

Negotiating Transport Interfaces: Public Space, Everyday Mobility and Public Authority in Rapidly Urbanising African Cities

Abstract

This article develops a toolkit connecting transport-interface design with public influence in rapidly urbanising African cities. It conceptualises interfaces as socio-spatial arenas where mobility, public-space use, livelihoods and institutional authority are negotiated. Grounded in Southern urbanism, qualitative analysis of published scholarship identifies relationships and mechanisms, integration strategies, evidence of influence, and conditions for using digital and hybrid engagement tools. The toolkit links situated diagnosis, design alternatives, facilitated deliberation, institutional response and follow-up. A worked composite Cape Town example, informed by VPUU's Indawo learning game, demonstrates how these components translate competing spatial claims into design and governance requirements. Particular attention is given to virtual reality and gamification as media for embodied exploration and negotiation. The contribution provides urban designers, planners, modellers and decision-makers with a practical framework for connecting everyday access, public engagement and accountable implementation.

Keywords: transport interfaces; Southern urbanism; public participation; virtual reality; gamification

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1 Introduction

1.1 Transport infrastructure and the everyday city

This article develops an integrated toolkit for designing transport interfaces and tracing how affected people influence their transformation. Its central argument is that interfaces are socio-spatial arenas where mobility, public-space use, livelihoods and institutional authority are negotiated. The toolkit connects the physical and operational conditions of access with the processes through which people shape problems, alternatives and decisions. A worked composite Cape Town example demonstrates its application to competing demands for crossing, loading, waiting and trading space.

A corridor can connect employment centres while increasing the effort of reaching a nearby school, market or stop on foot. Its effects depend on entrances, interchanges, footways and adjoining spaces where metropolitan movement meets neighbourhood life. Integration concerns the continuity between a journey and the activities it supports, together with who defines acceptable access and negotiates improvements.

In rapidly urbanising African cities, infrastructure intersects with uneven services, peripheral settlement and combinations of formal and informal transport. Southern urbanism treats these conditions as sources of knowledge. Watson (2009) examines tensions between planning rationalities and everyday practices; Roy (2005) connects informality to regulation; and Simone (2004) foregrounds the social relations sustaining urban life. Public space includes narrow paths, trading edges and informal waiting areas whose value emerges through practical rights to enter, remain and work. Figure 1 identifies where coordinated responsibilities and public input can reshape corridor priorities.

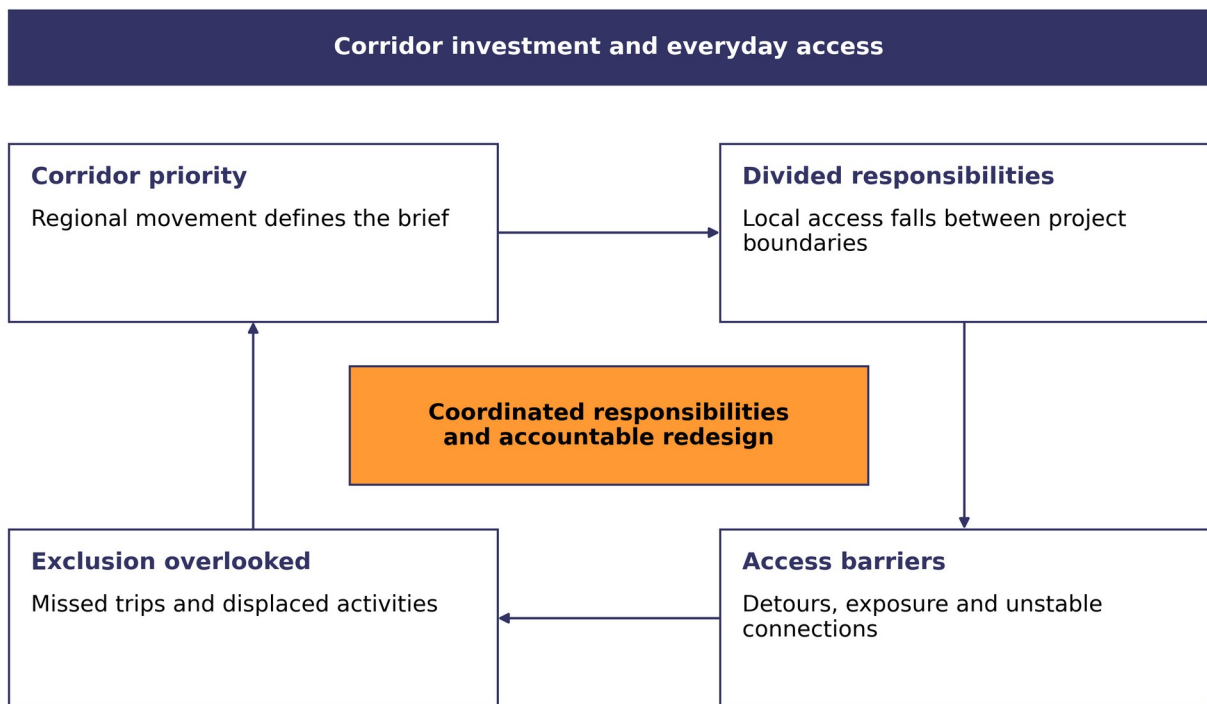


Figure 1. Corridor priorities, institutional responsibilities and everyday access barriers. Coordinated responsibilities and public input provide points for intervention. Author synthesis informed by Anciaes *et al* (2016), Watson (2009) and Yang *et al* (2019).

1.2 The gap between integration and public influence

Yang *et al* (2019) connect transport infrastructure, public space and human behaviour through relationship analysis, integration strategies, evaluation and computational tools. Their analytical sequence provides a foundation for interface research. Southern urban scholarship extends the inquiry towards whose knowledge defines the problem, which activities receive recognition and how contributions enter institutional decisions.

Transport research assesses movement and accessibility; urban design examines spatial form and public life; participation studies investigate representation and influence. Bringing these traditions together yields three propositions. First, access depends jointly on physical connections, operating arrangements and public authority. Second, influence becomes traceable through changes to problem definitions, alternatives and implementation commitments. Third, engagement tools contribute through accessible representation, facilitation and opportunities to shape decisions. The toolkit makes these propositions usable through linked spatial, operational and institutional records, demonstrated in Section 7.1.3.

1.3 Aim and research questions

The aim is to explain how transport infrastructure, public space and everyday users can be brought into a more equitable relationship in rapidly urbanising African cities, and how engagement supports public influence. Four questions organise the study:

RQ1 What relationships and mechanisms connect transport infrastructure, public space and everyday users at transport interfaces in rapidly urbanising African cities?

RQ2 What kinds of policies, operational strategies, and urban design methods are used to integrate these three components?

RQ3 What dimensions and forms of evidence are needed to evaluate whether public engagement influences transport-interface planning and decision-making?

RQ4 What capabilities, limitations and conditions of use characterise digital and hybrid tools for engaging publics in transport-interface planning?

Chapters 3–6 address RQ1–RQ4 respectively. Chapter 7 integrates the findings, demonstrates the toolkit and develops the theoretical contribution. Chapter 8 concludes.

1.4 Scope of the research

The geographical scope is rapidly urbanising African cities, with the transport interface as the unit of analysis. Nairobi and Cape Town scholarship informs mobility, public space and co-production; Kampala research contributes an infrastructural perspective. Southern urbanism provides the theoretical grounding, including concepts developed across Southern settings. International engagement studies supply methodological comparisons assessed through their spatial problems, participants and institutional conditions. The contemporary search covers September 2016–September 2026, supported by earlier foundational scholarship.

1.5 Definitions of terms and operational concepts

A game includes, in Merriam-Webster's definition, an “activity engaged in for diversion or amusement” (Merriam-Webster, n.d.). Here, it denotes a structured activity using rules, roles and shared scenarios to explore choices through boards, cards or digital environments. Indawo exemplifies material planning games: participants explore integration, co-design and diverse stakeholder perspectives in a fictional area (VPUU, 2021). A serious game directs structured play towards learning or deliberation. Gamification introduces game-design elements into non-game contexts (Deterding *et al*, 2011).

