# A Literature Review on the Assessment of Vitality and Its Theoretical Framework. Emerging Perspectives for Geodesign in the Urban Context

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**Abstract.** Vitality and Urbanity, as conditions for economic vibrancy and social diversity, are central objectives of policies for urban sustainable development. Vitality and urbanity are herein defined as distinctive urban qualities emerging from the combination of diverse practices, integrated into urban form and influencing the sense of place. The proposed study investigates the components of urban form that influence urbanity and vitality. A broad literature review on the formalization and operationalization of the concepts of urbanity and vitality is presented. The comparative analysis of selected articles investigates five aspects: i) conceptualization of urbanity and vitality; ii) identification of factors impacting urbanity and vitality; iii) definition of indicators and protocols; iv) co-relations among urban form factors and levels of vitality and urbanity and v) relevance and impact of investigated methodologies on planning processes. This study aims to define the theoretical foundation of a methodology that utilizes space syntax and spatial analysis techniques to address three issues related to sustainable urban development: clear representation of conditions of urbanity, understanding of criticalities and formulation of policies and strategies for reinforcing vibrant urban spaces. The proposed theoretical framework thus contributes to the application of the Geodesign paradigm to the urban realm by supporting the essential understanding of the spatial culture of a place.

**Keywords:** Vitality · Urbanity · Morphology · Space syntax · Geodesign

## 1 Introduction

Urban areas are emerging as the place where different global phenomena concur, including concentration and increase of population, social and spatial injustice, environmental

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issues as well as economic development and the production of cultural, social, scientific and institutional innovation. The role of urban governance and spatial planning in addressing the potential of the built environment to impact quality of life, sustainability, inclusion, and cultural and social diversity, emerges as a central question. Within this perspective, the issues of urbanity, vibrancy and urban vitality are central.

Vitality and vibrancy refer, in fact, to a fundamental urban quality resulting from the plurality of activities. Urbanity, on the other hand, concerns a quality distinctive of urban condition resulting from a specific combination of functions, amenities, practices, cultural constructs, social and emotional interactions, integrated into urban form and determining the sense of place. A consolidated tradition in urban studies, [1–6] investigates the spatial and functional components of the built environment that affect urban quality, while recognizing the relevance of vitality and urbanity as a central objective of urban planning. Within this perspective, urban morphology, as the study of the structural attributes of urban form and of its generative processes, emerges as the privileged dimension for investigating the relation between the spatial, physical, functional aspects of the urban realm and urbanity and vitality. More precisely, building on the Conzenian morphological tradition [7], urban form is conceptualized as the product of three components: i) the system of open spaces and, in particular of spaces of movement; ii) the system of plots and of buildings arranged on plots; iii) patterns of land-use. Space-syntax and Geo spatial theories and techniques have, in the recent years, fostered the establishment of conceptual apparatuses and methodologies aimed at individuating and describing components of urban form and at developing a common and essential morphological understanding of urbanity and vitality and of their determinants [8, 9]. Consequently, this article presents a comprehensive literature review on the formalization and operationalization of urbanity and vitality.

The literature review investigates articles indexed in the Scopus and Web of Science database and is articulated on four stages: i) definition of queries containing the terms urbanity, vitality, urban morphology; ii) selection of a set of articles related to the categories of urban studies; iii) comparative analysis of the most relevant articles. The comparative analysis focuses on four aspects: i) conceptualization of urbanity and vitality; ii) identification of dimensions of urban form; iii) definition of factors of urban form impacting vitality, protocols and indicators for quantitative analysis of urban form; iv) output and results of the case study analysis, including co-relation among factors of urban form and measured levels of vitality and urbanity, or categorization and evaluation of urban spaces; and v) relevance and impact of metrics of urbanity and vitality on planning processes.

