

It is a challenge of planning, it is a triumph of planning. It is a place with limited resources, it is a place with unleashed opportunities. This is a narrative of three tales of one city, the regional planning of Singapore.

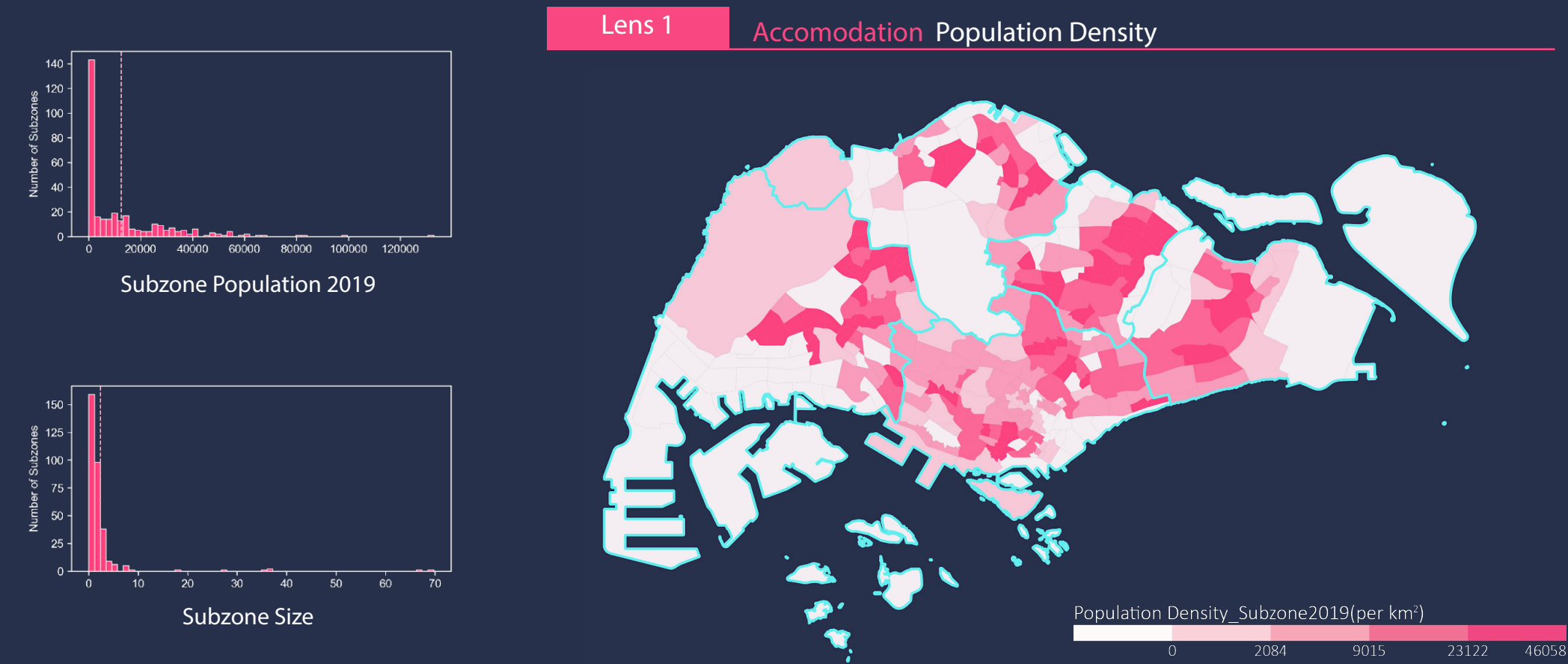
Singapore is a city-state known for its small size, dense population, economic success, and livable built environment. It is often related with ideologies such as efficiency, growth, technocracy, meritocracy, and sustainability. Prudent planning is what makes Singapore work, and its planning is laid out collectively across multiple statutory boards, involving different topics such as public housing, transit, and parks.

Intrigued by its planning challenges and success, we examine the outcome of Singapore's regional planning through three lenses: accommodation, accessibility, and nighttime activities, which are quantitatively evaluated by population density, transit centrality, and VENU Index. The comparison part weaves together the three branches, where we define new groups based on the distribution pattern of the 3 resources.