Virtual reality (VR) presents a navigable digital environment; augmented reality (AR) overlays information on an existing setting. Hybrid engagement combines material, face-to-face and digital activities. Phygital engagement specifically connects physical manipulation or movement with digital representation. Embodied experience concerns situated sensing, moving, waiting, interacting and working, interpreted through everyday social relationships (Simone, 2004).

Following Bhan (2019), Southern urbanism is a situated and relational approach that develops urban knowledge from particular places while questioning dominant categories of theory and practice. His vocabulary of squat, repair and consolidate foregrounds how people and institutions produce and sustain urban conditions. This study therefore begins with everyday practices and situated knowledge to understand infrastructure and public authority. Africa defines the geography; Southern urbanism defines the interpretive orientation.

Mega transport infrastructure denotes major road, rail and mass-transit corridors and interchanges. A transport interface connects these systems with feeder services, walking routes and adjacent public-space activities. Publicness concerns practical rights to enter, remain, work and participate in management. Everyday users include residents, passengers, traders, workers, operators and people with restricted access. Public influence concerns their capacity to shape problems, alternatives, decisions and implementation. Figure 2 situates these concepts within historical and institutional conditions.

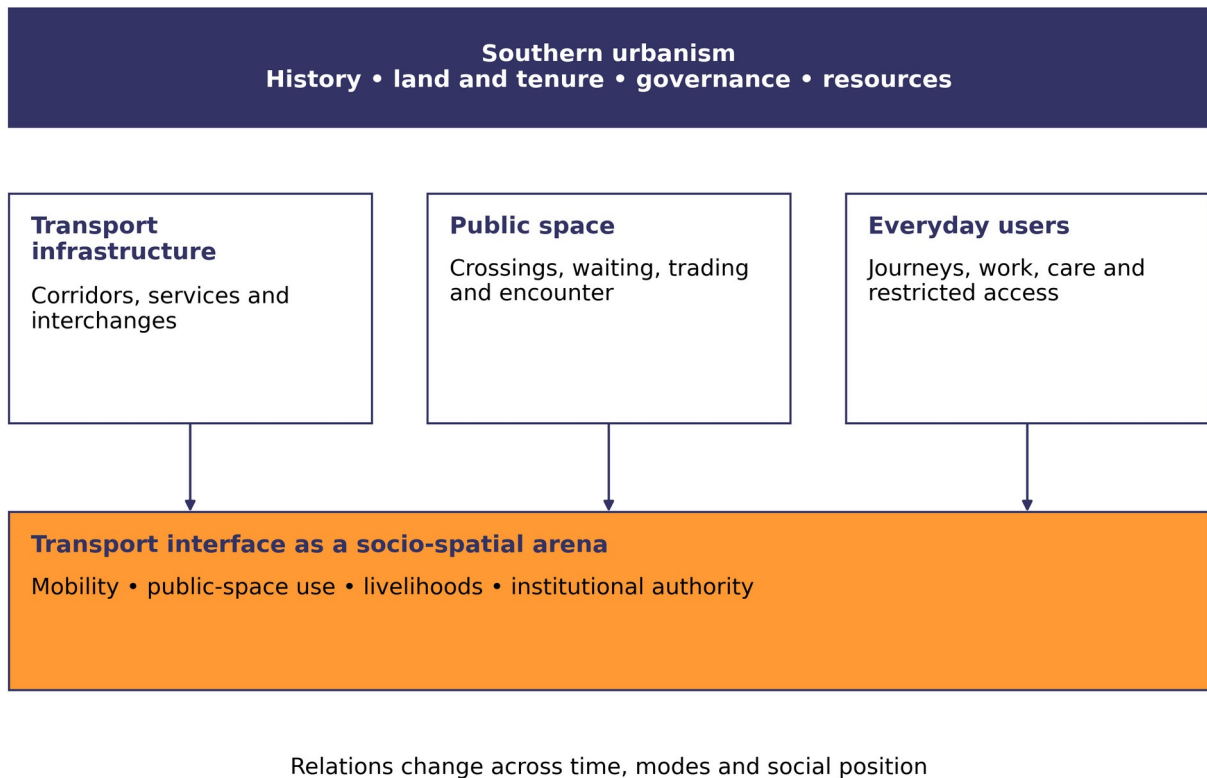


Figure 2. The transport interface as a socio-spatial arena connecting infrastructure, public space and everyday users. Southern urbanism supplies the historical and institutional perspective. Author synthesis informed by Bhan (2019), Roy (2005), Simone (2004) and Watson (2009).

2 Methodology

2.1 Qualitative research design and analytical approach

The study uses qualitative analysis of published scholarship to develop an explanatory and practical framework. Conceptual arguments, empirical studies and documented planning practices are compared across urban design, transport, Southern urbanism and participation research. The questions progress from defining interface relationships to examining integration strategies and evaluating engagement. Each has a corresponding evidence base: accounts of everyday access for RQ1; policy, operational and design arrangements for RQ2; participation and decision records for RQ3; and evaluations of engagement methods for RQ4.

The worked example applies the resulting framework analytically to a composite Cape Town interface. It combines the transport–public-space relationships identified in the literature with Indawo's documented approach to shared scenarios and stakeholder perspectives. Its design alternatives and decision requirements are constructed to demonstrate the toolkit. Figure 3 and Table 1 document selection; Table 2 links the analytical parts to methods and literature.

2.2 Literature identification and selection

Web of Science and Google Scholar were searched independently for publications from September 2016 to September 2026, with searches completed in September 2026. The search addressed Southern urban

scholarship and relationships between infrastructure, public space and everyday users. Citation-following and author searches supported theoretical grounding and engagement-method analysis, including earlier foundational work.

The core Web of Science query was:

TS=("transport infrastructure" OR "transportation infrastructure" OR "mega infrastructure" OR mobility OR traffic) AND TS=("public space" OR "urban space" OR "public participation") AND TS=(integrated OR integrating OR integration) AND TS=("urban plan" OR "urban design" OR planning OR "architectural design" OR "urban modeling") AND TS=("human behavior" OR "human activity" OR "physical activity" OR "public life" OR "urban everyday")

These groups identify movement–space relationships, integration methods and human activity.

Complementary inquiries used Southern urbanism, Southern urban practice, co-production, public authority, games, gamification, virtual reality, augmented reality and phygital engagement. Google Scholar combined “transport infrastructure” or “transportation infrastructure”, “public space”, “human behavior”, “integrated” and “urban design”, extending coverage to books and other scholarly materials.

The reconciled record contains 75 Web of Science and 76 Google Scholar records: 151 at identification.

Removing one duplicate left 150 unique records for abstract screening. Of these, 71 were excluded and 79 retained for qualitative analysis, comprising 41 Web of Science and 38 Google Scholar publications. Each publication enters the combined total once.

Eligibility required a substantive contribution to a research question. Transport studies connected at least two of infrastructure, public space and human behaviour through planning, design, policy, modelling or engagement. Southern urban scholarship explained everyday practice, informality, spatial production or authority. Engagement studies addressed representation, facilitation or decision processes. Relevant situated case studies were retained. Exclusions covered disease-spread modelling, underground construction and hub engineering outside everyday access, public-space use or engagement, and generic technology accounts with limited analytical evidence. These relevance criteria also governed the 38 Google Scholar selections.

The lead author reconciled totals and the duplicate against saved search records. Detailed interpretation used accessible full texts; abstract-only material supported claims within its reported scope.

