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Theme Paper – Hong Kong

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About the Research Centre for Construction and Real Estate Economics (RCCREE):

The RCCREE is the Hong Kong Polytechnic University's Research Centre for solution oriented research and consultancy in construction and real estate economics. It undertakes internationally relevant multi-disciplinary research that supports the advancement of the construction and real estate industries in the following areas: Economic Policy and Institutional Analysis, Real Estate Economics, Construction Economics, Housing, Human Behaviour in Economic Decision Making, and Value Management and Facilities Performance. For further information, please contact the Director, Professor Eddie C.M. Hui (bscmhui@polyu.edu.hk).

Theme: Projection of Construction Resources

1. Introduction

Projection of construction resources is one of the key tasks which helps sustain the development of Hong Kong's construction industry. This study reviews the demand and supply for different construction resources, including land, labour, equipment and plant, materials and funding. Issues related to each of these resources are highlighted to give a general overview that underpins this study on their projection. The Hong Kong SAR government has been implementing various infrastructure projects throughout the years. Apart from meeting the social developmental and economic needs, they also provide ancillary facilities for collaborative strategic development plan (e.g. the recent Belt and Road Initiative) proposed by the mainland Chinese government. However, there were several constraints which hindered Hong Kong's development. For instance, the land shortage problem is a barrier for housing provision, whilst the manpower shortage and ageing workforce lower construction productivity. From the perspective of construction cost planning, there have been cost overruns in a number of infrastructure projects. It led to additional expenditure and delays. To overcome these constraints, construction resources projection can be regarded as a crucial strategy for the future development of the economy. Through professional forecasting, public policy makers and private sector managers strive to maintain equilibrium between the supply and demand of the scarce construction resources, thereby sustaining one of the important pillars of the society. This paper depicts how the forecasting is carried out.

2. Main Issues on Construction Resources — Hong Kong Situation

2.1 Land

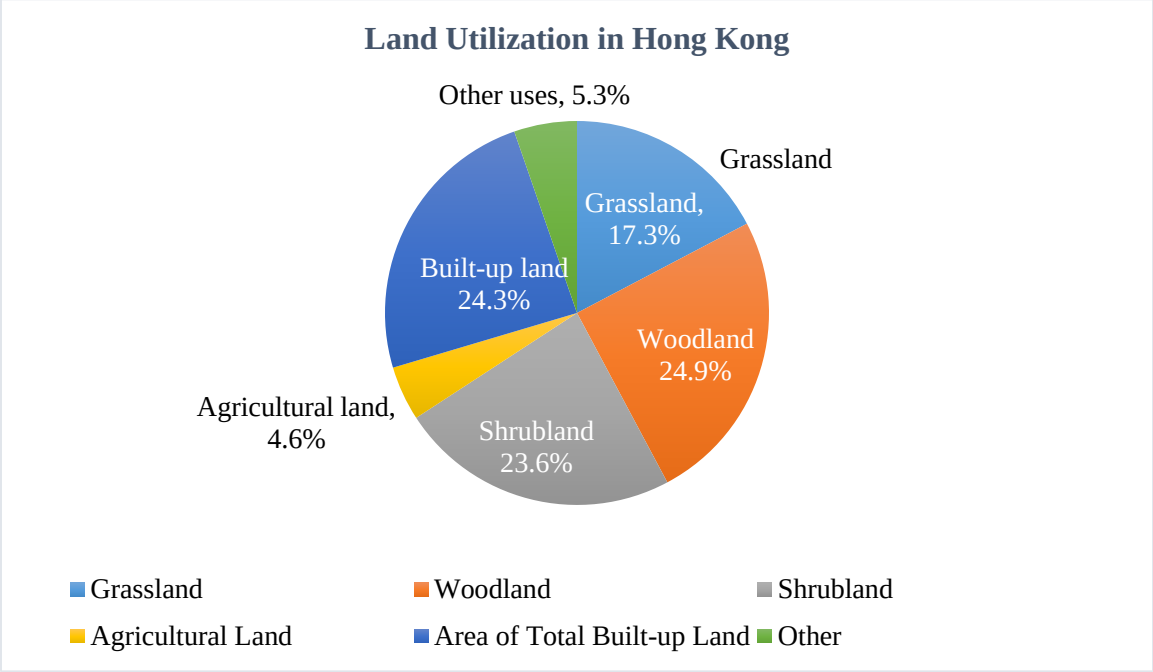
Land Shortage

Land shortage for building is currently a plaguing problem that hinders Hong Kong's further development if the problem is not resolved in the near term. The topography of Hong Kong is mountainous, and the total land area is 1,111 km^2. About 24.3% (270km^2) of the land area belongs to built-up area and the remaining 75.7% (841km^2) belongs to not-for-development or non-built up area which mainly constitutes country parks, wetland and reservoirs (Figure 1).

Over the past years, Hong Kong has been encountering various challenges during the planning and land development stages. The pressing need is to provide adequate and prompt supply

of land for the purpose of supporting the growing population, dynamic economy and ageing community and the associated developmental needs (Task Force on Land Supply, 2018).

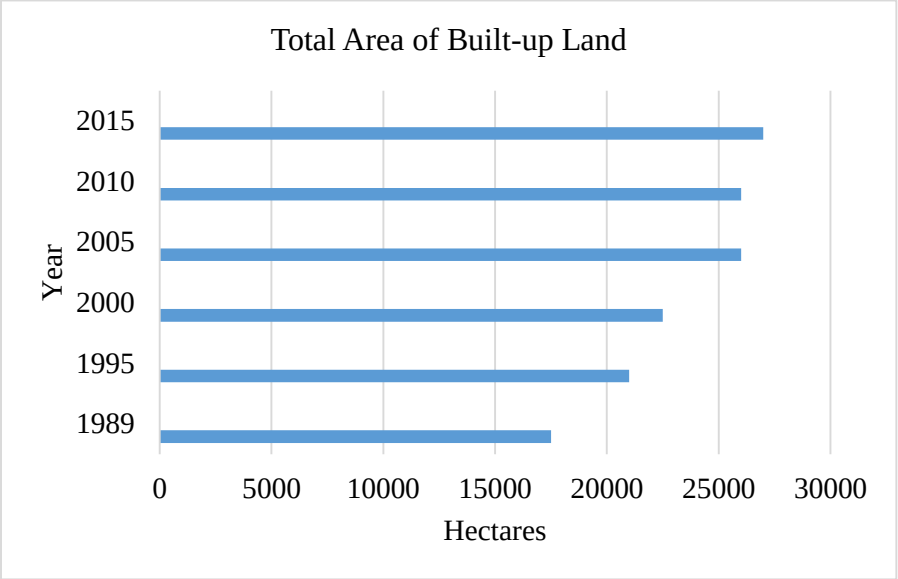
Figure 1. Land Utilization in Hong Kong



Source: Task Force on Land Supply, 2018. *Preamble.* [online] Available at: <https://landforhongkong.hk/en/demand_supply/index.php>

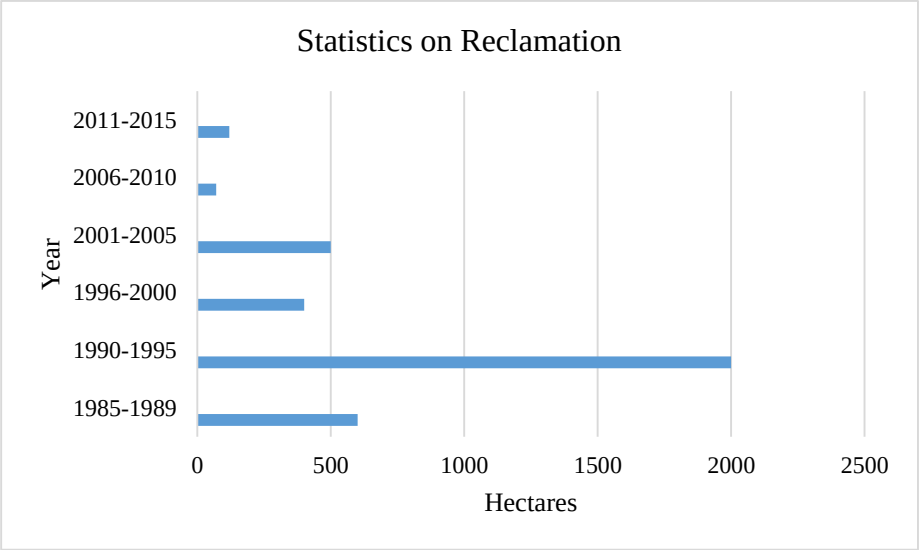
According to the Task Force on Land Supply (2018), land supply in Hong Kong has not kept up with the growing population, the increasing number of households or the social and economic development (Figure 2). Reclamation used to be one of the major strategies to provide land supply. However, due to legal challenges and subsequent legislative changes, a moratorium was put on reclaiming land at the Victoria Harbour between Hong Kong Island and Kowloon Peninsular due to environmentalists' objections since 2004 (Development Bureau, 2004). Consequently, the land supplied from reclamation had declined (Figure 3). Other land supplies are from site clearance of occupied areas and redevelopment (more often piecemeal rather than comprehensive).

Figure 2. Total Area of Built-up Land



Data Source: Task Force on Land Supply, 2018. *Preamble.* [online] Available at: <https://landforhongkong.hk/en/demand_supply/index.php>

Figure 3. Statistics on Reclamation



Notes: The total reclamation between 1985-2000 is 3,000 hectares; the total reclamation between 2001-2015 is 690 hectares.

