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The Formation of Engineering Labour Markets
in Kenya 1918 - 1979

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ABSTRACT

This paper outlines the basic theoretical and empirical objectives of a study on the historical constitution of engineering labour markets in Kenya between 1918-1979. The analysis of developments in the formal training and utilization of engineers, technicians and artisans focuses on the nature of the relationship between the supply and demand of these three categories of manpower within the modern sector. This in turn entails the elaboration of a theoretical framework within which the complex interaction of economic, political and social factors can be assessed.

The provision of training facilities has been determined by the basic conceptions of the state concerning the "needs" for engineering manpower. The study focuses in particular on the establishment of 'professional' engineering training and the role of the engineering profession in this process. The analysis of the utilization of engineering manpower will attempt to identify the changing labour requirements emanating from the economy and, in particular, the manufacturing sector.

The Formation of Engineering Labour Markets in Kenya 1918 - 19791. Introduction

The purpose of this study is to consider the historical constitution of engineering labour markets in Kenya since the early colonial period in an attempt to understand the nature of the relationship between the actual utilization of the different categories of engineering manpower in the economy as a whole, in particular in the manufacturing and public and private service sectors, and the system of technical and vocational training which has been introduced. It is therefore a study of the determinants of the supply and demand of engineering manpower in Kenya.

While it is generally accepted that the production of engineering manpower is a key input into the development process, few detailed studies have been undertaken on the development and present functioning of engineering labour markets in the Third World. This is perhaps surprising in view of the growing realisation of the adverse consequences of the dependence of (LDCs) on foreign technology which has highlighted the inappropriateness of the present pattern of production and utilization of engineering manpower in particular, the paucity of research and development activities and the general isolation of training institutions (particularly at the university and institute levels) in relation to the productive sectors of the economy.

Up until recently, manpower planners, themselves strongly influenced by human capital theories, have placed great faith in the need to increase the stock of manpower possessing formal technical skills since these are perceived as providing a key input into the industrialisation and rural development processes. And yet their reports and recommendations have in the majority of cases not been based on detailed analyses of the historical development and present functioning of these labour markets. In part this failure stems from the paucity of detailed empirical data concerning the training and subsequent employment patterns of technical manpower but, of perhaps greater importance, is the inadequacy of their overall theoretical framework, manpower planning exercises in Africa have been based on essentially technical assumptions concerning the nature of the relationships which exist between certain categories of skilled manpower and the attainment of target levels of

national output. Time series and country cross-sectional data have wherever possible been used to derive employment-output coefficients for each of the main categories of skilled manpower, conventionally designated as managerial and professional, technician and non-manual middle level occupations and artisan/skilled workers. But, in the absence of sufficient data, manpower planners have generally based their analyses on crude assumptions concerning the actual and/or desired ratios of one category of manpower to another in what is conceptualised as being a smooth-sided manpower skill pyramid. In the case of engineering manpower, the skill hierarchy is generally accepted as comprising of engineers, technicians and artisans, whose principle distinguishing characteristic is based on the acquisition of formal technical qualifications. 'Skill' is perceived as essentially a purely technical datum which each type of manpower category is required to utilize in the performance of his appropriate job position in the production process. According to this dominant conception of manpower organisation, the training system responds passively to the set of specific effective labour demands for engineers, technicians and artisans which emanate from the main sectors of the economy. There is, in other words, a basic functional correspondence between the production and utilisation of engineering manpower.

While considerable attention has been focused on the overall dynamics of the process of capitalist development in Kenya (Cowen, Leys, Swainson), little research has been undertaken on analysing the consequences of this process as regards the specific requirements of private enterprise and state organisations for technical labour. The educated elite have been identified as being one of the key fractions of an emerging petit bourgeoisie and yet no attempt has been made to consider the specific relations of production in production which this group or class are generally required to perform. This is clearly of considerable importance if the analysis of class formation is to develop beyond the simplistic formulations that have generally been advanced so far.

In common with the human capital theorists, Marxist writers have argued that the underlying rationale of the technical education system is to provide the skilled manpower required for the economy. This is generally expressed in terms of "the needs of capital" within the different /^{types} of production that coexist within the industrial and agrarian sectors. These needs are usually conceived as arising from the

specific technical requirements of the economic infrastructure. For example, Swainson argues :

One of the biggest perceived obstacles to the encouragement of productive investments in the colonies was the low standard of labour productivity. The labour force had to be shaped to the needs of capital and the state was to assist in the process. Therefore, a considerable proportion of aid was directed into training a skilled labour force to service industry as well as agriculture (1)

However this assertion that "the labour force had to be shaped to the needs of capital" is highly problematic for the simple reason that the state's perceptions of the labour requirements of capital and the training policies which have been subsequently pursued have significantly diverged from the size and type of the labour demands which actually exist. This lack of correspondence is reflected in the low level of demand for the products of technical and vocational training establishments and the increasingly interventionist role of the state in encouraging and, in some cases, even compelling enterprises to become more actively involved in the training process. This is in contrast to the situation that generally prevails in advanced industrial countries where a much greater degree of voluntary cooperation between the state and employers exists.