The aim of the literature review is to propose a theoretical framework instrumental to the development of a replicable methodology, based on open data, for the assessment of morphological factors conducive to the urbanity and vitality of public spaces across metropolitan areas, the understanding of criticalities and the formulation of policies and strategies for reinforcing meaningful and vibrant urban spaces. This theoretical framework represents a relevant contribution to the application of geodesign perspective to urbanized territories. Geodesign, in fact, is a data informed paradigm that utilizes spatial information to structure place-shaping processes [10, 11]. Hence, its effectiveness in orienting design solutions and planning strategies in the urban context could be improved

via the utilization of spatial analysis and space syntax techniques for understanding the spatial culture of a metropolitan region, and the relation between the configuration of spatial structures and patterns of collective practices determining urbanity and vitality.

The article is structured on five sections: After the introduction, notions of vitality, urbanity and urban form are presented. Then, in Sect. 3, the methodology and the case study are presented. In Sects. 4 and 5 the results from the literature review are presented and discussed. Finally, the Conclusions in Sect. 6, summarise the findings of the study and illustrates hypotheses for the future development of the research.

## 2 Concepts and Methods

The notions of urbanity, vitality and vibrancy are rooted in the essential aspect of the city as the place where propinquity fosters the encounter with the difference, transfer of knowledge, contamination of cultures and traditions, determining the production of identities, subjects, ideas and practices [12]. The role of the city is, thus, the promotion of contacts, emulation, transaction among individuals, groups and classes. The city is the stage-set where the drama of social life unfolds, in the continuous alternating of spectators and actors [13]. The notions of vitality, vibrancy and urbanity capture this aspect, summarising the specific qualities of the urban realm, and more precisely of competitive, resilient, prosperous urban environments.

A first issue emerging form studies on urban morphology concerns the terminological inconsistencies. More precisely, the terms vitality, vibrancy and urbanity are not synonym: urbanity can be defined as the quality of vital urban places, yet these concepts are not equal. Building on Montgomery [14], urbanity is the distinctive quality of the urban condition, and a central attribute of good urban places, hence of places revealing a unique sense of place. In this regard, urbanity is a peculiar condition determined by urban form, social and interpersonal relations, multiplicity of practices mediated by specific cultural constructs. The sociological perspective on urbanity underlines its situational nature, and its influence on socio-political relations and everyday life [15]. Hence, urbanity is herein defined as a condition resulting from a specific configuration of practices and socio-political interactions incorporated into urban form and influencing the sense of place. The latter, in fact, embodies a cultural, cognitive and emotional dimension and can be defined as the complex of beliefs, emotions, and meanings, symbols and qualities that an individual or a group ascribes to a region or space [16–18]. As a consequence, vitality – as the capacity of the built environment to facilitate social practices and economic activities [19, 20] - and vibrancy – as the potential of a place to respond to basic human needs and social public demands, creating a liveable environment [21] - emerge as pre-conditions of urbanity and of sense of place. Vitality and vibrancy are, as a result, central objectives of urban sustainable development. Vibrancy, in particular, engenders positive emotional experiences, stimulates creativity and produces resilience and prosperity. Moreover, a vital and liveable environment incorporates opportunities for multiple and varied social contacts, enabling the formation of interpersonal ties conducive to trust, co-operation, solidarity and empathy [5, 20, 22–24]. These ordinary virtues, in turn, are a central condition for the co-existence of different needs, identities, customs in the contemporary city [25, 26].

Moreover, Vibrancy and vitality are associated to active street life and diversity of uses - sustained by adequate levels of demand and, thus, by population density - and influence the image of a place [6]. Diversity, density, active street life and imageability are, in turn, influenced by urban form [5, 6]. The principle of Soft environmental determinism implies, in fact, that the structure of a space orients human activities by determining specific patterns of affordances. For instance, the conditions of spatial and functional proximity refer to the potential of spaces to generate specific patterns of co-presence and determine the frequency of encounters and social contacts conducive to the creation and activation of a community [25].

