Kwun Tong:
The Livable Neighborhood

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Content

1. Introduction

1.1. Research background

Kwun Tong is one of the largest redevelopment projects in recent decades. In the Vision 2030+ plan, Kwun Tong is shaped to be the CBD2, a new business hub after Central. With a site area of 570,000 square feet, the Kwun Tong Town Centre project will become an important node in Kowloon. Therefore, we would like to investigate the future possibilities of Kwun Tong by studying three scenarios.

1.2. Research goal and objectives

We have set three major research objectives in reimagining Kwun Tong:

- To understand Kwun Tong position as a CBD in Hong Kong when compared with CBD 1 and CBD 3
- To address the connectivity issues in Kwun Tong
- To improve Kwun Tong as a better community by studying GIC allocation

2. Literature Review

Dual Central Business Center

Rather than creating an integrated CBD, Beijing has planned two competing central business centres. There is a marked spatial divide between the international and trade-oriented eastern business centre and the government and finance-oriented western business centre. Both CBDs are located almost symmetrically on two sides of the old city. The dual CBDs are a marked spatial separation of functions that usually are grouped in a single CBD in Western cities. Jianguomen, which shares similar characteristics as Central, is preferred by foreign companies because of its well-established communication network, Western shopping and environment. The two CBDs in Beijing serve different purposes in catering to the unique urban landscape in Beijing.

3. Scenario Discussions

3.1. Role of East Kowloon as CBD 2

3.1.1 Scenario Creation

Central has been the only CBD in Hong Kong for decades. With the longstanding position of Central as a CBD, Central will still be the major central business centre for high-level business services such as finance, and law firms in the future. Kwun Tong as CBD 2 will be home to other sectors and back offices which conduct routine data and information processing instead of directly interacting with clients. The trend of office rent reflects other sectors and back offices can benefit from the low rental cost and CBDs level facilities. (Fig 3.1.1)
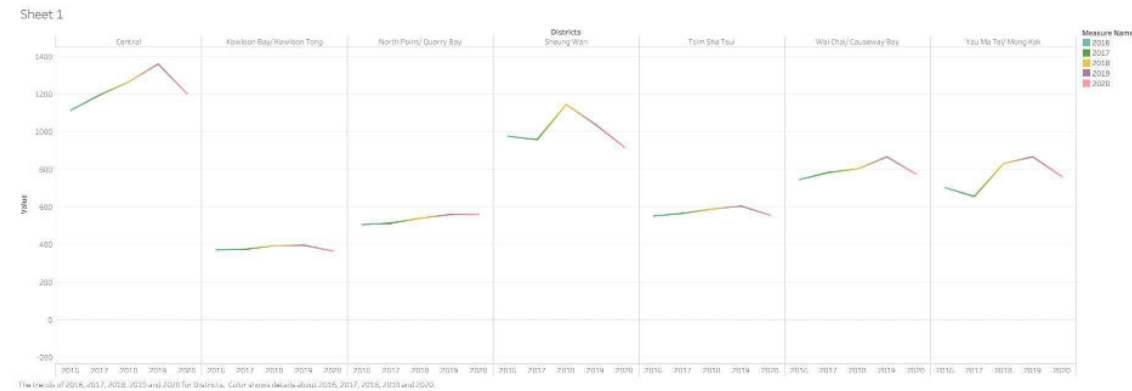
Fig 3.1.1 Office rent comparison between neighbourhoods in Hong Kong

In the Lantau Tomorrow Vision plan, the Hong Kong Government proposed the development of a number of artificial islands with a total area of 1 700 hectares by reclamation in the Central Waters and the development of the third Core Business District of Hong Kong on the artificial islands. The spatial separation of functions districted into different CBDs can echo the decentralization concept. However, as we can see in Fig 3.1.2, Hong Kong's road traffic infrastructure has long been hampered by its weak east-west connection efficiency. East-West connections between major centres are among those taking the longest travel time. A successful CBD 3 in the Central Waters has to have a solution to the East-West traffic dilemma unique to Hong Kong.

CBD 1 and CBD 2 have largely been developed and have their own self-regulating and evolving mechanisms. There is a vision plan laid out for CBD 3, but there is no specific implementation timetable at the moment. Therefore, there is uncertainty regarding the existence of CBD 3.

Fig 3.1.2 East-West Origin-Destination Links with the Highest Travel Time

The proposal of turning Lantau Island into CBD 3 might elevate Kwun Tong's capacity into an even better CBD 2. The concentration of commercial activities is good for planning as the Government can develop a holistic transportation system, communication and other social services dedicated to Kwun Tong.

In this scenario, the following parameters will be used:

(1) GFA of different building types used as a proxy for job opportunities
(2) Boundaries of the 18 districts and their center points
(3) Travel time between each pair of districts

Based on the above parameters, attractive scores based on travel time and job opportunities are calculated. We will examine the role of East Kowloon as a CBD 2 in relation to CBD and Yau Tsim Mong, the major commercial centre in West Kowloon.

3.1.2   Scenario Analysis

We are adopting a utility model to analyze the comparative attractiveness of the 18 districts. In our utility model, we assume a free market system dialectics, in which whether a worker chooses to travel to a particular centre/district to work depends on (1) whether the centre has enough job opportunities for her/his aspiration; and (2) the travel time cost to that centre/district. The attraction of a centre/district to workers on the other hand helps increase the desire of investors to develop business in that centre/district because the investor can ensure a sufficient labour force at a reasonable cost, which, as mentioned above, loops back to an attraction factor to workers with the emergence of job opportunities.

In our utility model, job opportunities of a centre/district are proxied by its GFA of commercial and industrial land uses in 2020. Travel time between centres is calculated by road traffic speed based on a particular AM travel time (ie. 2021-03-31 01:00:00 GMT) using Google Maps Distance Matrix API. MTR travel speed is completely ignored to simplify the model.

The proportion of the working population living in each district who is commuting to other districts to work according to the Census and Statistics Department's 2016 By-census is in Table 3.1.1 below. In our utility model, only the proportion of the working population who commutes to work is taken into account in calculating a centre's attractiveness to them. We further assume that the recorded proportion working in another district (Hong Kong Island) equally applies to all the centres within Hong Kong Island; the recorded proportion working in another district (Kowloon) all the centres within Kowloon; the recorded proportion working in another district (New Towns + Other areas in the New Territories) all the centres within the New Territories.
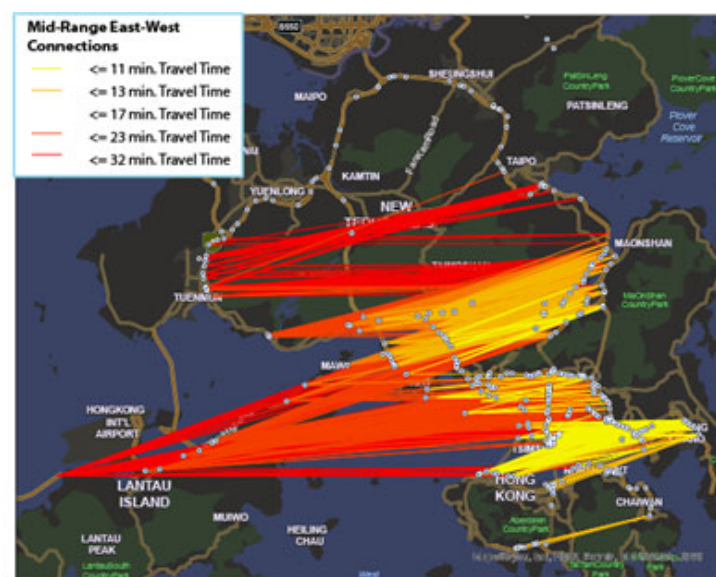
Table 3.1.1 Proportion of Working Population By Working Location

District Council District	Work in the same district	Work in another district (Hong Kong Island)	Work in another district (Kowloon)	Work in another district (New Towns)	Work in another district (Other areas in the New Territories)
Central and Western	0.4815	0.2563	0.1663	0.0742	0.0217
Wan Chai	0.2965	0.4134	0.1971	0.0751	0.0178
Eastern	0.2914	0.3919	0.2184	0.0783	0.0200
Southern	0.2753	0.4727	0.1678	0.0601	0.0241
Yau Tsim Mong	0.3524	0.2964	0.1906	0.1277	0.0329
Sham Shui Po	0.2152	0.2521	0.3180	0.1809	0.0338
Kowloon City	0.1984	0.2668	0.3665	0.1372	0.0310
Wong Tai Sin	0.1317	0.2173	0.4488	0.1625	0.0397
Kwun Tong	0.2787	0.2720	0.2756	0.1379	0.0357
Kwai Tsing	0.1852	0.1839	0.3095	0.2605	0.0608
Tsuen Wan	0.2101	0.2164	0.2920	0.2349	0.0466
Tuen Mun	0.2885	0.1487	0.2348	0.2515	0.0765
Yuen Long	0.1391	0.1565	0.2326	0.3780	0.0939
North	0.2152	0.1262	0.2633	0.3220	0.0733
Tai Po	0.2381	0.1626	0.3056	0.2493	0.0445
Sha Tin	0.1778	0.2008	0.3596	0.2180	0.0438
Sai Kung	0.1269	0.3283	0.4019	0.1031	0.0397
Islands	0.1939	0.2993	0.1764	0.1088	0.2216

Source: Census and Statistics Department's 2016 By-census

We also have assumptions on the weights assigned to commercial GFA and industrial GFA -- According to Census and Statistics Department's employment survey in 2021, the ratio of working population in commercial sectors vs industrial sectors is roughly around 0.6 to 0.4.

