STRATEGIC PLANNING FOR THE CONSTRUCTION INDUSTRY IN HONG KONG

BY

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ABSTRACT

The construction industry in Hong Kong will be facing some major challenges in the 21st century. The challenges come from different sources such as social, demographic, and economic changes, as well as from government policies. Moreover, the construction industry in Hong Kong has always been regarded as lagging behind international standards. The objective of this thesis is to analyze the changes in market demand for housing in Hong Kong and to investigate possible solutions to increase the overall construction capability in order to meet the current challenges. This thesis focuses on the public housing sector in Hong Kong because there is a major increase in demand in this segment of the construction market.

Historical data on Hong Kong's public housing sector, recent increase in demand in this sector, and possible areas of improvement are analyzed. Recommendations regarding how to improve the quality and efficiency of construction processes include upgrading the industry through technology, such as standardization and mechanization, management and restructuring the public housing building sector.

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TO MY MOM, DAD, GRANDMA & GRANDDAD:

For your unconditional love and care throughout my life. Without you, I would not learn how to grow as a person and fight on.

TO MY SISTER, CICELIA:

For always being there. Without you, I would not have all the laughter and tears that we shared throughout the years.

TO MICHAEL:

For being the one I love. Without you, I would not learn how to love and to be loved.

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CHAPTER 1

INTRODUCTION

Early in 1998, the government of Hong Kong distributed to the public a policy document concerning public housing policy. In this white paper entitled "Homes for Hong Kong People into the 21st Century," Governor Tung Chi Wah proposed an increase in flat production to 85,000 flats per year. Of this 85,000 annual flat production, it is expected that 50,000 flats will be public housing units. The upsurge in production was expected to impose pressure and challenges on land production from the government, as well as on all the participants of the whole supply chain of housing construction.

The Housing Authority, a statutory body, produces Hong Kong's public housing. The Housing Authority plans all the policies related to housing and coordinates all the issues related to the construction of public housings. With this imposed public housing demand from the Housing Authority, the construction industry has to adopt improvements and strategies to sustain the continuing development of both the industry and the property sector in Hong Kong. In addition, there are other socio-economic factors that increase the demand for public housing even further. These factors jointly pose a major challenge for the construction industry.

The construction industry is one of the vital industries that has helped Hong Kong sustain its economic growth for the last several decades. However, the construction industry of Hong Kong has always lagged behind its counterparts in foreign countries. The increase in housing market demand creates an urgent need for the industry to reform and increase the level of construction capacity. This thesis has two focuses: investigates the increase in housing demand from the perspective of the public housing sector of the construction industry; and suggest strategic planning for the industry to meet the challenge. This analysis emphases improving the quality of public housing and improving the productivity of the industry.

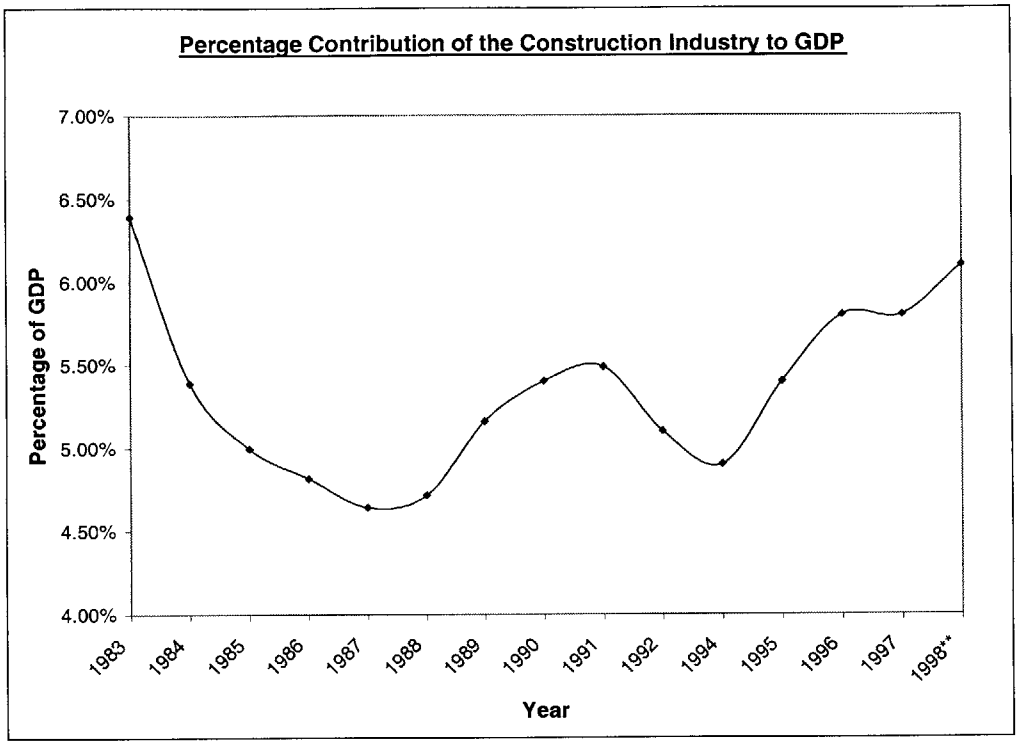
This thesis begins with an overview of the public housing sector over the past fifteen years; and analyses the factors leading to the increase in housing demand. The second part focuses on the strategic planning for the construction industry, through technology, management and restructuring the segment in which the market is operating now. Major possible solutions to upgrade the construction qualities and efficiencies will be investigated.

CHAPTER 2

HISTORICAL DATA ON THE HOUSING SUPPLY IN HONG KONG

The construction industry created a steady portion of Hong Kong's Gross Domestic Product (GDP) over the past fifteen years. Hong Kong's construction industry had an average of 5% contribution to the GDP of Hong Kong and this percentage has been rising in the past five years (see Figure 1). In 1997, the construction industry's contribution to GDP was up to 5.7%. (refer to the appendix for the actual percentage in the past decade16 years.) Figure 2 shows that building works (both public and private buildings) have always dominated the expenditure on total construction output. Even with the construction work on the new airport and related infrastructure in 1995, building construction still shared half of the total construction output, the same portion as its civil engineering works counterpart. This shows that building construction is a very important part of Hong Kong's economy and it will likely remain a major part of the economy.

Therefore, special strategies should be designed for the industry so that it can keep up with the growth of the whole economy, as well as the population growth in Hong Kong.



Source: Hong Kong: The Contractor's Experience

Figure 1. Percentage Contribution of the Construction Industry to GDP (1983-1998)

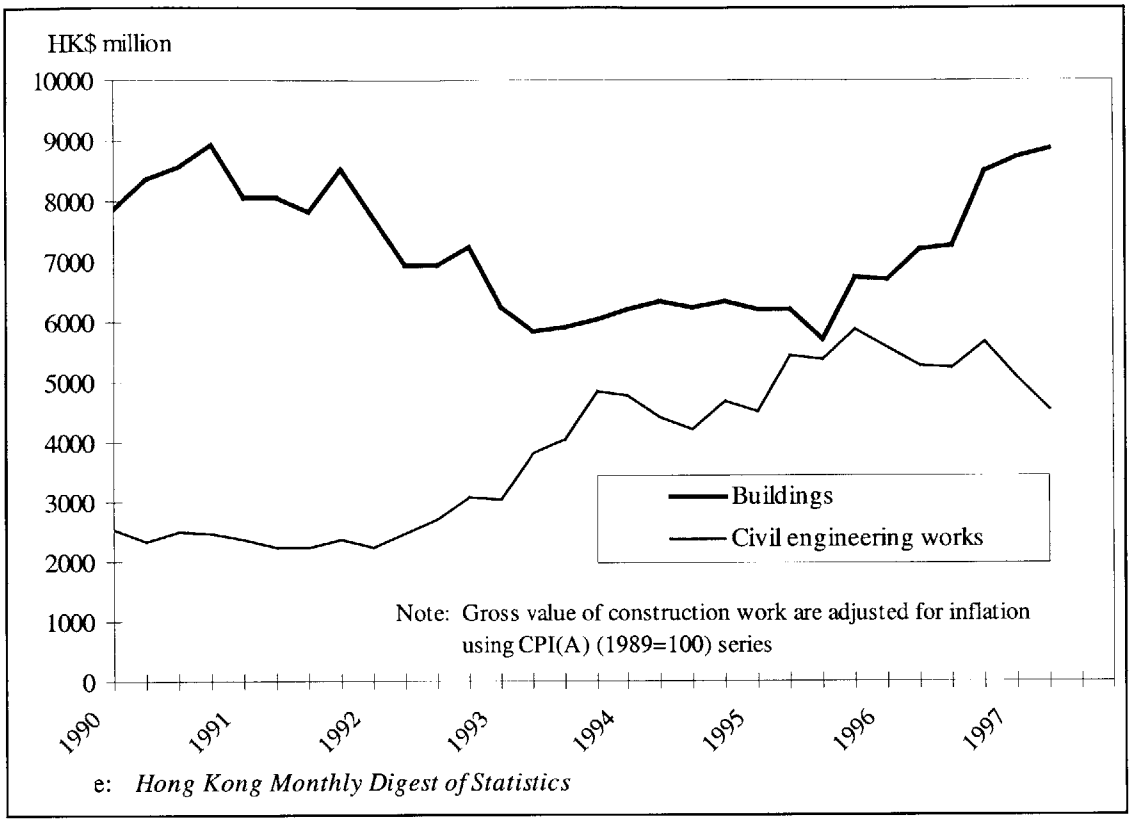
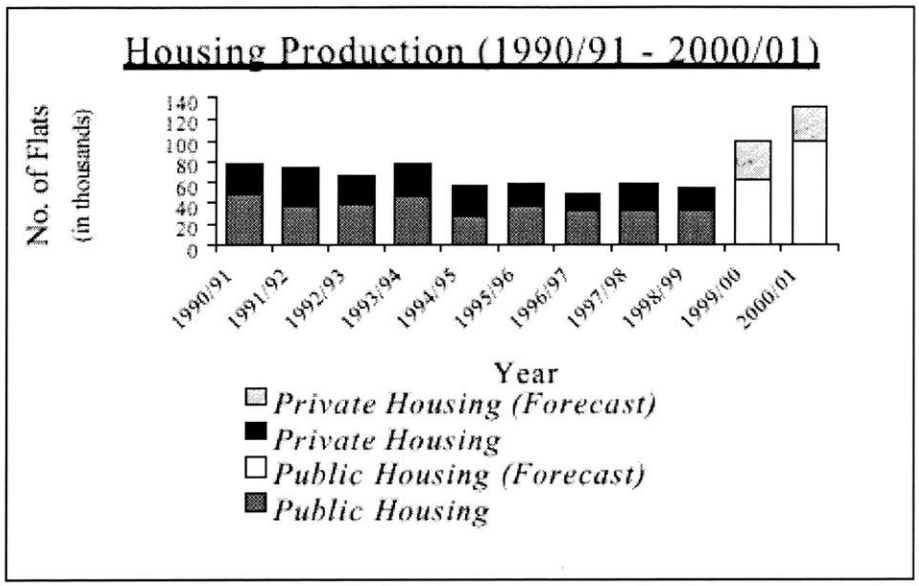


