



Forecasting the Manpower Demand for Quantity Surveyors in Hong Kong

Paul H K Ho (City University of Hong Kong, Hong Kong)

Abstract

Recently, there has been a massive infrastructure development and an increasing demand for public and private housing, resulting in a shortage of qualified quantity surveyors. This study aims to forecast the demand for qualified quantity surveyors in Hong Kong from 2013 to 2015. Literature review indicates that the demand for quantity surveyors is a function of the gross values of building, civil engineering and maintenance works. The proposed forecasting method consists of two steps. The first step is to estimate the gross values of building, civil engineering and maintenance works by time series methods and the second step is to forecast the manpower demand for quantity surveyors by causal methods. The data for quantity surveyors and construction outputs are based on the 'manpower survey reports of the building and civil engineering industry' and the 'gross value of construction works performed by main contractors' respectively. The forecasted manpower demand for quantity surveyors in 2013, 2014 and 2015 are 2,480, 2,632 and 2,804 respectively. Due to the low passing rate of the assessment of professional competence (APC) and the increasing number of retired qualified members, there will be a serious shortage of qualified quantity surveyors in the coming three years.

Keywords: Hong Kong, Manpower forecast, Quantity surveyors

Introduction

Since the early 2000s, Hong Kong has suffered a great economic recession which affects nearly all economic sectors, including the construction industry. Construction related firms and professions have actively looked for business and job opportunities outside Hong Kong. The massive building and infrastructure developments in Macau, Mainland China and some overseas countries provide a good opportunity for quantity surveying firms to expend their business. Following a long hibernation period and the global financial crisis in 2008, the Hong Kong Special Administrative Region (HKSAR) Government has decided to revitalise the economy by promoting infrastructure development, sustaining employment and improving living standard. To fulfil this policy objective, the HKSAR Government has significantly increased its expenditure in capital works from \$20.5 billion in 2007/08 to \$62.3 billion in 2012-13 and will further increase over \$70 billion in the next few years. In addition to the large-scale infrastructure projects, the government also provides public rental housing for low-income families, targeting to complete 75 000 units in the next five years from 2011-12. Besides, the HKSAR Government has also resumed the new Home Ownership Scheme, targeting to supply more than 17 000 flats over four years from 2016-17 (HKSAR Government, 2012). Furthermore, the demand for private residential properties has also increased significantly due to the modest economic growth, better living standard requirements and increasing number of households, thus attracting more developers to invest in private residential properties. As a result of the massive infrastructure development and the increasing demand for public and private housing, many consultancy firms, developers and contractors have experienced difficulties in recruiting quantity surveying staff.

In Hong Kong, the University of Hong Kong, the City University of Hong Kong and the Hong Kong Polytechnic University offer full-time surveying degree programmes which admit totally

about 200 students per annum. All surveying programmes offered by these universities is a generic programme combining the building surveying, quantity surveying and general practice surveying disciplines. Some graduates may eventually opt for building surveying and general practice surveying disciplines. Thus, the number of graduates who finally ends up in the quantity surveying discipline is much smaller than the admission quota.

The Hong Kong Institute of Surveyors (HKIS) is the only professional organisation representing the surveying profession in Hong Kong. In order to become a qualified member of the HKIS, all surveying graduates are required to undergo at least two years professional training under the supervision of an experienced qualified surveyor before attending the assessment of professional competence (APC). If a probationer can pass the APC, he/she will become a professional member of the HKIS. Currently, there are about 1 180 probationers undertaking the professional training in the quantity surveying discipline. However, the average number of candidates passing the APC is only about 89 each year. The low APC passing rate creates a bottleneck for the supply of qualified members. In addition, some qualified members also retire after reaching the normal retirement age of 65. The net increase in the number of qualified members is nominal.

At present, there is a strong demand for the qualified quantity surveyors due to the significant increase in the construction workload. However, there is limited supply of qualified quantity surveyors due to the low APC passing rate and the retiring of qualified members. As a result, there has been an unhealthy competition of human resources in the quantity surveying field. It is necessary to understand the demand for, and supply, of quantity surveyors in the near future so that the relevant parties may take the appropriate action to resolve the human shortage problem. Therefore, the aim of this study is to forecast the manpower demand for professionally qualified quantity surveyors in Hong Kong in the coming 3 years. While this study primarily deals with a practical human shortage issue, it will also propose a theoretical forecasting model that can overcome the problem of insufficient input data, while providing a reasonably accurate forecast.