The total Utility of a centre i to working population in centre j ("U_{ij}") is calculated using the following equation:

$$U_{ij} = 0.6 \times CI_{ij} \times ln(Commercial\ GFA_i) + 0.4 \times CI_{ij} \times ln(IndustrialGFA_i) - ln(TravelTime_{ij})$$

Where CI_{ij} is the proportion of the working population living in centre j going to centre i to work; $Commercial\ GFA_i$ and $IndustrialGFA_i$ are the commercial and industrial GFA of centre i respectively; $TravelTime_{ij}$ is the travel time from living centre j to working centre i in minutes. The aggregate attraction A_i of a centre is the summation of the U_{ij} to all the other centres.

$$A_i = \sum_{j \neq i} U_{ij}$$

The comparisons of A_i of centres vis-a-vis industrial and commercial GFA are illustrated in Figures 3.1.3 and 3.1.4 respectively. Besides, a table of utility scores U_{ij} is presented in **Table 3.1.2**.

Table 3.1.2 Attraction Score of Centres

|	D_CW	D_WC	D_E	D_S	D_YTM	D_SSP	D_KC	D_WTS	D_KT	D_KW	D_TW	D_TM	D_YL	D_N	D_TP	D_ST	D_SK	D_IS
O_CW	0.00	1.58	0.55	0.39	-1.47	-1.44	-1.35	-1.90	-1.45	-2.91	-2.96	-3.73	-3.84	-3.90	-4.13	-3.03	-3.07	-3.87
O_WC	3.47	0.00	3.44	3.17	-1.02	-0.90	-0.78	-1.38	-0.86	-2.89	-2.95	-3.75	-4.01	-3.90	-4.12	-3.01	-3.03	-3.88
O_E	1.93	1.14	0.00	1.76	-1.26	-0.89	-0.64	-0.87	-0.28	-3.02	-3.07	-3.79	-4.07	-3.77	-4.01	-3.14	-2.77	-3.92
O_S	3.12	2.14	3.23	0.00	-2.00	-1.93	-1.44	-1.98	-1.53	-3.57	-3.61	-4.15	-3.87	-4.11	-4.32	-3.39	-3.32	-4.26
O_YTM	0.25	-0.34	0.39	0.12	0.00	-0.59	-0.62	-1.12	-1.16	-1.60	-1.67	-2.60	-2.57	-2.76	-3.04	-1.79	-2.26	-2.75
O_SSP	-0.21	-0.69	-0.28	-0.74	1.20	inf	0.85	0.43	0.71	-0.28	-0.37	-1.56	-2.25	-1.76	-2.09	-0.42	-1.61	-1.76
O_KC	-0.09	-0.90	-0.27	-0.42	1.22	1.39	inf	2.16	2.72	-1.89	-1.95	-2.74	-2.79	-2.47	-2.78	-1.50	-1.36	-2.85
O_WTS	-0.54	-2.37	-1.34	-1.62	2.40	2.47	3.36	inf	3.81	-1.11	-1.18	-2.09	-2.54	-1.76	-2.12	-0.68	-1.17	-2.25
O_KT	0.02	-0.55	-1.20	-0.75	-0.24	-0.38	0.04	0.40	inf	-1.97	-2.03	-2.76	-2.39	-2.54	-2.83	-1.67	-1.36	-2.90
O_KW	-1.39	-1.92	-1.58	-2.69	0.38	0.91	0.40	0.22	0.39	inf	1.25	0.02	-0.02	-0.32	-0.77	0.88	-0.36	-0.26
O_TW	-1.13	-1.33	-1.25	-0.49	-0.80	0.84	0.28	0.10	0.21	1.56	inf	-0.26	0.02	-0.61	-1.06	0.42	-0.84	-0.54
O_TM	-2.00	-2.87	-2.47	-1.55	-0.58	-1.25	-1.57	-1.68	-1.49	0.43	0.48	inf	inf	0.13	-0.38	0.12	-0.83	-0.04
O_YL	-2.88	-3.25	-3.06	-3.19	-1.80	-1.44	-1.73	-1.84	-1.64	2.50	2.52	2.96	-4.22	2.53	1.87	2.21	1.10	1.73
O_N	-3.39	-3.57	-3.19	-3.58	-1.09	-0.99	-0.97	-0.79	-0.63	1.25	1.28	1.48	1.07	inf	2.59	1.68	0.55	0.55
O_TP	-2.94	-3.21	-2.74	-3.13	-0.58	-0.48	-0.48	-0.33	-0.07	-0.54	-0.49	-0.30	-0.98	2.08	inf	-0.04	-0.99	-1.11
O_ST	-1.68	-1.96	-1.64	-1.96	1.12	1.21	0.96	1.19	1.38	-0.24	-0.32	-1.16	-1.85	-0.60	-1.05	inf	-0.89	-1.38
O_SK	0.36	-0.19	0.78	0.00	1.48	1.28	1.62	1.90	2.85	-2.70	-2.74	-3.38	-3.26	-3.08	-3.34	-2.44	inf	-3.50
O_IS	-0.84	-1.54	-0.94	-1.17	-2.67	-2.35	-2.65	-2.71	-2.59	0.13	0.22	-0.32	-0.34	-0.62	-0.99	-0.04	-0.95	inf
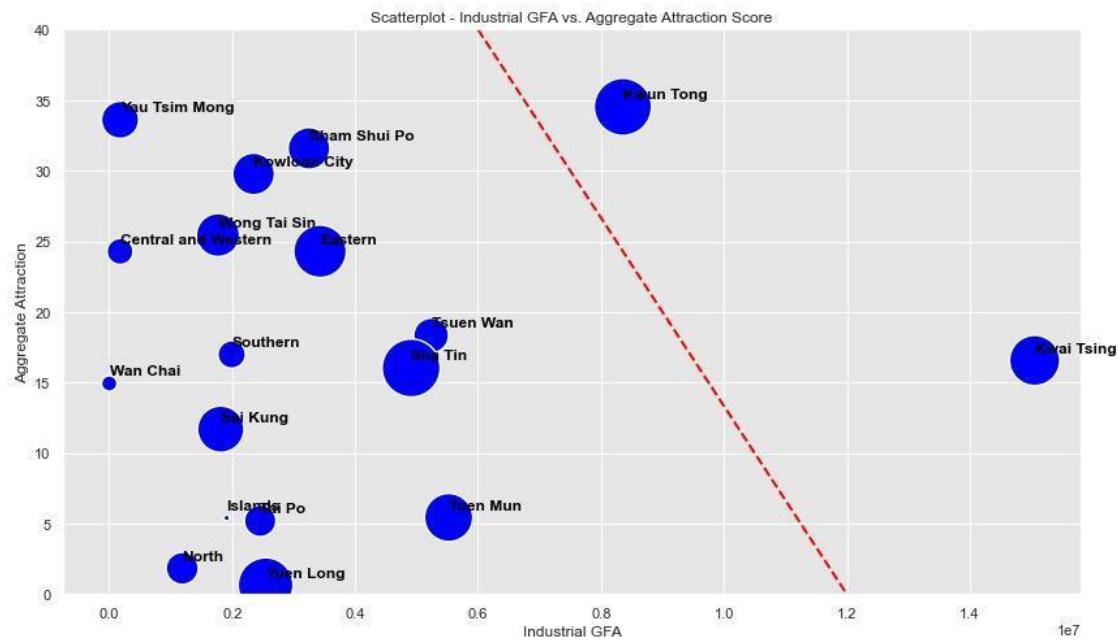
Figure 3.1.3 Scatterplot - Industrial GFA vs Aggregate Attraction Score
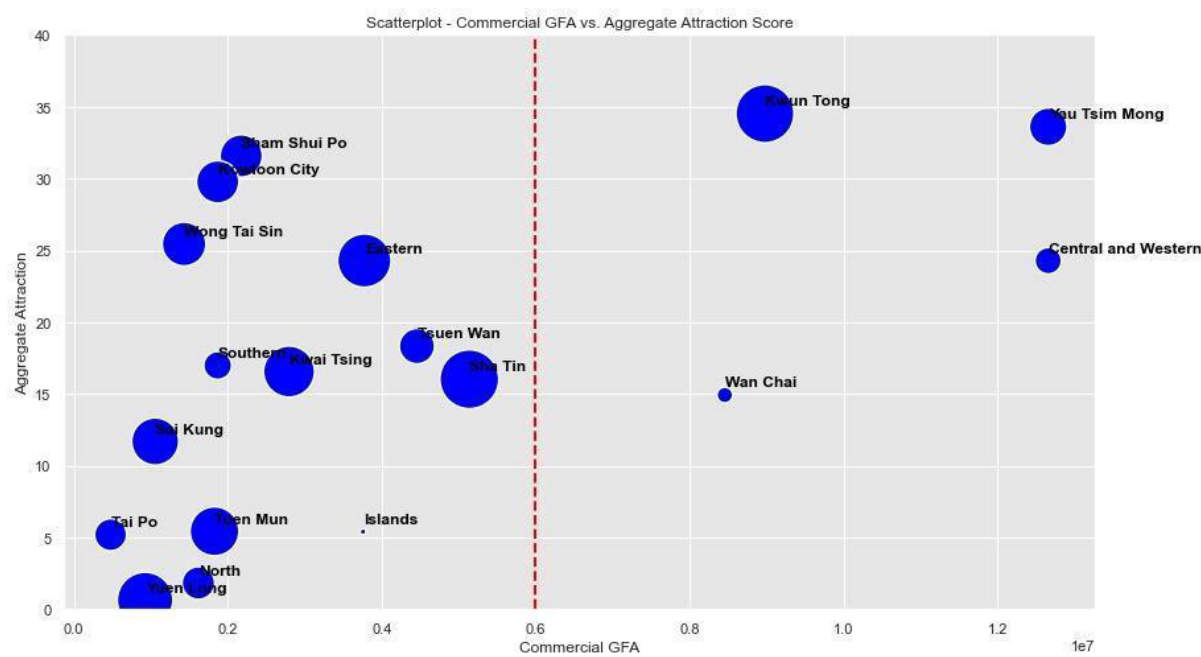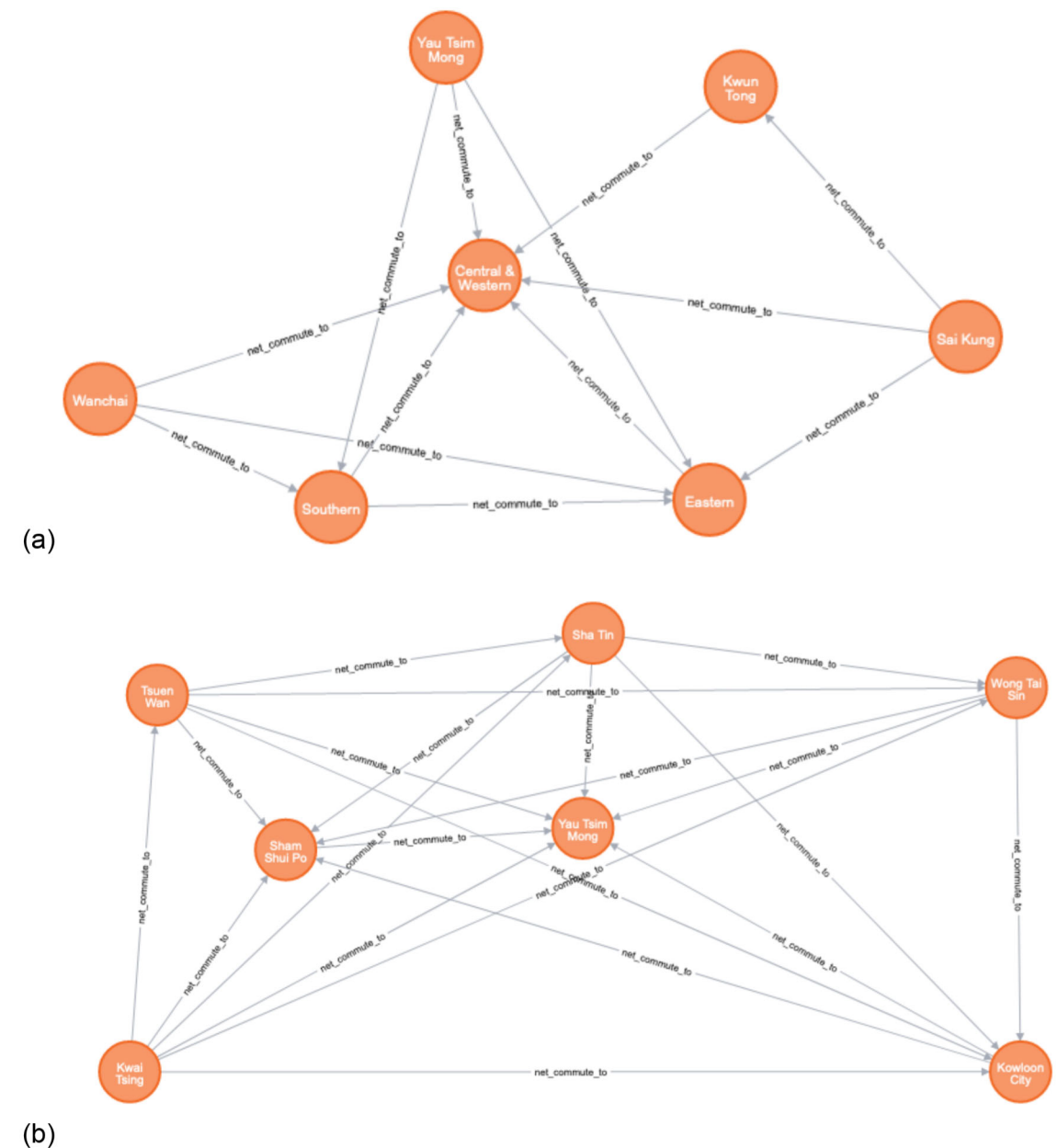