Figure 2. Inflation-Adjusted Gross Value of Building Construction in Hong Kong (1990-1997)

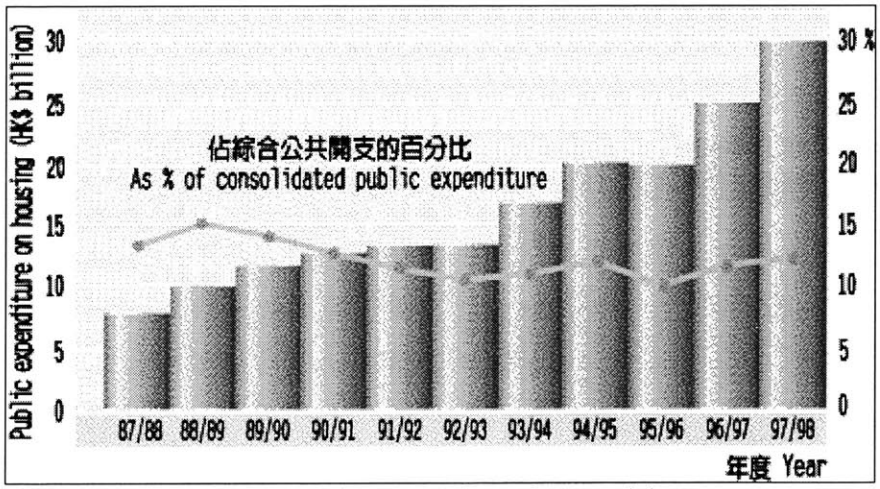
The construction of public housing blocks by the Housing Authority is making a major contribution to the total housing production. In fact, the Housing Authority is the largest housing developer in Hong Kong, providing housing for half of the population in Hong Kong. There is a close relationship between the increase in population and the need for the Housing Authority to increase production in the meantime. Figure 3 shows that there was ample production of public housing during 1990-1994, and there was a peak of almost 50,000 units in 1993/1994. However, the number of permanent public housing flats decreased since 1994/1995 and had an average of 38,000-unit annual production in the last five years. Figure 4 exhibits that public housing consumed an average of 13% of total consolidated public expenditure in the past five years. The decrease in public housing production since 1994 can be explained by the diversion of public resources to the new airport and related infrastructure. With the completion of the new airport, the

outlook is that more social resources can be put into public housing and a robust increase in both quantity and efficiency of the public building sector is expected [3].



Source: Housing Authority and Housing Society historical data

Figure 3. Total Production of Public Housing in Hong Kong (1990-2000)



Source: Housing Authority and Housing Society historical data

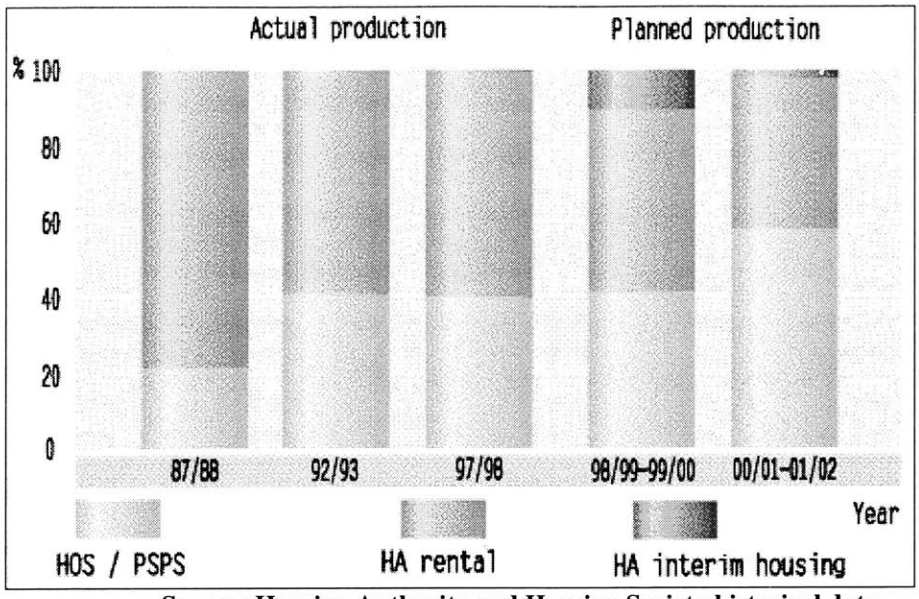
Figure 4. Expenditure on Public Housing as percentage of Consolidated Public Expenditure

2.1 TYPES OF PUBLIC HOUSING

Public housing in Hong Kong is divided into several categories. The Housing Authority housing production program builds rental flats and interim housing flats. The Housing Authority also sells flats under the Home Ownership Scheme (HOS) and the Private Sector Participation Scheme (PSPS). Respective portion of flat production is shown in Figure 5. At the beginning of 1997, these three sub-sectors totaled 917,900 units. Of this total production, 24.1% are for rental and 75.9% are for public ownership [3].

The Housing Authority provides public rental housing to families in genuine need who cannot afford adequate accommodation of other types. As of 1997, about 2.4 million people, 38% of the population, live in rental public housing provided by the Housing Authority. Public housing rent levels are determined on the basis of tenants' ability to pay. The principle of affordability is translated by the Housing Authority into appropriate median rent to income ratio (MRIR) ceilings for its estates. The Housing Authority also takes into account inflation, its own operating costs and the relative value of the housing estates.

The public ownership units are designed for households who exceed the income ceiling for public rental accommodations. The objectives of home ownership programs launched by the Housing Authority are to help eligible families to own their homes, and to make equitable use of public resources in subsidizing home ownership. The targets are middle and low-income families. Under these schemes, buyers can enjoy prices that are about 30-40% of private real estate prices. In addition to the two kinds of flats mentioned earlier, namely the HOS and PSPS, the sale of public rental flats to existing tenants is also an important strategy of the government to promote home ownership in the community of Hong Kong [9].



Source: Housing Authority and Housing Society historical data

Figure 5. Distribution of rental and home-ownership public housing at a 5-year interval

Hong Kong's construction industry always has been an important part of the economy. Over the past five years, most of the resources in the industry were engaged in the infrastructure sector because of the construction of the airport and related infrastructures. However, as the population increases and the airport project was completed, more resources will be reallocated into the building sector. The next chapter describes the details of the increase in overall housing demand in HongKong.

CHAPTER 3

INCREASE IN DEMAND FOR HOUSING

3.1 MACRO ECONOMIC SITUATION IN HONG KONG IN 1997 [3]

As in many countries abroad, the housing market in Hong Kong has always experienced sharp swings in response to the state of the economy. Therefore, it is essential to include an overview of economics and Gross Domestic Product (GDP) when assessing housing demand.

Hong Kong's economic prospect relates closely to the Asian-Pacific economies, especially that of Mainland China. Since Hong Kong's reunification with China on July

1, 1997, Hong Kong has played a more vital role as China's window on the world as foreign companies and industries use the city of Hong Kong as a stepping stone for their investment and trade in China. With Hong Kong's close connection with the Chinese economy, it is reasonable to assume that Hong Kong will continue to take full advantage of China's continued modernization with controlled economic growth to develop its own economy. Re-export is the trade of importing goods from abroad and then export them to another country. The re-export trade basically provides service to other countries and it has always been a major component of Hong Kong's GDP and the largest re-export destination of Hong Kong is Mainland China. With China's stability in political succession and economic growth, it is expected that Hong Kong's trading industry will continue to grow. Although re-exports only rose by 3.3% in value terms in 1997, which is far less than the double digit growth in re-export in the 1980's and early 1990's, it is still contributing a significant part to Hong Kong's economy.

The Administrative regime within the Hong Kong Special Administrative Region (HKSAR) government directing the planning and development of the territory remains mostly unchanged. The reunification of Hong Kong with China has not created any noticeable adverse shocks to the economy. People regained confidence and therefore were willing to invest in the property market. There was a sustained growth in consumer and investment spending in the first half of 1997 and it was the major factor in the expected increase in GDP growth.

In spite of the aforementioned positive factors to the economy, there are several negative factors that hinder Hong Kong's economic growth. The economic downturn of other Asian-Pacific countries in 1997 created several adverse factors to Hong Kong's economy. The currency and stock market turmoil in Southeast Asia, coupled with the political uncertainty from the handover of Hong Kong, decreased the tourist arrival rate by 35% in July 1997, compared to the previous year. The decline in number of tourists certainly had a significant effect on Hong Kong's economy. The hotel and retail industries contributed 26% to Hong Kong's GDP in 1997 and these industries rely heavily on the number of

tourists. This led to a decline in income and subsequently reduced overall private consumption of the whole economy.

Another negative factor was the effect of the huge decline in the stock market and the use of foreign reserves to defend the peg of local currency to the US dollar. This reduced the level of confidence of investors, both local and overseas, and creating a sluggish effect on the growth of the GDP. Moreover, the use of foreign reserves increased the interest rates and indirectly slowed economic activities.

As a result of combining all the positive and negative factors, the government still expected that there would be a 4-5% real GDP growth. According to Tse and Ganesan [8], the GDP leads the construction flow in Hong Kong, in the short term. Therefore, it was expected that there would be an overall increase in demand for construction as the GDP grew. Moreover, there would be a substantial increase in housing demand.

3.2 POPULATION FLUCTUATIONS

In assessing housing market demand for the whole community, economy plays a vital role. However, when looking at the demand for public housing, investment demand should be separated from actual housing space demand. As a result, the pattern of population carries a more dominating effect on housing demand in the public sector [10]. In the following section, the major changes in the pattern of population and their substantial influence on total housing need will be discussed.

The resident population of Hong Kong in March 1996 was 6,218,000, an increase of 722,000 or some 13% over that of 10 years ago, according to the results of the 1996 Population By-census. Moreover, the population growth was much faster in the second half than in the first half of the 10-year period. The annual growth rate averaged 1.8% over the period 1991-1996, but only 0.6% over the period 1986-1991. Furthermore, according to figures from the Census and Statistics Department [12], the population of Hong Kong at the end of 1997 was 6,617,100. This number represented a 3% growth compared to the end of 1996.

The natural increase (births less deaths) and the inflow of immigrants, mainly from Mainland China, made up the increase in population. In 1997, the balance of arrivals and departures showed a net inflow of 167,700 persons, which constituted 86% of the population growth. The remaining 14% growth of population was from the natural increase. From the above data, it can be expected that a constant supply of public housing was needed to house the increasing population. The huge increase in the population from the immigrants of Mainland China contributed to a crucial amount of public housing demand. As stated in the Housing Authority's long term housing strategy paper, the government recognized a particular responsibility to these new immigrants from Mainland China because many newly arrived families faced serious difficulties in securing adequate accommodation.

