<u>Spatial Structure of the Pearl River Delta Metropolitan Region</u> <u>A study proposal</u>

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A. BACKGROUND

As one of the largest and fastest growing urban regions in the world with a total population of 30 million the Pearl River Delta Region (PRD) includes the jurisdiction of 25 municipalities, 3 counties and 450 statutory towns in addition to the two SAR of Hong Kong and Macau. With the increase in competition from Shanghai, from other major cities of China, and from other Asian urban regions, the Pearl River Delta needs to significantly strengthen the economic integration between its various jurisdictions if it is to continue to attract both domestic and foreign investment in higher value-added manufacturing and tertiary and quaternary services.

Compared with other large metropolitan areas around the world, the PRD has unique spatial features. Settlements of very high density are dispersed over a large area without much continuity. This spatial dispersion is due in parts to the singular political history of the region, in other parts to a unique topography combining mountains 1000 meters high with low laying alluvial plains. The PRD singularity comes also from its bipolarity with Guangzhou and Hong Kong located at both extremes of the metropolitan region. The emergence of Shenzhen as a third major pole, and the probable emergence of several important additional sub centers in the future will make the spatial structure of the PRD even more complex.

While making the spatial integration of the region quite challenging, the peculiar topography of the PRD is associated with unique assets: a natural deep sea port; extremely fertile agricultural areas; coastlines and mountains of unique beauty.

Given the unique spatial features of the PRD and its history, it is natural that the economic cohesion of the region has become an area of concern. Several studies have already been conducted in order to assist the development of the PRD. Among others, "project 2022" concluded that closer cooperation between the local authorities in the PRD was essential for the development of the region. Another study, managed by the Guangdong Government with World Bank assistance will cover the PRD area within the Guangdong province and will probably start around January 2002 and require about 1 year. This study will focus on identifying the need for sanitation and solid waste for the year 2020. In particular the study will include: (i) a projection of likely regional and urban development scenarios in the PRD to 2010 and 2020; (ii) an assessment of the general impact of past and projected development on urban and peri-urban environmental infrastructure, focusing on wastewater treatment and solid waste management to 2010 and 2020;

The a new study, proposed in this paper, should focus more narrowly on the spatial integration of the region and on the impact of road and rail infrastructure to achieve this integration. It will build on the work already done by others on the development of the PRD. It should coordinate closely with the Guangdong Government/World Bank study, in order to avoid duplication and insure data consistency, in particular for demographic projections in Guangdong Province.

B. PRELIMINARY ANALYSIS OF THE SPATIAL FEATURES OF THE PRD

The spatial organization of the PRD is very different from other metropolitan areas of comparative size (see for instance, London, New York or Tokyo). The various parts of the PRD are extraordinarily dissymmetric and heterogeneous in terms of land resources, land prices, level of income, wages, and quality of infrastructure. This heterogeneity confers large comparative advantages to different locations within the region. It implies also that the different parts of the region might have to be more narrowly specialized that it is the case in metropolitan areas in other parts of the world. However, the comparative advantages within the region will be able to be exploited to their full potential only if communications between its various parts are easy, fast and cheap.

The objective of the study will be to analyze the spatial organization of the region and to establish a methodology to measure how improved infrastructure would increase accessibility between various part of the region. As an illustration of the method to be developed during the study, using the crude data currently available, we will show the dissymmetry of land resources between the 2 main development poles Hong Kong and Guangzhou and how infrastructure investments could improve the situation in the future.

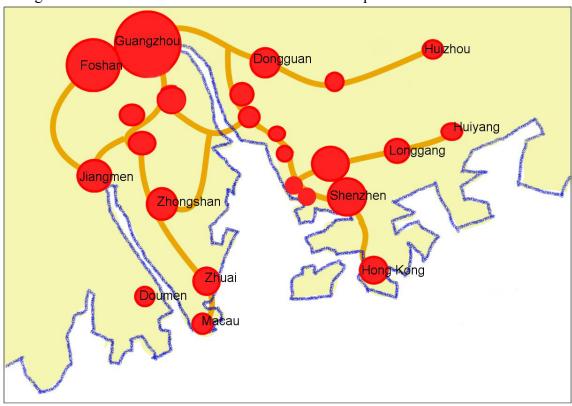


Figure 1: The settlements of the Pearl River Delta

The dominant poles of the PRD – Hong Kong and Guangzhou – are at the border of the region rather than close to its center of gravity as it is the case in most metropolitan areas. The linkage between these poles are not symmetrical but roughly follow a A shape with Guangzhou at the intersection of the 2 legs while Hong Kong is at an extremity. (see

Figure 1). In the future, this spatial arrangement might not be favorable to the development of Hong Kong for 2 reasons:

- a. As the region develops, the center of gravity of the population and of economic activities will move increasingly away from Hong Kong toward Guangzhou. The settlements located on the west bank (Zhongshan, Zhuhai), will have a better road link to Guangzhou than to Hong Kong.
- b. Hong Kong will be penalized by its lack of developable land which might impede the growth of the service sector and the development of its residential real estate.

