Counter-Geometries
An Alternative Urban Lens to Address Congestion-Driven Singularities in Tirana

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Abstract - *The urban trajectory of Tirana speaks of a city both devouring and displacing itself in one entangled spiral of congestion, collision, and centrifugal growth. At its center, the mobility system is driven and affected by a set of triple singularities: geometric, economic, and cultural nexuses; magnetizing the lifeblood of the city, asphyxiated by the centralized pressures of its gravitational pull. A network of infrastructure and roads radiating from it ought to have the effect of diffusing such pressures. Collapsing inward, it amplifies systemic congestion and spatial inequities. This research proposes a methodological framework that constructs and maps counter-geometries as an alternative potential to reading and formalizing decentralized latent centralities. Rather than extending the city outward in straight lines, this approach reads its growth as a new interdependent recursive model. The research employs hybrid computational models and spatial analytics to develop the design of one such illustrative prototype, demonstrating its scalability across the north-west peripheries of Tirana. The circularities, both geometric and infrastructural, shift from abstraction into form, materializing as a matrix of systemic equilibrium by acknowledging the current asymmetries deriving from informal developments throughout the last three decades of transition. The paper concludes by arguing that these emerging methods offer a pragmatic potential, articulating as a visionary framework far beyond normative planning logic, ultimately recasting single-core congestion into an archipelago of flexible circulatory zones.*

Keywords - *Counter-Geometry, Latent Circles, Decentralized Polycentric Networks, Beyond-Parametricism, Urban Structure.*

Introduction

The spatial morphology of Tirana reveals a topological condition wherein centripetal-ity perpetuates both economic intensity and mobility. Rooted in a radial order, the city's form has hardened into an over-coded diagram of convergence, where every arterial road folds inward towards the congested nucleus (Figure 1). This geometric insistence has rendered Tirana a living paradox: a city expanding in scale and density, yet collapsing in mobility.

As Alexander (1965) and Batty & Longley (1994) have argued in broader urban contexts, such centralization might transform into a morphological trap, a recursive feedback loop where access generates overload and overload breeds further centralization

Despite numerous investments, Tirana's major mobility networks remain dominated by such inward flows, reading its singularity as a triple-nexus: geometric, economic, and cultural; catalyzing congestion within the center (Dhamo, 2021; Pllumbi, 2013). This research started in late 2024, when the northern part of the Grand Ring of Tirana was still under construction (Figure 2-a). During 3 temporal frames (temporal frames: 6–9AM, 3–6PM, and 9–11PM), traffic data was observed daily along a 2 week period. Data was scrapped every 15 minutes across the temporal frames through Google Maps' API, getting color codes of live heatmaps at the Casa-Italia intersection point. The process of data scrapping was automated through AI agents running on n8n's cloud platform. A continuous temporal dataset was constructed. The dataset was post-processed and predicted across 24 hours per day, utilizing a stochastic simulation model for traffic analysis (Gaussian noise micro-fluctuations method) (Figure 3-a). The volume metric shown in the graphs (Figure 3), defined as the Congestion Index (CI), is the numerical remap of traffic heatmap density color on map/entry point (%) against the theoretical maximum throughput of the road segment (CI = 100%). Also informed by on-site surveys and local reports, it's clear that the daily mobility load far exceeds its infrastructural

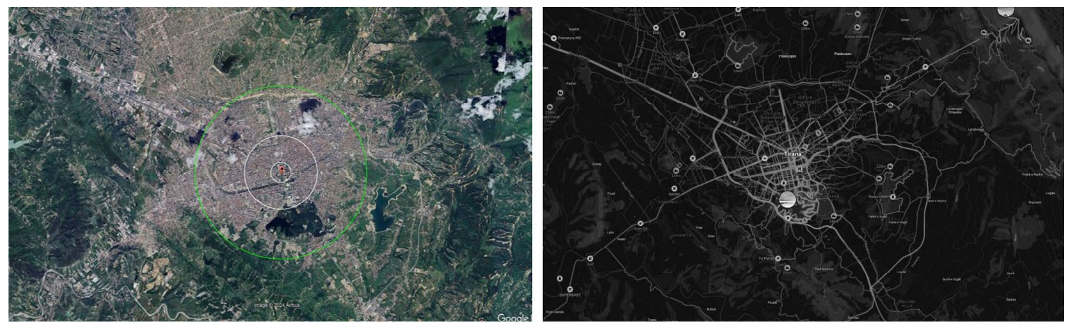


Fig 1 / (a) Left / radial order of Tirana, on top of orthographic capture, retrieved from Google Earth, 2024; (b) Right / mobility heatmap for Tirana, retrieved from Strava, 2024

Fig 2 / (a) Capture of Tirana live-traffic on map, h-15.00, congestion (grey</white>), retrieved from Google Maps on November 20, 2024; (b) Capture of Tirana live-traffic on map, h-15.00, congestion (grey</white>), retrieved from Google Maps on November 20, 2025.

capacities (Figure 3).

Driving into the city, talking to locals and in-situ observations suggest that the average driving speed of a car from point A to point B (Figure 4), would be 5-7 km/h, resulting in trips longer than 1.5h for distances of around 10 kilometers. In parallel, people who work and move daily toward the industrial area along Tirana-Durres highway (which is reported as the most congested one) prefer to undertake 25-kilometer distance loops to avoid 5-kilometer direct routes due to automobilistic congestion; not in pursuit of lower consumption, but in time-saving options and stability of daily driving experience. After the new Grand Ring officially opened in early 2025, congestion patterns still persist (Figure 2-b). Pressuring points in every exit of the ring during daily peak-hours suggest inadequate planning or integration of such a network (Figure 2-b). This phenomenon, where informal navigational behavior precedes mobility planning, serves as the empirical cornerstone for this inquiry.

Against this background, a framework of counter-geometries is introduced: a conceptual and computational apparatus which identifies and formalizes the peripheral latencies already embedded in Tirana's ad-hoc mobility networks. This research argues that these are not imaginary latencies, but emergent infrastructural needs, which

