Configurational Accessibility and Mobility Patterns in a Port-City Interface: A Space Syntax Analysis of Central Catania

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Abstract. Port-city interfaces represent complex urban environments where spatial accessibility, mobility patterns and functional constraints often interact in critical ways. This study investigates the relationship between the spatial configuration of the urban street network and observed movement dynamics within the historical center of Catania, specifically focusing on the port-city interface between Paolo Borsellino Square and Via Dusmet. By proposing an integrated methodology combining Space Syntax and empirical flow analysis, the research explores key configurational measures, i.e. connectivity, integration and choice, computed using an axial map; then, theoretical findings are cross-referenced with empirical data collected through gate counts, distinguishing between pedestrian and vehicular flows.

The results reveal a significant correlation between pedestrian movement and configurational accessibility, suggesting that the spatial structure of the network effectively guides pedestrian flows towards the city's monumental core. In contrast, vehicular traffic shows a weak relationship with the spatial hierarchy, being primarily influenced by external factors, such as port access and traffic regulation. These findings highlight a mismatch between the inherent spatial logic of the area and current traffic conditions, suggesting a high potential for pedestrian-oriented reorganization of the port- city interface.

Keywords: Spatial Analysis · Urban Mobility · Space Syntax · Gate counts · Urban Morphology · Accessibility

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1 Introduction

In modern urban planning, accessibility has become a key framework for understanding the developing relationship between port infrastructures and the nearby urban fabric. While in the past the port-city interface was identified by a heavy functional synergy, recent changes have progressively turned these areas into zones of friction, producing negative externalities such as physical disintegration and socio-spatial separation. In this context, accessibility plays a key role in determining the barriers that separate the waterfront from the urban fabric, obstructing equitable access to the socio-economic opportunities associated with the maritime-urban interface [1]. Dissimilar generalized urban expansion processes, disconnection in port-city environments often result from a structural imbalance between logistical and urban systems. The expansion of port-related infrastructures regularly reduces the permeability of neighboring urban areas, creating spatial breaks that affect the general quality of urban life [2]. These dynamics provide irregular accessibility conditions, where different parts of the urban system experience considerably different levels of connectivity to services and opportunities [3].

Within this framework, port systems constitute highly strategic and complex nodes in the urban fabric [4]. In this context, the systematic review of transport networks supplies as the fundamental basis for planning processes, since the transport network forms the infrastructural framework through which port functions interface with urban mobility [5]. Maritime transport, despite the evolution of other modes, proceeds to play a central role in global commerce, reinforcing the importance of port infrastructures in urban planning. The presence of port terminals presents additional functional and spatial complexity, needing integrated planning approaches able of managing the interaction between logistics and urban life [6]. Port systems can be understood as dual structures, constituted of seaside (the water area containing basins and water bodies) and landside components (the terrestrial side dedicated to the movement of goods and passengers), whose interaction causes critical spatial interfaces.

In port-city framework, these topics become especially pertinent in areas exposed to freight-related externalities, where the organization of bordering spaces may help moderate the pressure produced by port activities on the urban fabric and improve overall logistics efficiency [7].

The port-city interface is therefore increasingly identified by spatial and functional intersections, where urban activities and logistical operations coexist and often conflict. This coexistence necessitates a critical investigation of these dynamics to mitigate their negative effects [8]. In this point of view, the idea of the waterfront adopts relevance as a transitional space where the urban fabric meets the maritime domain. These areas show key opportunities for sustainable urban regeneration, focusing on balancing port efficiency and functional requirements with urban habitability through aimed redevelopment and revival strategies [9].

Within this wider perspective, the integration of urban planning and mobility strategies becomes essential to guarantee that spatial structure and transport dynamics are addressed logically, particularly in complex urban environments where accessibility, safety, and walkability must be jointly regarded [10].

To deal with such complexity, this study takes on the theoretical and methodological structure of Space Syntax [11], which envisages spatial configuration as a crucial

driver of movement patterns and urban activity. This approach interprets the structure of the street network as an active element enhancing accessibility and flows. Through the analysis of configurational properties, Space Syntax supplies a quantitative basis for understanding movement dynamics within urban systems [12], making it especially pertinent for investigating complex port-city interface areas. Recent studies have proved the utility of Space Syntax for examining port-city environments and waterfront transformations, containing quantitative analysis of port-area morphology and historical analyses of port-city interface evolution [13, 14]. However, these applications have mostly concentrated on morphological and configurational meaning, rather than on the empirical verification of configurational measures through observed movement data.