Land supply is important for the economic development of each pole of the region. Hong Kong has an absolute scarcity of developable land while Guangzhou has an abundance of it. Hong Kong can increase its land supply in 3 manners: (i) changing some of the regulations restricting the use of land within the SAR, (ii) recycling obsolete land (in particular industrial land) and land fill, and (iii) creating new infrastructure which provides shorter or faster access to areas outside the SAR currently only accessible through long detours.

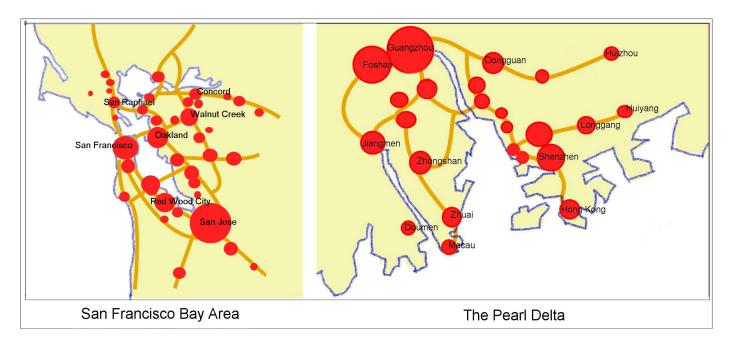


Figure 2: The Pearl Delta and San Francisco Bay represented at the same scale

San Francisco Bay is the metropolitan area which has the closest resemblance to the PRD because of its topography, however, San Francisco Bay's population of about 6 million people is much smaller. The comparison between the spatial arrangement of the settlements of the PRD and of San Francisco Bay illustrates the difference in the spatial integration between the 2 metropolitan areas. In San Francisco Bay, the three main poles – San Francisco, San Jose and Oakland – are tightly linked by a network of bridges and highways. By contrast in the PRD the three main poles, Hong Kong, Shenzhen and Guangzhou are aligned, with Hong Kong dangling in a dead end without any direct linkage to the western shore of the Delta and without room for much expansion. The effects of this unfavorable spatial location can be corrected by changes in land use policy and by investments in transport infrastructure.

The dissymmetry in land availability and access to existing urban areas between the 2 main poles of the PRD will means that Guangzhou and other part of the PRD will receive much more investments in the future and grow much faster than Hong Kong. In income weighted terms, Hong Kong of course carries a much heavier weight in the region than its small foot print might indicate. However, in the long term it is likely and desirable that the large income disparity between Hong Kong and the rest of the region will decrease; Hong Kong will then be left with its land supply constraint and unfavorable location in the region.

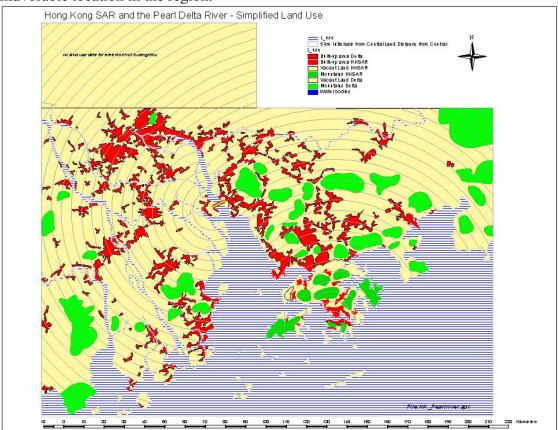


Figure 3: Simplified land use in the PRD

A measure of the area of land available at different distance from the two major poles of the PRD will give a concrete example of this dissymmetry. The map of Figure 3 shows an example of a simplified PRD land use map containing only 4 use categories: undeveloped land, developed land, mountains and water. In the proposed study more categories would have to be included including any areas undevelopable for topographical, ecological or regulatory reason. The concentric gray lines of Figure 3 shows a very crude way of measuring accessibility by drawing concentric circles from Hong Kong Central at 5 kilometers interval. The circles are interrupted on water and continue on the West bank across the Humen bridge. The same exercise is done starting from Guangzhou CBD. In the proposed study the accessibility lines will be drawn using existing roads rather than concentric circles.