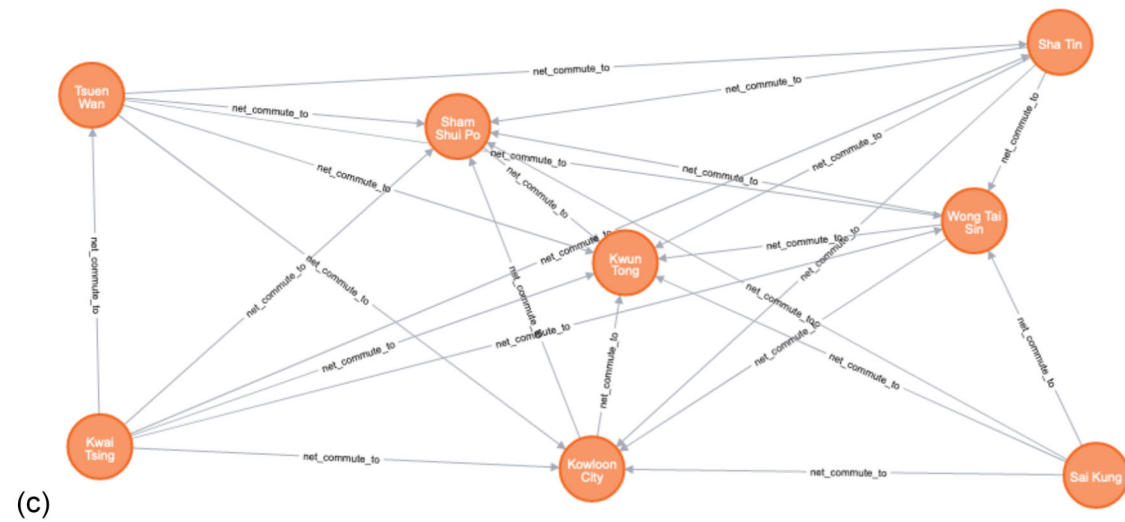*Figure 3.1.4 Scatterplot - Commercial GFA vs Aggregate Attraction Score*

Figure 3.1.3 & Figure 3.1.4 show Kwun Tong has the highest aggregate attraction score among other districts. The size of the bubbles shows Kwun Tong has a much bigger work population size compared to Central and other districts.

However, we also want to test the sensitivity of travel time to each living centre-working centre pair. As Table 3.1.2 above shows, attraction scores to a particular working centre fluctuates with different living centres. So we try to manipulate Table 3.1.2 above, by subtracting U_{ij} , or utility of traveling from centre

j to centre i to work, from U_{ji} or utility of traveling from centre i to centre j to work, for each centre to generate a "net commuting to" score. If both U_{ij} and U_{ji} are below 0 for a particular pair, we define it as no relation. If $U_{ij} > U_{ji}$, we assume the centre j has a "net commute to" relation to centre i, with the net score being the weight of that relationship. For example, U$_{KwaiTsing Yuen Long}$ is 2.4 and U$_{Yuen Long KwaiTsing}$ is 2.01, Yuen Long would form a "net commute to" relation with Kwai Tsing, with a score of 0.4.

Based on the above relationships, we build a commuting network graph using Neo4j web engine (https://betterprogramming.pub/the-beginners-guide-to-the-neo4j-graph-platform-a39858ccdeaa). The commuting network graph is shown in Figure 3.1.5(a), (b) and (c).

(a)

(b)

(c)

Figure 3.1.5 Commuting Network Graph of the Central and Western (a), Yau Tsim Mong (b) and Kwun Tong (c) respectively

Neo4j provides centrality calculation modules (called "GDS") for us to calculate the centrality rankings of the 18 centres. We choose the Eigenvector Centrality algorithm, which measures the transitive influence of nodes. A high Eigenvector Centrality score means that a node is connected to many nodes which themselves have high attraction scores. (https://neo4j.com/docs/graph-data-science/current/algorithms/eigenvector-centrality/). We think a high score, calculated using the "net commute to" score, can proxy a hub potential of that centre. The ranking of eigenvector centrality scores of the major job centres is in Table 3.1.3.

