

# **Spatial Analysis for e-Bike Market in Singapore**



**Submitted by:**

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## **Introduction**

Cars as a mode of transportation changed the way people used to travel. Initially it was considered as a luxury product and represent the social status as it was scarce and highly priced. But gradually as the production increased and cars became very common. When everyone can finally enjoy the ride with his or her dream car, now the society has to pay the price: traffic congestion, noise pollution, air pollution, lack of parking space, increased gasoline and diesel price etc. These issues cannot be neglected and when a serious thought was given to solve this problem bike sharing was solving many problems. It has become very popular all of a sudden.

Europe was the first to introduce the bike sharing into the world and it turned out to be a huge success. Gradually this concept was widely spread all across the world in many major countries like China. This has grown recently in Singapore also. There are many benefits of using this: first, bicycles do not add to the carbon footprint or traffic congestion. Second, they are ideal for last-mile travel (from bus stops/train stations to home). Finally, compared with other modes of travel, biking is healthier and cheaper option.

## **Objective**

With the increase in bike sharing in Singapore, issue of bikes parked randomly at bus stops, dock less, at pavement meant for public places or some even dumped at unwanted location and drains, has been observed. Unfortunately, this problem of indiscriminate parking is causing inconvenience to public and pedestrians. It also introduces a complex issue of bikes being left at locations at which they may pose a hazard or impede pedestrian traffic. Moreover, there is no guarantee that the location is easily accessible.

This geospatial analysis is for a new e-bike company who wants to enter the bike sharing market with a new e-bike product which runs on battery. These e-bikes can run at faster speed and take less space to park. This will be solving the problem stated above by introducing the fixed docking stations for e-bikes at various locations of the city. Each of these stations has a fixed capacity (typically around 20 e-bikes). Customers can swipe a card at the docking station to get access to the e-bike, and they drop it off at another station near their destination. These docking stations will be having an in-build charging point as well which will help to charge the e-bike once it is parked at the station. By doing a spatial analysis we aim to find the market for e-bikes in the city.

## **Data Collection and Preparation**

For this visualization and analysis, the data was taken from different publicly available resources for the year 2016.

*Data Sources Links:*

<https://data.gov.sg/>

<https://www.lta.gov.sg/>

<https://www.singstat.gov.sg/>

The obtained information on the data was first cleaned refined and transformed.

*Different transformations done:*

- For instance, we had postal codes on which we used geocoding to extract longitude and latitude details for all residential units.
- Identified and removed NULL values in records

*File Type used:*

.csv Files

SHP Files

In our project we are considering various factors affecting the installation of new e-bikes docks in Singapore:

- Population Density
- Residential Units (Private & Public)
- Existing Cycle Racks
- Bus Stops
- MRT Stations
- Theft Cases

## Spatial Analysis

### 1) Population Density

*(Polygon Feature)*

The overall population of all age groups was considered to plot on map. With the help of ARC GIS online the more denser area was mapped with darker colors compared to different lighter shades of color as the population density was reduced. This plot helps to analyze the areas where more e-bike can be introduced with the help of population distribution.