Literature Review on Forecasting Manpower Demand

Manpower forecasting models in construction can be divided into four levels: the national aggregate manpower level, occupational manpower level, regional manpower level and regional manpower by the occupation level (Briscoe and Wilson, 1993). There are four commonly used statistical approaches to forecast the aggregate manpower based on time series data: (1) single-equation regression model, (2) simultaneous-equation regression model, (3) autoregressive integrated moving average (ARIMA) model and (4) vector autoregression (VAR) model (Gujarati and Porter, 2009).

Over the past five decades, economists have developed a wide range of theoretical models to forecast the employment level (Wilson, 1980). Early versions of short-run employment functions were derived from neoclassical economics theories. The most seminal short-run employment model was proposed by Ball and St. Cyr (1966), who postulated that the employment level was determined by output via a production function, while the time trend reflected the productivity growth generated by the capital accumulation and technical progress. This autoregressive model included one lagged dependent variable among its explanatory variables as follows:

$$\log E_t = a_0 - a_1 t + a_2 \log Q_t + a_3 \log E_{t-1}, \quad (1)$$

where E = the employment level, Q = the product output and t = the time trend as a proxy for the capital input term. Ball and St. Cyr's model was considered as a short-term approximation since in the long-term the capital labour ratio would be influenced by factor price ratios.

Dhrymes (1969) argued that a profit-maximizing employer would have a desired level of labour input such that the marginal product of additional labour was related to the cost of that labour relative to the price of output. Dhrymes incorporated wages as one of the determinants of the desired employment level as follows:

$$\log E_t = a_0 + a_1 \frac{W}{P} + a_2 \log Q_t + a_3 \log E_{t-1}, \quad (2)$$

where E = the employment level, Q = the product output, W = the labour cost and P = the output price. In examining the forecasting ability of these two employment functions, Evans and Roberts (1975) concluded that both the Ball and St. Cyr's and Dhrymes' models seemed to have under-predicted the level of employment.

Early derived models are based on the assumption that employment is demand determined. However, traditional economics theory asserts that the labour market is determined by both the supply side and demand side which are eventually brought into balance through wage adjustments. On this basis, some economists derived the labour supply and demand functions by the simultaneous-equation regression approach. For instance, Beenstock and Warburton (1982) proposed a dynamic relationship between the labour supply and demand as follows:

$$L^d = \alpha_0 + \alpha_1 Q - \alpha_2 w \quad (3)$$

$$L^s = \beta_0 + \beta_1 P + \beta_2 w \quad (4)$$

where Q = the product output, w = the real wage rate and P = the population of working age. The equilibrium condition occurs when labour supply and demand is in balance (i.e. $L^s = L^d$). On substitution from equations (3) and (4), this implies the following equilibrium relationships for real wage rate and employment for the given level of economic activity and population of working age:

$$w^* = \Pi_{10} + \Pi_{11}P + \Pi_{12}Q \quad (5)$$

$$L^* = \Pi_{20} + \Pi_{21}P + \Pi_{22}Q \quad (6)$$

$$\text{where } \Pi_{11} = \frac{-\beta_1}{\alpha_2 + \beta_2}, \quad \Pi_{12} = \frac{-\alpha_1}{\alpha_2 + \beta_2}, \quad \Pi_{21} = \frac{\alpha_2 \beta_1}{\alpha_2 + \beta_2}, \quad \Pi_{22} = \frac{\alpha_1 \beta_3}{\alpha_2 + \beta_2}.$$

By identifying the appropriate reduced-form equations, the relevant coefficients were estimated by the ordinary least squares. However, the parameters estimated from the simultaneous-equation regression model were unstable over time.

The autoregressive integrated moving average (ARIMA) approach focuses on analysing the probabilistic properties of time series data itself. The dependent variable is explained by its lagged values and stochastic error terms. It comprises five basic steps: (1) differencing the series so as to achieve stationarity, (2) identification of a tentative model, (3) estimation of the model, (4) diagnostic checking and (5) using the model for forecasting (Maddala, 2001). It is fairly accurate and reliable for short-term forecasts. However, there are two major weaknesses. First, ARIMA is not derived from any economic theory and cannot provide insight into underlying factors that cause changes in the time series. Second, because ARIMA is based on extrapolation of the past trend into the future, there will be a large error if a sudden change occurs in the future trend. Wong et al. (2005) applied the univariate ARIMA model to forecast five construction manpower time series in Hong Kong: labour productivity, employment level, wage level, unemployment rate and underemployment rate. Their study indicated that except for the employment level, the univariate ARIMA model could produce

reasonably good forecasts for other variables. However, they also concluded that univariate projection is not appropriate for forecasting construction employment and that multivariate forecasting analysis would produce more accurate estimates.

