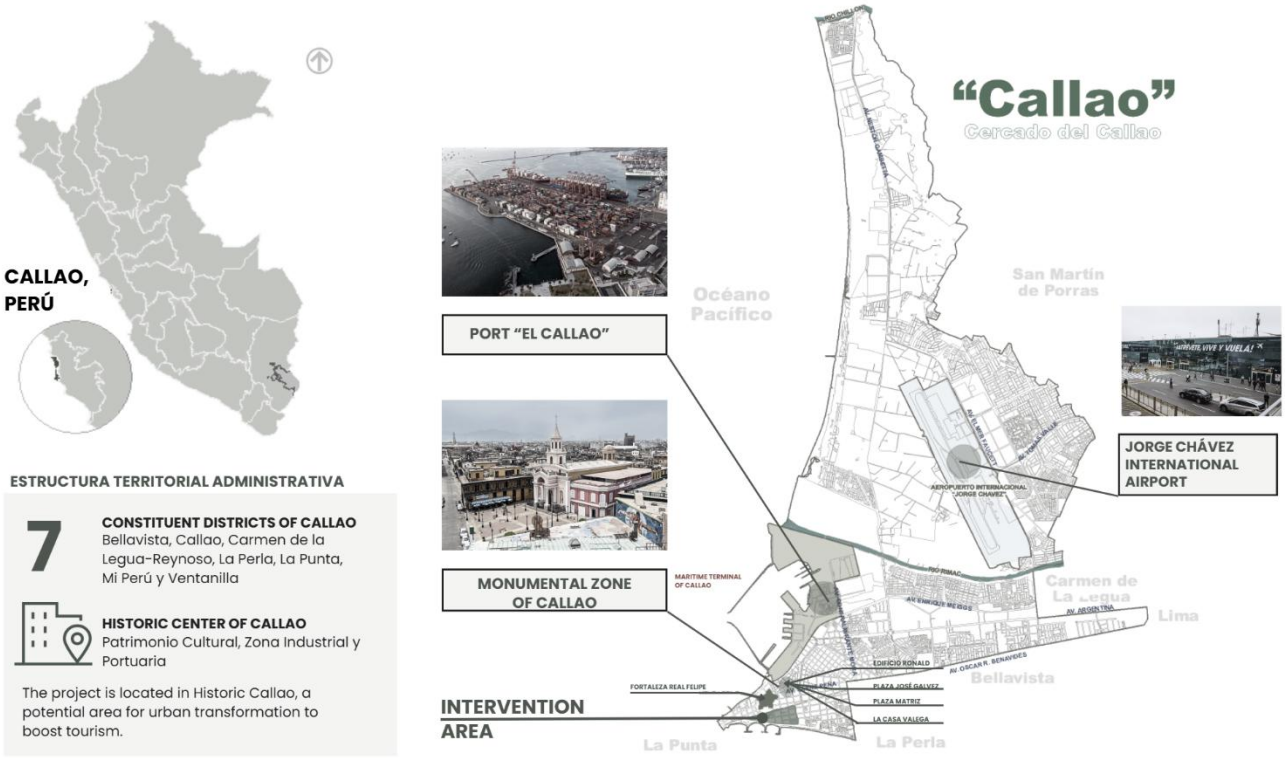


Figure 2: Map of Callao *Source: Reyes, E. (2005)*

However, this historical centrality now confronts a combination of spatial discontinuities, underperforming public spaces, and environmental stressors that erode everyday urban life (PDM 2040 Callao). As Velarde (2024) notes, Callao exhibits marked inequities in the distribution and quality of public spaces, with higher-quality infrastructure concentrated in specific sectors, while other zones face chronic deficits in both quantity and maintenance, exacerbating socio-spatial inequalities and limiting the right to the city for its most vulnerable inhabitants. Narrow and obstructed sidewalks, unsafe crossings, fragmented pedestrian networks, and the physical and operational impacts of port and airport logistics have weakened walkability and perceived safety. Simultaneously, exposure to multiple hazards, including seismic risks and tsunamis, demands open space systems that are both accessible and resilient (Callao Municipality, 2023). These deficits hinder inclusive access to services and cultural assets, restrict the potential of waterfront areas, and diminish the quality of the public realm.

Consequently, there is an urgent need for strategically oriented urban rehabilitation that reactivates the historic center with a focus on human-scale connectivity, environmental comfort, and disaster risk reduction (Metropolitan Planning Institute, 2020).

To address these challenges, the present research focuses on Historic Downtown Callao, one of the priority centralities identified in the Metropolitan Development Plan (PDM) Callao 2040, which integrates areas of significant cultural heritage value in proximity to the industrial and port zone. This strategic location positions the sector as a space with high potential for urban transformation to drive tourism development, revitalizing Callao's historical identity while improving habitability conditions for its residents (PDM Callao 2040).

To delimit the physical scope of the intervention, a study polygon has been defined covering 222,663.21 m² with a length of 2,524.45 m (Figure 3) an area that presents ideal conditions to implement and evaluate rehabilitation proposals. This research responds by testing an evaluation framework that compares three intervention intensities, ranging from low-cost tactical actions to comprehensive corridor improvements, against measurable sustainability and equity outcomes, in order to guide coherent, phased investments in Historic Callao.

Figure 3: Delimitation of the Area *Source: Rodriguez, M (2025). Analysis of the Intervention Area.*

1.1. Contextual Framework Analysis

The intervention strategy for Historic Callao is structured upon a foundation of complementary planning and risk management frameworks that establish essential parameters for urban rehabilitation.

The PDM Callao 2040 provides the strategic vision, outlining a polycentric urban development approach that prioritizes public transport integration, public space recovery, and strengthening of urban centralities. This framework validates an evaluation methodology centered on pedestrian networks that connect heritage areas with activity nodes and the coastal edge, while providing specific criteria to measure connectivity improvements and "territorial gain."

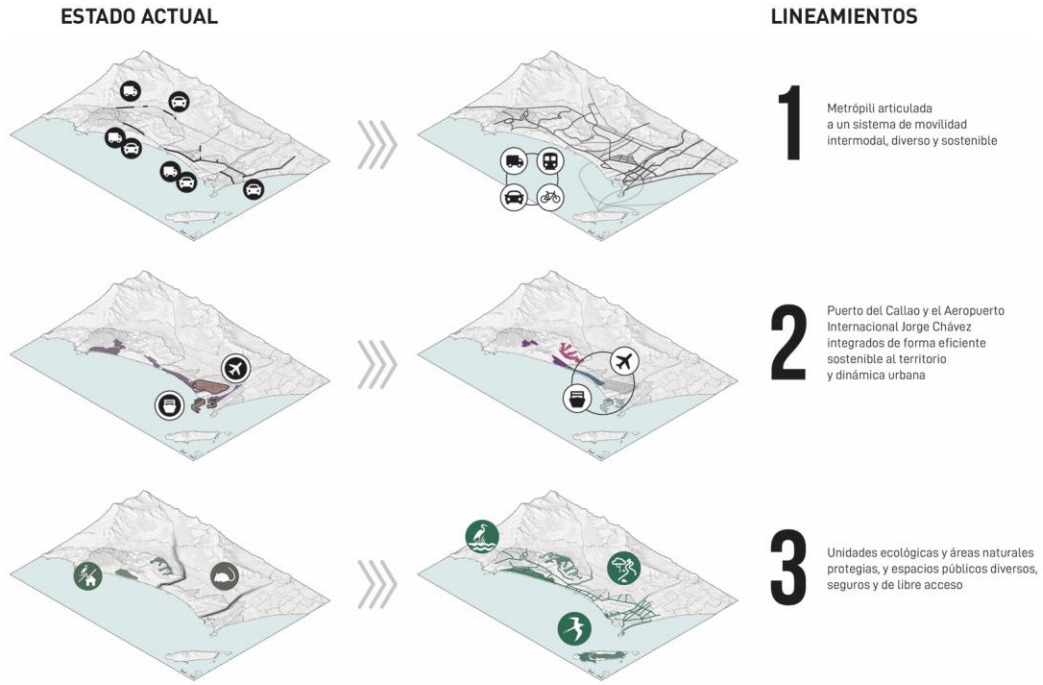


Figure 4: Axonometric Diagrams of the Strategic Pillars of the Urban Development Model for Callao
Source: PDM 2040 Callao

The PDM Callao 2040 provides the strategic vision, while the PDU 2011-2022 specifically categorizes the Historic Center as a "Special Treatment Zone" requiring differentiated interventions to preserve its heritage value and enhance its function as an urban centrality. According to the PDU, this area represents an urban space of great historical, architectural, and urbanistic value, but faces challenges including deterioration of buildings, overcrowding, incompatible land use changes, and public insecurity.

Complementarily, SIGRID hazard mapping and the PDU vulnerability analysis reveal that the Historic Center is located in a zone of "high seismic and tsunami vulnerability," a situation exacerbated by the presence of "aging buildings with vulnerable materials and deficient maintenance." The PDU indicates that this area presents "soils with low bearing capacity" and an urban configuration that hinders evacuation due to its "narrow streets and high population density."

1.2. Demographic and Sociological Profile

Demographic and socioeconomic data substantiate the social dimensions requiring consideration in urban rehabilitation efforts. According to the 2017 National Census (INEI), Callao's population of 994,424 inhabitants exhibits a relatively balanced gender distribution (51.1% women, 48.9% men), with a demographic profile

characterized by substantial cohorts of adults aged 30-64 (420,045 inhabitants) and youth aged 18-29 (216,397 inhabitants), alongside a significant elderly population (85,819 inhabitants). This demographic structure necessitates intergenerational approaches to public space design and programming.

Socioeconomic indicators reveal notable vulnerability, with APEIM 2018 data showing 47.6% of the population living in general poverty and 4.7% in extreme poverty. The socioeconomic stratification places Callao predominantly in lower-middle- and lower-income brackets (41% in Level D, 15% in Level E), with classification in Group 3 (higher vulnerability index). The prevalence of child exploitation due to economic necessity and frequent risk situations for minors further underscore the social challenges facing the area (Observatorio Socio Económico Laboral Callao, 2015).