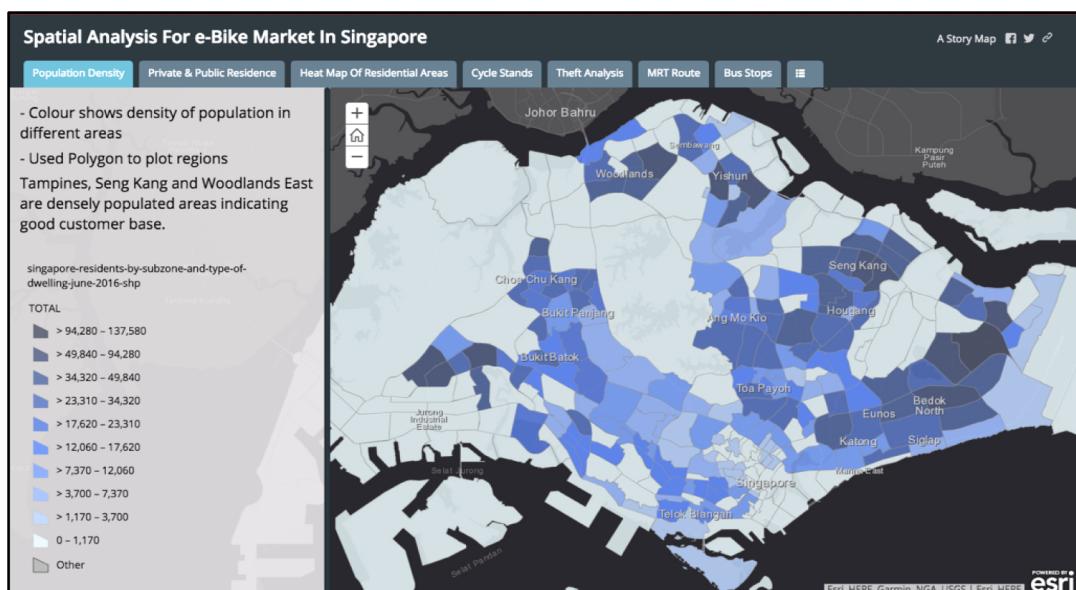


Figure 1: Spatial analysis of population density

**Observations:** Tampines, Seng Kang, Woodlands East came out to be the densely populated area which will act as a good customer base.

## 2) Private & Public Residence

(XY Coordinate Feature)

Singapore has two type of residential units i.e. Private and Public which are located all around. The data set for all of them was obtained and plotted on the map. The private was plotted with orange color and public units were plotted with black color on the same map so as to differentiate them. This plot helps us to analyze the areas with high population and max number of residence apartments and based on that the docks can be install on such areas.

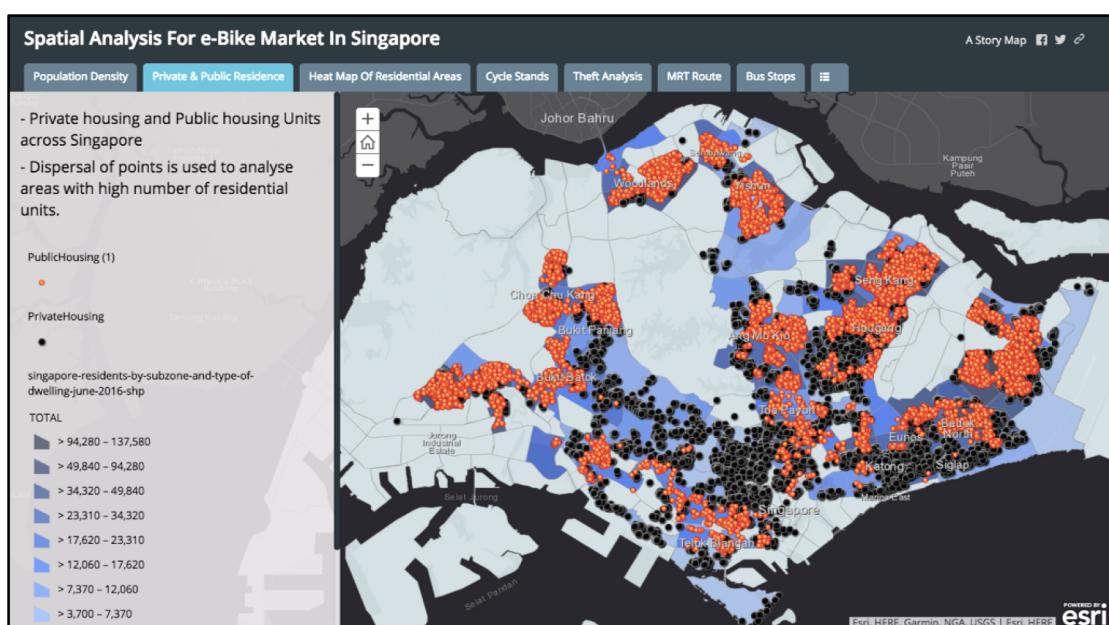


Figure 2: Spatial analysis of private & public residential

**Observation:** Public and Private residential units are plotted, and some areas are highly populated and also high number of residential units.

## 3) Residential Area

Analysis Type → Merge Layer

Two layers i.e. Public residential units & Private Residential Units are merged and plotted on same map. The map obtained was analyzed by the heat maps to get the concentration of areas with maximum number of residential units.