Although a significant body of literature has examined the relationship between space syntax measures and urban movement, a notable research gap remains concerning the empirical performance of these models in high-friction environments, such as port-city interfaces. While the theoretical framework established by Hillier and Hanson [11] suggests that spatial configuration is a primary driver of *natural movement*, in transitional maritime-urban zones this logic often interacts with and is potentially distorted by strong functional limitations and logistical pressures.

Existing studies on port-city areas, such as the quantitative morphology analysis of the Xiamen port [13] or the historical evolution of the Algiers interface [14], provide valuable insights into the spatial development and configurational meaning of these zones. However, they frequently lack a simultaneous, dual-mode empirical verification (pedestrian vs. vehicular) of how spatial hierarchy operates under the weight of port-related externalities. Empirical studies combining Space Syntax analysis with gate counts to directly compare configurational accessibility with observed pedestrian and vehicular flows in port-city intermediate areas remain limited. This study addresses this discrepancy by examining the relationship between the syntactic attributes of the street network and observed movement patterns in the port-city interface of Catania. The research focuses on a strategic area connecting the historic center with the port, focusing to evaluate whether spatial configuration can describe actual mobility dynamics. An integrated approach is adopted, joining Space Syntax analysis with empirical flow data collected through gate counts, allowing for a direct comparison between configurational accessibility and observed movement. By concerning configurational properties to observed movement, the study supply evidence on how spatial structure influences mobility in port-city transitional areas and provides insights for accessibility-oriented regeneration strategies.

2 Methodological Approach

2.1 Spatial Configuration Analysis via Space Syntax

The theoretical framework of the research lies in Space Syntax, a methodology that interprets the built environment not as a simple aggregate of individual streets, but as a system of combined spatial relations. According to Space Syntax ideals, the settlement's road network is understood as a collection of interconnected axial lines, which provide as the primary units of the system, defining both its spatial structure and the related accessibility between all its parts. [11, 15].

The approval of this analytical unit derives from the monitoring of navigation behaviors: evidence proposes that those moving through urban space, whether pedestrians or drivers, tend to arrange trajectories that minimize angular differences relative to their destination [16, 17]. Therefore, the axial line is not just a geometric notion; it shows the human tendency to reduce cognitive load during movement by limiting the number of turns necessary to navigate the territory [15, 18].

For the purposes of this analysis, the configuration of the street network is quantified through three main syntactic measures [19]:

- connectivity, a local measure describing the number of direct links of each axial line and, therefore, the immediate permeability of the network.
- integration, a measure of configurational accessibility expressing how central or segregated each axial line is within the overall system.
- choice, a measure of through-movement potential, identifying the routes most likely to be used as paths between different origins and destinations.

In addition, the study considers intelligibility, assessed as the statistical correlation between connectivity and global integration. This parameter expresses the extent to which local spatial properties reflect the global structure of the system and therefore provides an indication of the legibility of the urban environment [20–23].

The spatial modelling process was developed through a sequence of CAD-based and syntactic analysis operations, with axial mapping adopted as the primary tool for investigating the configurational properties of the street network and their relationship with pedestrian and vehicular movement patterns.

First, the technical cartography of the study area was obtained and updated. The cartographic base was then refined in AutoCAD, where the necessary geometric corrections were introduced to guarantee the topological continuity of the network. The resulting drawing was exported in DXF format and imported into DepthmapX. Within this analytical environment, the axial map was produced, permitting the construction of the relational graph required for subsequent configurational analyses. This workflow allowed the extraction and quantification of the main spatial variables, i.e. connectivity, integration, choice, and intelligibility, which give objective numerical values for describing the morphological structure of the urban and port fabric under investigation.

2.2 Data Collection Through Gate Counts Technique

To evaluate actual movement dynamics, the research embraces the Gate Counts technique, a combined methodology for measuring traffic density and volumes within urban space [20]. This approach was used to collect empirical data on both pedestrian and vehicular movement, allowing for a direct comparison between observed flows and syntactic properties of the street network. The option of monitoring points (gates) was implemented according to a layered sampling approach, based on the syntactic properties that appeared during the modeling phase. Particularly, the gates were scattered to represent different spatial conditions within the study area, including highly integrated routes, more separated segments, streets close to the port access, and transitional areas between the waterfront and the historic center. This scattering guaranteed adequate coverage of the morphological and functional heterogeneity of the study area.