Data Source: Task Force on Land Supply, 2018. *Preamble.* [online] Available at: <https://landforhongkong.hk/en/demand_supply/index.php>

Effects on Housing Demand and Supply

The land shortage problem, which causes a series of livelihood issues in Hong Kong, has severely affected the lower-income citizens' daily life. According to the Task Force on Land Supply, the average annual housing completions from 2007 to 2016 were about 25,700 units, which registered an overall decline of 50% compared with the preceding years (i.e. an average annual housing completions of 59,800 units). Public rental housing (PRH) applications are also one of the indicators of public housing demand. According to the Hong Kong Housing Authority (2018), by the end of March of 2018, a total of 272,300 applications for PRH were recorded, which composed of 153,300 general applications and 119,000 non-elderly one-person applications under the Quota and Points System. The up-to-date average waiting time is 5.1 years for general applications. This relatively long waiting time exceeds the Housing Authority's target of providing first flats offer to general applicants in around 3 years, and indicates that the public housing supply is in shortage compared with the growing population and the ever increasing aspirations of young families to split from their parents' homes.

Land Demand and Supply

A recent review on the land demand and supply was conducted by the Task Force, based on the *"Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030"* released by the Development Bureau and the Planning Department. The land requirement for the coming future will be a minimum of 4,800 hectares (Task Force on Land Supply, 2018). Table 1 shows that there is a total of 3,600 hectares of land resources to be released under the planned and committed projects (i.e. which are expected to be materialized in around 2030). Hence, the outstanding land requirement would be about 1,200 hectares and it should be noted that it is a conservative estimate owing to considerable uncertainties which may be encountered during the actual delivery of land (Table 2).

Table 1. Total Land Supply from Committed and Planned Projects

Total land supply (planned and committed projects by 2030s): 3,600 hectares	1. Kai Tai Development
	2. Kwu Tung North New Development Area (NDA)
	3. Fanling North NDA
	4. Hung Shui Kiu NDA
	5. Yuen Long South Development
	6. Kam Tin South Development Phase 1
	7. Tung Chung New Town Extension

Source: Development Bureau and Planning Department, 2016. *Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030.* [pdf] Available at: < https://www.hk2030plus.hk/document/2030%2BBooklet_Eng.pdf >

Table 2. Estimation of Overall Land Supply and Demand up to 2046 (hectares)

	Up to 2026			2026 – 2046			Total Shortfall
	Demand	Supply	Shortfall	Demand	Supply	Shortfall	
Land for Residential Use	768	660	-108	902	780	-122	**-230**
Land for Economic Use	196	61	-135	262	141	-121	**-256**
Land for Infrastructure and Facilities	1,661	1,089	-572	931	783	-148	**-720**
Total	**2,625**	**1,810**	**-815**	**2,095**	**1,704**	**-391**	**-1,206**

Source: Task Force on Land Supply, 2018. *Land Demand of Hong Kong.* [online] Available at: < https://landforhongkong.hk/en/demand_supply/land_demand.php>

Strategies Being Proposed by the Task Force

There is neither a single option nor a perfect solution to tackle the imminent land shortage problem, hence a multi-pronged approach is therefore proposed by the Hong Kong Task Force (2018) with the aim of increasing land supply. The Task Force has examined over 20 land supply strategies according to their development benefits, costs, the time required for land provision, overseas experience, challenges, government's public engagement and consultation and major findings from previous studies. The strategies are classified into 3 categories: short-to-medium term options; medium-to-long term options; and conceptual options (Table3). It is anticipated that over 380,000 residential units will be provided from the key measures in the short-to-medium term, whereas a total of 220,000 residential units can be provided under the medium-to-long term measures. Some of these strategies are controversial amongst conservationists and pro-development camps, or may be costly to develop due to substantial infrastructural requirements needed to materialize the plans.

Table 3. Land Supply Strategies

Categories	**Land Supply Alternatives**
Short-to-medium term (with opportunity to provide additional land in around 10 years' time)	• Developing brownfield sites • Using private agricultural land reserve in the New Territories • Alternative uses of sites under private recreational leases • Relocation or consolidation of land-extensive recreational facilities
Medium-to-long term options (with opportunity to provide additional land in around 10 to 30 years' time)	• Near-shore reclamation outside Victoria Harbour • Developing the East Lantau Metropolis • Developing caverns and underground space • Increase new development areas in the New Territories • Developing the River Trade Terminal site • Developing two pilot areas on the country park periphery
Conceptual options (unable to confirm when and how much additional land can be provided in the meantime)	• Developing the River Trade Terminal site and its vicinity in the long term • Developing more areas on country park periphery • Increasing the development intensity of "village type development" zone • Developing on the roofs of existing transport infrastructure • Using the development potential of public utilities sites • Relocating Kwai Tsing Container Terminals • Developing on top of Kwai Tsing Container Terminals • Reclaiming part of Plover Cove Reservoir for new town development

Source: Task Force on Land Supply, 2018. *Land Supply Options.* [online] Available at: < https://landforhongkong.hk/en/supply_analysis/index.php>

2.2 Labour

Insufficient Labour Supply

The Hong Kong construction industry sector, which is labour-intensive, has suffered from a persistent labour shortage problem in recent years. According to a survey on labour shortage in construction industry as conducted by the Hong Kong Construction Association (HKCA) in April 2018, a total of 197 construction sites were sampled with 38,647 construction workers being reckoned. The findings reflect that the shortage rate of construction workers is about 7.9% with a lack of 3,043 workers on site (Table 4). As the investigation only covered 34.2% of the total number of registered construction workers in Hong Kong, it is assumed that the total number of workers in shortage is 8,893. The current labour shortage rate is 7.87%, which is slightly higher than the corresponding rate of 5.47% in the same period of the preceding year (HKCA, 2017). Joiners, tilers, bricklayers, glaziers& curtain wall installers are facing the most severe shortage problem (Table 5).

It is noteworthy that the corresponding shortage rates in the recent two years registered a mild decrease as against with the same period from 2014 to 2016, reflecting that the manpower shortage has been slightly alleviated (HKCA, 2018). The shortage problem has appeared less intensive as the Hong Kong government has been spending efforts in collaborating with the Construction Industry Council (CIC). A series of measures have been launched to release more workforce, including the development of progression pathway and the attraction of new entrants to join the construction industry through promotions; upgrading the skill levels of semi-skilled or skilled workers by providing training; and assessing the supply and demand of professionals and workers in a timely manner.

Table 4. Sample Survey on Labour Shortage in Construction Industry

Survey on Labour Shortage in the Construction Industry					
Investigation period	**Apr 2014**	**Apr 2015**	**Apr 2016**	**Apr 2017**	**Apr 2018**
Number of construction site investigated	163	128	139	182	197
Number of workers investigated	24,466	20,726	30,353	40,635	38,647
Number of workers in shortage	3,247	2,356	2,930	2,222	3,043
Demand for workers	27,713	23,082	33,283	42,857	41,690
Shortage rate (%)	**13.27**	**11.37**	**9.65**	**5.47**	**7.87**

Source: Hong Kong Construction Association, 2018. *Press Release on The Survey Result of the Labour Shortage in Construction Industry (April 2018).* [pdf] Available at: <http://www.hkca.com.hk/uploads/vpr_doc/7254f406a55326f8fcfbb8c6e4d1a55b.pdf

Table 5. Sample Statistics of Apr 2018 by Type of Works (HKCA)

Sample Statistics of Apr 2018		
Type of works	**Number of construction workers**	**Number of workers in shortage (shortage rate%)**
General welder	1,147	96 (8%)
Leveller	660	93 (14%)
Bar bender and fixer	1,390	199 (14%)
Carpenter (formwork)	464	91 (20%)
Refrigeration/air-conditioning/ventilation mechanic	492	103 (21%)
Bamboo scaffolder	271	83 (31%)
Glazier & curtain wall installer	193	**83 (43%)**
Bricklayer	339	**165 (49%)**
Tiler	171	**94 (55%)**
Joiner	369	**202 (55%)**

Source: Hong Kong Construction Association, 2018. *Press Release on The Survey Result of the Labour Shortage in Construction Industry (April 2018).* [pdf] Available at: <http://www.hkca.com.hk/uploads/vpr_doc/7254f406a55326f8fcfbb8c6e4d1a55b.pdf

According to the aforementioned investigation conducted by the HKCA (2018), the type of works that are in shortage have been shifted from early stage construction trades to later stage construction trades. Although the manpower shortage problem has subsided, the ageing labour force, the skills mismatch in demand and supply and the low productivity continue to plague the construction industry. However, consequent to the completion of large scale infrastructure projects, such as the Hong Kong-Zhuhai-Macao Bridge, the Guangzhou-Shenzhen-Hong Kong Express Rail Link Hong Kong Section, and the Sha Tin to Central Link, it is anticipated that some labour force can be released to alleviate the short term labour shortage.

Ageing Labour and the Lack of Young Entrants

The Hong Kong construction industry is facing the problems of acute ageing workforce and the insufficiency of new blood. According to the statistics collected by the CIC, the age distributions of registered workers by trades and by skill levels in 2018 are as shown in Table 6 and Figure 4 below.