The lack of demand for manpower from technical training institutions somehow has to be reconciled with official pronouncements concerning the dire shortages of skilled manpower which, it is argued, are a serious constraint in the development process. In the case of the public sector this is not difficult mainly because manpower demands are based on projections of "need", particularly in the rural areas which are enormous. However the extent that additional manpower can be trained and employed to fulfill these needs is subject to the growth in state revenue. But the additional manpower demand within the public sector that can be made effecting does lead to a predictable, well organized pattern of training given the rigid relationship which exists within most government organisations between employment position and the acquisition of formal technical qualifications.

Within the private sector the pattern of demand for skilled manpower is considerably more complex, because of the diversity in the size, technological and managerial sophistication, ownership and type of productive activities of enterprises. But generally, Private Sector employers are much more pragmatic concerning the importance they attach to formal technical qualifications thus indicating the existence of other important recruitment criteria. The general lack of demand for formally qualified technical manpower in the majority of manufacturing sectors is attributable to the capital-intensity of the mass-production technology that is employed. For example King observes that:

"Principally this sector needs only operative skills on the production lines, with a handful of plant maintenance mechanics or technicians and even this latter skilled category can be reduced as actual plant size becomes more sophisticated". (2)

Skilled labour requirements for this kind of production activity are principally related to the hierarchy of managerial and supervisory positions which are needed to ensure the efficient control of a predominantly unskilled labour force:

"The frequent assertion that underdeveloped countries have a great need for intermediate manpower skills of the type supplied by formal vocational training institutions usually turns out to be incorrect. Careful analysis of wage rate data, employer recruitment practices and the experience of technical educational institutions reveals that the actual need is for supervisory skills and not for the higher level technical skills" (3)

The dependence on imported technology and the corresponding lack of sizeable research and development establishments by companies and the state itself severely curtails the utilization of the theoretical knowledge that is acquired at higher technical institutions in Kenya which have been largely modelled on the Anglophonic model. What little research and development activity that does take place is so minimal in its impact that in no way can it be considered to constitute a local source of significant invention and subsequent innovation. In the advanced industrial countries, on the other hand, it has been the institutionalisation of the innovation process that has provided the impetus for much of the expansion of higher technical

education.

2. The Scope of the Research

The development of engineering manpower in Kenya provides an interesting case study of the complex inter play of social, political and economic factors in shaping labour markets. In elaborating a theoretical framework within which to analyze these factors it is inevitable, therefore, that wider issues of political economy as opposed to the narrow theoretical parameters of conventional neo-classical 'economics' must be confronted. Of particular concern in considering the provision of engineering manpower is the role of the state in mediating the frequently contradictory relations which exist between the political, social and economic levels within any given social formation. (4) All too often, however, the analysis of the role of the state has been reduced to simplistic formulations concerning the identification of a particular class or fraction of capital whose interests the state is alleged to serve. But in the case of the engineering manpower it is clear that a more sophisticated approach is required in analyzing the role of the state via the provision of training institutions and the needs of capital. The high degree of dysfunctionality that characterises this relationship highlights the importance of other factors in determining the role of the state in the formal training of engineering manpower of crucial importance in this respect is the decisive role of the educational system in the process of job allocation and hence class formation especially since the second world war. Faced with the political necessity of expanding educational opportunities the state has however been unable to satisfy the expectations of an increasingly educated populace for relatively highly-paid jobs in the modern sector. While considerable qualification escalation has occurred, the type of engineering skills demanded by the majority of enterprises in the industrial sector have neither expanded in size or nature to a corresponding degree.

The rapid development of technical training institutions during the late colonial period was based on a specific set of perceptions by the state concerning the role of technical training. Given that the basic structure of technical training established during this period has remained basically unaltered since independence it is necessary, therefore, to first analyze the factors which shaped these perceptions

and their subsequent translation into concrete policies. The second part of the study will be concerned with a mainly quantitative assessment of the changing pattern of utilization of engineering manpower and the resulting effective demand for formal training. The third part of the study will then attempt to gauge the extent to which engineering training institutions have been functionally related to satisfying "the needs of capital" and to forward a number of theoretical propositions which seek to establish the basic nature of the relationship which prevails between the production and utilization of engineering manpower. However before discussing the research objectives and methodology of each of these three parts of the study, we shall briefly review the basic theoretical models which have been advanced to explain key aspects of the relationship which exists between systems of formal education and labour markets.