The vector autoregression (VAR) approach resembles the simultaneous-equation regression model where several endogenous variables are considered together, but each is explained by its lagged values and the lagged values of all other endogenous variables in the model. Since all variables in a VAR model are usually derived from economic theory, the forecasts obtained can be better than those obtained from the simultaneous equation model (Gujarati and Porter, 2009). Ball and Wood (1995) argued that the UK construction employment was a function of the construction output, different types of output, cost of capital, construction labour wages and materials prices. By combining these variables, they proposed four general models relating the employment growth as follows:

$$\Delta L_t = \alpha_0 + \sum_i \alpha_{1i} \Delta Y_{t-i} + \sum_i \alpha_{2i} \Delta W_{t-i} + \sum_i \alpha_{3i} \Delta CC_{t-i} + \sum_i \alpha_{4i} \Delta M_{t-i} + \varepsilon_t \quad (7)$$

$$\Delta L_t = \beta_0 + \sum_i \beta_{1i} \Delta YH_{t-i} + \sum_i \beta_{2i} \Delta YR_{t-i} + \sum_i \beta_{3i} \Delta YN_{t-i} + \sum_i \beta_{4i} \Delta W_{t-i} + \sum_i \beta_{5i} \Delta CC_{t-i} + \sum_i \beta_{6i} \Delta M_{t-i} + \varepsilon_t \quad (8)$$

$$\Delta E_t = \delta_0 + \sum_i \delta_{1i} \Delta Y_{t-i} + \sum_i \delta_{2i} \Delta W_{t-i} + \sum_i \delta_{3i} \Delta CC_{t-i} + \sum_i \delta_{4i} \Delta M_{t-i} + \varepsilon_t \quad (9)$$

$$\Delta E_t = \gamma_0 + \sum_i \gamma_{1i} \Delta YH_{t-i} + \sum_i \gamma_{2i} \Delta YR_{t-i} + \sum_i \gamma_{3i} \Delta YN_{t-i} + \sum_i \gamma_{4i} \Delta W_{t-i} + \sum_i \gamma_{5i} \Delta CC_{t-i} + \sum_i \gamma_{6i} \Delta M_{t-i} + \varepsilon_t \quad (10)$$

where L = the total employment, E = number of employees, SE = the self-employment, YH = the output of house building, YN = the output of non-residential construction, YR = the output of repair and maintenance, Y = the total construction output, CC = the cost of capital, PW = the real product wage and W = the deflated construction wage. All variables are in natural logarithms. Contrary to the theoretical prediction, Ball and Wood's study indicated a weak link between the total output and employment because of poor data quality, arising particularly from the self-employed workers. They concluded that more accurate construction data would be necessary; if not available, site-based estimate of labour requirements would be required.

When compared the accuracy among the univariate ARIMA, multiple regression and VEC approaches in predicting the construction manpower demand, Wong et al. (2010) derived the following manpower demand functions:

$$\text{Regression model: } \log_e MD = 11.25 + 0.56 \log_e Q - 0.59 \log_e LP - 0.96 v_t \quad (11)$$

$$\text{VEC model: } d = -0.63 + 1.28q + 0.81rw - 0.41mp - 0.02br - 0.77lp \quad (12)$$

where for the regression model: MD = the manpower demand, Q = the construction output, LP = the labour productivity and v_t is an autoregressive parameter; and for the VEC model: d = the manpower demand, q = the construction output, rw = the real wage, mp = the material price, br = the interest rate, lp = the labour productivity and all variables are in natural logarithms. Their study found that the multiple regression model was the most accurate method (MAPE = 2.93%), followed by the VEC model (MAPE = 4.38%) and then ARIMA model (MAPE = 11.92%).

The statistical approaches reviewed above are appropriate for forecasting the aggregate manpower demand. However, for a specific occupational manpower, one commonly used forecasting method is the multiplier approach, which is based on the premise that each type of project will demand the same level of human resources per unit of construction output because there should be no significant change in their productivity in the short run

(Uwakweh and Maloney, 1991). The manpower requirement is formulated by first deriving its multiplier.

$$M_i = \frac{D_i}{E_i} \quad (13)$$

where M_i = the multiplier based on historic data, D_i = the total manpower employed in different types of projects, E_i = the total expenditure of different types of projects, and i = different types of projects such as building works, civil engineering works and maintenance works. Once the multiplier is derived from historic data, it can be utilised to forecast the manpower requirement based on the projected expenditure for different types of projects. Ng et al. (2011) adopted this approach to forecast the manpower demands of construction related professionals in Hong Kong.

As the multiplier approach is based on the proposition that a direct relationship exists between the total expenditure of projects and the total manpower demand, it is very essential that the future expenditure of each category of projects can be accurately estimated in order to produce a reliable forecast. If there is any change in the construction method, construction price level, productivity, wage and working hour, the multiplier must be adjusted in order to produce an accurate forecast.