Table 1. Research procedure and reconciled selection record

Stage	Procedure and record
Search	Independent Web of Science and Google Scholar searches; core query and complementary concepts in Section 2.2. Contemporary period: September 2016–September 2026; foundational literature provides theoretical grounding.
Initial identification	75 Web of Science records + 76 Google Scholar records = 151 identified records.
Deduplication	One duplicate removed in the reconciled record, leaving 150 unique records.
Screening	150 unique abstracts assessed against the research questions and eligibility criteria; 71 unique records excluded.
Detailed assessment	Selected publications examined for setting, method, argument and evidential contribution. Interpretation uses full texts where accessible and the stated scope of abstract-only material.
Final corpus	79 unique publications retained: 41 from Web of Science and 38 from Google Scholar.
Analytical coding	Five dimensions: interface relationships; integration strategies; public influence; tool capabilities and limitations; contextual conditions of use.
Synthesis	Thematic comparison across studies and settings; three propositions linking spatial conditions, engagement processes and public authority.

Selection counts follow the author's reconciled search record. Figure 3 presents the combined sequence after deduplication; the corpus count refers to unique publications.

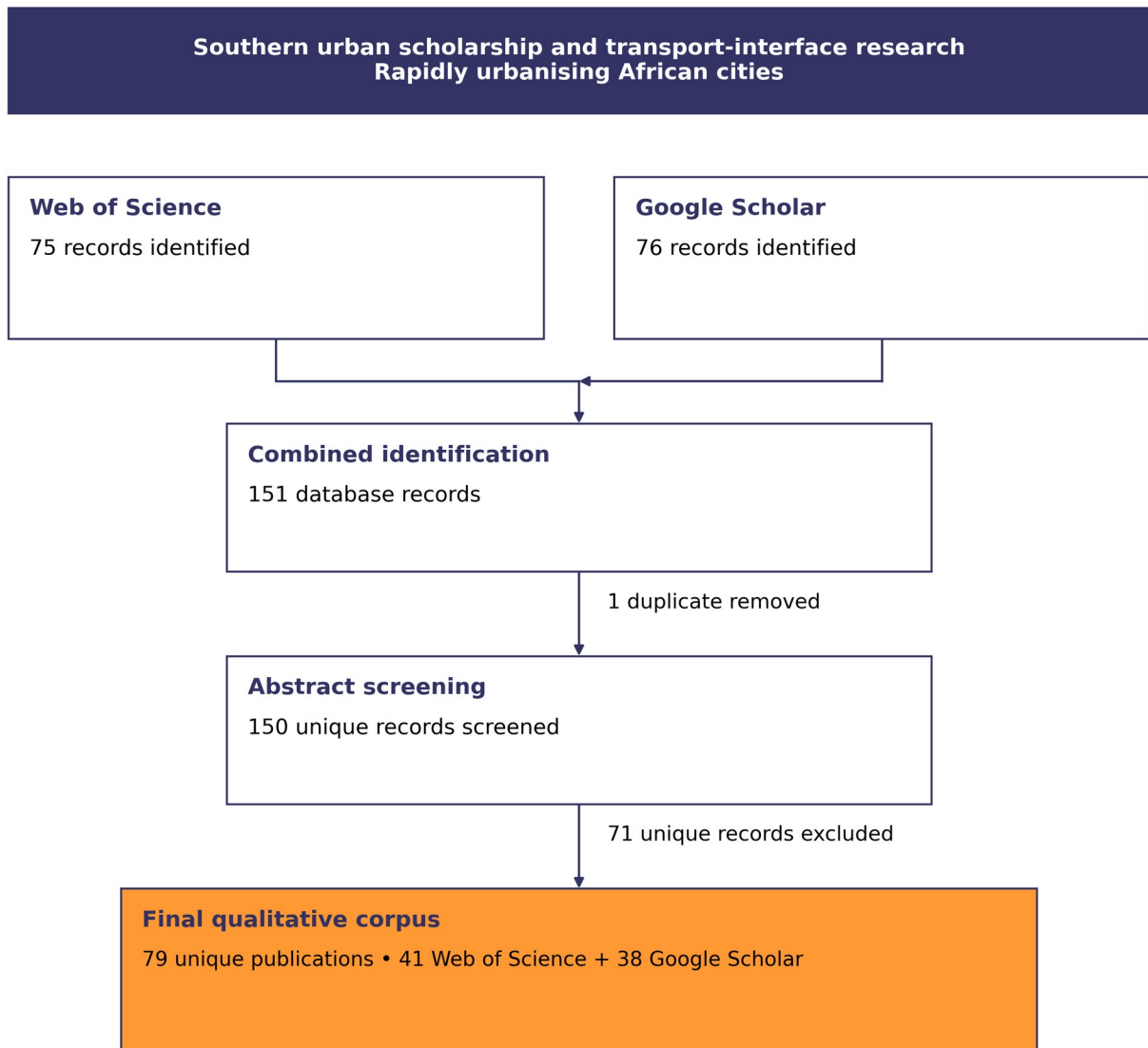


Figure 3. Literature-selection process: 151 identified records, one duplicate removed, 150 unique records screened, 71 excluded and 79 unique publications retained for qualitative analysis.

2.3 Analytical coding and thematic synthesis

Five dimensions organised analysis: interface relationships; integration strategies; public influence; engagement capabilities and limitations; and contextual conditions of use. Comparison connected each argument or finding to its setting, method and evidence. Appraisal considered conceptual clarity, methodological transparency, relevance and the relationship between conclusions and supporting material.

Thematic synthesis examined agreements and tensions across studies, distinguishing accounts of everyday practice, immediate tool responses and documented institutional decisions. The worked example follows these distinctions through a spatial brief, alternatives and a decision record. Equivalent outcomes across VR and desktop 3D would clarify medium selection; differences between understanding and institutional influence would identify where engagement arrangements need development. The framework's value lies in explaining these relationships across outcomes.

Table 2. Review matrix aligned with the three analytical parts

Parts of Review	Research Issues	Methods	Tools Used in Literature	Key Literature
Part I: Analysis – Relationships between Transport, Spaces and Humans				
1. Design and everyday use	Connections among network continuity, public-space practices and differentiated access.	Qualitative synthesis; accessibility and severance analysis.	Interface mapping; accompanied walks; audits; observation; interviews.	Bertolini (1999); Ancaes <i>et al</i> (2016); Salon and Gulyani (2010); Ewing (2021, 2025).
2. System mechanisms	Spatial form, travel choices and exposure across alternatives.	Scenario analysis; behavioural and environmental modelling.	GIS; agent-based models; Monte Carlo; ENVI-met/TRNSYS.	Yang <i>et al</i> (2019); de Nazelle <i>et al</i> (2011); Perini <i>et al</i> (2017); Parker <i>et al</i> (2003).
Part II: Strategies – Policy and Governance				
1. Transport policies	How fares, services and corridor investment shape everyday access.	Policy comparison; distributional and equity analysis.	Document coding; accessibility indicators; route and service data.	Venter <i>et al</i> (2018); Salon and Gulyani (2010); Williams <i>et al</i> (2015).
2. Governance and financing	Ownership, funding, maintenance and the capacity to contest decisions.	Institutional analysis; process tracing; co-production.	Responsibility mapping; decision records; interviews; cost tracing.	Bhan (2019); Roy (2005); Watson (2014); Carmona (2019).
Part III: Evaluation – Integrated Transport and Public-Space Plans				
1. Influence and implementation	Reach, understanding, deliberation, public influence and delivery.	Mixed-method evaluation; thematic comparison; follow-up tracing.	Surveys; observation; interviews; proposal versions; implementation records.	Arnstein (1969); Ampatzidou <i>et al</i> (2018); Meenar and Kitson (2020); Delaney (2022).

The three analytical parts address relationships, integration and evaluation. Digital and hybrid engagement capabilities are examined across these parts through RQ4.