3. The Theoretical Debate

The nature of the relationship between education and labour markets is a crucial aspect of the political economy of all relatively advanced social formations. Not surprisingly, therefore, it has become the subject of a heated debate among social scientists of differing theoretical and ideological persuasions. While it is not our intention to provide a detailed review of the numerous and often complex theoretical formulations which have been advanced it is, however, essential to briefly discuss some of the most important themes in this on-going debate since they provide major theoretical starting points for this study of the relationship between engineering education and labour markets in Kenya.

Human capital theory was originally advanced by Becker⁵⁾ and his associates in the late 1950s largely as a response to the mounting econometric evidence which highlighted the importance of education in the growth process. According to the human capital school, education, particularly at the higher levels, is the means whereby an individual enhances his future income earning potential by acquiring new sets of skills. There is postulated, therefore, a direct unambiguous relationship between the acquisition of these skills and the subsequent productivity and hence earnings for each individual. Significantly, however, the relationship between productivity, narrowly defined in terms of formal skill acquisition and on-the-job experience, is taken as being axiomatic which leads to an underlying assertion that there exists a high degree of functional correspondence between the educational sector and the labour requirements of the economy as a

whole. Furthermore, since education imparts skills and skills determine income levels, the provision of increasing educational facilities not only fuels growth but results in an improvement in personal income distribution as more and more of the population reap the benefits of skill acquisition. For newly-independent developing countries this was a particularly appealing philosophy which, in the majority of cases, was adopted as the corner-stone of their manpower strategies.

Criticism of the human capital school and the formulation of alternative theoretical frameworks has taken a number of widely differing forms. What they all have in common, however, is a rejection, to varying degrees, of the human capital emphasis on the supply-side of the employment - education equation which, it is argued, results in a highly technocratic, narrowly functionalist conception of "skills" and the role of the educational process in the overall reproduction of social formations. The screening theorists posed the first serious challenge to the human capital school (6) They argue that the education system is essentially a series of screens which serve to provide the requisite amounts and types of manpower required by the economy. Moreover, the actual knowledge content of formal education is considered to be of considerably less importance as a direct determinant of subsequent labour productivity since employers are more concerned with the inculcation of the right kinds of attitudes and the general motivational characteristics of employees than the formal acquisition of technical skills which can be mainly acquired on-the-job.

The most radical critique of human capital theory has been developed by labour segmentation theorists in addition to more strictly Marxian approaches. Their main focus of attention is on the organisation of labour i.e. the labour process within different types of productive enterprises and servicing organisations. Segmentation theorists identify a number of distinct segments within the labour markets of advanced capitalist societies, each segment being largely responsible for the performance of various types of job tasks. The majority of engineering manpower is situated in the "primary independent" segment which is characterized by mainly professional, managerial and higher supervisory employment positions. A key feature of these positions is that they require the internalization of a specific set of norms which relate to the underlying need to control members of the other segments, namely the "primary routinized" (mainly unionized workers employed in

oligopolistically organized productive enterprises and service organisations) and the secondary labour market (non-unionized unskilled workers). Segmentation theorists argue that within each separate segment there are distinct criteria for hiring and advancement and the determination of wage and salary levels and each has generally different groups of individuals who fill the jobs in each segment: Hence, "the primary unit of analysis is not the individual but groups or classes who face objectively different labour market situations" (7)

Segmentation theorists differ in the emphasis that they give to technological and control factors in the determination of the overall social division of labour. The most ~~extreme~~ form of the social control argument has been forwarded by Gordon, Reich and Edwards:

"Segmentation results not solely from the inter play of blind technological forces, but also from the conscious desires of managers and capitalists to maintain control over the labour force and the production process -----workers in the primary independent market (managers, engineers, technicians) are frequently used to maintain control over workers in the others, both directly and indirectly. Technicians and engineers design the machines and calculate the "efficient" rate of speed for the workers as well as directly supervise production. Seen from this perspective the high general educational requirements for entry into the primary independent labour market are due to the need for a separate socialization process so that workers in this sphere will identify with management and not with other workers". (8)

According to this view education is primarily an ideological preparation for specific roles in the labour process. Consequently segmentation theorists reject the human capital proposition that it is the formal acquisition of skills and on - the - job experience that are the key factors which determine productivity and hence income levels, for all workers. This hypothesis has been tested using a variety of earnings functions which attempt to measure the significance of human capital variables both within and between segments. Their main empirical conclusion is that the distribution of earnings is strictly related to the specific organizational hierarchy of employment positions within each type of enterprise and hence the equalization of educational attainment of employees has only a marginal effect in compressing wage

and salary differentials within but especially between labour market segments.

