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Projection of Manpower Requirements for the Sarawak Economy

Mohd Khairul Hisyam Hassan, Muhammad Asraf Abdullah, Audrey Liwan

Faculty of Economics and Business, Universiti Malaysia Sarawak Malaysia

Abstract

Through the use of the manpower requirement approach (MRA), this paper attempts to forecast the manpower requirements for the Sarawak economy in 2025. The MRA is used as the method for estimating the manpower as it is contended that the manpower requirement forecast is strongly related to the labour demand. Hence, it can be concluded that the manpower inventory and analysis provide valuable information pertaining to the present and future workers needed at each level. Although the information may not be completely accurate, it is still valuable and useful for providing a basis for the recruitment, selection, and training process. The projection for the manpower requirements in the manufacturing sector clearly shows a high demand. The results reveal that agriculture is the main sector that contributes to the job opportunities in the Sarawak economy while the skilled agriculture, forestry, and fishery workers are the main employment categories for the Sarawak economy in 2025.

Keywords: Manpower, Projection, Sarawak, Economy.

Introduction

Manpower projections or forecasts have been carried out in many countries around the world for more than 50 years. Initially, there was continuous debate about whether or not the work was necessary. In spite of the concerns, most countries have continued to concentrate their resources on such activities on a regular basis. In the early 1990s, several attempts were made to make manpower requirement forecasts. Dekker, De Grip and Heijke (1994), and Beekman et al. (1991) made forecasts for the Netherlands for occupations and types of education. In Denmark, Groes, Larsen and Tranaes (1994) used the manpower requirement model to forecast unemployment. While Heijke (1994) conducted an overview of the current manpower forecasting practices in the UK, Germany, and the Netherlands. In the manpower requirement approach, forecasts are usually made from the future labour market situation in terms of the type of education, for which the demand and supply are forecast separately. The basic assumption of this approach is that the requirement for labour with certain types of education can be recognised. Both the requirements and the supply are forecast and compared. If the supply does not match the requirements, the labour market problems can

91

be predicted. This differential can lead to a shortage or surplus manpower, which, in the pure requirements approach, is known as discrepancies, and have to be reduced by good policies. This is because educational resources are inefficiently used in a surplus, and economic goals cannot be attained in a shortage. With good policies, these gaps, if predicted, will not be a problem in the future.

Manpower projection has many uses. First of all, it helps individuals to choose a career and enables career guidance counsellors to guide and advise students and other job seekers on future employment prospects. In addition, it enables decision-makers who are responsible for education and training to decide which types of education and human resources training should be financed. Thus, manpower projection also provides information for managers to see the possible skill shortages. Manpower projection is a guide to both public and private spending on education training to monitor the labour markets and training incentives. Whereas the information that manpower planning brings is important for improving the efficiency of the resources that are used in training skills. The information is essential as a guide to the public and private training decisions and the management of training systems. There are many techniques in manpower planning, but, above all other techniques, manpower requirement forecasting is the most used by many researchers. Thus, the purpose of this study is to forecast future manpower requirements in the Sarawak economy. This paper consists of five sections. Section 2 presents a literature review of the theoretical and empirical studies. Section 3 discusses the data and methodology that are used in the empirical analysis. Section 4 presents a discussion of the results followed by the conclusion in Section 5.

Literature Review
Manpower Planning

Manpower planning is a process for determining the requirements for the right number and right skills of the human workforce at the right place and right time to fulfil the present and future needs. There are two objectives of manpower planning. Firstly, to make an assessment of the human resource skills that the economy needs within the specific time frame. Hence, it helps determine to what extent the production of skills will match the estimated demand and can suggest the possible estimation to reduce the supply-demand imbalance. Second, it provides an analytical framework for manpower planning that can serve as a guideline for educational planning, and to make appropriate investment for training, education, and manpower development. Manpower planning is needed by each organization around the world. Organizations have their own goals to accomplish, and, hence, human resources are required to achieve their organizational goals. These can be accomplished through effective manpower planning. Moreover, comprehensive manpower planning helps to maximise the effectiveness of human resources. In any organization, workers who have grown old or even resign, retire, or are on sick need to be replaced and new workers have to be recruited. This can be done through manpower planning. Identifying the surplus and shortage of manpower or balancing the manpower is essential in organizations. In brief, manpower planning can provide the right size and structure of human resources that accommodate the basic infrastructure for the smooth management of an organization. Also, it helps in minimizing the cost of employment and eliminating the effects of disruptions in developing and utilizing the human resources.