3 Scientific Knowledge of Relationships between Transport, Spaces, and Humans

This section examines mechanisms connecting transport infrastructure, public-space planning and everyday behaviour. It addresses RQ1 by relating spatial and operational conditions to the authority through which access is organised.

3.1 Conceptual frameworks linking transport and public-space design with human behaviour

Bertolini's (1999) node–place approach relates transport accessibility to the intensity and diversity of station-area activities. Community severance explains how infrastructure and traffic separate people from destinations and social relationships (Ancaes *et al*, 2016). Together, they direct attention from network connection towards the continuity of a complete journey. An available crossing can still impose a difficult level change, detour or exposure.

Ewing and Cervero (2010) connect built form, destinations and travel through aggregate associations. Salon and Gulyani's (2010) Nairobi study situates travel choices within poverty and gender, demonstrating why

necessary walking and freely chosen activity require different interpretation. Lived accessibility consequently concerns the monetary, temporal, physical and social costs of reaching opportunities, including how those costs vary between users.

3.2 Southern urbanism and the production of interfaces

Robinson (2011) supports comparison across cities through questions grounded in their particular conditions. Roy (2005) positions informality within regulation and state authority: a trader's place beside a stop involves permits, enforcement and bargaining as well as spatial opportunity. Simone (2004) foregrounds the relationships sustaining urban life. Lawhon *et al* (2018), drawing on Kampala, describe heterogeneous infrastructure configurations combining technologies, institutions and practices.

An interface can therefore comprise scheduled services, semi-formal routes, walking, information exchange and negotiated maintenance. These arrangements distribute the work and cost of sustaining access. Their analysis combines recognition of everyday capabilities with scrutiny of insecure livelihoods and unequal bargaining power.

3.3 Everyday practice, co-production and incremental transformation

Bhan's (2019) concepts of repair and consolidation begin with existing arrangements and the work of sustaining them. A damaged path, changing loading area or negotiated trading edge can reveal what a larger investment needs to address. Ewing's (2021, 2025) Cape Town research connects incremental place-making with local agency and responsibility. Watson (2014) examines state–society collaboration, while Miraftab (2009) foregrounds claims advanced through organising and contestation. Together, these accounts explain spatial transformation through whose knowledge is recognised and which institutions assume obligations.

3.4 Mechanisms and positive interactions

Four pathways emerge: physical continuity shapes crossing and transfer effort; service arrangements determine the usefulness of connections; comfort shapes waiting and walking; and occupation rules connect mobility with livelihoods. Income, disability, gender, care responsibilities and travel time mediate these relationships. Figure 4 connects these pathways with policy, design, exposure and health.

A forecourt can support transfer, rest and exchange when space and operating arrangements accommodate these activities together. Removing a feeder stop or trading area can redistribute access and income even where visual quality improves. RQ1 is thus answered through the interaction between spatial continuity, useful services, tolerable exposure and recognised use, interpreted across differentiated users and institutional settings.

3.5 Qualitative and mixed-method analysis of interface relationships

Walking interviews, observation, interface mapping and policy tracing explain negotiations omitted from network indicators. Salon and Gulyani (2010) connect travel evidence with poverty and gender; Watson (2009) and Simone (2004) explain institutional and relational conditions. For interface inquiry, accompanied journeys can connect mapped discontinuities with accounts of effort, safety and work. Comparing times,

modes and people who avoid a route makes the distribution of access visible. This study synthesises those reported relationships through the five dimensions in Section 2.3.

3.6 Quantitative analysis of the relationship between transport, spaces, and humans

Spatial statistics and simulation compare associations and scenarios. Yang *et al* (2019) assemble behavioural, procedural and exposure-modelling approaches; de Nazelle *et al* (2011) link active-travel policy, physical activity, pollution and health. Perini *et al* (2017) couple ENVI-met and TRNSYS to examine outdoor comfort.

At African interfaces, these methods can compare route continuity, queues, shade and exposure using locally grounded service and behavioural assumptions. Qualitative accounts explain the meanings and institutional conditions behind the represented choices. The synthesis connects statistical associations and scenario outputs to lived accessibility; Chapter 5 addresses evidence of participation and influence.

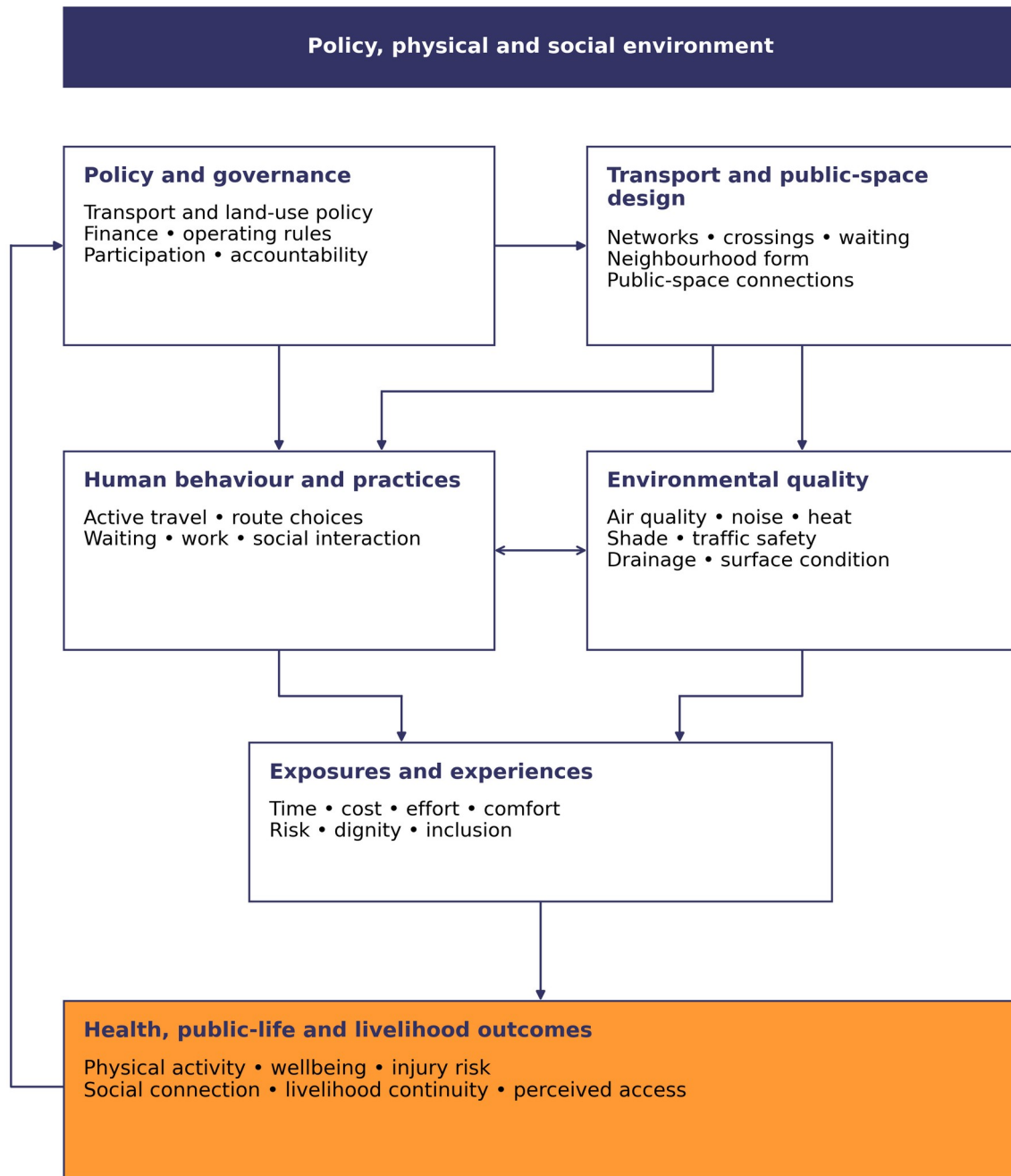


Figure 4. A conceptual model linking policy, transport and public-space design, human behaviour, environmental conditions and health. Adapted and extended from de Nazelle *et al* (2011, p. 768), with insights from Bertolini (1999), Salon and Gulyani (2010), Watson (2009) and Ewing (2021, 2025).

