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Manpower Requirements of Malaysian Manufacturing Sector under the Third Industrial Master Plan

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Abstract: Malaysia's competitive position is being challenged by emerging economies such as the People's Republic of China, India, Central European countries and Latin America. To enhance its competitiveness, the nation needs to increase its availability of skilled and knowledge workers in major categories. However, the present mismatch between the supply and demand for skilled workforce will need to be resolved. Hence, several aspects of manpower must be given priority in development planning to ensure that the manufacturing sector continues to contribute towards maintaining Malaysia's overall global competitive position. This paper attempts to forecast future manpower requirements in industry by different occupational categories under the Third Industrial Master Plan(IMP3). For this purpose, unpublished data from the manufacturing survey and Malaysia input-output table will be utilised. The method of forecasting is based on the manpower requirements approach (MRA). The results of our analysis show 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.

Keywords: Forecasting, Industrial Master Plans, manpower, manufacturing, occupation
JEL classification: J21, J24, J23.

1. Introduction

The manufacturing sector in Malaysia has experienced rapid structural change in its production process and the process is expected to continue as we move towards a high value-added economy. From techniques of production that were labour intensive, we have gradually shifted to more capital intensive production methods that require upgrading in the skills composition of its labour force. Consequently, the structure of labour demand in the economy has also changed, favouring more professional and skilled labour (Rahmah and Idris 2001; Rahmah and Idris 2002a; 2006). It is therefore important to give some focus

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on aspects of manpower planning in line with the priority given to it in the development planning of the country if we are to continue ensuring the manufacturing sector maintains its overall global competitiveness. In the Third Outline Perspective Plan (OPP3, 2001-2010), Ninth Malaysia Plan (RMK 9), 2006-2010 (Malaysia 2006) and the Third Industrial Master Plan (IMP3), 2006-2020 (MITI 2006), labour in the economy is projected based on average annual growth of labour (historical data on labour) and output targets. While projection of labour for 2010 in IMP3 is presented by sector only and projection of manpower for 2010 in OPP3 is presented by occupation only for the whole economy, the present study will add to the above plans by projecting manpower requirements by sub-sector and occupation categories. Projecting manpower requirement is normally based on the past trends of labour and manpower productivity. Therefore, the present study will first estimate future manpower productivity, taking into account direct and indirect technical change and then determine how changes in the final demand structure influence future manpower requirements.

This paper is organised as follows. Section 2 provides a review of literature, while Section 3 begins with a definition of manpower planning and employment classification. Section 4 presents the human resource requirements in IMP3. The MRA method together with its analytic framework and source of data will be discussed in Section 5. Section 6 will present the empirical results and projected manpower requirements by sub-industries and occupational categories in the manufacturing sector. The concluding remarks will be presented in Section 7.

2. Literature Review

2.1 Manpower Projection

For a number of decades, economists have disagreed over the need for forecasts of labour by skill and occupational group. Economists of neo-classical inclinations believe that labour markets are flexible, that skill substitution is relatively easy and that wage differentials adjust spontaneously to any imbalances that arise (Papps 2001). In contrast, those who are described as structuralists (Hughes 1991) mention that the labour market is relatively inflexible. Hence, they believe that forecasts of imbalances of demand and supply in some labour markets are pivotal to the development of programmes to ensure that labour is obtainable in the required quality and quantity in each occupation in the future. Occupational forecasts now have two main roles namely, an information role and a policy role (Hughes 1994). Their policy task is to provide information on labour trends for broadly defined occupational groups for labour market decision makers. Their information task is to supply data on labour trends for a large number of occupational sub-groups which will make the labour market more transparent for school leavers, employers, career guidance counselors and others. These users are interested in having occupational forecasts for educational planning purposes so that training programmes can be regulated to ensure that excess supply or demand do not appear for particular occupations and the intake of students into different levels of education is balanced.