Proposed Forecasting Model

As revealed from the above literature, there are some sophisticated statistical methods for forecasting the manpower demand. However, all of these methods require correspondingly sophisticated, comprehensive and reliable data in order to produce an accurate forecast. Given these constraints, it is necessary to decide whether to formulate a stringent theoretical model first and make appropriate adjustments to cater for the non-availability of data, or to look closely at existing data and develop a theoretical model which can make the best use of the available data. While both of these approaches have its own merits, this study adopts the latter approach because of the non-availability of reliable data.

The above literature review indicates that one key variable commonly used by all researchers is the product/construction output. Other variables such as the labour wage, labour productivity, output price, material price and cost of capital have a certain effect on the overall labour demand. However, these variables may not be significant for a specific occupational manpower. For instance, the manpower demand for quantity surveyors does not much depend on the construction cost, material price and cost of capital. Indeed, based on the classical economics theory, these variables can be assumed to be fixed in the short term. Therefore, the short-term demand for quantity surveyors is a function of the value of various construction outputs as follows:

$$MD_t = f(OB_t, OC_t, OM_t) \quad (14)$$

where t = the time trend, MD_t = the manpower demand for quantity surveyors, OB_t = output value of building work, OC_t = output value of civil engineering work and OM_t = output value of maintenance work. This model specification is in line with Ball and St. Cyr's (1966) and Uwakweh and Maloney's (1991) models which have been used for forecasting aggregate and disaggregate labour demands, respectively.

The proposed forecasting model involves two steps. The first step is to estimate the future values of building, civil engineering and maintenance works. This can be done by univariate forecasting (or time series) methods because it only uses the past, internal patterns in data to forecast the future. Univariate methods include exponential smoothing models (such as the simple, Brown's linear trend, Holt's linear trend, simple seasonal, damped trend, and Winters' additive and multiplicative models) and univariate ARIMA models. Since different

models may produce different forecasts, a search process is undertaken to find out the best-fitting model that produces the most accurate result.

The second step is to forecast the manpower demand for quantity surveyors based on the forecasted values of building, civil engineering and maintenance works. This can be done by multivariate forecasting (or causal) methods which make projections of the future by modelling the relationship between the dependent variable, MD_t , and the independent variables, OB_t , OC_t and OM_t . Multivariate methods include multiple regression, econometric, multivariate time series and few advanced techniques. However, most of these models require a large amount of statistical data in order to produce a reliable result. Due to this data limitation, it is found that the multiple regression model is the only feasible approach.

Data Sources

This study requires two types of time series data: the manpower demand for quantity surveyors and the gross value of various construction outputs. The data for quantity surveyors was based on the “Manpower Survey Reports of the Building and Civil Engineering Industry” published by the Vocational Training Council (VTC). The demand figures were compiled by summing the series of “number employed” and “vacancy”. Since the VTC’s manpower survey produced only biennial statistics, the manpower figure laid between two survey years was based on the simple average of two consecutive surveys. Figure 1 shows the manpower demand of professional quantity surveyors from 2000 to 2012.