Table 6. Manpower Supply by the Age Distributions of Registered Workers of All Trades and by Skill Level (2018)

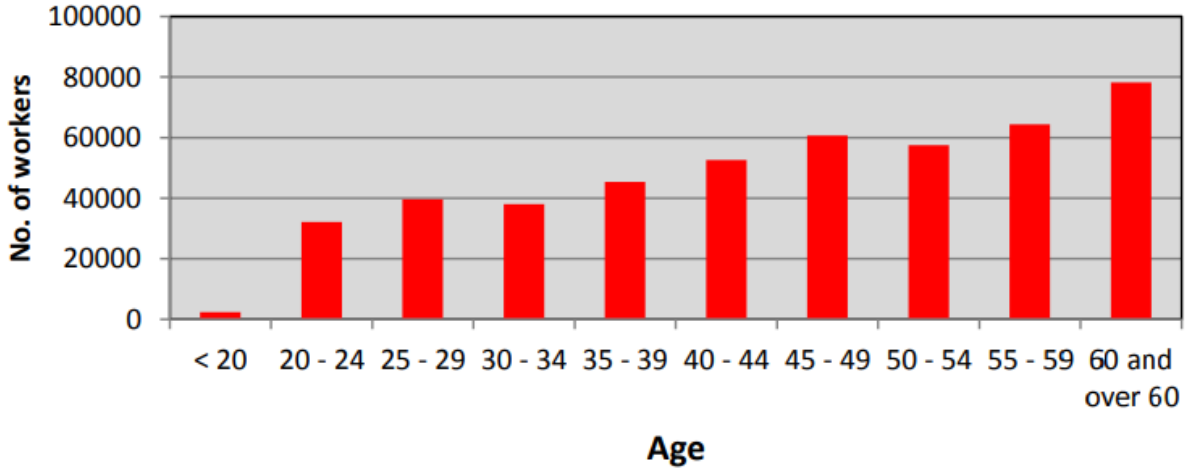
All Trades of Manpower Supply							
Age	**RGW**	**RSS**	**RSS (P)**	**RSW**	**PSW (P)**	**Total**	**%**
<20	2,135	208	0	12	0	2,355	0.50
20-24	27,914	3,329	0	908	0	32,151	6.83
25-29	30,243	5,729	0	3,702	0	39,674	8.42
30-34	23,295	4,322	0	10,442	0	38,059	8.08
35-39	21,975	3,315	0	19,970	102	45,362	9.63
40-44	25,034	2,636	0	24,645	268	52,583	11.17
45-49	29,272	2,393	0	28,675	334	60,674	12.88
50-54	25,964	1,734	0	29,537	284	57,519	12.21
55-59	23,459	1,763	0	38,866	253	64,341	13.66
60 and over 60	30,187	2,085	1	45,723	266	78,262	16.62
Total	**239,478**	**27,514**	**1**	**202,480**	**1507**	**470,980**	**100**

Notes: 1. RGW: Registered General Worker; RSS: Registered Semi-skilled Worker; RSS (P): Registered Semi-skilled Worker (Provisional); RSW: Registered Skilled Worker; RSW (P): Registered Skilled Worker (Provisional).

2. A portion of the registered workers may not turn up in construction sites

Source: Construction Industry Council, 2018. *Age Distribution of Registered Workers by Trade by Skill Level (No. of applicants) up to 30 June 2018.* [pdf] Available at: <http://www.cic.hk/files/page/192/AgeDistribution_20180630(a).pdf>

Figure 4. Distribution of Manpower Supply by Age of Registered Workers of All Trades (2018)



Source: Construction Industry Council, 2018. *Age Distribution of Registered Workers by Trade by Skill Level (No. of applicants) up to 30 June 2018.* [pdf] Available at: <http://www.cic.hk/files/page/192/AgeDistribution_20180630(a).pdf>

Currently, the number of workers aged below 30 accounts for about 15.8%, whereas the number of workers aged over 50 accounts for about 42.5% (Table 6). The trend reflects that there are insufficient new entrants to the industry and a succession gap of manpower supply will emerge after the ageing labourers retire. It will not only affect productivity but also hamper the vigorous development of the construction industry.

Despite promotion by the Development Bureau and the CIC, there are relatively few young new entrants joining the industry. The major reason is that youngsters are more educated nowadays due to the popularization of tertiary education, and they prefer taking up white-collar works rather than manual works which are highly demanding physically. The general image of the construction industry does not help neither. Rightly or wrongly, it is perceived to be dangerous working on sites and skill levels are low. The image problem severely deters the youth from entering the industry. The government and related construction associations have to spend effort in improving the industry image and removing the stereotypes by providing a more promising future, allocating resources for training, enhancing the safety awareness and supervising construction site safety in the industry (Ho, 2016). Apart from that, the industry has been adopting the "First-hire-then-train" approach, in that new entrants are employed by contractors or subcontractors first and receive on-the-job training provided by their employers (CIC, 2018). Indeed, accumulating young and

experienced local manpower reserve on a regular basis is the most effective way to address the deep rooted shortage problem to sustain construction development. Importing foreign labour that relieves the pressing need should be the last resort due to many undesirable social-economic and political issues which would arise (e.g. additional housing needs).

2.3 Equipment and Plant

Overview

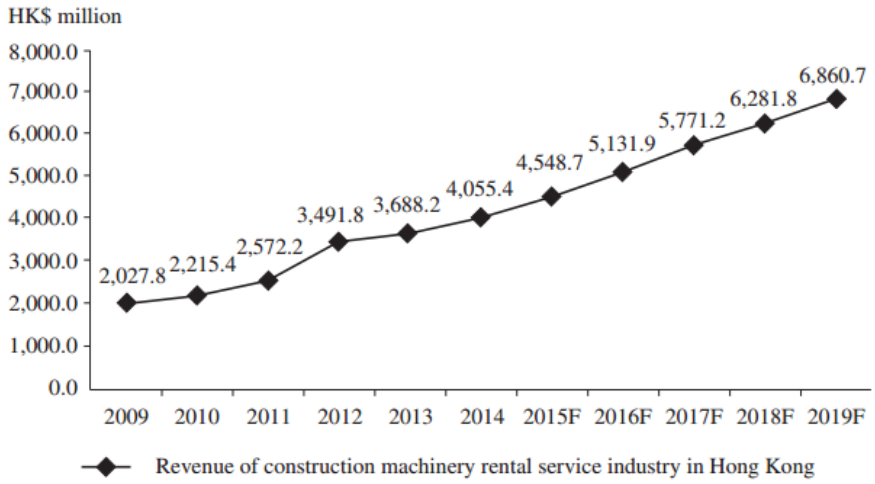
A heavy reliance on utilization of plant and equipment forms one of the features of the construction industry. Taking public construction works as an example, the adoption of mechanized prefabrication system for public housing construction has prevailed in recent years. Prefabrication of building elements (i.e. facades, slabs, partition walls and staircases) is aimed at increasing cost and time effectiveness and to enhance building quality. The private sector also actively explored the adoption of precast concrete construction since 2002 when the gross floor area concession was implemented. The prefabrication technology greatly reduces demand of on-site construction works. However, it also increases the reliance on large construction plant, such as tower cranes, to hoist and place the precast component to the designated position (Wong et al., n.d.). In the private sector, a leading construction firm has invested in a construction plant yard, which is the largest of its kind in Hong Kong. It stores a wide range of construction equipment primarily for building, civil and foundation engineering. An example is in the Technology Park, which incorporates the operations, for instance, maintenance, assembly and storage for plant and equipment.

According to a report commissioned by the IPSOS (2015), there are several ways to procure construction machinery for construction works, which include: purchase new machines from machinery manufacturers; purchase new or used machines from trading service providers; or rent new or used machines from rental services providers. Generally, the machinery manufacturers sell the new machines to machinery trading or rental services providers, or occasionally sell the machines directly or through finance lease to the end users. Apart from providing a wide range of construction machineries at one time, the machinery selling or rental services providers also offer a variety of services to end users, which include design consulting services, machinery recommendation, provision of operators throughout constructions; and after-sale services for value-adding through offering maintenance service. Hence, for convenience, contractors in Hong

Kong tend to acquire machineries from the rental and trading service providers. Moreover, the high demand of the application of plant and equipment for construction works has fostered the development of construction machinery rental service industry and the construction machinery trading industry. The machinery rental service industry and the machinery trading service industry are expected to expand continuously due to the strong demand from the forthcoming mega infrastructure projects (Figure 5 and Figure 6).

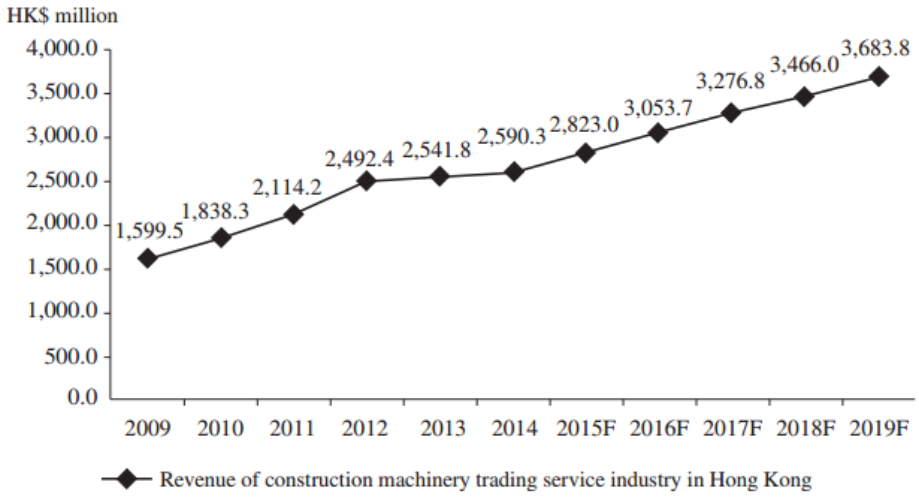
Notwithstanding the demand for machinery is anticipated to increase in future, the sufficiency and stability of machinery supply have aroused some concerns. Japan, Germany, Korea and mainland China are the major machinery manufacturers. Japan is the major country for machinery import on which Hong Kong industry is heavily relying. Statistics reflected that a total of 62.5% of the crawler cranes and hydraulic mobile cranes were imported from Japan, followed by 18.8% imported from Germany. However, the machinery supply from Japan is expected to edge down due to the 2020 Summer Olympics to be held in Tokyo. The construction machinery, instead of being exported to Hong Kong, tends to satisfy the domestic use of the manufacturers due to the commencement of construction works for infrastructures, hotels and public ancillary facilities within those countries (IPSOS, 2015).

