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SOME ASPECTS OF MANPOWER PLANNING IN
JAMAICA - ISSUES AND PROBLEMS

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INTRODUCTION:

The primary objectives of the Manpower Planning and Utilization process are the provision of education, training and productive employment for all persons requiring such services.

Several attempts have been made by Government, to establish institutions and to enact a policy to arrest and solve the persistent problems of the planning training and utilization of human resources.

Unfortunately the success of Manpower Planning in Jamaica has been limited because the planning system which evolved from the colonial period put very little emphasis on manpower planning as an integral part of social and economic planning. As a consequence the collection of sufficient manpower statistics was neglected. In addition, the meagre financial resources has led to insufficient technical expertise and tools with which to attack the problem. More over, the lack of systematic coordination of the various agencies and programmes resulted in a high degree of duplication, waste, disorganisation and an ⁱⁿeffective evaluation and feedback system.

As a consequence ,conditions of insufficient knowledge of the labour market, training needs and other supply and demand developed. The combination of all these problems made comprehensive and integrated manpower planning in Jamaica a myth.

This paper deals essentially with Jamaica's experiences in manpower planning, the problems encountered in the process and measures taken to correct the problems.

Section I deals with the methods used in forecasting manpower requirements. Section II outlines Jamaica's experiences and the problems encountered- An evaluation of the 1970-75 manpower projections and PLEALC study presented. The problems of manpower data availability and utilization are discussed in section III. Section IV examines the main issues which led to the establishment of the Manpower Planning, Training and Employment Project (M.P.T.E.). The trend of future manpower planning activities are highlighted and conclusions drawn.

SECTION I

MANPOWER PLANNING PROCESS AND METHODOLOGY

There is no internationally and rigidly accepted definition of manpower planning. Whatever the differences in definition, or level of planning, it is clear that manpower planning is concerned with matching manpower supply with demand. In Jamaica, at the moment, manpower planning is not fully integrated with the overall development planning process of the country.

The issues related to manpower planning process are diverse. They range from manpower assessment and forecasting to Manpower Action Programmes. The manpower action programmes are dealt with in section IV. The manpower assessment and forecasting is divided into ^{several} / components - The manpower assessment component which deals with Labour Force and Training surveys of house holds and institutions respectively on the supply side; and on the demand side, manpower assessment involves a survey of large and small establishments and the public sector. In order to keep the paper within reasonable limits, these issues wont be discussed here. Instead, attention will be focussed to manpower forecasting methodologies.

METHODS OF MANPOWER FORECASTING IN JAMAICA: A REQUIREMENT APPROACH

In Jamaica, there are four methods frequently used to determine manpower requirements:

- i. Manpower requirement method
 - ii. International comparisons
- Other supplementary methods are:
- iii. Direct questioning or Direct estimates of future needs.
 - iv. Special studies of specific industries

(i) Manpower Requirement Method

The manpower requirement approach is the most supported method of manpower and educational planning, since it treats education as a source of high and middle level manpower and employs rather simple techniques for calculating the skilled labour required to accomplish specific development targets. Here the quantity of skill input per unit of output is used in conjunction with the targets for output growth in projecting future requirements for each skill in each sector. Furthermore, the relationship between absolute labour input and output can be determined, subject to the assumptions regarding magnitude, direction and nature of productivity changes.

(ii) The Second Method is the International Comparisons

This method is used to circumvent the problem of data availability in the local situation. The theoretical justification of the use of data from one country to another is that productivity in an industry is a function of the occupation structure of the same industry regardless of location or national boundaries. This method is particularly used for forecasting the future requirements of new industrial sectors.

(iii) The Direct Estimate of Future Needs

This method consists of appraising employers' anticipations for demand of occupations in their establishments. This type of analysis is used for short-term planning, and, at best, serves as added information to check on other types of projections.

(iv) The Analytical Studies of Special Industries

This method is directed at manpower planning at ^{the} micro-level. This method is limited to a few industries like Auto Mobile, Electronics, Building etc. These studies are used by the Vocational Training and Development Institute (V.T.D.I.) to develop training programmes to meet the manpower requirements to those industries. Since Development Plans are not detailed enough to include plans at ^{the} plant level, this method is not extensively used at ^{the} macro manpower planning. The methodological issues outlined above, form a concrete basis for describing and analysing the Jamaican Manpower Experiences - both at ^{the} micro and macro-level.