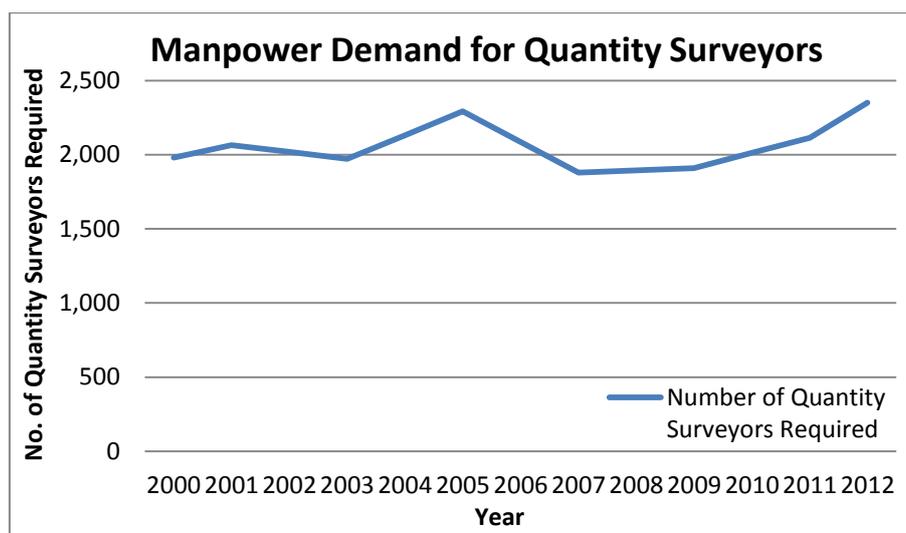


Figure 1 Manpower Demand for Quantity Surveyors

The construction output data was based on the “Gross Value of Construction Works at constant (2000) market prices performed by Main Contractors” published by the Census and Statistics Department of the HKSAR Government. The construction sector is divided into three main subsectors: building subsector, civil engineering subsector and maintenance subsector. It can be noted from Figure 2 that the construction output in both the building and civil engineering subsectors were declined substantially from its peak in 1997 to 2008 due to the Asian financial crisis in 1998 and the outbreak of SARS epidemic in 2003, but have significantly increased because the HKSAR Government has implemented a number of mega-infrastructure and housing projects to promote economic growth since 2009. On the other hand, the construction output in the maintenance subsector was gradually increased up to 2008, but has then declined in recent years.

It is revealed from previous studies such as Ball and St. Cyr (1966), Dhrymes (1969), Beenstock and Warburton (1982), Uwakweh and Maloney (1991), Ball and Wood (1995) and

Wong et al. (2010) that there is a direct relationship between the level of employment and the product output. As observed from Figures 1 and 2, both the manpower demand and total construction output curves are in downward and upward trends between 2000-2009 and 2010-2012, respectively, indicating a close relationship between the level of employment and construction output. Nevertheless, there are also few mismatches in some years between these two curves due to various reasons; for instance, the level of employment is only adjusted slowly over time rather than instantaneously. Based on this observation, it is found that these two sets of statistical data generally reflect the theoretical proposition, while there are also few abnormalities.

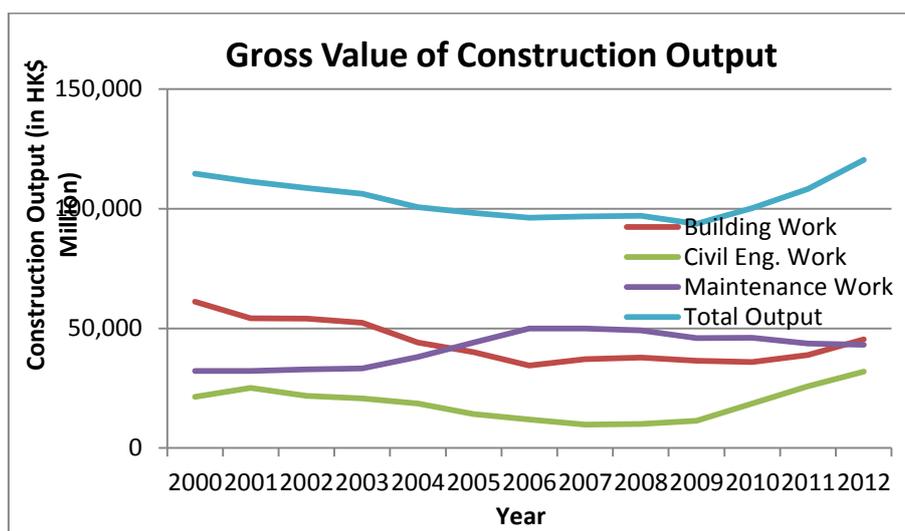


Figure 2 Annual Gross Value of Construction Output at Constant (2000) Market Prices

Findings and Discussions

The manpower forecast for quantity surveyors involves two steps. The first step is to estimate the gross values of various types of construction outputs by univariate time series methods, whereas the second step is to forecast the manpower demand for quantity surveyors by multivariate causal methods.

Forecast of Future Construction Output

First, the time series data in both normal and natural logarithm values are tested by univariate forecasting models. It is found that the data based on natural logarithm values produces a lower mean absolute percentage error (MAPE) and should be adopted. Second, since there are a number of univariate time series models, it is found that after testing all models, the Brown's double exponential smoothing is the best-fitting model for the building and civil engineering works time series, whereas the ARIMA (1,1,0) is the best-fitting model for the maintenance work time series. For both the building and civil engineering works time series, there is a linear trend but no seasonality. For the maintenance work time series, there are one order of autoregression, one order of differencing and zero order of moving average in the ARIMA model. Table 1 shows the model parameters of these three time series.

Model			Estimate	SE	t	Sig.
Log _e Building Work	No Transformation	Alpha (Level and Trend)	0.787	0.141	5.597	0.000
Log _e Civil Engineering Work	No Transformation	Alpha (Level and Trend)	0.951	0.123	7.724	0.000
Log _e Maintenance Work	No Transformation	AR Lag 1 Difference	0.603 1	0.231	2.614	0.024

Table 1 Model Parameters for Forecasted Construction Output

Table 2 shows the forecasted values of building, civil engineering and maintenance works (in natural logarithm) from 2013 to 2015. These values will be used for forecasting the manpower demand for quantity surveyors.