Figure 5. Revenue of Construction Machinery Rental Service in Hong Kong from 2009 to 2019



Source: IPSOS, 2015. *Industry Overview*. [pdf] Available at: < http://www.hkexnews.hk/listedco/listconews/SEHK/2015/1210/a6625/ECLEARLIFT-20151126-13.PDF>

Figure 6. Revenue of Construction Machinery Trading Service in Hong Kong from 2009 to 2019



Source: IPSOS, 2015. *Industry Overview*. [pdf] Available at: < http://www.hkexnews.hk/listedco/listconews/SEHK/2015/1210/a6625/ECLEARLIFT-20151126-13.PDF>

The Emergence of Equipment Exchange Platforms

Traditionally, contractors may have to acquire construction plant and equipment through the machinery rental or trading services providers. With technological advancement, construction machinery matching and leasing platforms, which are either in the forms of websites or mobile applications, have emerged recently. Suppliers (leasers) can carry out online advertisement of the machineries at hand, whereas the lessees can post the type of machineries that they seek on the platforms. The platforms then act as media to provide matching services for the suppliers and potential machinery users. The emergence of such leasing platforms brings a number of benefits to the construction industry. For instance, contractors are able to acquire construction machineries timely and with ease, as they can carry out the rental process on handy gadgets (i.e. mobile phones or tabs). Apart from that, as a wide range of machinery providers are expected to advertise their equipment online, they offer more choices for the potential lessees and hence the lessees are not limited to one or two makes only. Moreover, leasers also offer short duration machinery rental services, enabling the lessees to enjoy higher flexibility in deciding the type, the number and the duration of rental when acquiring machineries.

As the machinery leasing platform takes up the vital role in facilitating better utilization and allocation of construction resources, the possibility of resource mismatches and the idle time of machinery will be reduced.

The Rise of Robots

In recent years, there is a rise of the robotic application in the construction industry. Construction works are usually carried out in a disorganized environment with different types of potential hazards. The accessibility problems within construction site create obstacles for the entry and reduce the mobility of large machinery. Productivity will thus be lowered. To cope with the above-mentioned concerns, the robotics adoption is expected to enhance construction site safety, attain higher production quality and achieve higher productivity. Most importantly, robotic adoption could be one of the effective strategies in alleviating the labour shortage problem in Hong Kong through replacing some manual work trades (Li, 2018).

One of the largest local construction companies has been adopting robotics in construction works. For instance, robots are deployed to carry out large window panel installation works in a

hotel redevelopment project. A reduction of 25% of on-site workers was observed with the assistance of robots. The construction firm also introduced wearable robotics and carried out testing on its application. With the help of the wearable robots, human body mechanics are assisted, thus minimizing the risk of committing human error. The robots are designed to reduce physical strain in human works and to assist in the lifting and holding of heavy objects through the detection of lower back movement of workers (Li, 2018). Innovation and technology companies in Hong Kong also developed several kinds of robots in assisting different construction works, for instance, transport robot for building material transportation within a narrow site, welding robot to carry out welding in construction site or factory; grinding robot for concrete wall grinding, painting and drilling; and cable robot to replace human works that are to be carried out at height. Although robotic adoption is effective and feasible in attaining higher productivity, Hong Kong is still lagging behind countries such as the US and Japan.

2.4 Materials

Concrete Production

Concrete is widely used in infrastructure and building projects in Hong Kong. The future concrete demand will keep on rising due to the commencement of public housing, new town development and regional transport networks. According to a public sector estimate (IPSOS, 2018), the total commercial production of concrete reached 13,921 thousand tonnes in 2017. This is expected to further expand by 2.7% and will reach 16,254.9 thousand tonnes in 2022. However, there will be a slowdown in the growth of concrete production capacity due to the closure of concreting batching plants in Yau Tong and Anderson Road Quarry. To mitigate the risk of possible delays and cost overruns to upcoming construction projects, the Hong Kong government is working on a comprehensive strategy to ensure the stable supply of concrete over the short to long term (Civil Engineering and Development Department, 2018).

Material Import

Hong Kong is heavily relying on importing construction materials due to the lack of local sources. According to the statistics of the Hong Kong Merchandise Trade Statistics Imports in December 2017, China is the biggest source for the majority of Hong Kong's construction materials, for instance, steels, wood products, Portland cement, sand and aggregates (Table 7).

Whilst importing materials, Hong Kong used to have abundant aggregates supply in previous years. Aggregates extracted from quarries were used in concrete production and road construction works. Four major quarries in Hong Kong, which are located in Anderson Road, Shek O, Lamma and Lam Tei Quarries, altogether supplied 50% of the local aggregates requirements by rock extraction, ranging from 6 to 9 million tonnes per year. However, with the gradual depletion of these quarries, supply has dropped. Currently, the Lam Tei Quarry is the only quarry under operation, whereas the rock extraction period will expire by 2023 (Development Bureau, 2017). In light of this, Hong Kong would not be able to rely on local aggregate supply. The government should actively explore the possibility of developing new quarries to sustain the local aggregates production and supply, or else face the expensive cost of importing this bulky material which is almost indispensable for concrete construction.

Table 7. Imported Materials, their Sources and Quantities (Jan – Dec 2017)

Imported Materials (units)	**Importing Countries**	**Quantity**
Plasters (kg)	**China**	**2,525,780**
	England	1,477,530
	Germany	1,063,420
Sands (tonnes)	**China**	**1,225,521**
	Singapore	52,900
	Netherlands	27,332
Prefabricated structural components for building or civil engineering of cement/concrete/artificial stone (kg)	**China**	**1,566,029,750**
	Greece	837,326
	Switzerland	392,520
Sheet piling of iron or steel; welded angles, shapes and sections (kg)	**China**	**66,556,158**
	Korea	28,196,631
	Thailand	18,064,340
Pebbles, gravel, broken or crushed stone for concrete aggregates; macadam of slag etc.; tarred macadam (tonnes)	**China**	**29,792,440**
	Macau	329,663
	Philippines	232
Bituminous mixtures based on natural asphalt, natural bitumen, petroleum bitumen, or mineral tar/tar pitch (kg)	**Malaysia**	**1,196,252**
	China	353,178
	England	310,456
Building blocks and bricks, tiles, flagstones and similar articles of cement, of concrete or of artificial stone (kg)	**China**	**392,784,928**
	Italy	4,450,563
	Philippines	1,499,792
Portland cement (tonnes)	**China**	**2,669,821**
	Japan	1,612,725
	Macau	240,259
Plywood, consisting solely of sheets of wood (other than bamboo), each ply not exceeding 6mm thickness (m^2)	**China**	**9,772,396**
	Malaysia	2,689,768
	Indonesia	1,883,524
Other builders' joinery and carpentry of wood, including cellular wood panels (kg)	**China**	**22,503,899**
	Chile	1,715,626
	Canada	763,387

Note: the major sources are highlighted in bold font.

Source: Census and Statistics Department, 2017. *Hong Kong Merchandise Trade Statistics - Imports in December 2017.* [pdf] Available at: < https://www.statistics.gov.hk/pub/B10200012017MM12B0100.pdf>

Material Price Fluctuations

The average prices of most of the construction materials experienced a rising trend from 2014 to 2018. The average prices of bitumen and galvanized mild steel products increased significantly from 2017 to 2018. There were also remarkable fluctuations in the prices of metal formwork and steel reinforcement products from 2017 to 2018 (refer to Table 10 of the Country Report).

The fluctuations of exchange rates are contributing to the material price fluctuations. Hong Kong dollar has been linked to the US dollar and set at the approximate rate of $7.8 HKD to $1 USD. However, the fluctuations in USD affect the value of HKD against other currencies, for example, Renminbi, thus affecting the imported material prices. For the rising trend of steel products, as Hong Kong construction industry commonly adopts reinforced concrete structure construction, there is a relatively low impact due to structural steel price hikes (Yang and Chan, 2018).

Application of Recycled and Green Building Materials in Public Works

The Hong Kong government is actively taking the leading role in shaping Hong Kong into a green city through several measures, including the adoption of green procurement in public construction works. An Inter-Departmental Working Group on Green Government Procurement was established by the Environment Bureau that aims to promote the publicity of green building materials. A Sub-group under the Working Group was set up for the formulation of guidelines, policies and strategies, to promote the use of green materials, identify and monitor the use of green materials in public works projects. Various green materials have been introduced, which are as shown in ensuing paragraph and in Table 8 (Hong Kong Green Building Council, 2017).

a) Eco-pavers (mainly made with recycled glass) were being set as a standard requirement in road maintenance contracts and selected housing projects; a total of 1,086,300m^2 of eco-pavers were used during 2010 to 2015, which represents an equivalent 21,000 tonnes of recycled glass.

b) Crushed glass (e.g. glass cullet) was explored and to be used as fill materials for reclamations;

c) Reclaimed Asphalt Pavement (RAP) was used in road maintenance contracts. A batch of 128,000 tonnes of RAP were used in 2014; and

d) Ground Granulated Blast-furnace Slag (GGBS), being a by-product from iron manufacturing process, is used in concrete production. The GGBS concrete, which contains a lower level of embodied carbon than concrete made with pulverized fuel ash. It was successfully applied in the Tsing Ma Bridge and Stonecutters Bridge construction, as well as in the prefabrication of precast concrete facades.