SECTION II

THE JAMAICAN MANPOWER EXPERIENCES - MACRO-LEVEL

There have been three (3) major attempts to deal with the Manpower Planning in Jamaica. The first major Jamaican Experience in manpower planning at ^{the} macro-level dates from the late 60' during the preparation of the 1970-75 Five Year Development Plan. The second attempt was in 1976 by PREALC* in collaboration with the National Planning Agency.

* PREALC is an international organisation whose headquarters are in Chile and specialises mainly in studies related to Labour Force in the Latin American Countries. This organisation is linked to the International Labour Organisation.

The third attempt started in 1973 with the establishment of a manpower planning, training and employment project with the objective of establishing an integrated and comprehensive manpower planning system. The details of the activities of the project are dealt with in section IV.

(a) The Five Year Development Plan 1970-75 Experience

The 1970-75 manpower planning exercise aimed at forecasting manpower requirements and supply in the target year in 1975 according to crude occupational categories and industrial sectors. There were eight (8) occupational groups identified for a sixteen (16) sector breakdown of the economy.

Manpower requirements for the year 1975 were forecast for the major industrial sectors by applying alternative output growth targets to an occupational skill matrix of labour requirements conducted by the Manpower Research Unit of the Central Planning Unit (now the National Planning Agency). The data was processed, i.e. classified and tabulated within the Agency. Data for new industries expected was derived from other sources. Projections of government sector requirements were done mainly by extrapolating observed trends.

Manpower supply 1975 was forecast on the basis of the composition of the Labour Force in 1963 as provided by the Department of Statistics on the basis of household surveys. The forecast was based on assumptions regarding attrition due to migration, death and retirement from the Labour Force, accessions to the Labour Force based on alternative projections of population, ^{and} assumptions regarding Labour Force participation rates in the acceding age groups. The occupational/skill composition of the acceding persons were estimated on the basis of the expected output mix of various educational institutions under assumptions of normal growth of these institutions and of the skill mix of returning migrants.

The resulting forecast allowed the estimation of the gap between jobs and persons wanting work, the imbalance between the requirements and availability of various skills, and hence the gap to be filled by increasing the supply through training or by bringing in people on work permits. These projections were not achieved without problems.

Problems:

There were many problems and short-comings experienced in projecting manpower requirements. These are described as follows:

1. The Labour Force Survey used a different occupational skill classification from the Manpower Survey which made it necessary to make adjustments before requirements could be compared with supplies.¹
2. Manpower Requirements were not converted into full time equivalents nor were those wanting jobs asked to indicate how many hours they were willing to work. This resulted in the projection of a job gap which did not say anything about the under-employment.
3. The /Occupational structure of /the Labour Force forecast was very crude due to the imprecision in matching educational output and occupational/skill categories. Furthermore, they failed to take into account on-the-job training and other facilities for skill upgrading.²

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1. In the absence of a standardised classification of occupations the problems was and still is of great significance. We have already experienced the same problem in the pre-testing of the Manpower Survey Questionnaire in August/September 1979. In the PREALC Study the same problem was reported. At present, effort are being made to standardise the classification of occupations.
 2. This is a very serious problem and it may have contributed to the inaccurate projections in labour force supply for the target year 1975 -- see section on evaluation below:
This problem has been corrected. Information on on-the-job training has been collected and will be incorporated into the manpower planning and forecasting exercises.

4. The assumptions about productivity change were admittedly unrealistic because "it was assumed that productivity change would lower the ratio of labour to output without changing the skill mix". Furthermore, capital/ labour ratios were assumed fairly rigid in that while productivity change tended to be associated with rising capital/ labour ratios, the ratio of capital to particular skills required were changed differently for all skills.
5. Finally, no account was taken of the changing skill shortages on the required skill mix.

(b) The second manpower planning experience was in 1976. This was the study by PREALC. This study is fairly comprehensive and brings out clearly a number of problems any manpower planner in Jamaica should expect in attempting to use sophisticated methods which demands a gamut of detailed manpower data.

Methods Used By PREALC In Forecasting Manpower in Jamaica (1976)

According to ^{the}PREALC Study, the methods used for projecting future manpower needs for Jamaica were based on what they called a mixture of elements of the so-called Mediterranean Region Project (M.R.P.) approach as well as historical trends and international comparisons.

The basic assumptions were that "the growth rate of each occupational group in each industry could be determined for the time horizon and that the rates of growth of employment by industry, the rate of labour productivity by industry, and the elasticity that relates to the proportion of a specific occupation group in the employment level of a specific industry to the assumed change in labour productivity in that industry were known. In other words, before the application of the above methods, the growth rate of employment by industry, average labour productivity and the elasticities by each occupational group by each industry must first be determined. (See Appendix A for projection equation).