Model	2013	2014	2015
Log _e Building Work	24.648	24.763	24.878
Log _e Civil Engineering Work	24.413	24.639	24.865
Log _e Maintenance Work	24.479	24.474	24.471

Table 2 Forecasted Construction Outputs

Forecast of Future Demand for Quantity Surveyors

First, it is observed from Figure 2 that the time series data of the building, civil engineering and maintenance works are not linear. Thus, it is necessary to transform these data by natural logarithm. Second, the manpower demand function can take the following two forms:

$$\log_e MD_t = f(\log_e OB_t, \log_e OC_t, \log_e OM_t) \quad (15)$$

or

$$\log_e MD_t = f(\log_e MD_{t-1}, \log_e OB_t, \log_e OC_t, \log_e OM_t) \quad (16)$$

Equation (15) implies that the employers would hire and dismiss their employees instantaneously in response to the current construction workload. On the other hand, equation (16) implies that the employers would adjust the level of employment slowly over time in response to the current and future construction workload. After testing both manpower demand functions, it is found that equation (16) produces a R^2 higher than equation (15) and should be adopted.

With $\log_e MD_t$ as the dependent variable and $\log_e MD_{t-1}$, $\log_e OB_t$, $\log_e OC_t$ and $\log_e OM_t$ as independent variables, regression analysis is used to estimate the various coefficients. By using backward elimination method which evaluates all variables in the model and remove the one that results in the smallest change in R^2 , and stops when there are no more variables that meet the criterion for removal, the model is summarised in Table 3. It is found that model 1 consists of $\log_e MD_{t-1}$, $\log_e OB_t$, $\log_e OC_t$ and $\log_e OM_t$ as independent variables, whereas model 2 consists of $\log_e MD_{t-1}$, $\log_e OC_t$ and $\log_e OM_t$ as independent variables. Both models 1 and 2 have the same R^2 , but the adjusted R^2 of model 2 is higher than model 1. In model 1, the observed significance level is relatively small ($p=0.092$) so that the null hypothesis that the population values of all of the regression coefficients are 0 can be rejected. On the other hand, the null hypothesis in model 2 cannot be rejected because the observed significance level is high. Therefore, model 1 should be adopted.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.799	.639	.433	.053	.639	3.097	4	7	.092
2	.799	.639	.504	.049	.000	.000	1	7	.985
3	.753	.567	.470	.051	-.072	1.605	1	8	.241

Table 3 Model Summary

	Model	Unstandardized Coefficients		t	Sig.
		B	Std. Error		
1	(Constant)	-3.672	15.712	-.234	.822
	Log _e Building Work	.006	.336	.019	.985
	Log _e Civil Engineering Work	.143	.053	2.680	.032
	Log _e Maintenance Work	.157	.337	.467	.655
	Log _e Manpower Demand _(t-1)	.516	.295	1.751	.123

Table 4 Coefficients

Based on the coefficients of model 1, the derived demand function for quantity surveyors is as follows:

$$\log_e MD_t = -3.6723 + 0.006 \log_e OB_t + 0.143 \log_e OC_t + 0.157 \log_e OM_t + 0.516 \log_e MD_{(t-1)} \quad (17)$$

By applying the above derived equation and based on the forecasted values of building, civil engineering and maintenance works, the forecasted manpower demand for quantity surveyors in the coming three years is shown in Table 5. The forecasted demand for qualified quantity surveyors in 2013, 2014 and 2015 are 2 480, 2 632 and 2 804 respectively, representing an average annual increase of 5.7%.

Year	Forecasted log _e MD _t	Forecasted MD _t	Additional No. of QS	Percentage Increase
2013	7.815	2 480	128	5.2%
2014	7.875	2 632	152	5.8%
2015	7.938	2 804	172	6.1%

Table 5 Forecasted Manpower Demand for Quantity Surveyors

Supply of Quantity Surveyors

In theory, the supply of quantity surveyors is determined by (1) the number of students currently studying the surveying programme (i.e. potential members), (2) the number of probationers currently undertaking the professional training under the supervision of qualified quantity surveyors, (3) the number of existing qualified quantity surveyors (i.e. active members), and (4) the number of retired quantity surveyors (i.e. inactive members).

Currently, three local universities admit about 200 full-time surveying students each year. About 100-150 surveying graduates will join the quantity surveying discipline, while the remaining graduates will join the general practice or building surveying disciplines. In order to become a qualified member of the HKIS, a surveying graduate needs to apply to be a probationer and then undertake at least two years professional training. If a probationer passes the HKIS's assessment of professional competence (APC), he/she will become a qualified quantity surveyor. Therefore, there is a gradual increase in the number of qualified members each year.