Another contributing factor to the increase in housing demand was the significant improvement of the overall housing conditions during the last 10 years. From the 1996 Population By-census, the degree of sharing, which is measured by the average number of domestic households in a dwelling, decreased from 1.11 to 1.05. Furthermore, the proportion of domestic households living in rooms/cocklofts/bedspaces in private residential flats decreased significantly from 13 % in 1986 to five % in 1996 and that in temporary housing decreased from 8% to 2%.

3.3 GOVERNMENT POLICY DECISION [10]

Policy decisions of government are always one of the most effective means to create housing supply in a society. In February 1998, the Housing Authority released a White Paper on long term housing strategy in Hong Kong entitled "Homes for Hong Kong People into the 21st Century." In this paper, the government established new initiatives and measures to help all households gain access to adequate and affordable housing, and to encourage home ownership in the community. In particular, the government pledged that:

1. There would be not less than 85,000 flats per year (private and public sectors), starting from 1999-2000, as a long-term target to meet the future needs of the community;
2. There would be a home ownership rate of 70% by 2007, and
3. By 2005, the average waiting time for public rental housing would be reduced to 3 years. The following section is about the details of each of the initiatives established by the government of Hong Kong.

3.3.1 Target of production of 85,000 flats

In 1997, the government devised a computer model which produced an estimate of demand for housing at any given time. The demand model gave the following estimated flat requirements:

	Public	Private	Total
Total	457,000	343,000	800,000
Annual (average)	45,700	34,300	80,000

Table 1. Estimated Public Housing Demand

The total number of flat units was averaged over a 10-year duration, from year 1997/1998 up to 2006/2007. There was an average of 80,000 flats required annually. With a safety margin, the government drew up the annual target of production of 85,000 units. Furthermore, the target was broken down into two categories: 50,000 flats from the public sector and 35,000 flats from the private sector. The actual number of flats produced in any particular year will vary, depending on the market demand and supply. However, the government was determined to ensure there would be a sufficient supply of land and supporting infrastructure, and also to shorten development procedures to improve efficiency in flat production.

In coming up with the demand model, the total number of existing or new households, that will require adequate housing over the assessment period (1997-2006), was calculated. Besides the estimated average 1.6% population growth, this calculation took

into considerations of newly arising needs and generated needs. Newly arising needs included needs from marriages, divorces and immigrants from Mainland China, and generated needs included needs from redevelopment of public rental estates and clearance of Temporary Housing Areas and squatter areas. The model also took into account that there should be a splitting ratio between the private and public sector, based on household income and housing preferences. Furthermore, there was also an adjustment factor in the private sector housing demand, to allow a margin of vacant flats or flats used for such purposes as second homes or accommodation for imported labor.

3.3.2 Increase in home ownership rate

Along with the target of producing not less than 85,000 flats per year, the government also established a target of 70% home ownership in the community by 2007. By encouraging home ownership, the government can foster social stability and build a sense of belonging in Hong Kong. In 1997, the home ownership rate was less than 50% and thus the target represented a more than 20% increase, which was not an easy task to reach. Besides increasing flat production, the government also established other measures to achieve this target. The existing schemes included Home Ownership Scheme (HOS) and Private Sector Participation Scheme (PSPS) but they were not adequate to achieve the target on their own. The government planned to offer all prospective public housing tenants the opportunity to buy public flats at subsidized prices. This "buy or rent" option gives lower income families the opportunity to move up the ladder of home ownership without the need to go through the interim stage of public rental housing. Moreover, the government introduced a new scheme to sell public rental flats cheaply to existing tenants, which was another strategy to help lower income families to achieve home ownership. Another important means to increase home ownership was to provide loans for first-time homebuyers. There are many families that cannot pay the down payments for private flats, but with some special financial assistance, they can own their own flats. When the paper was released, there were two loan schemes that helped low and middle-income families to buy flats in the private sector. In addition to these two schemes, the government decided to launch a new "Home Starter Loan Scheme" (HSLS). The new

HSLS scheme targeted first-time homebuyers with monthly incomes not exceeding HK$70,000[1] and provided them with low interest loans.

3.3.3 Reduction in average waiting time for public rental housing

As discussed in the last chapter, the public rental housing sector housed around 2.4 million people, which was around 38% of the total population. It was expected that public rental housing would remain a major part of the Housing Authority's tasks. Another target of the government's long term housing strategy was to reduce the average waiting time of applicants for public rental housing units. In 1996-1997, the average waiting time was 6.5 years; the government aimed at reducing that to 5 years by 2001, 4 years by 2003, and to 3 years by 2005.

The Housing Authority has always operated a waiting list for allocation of new or refurbished public rental units to eligible applicants on a first come first served basis. The first implemented measures to fulfill the pledge would be the production of 141,000 flats for the public rental sector during the 6-year planning period ending March 2001. Other measures included reinforcing the application of means tests to prospective public housing tenants and long term tenants (after 10 years' stay in public rental housing); limiting the transfer of tenancies on the death of principal tenants and to charge fair but affordable rents according to tenant ability to pay.

The success of meeting this target depends on both the production of public rental flats and also on the government's thrust to convince capable existing public housing tenants to purchase subsidized housing under the aforementioned home ownership schemes. The home ownership scheme would help in freeing up existing public housing flats for reallocation to households on the waiting lists. The focus of this thesis is on the main measures to increase production of public rental flats. The other strategies aiming at reducing the waiting time are beyond the scope of this thesis.

[1] USD $1 = HKD $8

Related to public rental housing, the need for interim housing has always posed a continuing housing demand. The interim housing is provided for families who do not qualify for public rental housing (e.g. as a result of clearance operations) or who are on the waiting list but require shelter (e.g. immigrants from the mainland). The government also promised to build high-rise permanent flats of reasonable quality to replace the existing deteriorating temporary housing area (THA), in order to meet with the demand for interim accommodation. The plan was to construct 15,000 units of high rise interim housing between 2001 and 2005 in earmarked sites in the New Territories.

3.4 ESTABLISHMENT OF HONG KONG MORTGAGE CORPORATION

In March 1997, the government set up the Hong Kong Mortgage Corporation (HKMC) [1]. The HKMC purchases mortgage loans from authorized banks and deposit taking companies, and in turn issues mortgage-backed securities. Apart from enhancing banking and monetary stability and promoting development of the local debt market, the HKMC raised the amount of mortgage finance available to homebuyers and thereby indirectly increased the overall housing demand in the community.

In conclusion, the economic situation, the population increase and the proactive government long term housing policy increases the demand for public housing drastically. It is expected that the construction industry has to devise appropriate strategies to meet this challenge. These strategies should include all the participants in the industry, including the government, contractors, professionals and the labor force. Their respective roles in the industry will be discussed in chapter 4.

CHAPTER 4

COMPONENTS OF AND PARTICIPANTS IN THE CONSTRUCTION INDUSTRY

4.1 OVERVIEW OF THE CONSTRUCTION INDUSTRY

Hong Kong's construction industry is comprised of various sectors, as in many other developed countries. The chapter provides an overview of the components and structure of the industry with a special focus on the participants related to public housing production. As discussed earlier, the Housing Authority plays a vital role in executing and streamlining public housing strategies and procedures. Besides the Housing Authority, construction companies are also active participants in public housing construction. There is a cosmopolitan mix of contractors in Hong Kong. However, the majority of public housing projects are contracted to small to medium local contractors because of their low-cost advantage compared to their foreign counterparts. Furthermore,

professionals such as architects and engineers are mainly responsible for quality assurance in the public housing sector. A/Es do not perform as much design work for public housing, compared to the private residential or the commercial building sector, because the Housing Authority has been pushing standardization of public housing in the past few years. Details the organization and roles of each of these participants are presented below.

4.2 HOUSING AUTHORITY

The Housing Authority is the largest housing provider in Hong Kong in that it provides housing for over half of the population. It is a statutory body set up in 1973 responsible for implementing Hong Kong's public housing program within the government's long term housing strategy.

On the government side, the Housing Bureau is responsible for formulating and implementing long-term policies regarding the provision of housing in both the public and private sectors. The Housing Authority determines and implements details of the public housing policies set by the government. Besides the portfolio of public residential housing, which was detailed in Chapter 2, the Housing Authority also builds and manages extensive commercial facilities within its housing estates, factories and ancillary commercial facilities throughout the territory. To date, it has provided about 645,000 rental and 300,000 home ownership units in Hong Kong.

The Housing Authority plans and builds all public housing either for rent or for sale, through its executive arm -- the Housing Department. The Housing Department has a staff of 14,400 and figure 6 shows the organization of the Housing Department. It is divided into four core business branches and two cross business supporting services branches. The four core branches are Development and Construction, Allocation & Marketing, Management and Commercial & Business Development. The branches report through an executive board to the corresponding standing committees of the Housing Authority. The board performs an internal co-ordinating role in setting overall strategies, clearing policies and targets, and monitoring performance. The two cross-business

supporting units, the Finance and Accounting department and the Corporate Services department, provide advice on major policy areas and strategic issues [9].

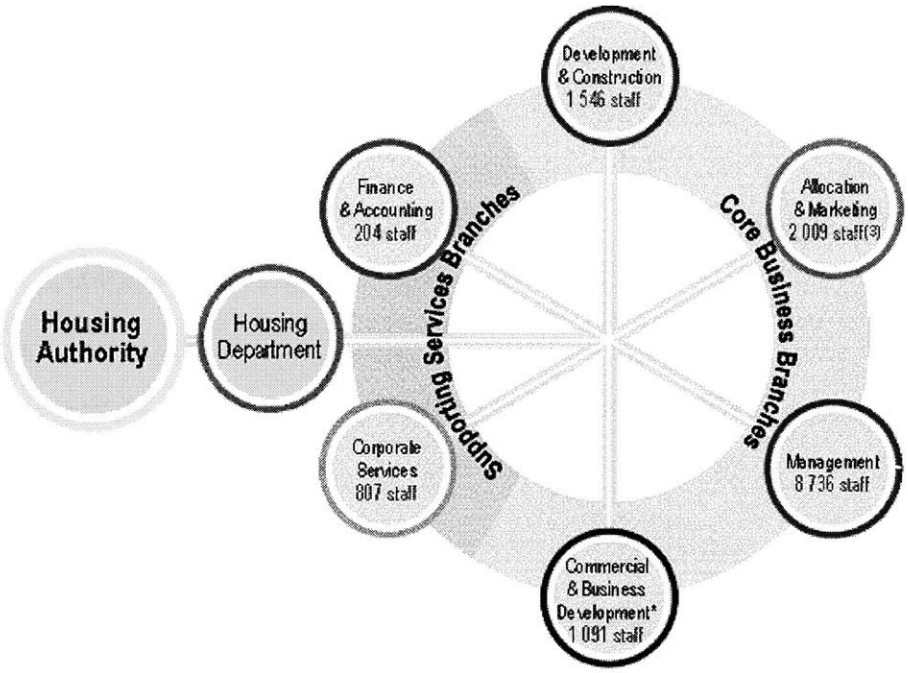


Figure 6. Organization of Housing Department

4.3 CONTRACTORS [2] [13] [14]

Contractors are diverse in terms of nationality and their sizes. There are a small number of large companies and a large number of small firms, which has an average of less than 10 persons per firm. Nearly 90% of all firms are in the category of having gross output of less than HK$5million per annum. There is no legislation of building regulations that require contractors to delegate construction professions such as engineers on site. The government also does not require contractors to be members of any professional associations.

