Hong Kong – Zhuhai – Macao Bridge ("HZMB")

Assessment of Economic Benefits and Cost Allocation for HZMB Main Bridge among the three Governments

INTRODUCTION

This paper provides supplementary information on the methodology of and rationale in the assessment of direct economic benefits and the cost allocation among the governments of Hong Kong SAR, Guangdong and Macao SAR for the implementation of HZMB Main Bridge.

GENERAL PRINCIPLES OF BENEFIT EVALUATION AND COST ALLOCATION

2. The three governments have agreed that it is most appropriate to allocate the project cost of the HZMB Main Bridge in proportion to the direct economic benefit to be received by them. Major direct economic benefits for the three territories arise from vehicle operating cost saving, reduction in travel time and benefits generated from induced traffic volume (i.e. value of traveling time saved for induced volume of passengers and economic value of the induced quantity of goods[1]) due to the existence of HZMB.

3. For indirect benefits, such as induced investments in the three territories as a result of the availability of a direct road link between western Pearl River Delta (PRD) and Hong Kong, it is difficult to produce a plausible analysis due to the enormous range of potential variations in formulating a workable statistical model.

METHODOLOGY OF TRAFFIC VOLUME FORECAST

4. The methodology for the forecast of the traffic volume adopted for the project is a four-stage modelling approach for deriving passenger and vehicle flows, which is in line with international practice. The four stages involved in the approach are as follows :-

[1] The economic value of the induced goods refers to the economic benefit that the goods will bring to the society through a series of induced commercial activities such as logistics, wholesaling, retailing, re-selling, etc.

(a) Trip Generation - Each of the three territories (i.e., Hong Kong, the Mainland and Macao) is divided up into smaller economic zones. The total cross-boundary passenger and cargo trips generated from and attracted to each zone are estimated, taking into account all influencing factors which reflect people's travel behaviour and characteristics of the region including population, employment situation and land use development.

(b) Trip Distribution - The number of trips made between pairs of zones are then estimated in this stage.

(c) Modal Split - The transport mode used by individual trips between each pair of zones are determined, taking into account factors such as income level, car ownership, accessibility to different transport modes, etc.

(d) Assignment - Trips made by using different land transport modes including private car, bus, coach, goods vehicles and container trucks are assigned to the highway network including HZMB.

ASSESSMENT METHODOLOGY OF ECONOMIC BENEFITS

5. With the traffic volume forecast deriving from the above-mentioned four-stage model, relevant benefits for an assessment period of 20 years are quantified, aggregated and attributed to Hong Kong, Guangdong and Macao in accordance with the following general principles:-

I. Benefits to passengers would be allocated according to their places of origin.

II. Benefits to freight vehicles would be split equally between the territories among which the vehicles are using HZMB for their logistic purpose.

6. Benefits relevant to the existence of HZMB are:

(i) Vehicle Operating Cost Saving

Saving in vehicle operating costs for passenger and freight vehicles are the differences in transportation costs between schemes with and without HZMB as a result of the vehicles traveling on a better and shorter road network, reduced traffic congestion and/or increased speed of traveling with the provision of HZMB.

(ii) Reduction of Travel Time

Part of this benefit refers to the saving in travel time due to the reduced travel distance and the increased speed of traveling, as a result of which the respective passengers could spare saved time for work or leisure. Other factors such as the effect of the reduced traffic congestion on roads because of the improved road network and the change of mode of transportation from waterborne vessels to land transport via the HZMB are also accounted for.

Another part of this benefit refers to the saving in the time cost for transporting goods.

(iii) Benefits Generated from Induced Traffic Volume

For benefits generated from the induced traffic volume in the three territories, there are two categories: one for the induced passenger volume and the other for the induced goods traffic volume.

In relation to the induced passenger volume, its benefit is estimated based on the saving in time cost for those passengers using the HZMB. In relation to the induced goods traffic volume, the estimation of its benefit is based on the economic value of the goods generated from the induced goods traffic volume.

EXAMPLES OF CALCULATION OF DIRECT BENEFITS

7. The estimation of direct benefits will involve complex analytical tools and empirical formula. Nevertheless, in order to illustrate how the direct benefits are calculated, we show below three simplified computation examples for each category of benefit:

i) Calculations for Vehicle Operating Cost Saving

Taking the saving in vehicle operating cost for traveling between Hong Kong and Zhuhai in 2016 as an example, for the case without HZMB, trucks will have to travel via Zhongshan, Humen Bridge to Hong Kong. The weighted average of the unit vehicle operating cost on this route is RMB￥1.72 per km for ordinary trucks and RMB￥2.25 per km for container trucks. The distance of travel on this route is 214.8 km.

With the commissioning of HZMB, the vehicle operating cost for goods

transportation would be reduced as a result of better and shorter road network, reduced traffic congestion and increased speed of traveling. For trucks traveling via HZMB to Hong Kong, the corresponding unit transportation cost would be RMB￥1.64 per km for ordinary trucks and RMB￥2.14 per km for container trucks. The distance of travel on this route is 66 km.