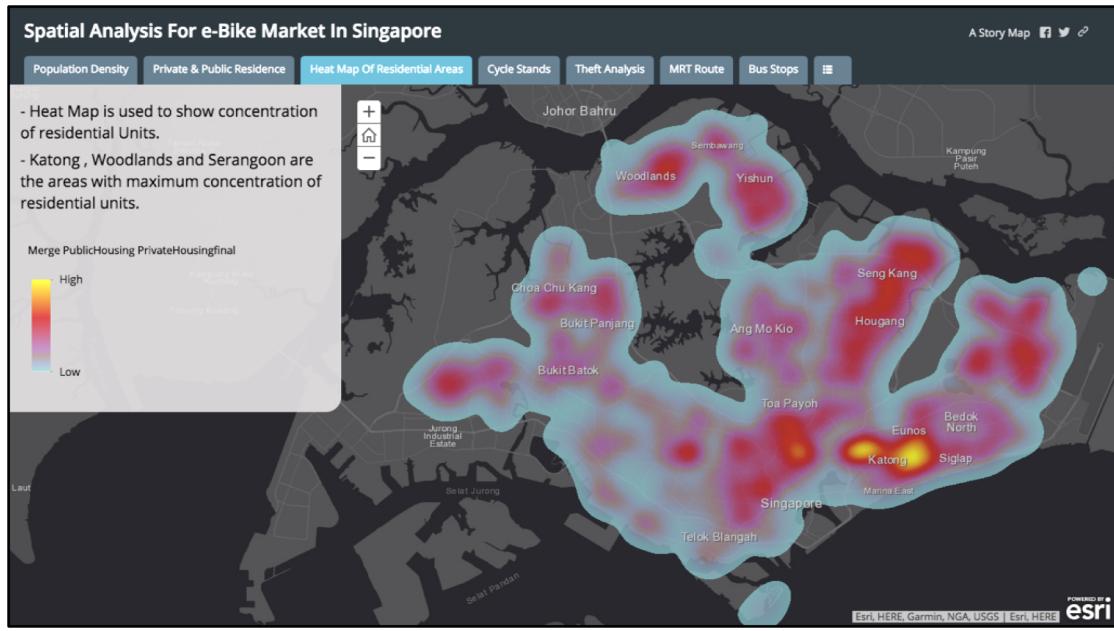


Figure 3: Spatial analysis of residential areas density (merged layers)

**Observation:** Katong, Woodlands and Serangoon areas were highly concentrated with maximum residential units.

#### 4) Cycle Stands

Data points plotted show the various cycle stands currently existing all around Singapore. These can be used for docks and installation of new racks will be required in areas with less no of cycling racks.