Table 3.1.3 Eigenvector Centrality Scores of Top 5 Centres

Centre	Score
Central & Western	0.9955
Eastern	0.0943
Southern	0.0065
Yau Tsim Mong & Kwun Tong	**0.0003**

As illustrated in Table 3.1.3 above, Central and Western District, the CBD 1, has a very high score. It is understandable as both commercial GFA and the overall attractiveness of the centre are high (Figures 3.1.3 and 3.1.4 refer). More interesting is the observation that other centres on Hong Kong Island also have high rankings of centrality, especially so when their overall attractiveness is not very high. Another point worth noting is Kwun Tong, the CBD 2, while having a high overall attractiveness score, with commercial GFA and industrial GFA ranking high among the centres as well, ranks joint-4th in centrality

score. We infer that the inclination to commute to Kwun Tong is influenced by travel time cost. Such inference is corroborated by Figure 3.1.6, which shows the distribution of the percentage of travelling workers along with the travel time variable. Over 7% of commuting workers take over 40 minutes to Kwun Tong to work.
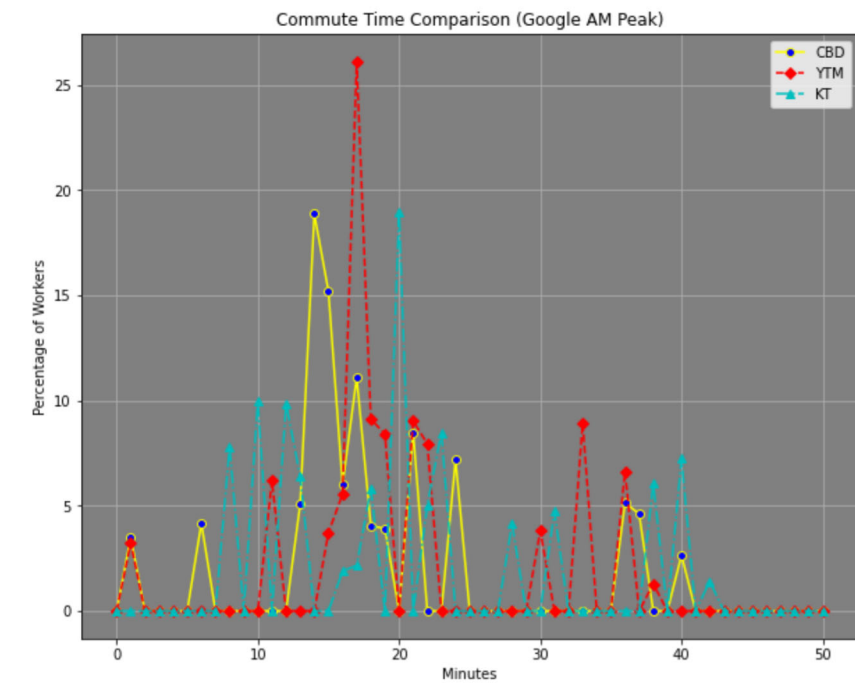

Figure 3.1.6 Percentage of Workers along with Commute Time Variable for CBD 1, Yau Tsim Mong, and Kwun Tong the CBD 2
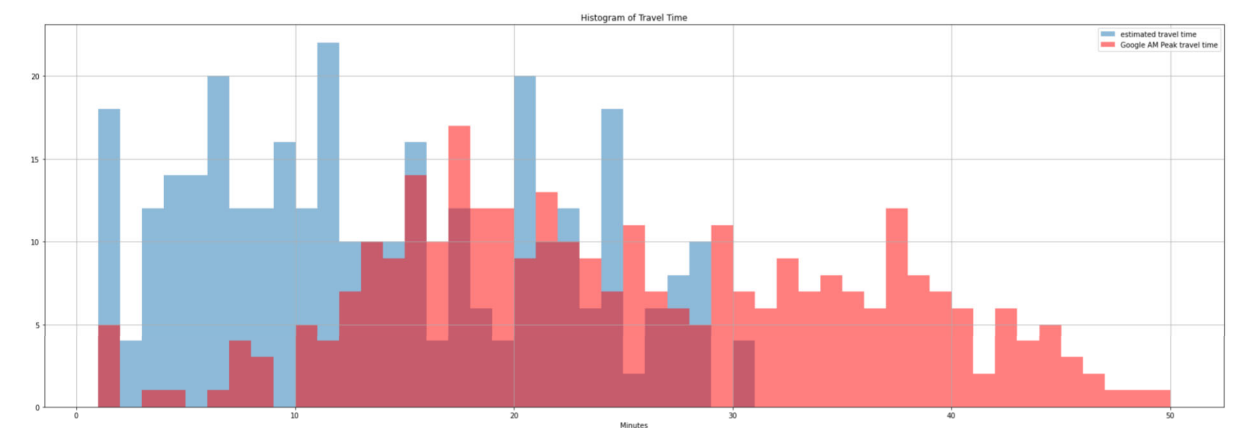

Figure 3.1.7 Histogram of Workers along Travel Time
Blue histogram is the calculated time based on average speed for different road classes; the red one is the real AM Peak time based on Google Maps Distance Matrix API

When we decrease the travel time from any other centres to Kwun Tong by 50%, we see significant change of "net commute to" relations and scores between other centres to Kwun Tong (Table 3.1.4 refers). The Eigenvector Centrality score of Kwun Tong improves significantly as well (Table 3.1.5 refers).

Table 3.1.4 - Comparison of "Net Commute To" Score Between B.A.U. Scenario and 50% Travel Time Improvement for Kwun Tong

	Net_Commute_To Score (Original)	Net_Commute_To Score (50% Travel Time Improvement)
Central and Western	-1.33	-0.33
Wan Chai	-0.21	0.79
Eastern	-0.62	0.38
Southern	-1.25	-0.25
Yau Tsim Mong	-0.99	0.01
Sham Shui Po	1.02	2.02
Kowloon City	1.85	2.85
Wong Tai Sin	3.24	4.24
Kwai Tsing	2.25	3.25
Tsuen Wan	2.00	3.00
Tuen Mun	0	0
Yuen Long	0	0
North	0	2.75
Tai Po	2.50	3.50
Sha Tin	3.07	4.07
Sai Kung	3.98	4.98
Island	0	0

Remarks - The scores are calculated based on estimated average travel time based on OpenStreetMap Highway Classes.

Table 3.1.5 Eigenvector Centrality Ranking of Centres after 50% Travel Time Improvement for Kwun Tong

Centre	Before Travel Time Improved	After Travel Time Improved
1st Attractive	Central & Western	Central & Western
2nd Attractive	Eastern	**Southern & Kwun Tong**
3rd Attractive	Southern	Eastern
4th Attractive	**Yau Tsim Mong & Kwun Tong**	Yau Tsim Mong

3.1.3   Spatial Strategy

The above study shows that CBD 3 is not as efficient as CBD 1 and CBD 2 based on all metrics. Island District in itself has low commercial and industrial GFA, henceforth job opportunities. As shown on Figure 3.1.2, Island District is very inefficient in its connection with the existing CBDs and other job centres and living centres. CBD 3 is a concept that works if and only if the following 2 conditions are all fulfilled:

(1)   There will be a significant increase in the commercial floor area in CBD3; and

(2)   A significant improvement of its travel time with other living and working centres.

Considering its low job opportunities base, condition 1 cannot be fulfilled unless very large Government intervention favouring CBD 3 development to the detriment to market economy and fair competition which are the two pillars of the Hong Kong prosperity; while condition 2 cannot be fulfilled unless very large Government investment in infrastructure network from Island District to the existing centres. It may worsen the current environmental and ecological controversy of the surrounding water area. Also, it may run the risk of serving to further boost the existing importance and congestion of CBD 1, physically the closest to the CBD3.

On the other hand, CBD 2 is beneficial to the city of Hong Kong as residents in Kowloon can minimize the commuting time to work. CBD 2 can also provide additional support to residents in the Kowloon side. The decision to retrofit Kwun Tong as the CBD 2 is valid in terms of spatial planning strategy. To further boost the attractiveness of Kwun Tong as the CBD 2, a direct link between Yau Tsim Mong to Kwun Tong should be considered. Creating a direct link between Yau Tsim Mong to Kwun Tong (like the Central-Wanchai Bypass) can help reduce the travel time between West Kowloon to Kwun Tong. Also, a water taxi route between Central and Kwun Tong is suggested. By making use of the existing dock stations, it can strengthen the connection between the two CBDs. (Figure 3.1.8)

Figure 3.1.8 - Proposed water taxi route between Kwun Tong and Central

3.1.4   Limitation

There are 2 limitations in the above analysis:

(1) Yau Tsui Mong is highly competitive to Kwun Tong in terms of attractiveness. Travel time corresponding to the percentage of workers in Central, Kwun Tong, and Yau Tsui Mong should be further studied. As we have not yet obtained MTR travel time data, the existing travel time suggested here only represents driving time, thus far from realistic.

(2) OD Matrix data is biased - the original modelled scores were based on estimated travel time according to OpenStreetMap Highway Classes. Later we complimented our model with Google Map Distance Matrix API to get AM peak time travel time. However, we only chose an arbitrary weekday (i.e. 2021-03-31 01:00 GMT), rather than taking the average of the AM and PM peak travel time of the whole year. From our group's perspective, however, such limitation was unavoidable as Google Maps Distance Matrix has a daily cap of data extraction of 25 OD points for one specific historical time. The data collection period would still be untenable even if we started our data extraction right from the start of the semester.

3.2.   Addressing the connectivity of Kwun Tong

3.2.1   Scenario Creation

After analyzing Kwun Tong as CBD2 and its travel time, spatial pattern and road network study are the scopes for further study.

In scenario 2, we focus on two directions for analysis:

(1) Spatial Structure Analysis: Compare the road connectivity and space compactness of Kwun Tong with Hong Kong Island and Yau Tsim Mong, respectively;

(2) Gross floor area comparison: Compare the gross floor area(GFA) between Hong Kong island, Yau Tsim Mong, and Kwun Tong.

This scenario aims to determine the cause of low attractiveness in Kwun Tong and analyze the built environment formed by the spatial network.

3.2.2   Spatial Structure Analysis

We utilize the central spatial analysis ideology "space syntax" to view the spatial structure. The software Depthmap has a built-in function, based on the road network downloaded from the Open Street Map, to conduct the following research.

To theoretically demonstrate the initial findings from Scenario 1, the first part of the analysis combined Kwun Tong with the two traditional CBDs, forming a new integrated spatial entity to testify the connectivity in Kwun Tong- Yau Tsim Mong and Kwun Tong- Hong Kong Island. The idea assumes the origin and destination are settled in the combination area, and the connectivity of spatial structure would affect the outflow possibility in such an area.

