

**Paper Title:** Exploring Spatial Patterns in Sustainable Integrated Districts: A Methodology for Early-Phase Urban Network Analysis

**Paper Link:** [Link](#)

## **Summary**

### **1.1 Motivation/purpose/aims/hypothesis**

The paper is motivated by the need to understand how the spatial configuration of urban districts affects their sustainability and livability. The paper aims to propose a new methodology for early-phase analysis of large urban spatial networks using Social Network Analysis (SNA) based on Graph Theory. The paper hypothesizes that SNA can reveal the spatial patterns and characteristics of urban districts that influence their performance and potential for integration.

### **1.2 Contribution**

The paper contributes to the literature on urban network analysis by introducing a new methodology that combines two SNA methods that capture pedestrian movement patterns differently: the Space Syntax method, which uses axial lines to represent the connectivity and accessibility of urban spaces; and the Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) method, which uses nodes and links to represent the hierarchy and diversity of urban transport modes. The paper also contributes to the literature on sustainable urban design by applying the methodology to the case of one-north, a planning subzone in Singapore that aims to be a sustainable integrated district.

### **1.3 Methodology**

The paper uses a mixed-methods approach that combines quantitative and qualitative methods. The paper uses spatial data from various sources, such as OpenStreetMap, Google Maps API, and Singapore Land Authority, which contain information on the land use, street network, building footprint, green space, and public transport network for one-north. The paper uses these data sources to create two spatial network models for one-north: one based on the Space Syntax method and one based on the SNAMUTS method. The paper then uses these models to calculate various SNA metrics, such as degree centrality, closeness centrality, betweenness centrality, clustering coefficient, and modularity, for each spatial unit in one-north. The paper also uses qualitative methods, such as site visits and interviews with stakeholders, to validate and interpret the results of the quantitative analysis.

### **1.4 Conclusion**

The paper concludes that the SNA methodology can reveal the spatial patterns and characteristics of one-north that influence its sustainability and livability. The paper finds that one-north has a high degree of connectivity and accessibility within its subzones but a low

degree of integration across its subzones. The paper also finds that one-north has a high diversity of land use and transport modes but a low hierarchy of transport modes. The paper suggests that urban planners and designers can use this methodology and findings to inform spatial planning and design interventions that can enhance the integration and performance of one-north.

## **Limitations**

### **2.1 First Limitation/Critique**

One limitation of the paper is that it relies on static spatial data that may not reflect the dynamic nature of urban networks. For example, some spatial data may be outdated or inaccurate due to changes in the urban environment or errors in the data collection or processing; some spatial data may not capture the temporal variation of urban networks due to seasonal or daily fluctuations in pedestrian movement patterns or transport demand; and some spatial data may not capture the behavioral variation of urban networks due to individual or group preferences or constraints in choosing urban spaces or transport modes. These issues may affect the validity and reliability of the spatial data and introduce noise or bias into the analysis.

### **2.2 Second Limitation/Critique**

Another limitation of the paper is that it assumes a linear relationship between SNA metrics and urban performance indicators without considering other factors that may influence them. For example, some SNA metrics may have nonlinear or interactive effects on urban performance indicators depending on the context or scale of analysis; some SNA metrics may have trade-offs or synergies with other SNA metrics or other urban performance indicators depending on the objectives or priorities of analysis; and some SNA metrics may be influenced by other factors besides spatial configuration, such as social, economic, environmental, or institutional factors. These issues may affect the accuracy and sensitivity of the SNA metrics and overlook the complexity and diversity of urban networks.

## **Synthesis**

The paper provides a novel and comprehensive perspective on how social network analysis based on graph theory can be used to explore spatial patterns in sustainable integrated districts. The paper demonstrates the importance of considering spatial configuration as a key factor that influences urban sustainability and livability. The paper also shows how spatial configuration can be modeled and measured using various data sources and tools, which can facilitate the integration of spatial information into urban planning and design processes. The paper suggests that urban planners and designers can use this methodology and findings to inform spatial planning and design interventions that can enhance integration and performance of urban districts.

The paper's ideas relate to potential applications or future scopes in several ways. For example, the paper's methodology can be applied to other urban districts or regions that have different

spatial characteristics, objectives, or challenges, which can provide comparative insights and best practices. The paper's SNA metrics can be refined or extended to include other spatial indicators, such as density, diversity, or efficiency, which can capture more aspects of urban sustainability and livability. The paper's analysis can be updated or repeated with more dynamic or diverse spatial data, such as from mobile phone or GPS tracking, which can provide more realistic and timely information on urban networks and behavior. The paper's findings can be translated or communicated to various stakeholders, such as policymakers, practitioners, researchers, or citizens, who can use this information to make informed decisions or actions regarding urban network issues.