The saving in vehicle operating cost for traveling on HZMB between Zhuhai and Hong Kong for:

(a) ordinary truck
= cost of travel without HZMB – cost of travel with HZMB
= RMB￥1.72 per km x 214.8 km - RMB￥1.64 per km x 66 km
= RMB￥261.22 per ordinary truck

(b) container truck
= cost of travel without HZMB – cost of travel with HZMB
= RMB￥2.25 per km x 214.8 km - RMB￥2.14 per km x 66 km
= RMB￥342.06 per container truck

The above benefits would then be split equally between Hong Kong and Guangdong according to the principle II as mentioned in paragraph 5 above.

ii) Calculations for Benefits from Reduction in Travel Time

Taking reduction in travel time for passengers using HZMB as an example, in 2016, there is a Hong Kong private car with two passengers which will travel from Hong Kong to Jiangmen, the travel time without HZMB would be approximately 2.83 hours. With HZMB, the travel time would be reduced to 2.17 hours. Therefore, the time saved for the two passengers in this private car in this trip is 0.66 hour.

By analyzing the statistic data, the Mainland consultant estimated that the hourly time value for a Hong Kong passenger is RMB￥52.3 per hour.

Hence, according to the principle I as mentioned in paragraph 5 above, the benefit from the time saved for these two passengers attributed to Hong Kong is
= RMB￥52.3 per hour x 2 x 0.66 hour

= RMB￥69.04

For the other way round, in the case of a Mainland private car traveling from Jiangmen to Hong Kong, the hourly time value for a Jiangmen passenger is RMB￥8.6 per hour. Therefore, the benefit from the time saved for these two passengers attributed to Jiangmen and hence to Guangdong is
= RMB￥8.6 per hour x 2 x 0.66 hour
= RMB￥11.35

iii) Calculations for Benefit Generated from Induced Traffic Volume

Taking benefits generated from induced goods as an example, in 2016, each container truck and ordinary truck is assumed to carry 6 tonnes and 2.8 tonnes of goods respectively.

Based on the past statistical data of the prices of ten types of common imported goods as well as their annual import quantities, the Mainland consultant recommended to adopt an average economic value of goods of RMB￥1162.5 per tonnes for ordinary trucks and RMB￥2325 per tonnes for container trucks with due consideration of the nature and prices of goods being transported. The economic benefits as a result of the induced goods traffic volume for each type of trucks are:

Ordinary Truck	= RMB￥1,162.5 per tonnes x 2.8 tonnes
	= RMB￥3,255 per ordinary truck
Container Truck	= RMB￥2,325 per tonnes x 6 tonnes
	= RMB￥13,950 per container truck

The above benefits would then be split equally between Hong Kong and Guangdong, or between Hong Kong and Macao as the case may be, according to the principle II as mentioned in paragraph 5 above.

ASSESSMENT RESULT OF DIRECT BENEFITS

8. As illustrated in the examples in paragraph 7 above, the total direct benefits arising from vehicle operating cost saving, reduction in travel time and benefits generated from induced traffic volume due to the existence of HZMB are quantified, aggregated and attributed to the three territories. It should be noted that the Mainland consultant has made use of complex analytical tools and

empirical formula to quantify these total direct benefits which are apportioned among the three territories as shown in the following table.

Table 1 Estimated Economic Benefits of the HZMB for 20 Years

Economic Benefits *(in RMB ¥ Billion)*	Hong Kong	Mainland	Macao	Total
Discounted Total Benefits	42.8	24.1	7.1	74.0
Discounted Total Benefits Ratio	57.8%	32.6%	9.6%	100%

9. Hong Kong receives a larger proportion of the benefits according to the two principles as mentioned in paragraph 5 above because benefits to passengers would be allocated according to their places of origin and the value of time saved for Hong Kong passengers is much higher than that of Guangdong and Macao passengers. For example, in year 2016, the value of time saved for passengers of Hong Kong, Guangdong and Macao recommended by the Mainland consultant are RMB¥52.3 per hour, RMB¥15.9 per hour[2] and RMB¥27.6 per hour respectively.

10. Furthermore, the Mainland consultant considered that different rates of economic development of the three territories as well as the value of time preference by the local population should be accounted for and hence recommended the benefits received by the three territories need to be discounted to a base year for equal ground comparison.

COST ALLOCATION FOR THE IMPLEMENTATION OF THE HZMB MAIN BRIDGE

11. Since the cost for the implementation of the HZMB Main Bridge will be split based on the principle of Equalization of Benefit to Cost Ratio (Rbc), taking into account the fact that each territory has already agreed to fund the costs of connecting roads directly, contributions to the costs of the HZMB Main Bridge is accordingly adjusted a ratio of 50.2 : 35.1 : 14.7 as delineated below:-

Table 2 Cost Allocation of the HZMB Main Bridge

	% of Benefit Allocated	Cost Allocation for Main Bridge & Connecting Roads *(in RMB ¥billion)*	Cost for Respective Connecting Roads	Cost Allocation for Main Bridge *(in RMB ¥billion)*	% of Cost Allocation for Main Bridge

[2] The figure for Guangdong is an average time value for passengers from different areas of Guangdong, including Zhuhai, Zhongshan, Jiangmen, Guangzhou, Foshan, etc.

	(a)	(b) = (a) x 47.5	*(in RMB ¥ billion)* (c)	(d) = (b) – (c)	(e) = (d)/31.03
Hong Kong	57.8%	47.5x57.8% = 27.455	11.88	27.455-11.88 =15.575	15.575÷31.03 = 50.2%
Guangdong	32.6%	47.5x32.6% = 15.485	4.59	15.485-4.59 =10.895	10.895÷31.03 = 35.1%
Macao	9.6%	47.5x9.6% = 4.56	0	4.56	4.56÷31.03 = 14.7%
			TOTAL	31.03	100%

Note: The total project cost of the HZMB Main Bridge and its connecting roads is estimated to be RMB¥47.5 billion in the HPDI's report in January 2007.