2.2 Manpower Requirement Approach

According to Papps (2001), the major objectives of labour forecasts now are to (i) provide information on the current state of labour markets and expected changes; (ii) evaluate the effects different policies might have on the level; and (iii) identify the implications of existing occupational trends and structure of labour in the future. Boothby *et al.* (1995) also believe that the aim of occupational forecasting should be to project *ex ante* imbalances between labour demand and supply across occupations and therefore “contribute to increasing the average rate of return to education by securing a better match between skills that are supplied and demanded.”

As noted by Psacharopoulos *et al.* (1983), a wide range of planning techniques are available to manpower planners. However, one technique above all others has become synonymous with manpower planning: the Manpower Requirement Approach(MRA) or Manpower Requirement Forecasting. MRA was developed for one of the first manpower planning projects in the Mediterranean Regional Project initiated by the OECD in the early 1960s. In those days, the idea was to use forecasts for planning purposes. Given economic targets such as the growth path of the economy, labour requirements in terms of various qualifications and occupations were derived. Compared with rather simplistic projections of the supply side of the economy, this approach was to assist policymakers in the determination of training and education policies necessary to achieve the targets for economic growth (Neugart and Schomann 2002). Boothby *et al.* (1995) observed that the manpower requirement approach considers the level and composition of economic activity to be the main determinants of occupational requirements, assuming a relatively fixed production technology.

However, MRA has been widely criticised especially on its assumption of a fixed relationship between the quantity of goods and labour (Adams *et al*. 1992). The fixed relationship between labour and the quantity of goods produced is not borne out in practice. Furthermore, goods and services can be produced with more or less labour of different kinds as dictated by economic conditions and the relative prices of capital and labour. Manpower requirement ratios do change in response to economic circumstances. The second essential assumption in MRA is that the elasticity of substitution between different kinds of labour is equal to (or near) zero (Hopkins 2002).

According to Schultz (1988), although models of manpower requirement have lost favour among economists, this perspective preserves considerable followers among policy makers and other practitioners. Manpower forecasts are still utilised in many parts of the world especially for setting long-term quantitative targets for educational systems. Models of manpower requirement are useful in providing an objective description of the economic scarcity of the specific skills that the educational system contributes to produce. MRA also offers information where priorities can be set with the goal of maximising returns from resources and distributing these returns to individuals equitably.

According to Zakariah and Siti (1997), manpower forecasts can be used as an aid to educational planning. The forecasts feed into educational decision-making directed towards the formulation of immediate employment policy. They used MRA to forecast manpower requirements in Malaysia for year 2000 by using unpublished data on the number of persons engaged in the manufacturing industries. Their study concluded that by the year 2000 there may be a substantial deficit of skilled technical and professional expertise needed to support industry. They also claimed that too much money is being spent in Malaysia on educational administration and not enough on technical and vocational education. A variety of government programmes are designed to redress the skilled manpower imbalance, but there will always be manpower disequilibrium in a dynamic economy.

In another major study, Rahmah and Idris (2002a) forecast future manpower requirements in Malaysian agriculture-based industries for 1997-2001 by using MRA. They found that for the period 1997 to 2001, the types of industries that demand high manpower are manufacturing firms that deal with wood, cork and rubber. However, skilled labour such as engineers and technicians are less required in agriculture-based industries compared to the non-agriculture based industries.

3. Manpower Planning and Employment Classification

Manpower planning is basically concerned with securing the right number of people with the right qualifications for the right jobs at the right time (Ritcher 1984). The most popular approach begins with a conditional projection of manpower needs given sectoral output forecasts. According to Amjad (1985), manpower planning has two objectives. The first is to make an assessment of the skilled human resource needs of the economy during a specific time period (say a five-year plan). The second is to provide an analytical framework for undertaking human resource planning which will help identify the skills requirements for educational planning and the making of appropriate investments in education, training and manpower development.