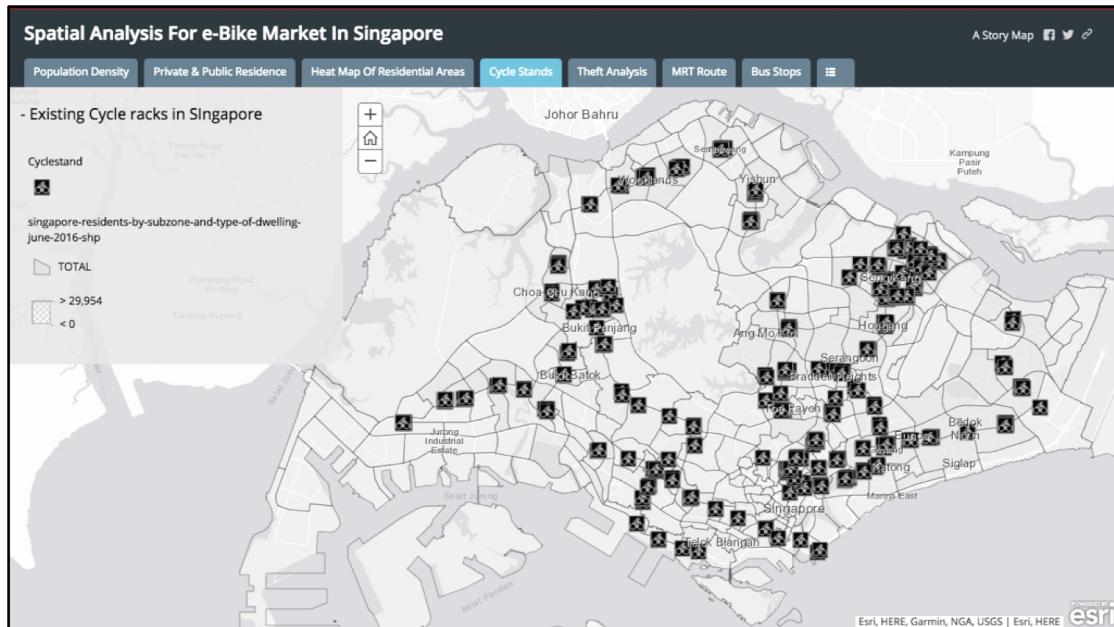


Figure 4: Spatial analysis of existing cycle stand

## 5) Bus Stops

Buses are wide spread in Singapore connecting almost all the places. Hence there are so many bus stops all over. For our study we plotted the bus stops and used buffer analysis. A buffer is an area that covers a given distance from a point, line, or area feature. The analysis helped us to find out the areas which are walkable by 500 meters around the bus stop.

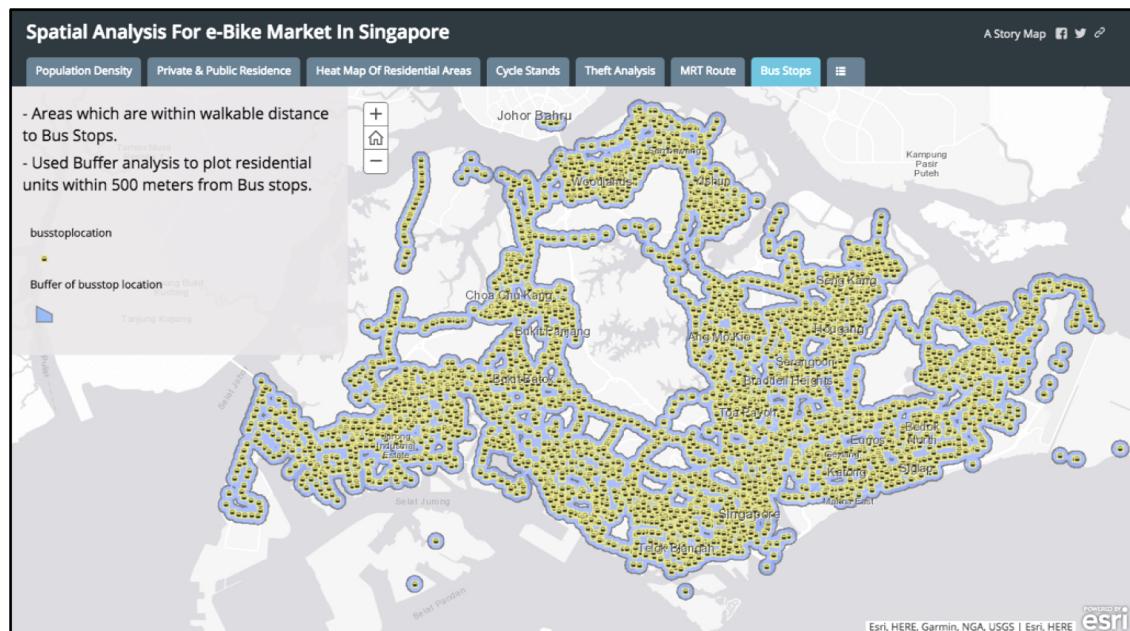


Figure 5: Spatial analysis of bus stops

## 6) MRT Stations

MRT covers the complete Singapore. The plot is obtained by plotting the MRT station is obtained for different places and connecting all of them. By using the **drive time analysis**, we found and highlighted the walkable areas which are 500 Meters around every MRT station. MRT stations and further analyzed based on the population density in the focused area.