Table 8. Applications of Recycled Materials in the Construction Industry

Recycled Materials	**Form and Use**	**Local examples**
Aggregate	Sub-base material for road construction, hardcore for foundation works, base/fill for drainage, aggregate for concrete manufacture and general bulk fill	Exploratory studies carried out by works departments
Asphalt	Aggregate fill and sub-base fill	Being investigated by Highways Department
Excavated materials	Filling materials	Housing Department's building projects
Public fill	Land reclamation	Site formation at Public Filling Areas
Pulverized fuel ash	Manufacture of concrete products, uses in fill and reclamation, highway construction and reinforced soil structures	Construction of Chek Lap Kok Airport, structural concrete uses for sub-structure works in the Housing Department's building projects
Metals	Manufacture of new metals	Widely adopted in local construction industry
Glass	Manufacture of eco-pavers, eco-partition blocks and glassphalt, substituting sand and aggregates as mortar, backfilling and reclamation materials	Use of eco-pavers by Works Departments for road paving. Trial uses are undertaken by Works Departments for other applications
Plastic	Synthetic materials in the form of plastic lumber for landscaping, horticulture and hydraulic engineering	Some public recreational facilities used them as garden furniture
Rubber	Manufacture of rubber slate tile use in roofing and sport / playground surface mat	Some public recreational facilities used it as playground surface mat
Expanded polystyrene	Manufacture of lightweight concrete for non-structural works	Manufacturing lightweight concrete in Housing Department's building projects

Source: Environmental Protection Department, 2013. *Recycled Materials for Construction Industry*. [online] Available at: <https://www.epd.gov.hk/epd/misc/cdm/products1.htm>

The Hong Kong Green Building Council (HKGBC, 2018) also established a green building certification system – *Beam Plus*, which promotes and practices green building through the provision of different standards for adoption. A rating system is set up to access the overall performance of an existing or a new building throughout its life cycle. Most importantly, *Beam Plus* enables stakeholders to demonstrate their commitment in supporting sustainable development in Hong Kong. The HKGBC (2018) also established the Green Product Accreditation and Standards (HK G-PASS), which aims to certify green building materials and provide a list of products, which help stimulate supply and demand for green building materials. The adoption of green building materials in construction projects is considered a good starting point to adhere to the green building guidelines. However, the availability and the price issues of green building materials remain a major concern among the stakeholders. The prices of green building materials are generally higher than the traditional ones, which increase the construction costs. The publicity of green building materials is however inadequate. The government and related associations should spend more efforts in promoting a wider application of green building materials through providing subsidies and carrying out more pilot schemes that provide better insights into their uses.

2.5 Funding

Hong Kong Loans Overview

According to the Basis Point 2017 Annual, the syndicated loan volume in Hong Kong registered US$106 billion from 174 deals in 2016, as against the previous loan volume of US$92 billion in 2014. The quarterly loan volume has been increasing gradually from 2011. The increase in Mergers and Acquisition activity contributes to the provision of more lending opportunities for bank in 2016. In 2015, taking the whole Asia Pacific loan market as a whole, a first tier Hong Kong developer ranked the second position among the ten largest syndicated deals in 2015 stated in *Basis Point 2016 Annual*. Syndicated loan borrowings are useful sources of finance for Hong Kong property developers.

The long-term and short-term interest rates saw a fluctuation trend in recent years, affecting the cost of finance for development (Table 9). As in May 2017, the Hong Kong Monetary Authority (HKMA) announced that the credit risk management rules on bank loans for property

developers are tightened. Banks can only lend a maximum 40% of a site value to the developers, as against 50% that was previously adopted. For the cap on construction cost financing, it would be lowered to 80% from 100%, and the overall lending cap is reduced to 50% of the expected value of property completed, as against 60% in previous practice. However, it is expected that the aforementioned measures are unlikely to bring notable impact to local developers who are financially resourceful. Mainland Chinese companies or small local developers will be mostly affected instead as they have heavy reliance on financing from banks (Reuters, 2017).

Table 9. The Short-term and Long-term Interest Rates (Source: HKMA)

	2013	2014	2015	2016	2017
Short term interest rate** (%)	0.11	0.04	2.05	0.31	0.33
Long term interest rate*** (%)	2.31	0.04	1.66	1.5	1.431

Source: Hong Kong Monetary Authority, 2018. *Monthly Statistical Bulletin.* [online] Available at: <https://www.hkma.gov.hk/eng/market-data-and-statistics/monthly-statistical-bulletin/>

Green Loans for Projects Development

One of the largest local developers in Hong Kong announced that a "Green Finance Framework" is developed, intending to issue green bonds and green loans. The net proceeds would be used to finance or refinance its eligible projects related to the environmental performance improvement of the real estate assets and properties., including the following: -

a) Green Buildings - certified by at least one of these green building certification systems: HK BEAM or BEAM Plus (Gold or above), China Green Building Evaluation Standard (Two-star or above) or LEED (Gold or above);

b) Energy Efficiency and Renewable Energy;

c) Water Management;

d) Waste Management; and

e) Climate Change Adaptation.

Mortgage Loans and Bridging Loans

Banks in Hong Kong offer mortgage loans to property buyers, whereas some local developers may entice bridging loans or short-term financing with lower interest rates compared with banks to potential buyers in order to attract them to purchase their latest projects. The provision of mortgage loans and bridging loans altogether stimulated the sales of properties. The mortgage loans statistics are as shown in Table 10:-

Table 10. Loan Portfolio (2017) (in HK$ million)

	Amount	
	2017	**2016**
Mortgage loans, at amortised cost	7,485	9,085

Source: Hong Kong Monetary Authority, 2017. *2017 Annual Report.* [pdf] Available at: <https://www.hkma.gov.hk/media/eng/publication-and-research/annual-report/2017/AR2017E.pdf>

Private Developer Financial Viability

The Hong Kong government has been adopting the public-private partnership with the local railway corporations in railway development. The "rail + property" approach provides economic benefits for the railway corporations. With properties built on the existing railway station, the income from property development may be used for railway construction. Local property developers also engage in a variety of businesses, for instance, energy, telecommunication, retail, port services to provide varies sources of income. They also issue bonds as investment products and offer stocks for investors. With these, they have accumulated abundant land reserve for property development from time to time.

Funding in Public Projects

Tax income is the major source of funding for public works. Some existing tolled facilities and rent out assets (such as tunnels and bridges as well as public housing shopping malls and carparks) were securitised to derive an upfront cash injection for new construction some years ago. With a prudent budgeting and public expenditure system (e.g., vetting by legislative councilors) in place, Hong Kong SAR government does not normally resort to borrowing in its public work

programme. The new extension of airport runway will be funded by a passenger fee to be levied on users, with some loans to be taken out, as one of the exceptions.

3. Methodology of Construction Resources Projection

3.1 Land Availability Projection

Background and Principles

According to the *Long Term Housing Strategy December 2014* by the Transport and Housing Bureau (2014), a supply-led strategy was proposed by the Long Term Housing Strategy (LTHS) Steering Committee, which mainly focused on the demand anticipation and land supply planning. The following are the major aims:

a) to plan for land supply for public and private housing production, by the adoption of a new housing demand projection model;

b) to update the long term housing demand projection and achieve the gradual ten-year housing supply target in every year; and

c) to maintain the developmental stability of private housing market by securing stable land supply.

The long term housing demand projection was primarily based on a considerable amount of assumptions and hence a wide range of projections was produced so as to reflect possible housing demand scenarios.

Methodology

Under the proposed long term housing demand projection methodology and model (i.e. the new projection model) by the LTHS Steering Committee, the following major components in determining the projection of new housing units needed over ten years are included:

a) net increase in the number of families;

b) families displaced by redevelopment;

c) inadequately housed families; and

d) miscellaneous factors.

The item of "miscellaneous factors" is to cover the housing demand projection based on past trends, which include non-local buyers taking up flats for not selling and leasing; non-local students taking up accommodation in Hong Kong; and mobile residents occupying private permanent living quarters.

Projection for Long Term Housing Demand and Supply based on the Projection Model

The Task Force (2018) estimated the demand and supply for public and private housing land use up to 2046, based on the projection methodology proposed in the *Long Term Housing Strategy December 2014*.The total area of land needed for long term residential development is estimated in Table 11. Before 2026, there will be a shortfall of 108 hectares for housing. The projection from 2016 to 2046 is based on the estimation from *Hong Kong 2030+*: 600,000 housing units are expected to be provided under the currently committed or planned major development projects. Consequently, there will be a shortfall of 230 hectares of residential land for satisfying the housing demand over the next 30 years. Hence, the land shortage problem remains inextricable and there is a need to solve it.