As skills is a multi-dimensional concept, direct measurement is difficult. In empirical work, proxies for skills are often used. Two methods are frequently used to separate aggregate labour into different components. First, one uses job or occupation classifications to create proxies for skilled and unskilled labour, and the other employs educational characteristics to measure skills (Poo 2006).

In order to make the data comparable with the Malaysia Standard Classification of Occupations in the Labour Force Survey Report published by the Department of Statistics, Malaysia (DOS), the present paper classifies the labour occupations according to the Dictionary of Occupational Classification (DOC) (see Table 1). The DOC is fundamentally aligned to International Standard Classification of Occupation published by the International Labour Organisation (Poo 2006).

Table 1. Employment classification

Group 1	Professional Technical and Related Workers
Group 2	Administrative and Managerial Workers
Group 3	Clerical and Related Workers
Group 4	Sales Workers
Group 5	Service Workers
Group 6	Agriculture, Animal Husbandary and Forestry Worker, Fishermen and Hunters
Group 7	Production and Related Workers, Transport Equipment, Operator and Labourers

Source: Poo (2006)

4. Human Resource Requirements in the Third Industrial Master Plan (IMP3)

During the first five years of the Plan period, overall employment in the economy is expected to increase by an average annual growth of 1.9 per cent, from 10.9 million in 2005 to 12 million in 2020. The services sector will continue to be the largest source of employment, accounting for 52.2 per cent of the total employment by 2010, while the manufacturing sector accounts for 30 per cent (Table 2). For the period 2011-2020, total employment is expected to register higher growth. This is in tandem with the anticipated expansion in the economy, particularly the manufacturing, services and construction sectors which are expected to contribute more than 95 per cent of the GDP in 2020.

Employment share in the agriculture sector is estimated at 11.1 per cent in 2010. There will be greater need for a skilled workforce as the sector is targeted to become knowledge-intensive and commercially driven. Among the categories of skilled workforce required are agricultural and soil scientists, botanists, herbalists and aquaculture and organic farming specialists. The application of high technology planting methods and mechanisation will enhance the productivity of the sector and reduce dependency on unskilled labour (MITI 2006).

To facilitate achievement of the macro-target of the human resource requirement in IMP3, a strategy of developing innovative and creative human capital has been set. The availability of the required talents and expertise by both manufacturing and services sectors will become important as industries and services move towards a more knowledge-based operating environment. Strategies to meet the required talents and expertise include the following:

1. Matching the supply of talents and expertise with market requirements.
2. Increasing the supply of technically-skilled, knowledge-intensive and ICT-trained workforce.

Table 2. Employment by sector (2005-2010)

Sector	2005 ('000 person)	2010 ('000 person)	Average annual growth 2006-2010 (%)	Share of total employment 2005 (%)	Share of total employment 2010 (%)
Total Employment	10,897.8	11,976.0	1.9	100.0	100.0
Manufacturing	3,132.1	3,594.7	2.8	28.7	30.0
Services	5,554.7	6,248.1	2.4	51.0	52.2
Agriculture, forestry and fishery	1,405.7	1,323.8	-1.2	12.9	11.1
Construction	759.6	764.7	0.1	7.0	6.4
Mining and quarrying	42.7	44.7	0.9	0.4	0.4

Source: Third Industrial Master Plan (2006-2020)

3. Encouraging greater collaboration between training institutes and industry to optimise the utilisation of available resources and facilities.
4. Emphasising a higher level of creativity, innovation and other enabling skills in the educational, and technical and vocational training systems.
5. Creating a critical mass of local experts in scientific and engineering fields to meet R&D requirements.
6. Rationalising laws and regulations to provide greater flexibility and mobility in employment.