4.3.1 Government-Approved Contractors

All contractors must register as Registered Contractor under the Building Ordinance, so that the government can monitor their performance. The government maintains a list of contractors who are eligible to bid for governmental projects. Currently, there are 250 local contractors and 68 overseas contractors on the government's list.

The contractors in Hong Kong can be classified into three groups:

Group A contractor - bidding contracts of value not exceeding HK$20 millions

Group B contractor - bidding contracts of value not exceeding HK$50 millions

Group C contractor - bidding contracts of unlimited value

Registration of government-approved contractors is not strict. The Building Ordinance Office (BOO) administers the registration; however, the details of registration do not reveal the competence of the contractor, either technically or financially.

4.3.2 Local and Overseas Contractors

As Hong Kong maintains an open construction market and because of the low entry barrier in the construction industry in general, there is a significant number of overseas contractors in Hong Kong. No firm, either local or international, receives discriminatory or protective treatment from the government. Contractors from China, Japan, France and the UK have been active in Hong Kong's construction industry. However, only jobs with a higher requirement on technology or financial resources are challenging and profitable to these foreign contractors. Therefore, most of the work that foreign contractors undertake consists of civil engineering projects, which need more sophisticated construction techniques and specialized skills. In addition, Chinese and Japanese contractors are more active in public sector projects.

4.3.3 Contractors for public housing production

Although there are a significant participation of overseas contractors in the Hong Kong construction industry, the majority of contractors engaged in public housing projects is from the local sector. This is due to the small contract size and non-innovative construction process nature of public housing projects. The Housing Authority has 2 lists of building contractors, one is for maintenance work, which has 76 firms; and one is for new works, with 52 contractors on it.

Furthermore, contractors bid for public housing works. In principle, the Housing Authority generates a list of eligible contractors according to volume of work. From this list, the contractors compete in terms of price and also technical qualifications. The Authority evaluates the contractors according to the new Performance Assessment Scoring System (PASS), a standard which includes financial, managerial staff and

construction plant resource assessments. There is usually a one-to-one correspondence between the price and the technical competency of contractors. Except for projects that require special skills, such as achieving the one floor every four days cycle, most of the contractors are invited to bid.

4.4 SUBCONTRACTORS [13]

Sub-contracting is very popular in the construction industry of Hong Kong, and this applies to the public housing building sector. There are two kinds of sub-contracting in Hong Kong, labor only subcontracting and general sub-contracting. The former provides labor and the latter provides labor, plant and material that are required to complete the sub-contracted part of the job. General contractors shift part of the risks and commitments associated with construction projects to the lower level sub-contractors through sub-contracting. Sub-contracting provides flexibility to meet the large range of risks in construction projects. Furthermore, managerial responsibility is shifted and managerial structures are simplified by sub-contractual arrangements.

As in many other countries, sub-contractors in Hong Kong practices the "multi-layer subcontracting", in which main contractors and subcontractors assign their work to other subcontractors. However, the multi-layer system is getting too far down the value system of the industry that it is creating non-value-added activities. These activities lead to major problems such as decrease in efficiency, productivity and quality. For example, too many layers of subcontractors makes main contractors lose control over the quality and progress on the project. Moreover, since there are so many layers of subcontracting, the profits for the different levels of contractor lowers the amount the final delivery agent can charge. Therefore, multi-layered subcontracting leads to sub-contractors' attempt to reduce cost by cutting corners in quality or quantity of the final product. This fact contributed to some of the recent scandals in piling works for public housing in Hong Kong.

At present, the Housing Authority adopts a "Nominated Sub-contracting" system in which main contractors have to employ building services sub-contractors that are on

Housing Authority's approved lists to install specialist items. The nominated system gives more control to the Housing Authority on their building projects. Local contractors expressed that the present system leads to segmentation of the construction process and contractual interface problems. In the private sector, main contractors have the freedom to choose their preferred professional sub-contractors. This enhances the partnering sprit as well as productivity in the construction industry.

4.5 PROFESSIONALS [14]

Professionals in the construction industry refer to those with higher academic qualifications, compared to the technicians and laborers. They also possess professional licenses. These professionals include architects, engineers, building services engineers and quantity surveyors. There are currently 12,500 to 13,500 of these construction-related professionals in Hong Kong. Their respective %age is shown in figure 7. Most of these professionals possess either university degrees or extensive practical experience in the construction industry. These professionals carry out design and management of construction work.

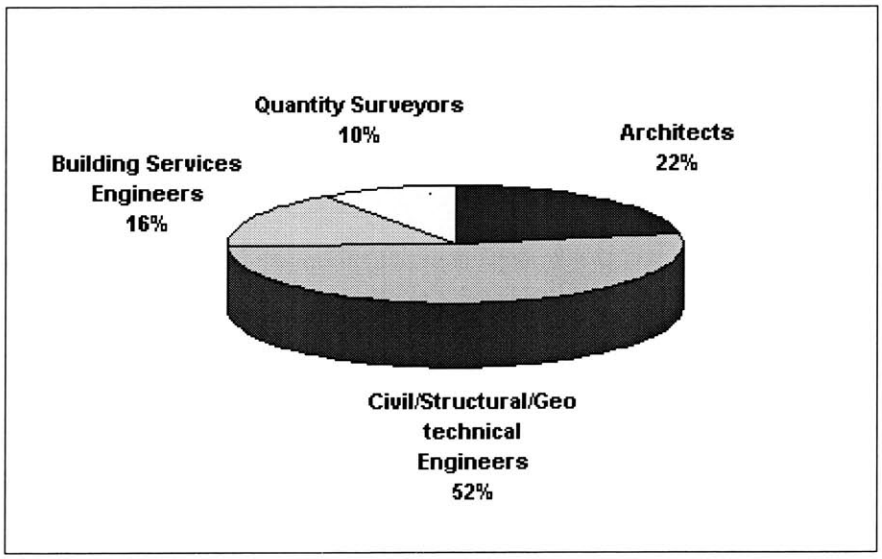


Figure 7. Share of construction-related professionals

At present, the Housing Authority has its in-house design engineers to perform the design work for public housing blocks. The engineers work for the Development and

Construction branch of the Housing Department. However, the amount of design is greatly reduced due to the current standardization of the housing. The main design criteria that vary at different locations are the wind load and the types of foundation required. Major investigations and design of public housing blocks by the Housing Authority's engineers address these two conditions.

Other than the aforementioned design work, engineers and architects are less involved in the public housing construction process than in typical private building projects. Nevertheless, this can be seen as one of the areas where improvements can be made. Suggestions and recommendations are discussed in chapters 5 and 6 which follow. In addition, the Housing Authority has been increasing the quality of their building projects through design, and it is believed that this will indirectly increase the productivity of the labor and the efficiency of building projects as a whole.

4.6 LABOR

Labor has always been a very important input of the construction industry. In Hong Kong, this fact is even more valid because the industry has a primitive structure and is very labor-intensive. Small contractors are not willing to invest in more sophisticated plants and construction techniques, therefore the practice of construction still relies heavily on site-based labor. As a result, the construction industry employs over 8% of the total workforce in Hong Kong. The majority of this labor force consists of on and off-site laborers. The remaining portion is clerical and administrative staff.

4.6.1 Industry Status

Owing to the daily-wage system and the extensive multi-level characteristic of the sub-contracting system in Hong Kong, laborers are hired as needs arise. Thus the total number of laborers fluctuates from year-to-year with changing construction demand. As a result, the mobility of workers in the industry is very high, and the value of training is not well recognized. Although many construction companies hire a limited number of skilled laborers (contract workers) to maintain a high quality, the use of contract workers is not very common.

4.6.2 Labor Shortfall

Since the mid-eighties, there have been labor shortages in all industries in Hong Kong. The labor market has remained tight in the construction industry, in spite of the government's effort to import labor from Mainland China and other Southeast Asian countries. This is because there are certain social problems and restrictions related to imported labor. Local contractors also argue that the limited amount of imported labor gives benefit to foreign contractors, as they have less access to the local worker pool. Because of this disadvantage, the government grants a larger quota to these foreign contractors.

There are two main causes of this labor shortfall. Hong Kong has experienced several demographic changes in the last decade. First, there has been a slowdown in population growth due to birth and immigration control. Second, society has become more wealthy and has achieved higher living standard with greater educational opportunities. The implication for the labor market is that there will be a diminishing supply of younger people seeking to enter the construction industry as on-site workers. The one encouraging fact is that the current local labor force has become more experienced and skillful. There is a continual effort by the Hong Kong Construction Association and the government to continue to create training opportunities for construction workers. [1]

With the persistent shortage of labor, the wages of these workers had been rising. The increase in labor cost is especially vigorous in the construction industry because of its heavy reliance on labor for the added value of construction activities. The trend of construction labor cost is shown in figure 8 where it can be observed that the increase in construction labor wages is almost 13% per annum. This rate is about 40% higher than the GDP deflator, which represents the average real price trend in the economy. The labor demand will continue to increase, especially in building construction; and supply is unlikely to be able to keep up with the growth in demand. As a result, the labor shortfall is expected to persist over the next few years. The construction industry is faced with increased competition in this tight pool of labor, and thus will encounter a major obstacle to its future growth. The need to improve productivity becomes even more urgent in view

of the fact that there is an inadequate supply of labor to meet the projected growth of construction demand.