Using the 'rate of return' analysis in investment in education provides a different approach to manpower planning. With this approach, the priorities are given to investment in human capital, which is determined in the same way as priorities are given in the direction of the highest rate of return. Basically, in physical investment an educational investment has a cost and benefit. The benefits are in the increased earnings obtained from training and education. While the cost consists of the range of items linked to the investment, such as workers' salaries, rent on buildings and equipment, and foregone earnings. The difference is made in the social and private rate of return as individuals and society have to measure the costs and benefits differently. An indication is given of the future demand of different types of education, in which the social and not private rate of return is directly used in determining priorities.

There are major problems associated with implementing the cost-benefit approach in manpower planning, especially in determining the costs and benefits. While these problems continue, there is a considerable body of literature on the estimation of the social and private rate of return by educational level and by type of specialisation. The first problem is that the rate of return to invest in education is commonly higher than the alternative rate of physical capital. Then, in less developed countries the returns for education are higher and there is a narrower base of education. Third, among all the educational levels, the returns for primary education are the highest. Last but not least, the private returns are more than the social returns, especially at the university level. In the manpower requirements approach, forecasts are usually made from the future labour situation concerning the type of education in terms of the demand and supply, which are forecast separately.

Labour Skills
It is essential to recognise that there are significant differences between countries in their approach, especially in terms of their anticipation of future labour skill requirements. Such distinctions reflect the differences in the cultural, historical, and institutional background, and influence the general approach to labour skills. Furthermore, more specific differences are associated with data availability. By using the manpower requirements approach, Ismail and Jajri (2002) forecast the future manpower requirements in Malaysian agriculture based on the industry from 1997 until 2001. They found that the demand is high for manpower in the manufacturing industries that deal with cork, wood, and rubber. Nevertheless, labour skills, such as engineers and technicians, are less needed in agriculture-based industries compared to the non-agriculture based industries. As similar to the previous study, Poo et al (2012) found that the amount of labour required to produce the same unit of output over a period has decreased and output growth is faster than employment growth, implying an increase in labour productivity in the manufacturing sector and other sectors, especially in the high skilled categories. Recently, Sulaiman (2017) stated that Malaysia has great potential to increase its domestic demand and exports to other countries in the economic region due to the high capacity of final demand between the subsectors of the manufacturing sectors. The main concern in his study is the share of skilled labour by occupational type. Type 1 (skilled labour) and type 2 (medium skilled labour) skills occupation both show expansion in 2020.

Education

The most well-known manpower forecasts are the manpower requirements approach adopted in the Mediterranean Regional Project (Parnes, 1962), which are usually based on the insights for an optimal economic development and not where one specific type of education has to be stimulated. However, certain optimal mixtures of the type of education exist that would complete each other. This situation will lead to the practice of making the forecasts of demand and supply for each educational category separately and use the gaps between the supply and demand as a guideline for educational planning. Many researchers have criticised the manpower requirement approach. Most of the criticisms are that the manpower planning approach ignores the possibility of substitution between different types of educated labour. For example, if there is a surplus of one type of labour and a shortage of another, a substitution process will occur and people with a certain educational background will move to different occupations than initially might have been expected. As stated by Bean (1991), the adjustment processes limit the extent of mismatch-unemployment. Also, there are doubts about the basic assumption of the manpower planning approach. According to Blaug (1967), the approach is based on the Leontief production function, which is too inelastic to be able to describe the labour market development accurately. Besides that, concerns have been increasing about the potential outcomes to make projections that are sufficiently accurate to construct the entire educational planning upon. Also, there have been questions about the ability of governments to control the educational market based on these plans. Continually mediating, markets are not capable of uncovering the value of certain types of educated labour, which, in the long run, further hampers the planning process.