Urban form entails the structural and functional properties of the built environment, including the configuration of the system of public open spaces, the conformation of plots and of buildings located on plots and the distribution of land uses. In particular, the configuration of the system of open spaces refers to the set of topological relations among streets and square, that interdepend in the overall urban structure. Configurational attributes of the built environment influence the patterns of natural movement, co-presence, and co-awareness across the urban space. Co-presence refers to the simultaneous presence, within a space, of people that may not know each other; co-awareness refers to a group of people who use and share a space and are aware of one another. These two patterns are the raw material for the creation of a community. Furthermore, patterns of natural movement are observed to affect the distribution of economic activity and of land uses [27] thus influencing the formation and location of vibrant and vital cores and engendering the multi-scale structure of pervasive centrality across the urban space [3, 23, 28–31].

The formalization of urban morphology in terms of specific variables, and their relevance in influencing urban vitality and vibrancy are described in the subsequent sections.

## 3 Methodology

This study investigates the existing literature on urban morphology and vitality, to identify which aspects of the functional, configurational and compositional dimensions of the built environment are most relevant in terms of their influence on the vibrancy and liveability of the urban realm. This study is thus articulated on five steps: i) selection of a sub-set of relevant articles; ii) construction of a matrix for the analysis of existing studies; iii) comparative analysis of articles selected in stage i; iv) identification of aspects of urban morphology influencing urban vitality and v) measurement of their relevance within the sub-set of the articles analysed; More precisely, articles are retrieved from the Google Scholar database via a query containing the terms “urban morphology”, “vitality” OR “vibrancy” OR “urbanity”. Relevant articles are selected according to three criteria: pertinence to the discipline of urban and regional studies; publication on Open Access journals or storage on open platforms; and period of publication included in the time-span 2016–2021. Google Scholar and Open Access journals and platforms are privileged because they represent optimal solutions for accessing and communicating research findings, thus increasing the potential of research on the urban realm to impact planning processes and urban policies. The matrix is articulated on eight criteria, including definition of the urban condition investigated, aspects of urban form considered,

definition of the unit of analysis, definition of independent and dependent variables, results, and relevance and impacts of findings. Lastly, a set of independent variables, related to central environmental determinants of vitality is identified; the centrality of the selected variables is then evaluated via four indicators: Relevance (REL), defined as the ratio of article considering the i-th variable over the total number of articles selected; Frequency of positive co-relations (FPOS), defined as the ratio of studies observing a positive co-relation between the i-th variable and urban vitality, over the total number of articles considering the i-th variable; Frequency of negative co-relations (FNEG); and net normalized influence (NET), defined as the product of relevance and the difference between frequency of positive co-relations and frequency of negative co-relations (see Table 2). This methodology thus encompasses a replicable, time-saving procedure for the comparative analysis of research publications, for the identification of pertinent and relevant variables and of recurrent co-relations among independent and dependent variables. The aim of the comparative analysis discussed in the subsequent sections is, thus, to identify components of urban form and properties of the urban landscape that influence vitality.

## 4 Results

The comparative analysis focuses on a sub-set of 21 relevant articles. Google Scholar returns 6770 entries to the query ((“urban form” OR “urban morphology”) AND (“vitality” OR “vibrancy”)). The Web of Science database identifies 28 articles. Studies on the impact of urban form components on urban vitality are pre-eminently associated to the Categories “Urban studies” (11 articles), “Environmental studies” (11 articles) and “Green Sustainable Science and Society” (7 articles). The sum of citations is equal to 201; the average number of citations per item is 7.18, determining an H-index of 7. These values and the positive trend in the total number of citations per year underline two aspects; the increasing relevance of studies on urban form and vitality in the disciplinary areas of urban and environmental studies, and the need for further studies, aimed at operationalizing the relation among components of the built environment and urban vitality. The analysis of the theoretical framework of the articles reveals the centrality of the studies conducted by Jacobs [5], Montgomery [14], Gehl [2, 7] whose findings define the foundation of contemporary research on urban morphology and on its significance as a pre-condition for sustainable, vibrant urban spaces. The selected articles focus on vitality (0.67), vibrancy (0.14), and urbanity (0.10). Yet a clear distinction among these terms does not emerge: they converge on the notion of the potential of the urban realm to induce lively social and economic activities. The concepts of vitality, vibrancy and urbanity are frequently associated with the conditions of liveability, variety, diversity and sustainability [20, 32–34]; in particular vitality, vibrancy and urbanity emerge as a central aspect of urban sustainable development, and as a distinctive condition of multi-functional, varied, urban environments. In particular, Jacobs’ conceptualization of diversity as a condition for vitality emerges as a central aspect [5, 35, 36]. Moreover, urban form is conceptualized as the product of distinct structures. In particular, building on Conzen’s findings [7], urban form comprises three dimensions: the spatial structure of spaces for movement, the built fabric, constituted by the system of plots and buildings,