Table 11. Estimation of Supply and Demand for Residential Land up to 2046

	Land for Residential Use (hectares)		
	Demand	**Supply**	**Shortfall**
Year	*Up to 2026*		
Public Housing	257	208	-49
Private Housing	511	452	-59
Total	768	660	-108
Year	*2026-46*		
Public Housing	300	228	-72
Private Housing	602	552	-50
Total	902	780	-122
Year	*2016-46*		
Public Housing	557	436	-121
Private Housing	1,113	1,004	-109
Total	1,670	1,440	-230

Source: Task Force on Land Supply, 2018. *Land Demand of Hong Kong*. [online] Available at: < https://landforhongkong.hk/en/demand_supply/land_demand.php>

3.2 Labour Projection

To sustain development, it is vital for the policy makers to strike a balance between the supply and demand of workforce in construction industry, which facilitates forward planning that avoids unemployment or labour shortage problems. In light of this, stakeholders in construction industry have been adopting various manpower projection approaches as follows.

i) Time Series Projection

According to Chan et al. (2006), the time series projection is a common approach for forecasting manpower. This approach examines the sole relationship between time and past behaviours, and thus extrapolates the trend into the future. Univariate time series analysis is simple, reliable but inexpensive, which helps prevent personal bias from being introduced into the forecasting progress. Adopters could focus on the underlying trend, the seasonal and cyclic elements, then include specific repetitive or continuous patterns observed from previous manpower-use data. In Hong Kong, the Vocational Training Council (VTC) has been adopting weighted exponential smoothing time series forecasting technique for 22 industry sectors since 1970s. Given the weightings, the survey data is weighted to form a geometric series. More recent data is given a higher weighting and vice versa, so the forecast depends more on recent data. Random fluctuations in past data are smoothed out under this technique, thus the trends could be revealed (Wong, Chan & Chiang, 2012).

However, the time series models are good only for producing short term forecasts (i.e. one year ahead) due to its structural limitations. It does not include the factors leading to changes in occupational structure and manpower requirements. It is difficult to learn from past mistakes while carrying out evaluation based on the forecasts. As explanatory capabilities are lacking, this approach is not suitable for the forecast that demands explanation (Chan et al., 2006).

ii) Labour Multiplier Approach

The labour multiplier approach is an alternative that forecasts manpower requirements. This approach is based on the principle that project of each type demands the same level of labour requirement per unit of project expenditure, following a standard pattern of demand. Under this approach, a series of labour productivity multipliers are derived from past project-based records. By the multiplication of the corresponding multipliers and the project expenditure estimate, the

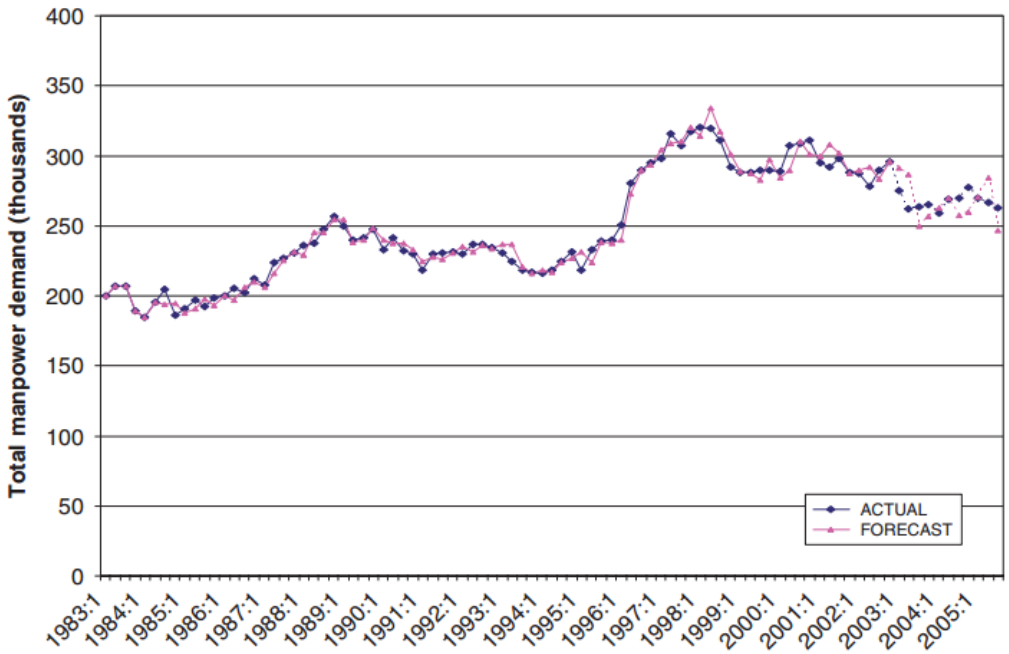
estimated labour demand by occupations can be projected. After the derivations from all future projects, the occupational manpower demand can thus be aggregated to produce the overall industrial labour market requirements (Chan et al., 2006).

For the forecasting model, fixed coefficients are established for different categories of building, housing and civil engineering works. As categorization as such could allow different multipliers to be derived, the multipliers are able to reflect the effects on different technologies adopted in various types of project and the different labour productivity data, and hence estimation with higher accuracy can be obtained. The simple relationship between manpower requirements and its determinant (construction cost and labour productivity rate) is used for prediction. The adoption of the coefficient approach in forecast is proven reasonably reliable. However, the forecasting model needs to be updated from time to time with respect to changes in technology. The new sets of labour multipliers so derived can reflect the up-to-date labour mix. It is noteworthy that considerable expense and effort would be needed for updating the database on a regular basis. Time lag would be a constraint in assessing the impact of the changes of a number of factors, including competition, technology, legislation, etc. Hence, updating coefficients are critical for the provision of accurate forecasts (Chan et al., 2006).

The multiplier approach is proven to have produced reliable manpower forecasts in the short to medium term (one to five years). In Hong Kong, the Works Bureau (i.e. transformed into Development Bureau) adopted the multiplier approach for the prediction of manpower requirements. Following this, in 2001, the Works Bureau commissioned a consultancy team from HKPolyU to develop a computer-based model, which aims to estimate the demand for different categories of construction personnel (Chan et al., 2006). Since then, the aggregate labour demand of a project has been routinely presented to the Legislative Council, when funding approval is sought.

Apart from the approaches mentioned, a number of manpower forecasting models were established in previous years. A vector error correction (VEC) model and a broad occupational demand forecasting model using time-series regression analysis were adopted by Wong, Chan and Chiang (2007 and 2010). Predictions were made based on the models and statistics proved that the forecasting models were able to yield accurate estimates (Figure 7 and Figure 8).

Figure 7. Predictability of the VEC model



Notes: Solid line, ex post simulation period; dotted line, ex post forecasting period.

Source: Wong, M.W., Chan, P.C. and Chiang, Y.H., 2007. Forecasting construction manpower demand: A vector error correction model. *Building and Environment*, 42(8), pp.3030-3041.

Figure 8. Evaluation of the Broad Occupational Share Forecasts

	2005			2006			2007			2008		
Occupations	Estimate	Actual	Diff. (%)	Estimate	Actual	Diff. (%)	Estimate	Actual	Diff. (%)	Estimate	Actual	Diff. (%)
Managers and administrators	4.73	5.23	−0.50	5.06	5.88	−0.82	5.02	5.47	−0.45	4.99	5.34	−0.35
Professionals	4.17	4.64	−0.47	3.97	4.36	−0.39	4.06	4.64	−0.58	4.16	3.91	0.25
Associate professionals	10.41	11.03	−0.62	10.65	12.32	−1.67	11.22	11.89	−0.67	11.83	12.04	−0.21
Craft and related workers	59.68	57.47	2.21	58.43	55.43	3.00	57.31	55.97	1.34	56.43	55.03	1.40
Plant and machine operators and assemblers	3.64	4.36	−0.72	3.67	3.79	−0.12	3.74	4.19	−0.45	3.83	4.97	−1.14
Clerks	4.51	3.98	0.53	4.59	4.16	0.43	4.69	3.76	0.93	4.80	3.92	0.88
Elementary occupations	12.86	13.25	−0.39	13.62	14.00	−0.38	13.96	13.98	−0.02	13.96	14.74	−0.78
Total	100	100		100	100		100	100		100	100	
		MAPE: 0.78%			MAPE: 0.97%			MAPE: 0.64%			MAPE: 0.72%	

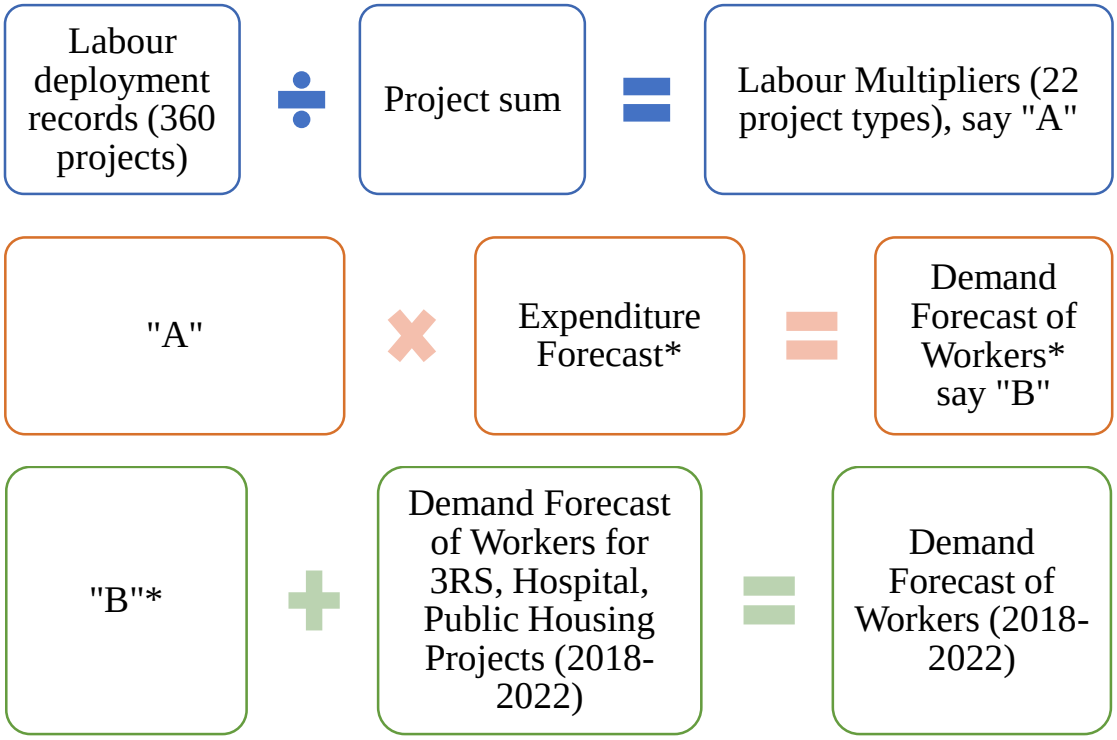
Notes: MAPE is the abbreviation of mean absolute percentage error; all occupational shares are constrained to sum to 100%.