Field observations were carried out under similar observation conditions, guaranteeing clear visibility of each monitored section and the reliability of the counts. At each gate, pedestrian and vehicular flows were recorded separately, to explore possible variations in the relationship between spatial configuration and movement patterns. Depending on [24], the use of gate counts in this study serves two main purposes: first, to verify the extent to which the syntactic model is consistent with actual movement patterns; and second, to determine whether configurational accessibility impacts pedestrians and vehicles in a different way within the port-city interface.

2.3 Syntactic Analysis

The final stage of the methodology consists of statistically comparing the main syntactic measures, connectivity, integration, and choice, with the empirical flow data collected through gate counts. For each monitored gate, observed pedestrian and vehicular volumes were associated with the configurational values of the corresponding axial line. The analysis was performed using Pearson's correlation coefficient and simple linear regression, implemented in an Excel environment.

The methodological approach involves crossing the three analyzed syntactic measures introduced above, i.e. connectivity, integration and choice, with the observed pedestrian and vehicular flows derived from the gate counts.

Separate correlation and regression analyses were performed for pedestrian and vehicular flows to identify possible differences in the way spatial configuration influences the two movement patterns. For each analysis, the coefficient of determination (R2) was extracted and used as an indicator of the model's ability to explain the variance in the observed flows.

Finally, intelligibility was assessed as the statistical correlation between connectivity and integration. This indicator was used to evaluate the legibility of the urban fabric, namely the extent to which local spatial properties reflect the global structure of the system. Higher correlation values indicate a more readable and navigable environment, whereas lower values suggest a more fragmented spatial configuration.

3 Case Study

The analysis focuses on a strategic sector of Catania's urban fabric, located in the transition zone between the historic center and the access to the tourist port. Although Catania expands over a complex urban area of about 180 square kilometers, the center of this research lies in this specific area, where metropolitan traffic strains and the mobility demand produced by around 300,000 residents, together with an extensive service area of commuters from the hinterland, converge towards the waterfront [25].

The study area constitutes a critical interface space, where the urban street network accommodates the complex coincidence of urban, tourist, and port-related flows. Within this transitional area, despite the availability of public transport infrastructure and services in the nearby urban area, there is a prevalence of private vehicle use. This condition highlights a structural weakness within the port-city interface, where public transport

alternatives do not constitute a competitive enough option to the flexibility of private vehicles.

As a result, accessibility to the port and waterfront is strongly influenced by road-network saturation and frequent congestion. In this context, the case study gives an appropriate setting for analyzing whether the configurational structure of the street network is consistent with the observed distribution of pedestrian and vehicular flows.

3.1 Territorial Framework

Due to daily travel patterns and the strategic attraction of the waterfront, the primary traffic routes in the area correspond with the main access corridors leading to the historic center and the port infrastructures. Indeed, the area is also impacted by its proximity to the central railway station, which behaves as a major regional mobility attractor, focusing a constant mobility demand on the local road network. As shown in Fig. 1, the study area provides as a development and distribution node between the railway infrastructure, the port basin and the historic urban fabric. Key corridors such as Via Dusmet and the roads connecting the waterfront to the historic center play a strategic role in port access, local circulation, and the distribution of incoming and outgoing flows.



Fig. 1. Study area and POIs

Despite the significant presence of public transport lines and the proximity to railway system, mobility in the area is still dominated by private vehicles. Traffic volumes are further increased by the presence of points of interest (POIs) related to yachting activities and to the tourist and commercial attractiveness of the historic center.

At the same time, the road configuration has experienced several alterations over time to manage the coexistence of port-related logistic operations and urban mobility in a sector influenced by chronic saturation.

3.2 Data Collection

Following the initial observations performed on the study area and the studies of the main flow patterns characterizing the port-city interface, particular monitoring sections were

identified. The choice of these sections was planned to provide direct empirical references within the studied network, thus allowing the syntactic analysis to be compared with the actual dynamics of movement.

Specifically, four crucial sections along Via Dusmet were selected and marketed as Gate Counts (C1, C2, C3, C4), as shown in Fig. 2.

These locations were selected because they catch different movement conditions within the port-city interface, including access-related traffic, urban circulation, and the influence of nearby transport nodes. Their position also reveals the pressure produced by the nearby central railway station and by the bus services operating in the area.