and the land use pattern. These dimensions encompass the categories defined by Jacobs as aspects of diversity: Connectivity, operationalized in terms of block size and border vacuums, typological variety of buildings, density, diversity of primary and secondary uses [5, 35, 36].

**Table 1.** Results of the comparative content analysis for the most relevant selected articles

| Title | Urban condition investigated | Unit of analysis | Independent variables |
|---|---|---|---|
| Jacobs-Crisioni et al. [37] | Patterns of activities | Regular grid unit | Population Density (DPOP); Density of POIs (DPOI); Distance from tourist squares (TS); Condition of districts (Advantaged vs Disadvantaged) (AD) |
| Ye and Van Nes [9] | Urban vitality | Modules of a 150 × 150 m grid | Integration (IN); Building Density (FAR); Diversity of Uses (DVLU) |
| Ye et al. [8] | Urbanity | Grid/block | Choice (CH) Building Density (FAR); Proportion of Built Area (GSI); Vertical Dimension (H); Diversity of uses (DVLU) |
| Delclòs-Alió and Miralles-Guasch [36] | Urban vitality | Modules of a 100 × 100 m grid | Population Density (DPOP); Housing Density (HD); Building Density (FAR); Diversity of Uses (DVLU); Block Size (BLS); Road Section (SW); Diversity of Buildings Age (DAB); Proximity to transport nodes (DTRN); Distance from border vacuums (DBV) |

(*continued*)

**Table 1.** (*continued*)

| Title | Urban condition investigated | Unit of analysis | Independent variables |
|---|---|---|---|
| Ye et al. [19] | Vitality | Block | Building Density (FAR); Proportion of Built Area (GSI); Vertical Dimension (H); Diversity of uses (DVLU) |
| Zeng et al. [38] | Urban vitality | Sub-district | Population Density (DPOP); Road Density (RDI); Building density (FAR); Density of POIs (DPOI); Diversity of Uses (DVLU) |
| Lu et al. [39] | Urban vitality | District | Population Density (DPOP); Local Tax income (LTI); Area (S); Compactness (RCI); Proximity to transport nodes (DTRN); Diversity of Uses (DVLU); Floor rea ratio (FAR); Proportion of Built Area (GSI); Road Density (RDI); POI Density (DPOI) |
| Lu et al. [40] | Vibrancy/vitality | Sub-district | Population Density (DPOP); Price Levels (HPL); Density of Roads (RDI); Proximity to transport nodes (DTRN); Building Density (FAR); Proportion of Built Area (GSI); Diversity of Uses (DVLU); Shape indicator (RCI); Landscape Qual ind (GCI) |

(*continued*)