They further assumed that "the natural growth rate of each occupational group i in sector j could be compounded by the arithmetic sum of the growth rate of employment in sector j plus a component that results from multiplying the corresponding elasticity for occupational group i and industry j , by the percentage change of labour productivity for sector j ." The derived elasticities would then be used to estimate manpower requirements by each occupation i and industry j .¹

Specific growth patterns of value added and employment by detailed sector and occupations were used to project manpower required in the target year. The occupational profile was estimated by using the Zymelman equation (see appendix A for details of the equation).

Problems

The basic problem was the determination of the elasticity of occupational group i in industry j .¹ The times series required to derive the b_{ij} s are scarce and where available were too aggregated; and where disaggregated, for instance, from the census data lacked consistency. All these problems forced PREALC to use b_{ij} s from international sources².

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1. The type of elasticity coefficients are claimed to reflect the influence of technological progress at the industry level, measured by the rate of change of labour productivity on the rate of change of requirements of a specific occupational groups. These elasticities could be derived by relating time series on labour productivity, both by sector and occupation.
 1. The estimates of the b_{ij} s forms the basic problem. They are derived by relating time series of occupational structure to time series on labour productivity, both by sector and occupational. Since time series by detailed occupational groups and industry are scarce - therefore b_{ij} s were derived from international sources. This made the whole exercise a suspect since the b_{ij} s are the basics of the investigation.
 2. Unfortunately the PREALC does not explicitly indicate the countries where data was obtained. But the study mentions that the b_{ij} s were successfully used in the Dominican Republic. It is questionable whether the problems existing in the Dominican Republic were or are similar to those in Jamaica at that time. Moreover we do not know when these b_{ij} s were applied to the Dominican Republic in order to evaluate the success or failure of the methods in that country. These are areas of doubt which are subject to criticism.

The second problem was that there were neither long, medium or short term plans/
the
targets available at/national level. The alternative used, for example trend in
output, employment and occupational structure by sectors during the intercensal
period was full of uncertainties. Equally important, Jamaica has not yet developed
a standardised classification of occupations, therefore, resulting in the occupations
with different meanings and interpretations. Finally data used was
derived by interpolation based on the assumed growth rate in the past.

Since there is no standardised classification of occupations, some
adjustments were made on certain groups of occupations based on subjective
judgement, which is subject to individual interpretation. The methods used in
projecting manpower supplies too, were constrained tremendously by the general
lack of detailed data.

On the supply side, the quantitative historical variables under investigation
were:

1. Labour force by occupation
2. Participation rates by occupation, age, groups and sex
3. Migration by occupation
4. Historical trends of enrollment
5. Transition rates
6. Female participation rates in higher education
7. Drop-out of the educational system
8. New entrants into the labour market
9. Withdrawals from labour force by death and/or retirement

It should be noted however, that detailed manpower data by occupation on
these variables are lacking. Therefore data were generated using linear programming
techniques. With the interpolated data, regression analysis techniques were
applied to estimate future manpower requirements.

(c) The Manpower Planning, Training and Employment Project was established within the National Planning Agency in 1978 in partial response to the problems of manpower data availability. The details of the project's purpose and the spectrum of activities undertaken are discussed in detail in section IV.

A brief quantitative evaluation of the manpower projections for the 1970-75 Development Plan showed mixed success. The projections for the demand for manpower were generally accurate. The relative accuracy ranged between 2% - 15% off the target period. The supply side however, in spite of the broad occupational groups, was inaccurate. The inaccuracies varied between 25% - 40% off the target year.¹ The PREALC Study's projections can be evaluated in 1981.

The problems discussed here are to a large extent related to the problems of data availability, the level of aggregation, inconsistency in the definitions, ^{and} occupational grouping. These and other problems are discussed in detail in section III.

1. The Labour Force Survey 1975 by the Department of Statistics were taken as the actual figures. The projected figures were derived from the 1970-75 Development Plan. Actual supply is derived by adding total employed to unemployed by occupation while the employed represented manpower demand by occupation.