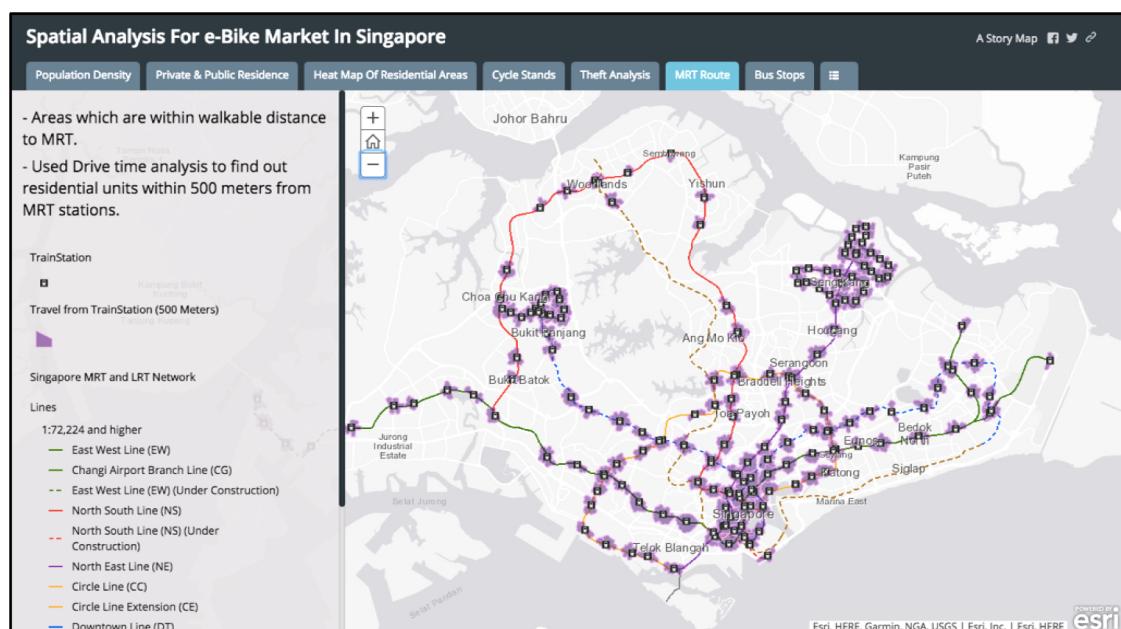


Figure 6: Spatial analysis of MRT stations

## 7) Potential Residential Units Analysis

Combination of residential units(Public & Private) and the public transport (MRT and Buses) having a buffer of the 500 meters was plotted and based on the **Proximity analysis** the residential units which are not within walkable distance from public transport were identified.

**Overlay tool** was also used to extract the outlier(Residential Units) identified in first analysis and plot them on the map separately. These units will give idea of the promising areas for installing the additional e-bike.