As a result, the CBD1 shows higher connectivity, and Kwun Tong shows the opposite result in Figure 3.2.1.. Due to the different historical development factors, the Hong Kong island naturally equipped a more human-scaled spatial network, proving that Hong Kong is also famous for its landscape and tourism resources. However, the early planning of Kwun Tong is self-sufficient and industrial-led, with a mixture of residence and industrial land use, so the road connectivity was not considered in the beginning. They also adopted a rigid gridiron block design in Kwun Tong for the simplicity of surveying. Those issues leave Kwun Tong with disadvantages to compete with the traditional CBD. In terms of space attractiveness, people are more willing to move from Kwun Tong to CBD1 without a doubt.

When taking Yau Tsim Mong and Kwun Tong as a component, the result of outflow tendency remains the same as shown in Figure 3.2.2. And, the Yau Tsim Mong and Kwun Tong area traffic networks could appear as evidence of urban planning. The initial design purposes are quite different, which resulted in the spatial connectivity in the Yau Tsim Mong area being higher with more small street blocks and more well-connected roads, sequenced by a transparent network system attracting people. The road network in Kwun Tong could be problematic for its future development.
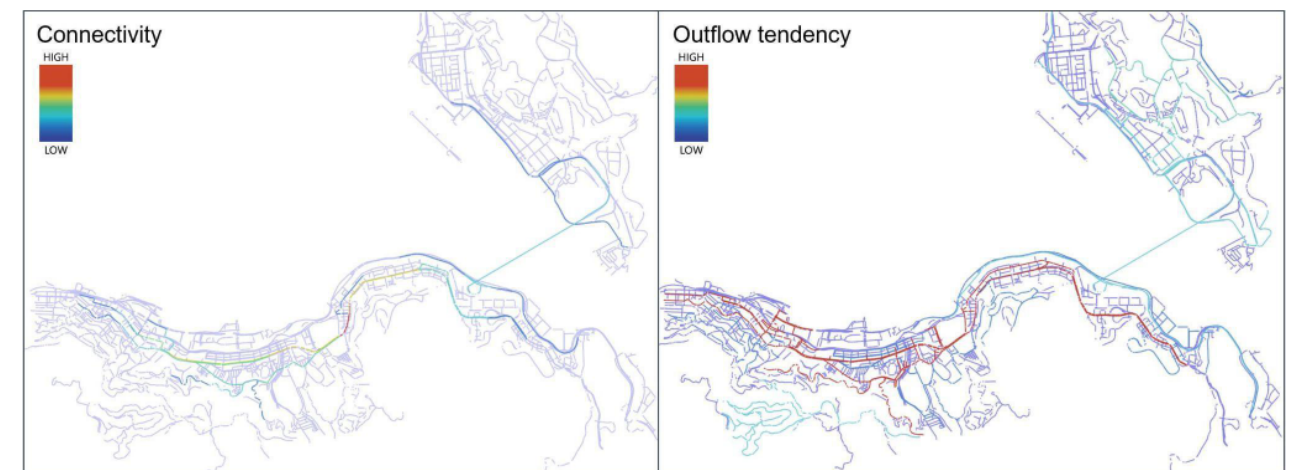

Figure 3.2.1 - Connectivity and outflow tendency contrast between Hong Kong Island and Kwun Tong

Figure 3.2.2 - Connectivity and outflow tendency contrast between Yau Tsim Mong and Kwun Tong

3.2.3 Gross Floor Area Contrast

On the other hand, the space compactness in Kwun Tong obtains a decent result. As Spatial Syntax only considers the road network, the less compact road network in Kwun Tong is considered relatively good in Space Syntax's terms. The low compactness means lower spatial integration and longer distance for people to travel. However, the integrated spatial structure cannot be reflected in the limited traffic network view.
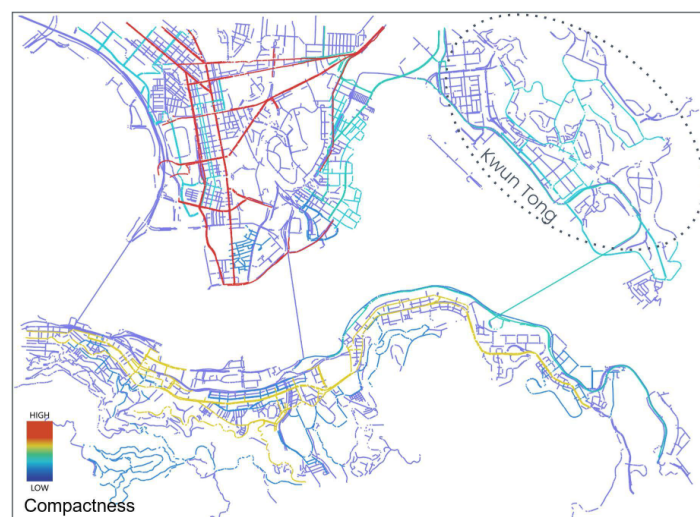
Figure 3.2.3 - Compactness contrast between Hong Kong Island, Yau Tsim Mong and Kwun Tong

Therefore, we examined the GFA of Yau Tsim Mong, Kwun Tong, and Central Western district in parallel. The bar chart in Figure 3.2.4 shows the comparison of three areas. Kwun Tong has higher GFA in

residential building type and other GIC buildings, commercial building use. When comparing the total building GFA in Figure 3.2.5, Kwun Tong's GFA is significantly higher than the other two areas. Therefore the less compact road network is not comprehensive to support all the GFA activities in Kwun Tong. The need to revise the transportation network in Kwun Tong may lead to the following demand for further constructing CBD2.

The overall spatial structure in Kwun Tong has its disadvantages, which resulted in the low attractiveness to people in Hong Kong. The problem of spatial pattern cannot be issued by re-structuring the traffic network. Such spatial issues could be summarized as the imbalance between initial planning purpose and current use pattern. As the first generation of a new town in Hong Kong, Kwun Tong was planned to become a self-sufficient industrial new town. Due to the lack of integrated planning in the surrounding area, Kwun Tong cannot be self-sufficient in the sequence development. Furthermore, the residents living in Kwun Tong have to take a long daily commute to other attractive places.
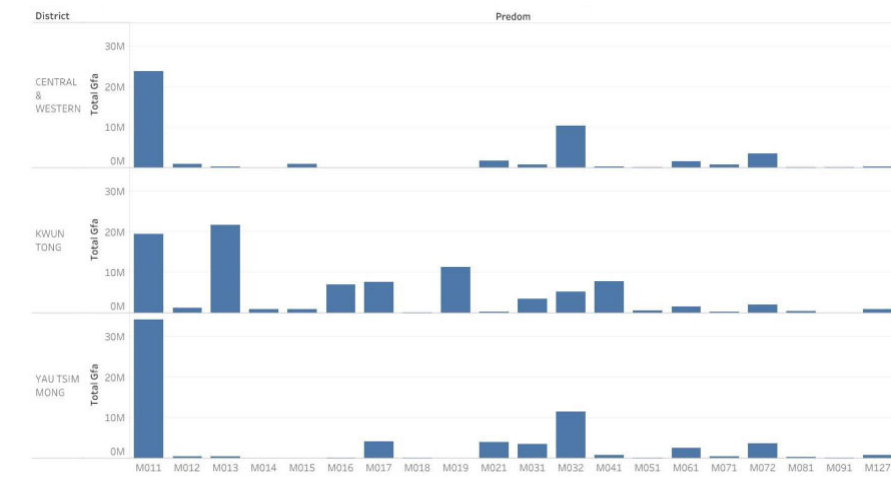

Figure 3.2.4 - Comparison of GFA by type between Central&Western, Kwun Tong, Yau Tsim Mong District
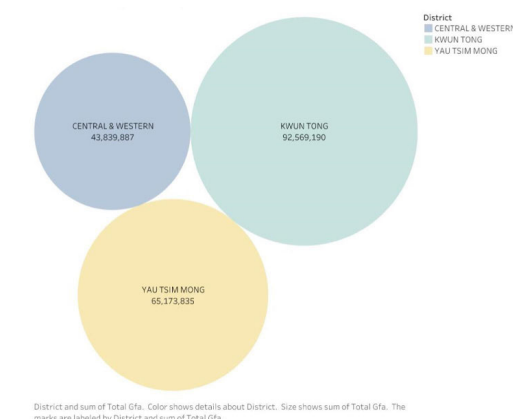

Figure 3.2.5 - Total Building GFA Comparison between Central&Western, Kwun Tong, Yau Tsim Mong District

3.2.4 Scenario Strategy

The spatial connectivity issue led to the low competitiveness in Kwun Tong. As proposed, Kwun Tong will become the future CBD 2. Improving road connectivity, from the vehicle system to the cycling and pedestrian system, it can make Kwun Tong attractive for working and living.

Meanwhile, the entire traffic network is impossible to reconstruct on a city-level scale. The adjustment on supply-demand could be more accurate to improve the efficient usage of the current network structure and pattern. This proposal requires more integrated planning guidance that takes the CBD2 and surrounding area as an entity, reflects on the correlation among different areas in Hong Kong, optimises the pattern layout in Kwun Tong, and realises the CBD2 strategy in Kwun Tong.

With the combination of GFA data and transport network analysis, the low connectivity cannot satisfy local traffic demand. There exists a contradiction with the original Kwun Tong new town planning. To build Kwun Tong as the new CBD2, which is essential to attract people to Kwun Tong, we should start with the transportation network.