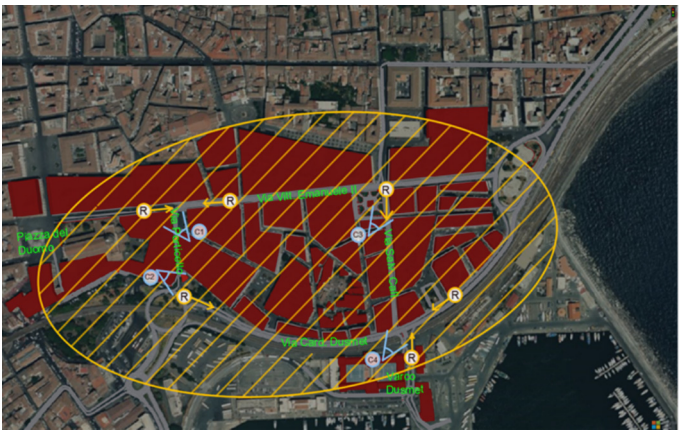

Fig. 2. Gate counts

Intelligibility

Intelligibility represents the degree when a user can understand the global structure of the city based on local visual cues, such as immediate intersections. Mathematically, it expresses the correlation between Connectivity (local scale) and Integration (global scale).

Figure 3 displays the plot with a positive regression line ($y = 0.0225x + 0.0225$), with a coefficient of determination of $R^2 = 0.25$. In an organic and historical urban fabric context, this value indicates a moderate intelligibility. While the system is not immediately readable as a regular grid, it still displays a detectable configurational logic: the red and orange points (top-right) confirm that streets with higher local connectivity tend also to have more central positions within the overall network.

The dots clustered in the upper part of the graph are associated to the main axis and the Paolo Borsellino Square core. In these areas, intelligibility is higher (i.e. pick values), allowing users to immediately perceive their position within the system. By contrast, the intensity of blue and green dots in the lower-left part of the plot represents the secondary street network, where low connectivity is associated with greater configurational segregation.

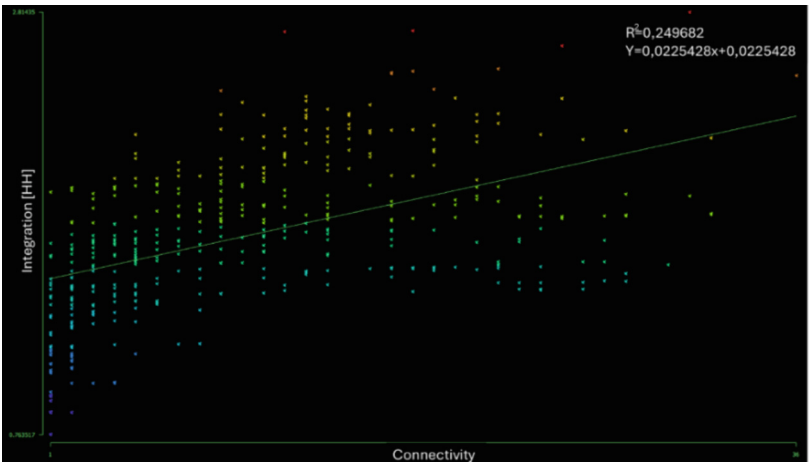

Fig. 3. Intelligibility plot

4 Results

This section shows the results acquired through the configurational analysis of the network and empirical field observations. First, the spatial structure of the case study is reviewed by processing Connectivity, Choice, and Integration maps to determine the morphological hierarchy and the degree of intelligibility of the urban fabric. Subsequently, the parameters obtained from the syntactic analysis are related to the data collected through Gate Counts to verify the model's stability with the observed real-world flows. The investigation uses the coefficient of determination (R^2) as a key statistical indicator to assess the extent to which the spatial configuration describes the distribution of the observed movement. Finally, the comparison between pedestrian and vehicle flows highlights the different movement logics defining the study area.

4.1 Space Syntax Analysis

Configurational analysis through Space Syntax permits the complexity of the urban fabric to be understood by transforming street geometry into numerical values that describe its spatial hierarchy. This section analyzes the four fundamental parameters that define the movement potential and legibility of the study area.

Connectivity
The connectivity map (Fig. 4), developed through DepthmapX, reveals the local hierarchical structure of the urban fabric. In this representation, the chromatic gradient represents different levels of direct connection among axial lines. The map is controlled by a clear axis colored deep red, equivalent to the main artery of the study area. This segment records the highest number of direct intersections and therefore the highest local connectivity with alleyways and secondary streets. The orange and yellow areas branching out from the main axis symbolize secondary distribution roads, which perform as connectors between the central core and the surrounding streets. By contrast,

the light blue and blue lines determine alleyways and local streets, which exhibit low connectivity because they are connected to a limited number of other lines or are dead ends.