According to the HKIS's membership statistics, the numbers of available qualified quantity surveyors, probationers and newly qualified members as at 1 January 2013 are shown in Figure 3. At present, there are 2 207 and 1 185 qualified quantity surveyors and probationers respectively. While there are a large number of probationers, only a small number of these

probationary members can pass the APC each year. This reflects the relatively low passing rate of the HKIS's APC which has created a bottleneck for the supply of qualified members.

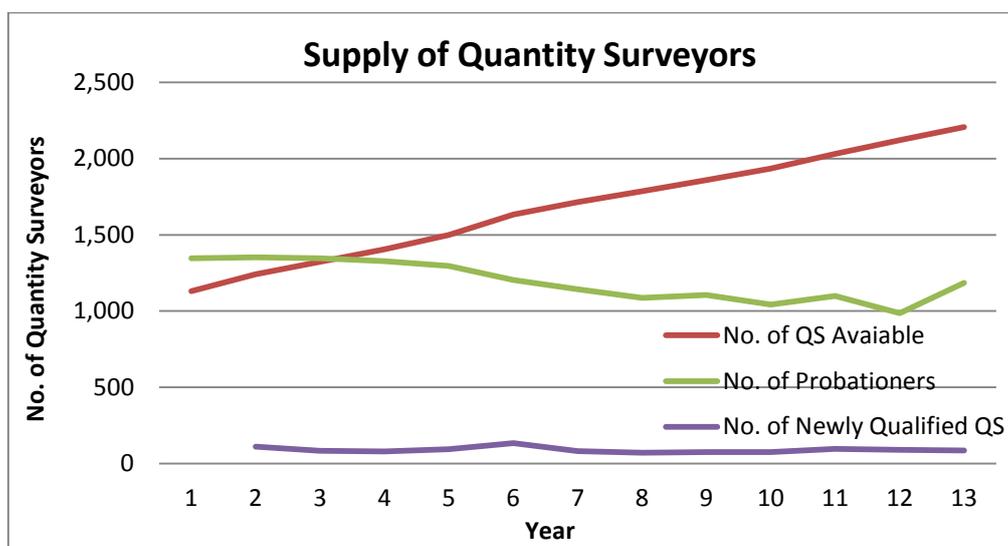


Figure 3 Supply of Quantity Surveyors

Currently, probationers are the main source of supply for qualified members. Based on the past three years' figures, the average number of probationers becoming qualified members (i.e. newly qualified members) is about 90. The past trend is fairly stable as shown in Figure 3. Assuming that the APC passing rate will remain unchanged, there will be a supply of 90 qualified members in coming three years. Based on the current number of qualified members and an increase of 90 members each year, the forecasted supply of qualified quantity surveyors in 2013, 2014 and 2015 are 2 297, 2 387 and 2 477 respectively.

Some of the qualified members would retire at the ages typically at 60-65, depending on individual's situation. Assuming the retirement age of 65 and based on the HKIS's membership profiles, the number of qualified members aged 66 and above will be 52, 59 and 71 in 2013, 2014 and 2015 respectively. After the adjustment of retired members, the number of qualified quantity surveyors will be 2 245, 2 328 and 2 406 in 2013, 2014 and 2015 respectively. The forecasted supply and demand of qualified quantity surveyors are summarised in Table 6.

Year	Forecasted Supply	Forecasted Demand	Shortage
2013	2 245	2 480	235
2014	2 328	2 632	304
2015	2 406	2 804	398

Table 6 Forecasted Supply and Demand of Quantity Surveyors

As shown in Table 6, there will be more and more serious shortage of qualified quantity surveyors in the coming three years because the increasing demand for quantity surveyors, the limited supply of newly qualified members and the retirement of more experienced members.

Conclusions

In view of the increasing workload available in the construction market, this study has investigated a practical issue of the shortage of qualified quantity surveyors in the short term. While there are many sophisticated models for forecasting the supply and demand of manpower, the availability of reliable data has created a great limitation on the choice of

these models. As a result, this study has adopted a practical approach to develop a model by making the most efficient use of the available data. If some advanced modelling methods are to be used for improving the accuracy of forecasts, the data quality should be improved first; otherwise, the “garage-in and garage-out” situation would still exist.

As at 1st January 2013, there has been already a shortage of about 145 members. This study indicates that the annual demand for additional quantity surveyors would be 128, 152 and 172 members in 2013, 2014 and 2015 respectively, while the net annual supply would only be 38, 31 and 19 members in 2013, 2014 and 2015 respectively after deducting the retired members. It is clear that the gap between the supply and demand would become wider and wider in coming years as the construction workload will be kept on increasing.