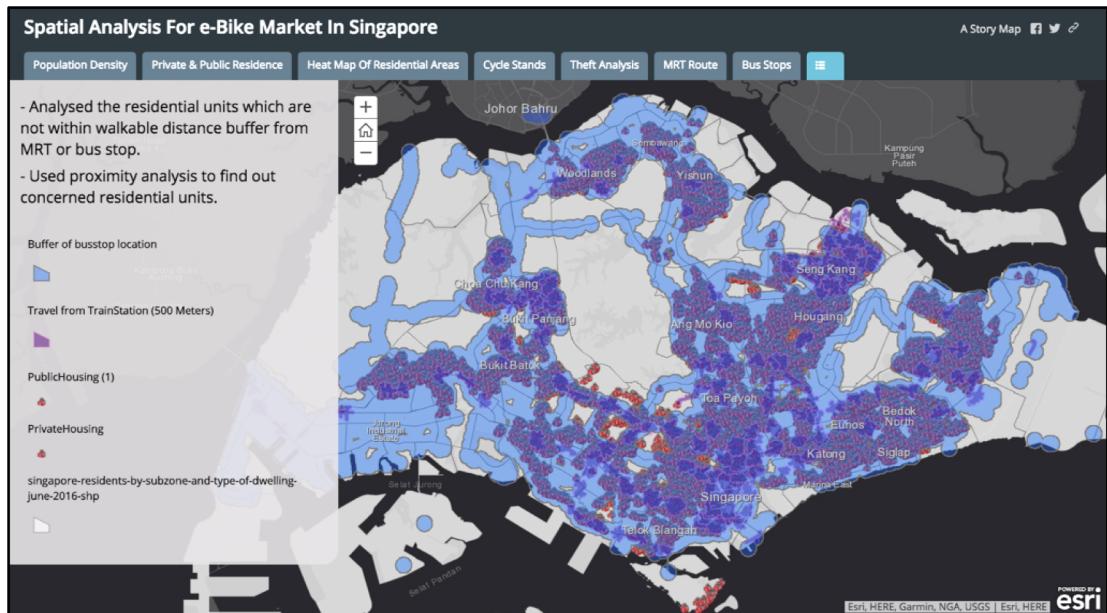


Figure 7: Spatial analysis of Potential Residential Units

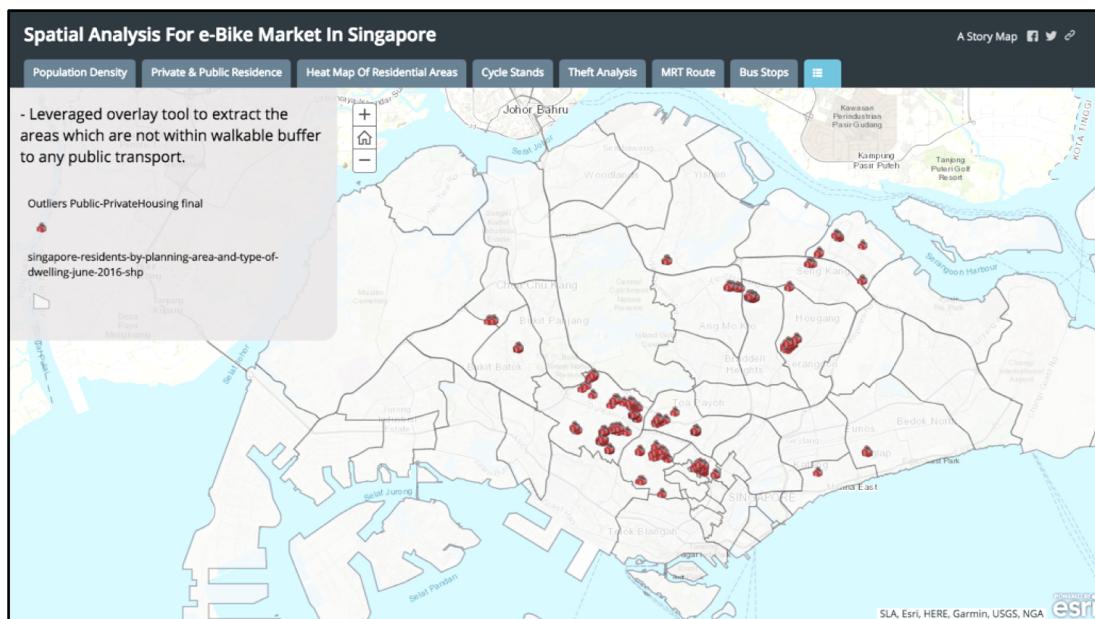


Figure 8: Spatial analysis of Potential Residential Units

## 8) Targeted Clusters

We are using **Spatially Constrained Multivariate Clustering tool (SCMC)** to cluster the potential residential units to place e-Bikes and charging docks. Using SCMC we constructed clusters with space (and potentially time constraints, when using a spatial weight matrix). We got a total of 30 clusters through this technique

The default option of Trimmed Delaunay triangulation which will ensure all cluster members are proximal and that a feature will only be included in a cluster if at least one other feature is a natural neighbor.