4 Strategies for Integrating Transport Spaces and Humans

4.1 Policy and governance across project boundaries

Integration requires a shared brief identifying access to preserve, decisions open to revision and responsibilities for the spaces between assets. A walking link outside a station or an informal transfer point can fall between institutional mandates. Carmona (2019) connects spatial quality to development and management processes; application in African settings also requires attention to livelihoods, tenure and contested occupation. Funding should cover maintenance, feeder access and participation alongside capital works, with transparent allocation and accessible routes for contesting exclusion.

4.2 Operational integration and existing mobility systems

Operational integration concerns affordable transfers, service coordination, information and the location of boarding and waiting. Venter *et al* (2018) show why bus rapid transit investment requires distributional analysis. Digital Matatus demonstrates how representing Nairobi's semi-formal services can strengthen planning knowledge (Williams *et al*, 2015). Interface assessment adds changing stops, transfer conditions and everyday use to that network representation.

Operators and workers belong within design negotiations because changes to stopping arrangements redistribute passenger access and trading opportunities. Agreements should connect loading practices and service reliability with pedestrian continuity. Distinct interests within user and operator groups need representation when resolving conflicts over scarce space.

4.3 Urban design and incremental intervention

Movement mapping, sections, accessibility audits and accompanied walks connect individual facilities to wider journeys. Candidate interventions include continuous footways, crossings aligned with everyday routes, legible level changes, shelter, drainage, resting space and negotiated livelihood provision. Geometry and operating rules determine whether mapped proximity becomes usable access.

Temporary waiting areas or reversible forecourt reallocations can make alternatives discussable before larger commitments. Their development requires funded maintenance and a route into permanent delivery (Bhan, 2019; Ewing, 2025). The worked example in Section 7.1.3 combines a revised spatial arrangement with operating and maintenance responsibilities.

4.4 Co-production and the right to contest

Participation begins with defining the problem and the decisions available for revision. Watson (2014) distinguishes forms of collaboration and co-production; Miraftab (2009) recognises organising, protest and refusal as ways excluded claims enter planning. Workshops should therefore accommodate challenges to the brief, proposals beyond the model and contributions through different media.

RQ2 is answered through coordinated governance, recognition of existing mobility and public-space practices, situated design and accountable implementation. Their contribution is the connection between a physical intervention and the terms under which it is operated, occupied and maintained.

5 Evaluation of Integrated Transport Spaces and Humans Plans

5.1 Defining the effectiveness of public engagement

RQ3 follows contributions from engagement into planning decisions and subsequent interface outcomes. Arnstein (1969) directs attention towards decision-making power: the same platform can present a predetermined project, support negotiated redesign or serve shared authority. Figure 5 distinguishes participants' influence from spatial and institutional integration. A connected design with limited public influence and an influential process with fragmented delivery present different evaluation problems.

Spatial and institutional integration × participant influence			
Spatial and institutional integration			
	Limited	Partial	Delivered
Shared authority	Shared authority Low delivery	Shared authority Partial delivery	Shared authority Delivered integration
Consultative influence	Consulted only	Informed input	Negotiated input
Low or absent influence	No cooperation No influence	Minimal influence	Token influence

Figure 5. Conceptual matrix relating participant influence to spatial and institutional integration. The cells provide a common vocabulary for comparing how engagement and delivery interact in a project.

5.2 Evaluation domains and appropriate evidence

Table 3 specifies six domains: reach, accessibility, comprehension, deliberation, influence and continuity. They connect who can participate to what happens to their contributions. Evaluation retains each domain separately because attendance, satisfaction, understanding and influence answer different questions. Quantitative summaries require denominators and missing-response reporting; qualitative accounts explain disagreement, withdrawal and concerns outside predefined categories.

Table 3. Dimensions and evidence for evaluating public influence at transport interfaces

Domain	Forms of evidence	Analytical interpretation
Reach	Recruitment routes; eligible population; attendance and non-response by relevant group.	Distinguish who attended from who had a realistic opportunity to participate. Report denominators.
Accessibility	Language and access needs; support used; reasons for opting out; equivalent non-digital contributions.	Digital completion is one route to contribution; compare it with supported and non-digital routes.
Comprehension	Explanations of alternatives and uncertainties before and after comparable presentations.	Separate understanding from agreement, satisfaction and familiarity with the device.
Deliberation	Recorded reasons, disputed assumptions, speaking opportunities and proposals outside predefined options.	A high volume of comments can conceal restricted agendas or domination of discussion.
Influence	Versioned proposals and a decision record linking issues to responses, reasons and responsible institutions.	Adoption rates should be read with the significance of contributions and the reasons for revision or rejection.
Continuity	Participant feedback on decisions; delivered changes; recurring costs and maintenance responsibilities.	Follow-up connects workshop contributions to durable interface conditions and institutional obligations.

Author synthesis informed by Arnstein (1969), Watson (2014) and the studies discussed in Chapter 6. The domains connect participation processes to planning decisions and follow-up.

5.3 Comparative and qualitative evaluation

Comparisons between plans and sections, desktop 3D and VR should present equivalent alternatives and uncertainties. Documenting facilitation time, opportunities to question the brief and proposal-editing rights helps identify what the medium contributes. Separate groups or counterbalanced sequences can support comparison according to the research question and setting.

Recruitment should include people with restricted digital access and those whose work or care commitments limit attendance. Equivalent paper, audio and assisted contributions broaden participation. Think-aloud accounts, annotations, observations and interviews distinguish difficulty operating a tool from disagreement with a proposal. Analysis should document how interpretations developed and examine accounts that challenge the dominant reading.

5.4 Tracing influence and subsequent outcomes

A decision record links each substantive issue to a proposal version, institutional response, reasons and responsibility for action. Participants can review how their contributions were interpreted. Later assessment examines delivered changes, journey interruptions, transfer experience and continuity of valued activities against baseline conditions and changing services.

The evaluation architecture answers RQ3 by connecting access to participation with evidence of understanding, deliberation, decisions and follow-up. Its practical unit is a traceable issue-to-decision sequence, illustrated through the competing claims in Section 7.1.3.

6 Digital engagement as an enabling condition

6.1 Participation versus representation

Digital and hybrid tools enable engagement through spatial representation and facilitated deliberation. Their democratic value depends on the opportunities participants have to revise alternatives and influence responsible institutions (Arnstein, 1969; Watson, 2014). RQ4 therefore examines each medium's capabilities, limitations and conditions of use. Selection begins with a task such as identifying a barrier, comparing waiting conditions or negotiating trading space; Chapter 5 provides the common evaluation criteria.

6.2 Material and game-based engagement

Board and card games organise scenarios through rules, roles and choices. Indawo's fictional area supports learning about integration, co-design and diverse stakeholder perspectives (VPUU, 2021). For transport-interface planning, this offers a way to make competing spatial claims discussable before translating them into design alternatives.

Gamification adds selected game elements to an activity (Deterding *et al*, 2011). Poplin (2012) examines playful planning participation; Ampatzidou *et al* (2018) identify facilitation and resource requirements; Thiel *et al* (2017) address motivational features in civic engagement. The design of rules matters: rewarding agreement can suppress a legitimate dispute over access or livelihood provision.

Digital games extend collaborative spatial construction. Delaney's (2022) Minecraft workshop combines proposal making with a platform-experienced participant profile and questionnaire attrition. Crilly *et al* (2026) connect geogames with wider planning traditions. A phygital process can link material choices to a navigable representation and return to shared negotiation. Section 7.1.3 demonstrates this transition using a composite interface.