5. Methodology and Data Sources

5.1 Input-Output Model

In the input-output approach, the balance equation can be written as

$$X=AX+F \qquad (1)$$

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

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

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

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

We may write equation (1) as $X=RF$. (2)

5.2 Input-Output Industrial Labour Model

Industrial labour can be thought of as being distributed in certain proportions throughout all industries. Using equation (2), we can estimate the impact of any change in final demand on the level of total industrial labour in the economy. By deriving a row vector of n labour coefficients, l_i (each element of which depicts the number of workers required to produce a unit of industry i´s output , where $i = 1\ldots\ldots n$) , the labour coefficient is therefore, calculated as follows for each industry:

$$l_i=L_i/X_i$$

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……..n).

Then

$$l_i = [l_1\ l_2\ l_3 \ldots\ l_n]$$

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

$$L_T = \sum_{i=1}^{n} l_i X_i \tag{3}$$

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

$$L = lX \tag{4}$$

By combining equations (2) and (4) the following expression is arrived as

$$L = lRF$$

Thus the labour requirement equation of an I-O production system of *n* sector is

$$L = l(I - A)^{-1} F \tag{5}$$

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 differences between types of employed labour, this assumption directly violates the basic idea of I-O economics, that is, structural differentiation (Holub and Tappeiner 1989). The most important of these structural differentiations is certainly based on the different categories of labour. The model of manpower structural decomposition analysis begins with the labour requirement equation of an input-output production system with *n* sectors and *m* occupations or manpower. Labour row vector coefficient l_i have to be extended to an *m* x *n* matrix or manpower coefficient matrix (*H*). Thus, the replacement of labour vector coefficient (*l*) with manpower coefficient matrix (*H*) yields the equation shown below:

$$L = H(I - A)^{-1} F \tag{6}$$

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

5.3 The Inter-industry Manpower Requirement Model

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

Thus, the manpower requirement for n sectors can be expressed as:

$$L = H(I - A)^{-1} (F)^{\wedge} \quad (7)$$

^ denotes the diagonal matrix of the F vector in the parentheses

The manpower coefficient matrix H of the base year will not be the same as that of the target year of the projection. In order to take into account the change in manpower productivity, we should ideally adjust every element of the H matrix. In the present research, manpower productivity is measured by compounded annual growth rate of labour (π). The adjustments factor reflects productivity growth of a particular occupation of labour or manpower in that sector. Thus equation (7) becomes

$$\hat{L}_T = H_{adj}(I - A_t)^{-1}(F_T)^{\wedge} \quad (8)$$

$$H_{adj} = b\pi$$

where

$\hat{L}_T$ = 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 and

$(F_T)^{\wedge}$ = forecast of diagonal matrix of final demand

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

5.4 Compounded Annual Growth Rate of Labour (π)

Compounded annual growth rate of labour was used to obtain the labour productivity adjustment. The function took the simple form of

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

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

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

$$\pi = \left(\frac{W^{t}_{jm}}{W^{0}_{jm}}\right)^{\frac{1}{n}} - 1 \qquad (9)$$

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

5.5 Data Sources

This study utilised two kinds of data. The first set of data is unpublished data on number of persons engaged in the manufacturing industries classified by Malaysia Industrial Classification (MIC) (DOS 1972) and the Malaysia Standard Industrial Classification (MSIC) (DOS 2000) at 5 digits collected from the DOS. These data were for the years 1978 and 2000. The unpublished data for final demand in year 2010 were collected from Economic Planning Unit (EPU). As mentioned earlier, we classified the labour occupations according to the DOC, in order to make the data comparable with the Malaysia Standard Classification of Occupations in the Labour Force Survey Report (Ministry of Labour 1972)

The second set of data used Malaysia's Input Output tables for 1978 and 2000 published by the DOS. The input-output data have been aggregated and reduced to 32 x 32 dimensions, covering all 31 manufacturing industries/commodities and single sectors which represent 'other sectors' that include the services, agriculture, mining, construction, and the rest of public sectors (Poo 2006).