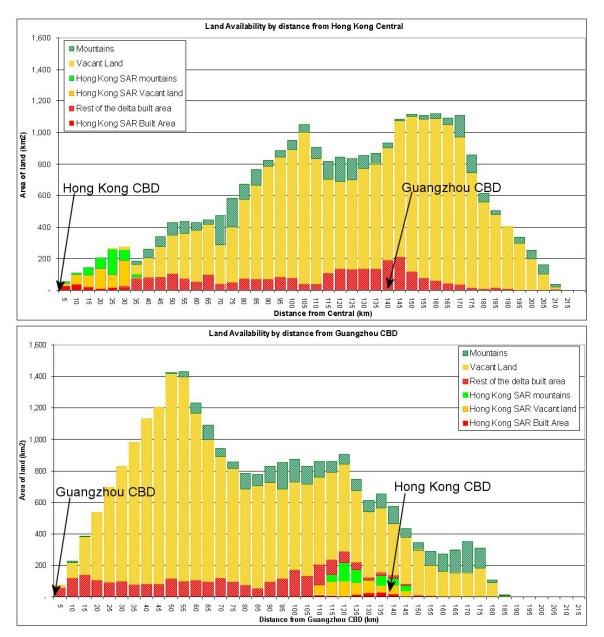


Figure 4: Land accessibility at 5 km intervals from Hong Kong and Guangzhou

The area of land accessible at different distance from Honk Kong and Guangzhou is shown on Figure 4. We can see that at a distance of 50 km, Hong Kong has about 200 km2 of vacant land while Guangzhou has 1400km2. If land constrained by development regulations would have been included the real amount of developable land would probably be less, but the difference between the land resources between the 2 cities would remain of the same magnitude.

A large part of this difference in land availability is due to topography. However, developing new infrastructure could increase the supply of land. For instance a bridge across the Zhudiang Kou would bring Zhuhai and Macau and the land around these 2 cities at about 60 km by road from Hong Kong Central instead of the current 160km.

This preliminary analysis, using the crude data available, shows how it is possible to quantify some spatial features of the PRD and to analyze how a change in infrastructure or regulations can affect land accessibility. In the proposed study more land use categories would be used, access will be measured by distance following existing or proposed roads not by the crude circle method used above. In addition, land value, current and projected population will be used to weight accessibility.

C. OBJECTIVE OF THE STUDY

The study aims at providing a reference frameworks and a spatial data base to test the potential impact of infrastructure projects on the integration of the PRD.

The study will be conducted over several phases. Each phase will focus on different sector of the economy of the PRD. The first phase, corresponding to the present terms of reference, will focus on accessibility and transport infrastructure. Subsequent phases could cover issues such as housing, social services, migration, population structure and the protection of the environment.

The data base generated by the study will be publicly accessible and widely distributed in order to generate an informed debate on spatial issues affecting the region.

The study will develop a set of indicators to (i) measure and analyze the current level of spatial integration, (ii) test the impact of new infrastructure projects on the accessibility of various parts of the PRD and, (iii) monitor in the future the progresses made in the spatial integration of the PRD. This set of indicators will also be available to other researchers to test infrastructure projects alternative not envisaged by the present study.

D. THEORETICAL FRAMEWORK

The economic potential of a metropolitan region is more than the sum of its parts because of the increasing returns to scale brought by large labor and consumer markets. However this economy of scale can be realized only if the region is spatially integrated, i.e. if any part of the region is easily accessible from all others. Any market fragmentation reduces the economic potential of the entire region. Market fragmentation within a region is often due to poor accessibility or defective infrastructure networks. The development of an adequate infrastructure will become a crucial factor in integrating markets within the region.

The various settlements of the PRD are widely dispersed around an area that is heavily constrained by topography and by administrative borders. Because of the combination of topographical constraints and environmental considerations, only a small portion of the geographical area of the PRD is developable. In this context, every area of developable land has a high scarcity value. As a consequence, misuse or under use of land will prove much more costly in the PRD than in a region where the amount of developable land is relatively unconstrained (for example in metropolitan areas like Shanghai, Beijing or Jakarta). Because of the resilient nature of land development, misallocations of land are not easily corrected and tend to weight heavily on the economy of a region for very long periods of time. The locational characteristics of every part of a metropolitan region contribute in defining their economic comparative advantage within the region. Topography constitutes a constraint and an opportunity in defining this comparative advantage. By identifying correctly its regional comparative advantage, each settlements in the region will maximize it own prosperity. Within a metropolitan area, the comparative advantage of a settlement is related to its location within the region and to the degree to which it has a direct access to the rest of the country and to the rest of the world. The analysis made through the present study should highlight the spatial comparative advantages of the various parts of the PRD and will show how these advantages can be enhanced by improving the infrastructure network.