6.3 Immersive engagement: VR and AR

VR supports exploration from an immersive viewpoint; AR connects proposed information with an existing setting. Meenar and Kitson's (2020) 40-participant study examines multisensory VR, recall and emotional responses. Reaver's (2023) youth AR workshops connect proposal development with municipal tree planning while identifying tracking and expert-mediation challenges.

At an interchange, immersive views can clarify entrances, sightlines, levels and waiting arrangements. Embodied interpretation also depends on testimony about effort, heat, safety, care and work. Southern urbanism grounds these accounts in situated practice and the social relations sustaining access (Simone, 2004; Bhan, 2019). A visually navigable route becomes meaningful through participants' interpretation of its everyday use. Equivalent non-headset routes and transparent modelling assumptions support that interpretation.

6.4 Conversational and AI-mediated engagement

Conversational systems can help people express concerns and help planners organise contributions. Veloso-Luis *et al* (2026) describe XRCity's integration of XR, conversational AI and planner-facing analysis. Their

abstract reports 191 usable sessions, of which 14.7% generated at least one structured response to a planning question. This operational yield illustrates the distinction between interacting with a system and producing planning input.

Application in multilingual African settings requires ways to inspect and correct summaries, preserve disagreement and trace how an institution responds. Automated grouping can obscure minority claims when different concerns are assigned the same category. Table 4 compares study contributions and transfer conditions.

Table 4. Engagement capabilities, evidence and conditions of use in selected studies

Study and setting	Evidence and contribution	Transfer and evaluation focus
Ampatzidou <i>et al</i> (2018) Three European cities	Survey and practitioner interviews illuminate facilitation, resources and barriers to adopting games.	Implementation conditions are clear; representation and redistribution of authority require a separate decision-tracing study.
Meenar and Kitson (2020) Glassboro, USA	A 40-participant focus-group study compares planning presentations with multisensory immersive simulations.	Immediate participation, recall and emotional responses support further testing; long-term influence and controls require additional evidence.
Delaney (2022) Online UCLCraft workshop	Collaborative Minecraft proposal making; initial and final questionnaires show participation and response attrition.	Experienced and young participant profile; speculative site brief. Inclusion and consequential planning influence remain open.
Reaver (2023) Oslo, Norway	Youth AR workshops connect on-site proposal making to municipal tree planning.	Technical tracking and expert mediation remain consequential. The setting differs from transport operations and livelihood conflicts.
Crilly <i>et al</i> (2026) Cross-disciplinary review	Connects geogames and planning traditions and identifies methodological and democratic questions.	Heterogeneous literature supports conceptual synthesis and points to digital exclusion, reductionism and sustained-outcome questions.
Veloso-Luis <i>et al</i> (2026) Torres Vedras, Portugal	XRCity integrates public-space XR interaction, conversational AI and planner-facing analysis.	Operational yield is reported; representation, language coverage and decision influence require separate assessment.

Study descriptions summarise the cited publications. Transfer considerations connect the reported settings and evidence to transport-interface planning in rapidly urbanising African cities.

6.5 Conditions under which digital tools become consequential

Participatory mapping locates barriers, games structure negotiation, shared models compare alternatives, and VR or AR adds spatial viewpoints. Their combination should follow participants' needs and the decision at issue. Budgets must include recruitment, translation, assistance, model revision and follow-up alongside equipment. Flexible sessions and material or audio contributions accommodate differences in work, care and digital access.

Facilitators need to preserve proposals outside predefined options and return unresolved issues to the brief. Responsible institutions need to specify which decisions remain open and how responses will be recorded. These arrangements make representation consequential. Figure 6 shows the engagement cycle; Figure 7 connects it with relationship analysis, governance, operations and design in the integrated toolkit.

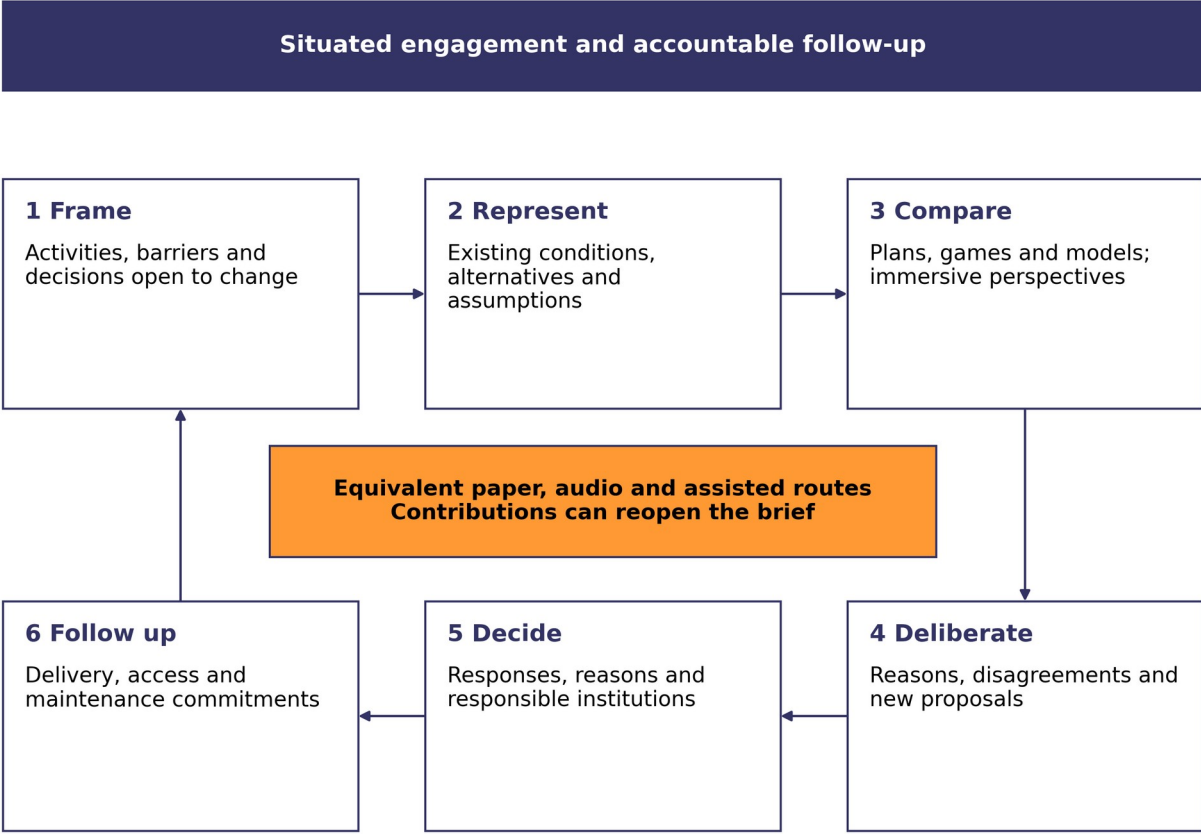


Figure 6. Engagement cycle connecting situated diagnosis, material and digital representations, deliberation, decisions and follow-up. Equivalent paper, audio and assisted routes connect to each stage.