6. Results and Discussion

The input-output model enables us to evaluate the performance of the economy in terms of the amount of primary factors required, particularly labour, to deliver a given bill of final demand (Zakariah 1991; Zakariah and Chan 1995; Zakariah and Chan 1997; Zakariah and Siti Khairon 1997). Hence this paper attempts to estimate future manpower productivity by taking into account direct and indirect technical change and changes in final demand structure that influence future manpower requirements. The final result in manpower forecasting will be the number of workers employed by various categories of occupation in the future.

Based on Table 3, the manpower projection under IMP3 by using MRA can be seen from the estimated results that summarise manpower requirement for the year 2010 and is projected to increase by 88.4 per cent compared to year 2000. Comparing these results with IMP3 published by Ministry of International Trade and Industry (MITI 2006) and under the projection of the Ninth Malaysia Plan (2002-2010) (Malaysia 2006), there are differences in the data for total manpower requirements in the economy, and total manpower requirements in the manufacturing sector, but the differences are not too wide as shown in Table 4. The estimated results, as reported in Table 3, indicate that total manpower requirement projection

Table 3. Projected manpower requirements 2010 (number of persons)

Sector	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Total
Meat diary products	2352	848	1561	141	615	0	18137	23654
Veg fruit (Preserved food)	919	481	828	172	319	0	16470	19189
Oils and fats	22154	1601	6164	75	6561	0	95828	132383
Grain mill products	4638	816	4867	713	1893	0	22907	35834
Bakery, confect. products	2518	772	1878	1666	1452	0	29589	37875
Other foods	5164	1723	5079	2274	3708	0	47252	65200
Animal feed	1297	326	1274	4	623	0	4673	8197
Beverages	975	298	319	60	238	0	5143	7033
Tobacco	942	521	548	724	215	0	12384	15334
Textile products	6075	969	2248	399	4434	0	37894	52019
Wearing apparel	6735	943	4677	5539	4794	0	101851	124539
Wooden products	10143	2303	5304	522	3449	0	203644	225365
Furniture & fixtures	2909	1119	2341	548	533	0	56312	63762
Paper & printing products	12511	4384	11255	436	3456	0	82864	114906
Industrial chemicals	12396	2695	3418	5	1516	0	21721	41751
Paints and lacquers	1845	499	1021	0	190	0	5411	8966
Other chemical products	2193	533	1373	99	145	0	9475	13818
Petroleum, coal products	2855	788	631	1	132	0	13119	17526
Processed rubber	2153	368	1507	10	1392	0	25182	30612
Rubber products	9171	1422	3795	44	1190	0	89440	105062
Plastic products	14911	3102	6575	123	2735	0	99614	127060

Table 3. Continued

Sector	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Total
China, glass & clay product	6924	1363	2339	150	1112	0	39328	51216
Cement, lime plaster	2224	309	1191	40	1666	0	6107	11537
Other non-met mineral products	7692	1144	3648	607	3049	0	36948	53088
Basic metal products	35144	7558	13756	4984	6972	0	201072	269486
Other metal products	7798	2274	3098	341	1205	0	45974	60690
Non-electrical machinery	15803	1398	3113	190	858	0	68622	89984
Electrical machinery	48685	8688	10020	20	3547	0	246804	317764
Motor vehicles	5012	2001	1431	108	568	0	34920	44040
Other transport equipment	5928	2883	2110	249	574	0	46770	58514
Other manufacturing products	8578	914	2757	869	1134	0	55279	69531
Other sectors	926074	541928	1070076	1068002	1292560	1117288	2940346	8956274
Total	1194716	596973	1180201	1089114	1352834	1117288	4721081	11252207

Source: Estimated from equation (8)

Table 4. Comparing projected manpower requirements in 2010 under MRA with IMP3 and the Ninth Malaysia Plan

Sector	IMP3 (2006-2020) and the Ninth Malaysia Plan (2006-2010)		Manpower Requirements Approach (MRA)	
	('000)	%	('000)	%
Manufacturing	3,132.1	26.15	2,295.9	20.4
Other sectors	8,843.9	73.85	8,956.3	79.6
Total	11,976.0	100.00	11,252.2	100.0

Source: IMP3 (2202-2010), Ninth Malaysia Plan (2006-2010) and Table 3 in the economy for year 2010 was recorded as 11.25 million workers, while in the IMP3 (MITI 2006) and Ninth Malaysia Plan (Malaysia 2006) projections, it was about 11.98 million workers.