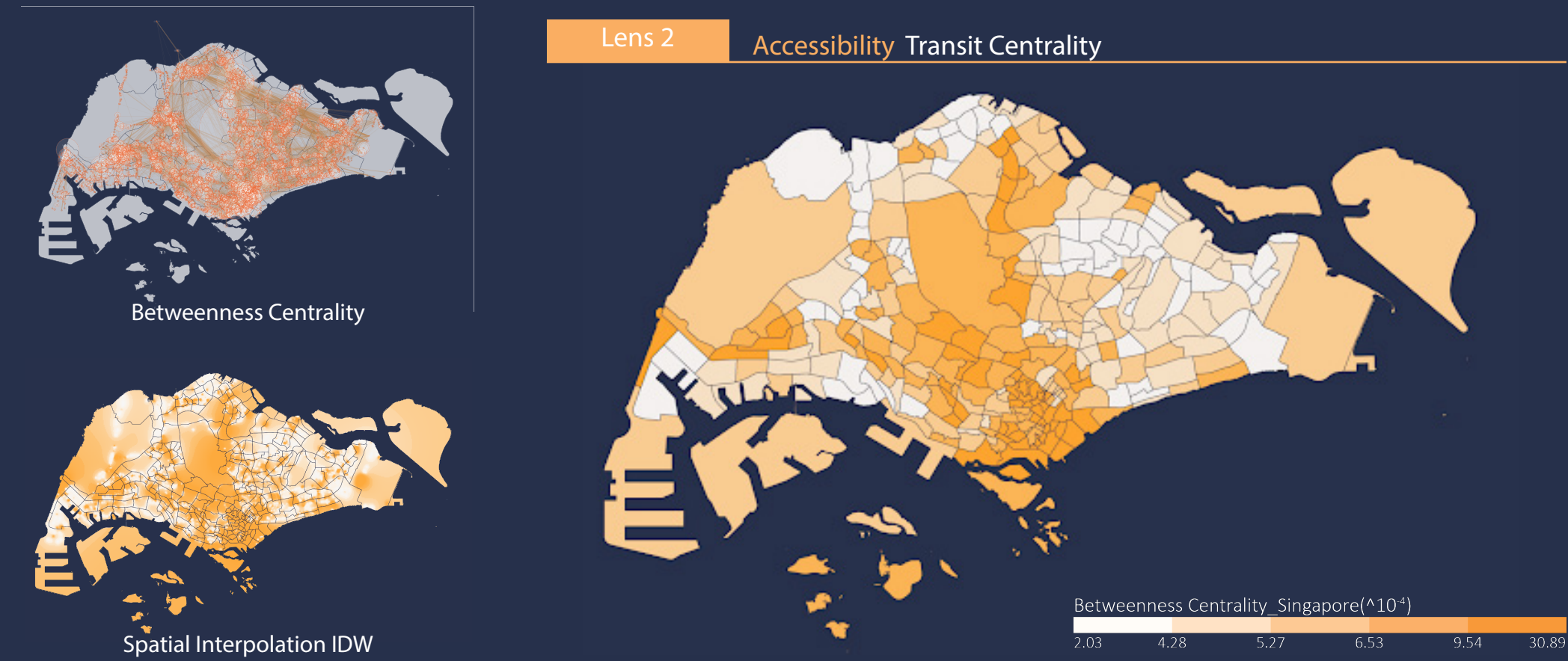
# Three Tales of One City

## Exploring Singapore's Regional Planning

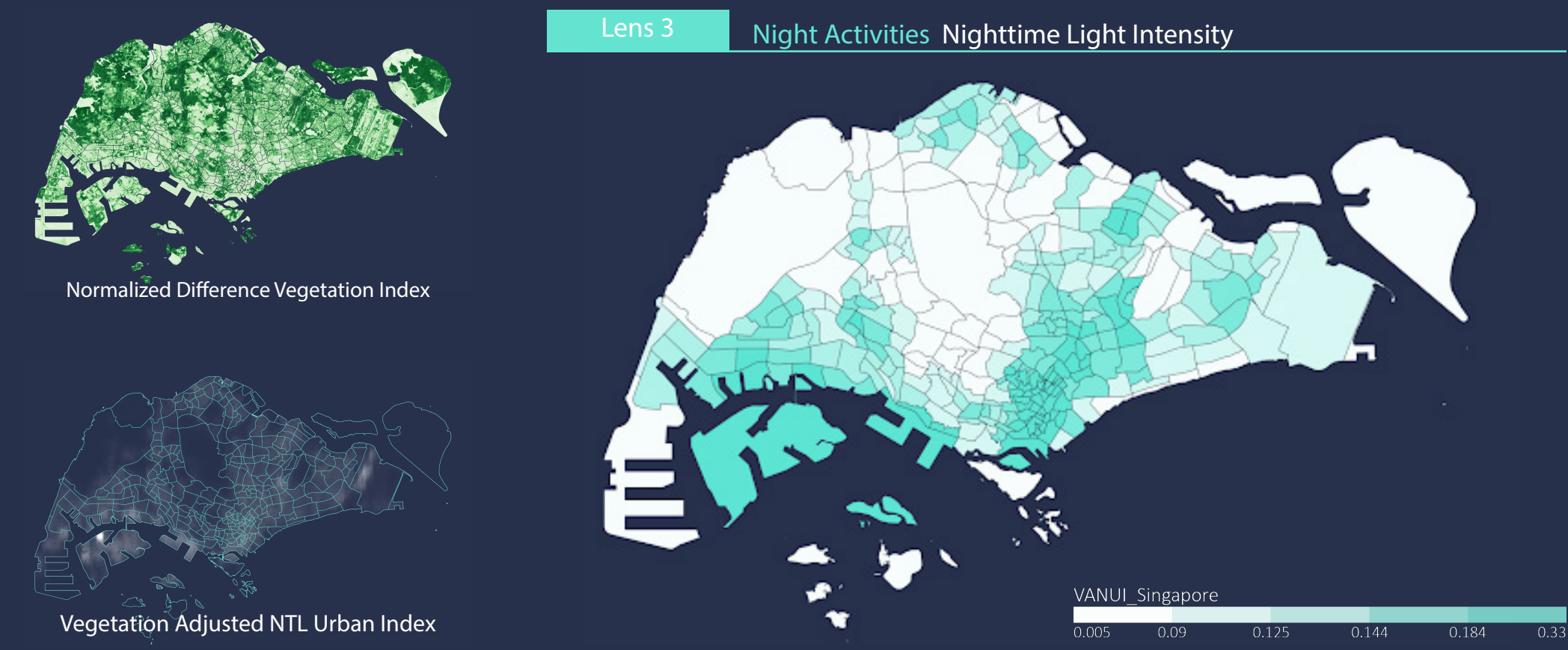
Advanced Spatial Analysis Kari Gao, Xinyu Liu, Shiyu Ma