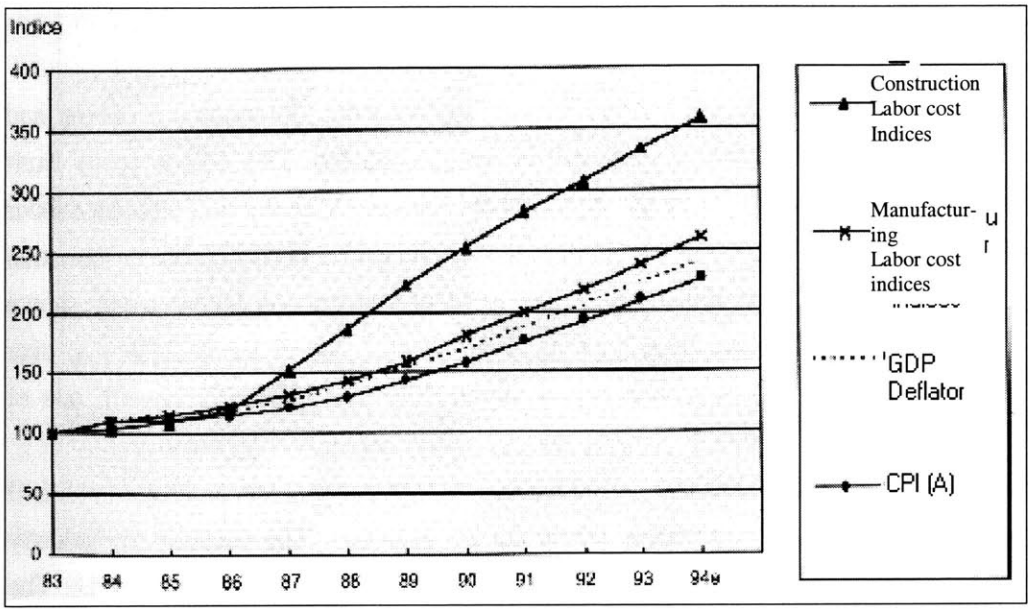


Figure 8. A comparison of the trend of construction labor costs, manufacturing labor costs and inflation

4.7 MATERIAL AND PLANT SUPPLIERS

Most of the materials for the construction industry are obtained from suppliers worldwide. The major construction materials used by the industry are cement, aggregate, sand, lime, steel and timber. Of these, local manufacturers supply only cement, sand and aggregate. There is a wide variety of sources and qualities of imported materials and considerable variation in price is possible. Material costs depend heavily on the exchange rates and the demand in the whole Southeast Asia's construction market because they are imported from abroad [13]. For the last decade, the cost of materials did not grow as rapidly as the cost of labor. However, as the infrastructure market in the whole region will grow rapidly in the coming few years, the costs of material is expected to grow at a much faster rate. This may create another challenge for the construction industry clients and contractors.

Since small to medium contractors dominate the public housing market, most of the contractors in this segment do not have their own plant and equipment. Smaller contractors do not want to make these capital investments because they cannot predict future demand very well. Also, the investment in plant and equipment requires high capital and sufficient contracts of the same type to keep the plant profitable. Therefore, hiring plant and equipment is the usual practice in the building construction sector. Hired plants are usually less technologically sound and usually restrict the types of project that a contractor can bid for.

CHAPTER 5

IMPROVING CONSTRUCTION PRODUCTIVITY THROUGH TECHNOLOGY AND MANAGEMENT

In order to meet the Housing Authority's annual production target of 50,000 flats, construction productivity has to be improved on an on-going basis. The urgency of the productivity issue is even more prominent because of the decreasing sources of labor over the past decade, as discussed in Chapter 4. The Housing Authority itself has taken the initiative to improve the productivity in several ways including incorporating labor-minimizing building methods and increasing imported labor from other Southeast Asian countries especially from Mainland China. This chapter will look into issues that increase productivity of the construction industry as a whole. The Housing Authority introduced measures are discussed in this chapter, along with others possible recommendations such

as innovative construction techniques, utilizing technology and upgrading the management level of the industry.

5.1 LABOR PRODUCTIVITY

In general, labor productivity has increased in the public building sector over the past decade. However, how to further increase labor productivity is a key issue in ensuring the ample supply of housing in Hong Kong. The importance of this issue is due to the fact that Hong Kong's construction industry is still very labor intensive.

As stated in chapter 2, labor refers to the workers who work both on and off site. This includes skilled workers (usually called craftsmen) and unskilled labor (laborer) and does not include professionals such as project managers and engineers. Labor productivity can be measured by the ratio between work output and labor input. The following table shows a trend in labor productivity from 1989 to 1995. The data in Table 2 is from the "3rd Asiaconstruct Conference" and is focused on the public building sector.

	1989	1990	1991	1992	1993	1994	1995
Expenditure at constant (1980) market price	4128	4111	3796	3823	4136	3251	3940
No. of manual workers engaged	15489	14724	12999	13960	9231	9323	13043
Value of work per manual worker	0.27	0.28	0.29	0.27	0.45	0.35	0.30

Table 2. Labor Productivity from 1989 to 1995

However, it is well recognized that single factor productivity measurement, as described by Ganesan [1], does not reliably indicate the productivity of labor in Hong Kong. Single factor productivity looks solely at the work output and labor input. Another way to measure productivity includes measuring the value of output against the total construction cost. For construction processes, it is more valid to consider all the resources as a whole when evaluating productivity. There are many different resources involved in

construction processes that are all inter-related. The savings in labor might very likely be a result of the increased investment in technology or improved managerial resources.

5.2 ADDRESSING TRAINING NEEDS AND INCREASING THE NUMBER OF TECHNICIANS

Output of labor during the productivity time depends on their 'knowledge', 'skills' and 'attitude', as described by Kumaraswamy [2]. Knowledge refers to the learning of the necessary techniques; skills are the ability to perform these techniques efficiently; and attitude is the motivation and commitment to apply such skills and knowledge in general, as well as in the given situation. Therefore, increasing the general level of knowledge and skills is a direct approach to increasing the labor productivity.

The Construction Industry Training Authority (CITA) in Hong Kong has recognized and addressed the need to continuously improve labor's productivity. CITA provides construction management and safety courses, as well as craft training courses. The former training courses are for experienced people who are already engaged in the industry; while the latter is a one-year full time course for youngsters who want to join the construction industry. The participants can choose a stream, such as bamboo scaffolding or carpentry, they receive practical training and also attend a technical institute for their technical education. After completion of the one-year course, all trainees are required by law to enter the workplace as apprentices to receive on-the-job training. This ensures that there is always a supply of skilled labor in the industry [13].

Although CITA supports the general training needs in the local construction industry to further increase the productivity of labor, it is suggested that more technicians and technologists be trained for the industry. Technicians are slightly different from skilled laborers in that they have more rigorous academic training and play a supporting role to the professionals. Technicians have a heavy influence on labor productivity because they are direct supervisors of the labor. The construction sector encounters several difficulties in recruiting and keeping skilled staff:

1. Many of the better-educated personnel become disillusioned with the construction industry and are lured away to other more attractive professions. Even if they are willing to start from the bottom of the ladder, not all entry-level personnel are physically able to handle the manual work involved. In addition, the sites are always considered an unsafe working environment.
2. Less qualified staff, remaining in the construction sector, may not possess the necessary educational and technical backgrounds to advance to foremen and technician level positions [1].

Today's construction projects are so complex that it is inefficient to use the traditional method of on-site training of supervisory staff over long periods of time. This is the result of a higher degree of mechanization of construction processes, and more sophisticated clients, who demand higher standards in quality control and assurance. An off-site training method should be established to train more technicians and technologists for the industry. Focusing on both the technical skills and the overall skills for site supervision, a comprehensive training program will increase the number of capable site supervisors and hence enhance the overall efficiency of the labor force. Furthermore, an increase in the quality of the working environment, as well as an increase in the status of the industry can aid greatly in retaining the technicians and laborers.

5.3 IMPORTED LABOR

5.3.1 Attractiveness of imported labor

There is a trend to import skilled and unskilled labor from Mainland China. This represents an immediate solution to the labor shortage problem in Hong Kong. Professionals regard imported labor as more loyal and hard working than their local counterparts. Mainland Chinese workers are prepared to take on jobs under less attractive project conditions, often in remote areas, and work longer hours. Skill levels depend on the individual. In general, imported labor from China is described as diligent and dexterous. Last but not least, contractors are very motivated to hire foreign workers

because of lower wage rates. However, this does not automatically imply savings in the overall construction project.

Imported labor is productive in general, they contribute to solving the labor shortage problem and raise the productivity of the construction process. However, there are several reservations to this solution and these reservations are discussed below.

5.3.2 Disincentive to industrialize the building construction industry

First, the import of labor from across borders is only a short-run solution to alleviate the labor shortage problem. This policy is the greatest disincentive to industrialization of building processes over the past two decades. This is because without the initiative of the government, contractors will naturally resort to cheaper short-term solutions. Contractual incentives to reduce labor importation are needed to encourage utilization of labor-saving innovations. In the long run, this cheaper alternative represses long-term technological growth and diverts monetary resources.

5.3.3 Disincentive to recruit local workers

Another disadvantage of importing labor is the disincentive to provide innovative training for technicians and to make special efforts to attract local people to the industry. Because there are decreasing numbers of technicians in the industry, more often than not, immigrants take on the role of site supervisors. Although physically fit, they are under-qualified (in terms of experience and skills) to take up positions of overall site supervision compared to the locals. Employers have little choice but to employ these less qualified but willing staff because of the decreasing number of locals to work in the construction industry.

5.3.4 Social instability

Importation of labor also creates potential social instability in the community. Besides the language problem, there is resentment between imported labor and local labor. This in turn can create a hostile environment, both in the construction workplace and in the general community. Another reservation is foreign labor's lack of familiarity with local

conditions and the long orientation period required to acquaint them with local practices. This contributes adversely to the overall labor productivity.

There is a tradeoff between the immediate alleviation of the labor shortage problem and need for an incentive to industrialize the building construction industry in Hong Kong. Therefore, the government should increase the limitation on the quota of imported labor. This may create some inefficiency in the short run, because time is required for the effects of technology and innovations to be fully realized by the industry. Reducing the pace of importation of foreign workers will also ease the socio-political issues associated with a foreign labor force.

5.4 ATTRACTING PEOPLE TO JOIN THE INDUSTRY [11]

The construction sector of Hong Kong lags behind other industries in their treatment of employees. In Hong Kong, construction sites always have been regarded as dangerous and dirty places [11]. Mobility of workers is high under the daily-wage system, making the industry very unattractive to prospective workers. Since a professional and efficient workforce is very important to the industry, the government and the construction industry should collaborate and initiate a change in the industry status to attract more people to join the industry.

Construction employment conditions should be reassessed to make the construction industry more attractive. The talent and energy of new generations are central to the future successful development of the Hong Kong construction industry. Methods to increase the appeal of the industry might include:

a) uplifting the industry's status
b) developing a visionary training strategy
c) recognizing the value of skills and knowledge
d) improving site safety

5.4.1 Uplifting the industry's status

It is important to develop an industry in which workers take pride in their work. In addition, job security and clear career paths for workers are essential to attract and retain talents and to obtain workers' commitment to their work. This policy not only attracts more new blood to the industry but also directly increases the productivity of existing labor because they become more committed and motivated.

5.4.2 Developing a visionary training strategy

The urgency of the need for a more comprehensive training program for the whole construction industry was presented in section 5.2. The comprehensive training program should focus on both on-site laborers and managerial staffs. Besides increasing the productivity of existing labor, it also will help to attract more new blood and improve the image of the whole industry.

5.4.3 Recognizing the value of skills and knowledge

Proper recognition of the benefits of training facilitates the development of professionalism. The provision of training must be linked to the requirement of the job market. Trade-testing has proved to be an effective means to recognize the value of training.

The Housing Authority has taken the initiative to put greater emphasis on the professional and trade-test requirements for site supervisory staff and workers. The Housing Authority will increase by 25% the proportion of trade-test workers on their contracts, over a three year time period. This policy improves the quality of workers and recognizes the value of training. The Housing Authority will also specify and enhance the qualifications and experience requirements for site supervisory staff under new Quality Supervision Plans.