In order to mitigate the manpower shortage, the universities should increase the admission quota for the surveying programme to ensure that there would be adequate supply of fresh graduates to cater for the industrial need. Since education and professional training would take totally at least six years, the increase in surveying students would only be useful in the medium term. In the short term, the HKIS should find ways to help their probationers pass the APC so that there would be more supply of qualified members. In this regard, the HKIS should organise some specific APC training courses (including the mock APC) in addition to the normal pre-qualification structured learning (PQSL) and continued professional development (CPD) seminars. In addition, the employers should also strengthen the on-job professional training for their young surveyors to ensure that they would undergo an adequate training to cover all required competency areas before attending the APC. It is noted that if half of the current probationers could pass the APC, it would be adequate qualified members for serving the construction industry. However, if the above measures still could not resolve the manpower shortage, it would be necessary to import some foreign quantity surveyors. Finally, the manpower supply and demand should be continually monitored so that an appropriate action would be taken to remedy the situation.

Due to the data limitation, this study is based on an assumption that local quantity surveyors would primarily serve the local construction industry. Nowadays, many local quantity surveyors are actually working in projects located in the Mainland China, Macau, Middle East and other countries. In the short term, this could be considered as a constant in the statistical estimate. However, as the globalization trend would increase, more and more quantity surveyors would work on overseas projects. This additional manpower demand should not be neglected and would be a good area for future study, subject to the availability of reliable data.

Traditionally, researchers spend a considerable effort to develop the best all-purpose forecasting model (i.e. one that can forecast all situations accurately). However, in order to overcome the data limitation problem, this study has adopted a different approach where various theoretical models are reviewed at the beginning, and the model that produces the most accurate result is chosen for carrying out the forecast. This study has demonstrated that the traditional goal for the development of all-purpose forecasting model may not be achievable and that some approaches are better than others in particular circumstances. A simple forecasting model may perform better than an advanced model. In addition, most statistical models are only appropriate for forecasting the aggregate manpower demand of individual industry. There are also few previous studies based on a specific occupational manpower. Therefore, this study has contributed to a better understanding of the theory and practice in forecasting specific occupational manpower in the construction industry.

Acknowledgement

I would like to thank the HKIS for providing the relevant membership statistics for this study.

References

- Ball, J. and St Cyr, E. (1966) 'Short-term employment functions in British manufacturing', *Review of Economic Studies*, **33**, 179-207.
- Ball M. and Wood, A. (1995) 'How many jobs does construction expenditure generate?' *Construction Management and Economics*, **13**, 307-318.
- Beenstock, M. and Warburton, P. (1982) 'An aggregative model of the UK labour market', *Oxford Economic Papers*, **34** (2), 253-275.
- Briscoe, G. and Wilson, R. (1993) *Employment forecasting in the construction industry*, Avebury Publishing Co., Hants, England.
- Dhrymes, P.J. (1969) 'A model of short-run labour adjustment', in Duesenberry et. al. (eds.), *The Brookings Model: Some Further Results*, North-Holland Publishing Co., Amsterdam, 110-150.
- Evans, G.J. and Roberts, C.J. (1975) 'Short-run employment functions in simulation and forecasting', *Journal of the Royal Statistical Society*, **24** (4), 269-282.
- Gujarati, D.N. and Porter, D.C. (2009) *Basic econometrics*, McGraw-Hill, New York.
- Hong Kong Special Administrative Region Government (2012) *The 2012-13 Budget*, Financial Secretary.
- Maddala, G.S. (2001) *Introduction to econometrics*, John Wiley & Sons, Chichester, England.
- Ng, S.T. and others (2011) *Development strategy for professional resources of Hong Kong's construction and related engineering service sector*, A consultancy study for Development Bureau, the HKSAR Government submitted by the University of Hong Kong in association with the Hong Kong Polytechnic University and Ove Arup Hong Kong Limited, Hong Kong.
- Uwakweh, B.O. and Maloney, W.F. (1991) 'Conceptual models for manpower planning for the construction industry in developing countries', *Construction Management and Economics*, **9** (5), 451-465.
- Wilson, R.A. (1980) 'Comparative forecasting performance of disaggregated employment models', *Applied Economics*, **12**, 85-101.
- Wong, J.M.W., Chan, A.P.C. and Chiang, Y.H. (2005) 'Times series forecasts of the construction labour market in Hong Kong: the Box-Jenkins approach', *Construction Management and Economics*, **23**, 979-991.
- Wong, J.M.W., Chan, A.P.C. and Chiang, Y.H. (2010) 'Construction manpower demand forecasting: a comparative study of univariate time series, multiple regression and econometric modelling techniques', *Engineering, Construction and Architectural Management*, **18** (1), 7-29.