**Table 1.** (*continued*)

| Title | Urban condition investigated | Unit of analysis | Independent variables |
|---|---|---|---|
| Meng and Xing [33] | Urban Vibrancy | Block | Density of POIs (DPOI); Building Density (FAR); Landscape Shape Index of buildings; Average vertical dimension (H); Perc of non-built A; Road Density (RDI) |
| Sulis et al. [41] | Urban vitality | Spatial Units based on 400 m buffer around stations | Diversity (DV); Intensity (I); Variability (V); Consistency (C); Integration (IN); POI Density (DPOI) |
| Tang et al. [21] | Urban vibrancy | District | Road Integration (IN); Road Choice (CH); Diversity of Uses (DVLU); Density of residence (DPOP); Density of traffic (TRD); Density of POIs (DPOI); Distance to city center; Distance to airport (DTRN) |
| Yue et al. [34] | Vitality | Sub-district | Diversity of buildings age (DAB); Block size; Road junction; Road length (BLS); Diversity of uses (DVLU) Population density (DPOP); Density and diversity of POI (DPOI) (DVLU); Road density (RDI); Proximity to transport nodes (DTRN); Border Vacuum distance (BVD) |

(*continued*)

**Table 1.** (*continued*)

| Title | Urban condition investigated | Unit of analysis | Independent variables |
|---|---|---|---|
| Zhang et al. [42] | Urban vitality | Block | Proximity to transport nodes (DTRN); Road Density (RDI); Block Size (BLS); Vertical Dimension (H); Diversity of Uses (DVLU); Building Density (FAR); Price Level (HPL) |
| Zumelzu and Barrientos-Trinanes [20] | Urban vitality | District | Front Size (BLS); Proportion of Built Area (GSI); Diversity of uses (DVLU); Population Density (DPOP) |
| Fuentes et al. [35] | Urban vitality | Modules of a 100 × 100 m grid | Population Density (DPOP); Housing Density (HD); Building Density (FAR); Diversity of Uses (DVLU); Block Size (BLS); Road Section (SW); Diversity of Buildings Age (DAB); Proximity to transport nodes (DTRN); Distance from border vacuums (DBV) |
| Kim [43] | Urban vitality | Sub-district | Street Density (RDI); Block Size (BLS); Proximity to transport nodes (DTRN); Building Entrance Distance (BED); Building Density (FAR); Open space Ratio (OSR); Diversity of Uses (DVLU) |

(*continued*)

**Table 1.** (*continued*)

| Title | Urban condition investigated | Unit of analysis | Independent variables |
|---|---|---|---|
| Li et al. [24] | Urban vibrancy | District | Density of Roads (RDI); Integration-Choice (IN*CH); Building Density (FAR); Proportion of Built Area (GSI); Diversity of buildings age (DAB); Diversity of uses (DVLU) POI Density (DPOI); Proximity to transport nodes (DTRN) |
| Liu et al. [32] | Urban vitality | Regular grid unit | POI Density (DPOI); Diversity of uses (DVLU); Building density (FAR); Road Access (RA); House price level (HPL); Salary level (SL); Job richness (JR); Business popularity (BP) |
| Niklas et al. [44] | Urbanity | District | Proximity to transport nodes (DTRN); Proportion of Built area (GSI); Industrial A ratio; Population density (DPOP); POI Density (DPOI) |
| Zhong et al. [45] | Living convenience | Building | Daily Accessible Area; Proximity to transport nodes (DTRN); Density and diversity of POI (DPOI); Diversity of uses (DVLU) |

(*continued*)

**Table 1.** (*continued*)

| Title | Urban condition investigated | Unit of analysis | Independent variables |
|---|---|---|---|
| Yue et al. [46] | Urban vitality | Sub-district | Diversity of Uses (DVLU); Block Size (BLS); Diversity of Buildings Age (DAB); Population Density (DPOP); POI Density (DPOI); Ratio of Residential Area (RRES); Road Density (RDI); Border Vacuum Distance (BVD); Proximity to transport nodes (DTRN) |