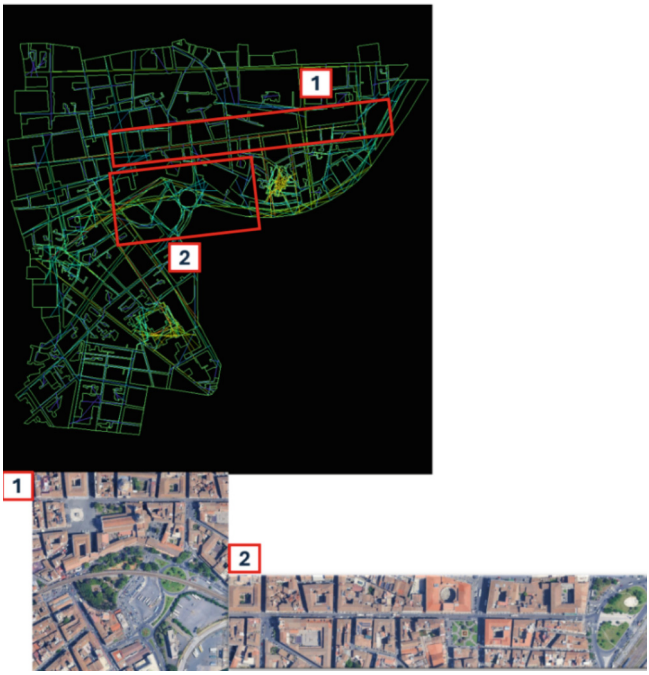

Fig. 4. Connectivity attribute: (1) Via Vittorio Emanuele II; (2) Duomo

The connectivity analysis shows significant values along the axis of Via Vittorio Emanuele II (Fig. 4, detail 1), one of the city's most important arteries, can distribute traffic flows between the top part of the city and the waterfront. A second area characterized by high connectivity is Duomo Square (Fig. 4. Detail 2), dominated by Saint Agatha Cathedral. The high connectivity in this area shows the importance of the site and indicates how the street grid converges toward this public space, developing a fundamental pedestrian and vehicular distribution node. The spatial structure thus seems to support the monumental hierarchy: the Saint Agatha Cathedral and the Duomo serve not only as tourist destinations but also as central hubs integrated into the local network, promoting the overall permeability of the historic center.

Choice

The Choice attributes measure the through-movement potential of each street within the system. In DepthmapX, this value indicates which streets are most frequently selected as the shortest path between different origins and destinations. Referring to the Choice map (Fig. 4), a single, prominent deep red line is clearly visible.



Fig. 5. Choice attribute: (1) Via Vittorio Emanuele II

This indicates that one axis (Fig. 5, detail 1) concentrates most of the through-movement potential within the analyzed network. Due to its strategic position and linearity, this route functions as the main movement corridor. In an urban fabric characterized by numerous secondary streets and alleys (shown in blue), the main axis acts as a primary channel for movement across the system. Consequently, the Choice value is highly concentrated along this axis, while the remaining streets show lower values and play a more local role.

Integration

Integration (Fig. 6) measures the global accessibility of urban network. In Space Syntax, it describes how topologically close a street is to all other streets in the system by given the number of directional changes (turns) required to arrive at any point in the network. A highly integrated street therefore symbolizes an accessibility core within the system.

The most noticeable element is the long horizontal axis (Fig. 6, detail 1) shown deep red. This represents the main artery of the area, crossing the urban fabric and guaranteering maximum continuity. In syntactic terms, this road acts as a global collector, concentrating movement from different parts of the system, thereby decreasing the topological effort required to navigate the neighborhood.

Close to this artery, the integration core expands, with peak values, in Paolo Borsellino Square area (see Fig. 6, detail 2). This node is not only a transit point but also a central configurational element within the system. Its importance is related to its strategic position within the Dusmet area, which serves as a transition point between the tourist port and the historic center, including the area of Saint Agatha Cathedral. The

high integration values extending on both sides of the square confirm that this sector represents the main accessibility core for movement between the waterfront and the monumental center.