The housing typology identified by INEI (2017) indicates a heterogeneous residential pattern dominated by independent houses, with "quintas" (characteristic residential complexes) prevalent in the historic area, creating a distinctive urban fabric that influences circulation patterns and public space utilization. Employment data from MTPE reveals a mixed economy centered around agriculture/mining (58.1%), services (21.7%), and commerce (13.4%), with the working-age population between 30-45 years representing the largest employment cohort (41.1%).

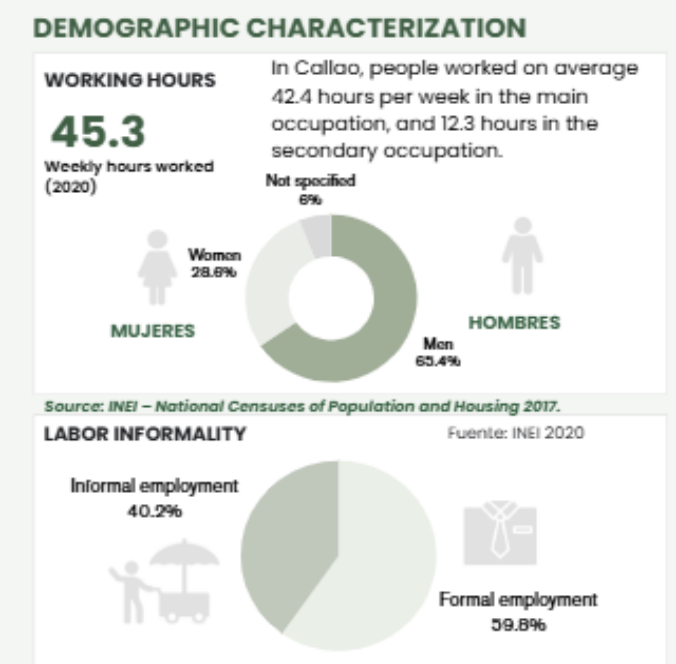


Figure 5: Demographic Profile Source: Rodriguez, M (2025). Analysis of the Intervention Area.

These sectoral employment patterns shape not only economic activity but also labor conditions and time allocation among Callao's residents. Recent demographic data from the National Censuses of Population and Housing (INEI, 2017) indicate that residents work an average of 42.4 weekly hours in their primary occupation, with 40.2% of the population engaged in informal employment (Figure 5), factors that significantly influence patterns of public space utilization.

Concurrently, Lima Cómo Vamos (2024) documents persistent perceptions of insecurity and deficits in public realm quality at the metropolitan scale, a pattern consistent with local findings in Callao regarding unsafe intersections, inadequate lighting, and conflicts between pedestrian flows and logistics operations. Specific data reveal that 80.2% of residents consider public safety a major concern, while 44.7% express dissatisfaction with street lighting, and 55.8% report dissatisfaction with the condition of streets and plazas (Figure 6). Consequently, walkability and safety through design are not isolated intentions but measurable social priorities with implications for well-being and inclusion.

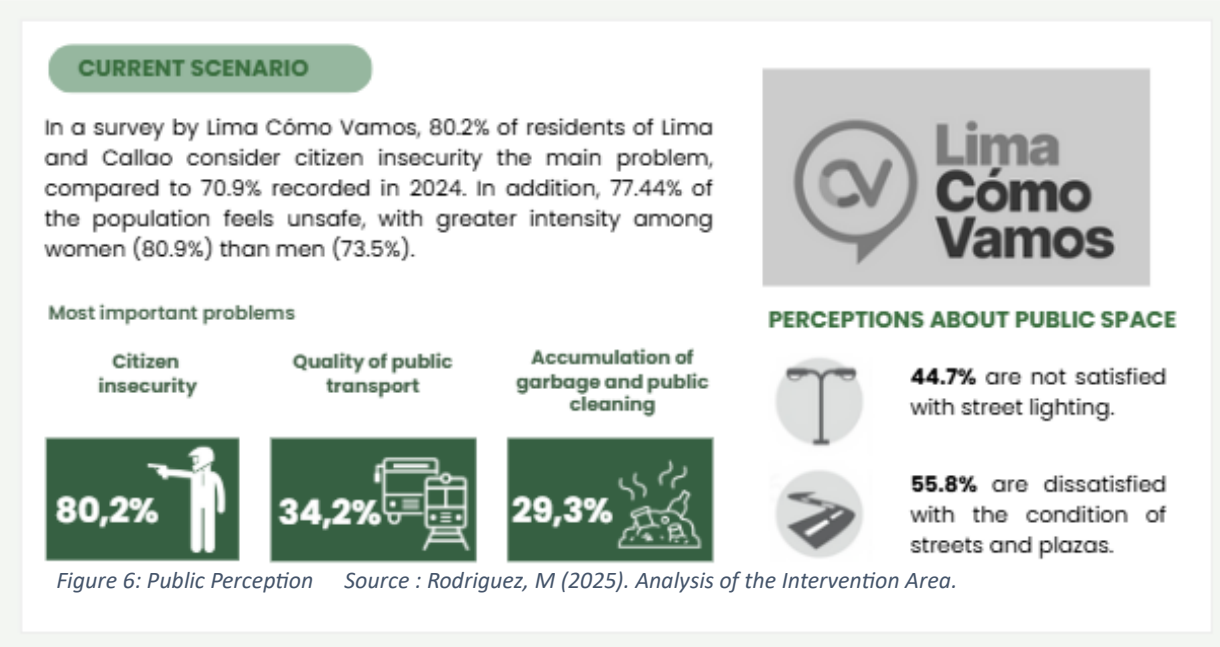


Figure 6: Public Perception Source : Rodriguez, M (2025). Analysis of the Intervention Area.

These demographic and socioeconomic characteristics frame the social priorities that must guide urban rehabilitation strategies for the Historic Center of Callao, particularly regarding accessibility, safety, and the creation of inclusive public spaces that address the needs of a diverse and vulnerable population.

1.3. Urban Morphology

Regarding typologies and spatial quality, recent academic works provide operational guidance that translates to the public realm. Cerdán (2023) demonstrates how multifunctional community facilities can serve as anchors for social development and neighborhood activation in La Perla, contributing criteria for nodes and active facades that enhance pedestrian continuity and vitality. Concurrently, Durand (2023) integrates neuroarchitecture principles including access to natural light, acoustic comfort, biophilia, and stress reduction in a community center in Callao, offering

transferable guidelines for streets and plazas that prioritize shade, visibility, acoustic attenuation, and sensory legibility, thus improving pedestrian comfort and natural surveillance.

The urban morphology analysis of the study area reveals diversity in block configurations: small, irregular, and regular blocks, along with park spaces that insert themselves into the urban fabric as open space nodes (Figure 7). This morphological variety responds to both historical and topographical conditions, creating a heterogeneous urban fabric that must be considered in rehabilitation interventions.

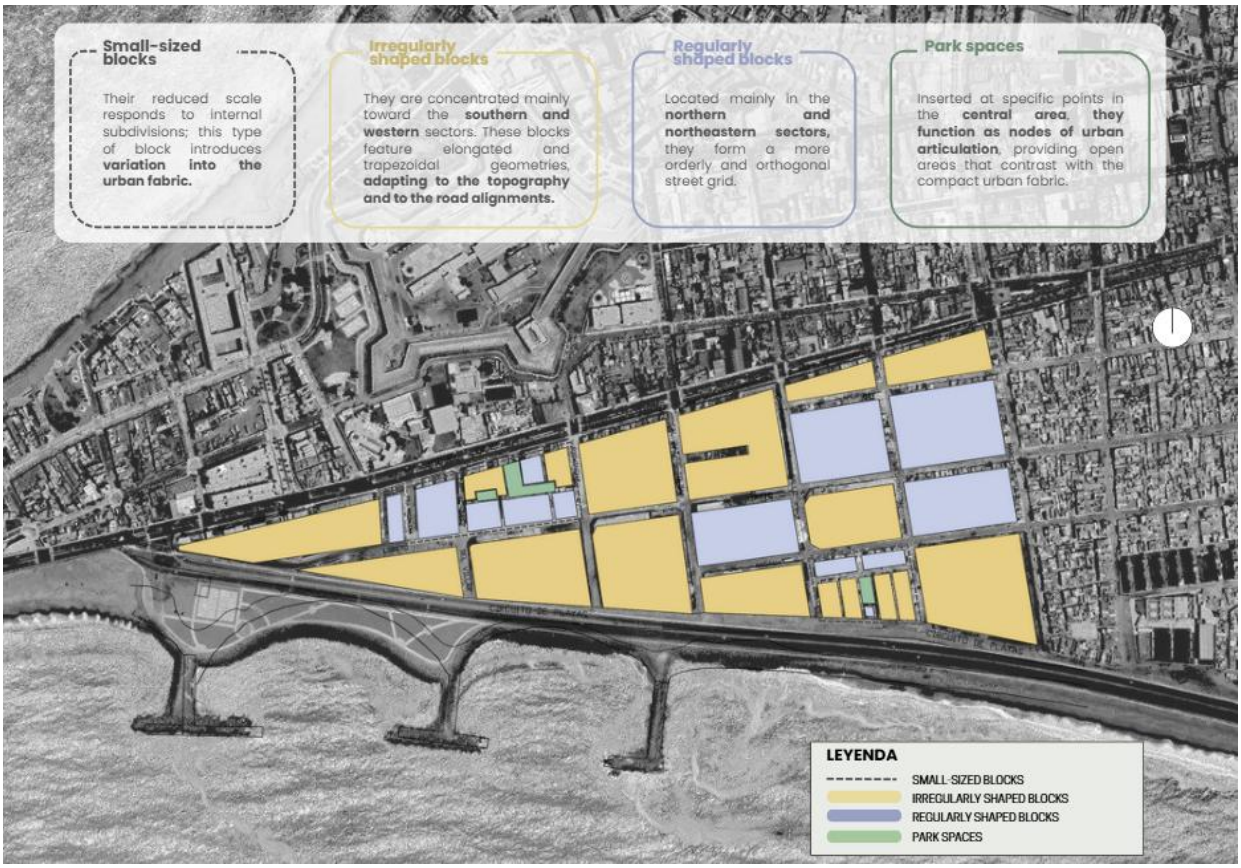


Figure 7: Urban Blocks and Park Spaces Source: Rodriguez, M (2025). Analysis of the Intervention Area.