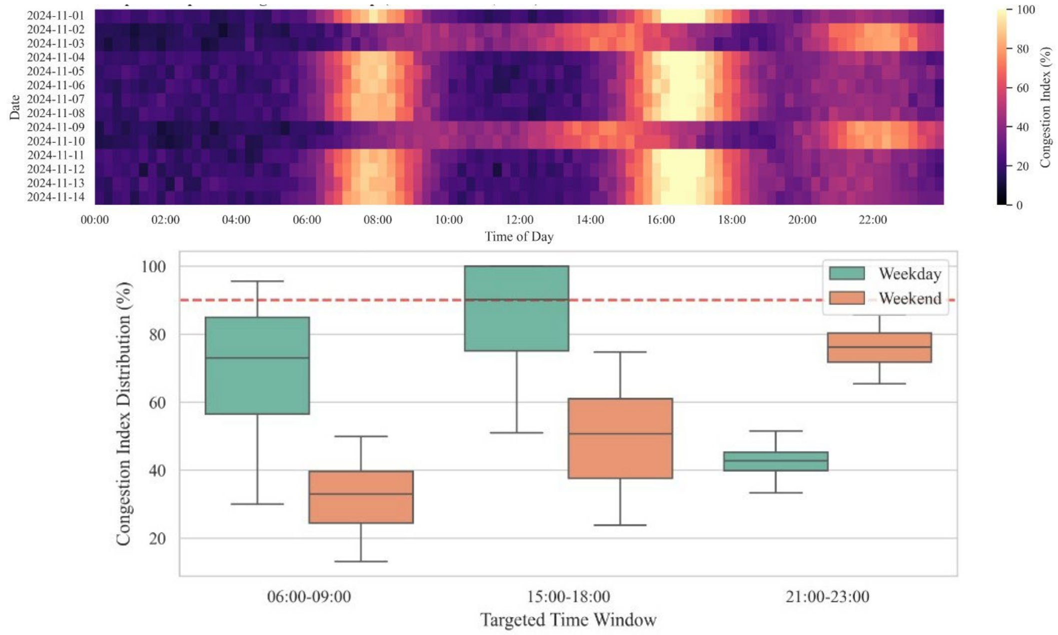


Fig 3 / (a) UP / Spatiotemporal heatmap of traffic congestion, mapped hourly across 14 days (from November 01-14, 2024) through the Congestion Index (%). Monitoring point: Casa-Italia / Hygeia intersection point, entering Tirana-Durres Highway; (b) DOWN / Congestion Index Distribution (%) mapped via targeted time windows graph (weekends/daily); Source: processed (py3) by Joni Zguro, 2025.

Fig 4 / Showing routing scenarios from point A to point B + relevant cong. points.

hold an alternative potential in resolving congestion patterns. By shifting from a radial bias toward a semi-lattice re-configuration, the framework aims to decentralize flows, not city centers alone, redistributing socio-spatial access, and challenge the dominance of the monocentric gridlock.

Literature review

Central Place Theory; Decoupling Geometrical and Urban Centers

The theoretical distinction between geometrical centers and urban centers has its roots in classical and post-classical urban theories dating since the early 30'. Figure 5, visualizes such differences. While traditional urban planning often equated the geometrical center with the urban core, contemporary urban theories recognize the emergence of multiple urban centers disassociated from strict geometric centrality.

The notion of a geometrical center, a point minimizing average distance to surrounding locations, finds its most rigorous formulation in the work of Walter Christaller (1933). In his Central Place Theory, Christaller conceptualized cities as hierarchical networks of central places organized in hexagonal spatial patterns to optimize service distribution relative to population thresholds and ranges (Christaller, 1933/1966). The geometrical

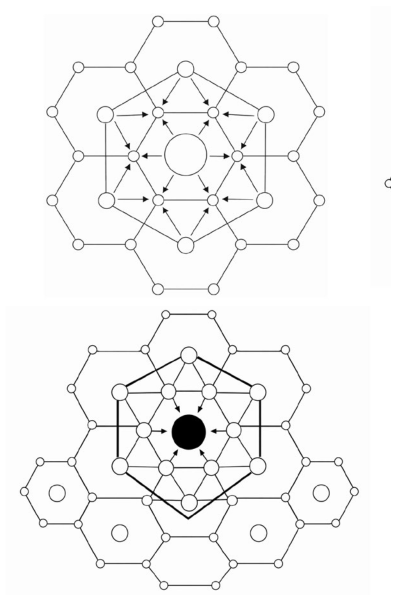


Fig 5 / (a) Left / urban center coincides with the geometrical center of the system; (b) Right / urban center is not the geometrical center of the system. Source: Author's understanding of the Central Place Theory (as per Christaller, 1933) simplified diagrams.

center, in this framework, functions as the pivot of an idealized service region, aiming to minimize transport costs and maximize accessibility. (Figure 5-a). However, the simplification inherent in Christaller's model which assumes isotropic and uniform population distribution, has been extensively critiqued. Empirical urban systems reveal deviations where geometric centers and lived urban centers no longer coincide, undermined by topography, socio-economic gradients, and infrastructural constraints (Parr, 2002; Fujita, Krugman, & Mori, 1999).

Asymmetric Centralities

Building upon and complicating Christaller's

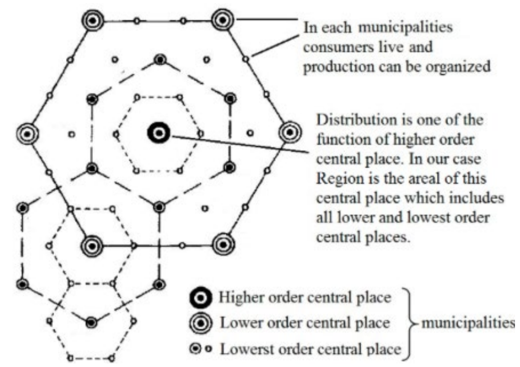


Fig 6 / Hierarchy of central place. Note. Adapted from Figure 3 in Spatial Patterns of Production - Distribution - Consumption Cycle: The Specifics of Developing Russia, by V. Timiryanova et. al, 2020, Economies, 8(4), Article 87.

legacy, Leslie J. King (1984) proposed a more dynamic understanding of urban centers as socio-economic condensations, irrespective of geometric positioning. According to King, an urban center is not merely defined by its physical centrality but by its economic, social, and cultural functions: commerce, governance, symbolic production, and institutional concentration. These centers differ from rural ones by exhibiting diversified hierarchical structures, higher levels of non-subsistence activities, and more intricate socio-spatial organizations. Urban centers, as King frames them, may multiply and shift over time, responding to evolving patterns of infrastructural investments, and demographic trends. Thus, the contemporary urban condition often displays multiple, decentralized centers, diverging sharply from the geometric purism of traditional models, which shall be differently mapped, understood and analyzed through various simulations in both space and time.

Central Place Functions & Pulling Power

Further expanding this conceptual lineage, Mark Jefferson's early insight that: "cities did not grow on their own; it is the countryside that brings them into existence" (Jefferson, 1931) introduces a relational understanding of urban growth. Urban centers were the result of functional needs of hinterlands, performing central place functions that provided goods and services to surrounding rural areas (Berry & Garrison, 1958) (Figure 7-a). Almost a century ago, Tirana also emerged from such an accretion, where locals coming from all directions started moving across routes which intersected in the later-coming bazaar, near the historical Et'hem Beu Mosque (Figure 7-b). These functions were scaled according to: (1) threshold populations - the minimum population necessary to sustain a given service; and (2) range - the maximum distance consumers are willing to travel (an organic accretion which later started formalizing and quantifying). This relational dynamic gives rise to the pulling power; which shall be understood as the capacity of an urban center to attract populations, capital, and services from its surroundings. Pulling power is not only a function of distance but also of functional richness; the more diverse and specialized the services an urban center provides, the greater its gravitational influence (Parr, 2002).