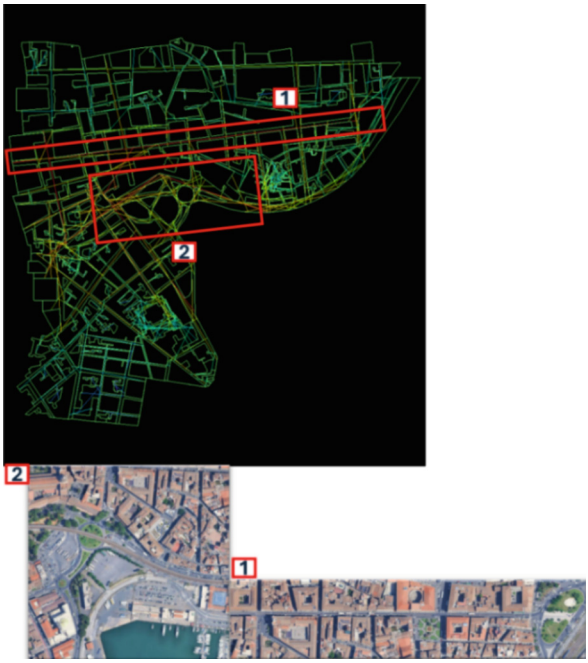

Fig. 6. Integration attribute: (1) Via Vittorio Emanuele II; (2) Paolo Borsellino Square

4.2 Empirical Observation: Gate Counts Analysis

This section analyzes the total pedestrian and vehicular traffic volumes recorded during the survey (from 4:30 p.m. to 5:30 p.m.). The data were collected at four strategic gates (i.e. C1, C2, C3, C4, as shown in Fig. 2) to outline the observed distribution of movement within the study area.

Table 1 summarizes the hourly totals pedestrian and vehicular flows recorded at the four analyzed gates. The data shows a clear hierarchical variation between the points of the network.

Table 1. Pedestrians and vehicular flows.

Gate count	Pedestrians	Vehicles
C1	171	882
C2	52	2002
C3	42	589
C4	51	2130

The data show a higher concentration of pedestrian flows toward the northern sector of the area. In more detail, Gate C1 records the highest pedestrian volume, with a total of 171 movements. This value makes the area as the main pedestrian attractor during the investigated period. Gates C2, C4, and C3 show substantially lower and more homogeneous pedestrian volumes. Specifically, Gates C2 and C4 record very similar values (52 and 51 pedestrians, respectively), while Gate C3 shows the lowest value for the area with only 42 pedestrian movements.

The vehicular pattern differs from the pedestrian results, emphasizing the transit role of the perimeter roads. Gates C4 and C2 represent the main transit corridors of the area, with volumes exceeding 2000 units (i.e. 2130 vehicles at gate C4 and 2002 at gate C2). The high traffic intensity recorded at these gates is consistent with their strategic role in traffic distribution, particularly for Gate C4, located near the port entrance. Gate C1, despite its pedestrian prominence, records a lower vehicular volume with 882 vehicles, suggesting a role more closely related to local distribution rather than to major through-traffic. Gate C3 records the lowest vehicular volume, with 589 vehicles, confirming its more marginal role within the traffic hierarchy.

4.3 Correlation Between Syntax and Observed Flows

The statistical analysis conducted through the scatter plots suggests a differentiated relationship between syntactic measures and observed movement within the study area.

The three graphs shown in Fig. 7, Fig. 8 and Fig. 9 related to pedestrians show a positive trend, indicating that higher syntactic values are associated with higher pedestrian flows.

The relationship between pedestrian flows and choice yields an $R^2 = 0.995$), indicating an almost perfect linear correspondence between the observed values. Although this result suggests a very strong association between through-movement potential and pedestrian flows, it should be interpreted with caution due to the limited number of monitored gates. The correlation between pedestrian flows and connectivity is also high (R2 = 0.86), indicating that local permeability and direct connections are closely associated with pedestrian presence. The relationship between pedestrian flows and integration, although slightly lower (R2 = 0.72), still indicates a substantial association between global configurational accessibility and pedestrian movement. Overall, these results suggest that pedestrian flows are more consistent with the configurational structure of the street network, particularly in relation to choice and connectivity.