The lower employment forecasts in the present study may be due to labour productivity improvement provided for in MRA. Mathematically expressed as $H_{adj} = b\pi$ in equation (8), the smaller value of π will yield a smaller value of $b\pi$. Therefore, pre-multiplying $b\pi$ with the output targets will also yield a lower projected employment.

Projected manpower requirements using equation (7) which is based on a matrix of manpower requirements in the base year only (assume that occupation matrix H of the base year is the same as that of the target year of projection) will yield higher employment forecasts compared to equation (8) because $H_{adj} = b\pi < H$, therefore $\hat{L}_T < L$.

On the other hand, the manufacturing industry accounted for about 2.29 million (20.40%) of total workers in the economy, while in IMP3 and the Ninth Malaysia Plan, the total was 3.13 million (26.15%) (see Table 4). In that respect, electrical machinery (14%), wooden products (12%), and basic metal products (10%) industries are the sub-sectors in manufacturing industries which contributed highly to the economy. It might be that these industries are labour intensive. For the category of workers, group 7 is the major group of workers in the manufacturing industries sector with 1.7 million with the major contribution coming from electrical machinery, wooden products, and basic metal products, which accounted for 0.24 million, 0.21 million, and 0.20 million, respectively. It is followed by group 1 and group 3 where the workforce is also engaged in the same industries with group 7.

Table 5 shows that during the period 2000-2010, output increased by 6.76 per cent and employment by 1.90 per cent indicating an increase in labour productivity in the Malaysian economy. Within the same period, manufacturing output increased by 7.0 per cent and employment by 4.0 per cent. The higher growth in groups 1, 2 and 7 (professional, technical and related workers; administrative and managerial workers; production and related workers and transport equipment, operator and labourers) indicates a higher demand for skilled workers (groups 1 and 2) as industries shift towards higher valued-added and knowledge-intensive activities. However, demand for group 6 namely agriculture, animal husbandary and forestry worker, fishermen and hunters will see a decline in 2010 compared to other categories of occupation.

A comparison by sub-industries in Table 5 shows that other chemical products, non-electrical machinery, and electrical machinery had a negative growth in employment. This implies that an increase in output required less amounts of labour employed in 2010. With rapid developments in new and innovative products, the industry requires qualified and experienced scientists in various areas. In contrast, three sub-sectors showed no labour productivity improvement (increase in employment higher than the increase in output) namely processed rubber, basic metal products, and meat dairy products industries. It might be due to the labour-intensive nature of these industries. In the long run, these industries must attempt to reduce the labour component and improve productivity by developing and adopting automated production processes. Meanwhile, industries such as bakery, confectionery products, beverages, and other manufacturing products show labour productivity improvement. The move towards more capital-intensive operations and expansion into higher value-added production has seen a greater number of skilled workers being employed to handle more sophisticated machinery in these industries.

Table 5. Annual rate of growth of output and manpower requirements (2000-2010)