Monocentric & Polycentric Paradigms

To speak of a purely monocentric city today is, perhaps, to speak in a language whose syllables are inherited from another epoch; one that still idealizes the centrality of the center. Historically convenient, yes, but its clarity has, in many urban conditions, given way to congestion, to ritualized delays, to a choreographed inefficiency whose choreography remains rigidly tethered to a single gravitational basin (Bertaud, 2003; Gordon & Richardson, 1997). promise of centralization becomes its pathology. Peripheral populations, navigating through centripetal-ity, are taxed not only in time and travelling costs, but in spatial indignity; caught within geometries of inequity that grow denser with each rush hour (Batty, 2013). Polycentricity does not so much resolve this as it reframes the question. It is a dispersal, but not always a liberation. Cities like Atlanta or the diffuse logics of outer Paris provide partial testimony of redistributed congestion (Figure 9-b). But in post-transitional growing cities like Tirana, a risk persists: the one of centers that are centers in name alone, unmoored from meaningful institutional presence or mobility support (Reid et al., 2023; Bertaud, 2003). And in cities undergoing that particular fever-dream of post-socialist or post-colonial transformation, the idea of the polycentric becomes precariously ornamental. Without synchronized land-use regimes and infrastructural intelligence, the city will be alienated from the metabolic realities of its urban life (Neto et al., 2025).

Network Theory & Complexity Sciences

The city, in fact, should be understood as a terrain of entanglements, where what emerges is rarely what was predicted (Mitchel, 2009). It listens poorly to commands. It adapts, folds, resists, reshapes.

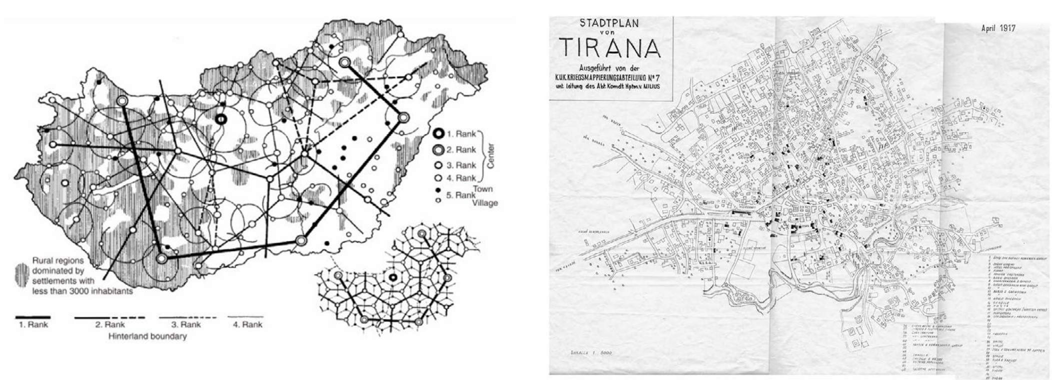
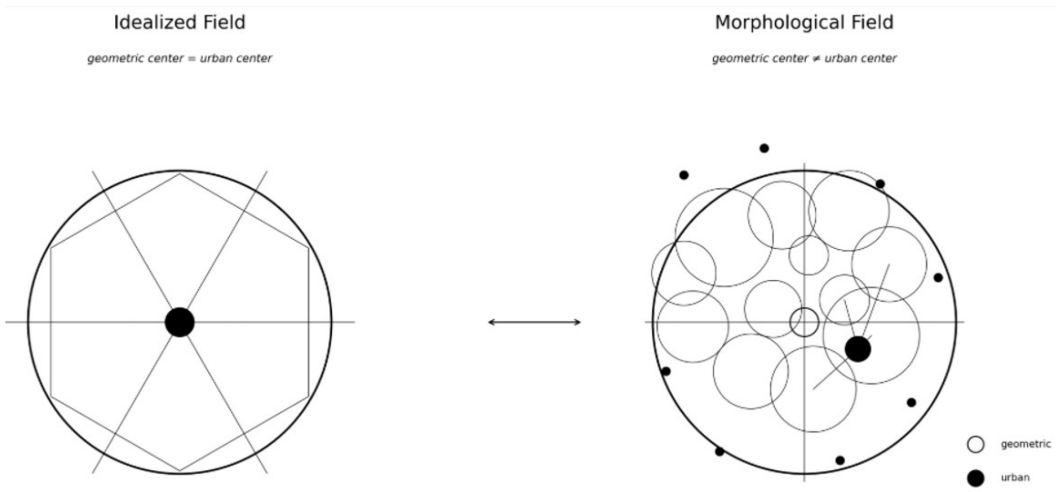


Fig 7 / (a) LEFT / The hierarchical order of the urban network in Hungary. Note. Reproduced from A magyar városhálózatról [On the Hungarian urban network] (p. 57), by J. Major, 1964, Településtudományi Közlemények, 16, 32–65; (b) RIGHT / Tirana large scale old map - 1917 / city of Tirana, Albania.



Within this framing, the conventional masterplan, particularly the one shaped through strict hierarchy, a tree diagram with limbs thinning as they branch, is not only outdated; it is epistemologically incompatible with how cities evolve. Alexander (1965), decades prior to the digital turn, named this limitation with remarkable precision: urban life does not obey the logic of separation. Instead, it functions through the overlapping of zones that are neither fully discrete nor wholly united, but entangled. He called this condition a semi-lattice, a structure more akin to a living nervous system.

From this, one might pivot to networks as operational frames. The radial form, visually compelling as it is, centralizes power and pressure. At its center: bottleneck. A known vulnerability. The metric of betweenness, as outlined by Batty and Longley (1994), becomes more than mathematical. Congestion is not incidental in such configurations; it is pre-encoded in its form. What follows, then, is a rethinking toward webs, toward topologies that interlace, that blur periphery and core, that allow movement to find alternate paths. In this landscape, the notion of counter-geometries arises not as a stylistic inversion but as a systemic recalibration. Tangents take precedence over radials. Peripheral loops become vital circulatory routes. It is, in many ways, a spatial version of the shift from central-server computation to decentralized swarm logic. The gain is not just about redundancy, but resilience; and the possibility of autonomous fragments, spatial units, to reduce codependence from the main urban center.

Precedents of Decentralized Rings

If circular infrastructure has long been heralded as a theoretical antidote to the centripetal stress of radial urbanism, its real-world instantiations suggest a messier ledger. Let's take Beijing, a layered city in which concentric rings appear to be an infrastructural palimpsest (Figure 8). The form, at first glance, promises dispersal, a spatial release valve; but its condition, steeped in automobility, trades one pathology for another. Congestion is diffused horizontally, yet re-entrenched in spatial inequity (Gao & Kenworthy, 2017). London's M25 tells a subtler story. Its efficacy is conditional, in a sense. Where orbital arcs intersect with density and inter-modality, new centers flicker into being (Reid et al., 2023) (Figure 9-a). Paris, on the other hand, activates spider-web topologies, expanding its overall infrastructural level towards a more inclusive spatial access and function distribution (Figure 9-b). But this emergence is both a function of geometry and governance. What rings achieve, in fact, depends not merely on their curvature but on how they embed within land-use, transport diversity, and institutional foresight. And then, there is Tirana. Here, the issue is neither over-integration nor systemic overreach, but rather a chronic spatial disarticulation (Figure 1-b). Since the postwar period, the idea of rings has recurred, resurfaced, faded, proposed in plans, memorialized in political slogans, partially built, then abandoned or rerouted by shifting agendas (Aliaj et al., 2010). The opening of "Unaza e Madhe" (Grand Ring) was a step forward in resolving mobility issues; aspirational, yet uneven, tracing a loop whose coherence is undermined by the deeper gravitational pull of the centralized triple singularities (Figure 2). What's needed, then, is not another major bypass, but a re-reading of what is already there: latent geometries, informal flows, emergent patterns of movement. In this context, counter-geometries are not fantasies of planning speculation, but behaviors mapped spatially through subversive logics that evade the common-sense, yet insist on legibility. They demand to be theorized and excavated; formalized, and then, carefully activated.