Marxist explanations of the role of skilled manpower are also based on the nature of the labour process. However this is formulated in relation to the specific relations of production within different modes of production and the resulting pattern of class formation. The increasingly complex division of labour within modern enterprises complicates the identification of classes since the function of capital is no longer embodied in an individual capitalist but becomes the task of a "complex, hierarchical ensemble of people" (9), few of whom legally own the means of production. As with segmentation theorists, marxist writers have focused on the dual function of these particular agents of production since, on the one hand, they utilize certain technical skills while, on the other, they are collectively responsible for the control and surveillance of the labour force. However, the delineation of class boundaries rather than segments are considered to be the key determinant of (segmented) wage and salary distributions. (Wright: 1976)

Traditional Marxist theories of the relationship between technical education and the labour force have argued that there is a high degree of functionality in a strict technical sense, between the provision of these skills and the technological sophistication of the production process. However more recent theoretical formulations, while they continue to argue that the economic level remains "dominant in the last instance" recognize the importance of political and ideological relations in maintaining the overall cohesion and hence reproduction of the social formation as a whole. This theoretical framework is particularly useful in attempting to account for the various forms of non-correspondence between the specific technical labour requirements of capital and the nature of the intervention of the state in the provision of formally trained manpower. For example, Bourdieu and Passeron, recognizing the high-degree of non-correspondence between the needs of capital and the nature of the educational system, argue that:

"It has to be asked whether the freedom the educational system is given to enforce its own standards and its own hierarchies

at the expense for example of the most evident demands of the economic system, is not the quid pro quo of the hidden services it renders under the guise of technical selection and legitimating the reproduction of social hierarchies, by transmitting them into academic hierarchies" (10)

Hence, the social functions of the educational system (of employment/class allocation, socialization and legitimation) coupled with the need to accommodate political forces demanding increasing educational provision cannot be achieved unless the educational system and hence the state itself is able to exercise a relatively autonomous role in relation to the economic and political demands that emanate from the dominant classes in society.

4. The Development of Engineering Training

The system of engineering training has evolved according to the changing conceptions of the state concerning the formal provision of technical and general education since the early colonial period. The analysis of the complex interaction of economic, political and social forces which have shaped these conceptions centres on the processes of policy formulation and implementation which resulted in the establishment of each type of training institution.

The historical development of technical training in Kenya has been based largely on the British model, with the result that the structure of engineering training has been conceived on the basis of a strict delineation of professional engineer, technician and artisan manpower categories. Consequently, the appropriateness of this segmentation of engineering skills within the Kenyan context remained largely unquestioned at the time when each type of training institution was established.

The Professional Engineer

The professional engineer is at the apex of the so-called hierarchy of engineering skills. The intervention of the state via the provision of university-level training has been of even greater significance than for technicians and artisans where employers have been more intimately involved in the training process. More specifically, since the training of the majority of engineers has been sponsored by employers, the required output of engineers has been based almost exclusively

on manpower projections and furthermore, the content of the training has been determined by additional factors which have not been directly derived from the effective demands for engineers emanating from the economy and, in particular, the private sector. The state's adherence to the Anglophonic model of the professional engineer has been of key importance in this respect. It is necessary, therefore, to consider how this model was originally implanted and subsequently perpetuated. This in turn must be based on an adequate theoretical understanding of the nature of professional manpower as a specific occupational category within the overall social division of labour within Kenya.

In spite of the proclaimed importance of professional manpower in the development process in LDCS, research on the professions has been largely neglected. In part, this is attributable to the uncritical acceptance of the professional manpower category. Various theoretical models have also been advanced in support of the allegedly unique characteristics of the profession namely (1) "the existence of specialized intellectual techniques, acquired as a result of prolonged training (11). (2) the cohesion of the profession (3) the commitment to ensure the integrity of the profession which is closely related to a basic orientation towards "serving the needs of the community". It is clear, however, that these theoretical propositions are seriously flawed by their basic acceptance of the professions' own definitions of themselves as their basic reference points. In order to avoid this, a number of sociologists have attempted to penetrate the dominant professional ideology by studying the historical evolution of the professions i.e. the process of professionalization. As Lasson points out: "the ideal - typical approach seldom takes account of the concrete historical conditions in which groups of specific areas of the division of labour"