The current state of residential areas shows a significant urban contrast: 67% of housing is in good condition, while 33% fails to meet adequate habitability standards (Figure 8), which has implications for residential vulnerability and structural safety in case of disasters.

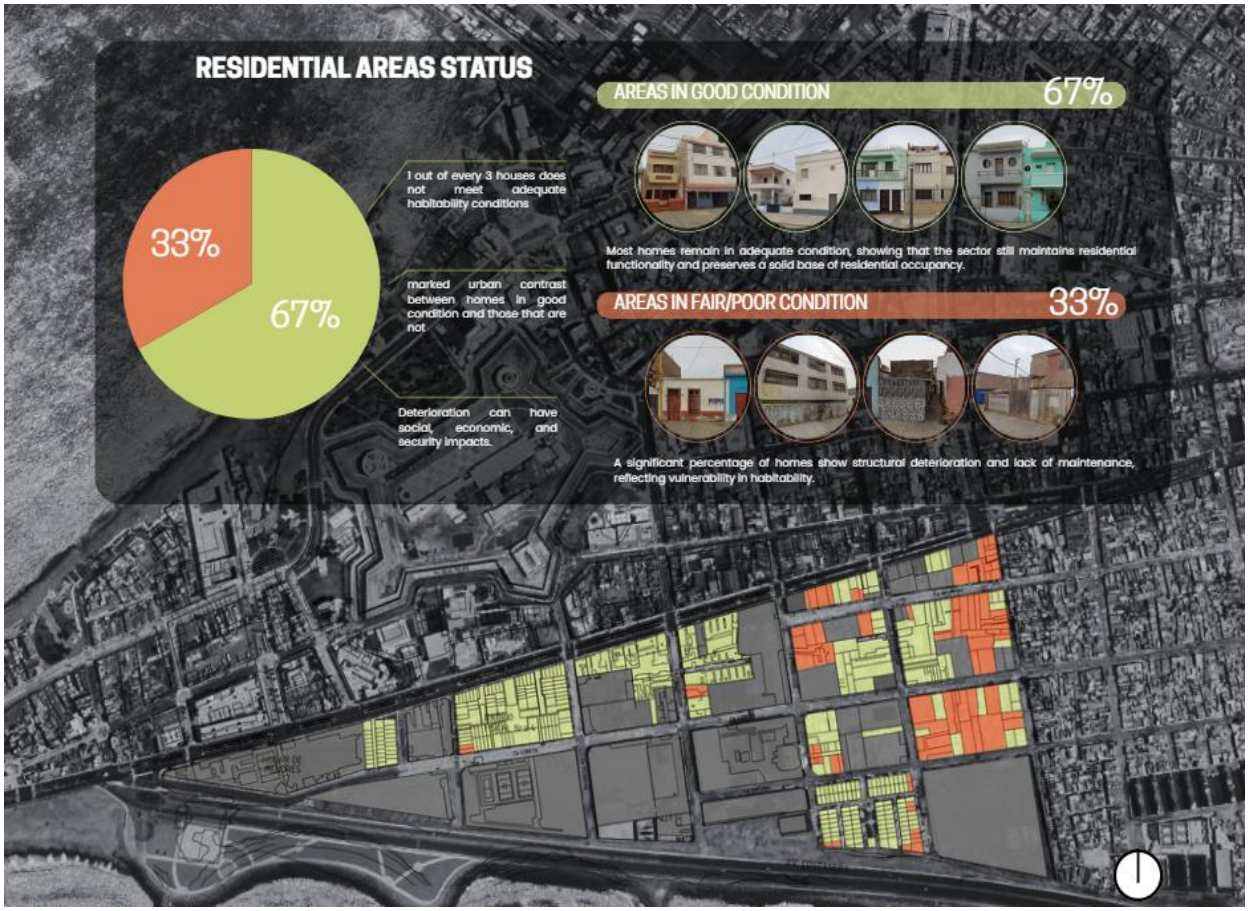


Figure 8: Residential Area Status *Source: Rodriguez, M (2025). Analysis of the Intervention Area.*

Existing building typologies reveal a predominantly residential area (37.7%), with a significant portion dedicated to other uses (34.4%) and a substantial number of abandoned or undefined-use spaces (25.8%), in addition to the presence of historic mansions (2.2%) (Figure 9). These abandoned spaces represent important opportunities for urban recovery projects that can strengthen social cohesion and improve the area's image.

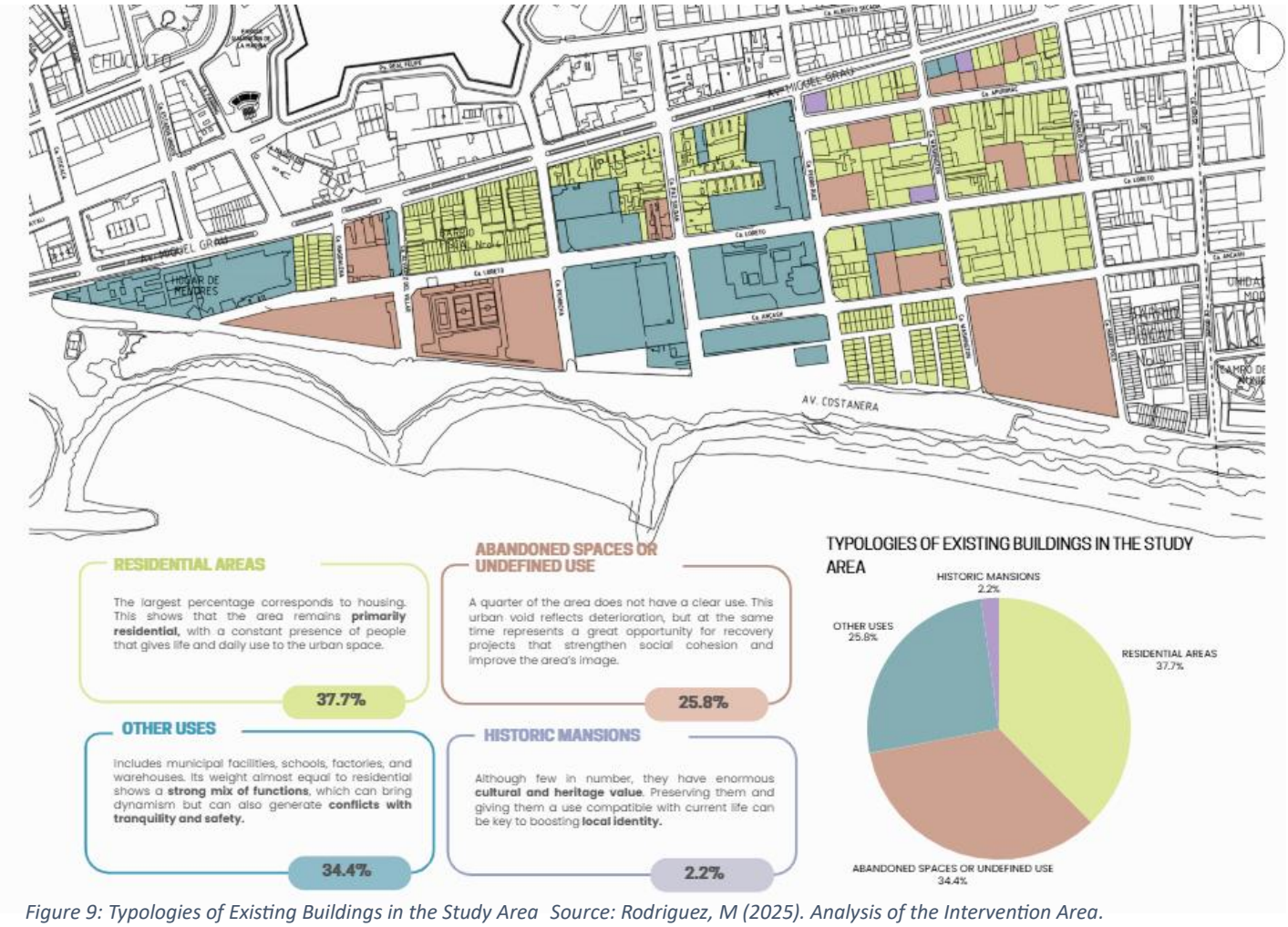


Figure 9: Typologies of Existing Buildings in the Study Area Source: Rodriguez, M (2025). Analysis of the Intervention Area.

1.4. Transportation Systems, Mobility and Accessibility

To translate these frameworks and evidence into site-specific decisions, local documentation on user accessibility (PDM Callao 2040) provides a situated diagnosis along corridors such as Av. Miguel Grau; identifying narrow sidewalks, discontinuous or unsafe crossings, and the presence of underutilized lots that weaken active facades and route continuity.

Vehicular flow analysis highlights current limitations in urban mobility, with particular emphasis on conflicts between different transportation modes and negative impacts on pedestrian and cyclist accessibility (Figure 10). The transportation system includes services such as the "Corredor Rojo" that connects to broader metropolitan areas. However, the road system remains precarious and disjointed.

Figure 10: Vehicular Flow *Source: Rodriguez, M (2025). Analysis of the Intervention Area.*

Current road sections illustrate traffic congestion and competition for road space among different vehicle types (Figure 11), evidencing the need for reconsideration of these sections to prioritize sustainable mobility.

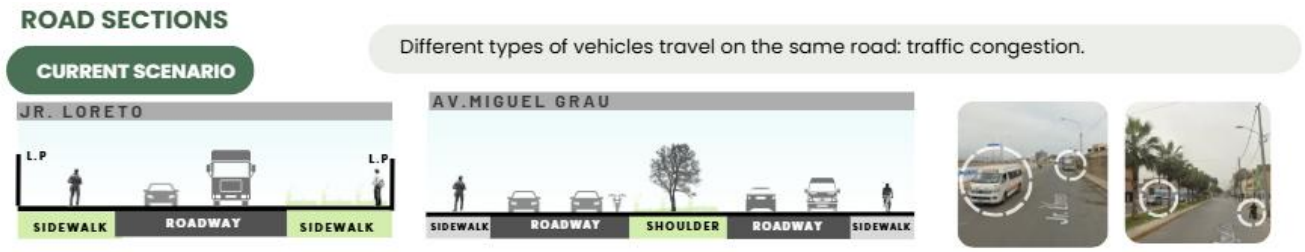


Figure 11: Road Sections *Source: Rodriguez, M (2025). Analysis of the Intervention Area.*

By mapping user profiles, from residents and workers to at-risk youth and heritage visitors, this input justifies differentiated but connected interventions, combining rapid safety and orientation improvements with specific reprogramming of public space to reactivate edges and improve legibility.