Fig 8 / Beijing urban sprawl and mobility ring roads. Source: The Economist

Urban Futures Beyond Static Paradigms

They demand to be The shift from static masterplan-ing toward dynamic, speculative urbanism has gained increasing traction in contemporary urban theory. Scholars such as Bishop and Williams (2012) argue for an "urbanism of possibility," where cities are understood not as fixed forms but as evolving fields of emergent potentials. Similarly, resilient planning frameworks (Ahern, 2011; Meerow et al., 2016) advocate for urban systems designed to absorb shocks, adapt over time, and reorganize in the face of systemic disruptions. These discourses converge with complexity-informed urbanism (Batty, 2013), proposing that successful urban configurations must embrace indeterminacy rather than suppress it. Within this lineage, the concept of counter-geometries introduced here aligns closely in reframing urban planning as the management of fluctuating territorial fields, not the inscription of permanent boundaries (Cache, 1995). The integration of wave-based simulations and predictive field morphologies extends speculative

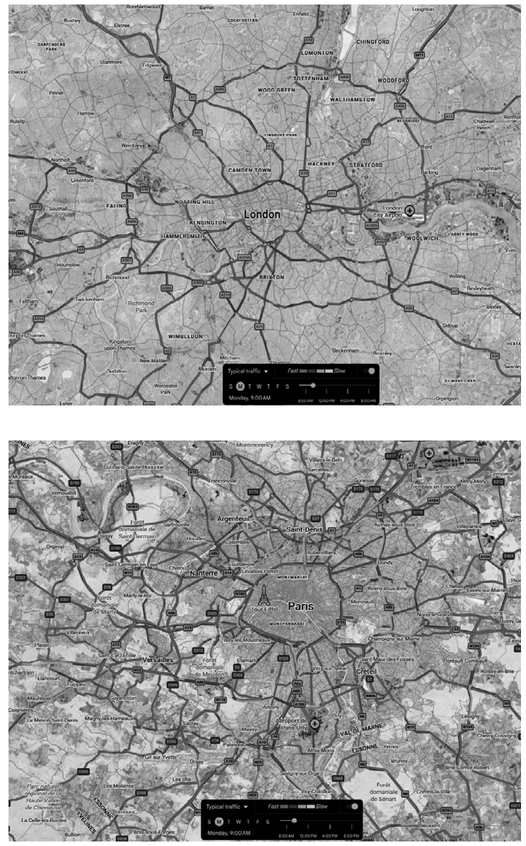


Fig 9 / (a) UP / London map with its typical traffic at 9AM. Retrieved from Google Maps November 2025. (b) DOWN / Paris map with its typical traffic at 9AM. Retrieved from Google Maps November 2025.

and resilient paradigms into computational and actionable methodologies, offering new tools for navigating the unpredictable materializations of urban futures (Lynn, 1999).

THEORETICAL UNDERPINNINGS

Defining "Counter-Geometries"

The term counter-geometries, as developed in this paper, does not propose the erasure of the radial, but its strategic subversion in both scale and ontology. It designates a spatial logic that acknowledges the inevitability of centripetal urbanism while simultaneously constructing a set of infrastructural tactics to undermine its dominance. In contrast to additive planning interventions, counter-geometries are conceived here as both methodological apparatus and morphological critique. They offer not a diagram, but a generative principle: to read the city not through what we see, but through how it is navigated, skirted, and circumvented in practice. The concept emerges from a paranoid understanding and territorial mapping of Tirana citizens' tactics. While formal plans remain fixated on the centrality of Skanderbeg Square and its radial tributaries, the lived city has already begun to trace informal potential solutions at the periphery. These are not designed forms but infrastructural residues of adaptive behavior, seeking mobility not through the center, but around alternative centralities. They should be understood as circles of necessity, formed through repetitive deviations or loops, which are often inscribed in opposition to the formal diagram. Here, the semi-lattice logic of Alexander (1965) becomes foundational. While modernist urbanism favored the hierarchical tree-structure, the adoption of the semi-lattice permits intersection, contradiction, and overlap; it mirrors the city's lived condition more accurately than the radial ideal. Likewise, Mitchell's (2009) complexity theory reminds us that cities adapt not through command, but through constraint, feedback, and re-routing. Counter-geometry, in this sense, is an act of epistemic recognition of what already pulses at the edge.

Methodology

The methodological corpus is constructed as a stratified system for detecting & projecting peripheral urban latencies. The methodology operates across four interrelated strata, each building upon the previous one, as follows:

Stratum One: Behavioral Geometries and Territorial Mapping

This first stratum employs an ethnographic diagram, mapping how everyday mobility behavior inscribes latent territorial geometries that both expose infrastructural inadequacies and suggest alternative logics of urban connectivity networks (Figure 10). In parallel, Urban Structural Units (from now on will be referred to as USU) are retrieved as geojson., alongside corresponding centroids, to help better understand Tirana's morphogenetic relations (Figure 11). Special attention was dedicated to transition zones that have not yet been officially incorporated into the metropolitan plan but are already yielding counter-radial mobility logics. These are areas such as Kamza, Yzberisht, Farka, Tufina, etc. A final territorial mapping which closes circular tendencies is proposed for infrastructural consolidation (Figure 10-b).

Stratum Two: Voronoi Tessellation as Morphogenetic Reading of USUs

The second stratum operationalizes Voronoi tessellation as a morphogenetic lens for reading gravitational tensions within the spatiality of the existing urban field. Formal and emergent sub-centers were internalized in a parametric environment (Rhino 7 + Grasshopper) to generate the initial Voronoi diagram. The resulting Voronoi's cell centroids are later used as inputs for recurring the Voronoi tessellation on the new displaced position of the centroids themselves. This recursion is computed for 4 sequential times, creating the vectors and rendering their energy levels through spread densities (Figure 12). The more the gravitational pull centers coincide with their own USU's geometrical centers, the more consolidated the USU is, and more congestion is expected. It demonstrates how infrastructural injustices relate to potential new urban centralities. Through these iterations, centroid drift patterns were revealed, mapping not only the inertia of existing systems, but also the gravitational aspirations of the city's latent forces. This process challenges the Cartesian fixity of urban nodality, proposing instead a fluid ontology for urban attractors, understood as a collective swarm-like intelligence for reading dependencies and potentials. The longer the vector displacement, the higher the probability to be a future pressure point; and as a consequence, it needs to be addressed by near-serving network potentials.

Stratum Three: Field-Based Simulations & Urban Flow Morphology

Moving beyond simple node-to-node simulations, this stratum introduces the field-based approach on urban morphology, treating the metropolitan region not as a collection of discrete artifacts, but as continuously differentiated energetic channels. Based on the recalibrated Voronoi frameworks and the empirical displacement patterns, a spatial field was generated where localized attractors (sub-centers) and repulsors (congested core zones) shape a dynamic, non-linear landscape of movement and influence.