While a certain amount of competition to attract investment is desirable among the various cities and towns of the region, the duplication of major facilities constitutes a waste of resources whose economic cost is borne by the entire region. But duplication can be avoided only if transport across the various parts of the region is easy, fast, reliable and cheap.

E. TASKS

The study will include 4 streams of tasks:

- a) Establishing a spatial database including: built-up area; areas with development potential; demography; wages; land values and transport networks.
- b) Collecting data on the flows of people and goods in terms of volume, distance, time and cost of transport within the PRD and at the contact access points with the rest of the country and the outside world.
- c) Establishing the current accessibility profile of the main cities of the PRD with a set graphs and indicators.
- d) Testing the change in accessibility caused by the construction of new infrastructure, the modification or improvement of existing infrastructure or the alleviation of administrative bottlenecks.

1. Establishment of a spatial data base

- a) Establish the borders of the region including: to the South: Gaolan;to the West: Taishan; to the North :Huadu; to the East: Huizhou.
- b) Establish a base map including: limits between land and water, built-up areas, protected areas, developable areas. Summary land use table of the region.
- c) Transport corridors within the region: main roads, highways, metro, railways, ferries. Restricted access highways will include access points;
- d) Transport corridors linking the region to the outside world, existing and projected highways and railways.
- e) Transport facilities: railway and metro stations, bus terminals, ferry landings, ports, containers ports, airports.
- f) Selection of economic center points within the region: selection of central points within the CBD of about 6 cities and towns within the region for which accessibility indicators will be measured. The economic centers of

the region should include Hong Kong, Guangzhou, Shenzhen, Dongguan, Zhongshan, and Zhuhan

- g) Administrative boundaries between towns, municipalities and counties, boundaries of SARs and SEZs.
- h) Districts census boundaries used for demographic calculations, population by census boundary according to 2000 census, density by built-up area.
- i) Median and minimum wage by administrative boundary
- j) Current land value or value for a base year in built-up and potentially developable areas.

2. Collection of flow data

(1) People movements:

- a) Average passengers per day per railway lines from station to stations, per metro line per bus terminals;
- b) Average passengers per day per ferry terminal
- c) Private cars per day at selected points of the road network
- d) Average transport time and cost between economic center points by different modes

(2) Movement of goods

- a) tons per day at selected points of the road network;
- b) tons per day per railway stations;
- c) containers movements within and from and to the region;
- d) Average transport time between economic centers points by mode of transport.

3. Current accessibility profiles:

For each of the economic center points, the consultant will build an accessibility profile which will consist of the following:

- a) Map of equidistant zones: following roads, railway and ferries networks defining equidistance zones from each economic center point. Measure of the built-up and buildable area within each distance interval. Measure of the value of land within each interval. Evaluation of number of people within each distance interval.
- b) Map of transport isochrones: same exercise as above but using travel time rather than distance for roads and rail.
- c) Accessibility profile for each economic center consisting of graphs showing the number of people, the land value, the built and developable area accessible at each distance and time interval.
- Accessibility indicator for each economic center consisting in the cumulative values of the profiles above measured at distance interval of 25, 50, 100 and 200 km

4. Testing accessibility changes

Same measures as above (maps of equidistant zones and isochrones, and corresponding derived indicators) after networks have been modified by:

- a) Adding a bridge between HKSAR and the West Bank of the Pearl river
- b) Modifying speed on highway and trains or by improving border process;
- c) Any other transport infrastructure modification.

5. Diagnosis based on data and test

The consultant will use the spatial analysis conducted in the tasks above to develop a diagnosis of the accessibility of the region and of the change in comparative advantage which could be brought about by a changes in the infrastructure network. The consultants will make a brief prognosis on the general trend in real estate prices and wages as the region expands and the accessibility of various parts of the region are modified.

F. STAFFING AND INPUTS

The study will require the following staff:

- a) a project manager coordinator with a background in economics (25 person/weeks)
- b) an urban planner/ GIS specialist; (25 p/w)
- c) a transport specialist; (10 p/w)
- d) a real estate specialist; (7 p/w)
- e) an outside adviser; (3 p/w)

for a total of about 70 pw

G. TIMING

The study will last about 6 months and should start around February 2002.

Technical note

One of the main objective of the study is to provide a spatial data base of the PRD which will be widely available to the private sector, NGO and academic researchers. The data base itself will be a main output of the study. For this reason it is essential that this data base is built using commonly used format.

The cartographic data base will be digitized from maps or satellite images at a scale not smaller than 1:250,000.

The GIS software is left to the discretion of the consultants but GIS files will be provided in shape format (*.shp). Tables will be provided in Excel format and reports in Words.