Sector	Output	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Total
Meat diary products	8.70	5.77	9.68	4.16	10.24	3.62	-	10.87	9.37
Veg fruit (Preserved food)	6.12	2.89	5.15	2.62	3.41	-1.39	-	7.66	6.75
Oils and fats	12.04	11.67	8.55	8.17	0.73	8.24	-	14.16	12.89
Grain mill products	9.63	16.32	12.42	15.18	13.67	11.16	-	18.10	16.69
Bakery, confect. products	5.43	1.63	0.57	0.51	3.08	-1.48	-	4.87	3.85
Other foods	8.10	8.38	6.90	7.87	7.79	6.74	-	11.66	10.39
Animal feed	13.05	8.45	6.74	7.19	-2.07	4.58	-	9.85	8.54
Beverages	6.43	1.49	2.17	-3.50	2.52	-3.95	-	3.85	2.55
Tobacco	3.78	2.55	6.99	0.60	6.19	-2.12	-	6.76	5.94
Textile products	6.93	-0.43	1.24	-1.02	0.86	1.40	-	1.64	1.21
Wearing apparel	4.60	1.42	-0.50	1.16	5.66	2.23	-	4.28	3.89
Wooden products	6.41	2.10	0.70	-1.10	-2.24	-3.15	-	6.86	5.94
Furniture & fixtures	4.52	-3.51	0.34	-1.57	-6.29	-7.58	-	1.48	0.81
Paper & printing products	10.27	3.80	4.84	1.54	-0.50	-0.33	-	7.00	5.51
Industrial chemicals	8.97	4.13	5.06	1.24	-12.75	-0.05	-	4.75	4.03
Paints and lacquers	8.70	4.89	6.72	2.29	-22.81	- 0.80	-	8.52	6.41
Other chemical products	8.17	-1.48	-0.51	-3.11	-3.48	-10.33	-	0.49	-0.54
Petroleum, coal products	9.01	1.50	10.18	1.24	-15.07	-4.89	-	10.95	7.92
Processed rubber	3.46	12.16	11.26	10.35	3.54	8.58	-	14.55	13.72

Table 5. Continued

Sector	Output	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Total
Rubber products	6.32	2.66	2.45	0.55	-3.74	-1.97	-	5.65	4.94
Plastic products	6.09	1.82	1.64	0.11	-7.04	-2.67	-	3.67	2.96
China, glass & clay products	9.75	3.26	3.02	1.93	-3.34	-3.42	-	4.85	4.11
Cement, lime plaster	14.18	7.68	7.80	8.72	9.67	11.30	-	9.38	9.16
Other non-metal mineral products	12.36	10.13	8.12	8.31	9.73	7.83	-	11.08	10.42
Basic metal products	9.76	9.84	10.17	7.65	9.47	6.52	-	11.75	10.97
Other metal products	10.84	4.15	5.56	1.56	3.38	0.25	-	6.04	5.32
Non-electrical machinery	3.90	-1.88	-6.18	-7.12	-13.82	-10.00	-	-1.70	-2.25
Electrical machinery	4.58	-3.84	-1.11	-6.33	-12.26	-6.80	-	-1.94	-2.48
Motor vehicles	6.93	0.79	3.93	-2.61	-3.40	-6.44	-	3.12	2.38
Other transport equipment	9.19	5.17	11.28	5.36	8.05	0.91	-	12.00	10.52
Other manu-facturing products	5.54	0.21	-2.49	-1.33	4.60	-2.89	-	3.09	2.27
Other sectors	6.68	1.93	5.05	1.85	0.30	1.68	-4.18	4.33	1.45
Total	6.76	1.95	4.86	1.77	0.36	1.64	-4.18	4.43	1.90

Source: Calculated from Industry Surveys and Annual Survey of Manufacturing Industries (unpublished data) and Table 3

Twelve industries in the manufacturing sector have been targeted for greater development and promotion under IMP3. Table 6 shows projected manpower requirements in the resource-based industry, non-resource based industry, other manufacturing industry and other industry. The resource-based industry registered about 1.07 million employed compared to the non-resource based industry of 1.02 million.

The wood-based industry contributed the most to the resource-based industry with 0.40 million, followed by the petrochemicals industry at 0.20 million, and food processing industry at 0.19 million. In the non-resource based industry, the major contributors to job creation were the metal industry with 0.33 million, followed by electrical and electronics industry with 0.32 million. Employment creation in the non-resource based industry is attributed to expansion in the basic metal and metal products industry, as well as electrical and electronics industry. For the other industries group, the increase comes mainly from the services sector, for example, business services and financial services, recording about 8.96 million workers.