In the constructed model, each emergent sub-center operates as a localized positive field emitter, generating a gravitational basin whose intensity is proportionate to its demographic and infrastructural potential (Figure 13). Conversely, zones of chronic congestion, particularly within the historical core, are modeled as negative field nodes, generating centrifugal repulsive forces that displace mobility outward along gradient vectors. (overlay, Figure 14)

A nodal expansion model can be visualized when new centralities redirect and distribute current centralization of triple singularities. The model serves as a detailed and rich visualization of the city through the lens of digital-density-drawing (ddd), assuming their correspondence with the triple singularities which we introduced in the beginning (Figure 15).

The superimposed interaction of these simulated fields produced a complex morphology of stabilized flow corridors (illustrated through dynamic vectors), scalar orbital formations (interlinked rings of influence), and threshold fields (densification

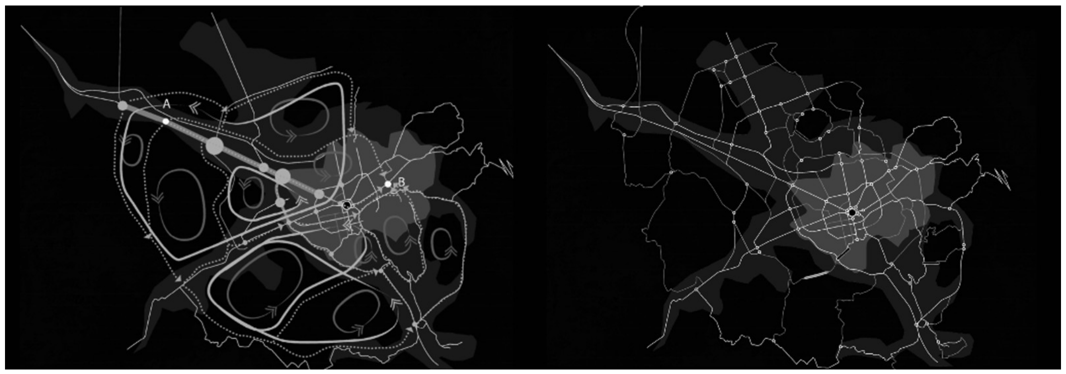


Fig 10 / Ethnographic reading of mobility behavior. These traces were subjected to a reading as if they were city annotations; instructions of resident logic overlaid upon infrastructural inadequacy. (a) LEFT / Diagram of mobility behavior; (b) RIGHT / connectivity routes - proposal.

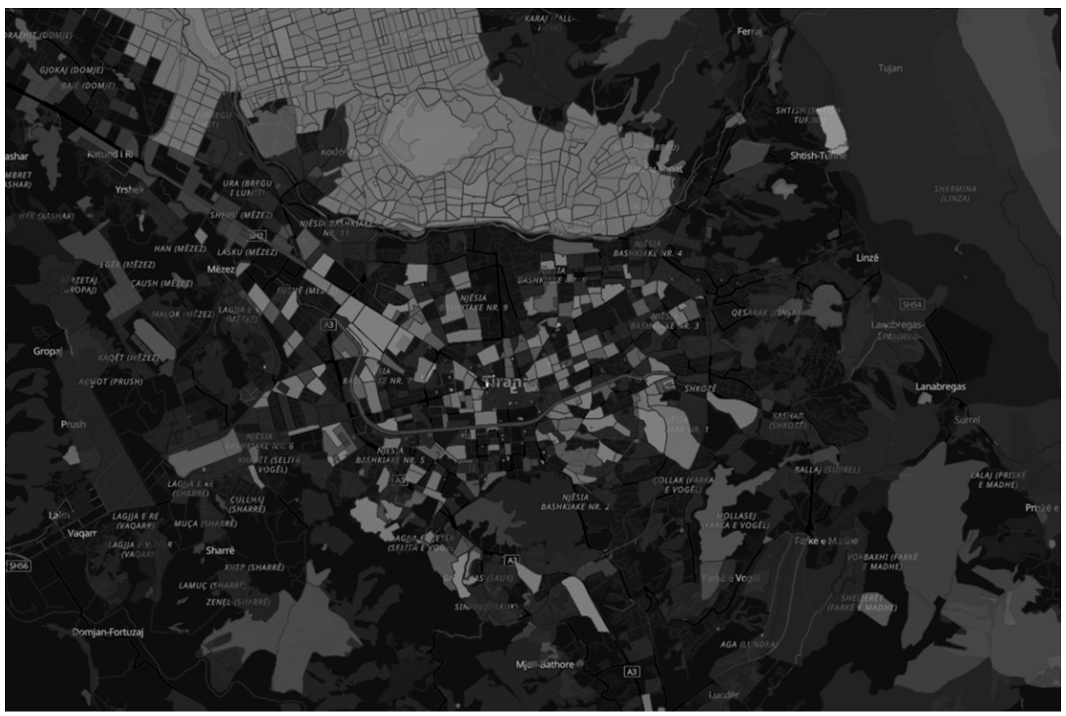


Fig 11 / Tirana map. Overlay of (Urban Structural Units); retrieved from AKPT through API.