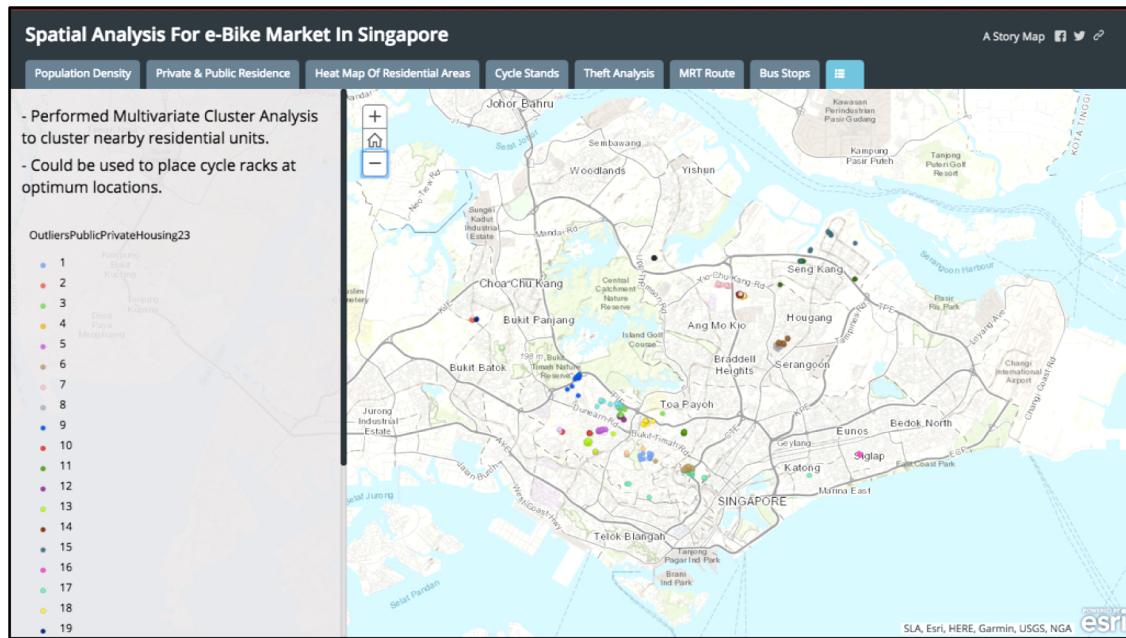


Figure 9: Spatial analysis of targeted clusters

## 9) Specific zone analysis for Tanglin

After observing the outliers, we focused on one specific area, **Tanglin** using **clipping technique**. On closer look we observed that the residential units which do not fall under any public transport coverage area are also the potential customers.

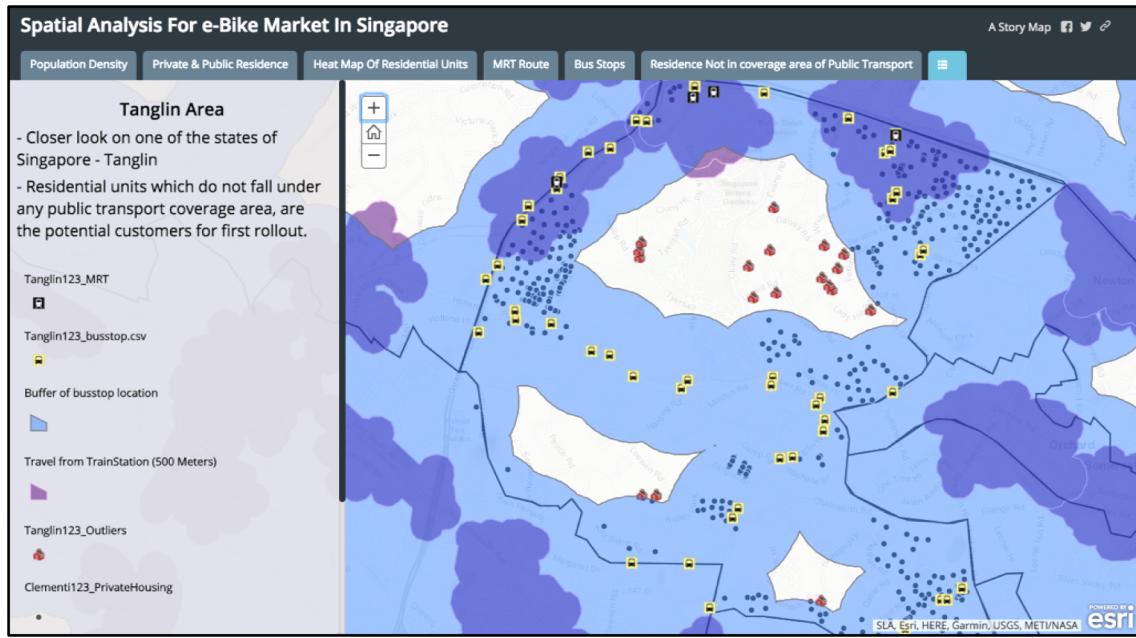


Figure 10: Spatial analysis of Tanglin area

## 10) Crime

Crimes in Singapore exists in many forms. For our analyzes we are considering theft & robbery at different places annually as this would affect the business of the company. Hence the number of reported crimes were plotted for all the area and analyzed with the population and apartments distribution. This gave an insight to the company to install less number of e-bikes if there were more crimes in a particular area. Initially based on the observed areas will have a reduced number of cycles and the dock facility.