The professionalization theorists argue that a profession can be distinguished from other occupations by its ability to attain a certain degree of autonomy as a collectivity to organize the conditions of its own work. In other words, professionalization is a historical process whereby certain individuals occupying certain "positions" within the social division of labour attempt to utilize a growing source of "professional power" in order to establish their own conditions of existence and reproduction as a distinct occupational group. The actual

source of this power in class terms is never made clear but the professionalization model is valuable to the extent that it adequately describes the ways in which the profession establishes and maintains control over two key processes, namely the creation of an exclusive, protected market for its 'skills' and the education and training of new recruits into the profession:

"... the double nature of the professional project intertwines market and status orientations, and both tend toward monopoly - monopoly of opportunities for income in a market of services on the one hand, and monopoly of status in an emerging occupational hierarchy on the other. The institutional locus in which both monopolising tendencies converge is the educational system" my underlining

This ability to exert control over the educational system is of decisive importance in analyzing the role of the engineering profession in Kenya. The East African Association of Engineers (EAAE) which was formed in 1945 exerted almost paramount control in ensuring that the new engineering courses at the Royal Technical College, Nairobi exactly conformed with the Anglophonic conception of the necessary training requirements for a professional engineer. This concern for the professional product also led the EAAE to take an active part in the more overtly political activities of the Association of Recognized Professional Bodies (ARPB) which aimed to ensure that professional standards did not deteriorate during the transition to independence and the localization of the Civil service. The issue of registration of professional engineers also became an increasingly important objective which culminated in the Engineers Registration Acts of 1969 and 1978. This legislation secured legal protection of title for the engineer based on a rigorous and protracted registration process, the requirements for which only a minority of Kenyan engineers have been able to satisfy.

The overall aim of this part of the study is to consider in detail these and other policies of the EAAE and the Kenyan Institution of Engineers which have served to preserve and consolidate the boundaries of professional monopoly within the hierarchy of engineering skills. The main sources of information are the records of the EAAE, KIE and the ARPB, in particular the minutes of general meetings and numerous standing and ad-hoc committees.

The Technician

It was not until the late 1950s that the need to formally train a technician stratum was seriously contemplated by the colonial state. Prior to this, engineering manpower had comprised of only two categories, namely engineers and artisans (although imported artisans were frequently labelled as "technicians" in order to more easily obtain a work-permit from the immigration Department) The question is, therefore, what were the factors responsible for precipitating this major reformulation of the state's conception of the engineering skill hierarchy. Firstly, the rapid growth in the size and organizational complexity of the state apparatus prompted a major reevaluation of the manpower requirements which were considered to be necessary for the efficient operation of an increasingly development-orientated state machinery. And secondly, the development of "secondary industries" began to be accorded high priority both during and after the second World War. The industrialisation strategy adopted was based on the need to attract foreign capital to invest in import substituting and intermediate good processing activities. It was believed that for this process of industrialisation to be successful, it was necessary to reproduce via a new training system the same pattern of engineering labour requirements as existed in the industrial metropolises and especially Britain. In the case of technicians, there had occurred a massive expansion in technician training since the early 1930s based on technical colleges offering a variety of courses to mainly employer-sponsored students. While this mode of technician training was imported almost completely unmodified by the colonial state in the late 1950s with the establishment of the Kenya Polytechnic and Technical Institute and the up-grading of the Mombasa Institute of Muslim Education to the status of a technical school - cum - college, considerable confusion still existed concerning the precise role of these new training institutions.

Information on the introduction and subsequent development of technician training in Kenya is obtainable from the National Archives, in particular the records of the East African Advisory Board for Technical Education. Only limited archival material is available at the Polytechnics themselves.

The Artisan

The analysis of artisan labour in the part of the study will, as with engineers and technicians focus on the changing conceptions of the state concerning the training of artisans.

Kenneth King's interesting study of artisan labour while concentrating on the process of skill acquisition in the informal sector does nevertheless provide a useful general overview of the changes in official policy in the formal provision of artisan manpower. (14) It is however based on generalised observations of the production and utilisations of artisans in the modern sector rather than systematic empirical analysis. King's concern to highlight the inappropriateness of the British system of conventional craft apprenticeship in Kenya is certainly not misplaced but he is however frequently guilty of oversimplifying the factors which shaped colonial training policies for artisan manpower. For example, an important theme in King's study is the attempt to show that the demand for formally trained artisan labour has remained consistently very low given the reliance of European and Asian employers on protracted on - the job training. However the first major intervention by the colonial state in the provision and formalisation of artisan skills occurred during the late 1940s when there was an acute shortage of artisans. Clearly the resulting expansion in the numbers of trade and technical schools, the introduction of trade tests and indentureship schemes cannot simply be viewed as attempts by the state to enhance the marketability of formally trained apprentices who generally were totally irrelevant in meeting the needs of capital. Similarly, King argues that Education and Labour Departments unilaterally escalated the level of apprenticeship training thus implying that the educational system, if not totally autonomous from the economic system, continued to respond in complete contradiction to the actual labour demands of employers. And yet a common complaint of many employers was that the general level of educational attainment of African artisans was inadequate compared to his U.K. counterpart. In making these qualifications intention is not to deny the general validity of many of King's conclusions but merely to highlight the need for a more detailed understanding of the determinants of the state's conception of the role of the craft apprenticeship system.