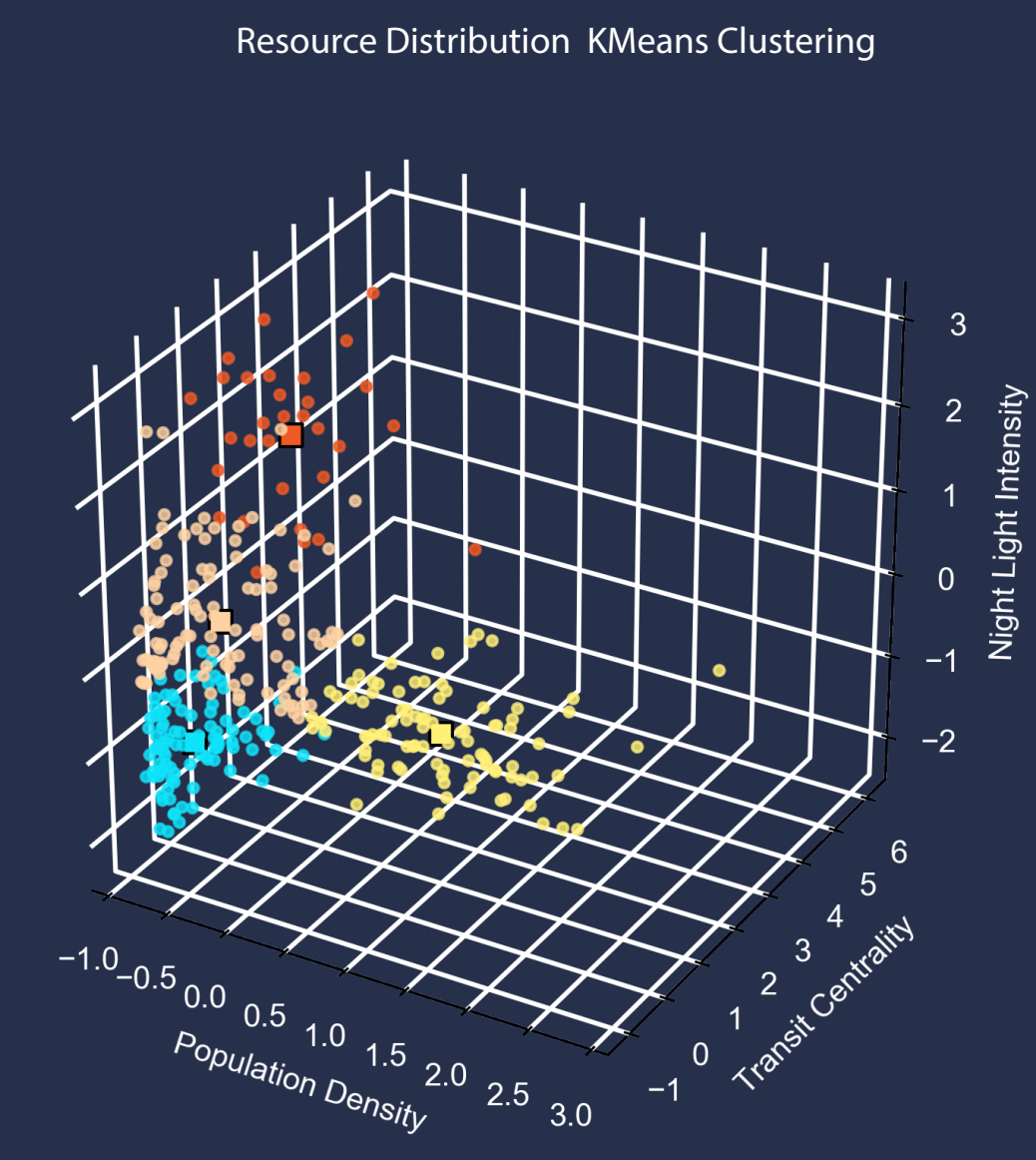
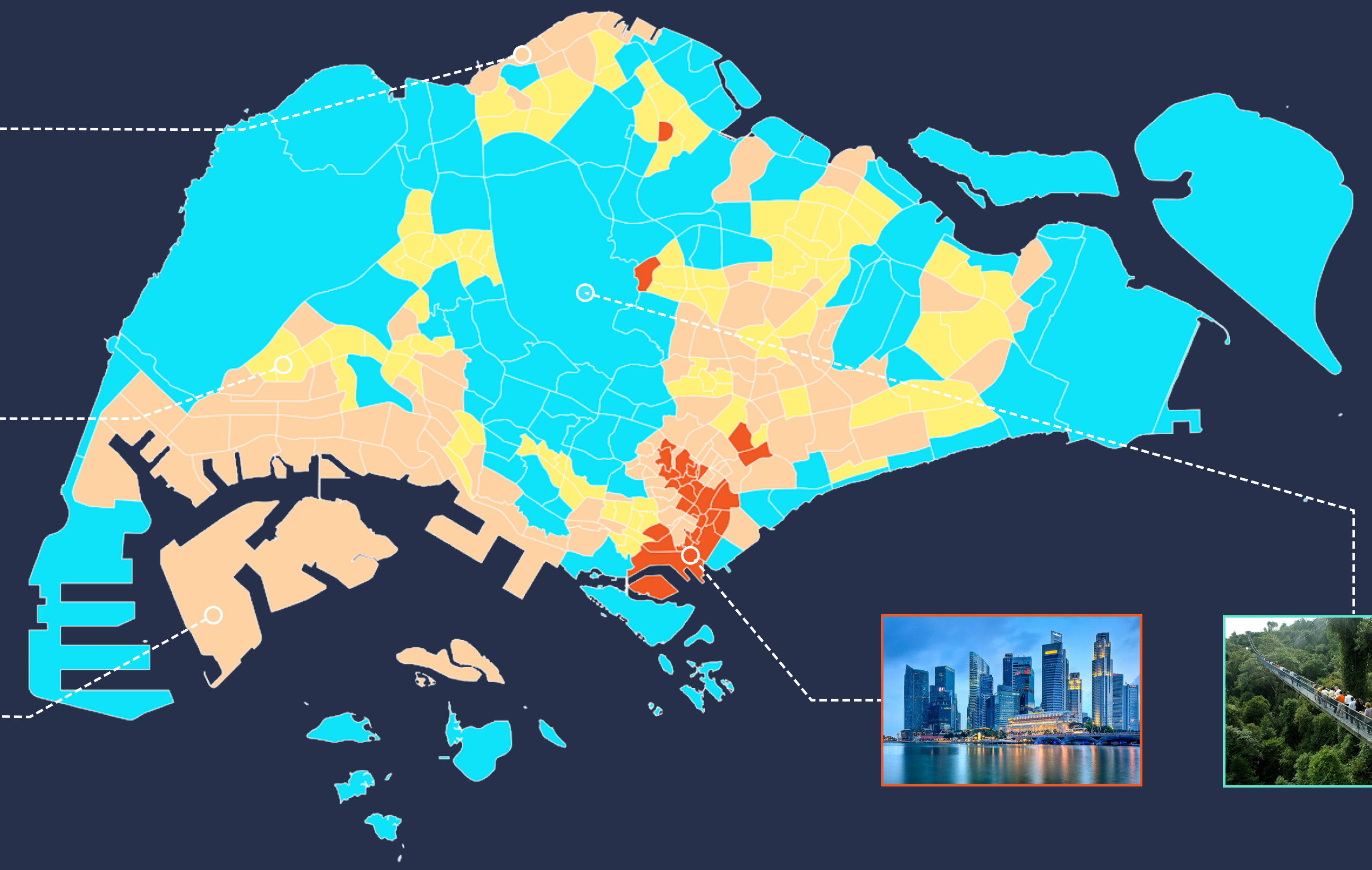
From the population density map on the right, one can immediately notice that population density does not follow a conventional monocentric pattern. Each planning region seems to have its own population density hotspot.