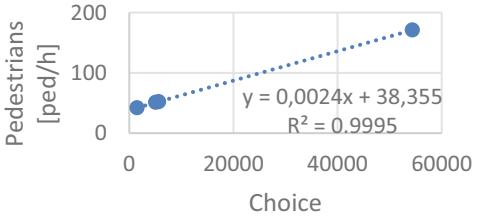

Fig. 7. Relationship between pedestrian flows and choice

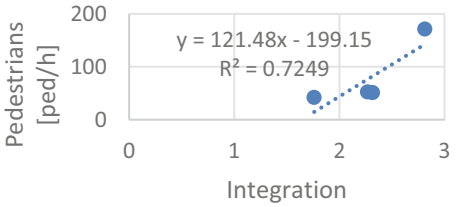

Fig. 8. Relationship between pedestrian flows and integration

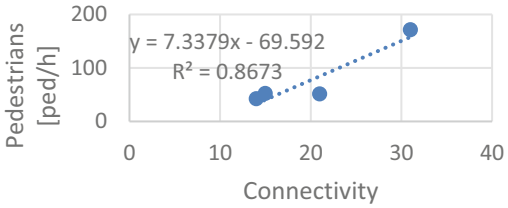

Fig. 9. Relationship between pedestrian flows and connectivity

By contrast, the plots related to vehicular flows in Fig. 10, Fig. 11 and Fig. 12 show weaker and less coherent relationships.

The relationship between vehicular flows and integration is extremely weak (R2 = 0.026), as is the relationship with connectivity (R2 = 0.029), indicating that vehicular traffic is only marginally associated with the natural centrality or local permeability of the network. The relationship between vehicular flows and choice is slightly stronger (R2 = 0.14) but still limited. This suggests that vehicular movement is only weakly associated with the through-movement potential identified by the syntactic model. Overall, these results indicate that vehicular flows are influenced less by the configurational structure of the street network and more by external functional factors, such as port-related access, traffic regulation, and the operational role of specific road sections.

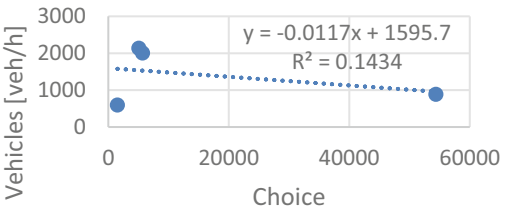

Fig. 10. Relationship between vehicular flows and choice

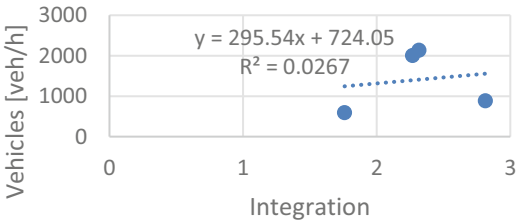

Fig. 11. Relationship between vehicular flows and integration

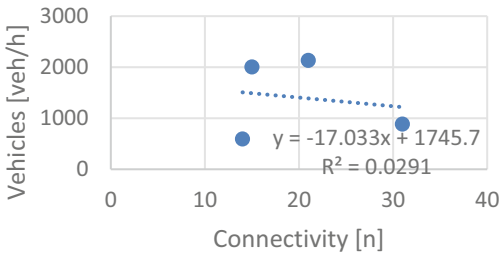

Fig. 12. Relationship between vehicular flows and connectivity

4.4 Discussion

The results highlight a differentiated relationship between spatial configuration and observed movement within the port-city interface of Catania. On the one hand, pedestrian flows show a relatively strong correspondence with the syntactic structure of the street network, particularly with respect to choice and connectivity. This suggests that pedestrian movement in the study area is closely associated with configurational properties such as route continuity, directness, and local permeability. Streets that are more accessible and more likely to be traversed within the network also tend to attract higher pedestrian volumes.

On the other hand, vehicular flows have weak relationships with the syntactic measures considered. In fact, integration and connectivity do not explain traffic volumes reasonably, while choice shows only a limited association. This result suggests that vehicular movement in the study area is not mainly modelled by the intrinsic configurational logic of the urban grid.

This discrepancy highlights a fundamental challenge in contemporary traffic systems within historical port-city interfaces: the conflict between *natural movement* and *forced movement*. While the historical urban fabric of Catania still dictates legible logic for pedestrians, vehicular traffic is increasingly decoupled from the spatial grid due to rigid traffic management, such as one-way systems and signalization, which override the natural hierarchy of the network.