### 4.1 Definition of Key Aspects

A relevant methodological issue concerns the definition of the unit of analysis. Studies on urban form and vitality focus on the metropolitan scale, and consider as unit of analysis parcels of the built environment ranging from the block to the district scale (see Table 1). In particular, the module of a regular grid super-imposed to the urban fabric emerges as the most frequent utilised unit of analysis (29%). The percentage of studies utilising a subdivision of the urban layout in parcels at the sub-district and district level is equal, in both cases, to 24%. In four cases (19%) the unit of analysis is constituted by the urban block. Lastly, 14 variables are identified as significant factors influencing urban vitality: Closeness Centrality (IN), Betweenness Centrality (CH), Density of Points of interest (DPOI), Diversity of Uses (DVLU), buildings density/floor area ratio (FAR), Proportion of built area (GSI), number of floors or vertical dimension of buildings (H), population Density (DPOP), Block size (BLS), Road density (RDI), Proximity to transport nodes (DTRN), Border Vacuum distance (BVD), Price levels (HPL), and Diversity of buildings age (DAB) (see Table 1). More precisely, border vacuum refers to negative impacts on intensity of pedestrian activities determined in surrounding areas by artificial impermeable borders, constituted by major infrastructures or mono-functional, segregated groups of buildings. Closeness centrality, operationalized in terms of the a-dimensional variable integration, refers to the distance of any space from all other spaces in the same spatial structure; betweenness centrality, operationalised in terms of the a-dimensional variable choice, refers to the probability that a specific space is comprised in the shortest path from any space to all other spaces in the same spatial structure [3, 23, 28, 47, 48]. Consequently, integration and choice capture two fundamental components of the impact of urban layout configuration on accessibility and on patterns of activity: these components are, respectively, the to-movement potential of a space, hence its relevance as a destination, and the through-movement potential of a space, hence its significance as a transit space.

**Table 2.** Relevance of properties of urban form on vitality and vibrancy determined measuring Relevance (REL), Frequency of positive co-relations in literature (FPOS), Frequency of negative co-relations in Literature (FNEG), net influence (NI) and Net normalized influence (NET)

| Variable | N | REL | FPOS | FNEG | NI | NET |
|---|---|---|---|---|---|---|
| HPL (Price Level) | 3.00 | 0.14 | 0.67 | 0.00 | 0.67 | 0.10 |
| IN (Closeness Centrality) | 3.00 | 0.14 | 0.67 | 0.00 | 0.67 | 0.10 |
| BVD (Border Vacuum distance) | 4.00 | 0.19 | 1.00 | 0.00 | 1.00 | 0.19 |
| CH (Betweenness Centrality) | 4.00 | 0.19 | 0.50 | 0.00 | 0.50 | 0.10 |
| H (Vertical dimension) | 4.00 | 0.19 | 0.50 | 0.25 | 0.25 | 0.05 |
| DAB (Diversity of Build. age) | 5.00 | 0.24 | 0.80 | 0.00 | 0.80 | 0.19 |
| BLS (Block Size) | 8.00 | 0.38 | 0.00 | 0.75 | -0.75 | -0.29 |
| GSI (Ratio of built area) | 9.00 | 0.43 | 0.56 | 0.11 | 0.44 | 0.19 |
| RDI (Road Density) | 9.00 | 0.43 | 0.44 | 0.00 | 0.44 | 0.19 |
| DTRN (Proximity to Transport nodes) | 11.00 | 0.52 | 1.00 | 0.00 | 1.00 | 0.52 |
| DPOP (Population Density) | 11.00 | 0.52 | 0.82 | 0.09 | 0.73 | 0.38 |
| DPOI (Density of POIs) | 12.00 | 0.57 | 0.83 | 0.00 | 0.83 | 0.48 |
| FAR (Building Density) | 13.00 | 0.62 | 0.69 | 0.08 | 0.62 | 0.38 |
| DVLU (Diversity of Uses) | 19.00 | 0.90 | 0.95 | 0.00 | 0.95 | 0.86 |