5.4.4 Improving site safety

Of the four categories of initiatives for attracting people to the industry, improving site safety is the most urgent one. A radical improvement in safety is necessary in its own right. It will also go a long way in enhancing the image and status of the industry, in

attracting new people, in retaining existing workers. The Housing Authority has been working collaboratively with the government and other related organizations to promote the importance of site safety on their public housing sites. It also has progressively strengthened site safety requirements in contract provisions and has given increased weight to safety issues when assessing tendering opportunities. However, more can be done. Subsidies can be provided to contractors to implement specified safety provisions. Heavier penalties can be imposed on contractors with poor site safety records.

However, these and other measures to be effective must have the full support of the government, contractors, workers, and training authorities.

5.5 INCORPORATING LABOR SAVING BUILDING OPERATIONS

As discussed earlier, the single factor productivity measurement does not address the full range of methods to increase labor productivity. Technological improvements, labor-saving innovations and advanced management techniques can also contribute significantly to increasing labor productivity. Although these factors are fundamental to the improvement of the industry, they are often expensive. Government intervention is always necessary to initiate the major technical innovations and investments needed to alleviate a labor shortage problem, and to move the industry towards increased industrialization in the long run. The Housing Authority is in the best position to encourage and support these technological advances [1] since it is the largest client for building projects in Hong Kong and the government's agent for implementing all housing strategies. The following section discusses some of the labor saving designs and construction techniques that the Housing Authority has adopted in the past few years which have already helped to increase the productivity of labor, and raise the competitiveness of the whole industry.

Hong Kong Housing Authority has standardized the design for most of its building projects. Harmony Blocks and Concord Blocks are prime examples of this standardization. Both Harmony and Concord Blocks are designed on the basis of standard modular flats. Modular flats permit the use of factory-produced components and a

construction sequence, which makes extensive use of advanced formwork. Although one motive of standardization is to save design manpower, it has a much larger impact on the subsequent increase in labor productivity in the construction phase. The increased extent of mechanization and use of prefabrication in the construction process reduces labor requirements and thus boosts the overall labor productivity. While there is a tradeoff between the reduction in labor content and the increase in expenditure on structural design, the reduction in labor content will be of much greater benefit to the industry in the long run [1].

5.5.1 Standardization and Prefabrication [15]

The Housing Authority has taken the lead in technological advances in the public building sector. Since its establishment, the Housing Authority has developed a portfolio of public housing projects comprise of standardized building designs with different heights and plan forms to suit different site conditions in Hong Kong. Standardization is even more important in the recent development of the Harmony and Concord Blocks, which includes a very extensive use of standardized and prefabricated factory products. This design concept is recognized as "Rationalization." The focus and value of rationalization is the integrated system of design and production leading to continuity in production operations. The standard designs allow the repetitive use of formwork and extensive use of prefabricated components, which replace the traditional building methods using timber formwork and bamboo scaffolding. The more modern designs not only allows for substantial reduction in labor requirements and higher productivity in the overall construction, but also enable interchangeability, modularization, optimum land use and efficient methods of construction.

Pre-casting systems have also been developed in many other countries as result of increasing construction costs and decreasing availability of skilled workers. Pre-casting techniques are particularly applicable to public housing because of the large production targets and economies of scale. Prefabrication offers many advantages over traditional cast-in-place construction. Some of them are:

1. Mass production of units saves labor and reduces price because of economies of scale of the manufactured units;
2. Designers get used to the standard units more easily and have access to details. Standard plans are used for public housing and the details of are also standardized.
3. The use of prefabricated units reduces the costs and on-site time of construction because there is less work to be done on site; and pre-cast units can be erected in bad weather.
4. Effective use of formwork: Steel formwork is used and can increase the number of use to 200 times. Pre-cast units can be shaped so that they are self-stripping, reducing labor cost and wear and tear on moulds.
5. Improved quality of units: Factory production is under strict quality control, and it is easier to achieve quality assurance than traditional cast-in-place construction. Pre-cast units can be closely checked after manufacture.
6. Special shapes and surface finishes: Units can be cast in any position such as upside down or on their sides; and colored concrete can be produced by using white cement and a color pigment.

Although there are many advantages of prefabrication, there are also limitations to this innovation in construction. Some of them are related to the costs of overall construction processes. A small number of units required may prove to be uneconomical for the economic soundness of the prefabrication approach. Another important limitation is the added costs of special connections, such as special bearings to transmit the vertical and horizontal loads. Another reservation is that subsequent plumbing and other building services installations may increase the total production costs of public housing. Because of more constrains when installing the plumbing and building services onto the prefabricated units, compared to when the buildings are built on-site. Additionally, the restricted road and site conditions in Hong Kong hamper the development of prefabrication. It is difficult to transport the pre-cast components to the site, and constrained site conditions make maneuvering and placement difficult.

Focusing on these aforementioned limitations, some tailoring and improvements have been introduced to further improve construction productivity. The Housing Authority's design team redesigned the project system for prefabrication. The redesigned system ensures that most public housing blocks are standardized for prefabrication. Other improvements take care of the potential increase in costs when the production requirement is low. For example, the design of Harmony 2 incorporates pre-cast concrete facades (figure 9), semi-pre cast slabs (figure 10 & 11) and pre-cast staircases, steel panel wall-forms for shear wall construction, and a range of factory produced components. The problem with special connections can be solved by continuous effort towards innovations in structural design. There are many examples from the private building sector where specialized and complex connections are avoided by conscious structural design directed at their elimination. For the extra cost associated with subsequent installation of plumbing and other building services, there are technological advances that allow building services and insulation to be built into pre-cast units. These advances should be investigated and applied to the Hong Kong programs if feasible.

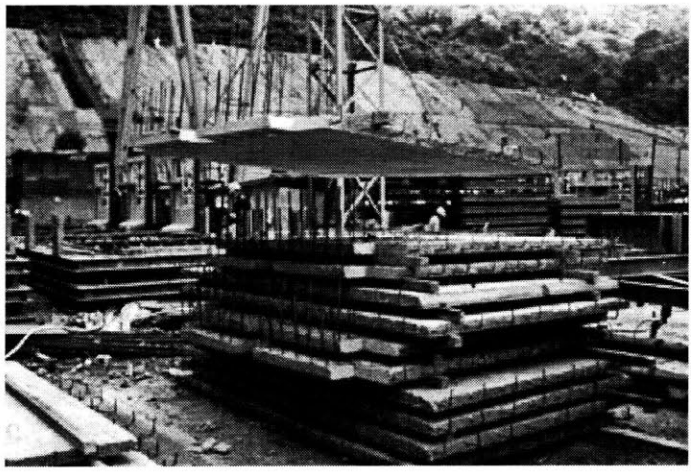


Figure 9. Prefabricated slabs

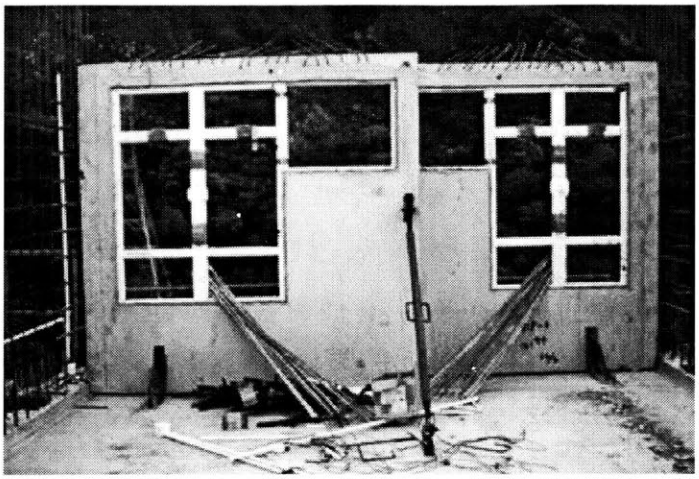


Figure 10. Prefabricated Façade

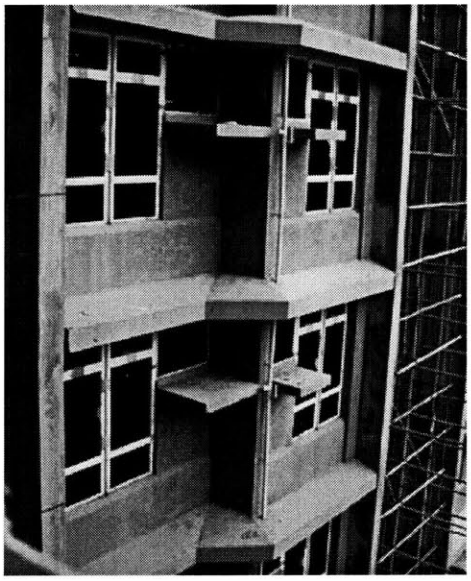


Figure 11. The finished pre-cast provides an acceptable surface finishing and large window areas.

The continuous effort of the Housing Authority has created ample demand for the prefabricated units, and economies of scale have been gained. The range of prefabricated components should also be gradually increased. Some possibilities in addition to plumbing and other building services, include pre-assembled door sets complete with ironmongery and glazing, and kitchen and bathroom modules.

5.5.2 Mechanization (increase in investment in plant and on-site labor) [1]

Investment in plants to substitute for labor-intensive construction activities is an effective way to increase efficiency and reduce duration of construction processes. In Hong Kong, the building construction industry traditionally does not utilize to a large extent because of the comparatively economical supply of labor. However, as the labor shortage problem is becoming more intense, there is greater motivation to redirect the industry towards greater utilization of construction plants and innovative building techniques. The need for development of some degree of mechanization can be justified. However, there are also some limitations for full mechanization. Most building sites do not have ample space for equipment other than tower-cranes. Congested road conditions also do not favor the transportation of large equipment to the site, or large prefabricated components from the factories to the sites. Conservative attitudes discourage some contractors from adopting the latest technology.

Public housing projects are the best place to promote mechanization in Hong Kong. Public housing blocks have the largest extent of standardization and prefabrication, which enhances the use of plants on site. In addition, as the biggest client in the industry and a government agency, the Housing Authority has the capital to initiate more frequent use of construction plants. It can initiate mechanization either through compensating the contractors or through investing in construction plants on its own. However, increase in investment is not the full solution to increase the level of technology in building construction. It must also be supplemented by considerations of other issues such as management and ownership. In the following section, one current innovative technique being used in public housing, namely the jump-form system, will be used to illustrate issues involving mechanization in Hong Kong and to develop suggestions for enhancement of future implementation suggestions.

Jump Form System [15]

One of the fully mechanized construction system in Hong Kong is the use of a climbing formwork system (sometimes referred too as self-climbing or self-lifting) to construct central core walls of high rise apartment buildings. This construction system was made

possible by the design of the Concord Blocks. Concord Blocks are a development from the Harmony series, and therefore, besides the jump form system, they also involve the extensive use of prefabricated components. The jump form system is one of the various systems in use. These systems range from crane-dependent climbing formwork to self-climbing systems based on mechanical jacks.