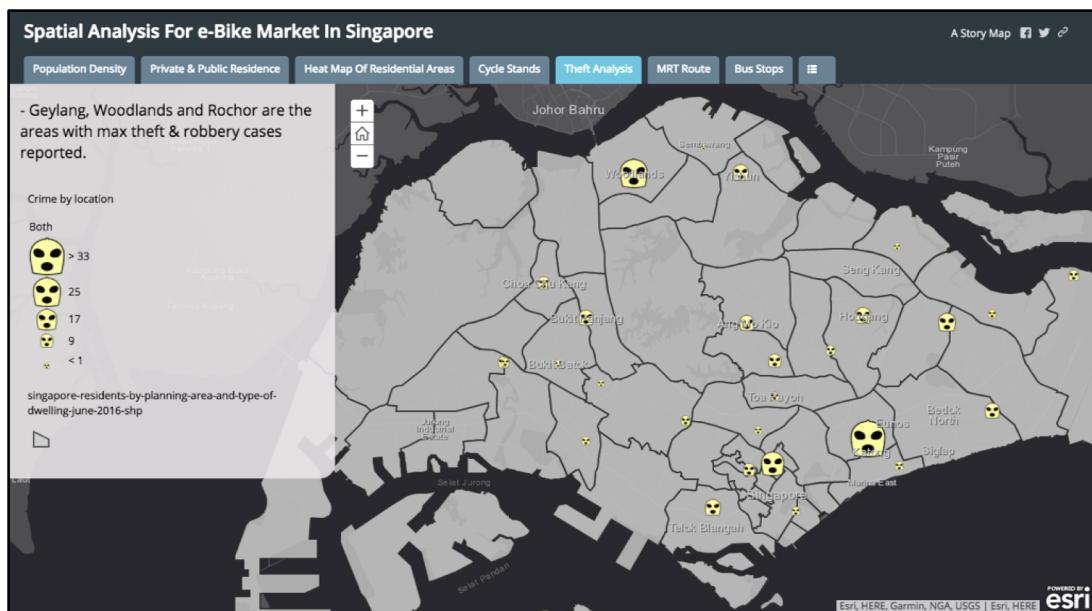


Figure 11: Spatial analysis of theft

**Observation:** Geylang and Woodlands had the maximum number of reported theft cases.

## **Insights & Conclusion**

Based on spatial analysis of all the factors considered we can say that a single factor cannot be used to identify promising areas for launching of new eBiking company. So, after analysis we can see Tampines, Seng Kang and Woodlands East are densely populated areas indicating good customer base. Whereas Katong, Woodlands and Serangoon are the areas with maximum concentration of residential units. Majority of the residential units in Singapore are located far away from MRTs but has state-of-art bus network. However, there are still few Residential Units that are located far from MRT's and Bus Stops. These residential units are more promising for the project and should be included in the initial rollout. But we cannot ignore the fact that few areas like woodlands have high number of theft and robbery activities reported and thus are risky for the business. Considering all the factors 30 clusters have been identified which can be targeted for first rollout of eBikes.

## **Limitation**

1. Not all the factors were considered which should actually be considered before a new company enters a market.
2. We are targeting only population density, residential units and public transport for first rollout of eBikes.
3. We are not considering important factors like weather conditions, cycling paths, educational institutes, hawker centers and other facilities for our analysis due to data unavailability.

## **Possible improvements**

- 1) Can include Weather analysis.
- 2) Cyclist patterns to analyze supply/demand and optimal locations for placing ebikes and dock stations.
- 3) Commercial area analysis.

**Reference:**

1. <https://analyticsandintelligentsystems.wordpress.com/category/geospatial-analytics/>
2. <https://www.academia.edu/people/search?utf8=%E2%9C%93&q=singapore+cycle>
3. <https://www.todayonline.com/commentary/new-regulation-drives-bike-sharing-operators-forward-not-burden-them>
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