SECTION III

Manpower Data Availability and Utilization

From the above discussion it is clear that any method that demands a gamut of detailed manpower data, at present in Jamaica, is likely to experience problems. A selection of a methods is / usually dictated by manpower data availability. Manpower Statistics have been one of the most neglected area of statistical data collection. The present basic statistical data is inadequate for any but the most rudimentary manpower planning. Before planning with any degree of sophistication can be undertaken, it is necessary to develop a manpower statistics programme to provide the primary inputs.¹

Aggregation of Manpower Data

A brief search into manpower data availability has shown that most, if not all, manpower data published by the Department of Statistics (D.O.S.) are highly aggregated. While aggregated labour market data at major occupational and industrial group level is required for long range planning, there is an equally urgent demand by training, placement, counselling, employment and planning institutions, apart from individuals, for very specific disaggregated data at minor occupational group levels for short range market adjustment.²

¹The NFA is developing a comprehensive manpower statistics programme. In that programme the top priority manpower statistics to be developed will be those used in: (1) employment planning; (2) projections of manpower requirements by occupations; (3) estimation of current and projected training needs; (4) planning of training systems and training projects; (5) developing occupational profiles of individual industries; (6) estimation of productivity trends; (7) regulation of wage rates for particular occupations and industries; (8) assessment of losses or gains for the skilled manpower through migration.

²Therefore if the seminar would wish to discuss the issues related to comprehensive manpower planning, training, employment and methodologies related to manpower forecasting, then emphasis should not only be put on the significance of disaggregated data but also on other limitations such as manpower personnel, funds for developing manpower statistical programmes etc. This will facilitate manpower planners to meet the challenges of the changing needs of the training, education, placement and employment institutions as well as individuals.

Apart from the level of aggregation, the inconsistency in the cross classification of the major data elements need serious consideration. For example in 1972 Labour Force Survey, no occupational classification by industry was given. Deaths were not cross-classified by occupations between 1965-1970.¹ This creates a problem for the compilation of time series from these sources. These two examples do not seek an infinite cross-classification of manpower data/rather a prioritising of these cross-classifications in accordance/^{with} the needs of manpower data users. The problem is exacerbated by/^a lack of standardised definitions and classification systems. L. Taylor found the similar problem with data in the labour force survey. We can do no better than quote him:

"The total labour force consists of employed and unemployed persons, but the data presented in the Labour Force Surveys is such that an independent investigator has considerable leeway in employing his own definitions and grouping the data accordingly".²

These observations were made in 1974, nevertheless their validity is unquestionable today. There are, however, a number of notable improvements that have been made. Where vagueness and imprecision exist, no effort has been spared for correction; and where a change of definition occurred, or vagueness and imprecision persisted, or still persist, data users have been cautioned.³ Such warnings

¹Information on death by occupation is required in the elimination of manpower supply by occupation. This information originates from the Registrar of Births and Deaths. Therefore, there is an urgent need to coordinate all sources of manpower data.

²The size of labour force is determined by the definition that relates to all persons aged 14 years and over not attending school full time during the survey week; and who (1) worked; (2) did not work but had a job; (3) had no job but were actively seeking work; and (4) had no job, did not actively seek work but wanted a job and was available. (discouraged worker.) See report on Human Resources and Manpower 1974. The unemployed are defined by 3 & 4 above. But this definition is controversial in the purview of some authorities in the area of manpower planning. All these definitions were not used consistently until after 1968/69. See pp 4 & 5 1973; p. 8 1974, Labour Force Surveys.

³See Labour Force Surveys 1968/69 p. 2, 1973 p. 2. Efforts in correcting vague and imprecise terminologies, have transcended beyond definitions to the area of sampling. A scientific sample selection was introduced in 1968/69 Labour Force Survey under the continuous social and demographic survey to replace the unscientific samples that existed.

as these below are not uncommon throughout the labour force surveys:

^a
"Labour Force is highly volatile and mobile entity and is very difficult to measure. It is important, therefore, when comparisons are being made, to take into consideration the concepts which have been employed at each enquiry along with the period during which each survey was conducted."¹

Equally important is the standardisation of definitions of occupations.

Lack of Standardised Definitions of Occupations

The lack of standardised definitions of occupations presents a lot of problems especially when dealing with data elements cross-classified by occupations. Since most manpower data are cross-classified by occupation, it is not difficult to imagine the magnitude of problems involved during the coding and tabulation of data.

The rudimentary classifications so far used in Jamaica are based on the International Standard Classification of Occupations (ISCO) developed by the (ILO). The places using modification of ISCO include the Department of Statistics, for the Labour Force Survey and population censuses, and the Ministry of Labour's Employment Exchanges and Ministry of Education for counselling. The NPA used the ISCO without any modification when conducting a manpower requirements survey of the larger establishments in 1967.