Source: Wong, M.W., Chan, P.C. and Chiang, Y.H., 2010. Modeling Construction Occupational Demand: Case of Hong Kong. *Journal of Construction Engineering and Management*, 136(9), pp.991-1002.

iii) The CICMF Methodology and Projection

Recently, the CIC has established a manpower forecasting model (CICMF) based on the labour multiplier approach, which is updated on a regular basis. The objectives are to assess the manpower demand and supply trend in Hong Kong so as to provide information for policy makers, solely for the implementation of effective manpower planning policies and for the formulation of short term actions and long term strategies in addressing the future needs (CIC, 2017).

(a) Methodology – Demand Estimation

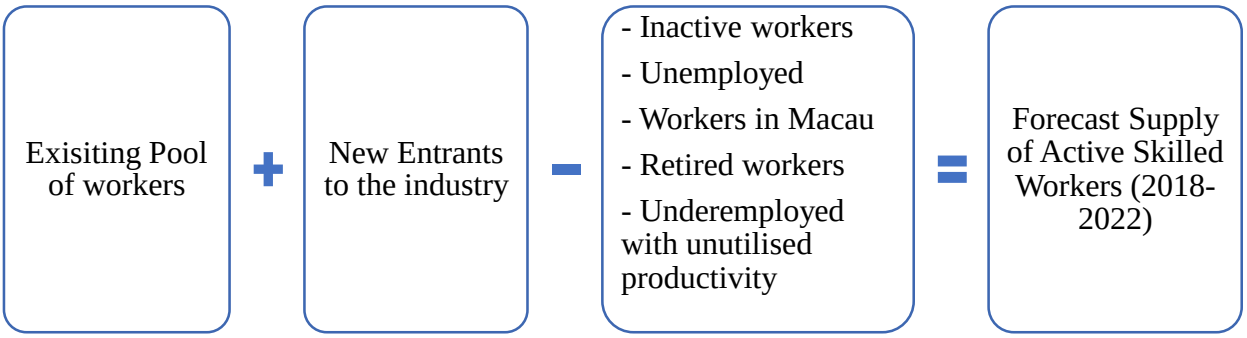


*Note: * represents the data for the projection of 2018 to 2022 and it excludes 3rd Runway, hospital and public housing projects*

Assumptions:

- Linear relationship between labour demand and construction output.
- Analogous labour deployment within a specific project type.
- Labour multipliers remain unchanged in the forecast period.
- The 25th percentile scenario of the expenditure forecast is adopted to reflect the potential effect of filibustering and economic uncertainties.

(b) Methodology – Supply Forecast



Notes: For new entrants, the retention rate, productivity proficiency, change of population, and in-services workers for nurturing are considered.

Assumptions:

- Training places and retention rates have no change in the forecast period.
- Productivity of new entrants after graduation is 63.2% in the 1st year, 81.2% in the 2nd year and 100% in the 3rd year (based on proficiency tests of CIC graduates).
- Discounted productivity of in-service skilled workers acting as trainers is required in nurturing new entrants in the 1st and 2nd years for a quarter of new entrants.
- Discounted productivity of under-employed workers is half that of fully employed workers.
- The number of retired workers is estimated based on the retirement pattern of individual trades with age higher than 60 by making reference to registration records over the past three years.

(iv) Key Projections using the CICMF Model

According to projections by the CICMF Model (CIC, 2017), it is anticipated that the overall estimated manpower shortage for skilled construction workers will fall between 5,000 to 10,000 in the upcoming 5 years. Among the various trades for skilled workers, electrical fitters (including electrician) registered the severest shortage (in terms of number) in recent years (Table 12).

According to the CICMF Model forecast for professionals, technicians and site supervisory personnel (2017), the land surveyor supply will register a severe level of shortage (Table 13). For technicians, the shortage problem is relatively mild for draftsman, E&M engineering technician and civil/structural/geotechnical engineering technician (Table 14). For construction site

supervisory personnel, the shortage for supervisor, inspector, agent, foreman and coordinator is moderate (Table 15).

A comparison of estimated total and actual employment (Table 16) over the past few years may indicate the level of forecasting accuracy of the Model.

Table 12. Estimated Manpower Shortage (Skilled Workers)

No.	Trade	2018	2019	2020	2021	2022
1	Bar Bender & Fixer	501-1,000	≤ 500	N/A	N/A	N/A
2	Concretor	≤ 500	≤ 500	≤ 500	501-1,000	501-1,000
3	Plumber	501-1,000	501-1,000	501-1,000	501-1,000	501-1,000
4	Scaffolder	≤ 500	≤ 500	≤ 500	≤ 500	501-1,000
5	Carpenter	≤ 500	≤ 500	≤ 500	501-1,000	501-1,000
6	Plant & Equipment Operator (Load Shifting)	≤ 500	≤ 500	≤ 500	≤ 500	≤ 500
7	General Welder	≤ 500	≤ 500	501-1,000	501-1,000	501-1,000
8	Metal Worker	501-1,000	501-1,000	501-1,000	501-1,000	501-1,000
9	Glazier	≤ 500	≤ 500	≤ 500	≤ 500	≤ 500
10	Plasterer Terrazzo & Granolithic Worker	501-1,000	501-1,000	501-1,000	1,001-1,500	1,001-1,500
11	Electrical Fitter (incl. Electrician)	≤ 500	≤ 500	1,001-1,500	1,501-2,000	1,501-2,000
12	Refrigeration/AC/Ventilation Mechanic	501-1,000	501-1,000	501-1,000	501-1,000	501-1,000
13	Fire Service Mechanic	≤ 500	≤ 500	≤ 500	≤ 500	501-1,000
14	Lift and Escalator Mechanic	501-1,000	501-1,000	501-1,000	501-1,000	501-1,000

Source: Construction Industry Council, 2017. *Report of CIC Manpower Forecasting Model 2017 (Skilled Construction Workers).* [online] Available at: <http://www.cic.hk/files/page/56/CICMF_en_17w.pdf>

Legend:

	Relatively Low		Relatively High
Shortage			

Table 13. Construction Professionals Shortage Forecast

Types of Professionals	**2018**	**2019**	**2020**	**2021**	**2022**
Architect					
Landscape Architect				N/A	N/A
Civil Engineer					
Structural Engineer					
Geotechnical Engineer					
Environmental Engineer					
Building Services Engineer					
Electrical Engineer					
Mechanical Engineer					
Building Engineer					
Building Surveyor					
Land Surveyor					
Quantity Surveyor					
Town Planner					

Source: Construction Industry Council, 2017. *Report of CIC Manpower Forecasting Model 2017 (Site Supervisory Personnel, Technicians & Professional).* [online] Available at: <http://www.cic.hk/files/page/56/CICMF_SSPTP_17.pdf>

Table 14. Construction Technicians Shortage Forecast

Types of Technicians	**2018**	**2019**	**2020**	**2021**	**2022**
Draftsman					
Quantity Surveying Technician					
E&M Engineering Technician					
Civil/Structural/Geotechnical Engineering Technician					

Source: Construction Industry Council, 2017. *Report of CIC Manpower Forecasting Model 2017 (Site Supervisory Personnel, Technicians & Professional).* [online] Available at: <http://www.cic.hk/files/page/56/CICMF_SSPTP_17.pdf>

Table 15. Construction Site Supervisory Personnel Shortage Forecast

Site Supervisory Personnel	**2018**	**2019**	**2020**	**2021**	**2022**
Manager					
Engineer					
Technical Officer					
Supervisor					
Clerk of works					
Inspector					
Agent					
Foreman					
Coordinator					
Safety Officer					

Source: Construction Industry Council, 2017. *Report of CIC Manpower Forecasting Model 2017 (Site Supervisory Personnel, Technicians & Professional).* [online] Available at: <http://www.cic.hk/files/page/56/CICMF_SSPTP_17.pdf>

Table 16. The CICMF Model Forecast and the Actual Employment

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total Estimated Demand	246,000	250,000	258,000	269,000	271,000	283,000	284,000	283,000	283,000	285,000
Actual Employment	310,125	315,900	328,325	344,325	352,800	N/A	N/A	N/A	N/A	N/A