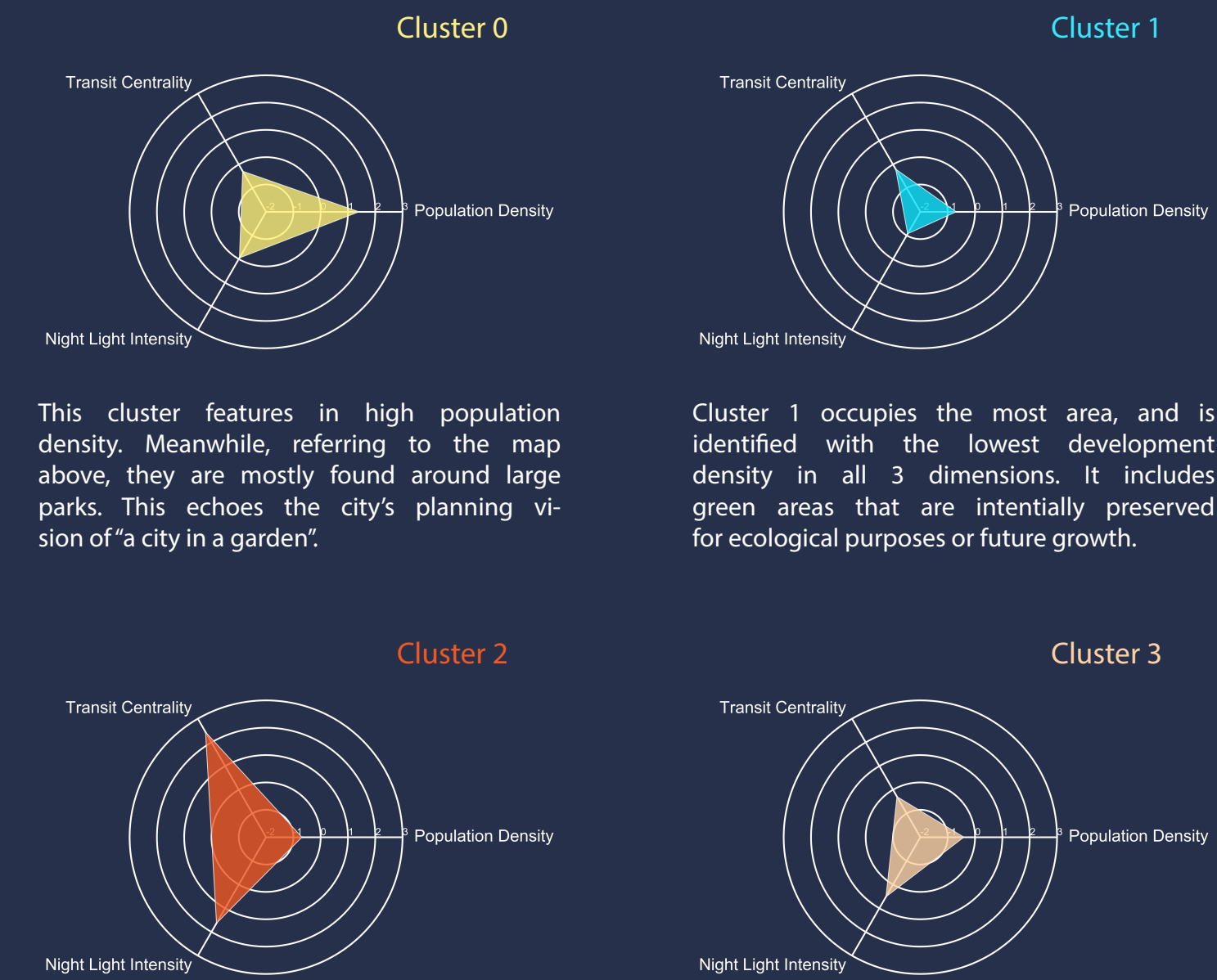
By using the origin-destination data from both the MRT and bus system, a transit network that shows passenger volume between each pair of station is constructed. Based on this network, betweenness centrality, which measures how accessible a node is, is calculated for each station and then interpolated with IDW method to the entire Singapore. The interpolated result is averaged to the planning subzones, and the darker color refers to higher accessibility. It can be seen that the most accessible areas are located in the south of the city, mostly around the downtown area.