The problem with the ISCO is that, as an international classification, it was not designed to suit the need and circumstances peculiar to any one country. Where certain industries exist only in a few countries and are not much known elsewhere, the ISCO is unlikely to include the occupations involved. Again in different parts of the world there may be variations in the set of tasks that make

¹ See Labour Force Surveys 1968/69 p. 2, 1973 p.2. Efforts in correcting vague and imprecise terminologies have transcended beyond definitions to the area of sampling. A scientific sample selection was introduced in 1968/69 Labour Force Survey under the continuous social and demographic survey to replace the unscientific samples that existed.

up the particular occupation. Above all, the ISCO as an international classification cannot attempt any ordering of occupation according to educational and training requirements, physical demands and working conditions, which makes it less useful for training, planning, placement purposes, counselling and personnel management.

The ISCO was in fact intended to facilitate international comparisons of occupational data originally organised according to national classifications which may be designed to be convertible to the ISCO. Actually, the ILO recommends that each country should try to develop its own occupational classification. The very sophisticated "Dictionary of Occupational Titles" developed by the Americans is impracticable for general use in Jamaica.

In response to these problems, the NPA in collaboration with the Ministries of Education, Youth and Sports, Labour, Public Service and Department of Statistics has just completed the updating of the D.O.S. list of occupation titles. The next step is the development of brief definitions for each of the occupational titles as perceived in Jamaica. This will act as a provisional coding manual until the National Dictionary of Occupational Titles based on the list is developed. In other words, the first step towards the solution of the problem is completed. So far we have examined the problems of aggregation and the lack of standardised definitions and concepts, the question is how reliable is the data collected under all these problems? The issues related to manpower data reliability and utilization are discussed in the next section.

Manpower Data Reliability and Utilization

The significance of manpower data reliability as related to manpower planning is unquestionable because the utilisation of any unreliable data, be it manpower data or not, leads to the production of unreliable information thereby defeating the whole purpose of manpower planning. Therefore a clear understanding of data unreliability beforehand will help to determine how the data may be used, and the scope and accuracy of the conclusions that may be derived.

According to the proposed manpower statistics programme, the only reliable and continuous sources of manpower information are:

1. the Labour Force Survey conducted by the Department of Statistics;
2. the monitoring of the annual output of training institutions in the country which is done by the National Planning Agency;
3. a quarterly survey of employment, earnings, and hours which covers the larger establishments in mining, manufacturing, construction and Jamaica Public Service; and
4. the vocational tracer study information on employment of new Secondary School graduates.

Historically, labour force surveys, prior to 1968, with the exception of the 1960 population census, are said to be unreliable. The basic reason stated is "the misgivings about the reliability of the samples which formed the basis of the investigations."¹

¹The Labour Force Survey 1968/69 seems to imply also that other population census data are unreliable. Therefore, if this is true then 1844, 1861, 1871, 1881, 1891, 1911, 1921 and 1943 population censuses data should be used with caution. In any case, it is debatable whether it would be worth the risk of using the unreliable historical series beyond 1960.

Regarding the discreditation of the population censuses prior to 1960, it is contended that labour force data obtainable from census reports had, even up until 1943, been somewhat inexact and not directly comparable because the concepts applied were somewhat vague and imprecise.¹

From the above information, the reliable labour force data dates from 1968/69 surveys and those sources cited above.

Manpower data utilization is a complicated function of the manpower data user. In general, however, any manpower data user would like to see that data: (1) are in proper form, e.g. level of disaggregation; (2) available at the right time; (3) have sufficient number of observations to permit analysis; (4) cover sufficiently the observed phenomena; (5) are reliable; (6) are comparable with other data from different or same source(s). There may be other characteristics expected of data availability, such as cross-classification of data elements, but all these are subjective issues related to the methodology used and the objectives of the planner.

One observation that should be noted however, is that although data adjustment is a normal function of a data analyst, nevertheless, excessive data manipulation should not be encouraged to cover data gaps, as it contributes to the problem of data unreliability, thereby undermining the rationale of manpower planning. It is therefore preferable to use a simple method to suit the available data than to employ a sophisticated method in the hope of manipulating the data to suit the method or model. With this observation, let us examine the issues related to the Manpower Planning, Training and Employment Project since it was established in direct response to all these problems.

¹These problems led to the redefinition of the vague and imprecise concepts and re-designing of the sample, and the subsequent establishment of the continuous Social Demographic Survey CSDS, in 1967/68. See pp 20-25 of the labour force survey report 1968/69.