This innovative technique allows the construction of a 40 story Concord Blocks' building to be on a 4-day floor to floor cycle, compared to the 6-day cycle of previous Harmony Blocks' building. The process utilizes steel climbing formwork to construct the central core of the blocks (Figure 12). A frame is constructed from structural steel members over the central core. Steel formwork panels are hung from this frame, some supported on rollers. Once the formwork is in place, the panels are closed and the concrete is poured. After the concrete walls are poured, the formwork is released and rolled back from the concrete face. The whole formwork frame is then jacked up by one level and the whole process is repeated. The whole process of pouring concrete into the central core and of the formwork frame to move up one level takes about one-and-a-half hours. This innovation allows the central core walls of one floor to be constructed in four days. However, the limiting factor is always the construction of the floor slabs.

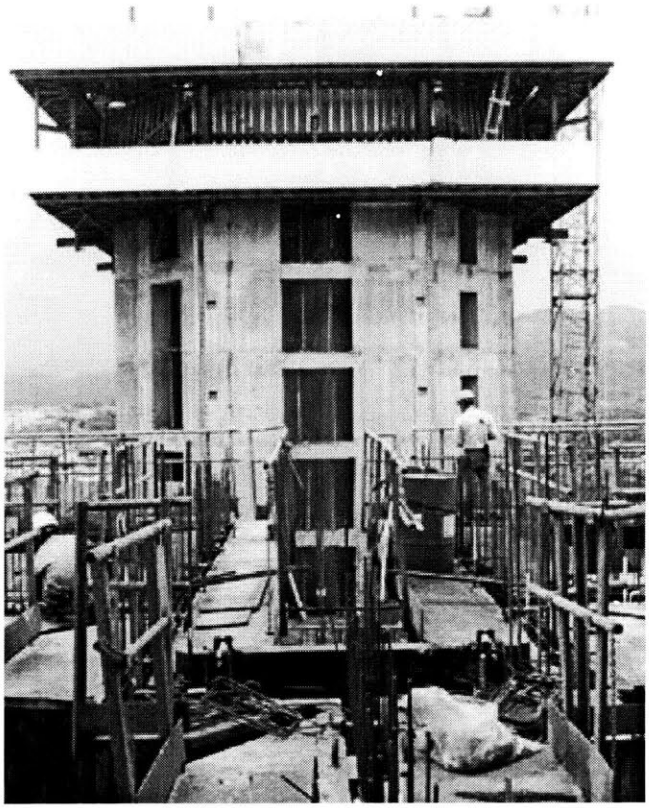


Figure 12. Core construction is leading wing construction with the Jump Form system

There are some limitations and difficulties in implementing extensive mechanization in Hong Kong's building construction sector. The present limited-time tendering process and contracting arrangement, which put very much weight on low prices, do not encourage contractors to adopt new methods or the latest plant technology. The lack of experience among local operators in the use of complex construction plant, and the absence of adequate practical courses for plant operators, are two of the obstacles faced by local construction industry. There are also previously mentioned restrictions such as limited land and road conditions. More importantly, the uncertainty of future workloads and the large capital investment needed for plants, discourage local contractors from investing, in spite of the fact that these innovations are the most immediate solution to increase output and decrease labor requirement.

Direct ownership of plants offers some advantages over leasing of plant. Although ownership of plant ensures the availability when the firm needs it and increases the competitiveness of the contractor when bidding for jobs, there is not much plant

ownership in the building construction industry. Contractors generally avoid purchasing specialized plant unless its cost can be written off as part of the project cost. In addition, since most of the local contractors engaged in the public sector building projects are small or medium sized contractors, very often they lack the large capital to invest in plants. The Housing Authority should take the initiative to increase the overall ownership of construction plants in Hong Kong. The government can provide financial assistance to contractors who are on the Housing Authority's eligible bidders list. Besides financial assistance, the Housing Authority can also encourage increased ownership by putting more weight on the value of sufficient plants when evaluating contractors' bids for Housing Authority's jobs. This not only will enhance production efficiency in the public housing sector, but it also will move the whole industry towards a higher technological level and higher capacity in the long run.

Another possible approach is investment in plants by the Housing Authority. The Housing Authority can rent these plants to the contractors who successfully win the bid for projects. In this way, the supply of plants can be ensured even in times of construction booms. Furthermore, as the design of public housing blocks become more standardized, the authority's investment will be extremely efficient because the plants themselves will become standardized and therefore fully utilized. It will also help motivate other contractors to reconsider their capital investment in plant technologies in a new light, thereby improving the total plant ownership by the industry.

Although there are views that the building construction industry should introduce more advanced building systems which incorporates robotics and automated construction, there are other views that believe an increase in the overall technological level is more important. An increasing degree of mechanization throughout the whole industry seems better than introducing automation which can only be afforded by the more financially capable contractors. The only way to achieve a higher technological level of the construction industry is by the government because the industry is too fragmented and also the contractors hold conservative views.

5.5.3 Enhancements in building materials [1]

As a complementary effort to mechanization, the use of better building materials also reduces labor in the construction process and improves building quality. The highest potential for minimization of labor is found in elements that require less preparation at the site (such as prefabricated materials and components) such elements require simpler installation and shorter construction time, or offer improved performance. High quality concrete and other materials of comparable durability are now used in public housing blocks. Besides reducing the labor requirement, there are other benefits to using advanced building materials. The amount of material and maintenance requirements will be reduced. Furthermore, some advanced material allows maximization of building area through minimization of number and size of structural members. However, since public housing construction is oriented towards low cost, enhanced building materials cannot be introduced only for the sake of improving the quality. They must also be able to achieve cost reduction in the overall life-cycle of the building.

The strategies to reduce the labor content of projects at the industry level have to be supported by management and organizational improvements at the individual firm level. This includes all participants, including designers, project managers and the government. One of the most fundamental and essential steps is to promote the awareness of designers and engineers of the need to think about labor-reducing construction methods during the design phase. Currently, most of the buildings are designed in such a way that advanced building techniques are not needed. This is due to the fact that most designers are concerned only with the functional, regulatory and aesthetic aspects of building projects [1]. This insensitivity to the labor issue is one of the major hindrances to the improvement of construction productivity at the industry level. Possible recommendations for addressing this issue are discussed in the following sections.

5.6 BUREAUCRACY

Bureaucratic procedures of the government are always among the main concerns of the majority of contractors in Hong Kong. In the building sector, lengthy approvals required by the Building Ordinance Office (BOO) delay both initial design submissions and

subsequent project amendments. Governmental procedures seem protracted and unduly complex. Few officials of the BOO are reported as willing to take responsibility for approval of unorthodox designs. Although these lengthy procedures act as a control system to prevent corruption in the government, it seems that the mechanism is far too rigid and inflexible. Another difficulty resulting from the rigidity of the governmental system is the concern about specifications and regulations, such as Construction Ordinance Chapter 123. These regulations are viewed as out-of-date and inflexible and create restrictions that not only hinder innovative construction techniques, but also reduce the incentives for professionals to incorporate labor saving designs. Apparently, these codes and regulations need to be reviewed and updated in order to keep up with the changes and innovations that are happening in the current industry [1].

Another possible measure the government can undertake is improving the procurement process. The industry is now using the traditional sequential procurement process, which is the design-bid-build option. The project is usually awarded to the lowest bidder. This method has often been criticized because there is a lack of integration between phases, poor communication channels, and fostering of adversarial working relationships all of which consequently lead to poor performance levels [5]. Mohammad and Tucker [4] proposed that the basis for selecting contractors should be on time, cost, quality, safety records and financial stability. Currently, the housing Authority has their own rating scheme, the "performance assessment scoring system (PASS)", to evaluate the performance of contractors. This evaluation methodology is based on both price and technical capability. This method has the merit of ensuring the quality of contractors, and also encouraging them to invest in plants and material because of the higher standard required. This performance-oriented procurement system should be promoted throughout the industry so that the overall industry status can be upgraded.

5.7 PROJECT MANAGEMENT

The fragmented nature of the construction industry often leads to a minimum amount of cooperation among the parties involved a project. This is normal because the team of

contractors only exists for the duration of the project. In order to maximize profits, each party tries to minimize its involvement and investment in the particular project, except for the parts that are absolutely necessary. However, efforts to improve industrial relations and to promote "partnering" among participants can contribute to improved construction productivity. Moreover, enhancing site management and introducing management in the earlier stage of construction also seem to have favorable impacts on productivity.

The fragmentation of the industry requires excellent coordination and communication throughout the design and construction. The promising technologies previously discussed require further improvements of professional and management skills at the project level. Project management teams should be trained in the use of new construction technology and site safety measures, as concerns both management and legal aspects. The project team's responsibility includes co-ordination of the various professional disciplines related to development, design and construction management. Also, there is currently limited formal management training for construction staff. Since managerial ability depends on both experience and training, both contractors and the government should encourage construction staff to take management courses directed at increasing overall management competency. In fact, a noticeable trend in construction companies to encourage employees to take management courses offered by both academic and professional institutions [1].

In the public building sector, it is easier to promote collaboration between the clients, professionals, contractors and sub-contractors. Partnering is a good option to achieve better communication and coordination among the parties. As discussed in the last section, as the agent of the government, the Housing Authority has the capital and influence to change the current practice of the industry. More up-to-date contract types such as design-build or joint ventures can be used to upgrade management capacity and to reduce overall construction duration. With joint ventures, design and construction teams can work together at the earliest stage of a project resulting in increased buildability and efficiency. Since public housing building projects are more standardized, and the client (the Housing Authority) has its own in-house design professionals, a joint

venture team containing addition engineers, construction contractors, and other industry firms, holds great potential for improving both the product and the process. From studies of Kumaraswamy [3], a short-term joint venture can be beneficial to both the constructors and to the Housing Authority. Small local contractors often lack resources to develop technology and better management on their own. Special arrangements with the Housing Authority could facilitate not only on-site technology innovations, but also enhance the overall effectiveness and productivity of the entire project delivery process.

Site management is largely the responsibility of the contractors. Engineering consultants are often more interested in the final product than the production process. One Japanese contractor suggested that the "bottom-up" approach of site management could be effective in Hong Kong. In such a 'bottom-up' approach, front line operators, such as skilled workers and supervisors, bring in problems and suggestions for discussions that are joined later by management. This approach can even be more successful if the subcontracting system is consolidated, and long-term working relationships are developed between the contractors and sub-contractors. Problems are solved through discussions among the resident engineers, the management contractor and sub-contractors. This type of organization proved to be particularly effective during some phases where decisions and actions are required immediately if work is to progress and delays avoided [1].