A set of multi-pronged approaches (Figure 3.2.6) are adopted to resolve the current traffic dilemma in Kwun Tong to achieve this purpose:

(1) Develop a moving walkway network along Wai Yip street. The connection between Kowloon Bay Action Area and Kwun Tong Action Area is relatively low. And the Wap Yip street should be emphasized since it links up these two areas when dealing with these long-standing issues. This proposal could enhance pedestrian walking accessibility as well as drive people to move between the two regions.

(2) Build a connection between Kwun Tong and Kai Tak by implementing a shared pedestrian-cycle road. The Kai Tak area is expected to be the integrity of tourism and leisure hubs soon, adopting a shared-use pathway for pedestrians and cyclists. Kwun Tong area could join this greenway integration to extend the whole area's pedestrian and cycle system and achieve more substantial accessibility
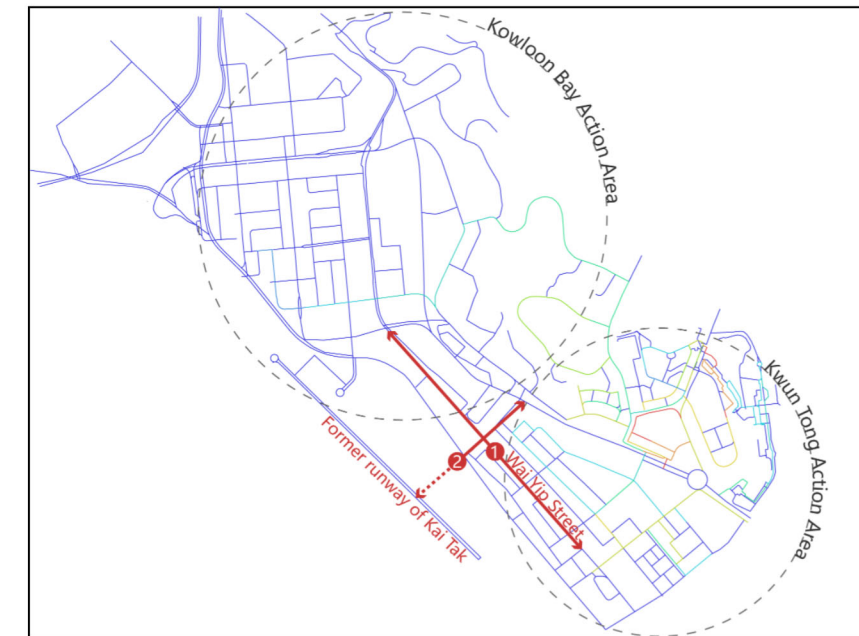
Figure 3.2.6 - Proposed approaches
(1)Develop a moving walkway network, (2)implement a shared pedestrian-cycle road

3.3. improve Kwun Tong as a better community

3.3.1 Scenario Criterion

Kwun Tong has been long recognized as one of Hong Kong's traditional industrial zones. Under the HKSAR government policy, Kwun Tong has been developing into a vibrant and people-oriented CBD2. This will not only be tasked to support Hong Kong's economic development and plays a crucial role to assist in embracing the local economic growth, but also provides a valuable opportunity to establish a new hub for sports, recreation, tourism, business, and quality housing, thus the 2nd generation of CBD over the main commercial and financial role of the first CBD in the Central area.

3.3.2 Scenario Objective

The objective of this section is to illustrate the coverage of the public facilities, in terms of sports, community, and health, in Kwun Tong forming a solid foundation for the subsequent scenario analysis, which will promote the health, convenience, and general welfare of the community by making provision for the systematic preparation and planning approval of area within which permission is required for the development.

3.3.3 Comparison of Public Facilities in Central (CBD1) and Kwun Tong (CBD2)

Central is a mature business and financial hub where the lion's share of the buildings and population are commercial buildings and the working population coming from other districts (Table 3.3.1). This

development focus gives rise to a little residential zone therein, and thus there are not many ancillary public facilities provided in Central (Figure 3.3.1).
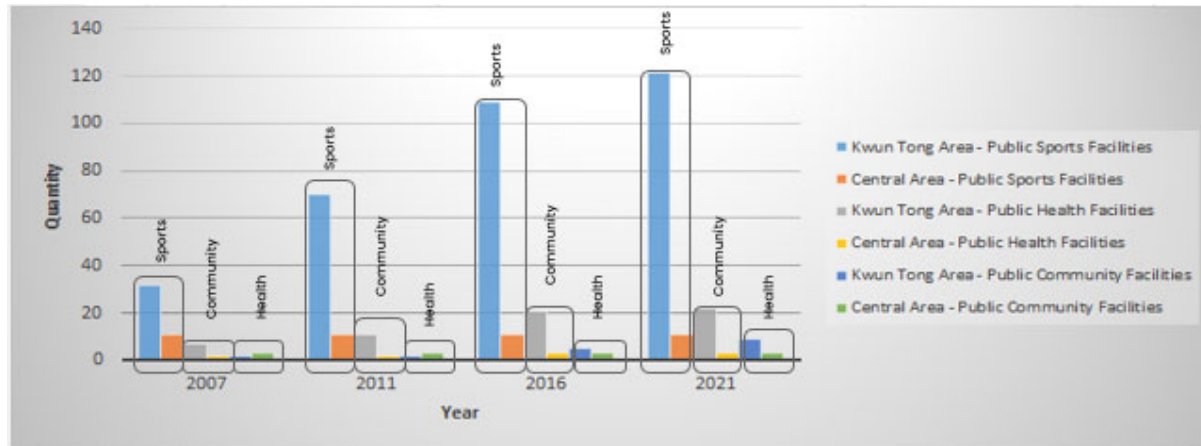

Figure 3.3.1 - Comparison of public sports, health, and community between Central (CBD1) and Kwun Tong (CBD2)

Table 3.3.1 - Change in different population and household data of CBD1 and CBD2 over the past 10 years

CBD	Year	Total population	Working population	Domestic households	Housing
CBD1	2011	46,575	26,805	20,057	19,972
	2021	45,573	28,277	20,115	20,344
	% Change	-2.2%	5.5%	0.3%	1.9%
CBD2	2011	622,152	290,213	214,300	215,033
	2021	648,541	315,577	226,487	226,487
	% Change	4.2%	8.7%	5.7%	5.3%

On the other hand, Kwun Tong is a well-developed and compact built-up area with a population of over 648,000 and a domestic household of over 220,000. Due to the endogenous and increase in genuine community needs, the provision of the public facilities among various aspects is much more than those in Central (Figure 3.3.1 and Table 3.3.1) and located over a wider geographic spectrum to serve the local demand. A holistic approach other than infrastructure-led or wholesale redevelopment is needed to facilitate organic growth in the future.

3.3.4 Methodology and Analysis

For analyzing the correlation between the public facilities' adequacy in terms of sports, community, and health attributes, 28 datasets of public facilities are acquired from the Public Sector Information ("PSI")

portal (website: data.gov.hk), which is the HKSAR Government well established free public open data platform (Figure 3.3.2).
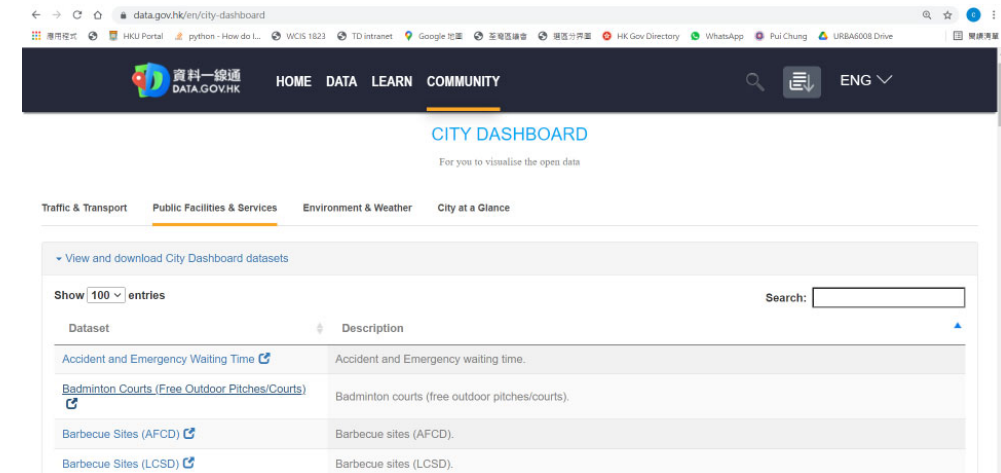

Figure 3.3.2 – PSI portal (data.gov.hk) platform

Data pre-processing (Table 3.3.2) is carried out to eliminate any nil-provided attributes from the PSI dataset for enhancing the analysis efficiency via geographical information system analytical software, ArcGIS Pro[1].