SECTION IV

The Manpower Planning, Training and Employment Project (M.P.T.E.)

B. Overview of the Project - Its Purpose

The Manpower Planning and Employment Project aims at establishing an integrated and improved manpower development and utilization system responsive to the labour market needs and planning goals of the country. This system will provide inputs aimed at:

- a. improving manpower data gathering on employment availability and seekers;
- b. upgrading the efficiency of occupational skill-training, vocational guidance and job placement services, making them more relevant to labour market needs.

In general the objective of project activities is to upgrade and coordinate the country's manpower planning, training and employment service activities, eliminate duplicative functions and increase the relevance and efficiency of its manpower related services. Ultimately, the goal is to increase the employment productivity. Furthermore, the Project is an inter-agency effort coordinated by the National Planning Agency and involves five other government agencies - the Ministry of Education, Youth, Sports and Community Development, the Ministry of Labour, the Department of Statistics and the Ministry of Finance. Within this inter-agency project are a series of programmes carefully selected to draw all manpower related activities into a comprehensive, integrated system. Appendix B gives a clear outline of the activities of the project and all agencies. The action programmes are designed to meet the shortfalls and dispose of the surplus skills. Diagram 1, gives the dynamics and interrelationships of these activities which aim at improving manpower utilization in the economy.

Essentially, the project activities involve --

- a) the development of techniques and instruments for upgrading all manpower related programmes and services;
- b)
- b) training of staff;
- c) provision of guidelines and recommendations for future planning and coordination of manpower activities.

The objectives of each of these activities are outlined in (additional paper to be distributed at seminar.

CONCLUSION

The paper has dealt with some of the major issues and problems influencing manpower planning in Jamaica. The general problems experienced in other fields of planning also apply to planning in the field of manpower and are at times, exacerbated by the generally weak form of integration of manpower plans and programmes into the national planning process.

If meaningful manpower planning is to be achieved, then attention should be directed to the development of a sound reliable statistical manpower data base. In addition, the needs of Data Users and producers should be carefully considered, if the manpower information which is difficult and costly to collect is to be maximised in the planning process.

The manpower planning experience in Jamaica has shown that the demand for certain skills have not always been balanced by occupational supply. This is further manifested in the twin problem of skill shortages existing alongside high unemployment rates - partially the result of a mismatch between demand and supply. Moreover, training institutions have been operating on reasoned guesses as to the kinds of demands of the country.

Furthermore, previous attempts at solving these problems have been hampered by (i) an inadequate manpower statistical base (ii) lack of systematic coordination of activities and (iii) meagre financial resources.

Consequently, the Manpower Planning, Training and Employment Project is an attempt to address the above problems and to integrate, more fully, manpower planning with the development planning process. This will be achieved through systematic coordination of all manpower related activities, improvement of the manpower information base, the development of projections aimed at improving the demand and supply match, upgrading techniques and instruments of occupational skill training, as well as improving job counselling and placement service.

It is hoped that the above efforts will greatly assist the country in ameliorating some of its problems related to labour productivity, unemployment and manpower development and utilization.

APPENDIX A

The Zymelman equation used is written as:

$$D_{it} = \sum_{j=1}^n (lij)_{t_0} e^{(bij rp_j + rLj)t}$$

Where D_{i_t} = the demand of occupation i in period t in absolute numbers.

rp_j = the rate of change of average productivity in industry j.

Lij = the absolute number of occupational group i working in industry j.

Lj = the absolute number of total persons employed in industry j.

Qj = value added of industry j.

B_{i_j} = elasticity coefficient of occupational group i in industry j.

Taking a derivative of equation $\text{Log } \frac{Lij}{Lj} = \log + bij \log \frac{Qj}{Lj}$

With respect to time, it can easily be shown that for each percentage increase in average productivity of industry j the proportion of occupational group i will tend to increase bij time one percent.

so that $rLij = rLj + rpi_{i_j}$

where $rpi_j = bij \frac{dQj/Lj}{Qj/Lj}$

where rpi_{i_j} = the rate of change of the proportion of occupational group i in industry j.

rLj = the rate of change of the employment level of sector j.

$rLij$ = the rate of change of the absolute number of persons in occupational groups i in industry j.

thus $rLij = rLj + rpi_{i_j}$ states that the growth rate of persons in occupational structure rpi_{i_j} plus the growth rate of total employment in industry.