5.8 DEVELOPMENT OF INFORMATION TECHNOLOGY IN THE INDUSTRY

As the information age is spreading throughout the world, the construction industry seems to be lagging behind other industries in gaining the advantages and full potential of information technology. The cost of obtaining, processing, transmitting and storing information has plummeted over the past decade. The use of information can create comparative advantages in an industry, especially one that involves many processes and separate activities. As discussed by Porter and Millar [6], information technology is more than computers. Although the current extent of computerization in the design and construction industry is quite comparable to the industry of other countries, there are many potential areas that information technology can help in restructuring the industry in

Hong Kong. The large network of activities in the construction industry creates many linkages and connections. Quite often, there is poor information transfer across these linkages and connections, resulting in poor coordination and work delays. With the help of advanced information technology, past records and data can be stored and readily retrieved. In addition, the transmittal of comments and instructions will be faster and thus facilitate timely decision making. Optimizing and coordinating the linkages among activities should be explored and the results utilized at the project level to enhance productivity and efficiency.

5.9 SUB-CONTRACTING SYSTEM

As discussed in Chapter 4, the subcontracting system is becoming too extensive and too complex. Many projects meet with managerial and organizational disaster when excessive layers of sub-contracting create and worsen the situation of non-buildability [2]. Sub-contractors often are relied upon too much and too early, creating an excess of non-value-added activities that not only increases costs but also reduces the levels of productivity and quality. Consolidation of the current fragmented sub-contracting system is an urgent issue in the industry. However, this will not be an easy task. Only the government can take the lead in addressing this problem. The Housing Authority should act proactively [5] by limiting its use of sub-contracting to these contractors which are committed to improving the industry and by updating the list of eligible specialty sub-contractors. By making long-term commitments to these companies, the authority will encourage them to invest in high technology plants and in improved management systems. This will help achieve some consolidation in the currently fragmented sub-contracting sector. Another possible solution would be to eliminate the current "nominated sub-contracting system". The current system forces main contractors to work with the sub-contractors specified by the Housing Authority, rather than allowing them to select the subcontractors they have worked with before and thus have already established good working relationships, communications channels, and a spirit of partnering and team work.

Long-term development of small and medium sized sub-contractors is necessary to increase their construction capability and level technology. Subcontractor competence, particularly among labor sub-contractors must be raised for effective utilization of the contracting system within the industry [1]. These developments have to be initiated and supported by the government and larger main contractors.

CHAPTER 6

RESTRUCTURE THE INDUSTRY AND ATTRACT MORE CONTRACTORS INTO THE INDUSTRY

Besides improving construction productivity, another major way to meet the increasing demand in the housing sector is to increase construction capability by attracting more participants into the industry. At present, most of the contractors engaged in the public housing sector are small local contractors. It is essential to increase the attractiveness of the public housing building industry. This chapter will discuss in detail the current situation of the industry and the major steps need to open it to and attract new types of contractors.

6.1 MISSION OF STAKEHOLDERS IN PUBLIC HOUSING PRODUCTION

The two main stakeholders in the public housing sector in Hong Kong are the government and the construction industry. The mission of the Housing Authority, as a government agency, is to provide affordable housing to the lower income group. The

mission of the public building construction industry is to construct this housing and to make a profit to not only reward their business efforts, but also to provide money to continue their own growth and development.

6.2 ENVIRONMENT

As demonstrated throughout this thesis, the construction industry in Hong Kong, especially the building construction sector, is very fragmented. A large number of small- and medium-sized contractors populate the market; and most of them do not have capital for investment in plants and machines. The industry must therefore rely heavily on labor which traditionally has been relatively inexpensive and plentiful. In the past, a policy to import labor to moderate any upward pressure on wages has helped perpetuated this deep-rooted reliance on labor. However, an emerging labor shortage of both skilled and unskilled labor is expected to persist over the coming decade, and therefore the industry has to move towards technological advances in order to ultimately reduce its labor requirement [1].

Since there is an open market in Hong Kong for importing goods and services from abroad, Hong Kong has always been in a good position to gain resources from foreign firms. This situation pertains to the construction industry where resources and services such as building plants, materials and foreign contracting services can easily be imported. Moreover, in Hong Kong, there are substantial foreign reserves for importing plants and technology to replace labor in construction activities. These factors indicate that the best long term solution to increase productivity and revenue to the housing sector, is to increase output through activities that rely less on labor and other scarce resources and more on resources more readily available or easily imported [1]. Another potential solution is to import foreign contracting firms. However, because quantity instead of quality, has always been Hong Kong's focus, very few foreign contractors are willing to participate in this sector of the industry. Therefore ways must be developed to attract these contractors to the public housing sector.

6.3 SEGMENTATION MATRIX FOR THE INDUSTRY

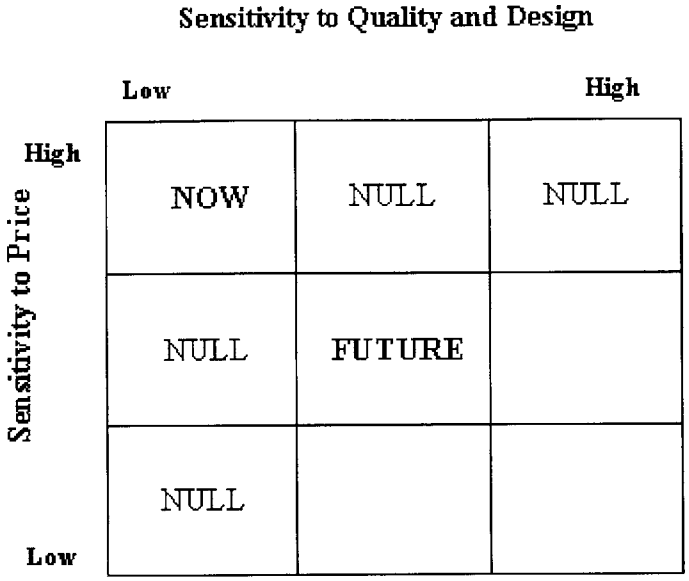


Figure 13. Segmentation Matrix for Public Housing Construction Industry

According to Porter, a segmentation matrix is an efficient way to divide an industry. It is useful in looking at the existing situation in an industry and also in developing potential segments of a market. The segmentation matrix is dependent on the buyers' type and the product. Figure 13 divides the buyer type into different degree of price sensitivity and the product types into different levels of quality. The above diagram is applied to only one area of the whole construction industry, namely the public building sector. As there is always a trade off between price and quality, some of the segments in Figure 13 (such as low price and high quality) are not applicable, and are referred to as null spaces. Currently, public housing production is essentially in the low price and low quality segment because the mission of the Housing Authority is to provide housing units to the lower income group at a low price. It is important to keep the budget at low levels because the public and construction costs are critical for government accountability. Moreover, the industry is fragmented and there is keen competition among the contractors. It is usual for contractors to offer extremely low tender prices, which are a trade off of building quality. According to Porter [7], a low entry barrier characterizes a fragmented industry. This is exactly the situation in the building construction industry in

Hong Kong because of the intensive use of labor, which makes the entry barrier very low compared to some other industries in the society.

The strategic planning for the industry should therefore focus on relocating the whole industry to another segment, namely the medium quality and medium price sensitive segment. The government accountability issue limits the resources for moving the public housing market to the high quality sector. However, it is still essential to increase the quality of current and future public housing blocks. The restructuring can be done more easily and at a lower cost because of the technological advances in the global construction field. The adoption of these advances will help remove the stigma of the "long recognized as low quality housing blocks," increase the overall living standard, for the lower income people of Hong Kong, and boost the productivity of the industry in the long run. The strategic planning should aim at restructuring the whole industry, to bring it up to the international standard, both in terms of quantity and quality.

Moving out of the segment in which the market is operating today can effectively attract a broaden range of contractors into the public building industry. Greater opportunity and room will be available for contractors to undertake more innovative construction and introduce more capital-intensive methods. Since the proposed new product is of higher quality than the existing ones, the new participants will be required to invest more capital thus raising the level of technology in the public building sector. Attracting different types of contractors into the segment is efficient because not only does it increases the construction capacity for the sector, but it also improves the quality of the housing units. The increase in overall level of productivity and quality will be both the cause and effect of attracting different kinds of participants into the public building sector.

CHAPTER 7

CONCLUSION

The housing market demand in Hong Kong has been on the rise during the past 3 years. The population growth from natural increase and immigration has resulted in an increasing need for housing units in Hong Kong. Moreover, the reunification of Hong Kong with Mainland China has created more economic opportunities. The formidable economic opportunities in Hong Kong also drive people to increase their demand for a more adequate housing supply in order to improve their living standard. More significantly, the Hong Kong government established a long-term public housing strategy in 1997 to increase the total housing production to an average of 85,000 units per year. Of the 85,000 units, 50,000 units will be public housing units. The demographic and economic factors, together with the government's housing policy, contribute to the need for the industry to devise a strategic plan to cope with the increasing demand.

A reform and consolidation of the industry is essential in order to increase the overall quality and efficiency of the construction processes. There are many different participants in the construction industry; they include the clients, contractors, subcontractors, professionals, laborers and suppliers. The whole supply chain of the construction industry in Hong Kong is extremely fragmented. Moreover, the heavy reliance on the labor-intensive activities due to traditionally cheap labor sources, aggregates the situation. Small to medium-sized contractors in the building industry are reluctant and often incapable of investing in more advanced technology and plants. The heavy dependence on labor is both the cause and effect of the slow development of technology within the industry. However the labor shortage problem persists and the number of skilled workers decreases significantly, it will be very difficult if not impossible for the industry to increase the overall production capacity efficiently. Moreover, a lack of concern and motivation for reducing labor content of construction activities through design also hinders the growth of industry capacity.

Strategic planning for the industry to meet the challenges of a growing market should therefore address the training needed to produce more skilled workers and to reduce the labor content in construction processes. Advanced technologies, such as prefabrication and mechanization, and design effort to standardize building components are eminent ways to improve the productivity and quality of construction activities. Moreover, use of better building materials can also be useful in reducing labor content. As discussed in earlier chapters, these improvements will not come cheap. The government and larger contractors have to take the lead to initiate and encourage these reforms.

Another strategy for increasing housing production capacity is to open up a new segment of the housing market that will attract more contractors into the building sector. Since the current public housing market is in the low quality and low price segment, larger domestic and foreign contractors are simply not interested in participating. By increasing the quality of housing, more contractors might then be willing to take part in the market. This will directly boost the overall level of technology and availability of resources in the

sector. Therefore, not only can the quality of the housing units be increased, but the construction capability at the industry level will be augmented as well.

APPENDIX

Year	GDP (HK$ Mn)	HK$ (HK$ Mn)	%GDP
1983	201,515	12,885	6.39%
1984	239,789	12,917	5.39%
1985	253,873	12,679	4.99%
1986	296,008	14,253	4.82%
1987	366,795	17,024	4.64%
1988	438,255	20,658	4.71%
1989	498,935	25,738	5.16%
1990	559,446	30,220	5.40%
1991	631,514	34,659	5.49%
1992	732,120	37,337	5.10%
1994	950,200	46,560	4.90%
1995	1,016,100	54,869	5.40%
1996	1,130,200	65,552	5.80%
1997	1,233,000	71,514	5.80%
1998**	1,182,400	72,126	6.10%

Contribution of construction industry to GDP

* Data not available.

* * The estimates are subjected to revisions later on as more data become available.

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