Finally, the territorial and bioclimatic conditions synthesized by ITP's Data Peru profile guide the environmental dimension of alternatives. Callao's coastal and climatic characterization directs the selection of nature-based solutions, such as the strategic incorporation of green areas with vegetation adapted to the coastal context (Figure 12). These interventions favor the expansion of the tree canopy, permeable surfaces, and stormwater management, facilitating the definition of co-benefit metrics adapted to the specific context of the study area.

Figure 12: Green Areas *Source: Rodriguez, M (2025). Analysis of the Intervention Area.*

1.5. Statement of Sustainability

Public spaces in historically central locations consistently underperform against strategic sustainability objectives, creating implementation gaps between policy intentions and daily urban reality. Historic Callao exemplifies this challenge, where poor walkability, safety, and environmental comfort contradict the inclusive use that heritage and urban identity should promote. The research develops a replicable and data-driven urban rehabilitation approach that is needed to prioritize alternatives that (i) expand equitable pedestrian access, (ii) improve safety and environmental comfort through

nature, (iii) remain viable within governance and logistical constraints, aligning with recognized sustainability standards (LEED standards).

2. Methodology

2.1. Research Framework

This study uses applied/practical research based on a qualitative sequential approach to effectively evaluate, analyze, and compare three alternative urban rehabilitation strategies for the Historic Center of Callao to improve walkability, safety, and environmental quality. The research operates as an action-oriented work, aiming to towards the implementation of recommendations for municipal decision-makers, community organizations, and urban designers.

Research question: *How do alternative urban rehabilitation strategies differ in their perceived effectiveness in relation to walkability, safety, environmental quality, and viability in the Historic Center of Callao?*

The research employs three complementary qualitative methods following a sequential approach that progresses from individual exploration to collective validation and systematic evaluation.

Method 1: Semi-structured interviews

Initially, the research conducts semi-structured interviews with key stakeholders, including municipal officials, community representatives, and urban planning experts, to gather diverse individual perspectives on strategy feasibility, community needs, and implementation challenges without group influence. The semi-structured format combines predetermined questions aligned with research objectives while maintaining flexibility to explore emergent themes and allow participants to elaborate on topics they consider most relevant to urban rehabilitation in the Historic Center of Callao.

The interview protocol addresses four core thematic areas: current perceptions of walkability, safety, and environmental conditions in the Historic Center, evaluation of proposed rehabilitation strategies and their potential effectiveness, assessment of implementation feasibility including resource availability and institutional capacity, and identification of community priorities and potential barriers to successful intervention. Each interview session lasts approximately 10-15 minutes and follows a conversational approach that encourages participants to share experiences, professional insights, and personal perspectives on urban challenges and potential solutions.

Participant selection employs purposive sampling to ensure representation across key stakeholder categories. Community representatives encompass neighborhood association leaders, local business owners and resident advocates who possess intimate knowledge of daily life challenges and community dynamics. Urban

planning experts comprise academic researchers and technical specialists with expertise in historic preservation, urban rehabilitation, and participatory planning processes.

Data collection occurs through face-to-face interviews conducted in participants' preferred locations to ensure comfort and encourage open dialogue. All sessions are audio-recorded with participant consent and subsequently transcribed verbatim for analysis. The interview process continues until theoretical saturation is achieved, typically requiring 4-8 interviews across stakeholder categories, ensuring that diverse perspectives are captured while maintaining methodological rigor and data quality standards.

SECTION 1: Current Conditions Assessment (6 minutes)

Topic	Question	Purpose
Walkability and Infrastructure	How would you describe the current condition of sidewalks and pedestrian infrastructure in the Historic Center?	Identifies specific physical barriers and infrastructure deficiencies affecting daily mobility.
	What are the main barriers that make walking in this area difficult or unpleasant?	Reveals obstacles (physical, maintenance, accessibility) that reduce walkability quality.
Safety Perception	Do you feel safe walking in the Historic Center during the day? At night?	Assesses perceived security levels and identifies factors contributing to insecurity concerns.
Environmental Quality	How would you describe the environmental quality (green spaces, air quality, noise levels) in the Historic Center?	Evaluates adequacy of green infrastructure and environmental conditions affecting quality of life.

SECTION 2: Rehabilitation Strategies Evaluation (6 minutes)

Context: *Three strategies presented with visual aids:*

- **A1 (Tactical):** Low-cost surface upgrades, paint, bollards, improved lighting
- **A2 (Intermediate):** Partial pedestrianization, wider sidewalks, pocket parks

- **A3 (Comprehensive):** Full pedestrianization, integrated green network, complete infrastructure

Topic	Question	Purpose
Strategy Effectiveness	Which strategy would be most EFFECTIVE at improving conditions in the Historic Center? Why?	Determines which approach participants believe will generate the greatest positive impact on identified problems.
Strategy Feasibility	Which strategy would be most FEASIBLE to actually implement here? Why?	Assesses realistic implementation capacity considering resources, timeframes, and municipal capabilities.
Priority Elements	Are there specific elements from any strategy that should be prioritized?	Identifies which intervention components are considered most critical for success.

Method 2: Focus groups

Building upon interview findings, focus groups with experts bring together urban planning professionals, architects, and rehabilitation specialists to collectively evaluate each strategy through structured discussions, validating themes that emerged from individual interviews while generating consensus-based assessments and identifying potential implementation barriers and opportunities. The focus group methodology leverages collective expertise and professional experience to generate deeper insights through interactive dialogue, allowing participants to build upon each other's ideas, challenge assumptions, and reach nuanced understandings of complex urban rehabilitation challenges.

The focus group protocol is structured around three sequential phases that maximize both individual contribution and group synergy. Initially, participants individually review and assess each rehabilitation strategy using preliminary findings from the interview phase, ensuring that personal perspectives are captured before group dynamics influence responses. Subsequently, facilitated group discussions explore strategy strengths and weaknesses, implementation feasibility, and potential modifications needed for successful execution. Finally, consensus-building activities guide participants toward collective recommendations and priority rankings while documenting areas of disagreement that require further consideration.

Each focus group session accommodates 3-5 participants to maintain optimal group dynamics that encourage active participation while preventing dominant voices

from overshadowing quieter contributors. The composition deliberately mixes professionals from different specializations, urban planning experts contribute policy and regulatory perspectives, architects provide design and spatial analysis expertise, and rehabilitation specialists offer technical implementation insights. This interdisciplinary approach ensures comprehensive evaluation that addresses multiple dimensions of urban intervention complexity.

Session logistics emphasize creating an environment conducive to professional dialogue and collaborative analysis. Each focus group lasts approximately 30-40 minutes, structured with clear agenda items and time allocations that balance individual reflection, small group discussions, and plenary sessions. Meetings are held in neutral, professional settings equipped with visual aids, strategy materials, and documentation tools. All sessions are audio-recorded and complemented by detailed facilitator notes that capture both verbal contributions and group dynamics, non-verbal reactions, and consensus-building processes that inform subsequent analysis.

Method 3: Score cards

Finally, the study utilizes evaluation score cards as assessment tools that systematically measure predetermined criteria across walkability, safety, and environmental quality dimensions, incorporating insights from both interviews and focus groups to enable standardized comparison between alternative strategies. The score card methodology transforms qualitative assessments and expert judgments into quantified metrics that facilitate objective strategy evaluation while maintaining the nuanced understanding developed through previous methodological phases.

The score card framework operationalizes evaluation criteria through structured assessment matrices that translate complex urban rehabilitation objectives into measurable indicators. Walkability dimensions include pedestrian infrastructure quality, accessibility compliance, connectivity improvements, and barrier removal effectiveness. Safety criteria encompass lighting adequacy, surveillance capabilities and crime prevention through environmental design (CPTED) principles. Environmental quality indicators measure air quality improvements and green space integration. Each criterion utilizes standardized rating scales that range from 1 (poor performance) to 5 (excellent performance), enabling consistent evaluation across different strategies and assessment contexts.

The study further employs Multi-Criteria Decision Analysis (MCDA) weighting system, which assigns numerical values to different evaluation criteria based on stakeholder priorities and expert judgment gathered throughout the sequential process. MCDA weighting incorporates stakeholder preference rankings identified through interviews, expert technical assessments developed during focus groups, and comparative importance ratings that reflect both community needs and professional

standards. The weighting system applies mathematical algorithms that multiply individual criterion scores by their assigned weights, ultimately generating composite weighted scores that facilitate objective comparison and ranking of the three rehabilitation strategies across equity and feasibility dimensions.

Data analysis procedures include statistical validation of score card reliability through inter-rater agreement calculations, sensitivity analysis to assess how weighting variations affect final rankings, and comparative analysis that identifies strategy strengths and weaknesses across different evaluation dimensions. Final MCDA scores are presented alongside qualitative context from interviews and focus groups, ensuring that numerical results are interpreted within the broader understanding of implementation challenges, community acceptance, and technical feasibility developed through the comprehensive methodological approach.

Table 1. Methods

Research Method	**Research Goals**	**Participant Characteristics**	**Data Collection Techniques**	**Analysis Methods**
Interviews	Gather practical insights from local actors regarding current conditions, priorities, barriers, and aspirations.	Businesses and community leaders (N=3–5 business owners, N=2-3 residents, N=2 municipal officials, N=1-2)	Semi-structured interviews (10-15 min, audio recorded, Spanish, open-ended questions organized by themes).	Thematic analysis (Braun & Clarke, 2006): inductive coding, theme development, triangulation with quantitative data; qualitative input informs feasibility assessment and criterion weighting.
Focus Groups	Validate feasibility, technical risks, and criterion weighting; refine intervention alternatives through professional critique.	Specialists in urban planning, landscape architecture, transportation, environmental design (N=3-5 in 1-2 sessions)	Focus groups (30-40 min, structured discussion with visual aids [maps, diagrams], audio recorded)	Expert judgments integrated into MCDA weighting (triangulated with interviews); thematic synthesis of technical recommendations.
Score cards	Systematically measure and compare rehabilitation		Structured assessment forms with standardized	Multi-Criteria Decision Analysis (MCDA), weighted scoring calculations,

	strategies across predetermined walkability, safety, and environmental quality criteria to enable standardized evaluation.		rating scales, criteria-based evaluation matrices, and systematic scoring protocols.	comparative ranking analysis, and quantitative synthesis of qualitative assessments.