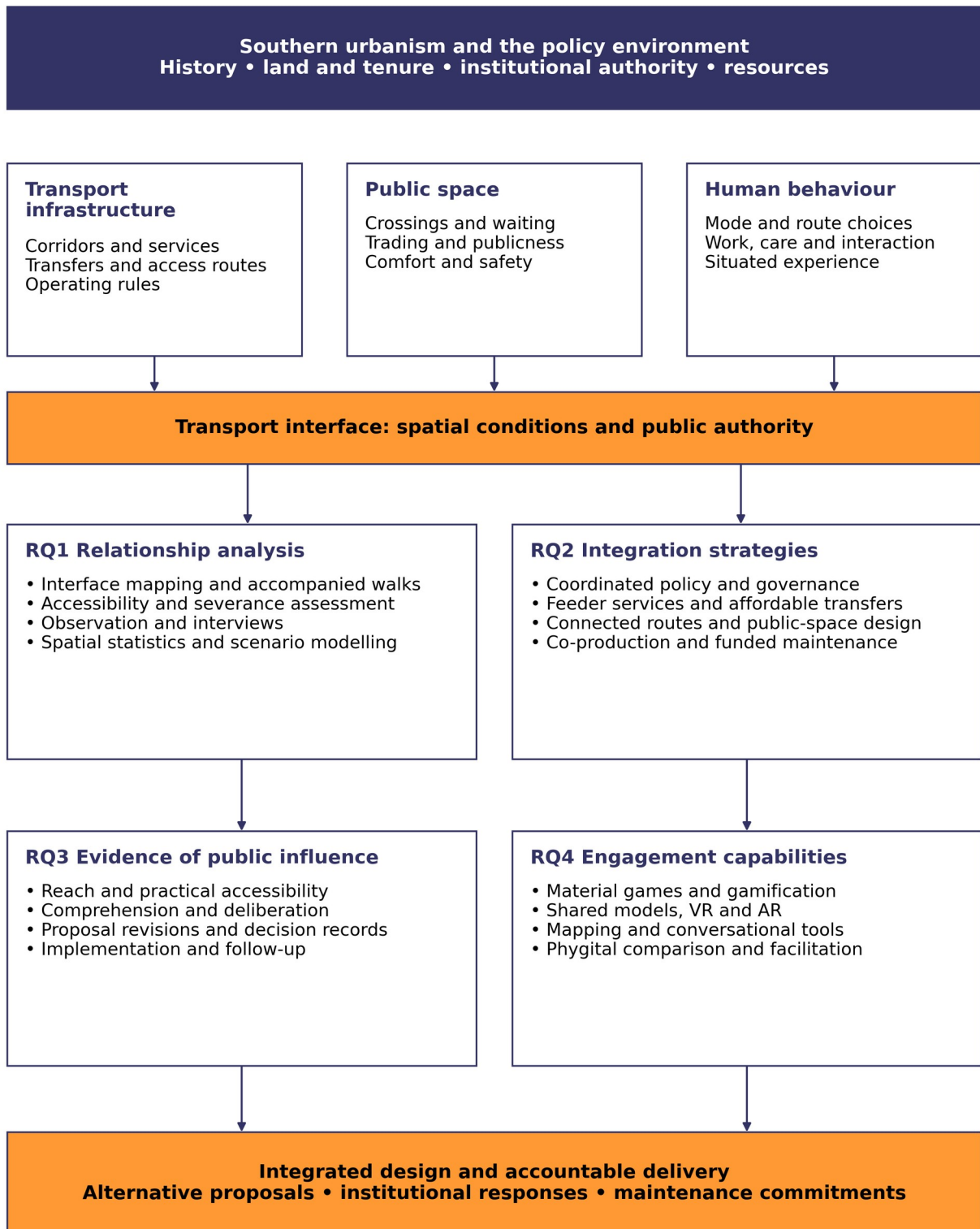


Figure 7. Proposed components of a toolkit for designing integrated transportation infrastructure and public-space systems considering human behaviour. Bold headings identify the principal analytical components; bullets identify methods and evidence assembled from the literature. The framework connects spatial conditions and public authority through RQ1–RQ4. Author synthesis building on Yang *et al* (2019) and the scholarship discussed in Chapters 3–6.

7 Toolkit Design and Research Challenges Identified

7.1 A multidisciplinary interface toolkit

Figure 7 connects four tasks: diagnose the connected journey and valued activities; develop spatial, operational and institutional alternatives; define evidence of influence; and select accessible engagement media. Each task produces a record usable in the next. Public contributions can change the brief, introduce alternatives or require a different representation. The toolkit's output is a linked design-and-decision record through which everyday experience enters accountable implementation.

7.1.1 Integration methods

Spatial methods address footways, crossings, levels, shelter and livelihood provision. Operational methods address feeder connections, information, fares and loading agreements. Institutional methods specify ownership, maintenance, occupation rules and routes for contesting decisions. Selecting these components together makes explicit which authority can deliver each part of an integrated proposal.

7.1.2 Analysis methods

Figure 8 connects literature synthesis, reported empirical evidence and modelling. Explicit selection and appraisal strengthen the link between questions and evidence (Petticrew and Roberts, 2006). Journey traces, observations, interviews and decision records explain conditions and practices. Conceptual and computational models describe processes and explore alternatives (Parker *et al*, 2003): network analysis examines continuity; discrete events represent queues; agent-based models examine differentiated choices; and environmental models compare exposure.

Method selection follows the question and intended decision. Mapping locates a discontinuity, accompanied accounts explain its significance, and scenario comparison explores interventions. Proposal versions and institutional responses then show how the evidence enters planning. This sequence connects analysis to deliberation and implementation.

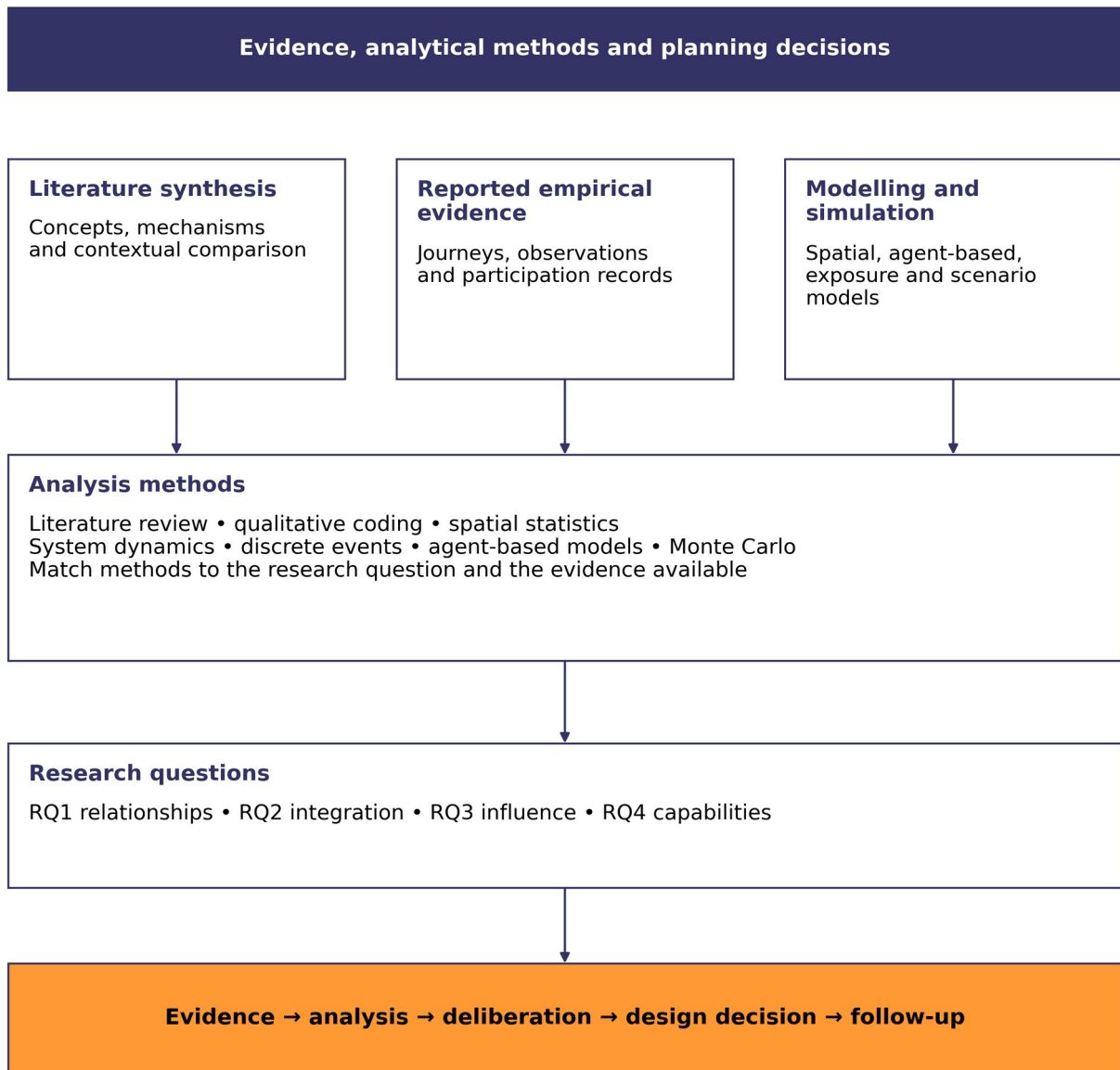


Figure 8. Analysis framework linking literature synthesis, reported empirical evidence and modelling methods to the four research questions, deliberation, design decisions and follow-up. Author synthesis.