In spite of these developments, policymakers continue to analyse the relationship between education and the labour market in terms of shortages and surpluses. If they continue to use manpower planning methods, it might indicate the naivete of the policymakers, however, it may also indicate that even in the context of flexible labour markets, manpower planning is still a valuable approach. According to Borghans (1993), providing information for educational guidance can enhance the functioning of the market mechanism, since students are able to adjust their human capital investment decisions to the labour market development. Moreover, if education choice is controlled by a free market, governments have to be informed about the directions of these developments. Education is generally seen as an essential factor for the economic performance of a country. Development of the educational structure of the labour force is regularly regarded by the government as a matter of concern. As stated by Blaug "educational planning by the State with the reason of promoting economic objectives is now as universally approved as economic planning itself. … The concept of 'forecasting manpower requirements' today the leading approach is throughout the world for integrating educational and economic planning" (1972: 137). There are two objectives of educational forecasts. First, they are vital for the government to predict the expected changes in the education field. Since the government is frequently an important investor in the educational system, significant information about these changes could enable it to adjust these investments in time. Forecasts are also viewed as relevant for the government in light of the expected shortages or surpluses, and, hence, they empower a policy that will adjust these discrepancies between the demand and supply. In a free market economy, it is not the government that controls the investment decisions in human capital, but the students themselves who are free to make an educational choice. Students can use manpower

forecasts as relevant public information. According to Borghans (1993), the provision of labour market forecasts can help students in making education decisions and thus reduce the mismatch of demand and supply.

Methodology and Data
Input- Output Industrial Labour Model
In the input-output approach, the balance equation can be written as:

$X = AX + F$

Where

F is the vector of final demand

X is the vector of sectoral output

A is the technical coefficient matrix

Solving the balance equation for X, we obtain:

$X = (I-A)^{-1}$

Let $R = (I-A)^{-1}$

Where $R = (r_{ij})$ is the Leontief inverse matrix.

We may write equation (1) as $X = RF$.

In this study, industrial labour can be thought of as being distributed in certain proportions across all the industries. We can estimate the impact of any change in final demand on the level of total industrial labour in the economy by using equation (2). The row vector of n labour coefficient, l_t, is derived (each element that depicts the number of workers needs to produce a unit of industry i's output, where $I = 1, 2,…n$), and the labour coefficient is calculated as follows for each industry:

$l_t = L_i / X_i$

where

L_i = level of labour in industry i

X_i = total output of industry i

L_i = row vector of labour coefficient (i= 1, 2, 3, 4,…n).

Then,

$l_i = [l_1 l_2 l_3 … l_n]$

The level of labour in each industry is inimitably related to the amount of total output produced by that industry. Hence, to find the amount of labour employed in industry i, we just multiply the corresponding labour coefficient, l_i, by the overall output, X_i, of that sector. By totalling the products of the labour coefficients and total outputs of all the industries throughout the economy, we can derive the following expression for the total industrial employment:

$L_T = \Sigma\, l_i X_i$

Where L_T represents the total industrial employment in the economy. From equation (3), in any given year, the following identity also has to hold:

$L = lX$

From the combination of equations (2) and (3) the following expression is:

$L = lRF$

Thus, the labour requirements equation of an I-O production system of *n* sector is:

$$L = l \, (I - A)^{-1} \, F$$

Theoretically and empirically, the most serious supposition in the I-O labour model is the assumption of a single type of labour per sector (labour is homogenous). By ironing out all the differences between the types of employed labour, this assumption directly violates the basic idea of I-O economics, which is structural differentiation (Holub and Tappeiner 1989). Based on the different categories of labour, the most essential of these structural differentiations is certain. The beginning of the model of manpower structural decomposition analysis is with the labour requirements equation of an input-output production system with *n* sectors and *m* occupations of manpower. Meanwhile, the labour row vector coefficient, l_i, has to be extended to an *m* x *n* matrix or manpower coefficient matrix *(H)*. Consequently, the replacement of the labour vector coefficient (*l*) with the manpower coefficient matrix *(H)* yields the equation as shown below:

$$L = H(I - A)^{-1} \, F$$

where

$$H = \begin{bmatrix} h_{11} h_{12} h_{13} \cdots h_{1n} \\ h_{21} h_{22} h_{23} \cdots h_{2n} \\ h_{31} h_{32} h_{33} \cdots h_{3n} \\ \vdots \ \ \vdots \ \ \vdots \ \ \ddots \ \ \vdots \\ h_{m1} h_{m2} h_{m3} h_{mn} \end{bmatrix}$$

Where L is the total manpower requirement column vector by occupations (*m* x 1), measured in workers; H is the manpower coefficient matrix by occupation and by sector (*m* x *n*) with the coefficient measured in terms of workers required per unit output; while F is the final demand vector (n x 1) measured in value terms; A is the technical coefficient matrix (*n* x *n*), which measures the input requirements per unit output in value terms; and *I* is the identity matrix (*n* x *n*).