2.2. Study Area Selection and Case Study Justification

2.2.1 Case Study

This research employs a **single instrumental case study design** (Stake, 2020; Yin, 2018). Case study methodology is appropriate when:

- The phenomenon of interest (urban rehabilitation in vulnerable historic contexts) is inseparable from its geographic, cultural, and institutional context
- Deep understanding of a specific place is required to develop actionable, context-sensitive recommendations
- The case offers **transferable insights** (Lincoln & Guba, 1985) applicable to similar contexts, though not statistically generalizable

The Historic Center of Callao is studied not solely for itself, but as an exemplar of broader problems facing coastal historic districts in Latin America: heritage degradation, socioeconomic vulnerability, climate exposure, and limited municipal capacity. Findings inform theory and practice applicable to analogous contexts (e.g., historic centers in Cartagena, Valparaíso, Havana).

2.2.2 Study Area Characteristics

Geographic Boundaries:

- **Area**: 222,663.21 m² (22.27 hectares)
- **Perimeter**: 2,524.45 m
- **Bounded by**: Av. Miguel Grau (south), Av. Guardia Chalaca (east), coastline (west).

Key Characteristics (from previously established baseline analysis):

Table 2. Key Characteristics

Dimension	Quantified Condition
Urban Morphology	Heterogeneous: small irregular blocks (colonial core), regular orthogonal grids (19th-century expansion), contemporary insertions
Land Use	Residential 37.7%, Commercial/Other 34.4%, Institutional 2.1%, Abandoned/Undefined 25.8%
Building Condition	Adequate 67%, Deficient 33% (per INEI habitability criteria)
Population Density	9,147.60 (hab/km²)
Connectivity	Direct access to BRT Red Corridor; 800m to port employment center.
Vulnerabilities	High seismic risk (liquefaction zone per SIGRID); social vulnerability (crime, informal commerce); environmental (limited vegetation, heat island)

2.2.3 Intervention Alternatives

This research evaluates and compares three alternative urban rehabilitation strategies for the Historic Center of Callao, each representing a distinct approach to intervention intensity, scope, and resource requirements. These alternatives were developed to span the spectrum from minimal, low-cost tactical interventions to comprehensive urban transformation, allowing systematic assessment of the trade-offs between ambition and feasibility.

Alternative A1: Tactical (Minimal Intervention) adopts an approach centered on surface upgrades and tactical safety improvements. This strategy is characterized by low-cost, rapid implementation interventions that focus omn improving existing infrastructure without undertaking major reconstruction. The tactical approach employs strategies borrowed from the tactical urbanism movement, including the use of paint to delineate spaces, bollards to protect pedestrians, and temporary furniture to activate underutilized areas. Safety is enhanced through upgraded lighting and improved signage, while the intervention is designed to cause minimal disruption to daily activities. The underlying philosophy of this alternative is to achieve "quick wins", immediate, visible improvements that demonstrate municipal commitment and capacity

while building community trust and political momentum that can support larger interventions in subsequent phases.

Alternative A2: Intermediate (Medium Intervention) represents a middle path, emphasizing partial pedestrianization, wider sidewalks, and the creation of pocket parks. This strategy is characterized by selective street redesign that focuses resources on high-priority corridors rather than attempting district-wide transformation. Sidewalks are expanded along key pedestrian routes, and small-scale public spaces such as pocket parks and neighborhood plazas are introduced to increase access to quality outdoor environments. Moderate greening is achieved through strategic placement of street trees and planters that enhance the urban microclimate without requiring extensive infrastructure modification. The philosophical foundation of this alternative is strategic intervention, achieving meaningful quality improvements that residents can experience in their daily lives while maintaining fiscal and institutional realism given the municipality's limited budget and administrative capacity.

Alternative A3: Comprehensive (Maximum Intervention) pursues the most ambitious vision, establishing continuous pedestrian corridors, an integrated green network, and comprehensive public amenities throughout the study area. This strategy features full pedestrianization of priority streets, removing vehicular traffic to reclaim space for people. A continuous, fully accessible sidewalk network is developed to meet universal design standards, ensuring mobility for all residents regardless of physical ability. An integrated green infrastructure system is implemented, including expanded tree canopy coverage, rain gardens for stormwater management, and permeable surfaces that reduce runoff while improving aesthetic and thermal comfort. High-quality public spaces are designed with durable furniture, comprehensive lighting systems, and professional landscaping that collectively transform the character of the streetscape. The philosophy underlying this alternative is holistic urban transformation, maximizing walkability, environmental quality, and safety through comprehensive redesign that addresses systemic deficiencies rather than isolated problems.

These three alternatives provide a structured framework for evaluating how different levels of investment, intervention scope, and implementation complexity affect outcomes across the five evaluation criteria: walkability, safety, environmental quality, equity, and feasibility.

Table 3. Comparison Framework

Dimension	A1: Tactical	A2: Intermediate	A3: Comprehensive
Investment Level	Low (< $500K USD)	Medium ($1-3M USD)	High (> $5M USD)
Implementation Timeline	Short (3-6 months)	Medium (1-2 years)	Long (3-5 years)
Spatial Coverage	Selective hot spots	Priority corridors	District-wide
Physical Permanence	Temporary/Semi-permanent	Permanent (selected areas)	Permanent (comprehensive)
Design Standards	Basic functionality	Moderate quality	High quality/LEED-aligned

These three alternatives will be systematically evaluated across five criteria (walkability, safety, environmental quality, equity, feasibility) using Multi-Criteria Decision Analysis (MCDA) informed by stakeholder priorities.

3. Results

3.1. Method 1 Results: Semi-structured interviews

SECTION 1: CURRENT CONDITIONS ASSESSMENT - RESULTS

Interviews with 10 key stakeholders (3 business owners, 3 residents, and 4 municipal officials) showed strong agreement on the critical problems affecting the Historic Center of Callao. Pedestrian infrastructure was described by all participants as severely deteriorated, with broken and uneven pavement, narrow sidewalks, not enough wheelchair ramps, and constant obstructions from street vendors, parked vehicles, and unfinished utility repairs. Traffic lights that need repair make mobility problems worse.

These physical infrastructure deficiencies are directly connected to safety perception, which was identified as the most important concern, confirming diagnostic data that shows 80% of stakeholders consider insecurity as their main worry. Participants described poor lighting throughout the area, abandoned buildings that create dark and isolated zones, and no pedestrian activity after 6pm because of fear. Moreover, residents and business owners said that walking through interior streets is considered dangerous for people not from the area, so movement is limited to main corridors only. This relationship between deteriorated infrastructure and safety concerns demonstrates how physical conditions directly influence people's willingness to use public spaces.

In addition to infrastructure and safety issues, environmental quality was described as critically poor, further compounding the area's livability problems. Participants reported almost no green spaces or trees, high noise levels from early-morning port activity, and visible poor air quality from traffic emissions, factories, and port operations. The heat island effect caused by the lack of vegetation was specifically mentioned as making the area uncomfortably hot, especially during summer months. Consequently, the combination of poor walkability, safety concerns, and environmental degradation creates a reinforcing cycle that discourages pedestrian activity and reduces overall quality of life in the Historic Center.

Table 4. Section 1 Findings

Topic	**Key Findings**	**Specific Issues Identified**
Walkability and Infrastructure	Severely deteriorated pedestrian infrastructure with systematic deficiencies across the intervention area	• Broken and uneven pavement • Narrow sidewalks • Need for more wheelchair ramps • Obstructions (street vendors, parked vehicles, unfinished pole repairs) • Presence of traffic lights that need to be repaired
Safety Perception	High insecurity perception validates diagnostic data showing 80% of residents identify safety as primary concern	• Inadequate lighting throughout the area • Abandoned buildings create dark, isolated zones • Lack of "eyes on the street" after 6pm • Perceived absence of police presence • Fear prevents evening pedestrian activity. People only walk along the corridors; walking through the streets is considered dangerous if you're not from the area.
Environmental Quality	Critical deficit in green spaces and environmental amenities confirmed by participants	• Virtually no green spaces or trees • High vehicular noise levels due to port activity at early hours • Poor air quality from traffic emissions, factories and the port. The smoke is visually visible.

		• Heat Island effect due to lack of vegetation

SECTION 2: REHABILITATION STRATEGIES EVALUATION – RESULTS

When evaluating the three rehabilitation strategies, stakeholders showed diverse perspectives based on their roles and priorities. Regarding effectiveness, there was a clear division between ideal outcomes and practical concerns. Municipal officials and some business owners leaned toward A2 (Intermediate) as the most effective strategy, arguing that it balances impact with feasibility by combining essential safety improvements through partial pedestrianization and the creation of pocket parks that address the green space deficit. However, residents and some business owners expressed that A3 (Comprehensive) would be most effective because only a complete transformation could address the interconnected problems of insecurity, poor infrastructure, and environmental degradation simultaneously. They emphasized that partial interventions might not reach the threshold needed to change people's behavior and perceptions about the area.

In contrast, when discussing feasibility, opinions shifted considerably. Municipal officials unanimously identified A1 (Tactical) as the most feasible option, citing limited budgets, short implementation timeframes, and the municipality's current technical capacity. They pointed out that tactical urbanism interventions require minimal coordination between departments and can be executed quickly to show visible results. Nevertheless, business owners expressed concerns that A1 might be "too little, too late," suggesting that superficial improvements could fail to attract visitors or improve business conditions. On the other hand, residents were divided: some supported starting with A1 to build momentum, while others feared that settling for minimal improvements would perpetuate the area's deterioration.

Regarding priority elements across all strategies, there was strong consensus on specific interventions regardless of which overall strategy is selected. All stakeholder groups agreed that improved lighting must be the first priority, as it addresses both safety perception and enables evening economic activity. Following this, the creation of at least some green spaces (even small pocket parks) was considered essential to combat the heat island effect and provide basic environmental quality. Throughout the discussion, stakeholders made strong emphasis on security measures, consistently returning to safety concerns as the foundation upon which any other improvement must be built. Without addressing the fear that prevents people from walking through the area, participants argued that no infrastructure or environmental improvements would succeed in reactivating the Historic Center.