Night time light is a powerful tool to describe urban context. However, the original night light data suffer from coarse spatial resolution and blooming effect. Therefore, we normalized and resampled the data, and then adjusted it using vegetation data from LandSat 8, which gave us a compound index named VANUI. The spatial resolution is enhanced significantly to 30m. Same as the first two lenses, we averaged the cell values to the subzone level. From this map above, we can observe some patterns of night light intensity in the city, e.g. light spots can be found in the downtown area, airports, and port area.



The K-Means clustering algorithm is applied here to divide the 323 planning subzones in Singapore into 4 groups, each of which has a typical combination of three measures. The 4 clusters therefore reveal the city's structure, specifically in terms of the distribution of accommodation, transit, and nighttime activities.



This cluster features in high population density. Meanwhile, referring to the map above, they are mostly found around large parks. This echoes the city's planning vision of "a city in a garden".

Cluster 2 stands out in transit centrality and night light intensity. Most of it is the commercial hub in downtown. The two areas in the north are new centers that are planned to bring jobs closer to residents.

Cluster 1 occupies the most area, and is identified with the lowest development density in all 3 dimensions. It includes green areas that are intentionally preserved for ecological purposes or future growth.

Cluster 3 identifies the industrial areas, including the well-known Jurong industrial district in the southwest. As an entrepot and manufacture hub in Asia, the city-industry integrated model remains a core.