Table 3.3.2 – Dataset garnered from data.gov.hk (PSI portal)

Public Sports Facilities (17 nos.)		Public Health Facilities (3 nos.)	Public Community Facilities (3 nos.)
Badminton Courts	Parks and Gardens	Clinics and Health Centres	Community Halls and Centres
Basketball Courts	Recreation Grounds	General Outpatient Clinics	Performance Venues
Cycling Sites	Sports Centres	Hospitals	Libraries
Fitting Rooms	Sports Climbing Facilities		
Hard-surface Pitches	Sports Grounds		
Grass Pitches	Squash Courts		
Hard-surface Pitches	Swimming Pools		
Jogging Tracks	Tennis Courts		
Pet Gardens			
Dataset of the following public sports facilities are excluded from analysis in data pre-processing due to inexistence in Kwun Tong			
Barbecue Areas	Stadia		
Beaches	Water Sports Centres		
Bowling Greens			

In Hong Kong, the Planning Department of the HKSAR Government has demarcated the territory into 291 Tertiary Planning Unit ("TPU"), which is a geographic reference system identified by a unique three-digit

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[1] ArcGIS is a geographical information system invented by the Environmental Systems Research Institute for integrating geographic information and maps in different forms. Its wider spectrum performance, supportive data visualization and powerful analytical capacity and highly compatibility enable the geoprocessing to reach a professional fashion.

number[2]. For urban analytics, the 9 TPU (i.e. 280, 290, 291, 292, 293, 294, 295, 297 and 298) covered by Kwun Tong are illustrated in Figure 3.3.3.
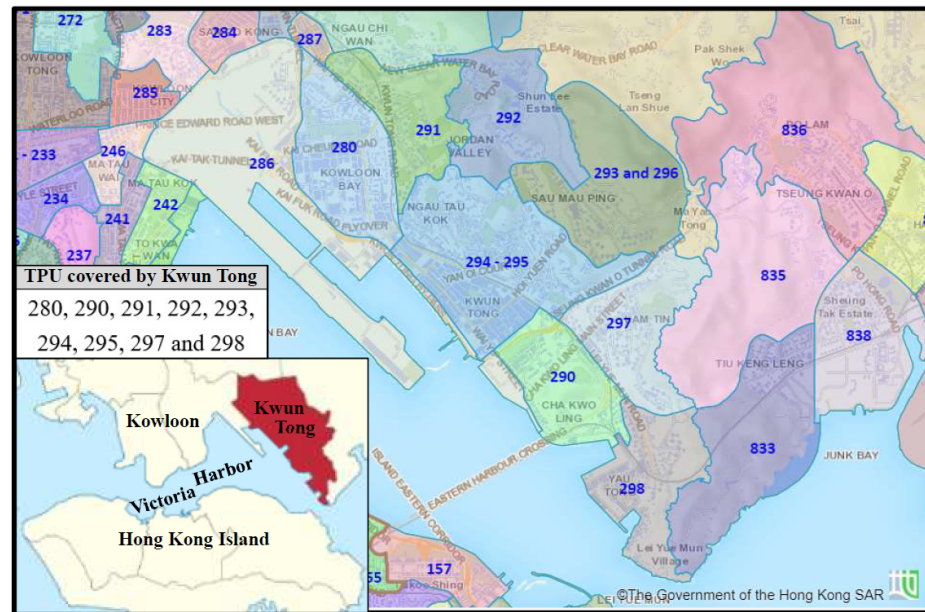

Figure 3.3.3 – TPU covered in Kwun Tong

Upon collection of the required dataset from data.gov.hk (PSI portal) and completion of data pre-processing, identification of the covered TPU, selection of ample data analytical software, the location of public facilities in Kwun Tong are spatially joined over the base map at ArcGIS Pro. Cross-checking of those locations are carried out in order to reaffirm the correctness of the geographical locations. Below please find the locations of public sports, community, and health facilities. In term of geography, Figure 3.3.4 shows that the distribution of different public facilities is all scattered over the Kwun Tong area.
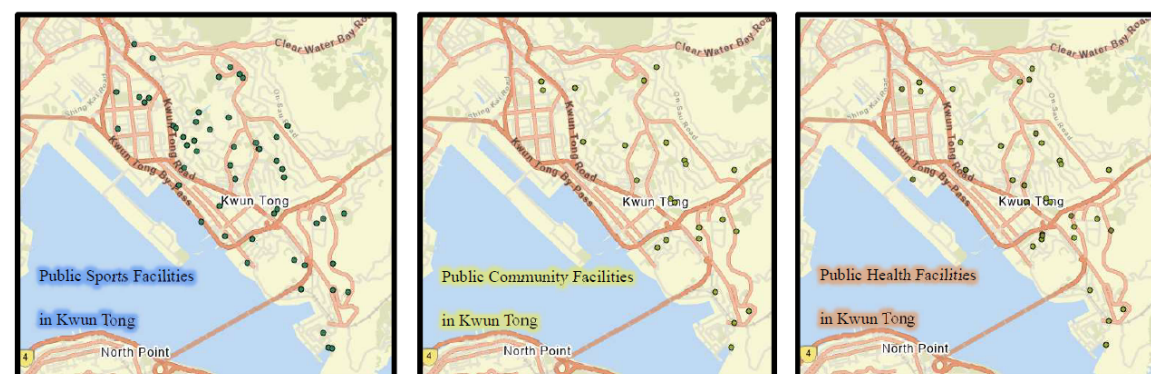

Figure 3.3.4 - Geographic locations of public sports, community, and health facilities in Kwun Tong

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[2] The TPU are identified by 52 Secondary Planning Units ("SPU") at the next higher level, which are further grouped into 9 Primary Planning Units ("PPU") at the highest level. Each TPU is identified by a unique three-digit number. The first digit of a TPU number represent the PPU code while the first and second digits together correspond to the SPU code.

After the validity of the public facilities' geographical locations, cross-check, the accessibility and the service coverage of the spatially joined public facilities are analyzed through accessibility methods, namely Service Area (Figure 3.3.5).
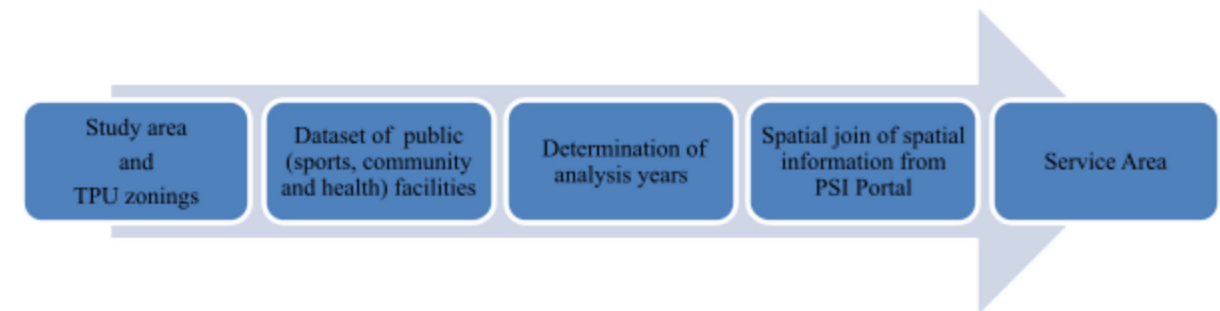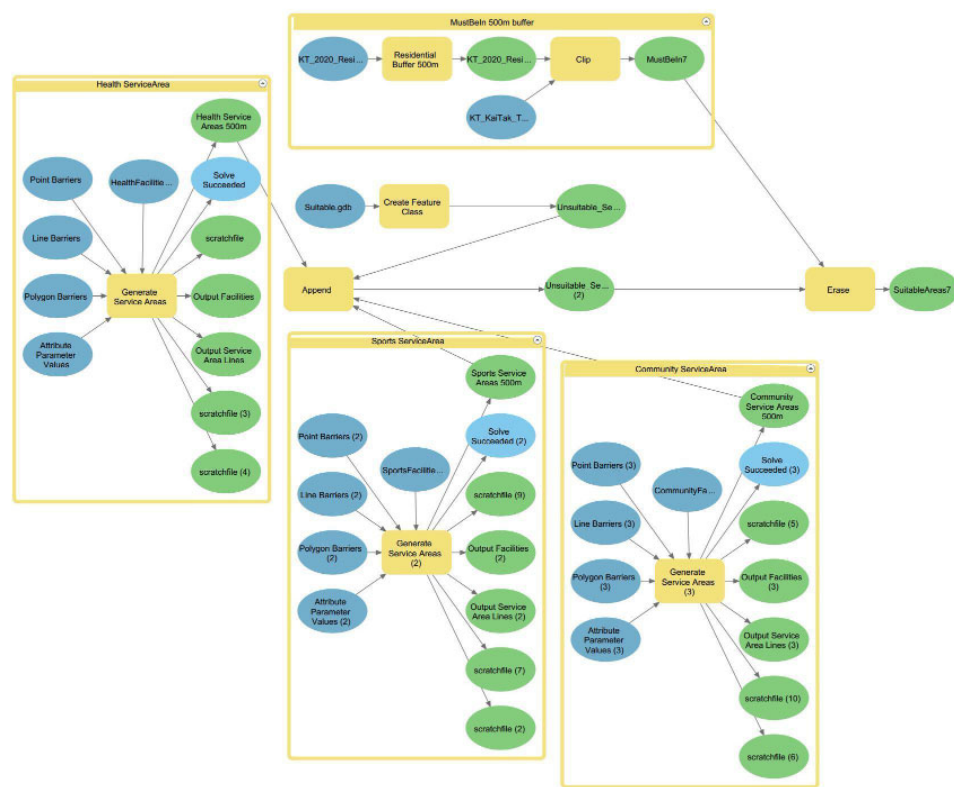

Figure 3.3.5 – Methodology of the geospatial analysis on accessibility of public (sports, community, and health) facilities in Kwun Tong

A service area is a zone that can be approached from one area within a particular accessible (travel) time or distance. By analyzing such service areas using the road network in the service area analysis, a more realistic and rational measurement of the level of service can then be analyzed.