Table 5. Section 2 Findings

Topic	Key Findings	Specific Responses by Stakeholder Group
Strategy Effectiveness	Division between ideal impact (A3) and practical impact (A2), with A1 considered insufficient by most stakeholders	**Municipal Officials:** Majority favor A2 as it addresses critical problems without overwhelming implementation capacity **Business Owners:** Split between A2 (practical improvement for business climate) and A3 (transformative change to attract tourism) **Residents:** Prefer A3, arguing that comprehensive change is needed to truly improve quality of life and safety perception
Strategy Feasibility	Strong consensus that feasibility decreases dramatically from A1 to A3, but concerns about whether feasible solutions are actually effective	**Municipal Officials:** Unanimous support for A1 as most feasible given budget constraints (estimated at 30% of A2 cost), technical capacity, and political timeframes **Business Owners:** Express skepticism that A1 will generate meaningful economic benefits; prefer A2 despite higher costs and longer implementation **Residents:** Divided between pragmatic acceptance of A1 and frustration that feasibility concerns perpetuate inadequate solutions
Priority Elements	Strong agreement on specific interventions that must be included regardless of overall strategy selection	**All Groups Agreed On:** • Improved lighting as first priority (safety + economic activation) • At least minimal green space creation (pocket parks minimum) • Community participation in design and implementation • Clear maintenance and management plans **Strong Emphasis on Security:** All stakeholder groups repeatedly emphasized that safety measures must be the foundation of any intervention, as fear prevents people from using

		public spaces **Additional Elements by Group:** • Officials: Quick wins to build political support • Business: Parking solutions and vendor organization • Residents: Accessibility features and children's play areas

3.2. Method 2– Results: Focus groups

To complement the stakeholder interviews and deepen the strategic evaluation, a focus group was conducted with 6 professionals and students from the University of Arizona's College of Architecture, Planning & Landscape Architecture. The group consisted of 2 faculty members from the Sustainable Built Environments program and 4 senior students from the same college, all with expertise in urban planning, public space design and sustainable urbanism. Participants were presented with the three rehabilitation alternatives (A1 Tactical, A2 Intermediate, and A3 Comprehensive) along with visual aids and contextual data about the Historic Center of Callao. The discussion was structured around four key questions:

1. Based on your professional experience and the information presented about Callao's context, which alternative do you consider most appropriate for the Historic Center, and why?
2. Given that 80% of residents identify insecurity as their primary concern, how effectively does each alternative address safety through environmental design principles?
3. If you had to justify THIS budget to the Mayor tomorrow, which alternative survives the meeting?
4. Which alternative can survive a change in government?

These questions aimed to move beyond theoretical evaluation and ground the strategy selection in the practical realities of implementation, political constraints, and long-term viability within Callao's specific institutional context.

Table 6. Focus groups findings

Question	Key Findings	Responses by Alternative
Q1: Most Appropriate Alternative (Professional Experience)	Strong consensus emerged around A2 as the most appropriate alternative, balancing technical soundness with contextual realities	**A1 (Tactical):** Rejected by most participants as "cosmetic" and insufficient to address systemic problems. **A2 (Intermediate):** Preferred by 4 out of 6 participants. Identified as addressing core problems (safety, walkability, environment) without exceeding realistic implementation capacity. Described as "ambitious but achievable." **A3 (Comprehensive):** Viewed as ideal in theory but impractical given Callao's municipal capacity and political instability. Two participants supported it as a long-term vision but not as immediate implementation strategy.
Q2: Safety Through Environmental Design (CPTED Principles)	Participants evaluated each alternative's ability to address the 80% insecurity concern through natural surveillance, territoriality, and activity generation	**A1 (Tactical):** Minimal impact on safety. Improved lighting helps but without spatial activation (natural surveillance) or territorial definition, fear remains. Score: 3/10 for safety effectiveness **A2 (Intermediate):** Moderate to high impact. Partial pedestrianization creates "eyes on the street," pocket parks generate daytime activity, wider sidewalks establish clear territorial boundaries. However, concerns about nighttime activation. Score: 7/10 for safety effectiveness **A3 (Comprehensive):** Highest potential impact through complete spatial restructuring, full green network creating territorial identity, and mixed-use activation. Concerns about maintenance and whether abandoned buildings would actually be reactivated. Score: 9/10 for safety potential, 6/10 for realistic safety outcomes

Q3: Budget Justification to Mayor (Political Feasibility)	This question generated the most debate, revealing tension between technical quality and political reality	**A1 (Tactical):** Easiest to justify politically due to low cost and quick results. However, 5 out of 6 participants said they would NOT recommend it despite political ease, calling it "short-term thinking that creates long-term problems." **A2 (Intermediate):** 4 out of 6 participants said this is what "survives the meeting. Requires demonstrating external funding partnerships and phased implementation to make budget defensible. **A3 (Comprehensive):** Would not survive budget meeting according to all 6 participants.
Q4: Surviving Government Change (Institutional Sustainability)	Participants applied lessons from Peru's political instability and interrupted projects across the country	**A1 (Tactical):** High survival probability due to low cost and completion within one term, but participants questioned whether "survival" matters if impact is minimal. One participant: "It survives because nobody cares enough to cancel it." **A2 (Intermediate):** Moderate survival probability IF first phase shows visible results and builds community support. Key factor: creating political cost for cancellation through demonstrated community benefits. Requires strategic phasing: complete high-impact elements (lighting, one pilot pocket park) in first 18 months. **A3 (Comprehensive):** Low survival probability. Vulnerable to cancellation during government transitions. Would require legal/institutional mechanisms (international funding commitments, protected heritage status, community oversight) to ensure continuity. All participants agreed this is A3's fatal flaw in Peruvian context.

By the end of the session, **5 out of 6 focus group participants recommended A2 (Intermediate) as the most appropriate strategy**, though they emphasized that its success depends on several critical conditions. First, strategic phasing is essential, meaning that high-impact safety elements such as improved lighting and at least one complete pedestrianized street must be completed within the first 18 months to demonstrate tangible results and build community trust. Additionally, participants stressed that the municipal budget alone is insufficient for A2 implementation, therefore requiring partnerships with national government programs, international cooperation agencies, or private sector investment to bridge the funding gap.

Furthermore, the group emphasized the importance of establishing formal mechanisms for community co-management, ensuring that residents and business owners participate not only in the design phase but also in ongoing implementation and maintenance to guarantee continuity beyond political cycles. To build initial momentum and demonstrate immediate commitment, participants recommended including some A1 tactical elements during the first 1-3 months as "quick wins" that can generate visible changes while larger interventions are being planned. Finally, they highlighted the need for legal protection by formalizing the project through a municipal ordinance or heritage protection mechanisms that would reduce the risk of cancellation during government transitions.

The one dissenting participant recommended starting with A1 to build institutional capacity and political will, then upgrading to A2 in a second phase if initial results prove successful. However, the majority countered that this "incremental approach has failed repeatedly in Peru" and that "you never get the second phase," arguing that starting with insufficient intervention would reinforce community skepticism rather than build the foundation for more ambitious future work.

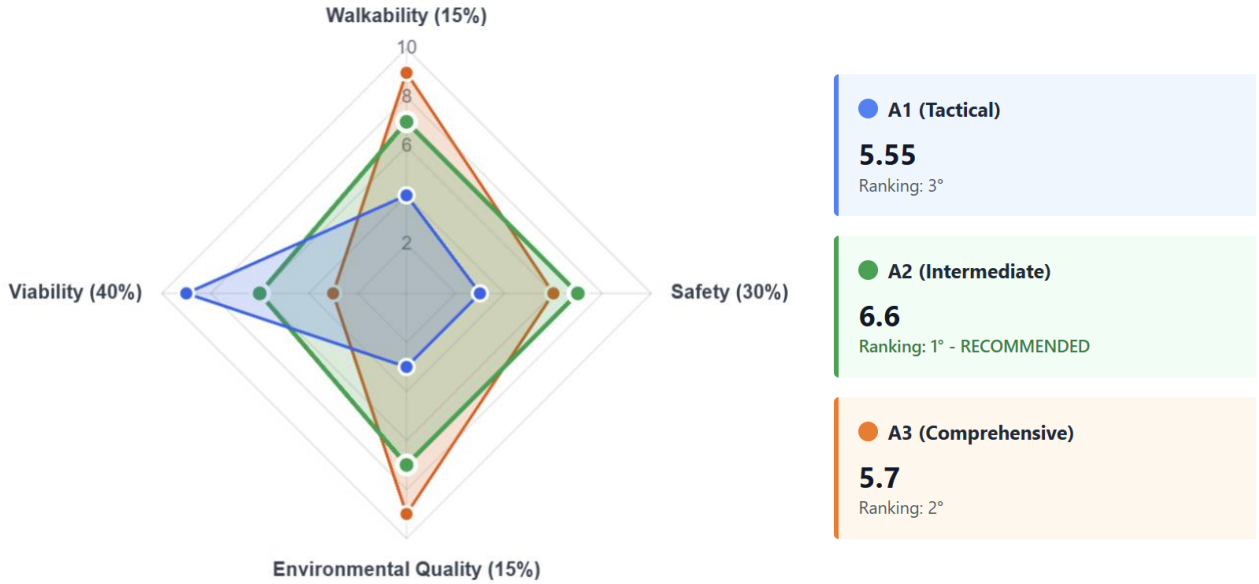
3.3. Method 3– Results: Score cards

Based on the results from Method 1 (stakeholder interviews) and Method 2 (focus group discussion), the following comparative matrix evaluates the three rehabilitation strategies across four key dimensions. The weighting percentages reflect the relative importance assigned by stakeholders, with Viability receiving the highest weight (40%) due to Peru's political instability and history of incomplete projects, followed by Safety (30%) reflecting residents' primary concern about insecurity, and Walkability and Environmental Quality (15% each) as complementary urban quality indicators.