The Inter-industry Manpower Requirement Model

In 1973, Psacharoupoulos introduced the technique of the input-output inter-industry manpower forecast model, which will be used in the present study. With respect to the modifications of the manpower requirement approach, the main feature of the model developed below links the skill structure of the manpower to the economy as a whole; as shown in equation (6).

In that way, the manpower requirement for *n* sectors can be expressed as:

$$L = H \, (I - A)^{-1} \, (F)^{\wedge}$$

$^{\wedge}$ represents the diagonal matrix of the F vector in the parentheses

In the base year, the manpower coefficient matrix *H* will not be the same as the target year of the projection. To address the change in manpower productivity, we should adjust every element of the *H* matrix. In the present research, manpower productivity is measured by the compounded annual growth rate of labour (π). With the adjustment factor, it reflects the productivity growth of a particular occupation of labour or manpower in that sector. So, equation (7) becomes:

$$L_T = H_{adj} \, (I - A_t)^{-1} (F_T)^{\wedge}$$
$$H_{adj} = b\pi$$

where
L_T =forecast of manpower for n sectors (number of workers)
b =matrix of manpower coefficient in the base year
      (where b = manpower coefficient matrix, H)
π =elements of labour productivity adjustment by sector and category of occupation
$(I-A_t)^{-1}$ = Leontief inverse matrix in the base year
$(F_T)^{\wedge}$ = Forecast of diagonal matrix of final demand

Equation (8) indicates that the labour by occupation estimate for a future period is determined by the growth rate of manpower productivity and expected output level. While the compounded growth rate of labour by occupation (π) will measure the adjustment to the manpower productivity growth. The manpower forecast is carried out under the general equilibrium framework, which allows interactive influences among the sectoral manpower coefficients, sectoral annual growth rate of manpower productivity, direct and indirect inter-industry transaction, and, lastly, the sectoral final demand.

Compounded Annual Growth Rate of Labour
The used of the compounded annual growth rate of labour is to obtain the labour productivity adjustment. The function takes the simple form of:

$$W^t_{jm} = W^0_{jm} (1 + \pi)^n$$

$$\left(\frac{W^t_{jm}}{W^0_{jm}}\right)^{\frac{1}{n}} = 1 + \pi$$

$$\left(\frac{W^t_{jm}}{W^0_{jm}}\right)^{\frac{1}{n}} - 1 = \pi$$

$$\pi = \left(\frac{W^t_{jm}}{W^0_{jm}}\right)^{\frac{1}{n}} - 1$$

where
    W^t_{jm} = labour coefficient in sector j by category of occupation m for terminal year
    W^0_{jm} = labour coefficient in sector j by category of occupation m for initial year
    N = difference between the terminal year and initial year

Data Description
This study uses two kinds of data. Firstly, the data is unpublished data on the number of persons engaged in the Sarawak economic sectors collected from the Department of Statistics, Malaysia (DOSM). These data were for the years 2005 until 2015. Secondly, the data for the final demand in year 2015 were collected from the DOS and input-output table for Malaysia. As mentioned earlier, the data are classified into the labour occupations according to the Malaysian Standard Classification of Occupations (MASCO) 2008. The MASCO is basically related to the International Standard Classification of Occupations published by the International Labour Organization.

Empirical Results

The input-output model enables us to evaluate the performance of the economy, particularly labour, in the expansion in the economic growth for the region or country. Hence, this paper attempts to estimate future manpower productivity by taking into account the direct and indirect technical change and changes in the final demand structure that influence the future manpower requirements. The final result in manpower forecasting will be the number of workers employed by various categories of occupation in the future. In Table 1, the agriculture sector was viewed as the most important sector in generating the total manpower for the Sarawak economy with a total manpower value of 0.455 million people in 2025, representing 28.47 per cent of the overall total manpower in the economy. The main activities in this sector that contributed most to the total agriculture manpower were forestry and plantations. On the other hand, other sectors in Sarawak also showed a significant contribution to the overall total manpower behind the agriculture sector. For instance, wholesale contributed about 0.275 million people (17.2 per cent), government with value of 0.223 million people (14 per cent), and manufacturing with value of 0.214 million people (13.4 per cent).