Despite their significance, the relevance of Integration and Choice as explanatory/independent variables in studies on urban vitality, is modest and equal to 0.14 and 0.19, respectively, and the frequency of positive co-relations on vitality is equal to 0.67 for Integration and 0.50 for Choice, determining a Net Influence equal to 0.10 for both variables (see Table 2). Diversity of primary and secondary uses and of points of interests, measured via Shannon's Entropy index, emerges as the most relevant independent variable (see Table 2). Relevance is equal to 0.90, the frequency of positive co-relations is equal to 0.95, determining a net normalized influence of 0.86. Diversity of uses emerges, thus, as the most significant condition of the built environment associated to urban vitality. Density of POIs, and proximity of transportation nodes also emerge as factors of the urban structure relevant in terms of impact on vitality and vibrancy. Relevance is equal to 0.57 and to 0.52 respectively, Frequency of positive co-relations to 0.83 and 1.00 and the net normalized influence on vitality is equal to 0.48 and 0.52 respectively. Building Density, measured via the Floor Area Ratio indicator, and Population density, are listed as distinct variables, despite expressing concentration of population, considered as a factor influencing opportunities for social contacts. Yet, as observed by Jacobs, conceptualization of concentration in terms of population density could engender an ambiguous representation of conditions of congestion that determine negative impacts on vibrancy and vitality. Relevance of Building density and Population Density is equal to 0.62 and 0.52, the Frequency of positive co-relations to 0.69 and 0.82 respectively and the Net normalized influence is equal to 0.38 for both variables. A relevant factor, engendering a

negative influence on vitality is Block size: the relevance is equal to 0.38, its frequency of negative co-relations is equal to 0.75, determining a net normalized influence equal to −0.29. Lastly, a modest significance as a condition for vitality is observed for factors Ratio of built area (NET = 0.19); Road density (NET = 0.19), Border vacuum distance (NET = 0.19), Diversity of Buildings age (0.19), Price levels (=0.10) and vertical dimension of buildings (NET = 0.05) (see Table 2). The results presented in this section, and their implications in terms of perspectives for operationalising the relation among built environment components and vitality, are comprehensively analysed and discussed in the subsequent section.

## 5 Discussion

Results presented in the previous section encompass a set of implications for the development of an analytical method for assessing urban form in terms of its influence on urbanity and vitality. A first observation concerns the terminological ambiguity in the definition of the dependent variable. Vitality, vibrancy and urbanity can not be considered as synonym. Urbanity refers, in fact, to a condition resulting from a specific configuration of practices and socio-political interactions incorporated into urban form and influencing the sense of place. On the other hand, vitality and vibrancy respectively denote the capacity of the built environment to facilitate social practices and economic activities and the potential of a place to respond to basic human needs and social public demands. As a consequence, the concept of Urban Intensity is herein introduced to denote the potential of the built environment to promote utilitarian, recreational and social activities, fostering inter-personal contacts and meaningful human-environment transactions, conducive to sociability and sense of place. A second consideration concerns the impact of data availability, comprehensiveness, consistency and accuracy on the validity, representativeness, replicability and relevance of indicators formulated to objectively and quantitatively describe built environment and its influence on human practices [23]. A further issue concerns the definition of the unit of analysis. The selection of blocks or block-groups as the object of study is consistent with the organization of urban governance processes. Blocks and blocks groups are considered, in fact, as independent spatial units which can encompass diverse functions. Consequently, they emerge as elementary components of the urban landscape, and as the primary object of design, development, planning and management actions [42]. Yet, the selection of regular grid cells as the unit of analysis implies the homogeneity of the spatial elements investigated. In this case, the dimension of the cell unit should not be so modest to separate plots and buildings related variables from public space configurational variables, nor so ample to reduce the resolution- and the relevance - of the description of the urban landscape [8, 9, 36]. With regard to the components of urban form that influence vitality, results underline the validity of Jacobs' observations concerning the quantity, plurality and variety of functions and of primary and secondary uses, as a central condition for producing social and economic vitality. A further relevant aspect of built environment is the transport dimension of accessibility: both the density or proximity of transportation nodes, and the porosity and permeability of the urban layout emerge as significant conditions for vitality. Yet, existing studies tend to focus on connectivity, as the configurational property of the urban layout that primarily affects accessibility. Connectivity,

operationalized in terms of Block Size or Road Intersection Distance and Road density, emerges as the second most relevant factor (REL = 0.76), determining a net normalized influence, obtained aggregating indicators calculated for Block Size and Road Density, equal to 0.48.