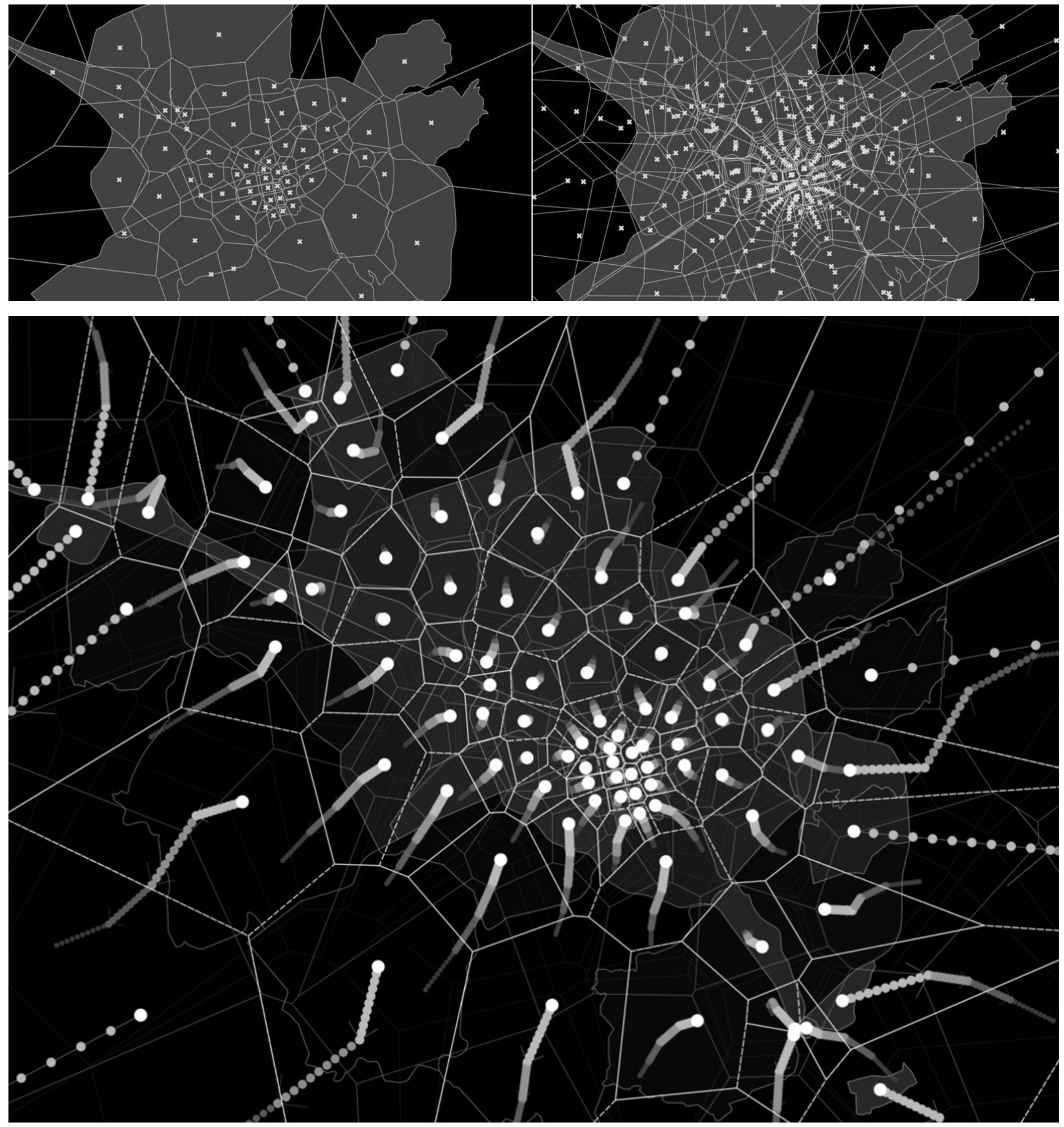


Fig 12 / Voronoi Tessellation Recursion (4 steps) & Entropy Vectors from USUs' Centroids.

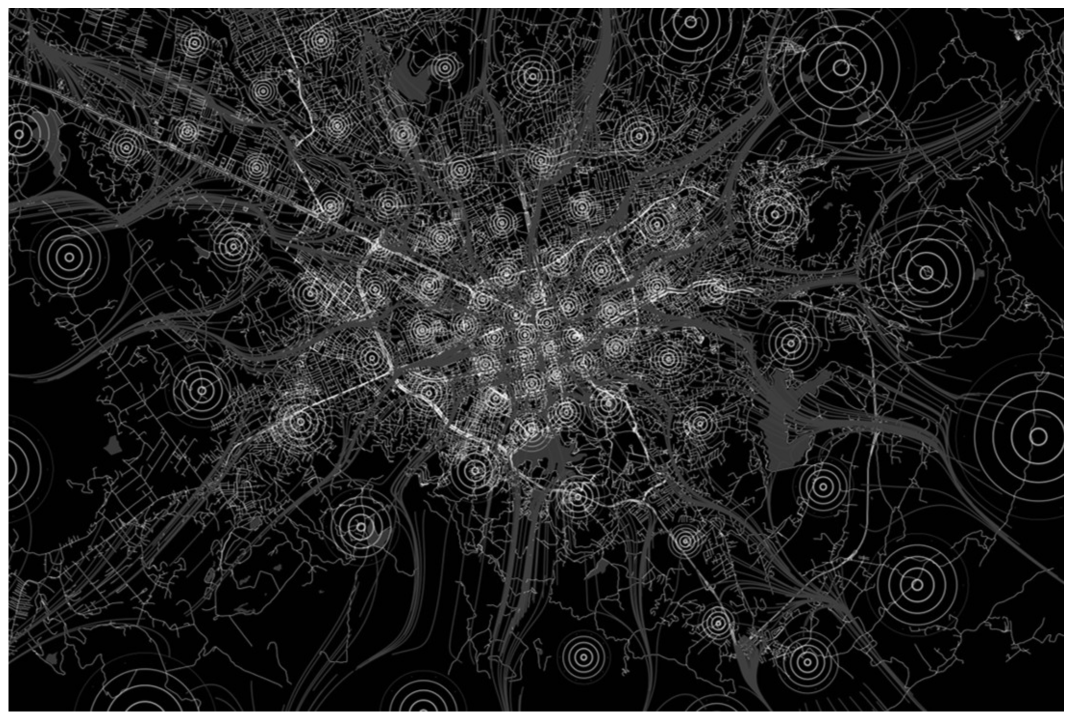


Fig 13 / Repulsive weighted centralities (-) / Also referred to as Scenario A.

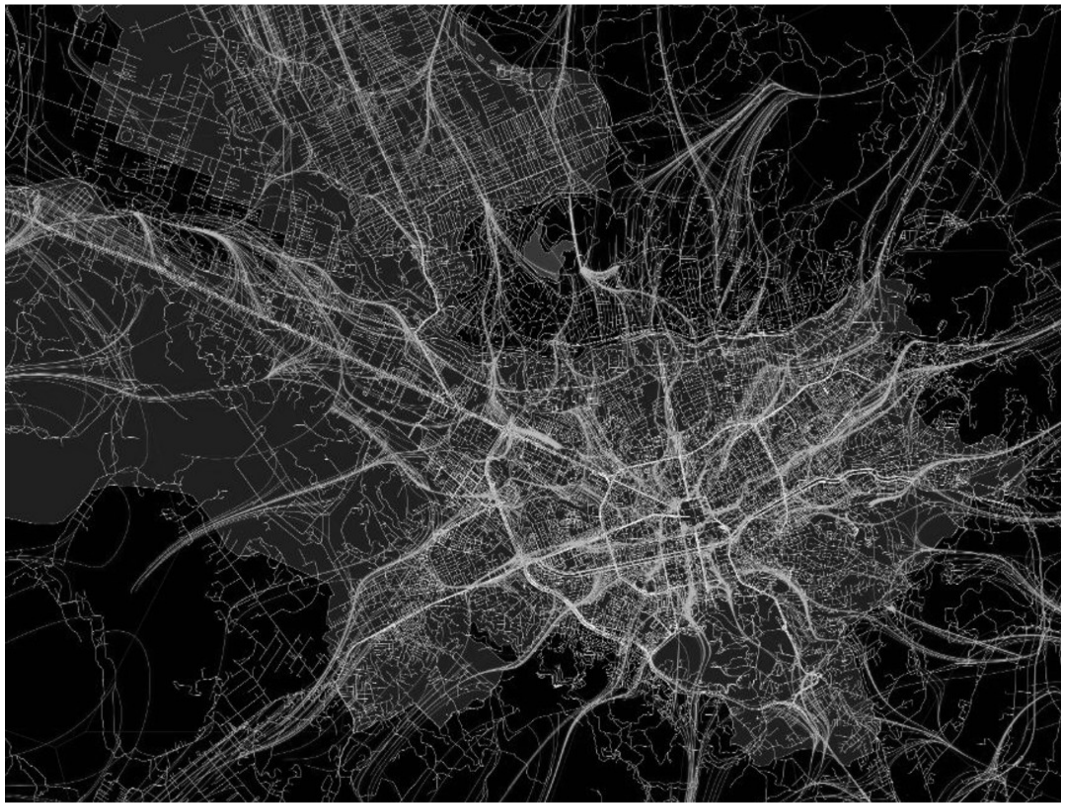


Fig 14 / Field Activization // Overimposed Attractors (+) / also referred to as Scenario B. Source: Fulvio Papadhopulli