Table 1 Number for Employment by Economic Sector in Sarawak, 2005-2025 ('000)

Sector	2005	2010	2015	2025*
Agriculture	276.10	298.50	304.40	455.62
Mining	6.10	10.30	21.70	15.95
Manufacturing	107.40	139.10	132.20	214.32
Construction	83.90	98.70	134.70	148.09
Utility	4.80	11.10	12.50	17.17
Wholesale	174.00	178.50	249.20	275.17
Finance	45.00	56.80	83.80	87.82
Other Services	90.40	106.20	116.60	162.25
Government	123.30	146.20	159.60	223.76
Total	911.00	1,045.40	1,214.70	1,600.15

Source: *Estimated by Authors

In a different analysis, Table 2 shows the total manpower requirement in Sarawak by employment category in 2025. Group 6 had the highest employment in the Sarawak economy with a value of 0.388 (24.26%) million people and the major sector that contributed to this value was the agriculture sector. This also shows the improvement in the technology in this sector. Group 5 and group 7 were ranked second and third highest employment in Sarawak with values of 0.199 million (12.50 per cent) and 0.197 million (12.34 per cent), respectively. Agriculture also contributed the most to these groups in the Sarawak economy.

Table 2 Projected Manpower Requirements in the Sarawak Economy, 2025 ('000)

Sector	Employment Category								
	1	2	3	4	5	6	7	8	9
Agriculture	24.73	21.91	53.20	39.05	56.94	110.29	56.23	43.23	50.03
Mining	0.86	0.76	1.86	1.36	1.99	3.91	1.97	1.51	1.75
Manufacturing	11.57	10.24	24.99	18.30	26.76	52.26	26.43	20.27	23.49
Construction	8.12	7.20	17.34	12.77	18.54	35.36	18.31	14.13	16.32
Utility	0.92	0.82	2.00	1.46	2.14	4.20	2.12	1.62	1.88
Wholesale	14.84	13.15	32.08	23.49	34.36	67.13	33.93	26.03	30.16
Finance	4.73	4.19	10.23	7.49	10.96	21.47	10.82	8.30	9.62
Other Services	8.80	7.80	18.94	13.90	20.28	39.30	20.02	15.39	17.81
Government	12.12	10.74	26.12	19.16	27.96	54.28	27.61	21.21	24.56
Total	86.69	76.81	186.77	136.99	199.94	388.21	197.43	151.68	175.62
	5.42%	4.80%	11.67%	8.56%	12.50%	24.26%	12.34%	9.48%	10.98%

Note: (1) Manager, (2) Professionals, (3) Technicians and Associate Professionals, (4) Clerical Support Workers, (5) Service and Sales Workers, (6) Skilled Agriculture, Forestry and Fishery Workers, (7) Craft and Related Trade Workers, (8) Plant and Machine-Operators and Assemblers, (9) Elementary Occupations

Conclusions and Recommendations

The purpose of this study was to forecast the future manpower requirements in the Sarawak economy, which consists of nine sectors (agriculture, mining, manufacturing, construction, utility, wholesale, finance, other services, and government sectors) and various categories of occupation. This study is important to see whether or not the number of employment opportunities we have today is sufficient, and, use this as a reference to predict the manpower requirements in future. Furthermore, projected manpower is not only based on targets output but also on worker's productivity improvement. Therefore, the findings show that agriculture will provide more job opportunities in 2025 with a value of 0.455 million people. For the employment category, group 6 recorded 0.388 million people in 2025 and our projection of manpower requirements clearly shows that there will be heavy demand for skilled agriculture, forestry and fishery workers. So, for the future economic growth and planning, policymakers should focus on the supply of labour, which is crucial to meet the employment requirements in the future. This can be achieved through a good education and training system particularly in the agriculture related sectors to Sarawak's economy by using a new technology and facilities in order to improve the worker's productivity in this sector. In a nutshell, future research can consider the labour productivity improvement adjustment factor by estimating elasticities of labour with respect to output for various sectors and employment categories.

Corresponding Author

Mohd Khairul Hisyam Hassan
Faculty of Economics and Business, Universiti Malaysia Sarawak (UNIMAS)
Email: hmkhisyam@unimas.my

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