By category of occupation, Groups 1 and 7 are the major group of workers in the resource-based industry and non-resource based industry. The total number of highly skilled workers (Group 1 and Group 2), in the non-resource based industry exceeds those of the resource based industry. This is reflected in higher speed factory automation or mechanisation which has seen increasing demand for these categories of workers in the industry as against the resource-based industry.

7. Concluding Remarks

This paper attempts to estimate future manpower productivity, taking into account direct and indirect technical change and how changes in final demand structure influence future manpower requirements. The results of our analysis show that the amount of labour required to produce the same unit of output over a period has decreased and growth of output is faster than growth in employment, implying an increase in labour productivity in the manufacturing and other sectors. Projection of manpower requirements clearly show that there will be heavy demand for professional, technical and related workers and administrative and managerial workers. This finding is supported by the study of Rahmah and Idris (2002a) who state that the types of industries where the demand for manpower is high are the wood and cork products and rubber products. However, skilled labour such as engineers and technicians are less required in the agriculture-based industry compared to the non-agriculture-based industries. In order to meet this demand, more high skilled workers (administrative and managerial workers, professional, technical and related workers) have to be supplied from either the local universities or from abroad.

If we compare our results with the IMP3 and Ninth Malaysia Plan targets, they do not vary significantly. Our analysis is more detailed because projected manpower requirements are done by sub-industries and occupational categories. Furthermore, projected manpower is not only based on targets output but also on labour productivity improvement.

In making forecasts of manpower requirement, we have constructed the labour utilisation matrix. Because of lack of data and time constraints, our study used two points in time (1978 and 2000) to adjust the labour productivity growth. In fact, when calculating the manpower requirements based on targets output, the alternative is using time-series data. Furthermore,

Table 6. Projected manpower requirements (2010) in resource-based and non-resource based industries

Sector	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group7	Total
Resource-Based Industry	109,806	23,752	57,916	6,888	29,524	-	842,109	1,069,994
Petro-chemicals industry	32,006	7,084	11,645	129	4,573	-	139,866	195,303
Pharma-ceutical industry	2,193	533	1,373	99	145	-	9,475	13,818
Wood-based industry	25,563	7,806	18,900	1,506	7,437	-	342,820	404,032
Rubber products industry	11,325	1,789	5,303	54	2,582	-	114,623	135,675
Oil palm-based industry	22,154	1,601	6,164	75	6,561	-	95,828	132,384
Food processing industry	16565	4938	14531	5026	8226	-	139,497	188,782
Non-Resource-Based Industry	131,179	26,715	40,452	11,830	22,952	-	783,908	1,017,036
Electrical and electronics industry	48,685	8,688	10,020	20	3,547	-	246,804	317,765
Medical devices industry	-	-	-	-	-	-	-	-
Textiles and apparel industry	12,810	1,913	6,925	5,937	9,228	-	139,745	176,558
Machinery & equipment industry	15,803	1,398	3,113	190	858	-	68,622	89,983

Table 6. Continued

Sector	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group7	Total
Metal industry	42,942	9,832	16,854	5,326	8,178	-	247,047	330,178
Transport equipment industry	10,940	4,884	3,541	357	1,142	-	81,689	102,552
Other manufacturing Industry	27,657	4,578	11,757	2,394	7,798	-	154,718	208,901
Other industry	926,074	541,928	1,070,076	1,068,002	1,292,560	1,117,288	2,940,346	8,956,274
Total Economy	1,194,716	596,973	1,180,201	1,089,114	1,352,834	1,117,288	4,721,081	11,252,206

Source: Derived From Table 3

there has been a change in code from MIC 1972 to MSIC 2000 since 2000 for the data in manufacturing sector at 5 digits resulting in difficulties in matching the classification. This could affect the quality of data. Given more time and resources, 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.

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