In the specific context of the port, this mismatch is further exacerbated by the role of the waterfront as a logistical corridor. Road sections like Via Dusmet function as forced channels for heavy-duty vehicles and port-related flows that are not exploring the city, but are being funneled toward specific gateways (i.e., the port entrance). This magnet effect of the port infrastructure creates a high-pressure environment where logistical efficiency

takes precedence over urban accessibility. Consequently, contemporary mobility patterns in this area are driven by external functional demands rather than the inherent properties of the street network, representing a significant barrier to the morphological integration of the waterfront.

This divergence between pedestrian and vehicular patterns is particularly meaningful in a port-city transitional environment, where different mobility logics coexist within a limited space. Pedestrian movement appears to have a more direct correlation with the spatial structure of the urban fabric, whereas vehicular traffic is influenced by infrastructural and functional pressures that partially defy the natural hierarchy of the street network. From this perspective, the study area can be interpreted as a space in which configurational accessibility still supports pedestrian movement, but where vehicular circulation reflects a more externally driven pattern.

As a result, the current mobility structure may reduce the potential of the waterfront as an integrated and accessible urban space. At the same time, the empirical validation is based on a limited number of monitored sections and on observations conducted within a specific time window. Therefore, the statistical relationships identified in this study should be regarded as context-specific and exploratory. Nevertheless, the observed patterns provide a useful indication of how Space Syntax can support the interpretation of movement dynamics in complex port-city environments.

4.5 Policy Implications

The relative relationship between configurational accessibility and pedestrian flows indicates that urban design and mobility policies should build upon the existing spatial logic of the street network. In practical terms, to reinforce pedestrian continuity along the most accessible axes some infrastructural interventions can be planned, e.g. improve crossings, sidewalk quality. In addition, introduce wayfinding systems to strengthen the natural walkability of the connection between the waterfront and the historic center. Conversely, the weak relationship between syntactic measures and vehicular flows suggests that road traffic in the area is driven less by urban form than by functional and operational constraints. This implies that traffic management strategies cannot rely only on the existing street configuration but should address port-related access and the regulation of vehicular circulation. Therefore, measures such as selective access control, traffic calming, redistribution of port-related movements, and the reorganization of loading and operational functions may be necessary to reduce pressure on the urban network.

The mismatch between pedestrian-oriented spatial accessibility and vehicle-dominated traffic conditions highlights the need for a more balanced mobility framework in the port-city interface. Some policies could help to increase the coherence between the spatial structure of the area and its actual usage patterns. They can be related to the improvement of intermodality, strengthening the connections with the railway station and public transport services, and limiting avoidable private vehicular traffic.

5 Conclusions and Future Research

This study explored the relationship between the configuration of the network and observed movement patterns at port-city interface of Catania, with a focus on the Dusmet-Paolo Borsellino Square area. The findings indicate that pedestrian flows are more closely associated with the configurational properties of the street network respect to vehicular flows. Choice, connectivity, and integration show a meaningful correspondence with pedestrian movement, suggesting that the spatial structure of the area supports pedestrian accessibility towards the historic center and the waterfront interface.

By contrast, vehicular flows exhibit only weak relationships with calculated syntactic measures. This should indicate that vehicular movement in the area is greater shaped by functional and operational constraints, including port access and traffic regulation. Thus, this divergence highlights a mismatch between the inherent spatial logic of the area and its current mobility patterns, especially in the transition between the waterfront and the historic urban fabric.

In this regard, from a methodological point of view, the study confirms its usefulness, combining Space Syntax analysis with empirical gate counts to investigate movement dynamics in complex port-city environments. The proposed approach provides an interpretable framework to correlate configurational accessibility with observed flows, distinguishing between pedestrian and vehicular mobility patterns.

At the same time, the results should be interpreted considering some limitations. The empirical analysis is based on a limited number of monitored sections and on observations conducted within a specific time window. While this basis is sufficient for an exploratory study aimed at testing the methodology in a complex interface, the statistical relationships identified here should be regarded as context-specific rather than a final generalization of urban behavior.

Future research should therefore aim to strengthen the empirical basis of the analysis by expanding the monitoring network (increasing the number of gate counts) and extending the observation campaign to different time periods and urban sectors characterized by different morphological conditions. Furthermore, expanding the spatial boundaries of the configurational model would be essential to verify the stability of the syntactic measures and to mitigate potential edge effects, ensuring that the integration and choice values remain consistent when considering a larger portion of the urban network. In addition, the inclusion of multimodal data, such as public transport and micromobility flows, could provide a more comprehensive understanding of movement dynamics in Catania and support more robust evidence-based planning strategies.

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