There is another commonly used geospatial analysis namely buffer analysis. In that analysis, a buffer from a feature identifies the areas surrounding a feature geographically by generating a linear straight-line distance buffer zone. The features are then selected and analyzed to examine the coverage of such buffer boundaries. As the buffer analysis does not take into account the commuting route, road network, road geometry and traffic pattern, these assumptions do not truly reflect the commuting route from a feature. Thus, an over-optimistic coverage of a feature will undermine the accuracy of the analysis. With the diversified road networks in Kwun Tong, buffer analysis is not considered to be adopted, while a 500m service area will be adopted in the service area analysis for public sports, health, and community facilities. Due to limited land resources, a model is built to select the potential areas for multi-purpose G/IC. The model tries to show a more real-life experience from the angle of residents accessing facilities by using a pedestrian network service area. The following is the criteria for the site selection.

Criteria & special requirements	GIS analysis
within 500 m of residential parcels	create buffer
within Kwun Tong & Kai Tak boundary	
3 different distance from existing facilities	
at least (500 / 400 / 300) m from existing health, sports, community facilities	create network service area

Figure 3.3.7 - Uncovered out-of-500m-service areas from the public health facilities

Figure 3.3.8- Uncovered out-of-500m-service areas from the public community facilities

3.3.5   Analysis Result

The Service Area analysis is adopted for assessing the 500m service coverage. Figures 3.6 to 3.8 show the out-of-500m area from the public sports, health, and community facilities with respect to the residential block within Kwun Tong. It reveals that the existing public sports facilities have a relatively higher service extent than those of public health and community facilities over the community. For the sake of embracing the 2nd generation of CBD, it is pledged to further enhance these public facilities, not to mention the growing residential and working population in the future.
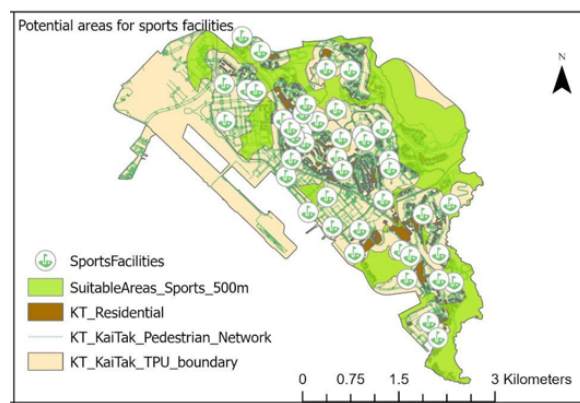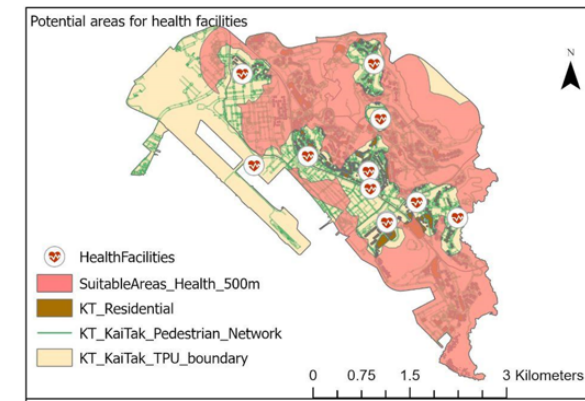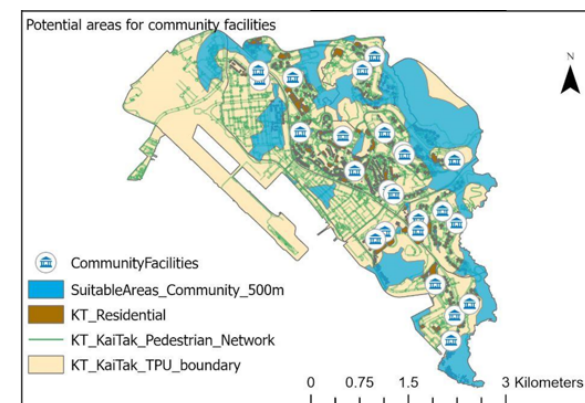
After superimposing the service areas analysis of the public sports, health, and community facilities over the map (Figure 3.3.9), it clearly shows the potential area, i.e. the suitable area of improvement, for facility enhancement. The more overlapping layer, a higher genuine need for the government to improve the public facilities in view of the prioritized and limited public resources.
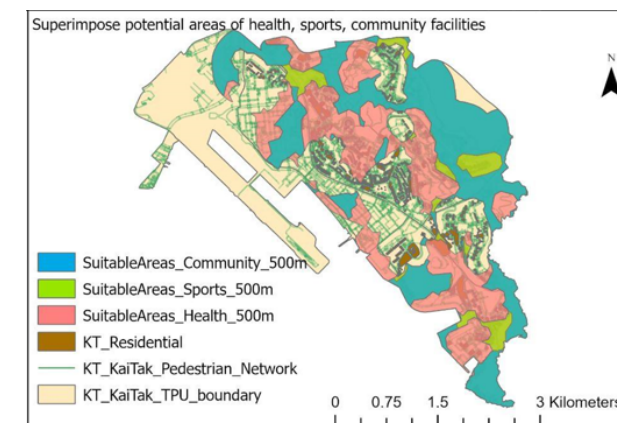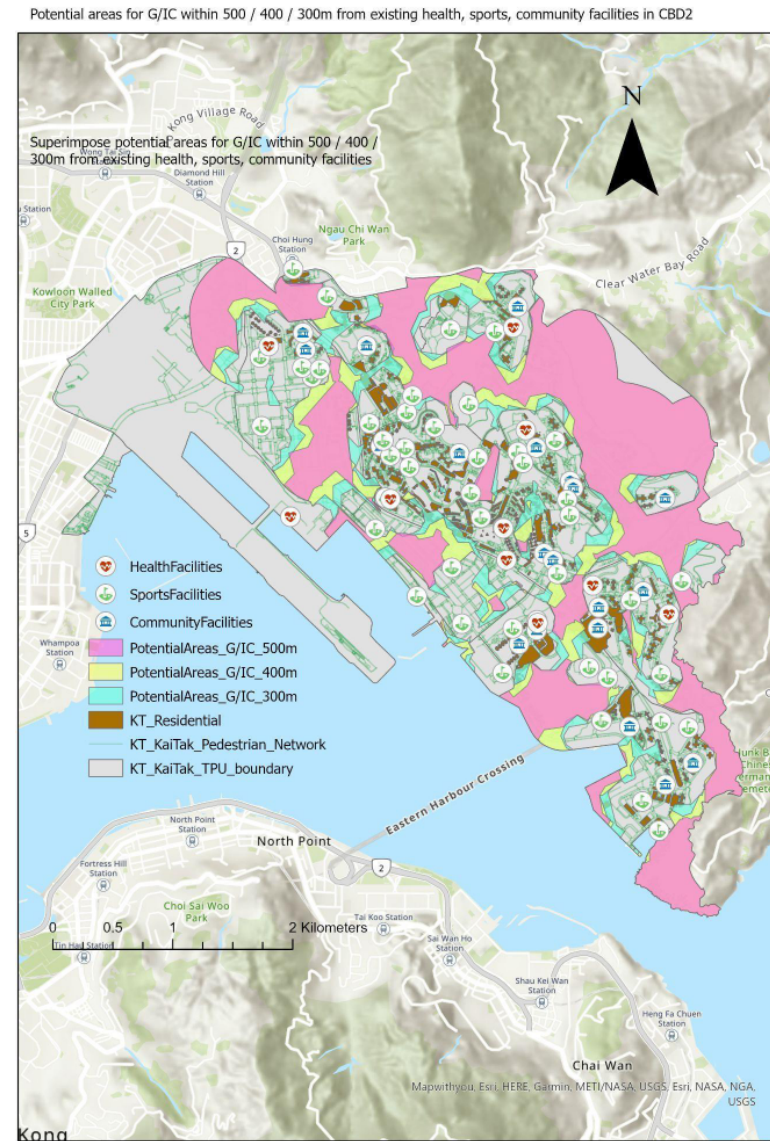

Figure 3.3.6 - Uncovered out-of-500m-service areas from the public sports facilities

Figure 3.3.9 - Superimposition of uncovered out-of-500m-service areas from the public sports, community, and health facilities

The above diagram shows the proposed potential areas for different periods of time.

The areas in red should put more improvement in facilities related to the community. The areas are the most crucial areas, probably located in KaiTak, and some parts of Kowloon Bay for integrated facilities or buildings, such as G/IC under limited land resources. It is suggested as a short-term development to fill up the lack of community facilities within the CBD2 for the local residents.

The areas in yellow can provide larger service areas as the extension of the red areas. The location can increase the service areas that provide a larger coverage of community facilities to local residents. It is not necessary compared to the red areas, but it could be suitable areas for easing the increasing population of community facilities in a medium period of time.

The areas in cyan can serve even closer to the Kwun Tong Town Center, which is the redevelopment area. Since the redevelopment site is proposed to build a high density of residential as well as a commercial skyscrapers to build a new Kwun Tong landmark. This area can be understood in local community-based service areas which try to increase the 3 types of facilities by shortening the distance from the existing facilities. As planning Kwun Tong as an energizing, liveable CBD2, it is suggested to support population growth in the redevelopment areas to increase the real-life living quality at a community level by enhancing the accessibility of 3 types of facilities in the long run.

4.   Conclusions

Kwun Tong has great potential to be the new key node in Kowloon. In order to further improve Kwun Tong as a CBD2, it is necessary to improve its transport connectivity and attraction for more job opportunities. On the other hand, integrated land use for community use needs to be improved to elevate Kwun Tong with a mixed city experience.

References

Zhou.Y., 1998. Beijing and the Development of Dual Central Business Districts. Geographical Review Vol. 88, No. 3 (Jul., 1998), pp. 429-436