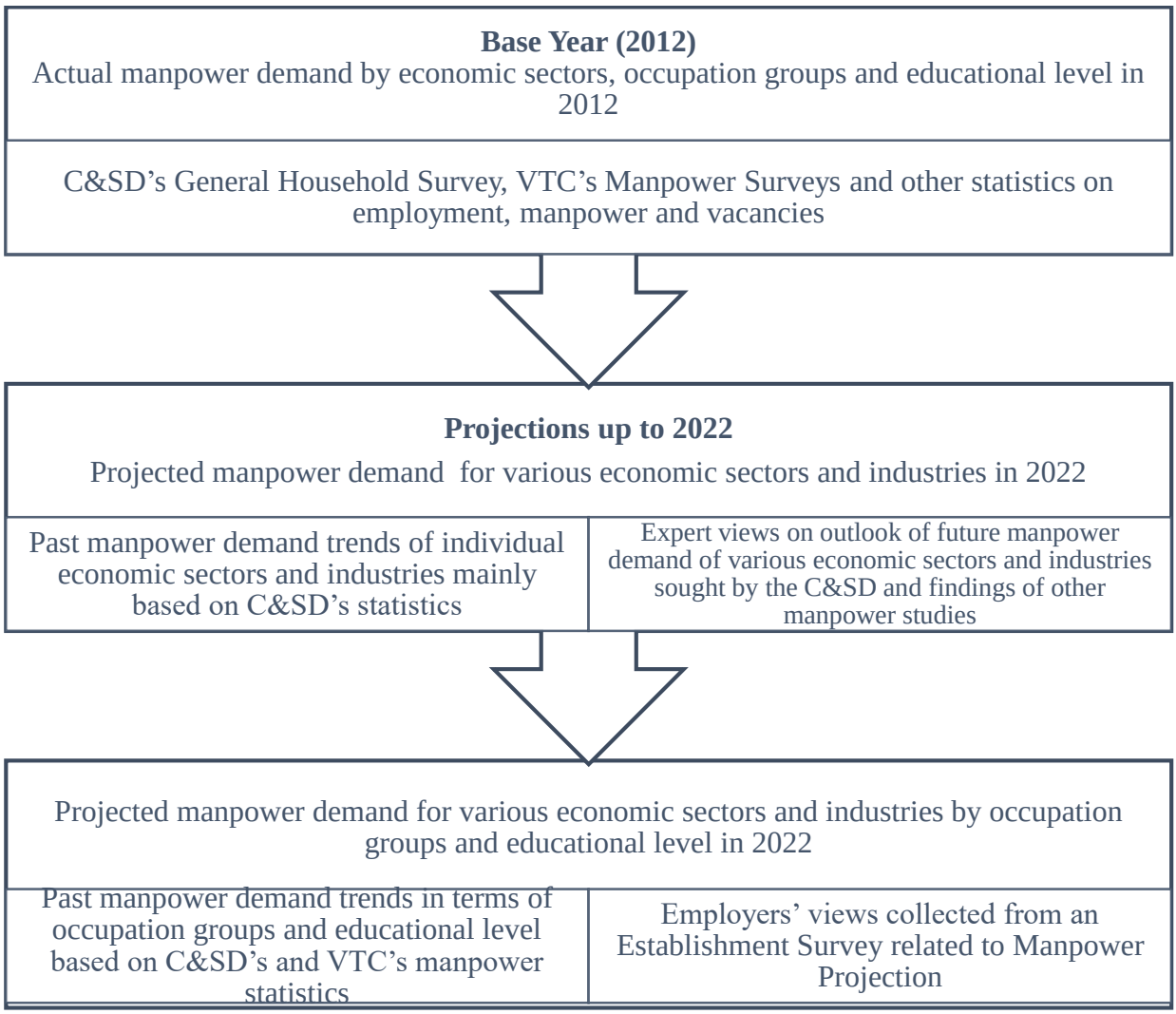
Source: Estimated demand – Construction Industry Council, 2014. *Report of CIC Manpower Forecasting Model 2014 (Workers) (Amended).* [online] Available at: < http://www.cic.hk/files/page/56/A10.12_e_V00_Report%20of%20CICMF%20201412.pdf>;

Actual employment – Census and Statistics Department, 2018. *Number of employed persons by industry and occupation.* [online] Available at: < https://www.censtatd.gov.hk/hkstat/sub/sp200.jsp?productCode=D5250003>

(v) The Hong Kong Government Manpower Projection

The Hong Kong government has conducted manpower requirement projection in 2012 and 2015. In particular, the projection of the construction industry was compiled by taking the historical trends of labour market and consultations with experts, the manpower surveys by VTC and taking the results from MP2018-related Establishment Survey on Manpower and Job Skills Requirements for reference. The general process for the 2022 manpower projection is shown in Figure 9. (HKSAR, 2015).

Figure 9. Schema on Compilation of Overall Manpower Requirement Projection to 2022



Source: HKSAR, 2015. *Report on Manpower Projection to 2022*. [online] Available at: < https://www.lwb.gov.hk/report/mp2022_en.pdf>

(vi) Summary on Manpower Forecast

Despite different approaches being used in forecasting manpower requirements for the construction industry, they all reflect the strong and solid demand in recent years for labour due to the ongoing large scale infrastructure projects. From the government perspective, it is necessary to formulate a long term labour supply strategy for satisfying the local demand. For all stakeholders in the construction sector, the projection figures from the various models should be constantly updated to reflect the changing situations, whereas the projection and data collection methods should be reviewed on a regular basis in order to yield accurate predictions.

3.3 Material Projection

Indeed, materials and cost projections are of paramount importance for construction projects. As stated before, to ensure a sustainable supply of concrete, the Hong Kong government has called for a feasibility study to address the increasing concrete demand. To briefly estimate the future demand for concrete volume, a simplified approach may be undertaken (Table 17). It may serve as a reference of comparison for concrete volume projection for structural elements, pending more detailed and accurate methods to be established through the upcoming consultancy study.

Table 17. Simplified Concrete Volume Projection Approach

Step 1		Annual building works turnover volume ($) × 50% × 30% (concrete cost)	Percentages to be gathered from typical construction cost plans for structural elements
Step 2	÷	Concrete supply & pour rate (per m^3)	– say $1,500 per m^3
Step 3	+	Wastage	– say 5%
Total	**=**	***Projected concrete volume (per annum)***	

Note: all figures are in HK$; for building projects only

3.4 Funding Projection

An infrastructure expenditure forecast is prepared by the Financial Secretary and is compiled in every year's public budget. As stated in the *2017-18 Budget (2017)*, a total of HK $107.2 billion will be allocated for infrastructure development, including $86.8 billion for capital works. As there is a host of infrastructure projects that will be commenced soon, the capital works expenditure is expected to remain at a relatively high level in the next few years.

Amongst all the approved category Category A projects (i.e. projects which are ready in all respects for tenders to be invited and construction works to proceed, and have been granted an approved project estimate by the Finance Committee of the Legislative Council), only 10% of them required application for additional provisions over the past 10 years. However, due to unforeseeable circumstances and perhaps alleged filibustering of some members in the Legislative Council, some of the controversial mega projects registered cost overruns arising from delays in funding approvals.

Recently, the Hong Kong Monetary Authority established an Infrastructure Financing Facilitation Office (IFFO). Different entities are welcomed to join the IFFO as partners in order to facilitate Hong Kong's infrastructure investments and financing through working with the key stakeholders. The IFFO (2017) is currently exploring the financing opportunities for the Belt and Road Initiative. The key functions of IFFO are as stated below:-

a) Provide a platform for information exchange and experience sharing;

b) Building capacity and knowledge on infrastructure investments and financing;

c) Promote market and product development; and

d) Facilitate infrastructure investment and financing flows.

4. Conclusion

This study reviews the current situation of the demand and supply of various construction resources and provides an indication of the general situation in Hong Kong. The mountainous topography of Hong Kong limits the development potential to a certain extent. The government is actively exploring feasible strategies of extra land provision through land use review conducted by a dedicated Task Force. The demographic trend also shapes the local manpower supply, which

faces the problems of an ageing workforce and the lack of young entrants to the construction industry (similar to other countries) To mitigate these, the government is cooperating with the Construction Industry Council in attracting and nurturing new entrants, and accumulating a pool of skilled workforce. From the perspective of construction materials, Hong Kong is heavily relying on importing materials from mainland China. Materials prices fluctuate along with the fluctuation of currencies, hence material prices become unstable at times. The long term supply of aggregates should be secured through exploring new quarries. The government and the HKGBC are taking the leading role in shaping Hong Kong into a green city by promoting green building material adoption. For plant and equipment, the emergence of machinery exchange platforms could enhance traditional machinery rental service. Robotic applications are on the rise, which not only improve construction productivity and site safety, but also partially replace manual work. For funding as a resource, local large developers are financially capable due to their wide coverage in various businesses apart from property development. Syndicated loans from banks, bonds and stock issuance form the remaining sources of their development finance. Whilst the cost of finance may be affected by the fluctuations of interest rate and the tightened rules of HKMA, the dwindling land supply may be a bottleneck of their long term development. The projection methodologies mentioned in this study should be constantly updated to reflect the actual situation; data collection and trends should be reviewed regularly to provide accurate predictions. This is fundamental for the formulation of long term strategies and planning for the policy makers.

As the construction industry is one of the pillar industries that drives the economy, the Hong Kong government and the stakeholders should continuously take up the responsibility of preparing comprehensive forecasts of labour, materials, investment, equipment and land in addressing the aforementioned constraints; to maintain the equilibrium between demand and supply of construction resources; to prevent shortage problems that may arise in the construction industry and enable the sustainable development of Hong Kong.

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