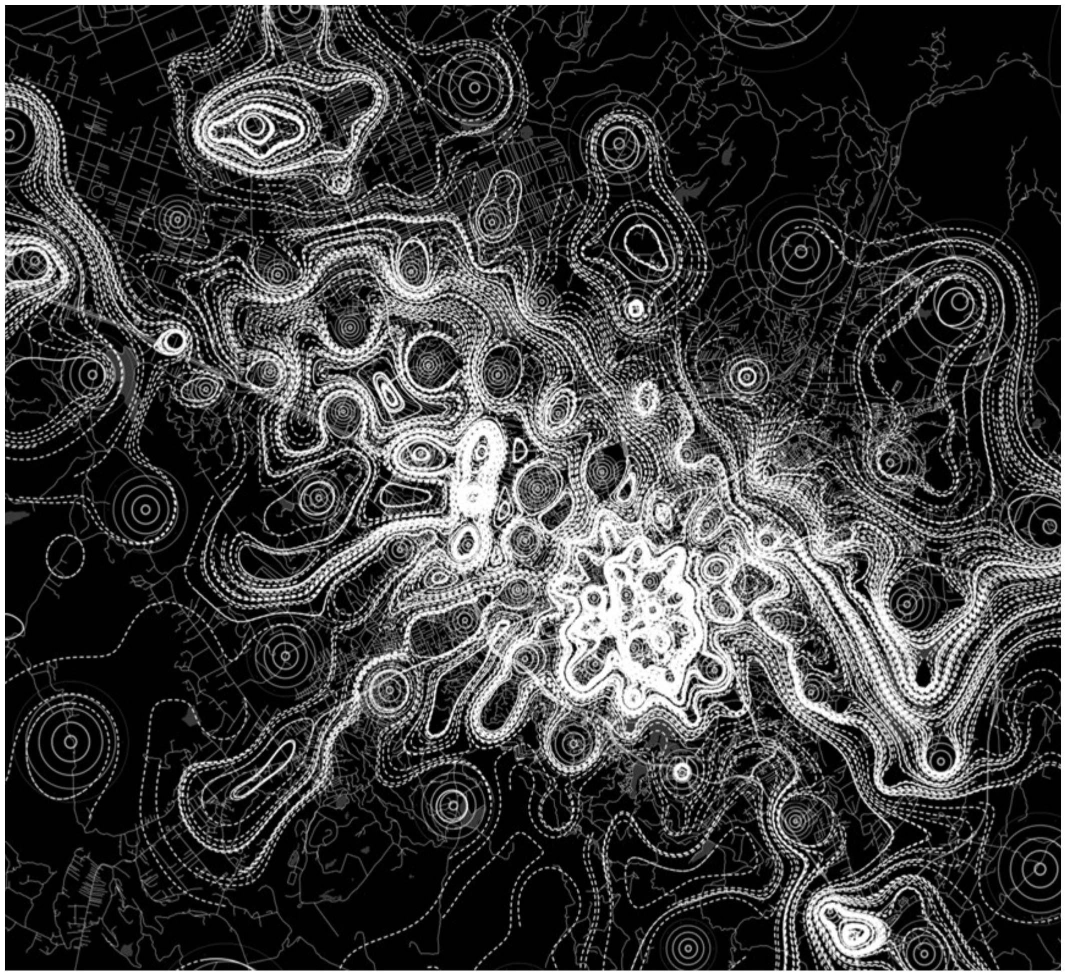


Fig 15 / Field Activization // Overimposed Attractors (+) / also referred to as Scenario B. Source: Fulvio Papadhopulli

zones delineated by gradient shifts) (Figure 16). The diagrams reveal how Tirana's latent urban forces configure themselves into a new structure of patterns and flows; channeling energy into emergent peripheries, hinting nested circulation rings, and articulating differentiated zones of consolidation and expansion through different density lines.

Critical computational metrics include:

-Field Intensity Isolines: Mapping zones of highest attraction-repulsion gradients. (Figure 16. Black Isocurves)

-Stabilization Paths: Vectorial routes where energetic flows consistently converge, suggesting optimal corridors for infrastructural alignment. (Figure 16. Cyan Isocurves)

-Field Overlap Density: Measuring the resilience of orbital formations through the redundancy of converging flow fields. (Figure 16)

Rather than imposing linear solutions, the field simulation exposes the self-organizing tendencies inherent in Tirana's urban metabolism, illuminating where counter-geometrical interventions could be synchronized with the city's formalized spatial dynamics.

Stratum Four: Urbs

The final layer of the methodological framework shifts from reading forces to strategically projecting their architectural consequences. Rather than forecasting through simulation, it operates through deduction: extrapolating from the energetic diagrams where attraction and repulsion fields expose the city's own tendencies toward alternative spatial organizations. The composite field (Figure 17) maps a terrain of functional dependencies and certain vacuum zones. Within this framework, they are visualized as heatmap fields, suggesting where and how to predict the city growth through an urbs model, as ontologically introduced by Ildefons Cerda. By proposing a formally divergent masterplan design emerging from field decoherence, the counter geometries affect and activate both artifacts and mobility networks, pushing the city towards new kinds of peri-urban formalization and growth strategy.
(Figure 18)

Results

Scenario A, entails minimal and more short-term strategic insights about adjustments to the existing conditions. Repulsive forces continue to dictate expansion; peripheral attractors remain weak, often disconnected, and radial dispersal persists along primary infrastructural axes. Orbital articulations surface sporadically but fail to cohere into a supporting network. The gravitational imbalance seems to consolidate congestion at the core, offering little systemic release. (Figure 13)

Scenario B visualized potential activations of the latent networks, empowering existing mobility patterns. Emerging attractor basins are selectively reinforced, and infrastructural stitching along tangential corridors redirects centrifugal pressures into semi-structured orbital flows. This move dilutes the dominance of the historical center, allowing sub-centers to share the systemic load. A semi-polycentric pattern takes shape by redistribution, opening a differentiated urban order where peripheral nodes begin acting as gravitational anchors. (Figure 14)

Finally, Scenario C enacts a full model synchronization. Gravitational basins interlink through nested orbital systems; centrifugal movements are absorbed into structured circulation loops. The former radial logic dissolves into a gradient field of differentiated centers, each calibrating territorial flows locally while contributing to a broader metropolitan equilibrium. Rather than a centrality, Tirana becomes a constellation of a new urbs model: self-sustaining polycentric metabolism shaped directly by its latent energetic order. (Figure 15)

Each drawing (ddd) does not propose an isolated understanding of reconfiguration; they sequentially inform the model from the city's own emergent behaviors. The methodology thus culminates by revealing that the counter-geometries necessary for resilience and distributive balance are not external strategies, but already embedded within the city's DNA; awaiting alignment, amplification, and articulation. (Figures 16, 17, 18)
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Discussion

Discussion of Findings

The results indicate that Tirana's congestion is not only a question of overloaded infrastructure, but a manifestation of a deeper spatial misalignment between the city's inherited monocentric organization and its increasingly dispersed patterns of movement, access, and everyday territorial dependence. What emerges from the three scenarios is not a simple alternative network, but a different urban reading: one in which peripheral attractors, tangential relations, and intermediate service nodes begin to operate as structurally relevant components of metropolitan organization rather than as secondary by-products of expansion. In this respect, the value of the proposed framework lies in making visible a layer of urban order that conventional radial planning models tend to suppress or misrecognize.