7.1.3 Worked example from Indawo to a composite Cape Town interface

The example applies the toolkit to a composite station forecourt connecting a rail entrance, minibus-taxi loading, a walking route and street trading. It is an illustrative design application constructed from the article's interface relationships and Cape Town co-production scholarship (Ewing, 2021, 2025). The engagement precedent is VPUU's Indawo: a fictional-area learning game addressing integration, co-design and stakeholder perspectives (VPUU, 2021). The forecourt alternatives below are the authors' application of those principles; the source documents the game and its learning aims.

The assumed brief is to improve pedestrian continuity where loading, waiting and trading compete for the route to the station entrance. The initial problem definition, “clear the forecourt”, frames occupation as an obstruction. Applying RQ1 changes the diagnosis: movement depends on loading practices and the location of activities as well as clear width. A journey map records connections; an activity map distinguishes walking, boarding, resting and trading; a responsibility map identifies the station manager, municipal road

and public-space functions, operators and trader representatives. Together, these records redefine the task as maintaining a continuous route while supporting transfer and livelihood access.

For RQ2, compare two alternatives. Alternative A clears the forecourt and moves waiting and trading to its edge. Alternative B establishes a continuous walking strip, organises loading beside it, and locates shaded waiting and trading spaces along the connected route. A protects visible circulation but relocates activities and can lengthen transfers. B coordinates activities but depends on agreed loading and occupation rules. The toolkit therefore carries a cross-section and an operating agreement into deliberation together. The design question becomes how space and responsibilities can jointly sustain access.

For RQ4, an Indawo-informed material exercise assigns stakeholder roles and uses activity pieces to negotiate both alternatives. Participants can revise the brief and introduce another arrangement. A shared desktop model then translates the chosen layouts into views from the crossing, loading edge and station entrance. Optional VR examines sightlines and the experience of waiting beside moving vehicles; returning to the board allows concerns to change the arrangement. These are proposed steps in the worked application. Each medium serves a defined task, with paper annotation and facilitated discussion retained throughout.

For RQ3, consider the illustrative issue “the relocated waiting area separates passengers from boarding information”. The decision record links it to the affected layout, a proposed waiting-space revision, the operator's boarding arrangements and the authority responsible for approval. It records acceptance, modification or rejection with reasons and a follow-up commitment. A second issue concerning trading access receives its own response, preserving disagreement between claims. Evaluation can then compare understanding of the alternatives with actual revision, assigned responsibility and eventual delivery.

The demonstration yields three connected outputs: a revised spatial brief, alternatives with operating responsibilities, and an issue-to-decision record. Its analytical result is that selecting a forecourt arrangement also selects conditions of occupation and public authority. The toolkit makes that relationship explicit and gives practitioners a procedure for negotiating it. Empirical application would establish which alternative local users favour and how institutions implement the resulting commitments.

7.2 Research Gaps Identified

The synthesis identifies gaps in explaining relationships, coordinating integration and tracing engagement into outcomes in rapidly urbanising African cities.

7.2.1 Gaps in Scientific Knowledge of the Relationship between Transport, Spaces, and Humans

Network accessibility, severance and everyday practice remain distributed across separate literatures.

Following complete journeys across formal and informal modes would connect these accounts, including people who avoid an interface. Comparative research should examine how gender, disability, income and time shape usable access and rights to occupy space.

7.2.2 Gaps in Integration Strategies

Comparative work should trace responsibility for spaces between assets, maintenance funding and representation of operators and traders. These relationships explain how corridor investment becomes public-space continuity and livelihood security, and how arrangements adapt when services or occupation change.

7.2.3 Gaps in Evaluating Integrated Plans and Engagement

Participation records need stronger connections to proposal versions, approvals, delivered changes and follow-up accounts. Digital studies require consistent reporting of language, device access, attrition and facilitation. Linking those conditions to institutional response would clarify why similar workshop experiences produce different levels of influence.

7.3 Theoretical contribution

The framework conceptualises transport interfaces as socio-spatial arenas negotiating mobility, public-space use, livelihoods and authority. Its contribution is the connection between spatial conditions and the processes through which affected people shape their transformation. Southern urbanism makes everyday practices and institutional contestation constitutive of infrastructure.

Three propositions organise this connection. Access is produced through physical continuity, operating arrangements and authority over use. Public influence is traceable through changed problems, alternatives, decisions and implementation commitments. Digital and hybrid tools become consequential through accessible representation, facilitation and decision-making opportunities. The worked example demonstrates their interdependence: a route allocation changes occupation; an operating agreement sustains the arrangement; and a decision record exposes whose claims shape both.

This approach extends integration toolkits by asking whether affected people can influence the categories defining improvement. It extends technology-focused participation research by tracing engagement into material and operational change. The shared analytical unit is the relationship between a connected journey and the public responsibilities sustaining it.

7.4 Research priorities in rapidly urbanising African cities

Subsequent research can compare contrasting interfaces within one city before wider comparison. Selection should capture different transport arrangements, activities and exclusions, with decision-making institutions involved from the outset. Equivalent content across material games, desktop models and VR can clarify medium-specific contributions. Follow-up should trace revisions, approvals and delivery, interpreting differences through governance, language and transport organisation.

7.5 Using the Potential of New Forms of Public Engagement Tools

The extension of material games into digital environments offers a sequence of negotiation, spatial exploration and revision. The worked example identifies where immersive views could add information and where shared material discussion remains productive. Research should examine which concerns become visible at each transition, which alternatives emerge and how institutions respond. Preserving participants' reasons across media connects embodied experience with the evidence used in planning.

7.6 Scope of inference and framework development

Purposive selection, uneven full-text access and the emphasis on selected cities shape the synthesis.

Published demonstrations provide stronger evidence of immediate interaction than of durable institutional influence. The composite application demonstrates the toolkit's procedure and analytical contribution; field application is needed to assess implementation and outcomes. Comparative refinement should retain locally defined access needs, participation conditions and responsibilities for delivery.

8 Conclusion

The toolkit connects everyday access with public influence through situated diagnosis, alternatives, engagement, institutional response and follow-up. It explains transport interfaces as negotiated relationships among spatial form, operations, livelihoods and authority. This Southern urbanism perspective makes those relationships central to integrated design in rapidly urbanising African cities.

Across the four research questions, the synthesis identifies mechanisms of differentiated access, combined integration strategies, evidence linking contributions to decisions, and conditions under which engagement tools support that process. The composite Cape Town example demonstrates how a spatial conflict becomes a revised brief, coordinated alternatives and an accountable decision record.

For practitioners, the contribution is a method for carrying public claims through design and delivery. For research, it provides propositions for comparing how institutions and engagement media shape interface transformation. Digital and hybrid experimentation becomes useful when connected to the material conditions and public responsibilities through which access is sustained.

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