Table 6. Score Cards punctuation

Dimension / Strategy	**A1 (Tactical)**	**A2 (Intermediate)**	**A3 (Comprehensive)**
Walkability (15%)	4/10	7/10	9/10
Weighted score	**0.6**	**1.05**	**1.35**
Safety (30%)	3/10	7/10	6/10
Weighted score	**0.9**	**2.1**	**1.8**
Environmental Quality (15%)	3/10	7/10	9/10
Weighted score	**0.45**	**1.05**	**1.35**
Viability (40%)	9/10	6/10	3/10
Weighted score	**3.6**	**2.4**	**1.2**
TOTAL SCORE	**5.55**	**6.6**	**5.7**
RANKING	**3º**	**1º**	**2º**

Figure 13. Radar chart of weighted scoring



The radar chart visualization and weighted scoring reveal critical patterns in how each strategy performs across the four evaluation dimensions. A2 (Intermediate) demonstrates the most balanced performance across all dimensions, achieving the highest total weighted score of 6.6 points. This balanced profile appears immediately evident in the radar chart, where A2 (Intermediate) forms a consistently strong polygon without the extreme peaks and valleys that characterize the other alternatives.

First, A2 (Intermediate)'s safety leadership represents its most decisive advantage. With a score of 7/10 in the Safety dimension (weighted at 30%), A2 (Intermediate) earns 2.1 weighted points, which is the highest safety performance among all alternatives. This becomes critical for addressing the primary concern that 80% of Historic Center residents identify: insecurity and fear in public spaces. A2 (Intermediate) achieves this through integrated CPTED principles, including pedestrianization that creates "eyes on the street," pocket parks that generate sustained activity, and improved lighting that addresses visibility concerns.

In contrast, A1 (Tactical) presents a viability paradox. While scoring highest in viability (9/10, yielding 3.6 weighted points), A1 (Tactical) critically underperforms across all impact dimensions: Walkability (4/10), Safety (3/10), and Environmental Quality (3/10). The radar chart dramatically illustrates this imbalance, showing A1 (Tactical) spiking sharply in the Viability axis but collapsing in all other directions. This visual pattern quantifies the stakeholder consensus that tactical interventions fall below the perception threshold for behavior change. As one focus group participant noted, such projects survive because nobody cares enough to cancel them.

On the other hand, A3 (Comprehensive) suffers from a fatal viability weakness despite strong urban quality performance. A3 (Comprehensive) achieves the highest scores in Walkability (9/10) and Environmental Quality (9/10), but its critically low Viability score (3/10, yielding only 1.2 weighted points) undermines these strengths. With Viability weighted at 40% of the total evaluation, A3 (Comprehensive) cannot overcome the reality that all focus group participants unanimously agreed it "would not survive budget meeting." The radar chart shows A3 (Comprehensive) forming an elongated polygon that reaches far into Walkability and Environmental Quality but barely extends into the Viability dimension.

Ultimately, the comparative analysis validates A2 (Intermediate) as the optimal intersection of meaningful impact and realistic implementation. Unlike A1 (Tactical) (implementable but insufficient) or A3 (Comprehensive) (comprehensive but infeasible), A2 (Intermediate) occupies the critical zone where urban transformation and municipal capacity overlap. Its consistent 7/10 performance across Walkability, Safety, and Environmental Quality demonstrates that it crosses the perception threshold necessary

for behavior change, while its moderate Viability score (6/10) positions it within reach of actual completion during one political cycle.

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4. Discussions

Walkability: Comprehensive Coverage vs Implementation Realism

The walkability criterion revealed a critical tension between comprehensive pedestrian infrastructure and the realistic scope of implementation. A3 (Comprehensive) scored highest in walkability (9/10, yielding 1.35 weighted points) through its proposal for full pedestrianization of priority streets, a continuous, fully accessible sidewalk network meeting universal design standards, and removal of vehicular traffic to reclaim space for pedestrians. However, all three methods identified serious feasibility concerns that undermined this technical advantage. Focus group participants noted that complete street closures would redirect traffic to residential streets, which would be unable to handle the load and create accessibility problems for elderly residents or people with disabilities trying to reach essential services like the market. Stakeholder interviews reinforced this concern, with municipal officials explaining that comprehensive pedestrianization fails to consider how traffic rerouting affects the broader neighborhood system.

In contrast, A1 (Tactical) got the lowest walkability score (4/10, giving 0.6 weighted points) because it suggested only simple fixes: paint to mark spaces, bollards to protect pedestrians, and better signs, but no major sidewalk rebuilding or road redesign. The similar findings from all methods are telling. Method 1 showed residents thought A1 was not enough, saying painted lines and bollards alone can't really change the street or how drivers behave if the basic setup stays poor. Method 2 agreed, as focus groups found A1 did not meet the level needed to change behavior, since it only improved what was already there and did not rebuild bad sidewalks or add new places to walk. Method 3's numbers supported these views by giving A1 the lowest score among the options. This agreement across methods shows that simple fixes cannot solve the deeper problems that make it hard to walk in Callao's historic center, where narrow sidewalks, rough pavement, and too many cars call for real rebuilding, not surface fixes.

A2 (Intermediate) achieved a moderate walkability score (7/10, yielding 1.05 weighted points) but received the strongest support across all three evaluation methods. The strategy proposed a selective street redesign focusing on high-priority corridors. This involved partial pedestrianization (making some streets accessible mainly to pedestrians), expanded sidewalks (widening walkways along key pedestrian routes), and small-scale public spaces such as pocket parks (very small parks) and

neighborhood plazas (community gathering areas). Method 1 revealed that participants appreciated this approach because it created real physical changes to street structure without attempting a district-wide transformation that would disrupt the entire neighborhood system. Method 2 showed that municipal officials valued the ability to achieve meaningful improvements within budget constraints by focusing resources on priority corridors rather than comprehensive coverage, and by learning from initial implementation before expanding. Method 3's scoring reflected this balanced assessment, positioning A2 between A1's insufficient scope (surface treatment only, such as basic repaving) and A3's unrealistic comprehensiveness (district-wide reconstruction, meaning total overhaul of all streets in the area).

However, the research identified an important limitation that held across all three methods: walkability fixes under A2 focus on main routes rather than the entire historic center. The scorecard showed that only about 40% of streets would get major walkability upgrades through A2's chosen areas. Stakeholder talks logged frustration from two residents that plans always focus on main roads like Sáenz Peña, while side streets also need better sidewalks. Focus group discussions recognized this concern but decided that selecting certain areas is the only practical way, given Callao's limited resources, because redoing all sidewalks in the district (A3's plan) is more than the city can handle. This shows a basic problem in places with few resources: fixing every street for walkability is not doable, but choosing just some areas can lead to unfairness, with some neighborhoods getting wider sidewalks and new public spaces while others still have narrow, worn-out paths.

Safety: Physical Spatial Restructuring as Essential Requirement

Safety emerged as the most decisive criterion across all three evaluation methods, fundamentally shaping strategy preferences and final recommendations. Method 1 revealed that 80% of interview participants identified insecurity as their primary concern about the historic center. Stakeholders described poor lighting throughout the area, abandoned buildings that create dark, isolated zones, a lack of pedestrian activity after 6pm due to fear, and walking through interior streets considered dangerous for people not from the area. This consistent prioritization of safety shaped how all three methods evaluated strategy effectiveness.

A2 (Intermediate) scored highest on safety (7/10, yielding 2.1 weighted points), representing its most decisive advantage over alternatives. Method 3's weighted scorecard showed that A2's safety performance contributed more to its total score than any other dimension, driven by a strong rating (7/10) and a high weighting (30%). Method 1 revealed why stakeholders valued A2's safety approach: the strategy creates permanent physical changes through partial pedestrianization that generates "eyes on the street," small-scale public spaces like pocket parks that attract daytime users and

increase natural surveillance, and moderate greening through strategic street tree placement that improves visibility while defining territorial boundaries. Method 2 confirmed this assessment through focus group discussion, where participants evaluated A2 as creating both physical spatial restructuring that reduces crime opportunities through increased visibility and legitimate activity through activated public spaces. The strategy addresses both objective crime problems (through spatial design that eliminates hiding spots and increases natural surveillance) and subjective fear perceptions (through increased pedestrian activity that makes streets feel safer) simultaneously, a combination that all three methods identified as essential for effectiveness in Callao's high-crime context.

In sharp contrast, A1 (Tactical) scored critically low on safety (3/10, yielding only 0.9 weighted points) despite including upgraded lighting and improved signage as tactical safety improvements. The convergence of findings across methods proves particularly striking here. Method 1 showed that residents dismissed lighting-only interventions as insufficient for addressing deep-rooted insecurity when street spatial structure remains unchanged. Method 2 demonstrated that focus group participants evaluated A1 as having "minimal impact on safety" because upgraded lighting helps visibility, but without physical spatial restructuring through pedestrianization or public space creation, streets remain empty, and fear remains unchanged. Method 3's quantitative scoring validated these qualitative assessments by assigning A1 the lowest safety rating among all alternatives, which, combined with the high 30% safety weighting, significantly damaged A1's overall performance.

This multi-method consistency challenges tactical urbanism approaches that assume surface improvements, including upgraded lighting, paint, and signage, automatically enhance safety through quick visible changes. In Callao's high-crime context, all three evaluation methods demonstrated that stakeholders demanded physical spatial restructuring that fundamentally changes street configuration to enable natural surveillance and legitimate activity, rather than surface treatments that leave underlying spatial problems unchanged. A1's approach of minimal disruption through surface upgrades proved inadequate precisely because it preserves the existing spatial structure that generates insecurity.

A3 (Comprehensive) presented a more complex safety profile that varied across evaluation methods. Method 3 showed A3 achieving the highest potential safety score (9/10) based on the technical assessment of how comprehensive public space design through full pedestrianization of priority streets, high-quality public spaces with comprehensive lighting systems, and integrated design would eliminate hidden spaces and abandoned areas that currently harbor criminal activity. However, Methods 1 and 2 revealed significant stakeholder concerns that reduced this theoretical advantage in practice. Stakeholder interviews documented worries about whether abandoned

buildings would actually be reactivated and whether the municipality possesses the capacity to maintain comprehensive lighting systems and professional landscaping over time. Focus group discussions produced a lower realistic outcome score (6/10, yielding 1.8 weighted points), reflecting these implementation doubts about maintaining complex infrastructure.