Archival materials from the Departments/Ministries of Education Commerce and Industry and labour are the major sources of primary

for data/^{for}this part of the study. Of particular interest are the reports and minutes of the Apprenticeship Control Board (ACB) which was established under the provisions of the Industrial Training Ordinance of 1959, in addition to the records of the Apprentice controller who was accountable to the ACB.

4. The Utilization of Engineering Manpower: A Quantitative Assessment 1945-1979.

A quantitative assessment of the changing pattern of utilisation of engineering manpower in Kenya is clearly indispensable in analysing the nature of the relationship which exists between the training process and the subsequent employment of these types of labour. The first task is to establish the overall size of the employment markets for formally trained engineers, technicians and artisans at various points in time in order to obtain basic empirical evidence concerning the overall growth and composition of engineering skills within the economy as a whole. Ideally, this will also allow us to derive approximate demand elasticities for each type of engineering manpower with respect to national and sectoral outputs. Secondly, it is necessary to try to disaggregate this data further thereby deriving a more detailed picture of the pattern of utilization. Of particular interest is the changing distribution of each type of engineering manpower as between: (1) the public (civilservice, local government, parastatals) and private sectors (2) the major sectors of the economy i.e. agriculture manufacturing, commerce and other service activities (3) enterprises of different sizes, ownership and types of production activities Thirdly, we need to know what kind of employment positions are occupied by engineers, technicians and artisans. Within the public sector this is relatively unproblematic given the rigid relationship which prevails between job position and the acquisition of formal qualifications. However within the private sector employers adopt widely differing recruitment criteria with the result that there is likely to be greater substitutability of engineering manpower possessing different educational qualifications. Similarly, the actual utilization of a given category of engineering manpower is also likely to depend (ie vary) on the supply of this type of manpower within the economy as a whole. This challenges the conventional assumption of the manpower requirements approach that there is zero substitution between different types of manpower (15) Other factors determining the relative utilisation of engineers, technicians and artisans are (1) the level

and type of technical skills required by employers (2) the relative importance of control (managerial and supervisory) skills (3) significant differences in the pattern of socialization and expectations of each category of manpower (4) the relative remuneration costs of employing engineers, technicians and artisans.

Sources of good-quality data on the utilization of engineering manpower in Kenya are meagre ^{to} say the least. Time-series data is particularly lacking. A number of censuses and surveys of manpower have been undertaken but the absence of any standardised definitions of the various categories of manpower that have been enumerated seriously restricts the usefulness of inter-temporal comparisons of the pattern of utilization. We list below the sources of information that have been used in our research.

- (i) The colonial censuses of European, Non European and African manpower and general archival material
- (ii) The unpublished manpower surveys of 1964, 1967 and 1972 which, although more detailed and systematic than their colonial predecessors, are still far from comprehensive
- (iii) The Annual Employment and Earnings Surveys of the Modern Sector conducted since Independence by the Central Bureau of Statistics. Unfortunately, however, no attempt to derive occupational breakdowns was made until 1968 and even then engineers were subsumed into a general "professional" category until 1976 when "architects, engineers and surveyors" were separately enumerated. Perhaps the most serious inadequacy of the EES data from the point of view of this study is that occupational definitions are based not on the possession of formal educational qualifications but largely on the subjective definitions adopted by each individual employer. In one respect, this is useful because it enables us to ascertain employers' own assessments of the breakdown of the occupational/skill hierarchy in their own establishments which can then be compared with the pattern of distribution of formally qualified engineering manpower. Of particular interest is the divergence

between the relatively limited numbers of formally trained technicians from the Polytechnics and the very much larger number of "technicians" in the EES thus indicating the importance of on-the-job training and experience factors in determining employer definitions.