As a consequence, a relevant gap in the existing literature concerns the comprehensive consideration of the influence of urban layout configuration on patterns of movement, and, more precisely, the operationalization of centrality. Space syntax theories underline, in fact, the relevance of the configurational properties of betweenness centrality and closeness centrality, described in quantitative terms by the indicators Choice and Integration, as extrinsic factors that affect patterns of natural movement, co-presence and co-awareness, safety and consequently, the distribution of economic activities and the formation of local centres [3, 27, 28, 49].

Consequently, an analytic method for assessing urban intensity, should encompass indicators representative of configurational properties of the system of public open spaces, including betweenness and closeness centrality and connectivity, distribution of transit nodes, concentration of population, spatial arrangement of plots, and land uses patterns, operationalized in terms of density and diversity of functions. Moreover, the development of quantitative methods combining spatial analysis and space syntax techniques is instrumental in the application of the geodesign paradigm to the urban context. Geodesign is defined, in fact, as a set of concepts and methods for using geographic knowledge to inform design and planning processes. It emerges as a perspective central to supporting smart and sustainable urban development. Consequently, its effective application to the urban context requires the establishment of techniques for the quantitative analysis of urban landscape aimed at assisting in the comprehensive understanding of the spatial culture embodied in urban morphology.

## 6 Conclusions

This article presents a Literature review on Urban morphology and on its influence on urbanity, vitality and vibrancy. The objective is to define a theoretical framework for operationalizing the relation between urban morphology components and vitality. The study focuses, primarily, on four issues. First, the terminological ambiguity, engendered by the utilization of the terms vitality, vibrancy and urbanity. The second issue concerns the definition of the optimal unit of analysis, as a pre-condition for a relevant, representative and precise quantitative description of urban morphology. The third issue concerns the identification of relevant dimensions of urban morphology. The last aspect is the identification of properties of the built environment related to vitality, vibrancy and urbanity, of representative indicators, the evaluation of their relevance across the literature, and of their significance as independent variables.

The relevance of this study lies in three aspects: firstly, the introduction of the concept of urban intensity, to denote the potential of the urban landscape to promote pedestrian activities, social contacts and meaningful experiences of urban spaces, conducive to sense of place and involving the dimensions of subjectivity and sociability. Secondly, the identification of properties of the built environment, including diversity of land uses, density of points of interest, proximity to transportation nodes, concentration of

population, connectivity, centrality, emerging as significant conditions of intensity and urbanity. Lastly, this study underlines a major gap in existing literature, consisting in the marginal consideration of effects of urban space configuration on patterns of movement and activity. In particular, the topological properties of closeness centrality and betweenness centrality are limitedly considered, despite research in space syntax theory has demonstrated their influence on natural movement, co-presence, co-awareness and on the formation of centres of economic activity. Findings from this study represent the first stage of a research aimed at developing a methodological framework for the quantitative analysis of urban morphology in terms of its effect on vibrancy, intensity and urbanity. The development of quantitative methods analysis is instrumental to the introduction of the geo-design paradigm into the context of urban planning and urban governance. Geo-design, as a conceptualization of design as an iterative process based on geo-spatial information, impact simulation and stakeholders inputs, emerges as a set of notions and methods facilitating holistic planning and design processes and assisting smart and sustainable urban development [50]. Yet, as observed by Ye et al. [8] the absence of analytic methods for adequately understanding urban form limits the effectiveness of current geo-design methods in supporting urban design. As a consequence, the future development of this research will focus on the definition of a set of indicators and of a model for operationalizing properties and factors of urban form that affect urban intensity. The objective is, thus, the development of a method for the quantitative analysis of urban morphology aimed at supporting urban planning by measuring the potential of the built environment to foster the intensification of individual and group practices, and by individuating fragile areas and emergent urban landscape criticalities.

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