More critically, all three methods identified an important temporal dimension that the initial technical analysis overlooked: rehabilitation strategies do not simply yield a final safety outcome but rather create safety conditions throughout the implementation process. Focus group participants noted that A3's long implementation timeline (3-5 years) means that by the time district-wide transformation completes, new problems will have emerged. More concerning, participants observed that during construction phases, safety actually worsens because construction fencing and closed businesses create even more dead spaces and reduce natural surveillance. This observation reveals a "safety valley" in which conditions deteriorate before improving. A2's shorter implementation timeline (1-2 years) and selective spatial coverage (priority corridors rather than district-wide) minimizes this temporal exposure to worsening conditions, which all three methods identified as a significant practical advantage, even though technical scoring of final outcomes might favor A3's comprehensive spatial transformation.

Environmental Quality: A Critical Issue Overlooked

Environmental quality emerged as the lowest-priority criterion across all three evaluation methods, subordinated to safety and infrastructure concerns despite its theoretical importance in sustainable urban rehabilitation. Method 1 revealed that interview participants acknowledged environmental deficits, including minimal green space, lack of shade, heat-island effects, and poor air quality, but framed these as secondary concerns that could be addressed only after establishing basic safety and functional infrastructure. Method 2 confirmed this pattern through focus group discussion, where participants spent approximately 45 minutes discussing safety concerns but only 8 minutes discussing green space and environmental issues. Method 3's quantitative scoring reflected this moderate environmental impact with a 7/10 rating, recognizing that strategic tree placement and pocket parks provide some benefit but do not constitute comprehensive environmental transformation.

A1 (Tactical) scored lowest on environmental quality (3/10, yielding 0.45 weighted points) because its approach of surface upgrades and tactical improvements includes no significant greening elements beyond potential temporary planters as part of tactical street furniture. The strategy focuses on paint, bollards, upgraded lighting, and improved signage, elements that provide no ecological function or meaningful environmental benefits. However, all three methods revealed that this limitation did not

significantly affect stakeholder preferences. Method 1 showed no strong criticism of A1's environmental shortcomings during interviews, as participants focused their critiques on inadequate walkability and safety impacts rather than environmental deficits. Method 2 demonstrated that focus group discussions did not identify environmental quality as a deal-breaker criterion. Method 3's weighted scoring showed that the 0.6-point difference between A1's environmental performance (0.45 points) and A3's environmental performance (1.35 points) had minimal impact on overall rankings compared to larger differences in safety and viability performance.

A3 (Comprehensive) scored highest on environmental quality (9/10, yielding 1.35 weighted points) through proposing integrated green infrastructure, including expanded tree canopy coverage throughout the district, rain gardens for stormwater management, permeable surfaces to reduce runoff, and professional landscaping in high-quality public spaces. However, all three methods identified that, even with this comprehensive approach, the alternative provides only limited absolute environmental improvement, despite being the highest-scoring alternative. Method 1 revealed that municipal officials worry the municipality lacks the budget and staff to maintain rain gardens, permeable surfaces, and professional landscaping over time. Method 2 showed that focus group participants expressed concern that complex green infrastructure will deteriorate without sustained maintenance capacity, potentially creating new problems. Method 3's scoring incorporated these feasibility doubts while recognizing that A3's integrated green infrastructure represents the most ambitious environmental approach among the three alternatives.

The convergence of findings across all three methods reveals that environmental quality improvements remain modest across all alternatives, even the comprehensive approach. A1 provides essentially no environmental benefit through its surface treatment approach. A2 provides limited environmental improvement through strategic tree placement and small parks. A3 provides the most substantial environmental improvement through integrated green infrastructure, but even this remains constrained by maintenance capacity concerns and primarily improves vegetation coverage rather than comprehensive ecological transformation. When basic safety and infrastructure functionality remain severely compromised, all three alternatives prioritize addressing these fundamental deficits over environmental quality enhancement, rendering environmental quality a complementary rather than foundational criterion across all strategy options.

Viability: The Constraining Reality Defining Possible Solutions

Feasibility functioned as the constraining factor that ultimately determined strategy preferences across all three evaluation methods. The research assigned a 40% weighting to viability, the highest among the four criteria. This decision reflected

stakeholder assessment documented through Methods 1 and 2, which showed that Peru's political instability and history of incomplete projects make implementation capacity the critical determinant of success. Method 3's quantitative scoring validated this prioritization by showing that viability performance explained more variance in total scores than any other single criterion.

A3 (Comprehensive) illustrated this decisively. Despite strong impact scores (Walkability 9/10, Environmental Quality 9/10, Safety potential 9/10), A3 received the lowest overall rating (5.7/10) because all three methods identified it as unrealistic. A3 scored only 3/10 on viability (yielding 1.2 weighted points). Focus group participants unanimously agreed it would not survive the budget meeting, noting that high investment (> $5M USD), long timeline (3-5 years), and district-wide coverage requiring coordination between Municipality of Callao, Regional Government, Ministry of Culture, and hundreds of private property owners exceed municipal capacity.

Two specific mechanisms explain these feasibility constraints. First, temporal mismatch: Peru's four-year political cycles clash with A3's 3-5-year timeline, creating a high risk of abandonment when administrations change priorities and making external funding difficult to secure. Second, institutional fragmentation: municipal officials explained that coordinating between departments within a single municipality proves difficult, making district-wide intervention requiring collaboration across multiple government levels unmanageable. Method 3's low viability score, weighted at 40%, proved fatal to A3's overall performance despite technical superiority on impact criteria.

A1 (Tactical) scored highest on feasibility (9/10, yielding 3.6 weighted points) due to low investment (< $500K USD), short timeline (3-6 months), selective coverage, and temporary/semi-permanent elements avoiding complex approvals. Projects can be completed within a single administration with minimal disruption. However, Methods 1 and 2 revealed that stakeholders rejected this feasibility advantage as insufficient justification. Focus group participants questioned whether survival matters if impact is minimal, noting A1 survives because nobody cares enough to cancel it. Stakeholders criticized A1 because its feasibility through surface treatment came at the cost of a meaningful impact that would require physical reconstruction. This reveals a "viability paradox": being easy to implement does not make a strategy valuable if it fails to address underlying problems. All three methods demonstrated that stakeholders demand strategies balancing implementation realism with meaningful impact, rejecting both the insufficient-but-feasible surface treatment (A1) and the comprehensive-but-infeasible holistic transformation (A3).

Given these trade-offs, A2 (Intermediate) achieved moderate feasibility (6/10, yielding 2.4 weighted points) while maintaining reasonable impact scores. This balanced profile proved decisive: 60% of interview participants preferred A2, 5 out of 6

focus group participants recommended A2, and Method 3 awarded A2 the highest total score (6.6 points) despite not maximizing any single criterion. The convergence occurred because A2 achieved adequate performance across all dimensions without fatal weaknesses.

Methods 1 and 2 revealed specific advantages, making A2 realistic. First, a medium investment ($1-3M USD) falls within the municipal budget and external grants over 1-2 years. Second, priority corridor focus reduces coordination complexity by concentrating efforts on high-visibility streets. Third, selective street redesign creates permanent physical changes in selected areas, generating sufficient permanence to justify investment while avoiding A3's unmanageable comprehensive scope. Focus group participants emphasized that this strategic selectivity proves essential for generating visible results within timeframes and building political support.

However, participants stressed that the municipal budget alone remains insufficient and requires partnerships with national government programs, international cooperation agencies, or private-sector investment. They recommended establishing formal mechanisms for community co-management to guarantee continuity beyond political cycles and legal protection through municipal ordinance or heritage protection mechanisms to reduce cancellation risk during government transitions.

The convergence on A2 led to the conceptualization of the strategic implementation zone, which represents the overlap between meaningful impact and realistic feasibility. A2 occupies this zone through medium investment, medium timeline, priority corridor coverage, permanent selective improvements, and moderate quality standards. The radar chart shows A2 forming a consistently strong polygon, without the extreme peaks and valleys that characterize alternatives. A2 maintains a consistent 6-7/10 performance across all dimensions, achieving sufficient impact through selective physical reconstruction to cross the perception threshold necessary for behavior change while remaining within realistic implementation capacity.

5. Conclusions

Alternative urban rehabilitation strategies in the Historic Center of Callao differ in perceived effectiveness for two main, interdependent reasons. The first is the capacity to address security, which is the community’s primary concern. The second is the perceived credibility of interventions within existing institutional constraints. In a context marked by institutional fragility, perceived effectiveness depends not only on technical quality but also on whether interventions seem achievable within current governance limits.

Security is the principal determinant of perceived effectiveness. It is the main criterion for how stakeholders evaluate urban improvements. Residents facing persistent insecurity consistently place safety above accessibility, environmental quality, or aesthetics. Crime significantly limits their use of public spaces. This shows a hierarchical pattern of perceived effectiveness: improvements in traffic flow and environmental quality are valued only after safety conditions improve. Security is a prerequisite for the relevance of other dimensions.

Perceived credibility amplifies effectiveness by shaping how stakeholders see a strategy's benefits as achievable in Callao's context. Stakeholders judge feasibility based on prior abandoned projects, limited technical capacity in the municipality, and short political cycles. This leads to a pattern: comprehensive transformations create distrust because they go beyond what residents believe is possible, and are dismissed as implausible, regardless of design quality. Strategies deemed unfeasible are considered ineffective, even if technically superior. Credible interventions gain perceived effectiveness when stakeholders trust they will be completed. In institutional fragility, optimal perceived effectiveness comes by balancing security impact with what is realistically achievable, rather than maximizing technical scope.

Several limitations frame these findings. First, the sample size is small (10 stakeholder interviews and 6 focus group participants), and it is concentrated within Callao's Historic Center. Second, this planning-phase evaluation reports on stakeholder perceptions and technical assessments rather than observed results. Longitudinal research is needed to measure actual impacts for validation. Third, the weighted scorecard assigned criteria percentages (40% for viability, 30% for safety, 15% for walkability, and 15% for environmental quality) based on stakeholder input. A sensitivity analysis with alternative weightings would determine whether the findings are stable across different scenarios. Fourth, the research evaluated three predefined strategies with distinct intervention intensities. Alternative configurations that combine elements may better fit the strategic implementation zone. Future research should see if hybrid approaches optimize the impact-feasibility balance more than the intermediate strategy tested here. Finally, the findings apply primarily to contexts characterized by Callao's political instability, limited municipal capacity, high crime rates, and heritage rules. They may not transfer to places with stronger institutions, more resources, or different urban challenges.

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