- (iv) A survey of scientists, engineers and technicians undertaken by the National Council for Science and Technology which was based on the more rigorous UNESCO occupational definitions. Only just over 150 of the largest firms and organizations in the public and private sectors were surveyed which limits the usefulness of the survey from a macro perspective. However the enterprise specific data provides interesting insights on the utilization of engineers and technicians in a variety of different sectors.
- (v) Our own 'tracer' survey of all Kenyan engineering graduates from the Faculty of Engineering, Nairobi University and from institutions overseas. Ascertaining the present whereabouts of these engineers has involved tapping a variety of different sources of information, the most important being major employers and engineers own information networks. Once an engineer has been traced a questionnaire is sent to him in order to obtain additional information on social and educational background, job history and remuneration profiles and general characteristics of his present employment position (see Appendix A). While the output and names of engineering graduates from Nairobi University are known this is certainly not the case for overseas trained engineers. This is partly due to the large number of privately sponsored engineering students overseas many of whom are Asians who have not returned to Kenya on a permanent basis coupled with the enormous statistical task of monitoring the return of qualified students from overseas. Some information can be obtained from the overseas student files compiled by the Ministry of Higher Education, foreign Embassies and even overseas universities and educational ministries and statistical units (eg. IIP's Opens Doors publication and the UK University Statistical Service). These sources of information at least allow some overall picture to be obtained.

- (vi) Conducting a comprehensive engineering technician survey poses even greater problems. The most serious of these being the absence of any sufficiently detailed records of students enrolled at the Kenya Polytechnic and MIOME prior to 1970. Not even the major examination board up until the mid - 1970s, the City and Guilds of the London Institute, keeps this information. In addition, there is the much greater variety of types and levels of courses for aspiring engineering technicians than the uniform degree structure which prevails for engineers. It was decided, therefore, to take as a sample, firstly, an students who passed the final technician (Part III) examinations in electrical and mechanical engineering between 1971-76 and, secondly, all successful higher diploma students in electrical and mechanical engineering during the same period. This yields a sample population of approximately 160 ordinary and higher technicians. Tracing these individuals is also considerably more difficult because preliminary results reveal that job turnover among technicians is higher than engineers and also they are considerably more dispersed among enterprises and organisations. As with engineers, once the whereabouts of a technician is known with a fair degree of certainty, the postal questionnaire is sent to him.
- (vii) As similar tracer survey of engineering artisans who have completed craft apprenticeships under the auspices of the Directorate of Industrial Training (DIT) has not been undertaken although a relatively limited sample may be selected during the next few months, time and DIT records permitting. A sample of sorts has been obtained from the artisans employed by approximately 50 firms who responded to a postal tracer questionnaire which required them to list the engineers, technicians and artisans currently employed by them. Again, these individuals have been sent their own individual questionnaire.

The Utilization of Engineering Manpower: Explanatory Factors

The purpose of this final section of the study is to analysis the factors responsible for determining the pattern of engineering manpower utilisation within the major sectors of the economy. Having obtained a detailed understanding of this pattern of demand we can then consider the extent to which this corresponds to the formal system of engineering training provided by the state.

We shall focus in particular on the manufacturing sector, firstly, because it is within this sector that engineering skills have been traditionally concentrated especially in the fields of mechanical, electrical, electrical, chemical and production engineering. And secondly, because the provision of engineering manpower for the emerging "secondary industries" in the early 1950s became the central preoccupation of the state training system especially at the artisan and technician levels. Great faith was placed on the need for locally trained engineering manpower to provide the motive force to propel the industrialisation process successfully forward. The fact that most of this manpower was essentially concerned with the maintenance and repair of relatively simple imported technology was not actively perceived as a major problem until the early 1970s.

The pattern of utilization of engineering manpower is clearly determined by the overall structure of the manufacturing sector and in particular its composition according to the various modes of production which coexist within it. At one extreme, there are a small number of relatively large-scale enterprises (most of which are MNCs) employing sophisticated technology. The maintenance and repair of this technology requires a well-trained cadre of local engineers and technicians and it is for reason that these enterprises have constituted the primary source of demand (via sponsorship) for the formal training of engineering manpower. This was particularly the case during the early stages of their operations but ^{with} the development of their own skilled workforces the demand for formal training has become increasingly less pressing. For the level of demand from this sector to be maintained requires, therefore, a steady expansion in the number of enterprises within it.

• The majority of small and medium sized manufacturing enterprises

in Kenya (of between 30 - 300 employees) utilize relatively simpler technology to produce mainly consumer goods the operation, maintenance and repair of which can usually be undertaken by a small number of technicians and artisans in addition to a much larger number of employees who have acquired the necessary technical skills on-the-job. The principal labour requirements in this type of enterprise are firstly a stable, well trained operative labour force and, secondly, a group of managers and supervisors whose responsibility it is to control the labour force. For this latter group, the acquisition of formal engineering skills is generally unnecessary and, for many employers, is seen as positively undesirable since the expectations created by formal training courses concerning job satisfaction and remuneration conflict with their requirements for mainly low-level, ^{well}/motivated supervisory manpower.