This has two implications. First, it suggests that Tirana should be interpreted less as a city with one dominant center and more as a transitional urban field in which centrality is multiple, uneven, and behaviorally produced. Second, it repositions masterplanning from a practice of formal prescription toward a practice of strategic calibration, where the task is not to impose a definitive geometry but to identify where decentralized intensities are already forming and how they might be spatially reinforced. Within this logic, the scenarios are not final solutions; they function as analytical projections that clarify how redistribution may occur when circulation is reorganized beyond the gravitational pull of the historic core.

Methodologically, the study also demonstrates the relevance of combining ethnographic observation with computational abstraction. The recursive Voronoi operations and field-based simulations gain value precisely because they are not detached formal exercises; they are grounded in observed mobility frictions, territorial asymmetries, and the informal circumventions through which the city already reveals its latent structure. The discussion therefore supports a broader methodological claim: in rapidly transforming metropolitan contexts, urban analysis becomes more robust when empirical behavior, spatial deduction, and scenario-based computation are treated as mutually reinforcing modes of inquiry rather than separate domains of knowledge.

Limitations

This study should be interpreted within the limits of its evidentiary and predictive scope. Although the simulations are informed by observed congestion patterns, territorial mapping, and deductive spatial modeling, they have not yet been validated through longitudinal mobility datasets, real-time GPS traces, or post-implementation assessment. In addition, the framework does not fully model the temporal instability of infrastructure delivery, including political delay, funding discontinuity, or shifting socio-environmental conditions. The proposed scenarios should therefore be read as analytically grounded projections rather than deterministic forecasts.

Future Research

Further research should extend the framework through longitudinal urban telemetry, including GPS-based mobility traces, traffic sensor data, and service-access datasets capable of testing whether the latent centralities identified here persist, intensify, or dissolve over time. A second line of inquiry should involve agent-based and scenario-sensitive simulations that incorporate behavioral adaptation, infrastructural phasing, and uncertainty in implementation, allowing the model to evaluate not only spatial reconfiguration but also temporal responsiveness. Finally, comparative application in other rapidly urbanizing and transition-driven metropolitan contexts would be essential for assessing the transferability of counter-geometries as a planning instrument beyond Tirana, particularly in cities where congestion, informal growth, and uneven centralization are similarly intertwined.

Conclusions

This paper has not sought to solve Tirana's congestion through a definitive planning prescription, but to test whether an alternative methodological lens can reveal urban relations that conventional center-oriented readings tend to suppress. Its principal contribution therefore lies less in proposing a finished urban model than in demonstrating that congestion can be re-read as a spatial symptom of deeper organizational imbalance, and that such imbalance can be investigated through a layered analytical framework capable of tracing hidden peripheral intensities, non-radial dependencies, and emergent logics of redistribution. In this sense, the study positions counter-geometries not as a closed doctrine, but as an operative research construct through which urban form, movement, and territorial pressure may be examined beyond the inherited assumptions of monocentric planning. (Figure 19)

Rather than concluding with a universal claim, the research establishes a proof of methodological plausibility. The value of the work resides in showing that ethnographic observation, recursive geometric abstraction, field-based simulation, and deductive urban projection can be assembled into a coherent analytical sequence for reading latent spatial behavior. What has been validated here is not yet a policy instrument in its final form, but the feasibility of a method: a way of detecting whether the urban periphery already contains measurable tendencies toward sub-central reorganization that planning systems have not adequately recognized. This is particularly significant within the context of a broader doctoral investigation, where the aim is academic exploration, conceptual refinement, and the progressive testing of new analytical apparatuses before their translation into operational planning frameworks.

The findings therefore open a future pathway rather than close an argument. The methodology developed in this paper suggests potential scalability toward more robust decision-support environments, including policy-oriented urban diagnostics, mobility restructuring strategies, and decentralized planning scenarios capable of informing long-term metropolitan governance. Yet such future applicability depends on further validation through expanded datasets, longitudinal mobility evidence, comparative urban cases, and stronger calibration between simulated spatial tendencies and real institutional conditions. The present paper should thus be understood as a foundational step: not the final statement of a finished system, but the rigorous opening of a research agenda in which methodological validation becomes the necessary precondition for later policy relevance.

References

Ahern, J. (2011). From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. Landscape and Urban Planning, 100(4), 341–343. https://doi.org/10.1016/j.landurbplan.2011.02.021

Alexander, C. (1965). A city is not a tree. Architectural Forum, 122(1), 58–62; 122(2), 58–62.

Aliaj, B., Lulo, K., & Myftiu, G. (2003). Tirana: The challenge of urban development. Co-PLAN.

Batty, M. (2013). The new science of cities. MIT Press.

Batty, M., & Longley, P. (1994). Fractal cities: A geometry of form and function. Academic Press.

Berry, B. J. L., & Garrison, W. L. (1958). Alternate explanations of urban rank-size relationships. Annals of the Association of American Geographers, 48(2), 83–91. https://doi.org/10.1111/j.1467-8306.1958.tb01559.x

Bertaud, A. (2002). The spatial organization of cities: Deliberate outcome or unforeseen consequence? World Bank.

Bishop, P., & Williams, L. (2012). The temporary city. Routledge.

Cache, B. (1995). Earth moves: The furnishing of territories. MIT Press.

Christaller, W. (1966). Central places in southern Germany (C. W. Baskin, Trans.). Prentice-Hall. (Original work published 1933)

Dhamo, S. (2021). Understanding emergent urbanism: The case of Tirana, Albania. Springer.

Fujita, M., Krugman, P., & Mori, T. (1999). On the evolution of hierarchical urban systems. European Economic Review, 43(2), 209–251. https://doi.org/10.1016/S0014-2921(98)00066-X

Gordon, P., & Richardson, H. W. (1997). Are compact cities a desirable planning goal? Journal of the American Planning Association, 63(1), 95–106. https://doi.org/10.1080/01944369708975727

Jefferson, M. (1939). The law of the primate city. Geographical Review, 29(2), 226–232.

King, L. J. (1984). Central place theory. Sage.

Lynn, G. (1999). Animate form. Princeton Architectural Press.

Major, J. (1964). A magyar városhálózatról [On the Hungarian urban network]. Településtudományi Közlemények, 16, 32–65.

Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. Landscape and Urban Planning, 147, 38–49. https://doi.org/10.1016/j.landurbplan.2015.11.011

Mitchell, M. (2009). Complexity: A guided tour. Oxford University Press.

Parr, J. B. (2002). Agglomeration economies: Ambiguities and confusions. Environment and Planning A, 34(4), 717–731. https://doi.org/10.1068/a34106

Pllumbi, D. (2013). Mirroring Tirana: Reflections on Tirana's urban context and perspectives. European Journal of Sustainable Development, 2(4), 73–84.

Timiryanova, V., Grishin, K., & Krasnoselskaya, D. (2020). Spatial patterns of production-distribution-consumption cycle: The specifics of developing Russia. Economies, 8(4), Article 87. https://doi.org/10.3390/economies8040087