The dominant pattern of engineering skill utilization up until the mid - 1950s was based on the skill requirements of a small number of engineering workshops owned and run mainly by Europeans who were principally engaged in the repair and simple fabrication of farm machinery and processing plant mainly on a one-off or small-scale production basis. The technology employed was simple, the principle activities being the cutting, bending, drilling and welding of imported iron and steel. The skilled artisans were predominantly Asian funds who were either poached from the Railways or other government departments or directly imported from overseas. Engineering skills were mainly manual requiring little theoretical knowledge and were acquired as a result of prolonged in-plant experience. Labour was organized in small units with generally a foreman and/or chargehand as the only intermediary between the worker and the owner manager and job satisfaction was generally high given the skilled, non-repetitive nature of the work. Prior to 1945 this metal fabricating sector comprised the bulk of manufacturing activities. The introduction of secondary industries during and after the Second World War resulted in the expansion of the metal fabricating sector in order to cater to the demands for the simple types of plant required by newly established industries. However, the basic technology and organisation of production and labour have remained largely unchanged. Reliance on the formal training system in the replacement of Asian funds by Africans has varied considerably among enterprises within this sector but has generally been low, in view of the importance which has been attached to on-the-job training.

A number of sources of information have been utilized in order to obtain a detailed understanding of the engineering skill requirements of the three types of manufacturing enterprises outlined above: (1) General archival material, (2) the existing literature and unpublished research on the nature of industrialisation in LDCs (3) the NCST study mentioned earlier (4) interviews with approximately 30 enterprises conducted in July 1980 by a UNIDO team of which I was a member who were concerned with investigating the system of formal technical training in Kenya. The interview methodology was largely unstructured (no formal questionnaire was used) since the primary objective was to obtain an overall assessment of the nature of the production process, the corresponding organisation of the labour process and the resulting pattern of demand for formally trained engineering manpower. A detailed discussion of the results of this aspect of the study will be presented at a later date.

Concluding Remarks

This study of engineering manpower in Kenya commenced in April 1980, and the collection of empirical data is expected to be completed by early April, 1981. The foregoing discussion of research objectives has, inevitably, therefore, been strongly influenced by my experience of having undertaken much of the field research already. In fact, the original formulation of this study has been subject to considerable modification as a result of a number of factors. Firstly, my original intention was to focus exclusively on professional manpower in Anglophone Africa but I was requested by the IDS and National Council for Science and Technology to concentrate upon the development of engineering manpower at all levels, professional, technician and artisan. I have, however, devoted a larger portion of the field research on investigating the training and utilization of professional engineers than I have done for technicians and artisans. And secondly, and most important, my increasing knowledge of this subject-area has, not surprisingly, resulted in the need to reformulate my original research priorities as new insights have been gained coupled with a more realistic approach to what data can and cannot be collected from existing sources and my own efforts. However, given the limited purposes of this paper, I do not propose to elaborate any further on my experience of the dialectics of applied research!

References:

- (1) N. Swainson: The Development of Corporate Capitalism in Kenya 1918-1977, University of California Press, Berkeley, 1980, pp. 113.
- (2) K.J. King, The African Artisan, Heinemann, 1976, pp. 43.
- (3) J.F. Rada, The Impact of the Labour Process and the International Division of Labour on the Formal Educational Level of the labour force, PhD. University of London, 1978, pp. 291.
- (4) N. Poulantzas, Political Power and Social Classes, New Left Books, London, 1973.
- (5) G. Becker, Human Capital, New York, 1964.
- (6) K.J. Arrow, "Higher Education as a Filter", Journal of Public Economics, 1973.
- (7) M. Carnoy, "Segmented Labour Markets: A Review of the Theoretical and Empirical Literature and its Implications for Educational Planning", Research Project on Employment, Nature of Work and Educational Planning, International Institute of Educational Planning, New York, 1978, pp. 6.
- (8) D. Gordon, M. Reich and R. Edwards, "A Theory of Labour Market Segmentation", American Economic Review, May 1973, pp. 359
- (9) G. Carchedi, On the Economic Identification of Social Classes, RKP, London, 1978.
- (10) P. Bourdieu and J.C. Passeron, Reproduction in Education, Society and Culture, Sage Publications, London pp. 123.
- (11) A.M. Carr - Saunders and Wilson P.A. The Professions, Frank Cass, London, 1964, pp. 284.
- (12) R. Larson, The Rise of Professionalism: A Sociological Study, pp. 192
- (13) Ibid, pp. 214
- (14) K.J. King, op. cit.
- (15) See C.R.S. Dougherty, "Substitution and the Structure of the Labour Force", Economic Journal, March 1972. and G. Psacharopoulos and K. Hinchliffe, "Further Evidence on the Elasticity of Substitution Among Different Types of Educated Labour", Higher Education Research Unit, London School of Economics, 1975.