THE RELEVANCE OF TECHNOLOGY IN THE ORGANISATION OF WORK IN A THIRD WORLD WORKPLACE: A CASE STUDY OF THE PORT HARCOURT REFINERY, NIGERIA.

A Thesis submitted for the degree of Doctor of Philosophy

by

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January, 1993

Acknowledgements

I would like to thank Keith Grint for his adroit supervision of the work. My gratitude is extended to the management and staff of the Port Harcourt refinery, Nigeria for providing the research site and for their considerable cooperation.

I wish to thank my parents, late Rebecca Ojiako and Daniel Ojiako for loving and educating me. Also importantly, I remain very grateful to my husband, Clifford Nwuche, without whose love, support and sacrifices going back to school again, and this subsequent success, would have been ruled out.

My appreciation also goes to my children, Owuze, Ugochi, 'Numa for the numerous denials they had to cope with whilst I was engrossed in work.

Many thanks to Ian McLoughlin and Keith Bradley for helpful comments on the work; to Johnson Asinugo for his willingness to come to the rescue at those times the PC/Printer would not function; to Ngozi Mbaka and Echan Nwuche for their help with some of the word processing; and to many other relatives and friends who provided support in various ways.

ABSTRACT

The organisation of work is seen here as concerning the ways in which various elements in work such as skills, tasks and structures of relationship are planned and managed. The technological artefact used in work is recognized as a relevant resource in the work organisation phenomenon. This is particularly so in a developing country like Nigeria where technology is looked upon as a harbinger of modernization along western lines. Hence, the study rejects the relegation of technology and the corresponding elevation of social factors to a determinist height by Gallie, Bijker and Pinch, and others. It agrees that technology is a social construct but argues that when a technological artefact becomes existent, it is capable of influencing its environment. Its construction or design would have been unnecessary if this was not the case. On the other hand, deviating from Ellul and post - industrial society theorists generally, the study argues that technological relevance does not mean its determinacy. It recognizes that it would be wrong to discount the social origins of technology as well as the import of social choice. Therefore, the study draws on the interactive model posited by Hughes, Law, Latour and others which rejects any form of determinism, whether `social' or `technological'. However, unlike some proponents of the model (for example, Latour) the study presumes the possibility of assessing the influence of these `actants'. Hence, it sees a crude oil refining plant as distinctly able to turn out refined petroleum products, not textiles; and able to influence certain aspects of work organisation. Overall, the study is congruent with the interactive model in arguing that the social and the technological are in `alliance', neither being the sole determinant of the way work is organised. This remains the order of things even in `developing' Nigeria where imported technology is yearned for and revered.

CONTENTS

INTRODUCTION

1.1 THE THEORETICAL FRAME

Interest in technology at work is not new and it has been sustained, particularly with the advent of microelectronic technologies. Many take the view that these technologies are capable of transforming the social order (Large,1984; Zuboff,1988;Kling,1990). As Kling explains, they play key roles in restructuring social relationships by "altering the kinds of information readily available, reorganizing patterns of access to information, altering the cost and work for organizing information, and shifting patterns of social dependencies..." (1990:3). For many in the underdeveloped world, technology, particularly the imported variety, is reckoned to be the cornerstone of the much-craved-for modernisation (Osifo, 1982, Udo-aka, 1982; NOIP, 1989; Anya, 1985). In the developed world, where modernisation has long taken place, Large (1984) and Francis (1986) point to a shift in employment from manufacturing to services, a reduction in the amount of labour needed on the shop floor and, in fact, the complete displacement of labour in certain areas. Another area of intense debate is the presumed changes in the skill levels. In this regard, whilst Braverman (1974) and his supporters are convinced about the fragmentation and deskilling of jobs, others like Gershuny (1978) and Fuchs (1968,cited in Penn R and Scattergood H:1985) take the view that advanced technologies require an educated and skilled workforce.

In apparent agreement with these assertions, some analysts go on to make prescriptions regarding the best ways to introduce and make effective use of new technology at work. For instance, concentrating on ergonomic concerns, Armbruster(1983) refers to the importance of ensuring systems accessibility in terms of physical proximity to machines and possession of the skills for operating the machines; provision of adequate space and layout for equipment; as well as ensuring the safety of workers and the security of equipment. Similarly, Mumford (1983) suggests 'consultative participation' of both management and workers in decisions concerning technological change. For developing countries, emphasis is on choosing foreign technologies which are appropriate to the needs of a given country. Essentially, this often means a choice between capital-intensive and labour-intensive technologies.

In any event, although all analysts seem to accept the plausibility of social transformation, they could still be categorised according to their conception of the 'effects', 'impacts' or 'implications' of technological change. First, there are those who regard technology as the primary determinant of all that goes on in the workplace. Some organisation theorists and industrial sociologists of the 1950s and 60s fall in this category. These include Walker and Guest (1952) who, from their assembly-line studies, contend that:

> [the] technology in any given operational unit may be the crucial factor in determining the character of the social relationships for any individual or for a group of individuals (quoted in Rose,1975:185).

Similarly for Sayles (1958), the technology in the workplace "shapes the relationships within the work-group and thus the structure of the group itself" (quoted in Rose,1975:197). Explaining this technological determinist view, Rose notes that the "technical arrangement may create 'islands' of workers whose highly interlocking task-structure encourages separation and cliques" (1975:197). In any case, Sayles accords even more powers to technology. He takes the view that in the plant he studied, the "social system [itself was] *erected* by the technological process ..." (In Rose,1975:198, emphasis in original). In this scheme, technology easily becomes the main explanatory variable in workplace relations.

In a similar vein, Ellul espouses identical technological determinist views. In Ellul's 'technological phenomenon', "workers are ... scarcely in a position to act in a distinctly human way ... [and] the integration of the individual into the technical complex is more complete than ever before" (1981:389). For Ellul, human choice in technological outcomes is out of the question. In his own words:

> It is no longer possible to reflect that on the one hand there are techniques which may or may not have an effect on the human being; and, on the other, there is the human being himself who is to attempt to invent means to master his techniques and subordinate them to his own ends by making a choice among them. Choices and ends are both based on beliefs, sociological presuppositions, and myths which are [already] a function of the technological society ... Modern manin choosing is already incorporated within the technical process and modified in his nature by it (1981:206).

In effect, under this technological determinist view, divergent group interests seems irrelevant. As it appears, all organisation participants would have common goals and the idiosyncrasies of individual workers are of no effect. But this hardly corresponds with what obtains in real life. When applied to the workplace, Ellul's technology-determinist model seems to recognize cooperation but, at the same time, apparently ignores possible conflicts that occur both between individuals and between groups of individuals in organisations. This runs counter to Edwards' observation of "a deeper antagonism" in the labour process and that "Conflict and Co-operation are created simultaneously in the organisation of production ..." (1986:72).

It is notable that conflict and cooperation themselves could be explained in terms of the idiosyncratic nature of individuals in social relationships as well as differences in goals. For one thing, McGregor's (1960) theory Y suggests differences between employee and organisational goals. But, very importantly, exponents of technological determinism are unable to demonstrate that technology accounts for these differences, or even determines unique organisation or individual goals. For example, it is difficult to demonstrate that technology determines absence/turnover rates, strike activity, or indeed, an individual's choice of type and place of work etc. As Sayles himself also recognises:

> technological factors ... do not explain what sets off a spate of aggressive activity, what brings it to a halt, and what are the personal motivations involved (quoted in Rose,1975:198).

These and similar arguments probably lead some analysts to dismiss any relevance of technology in workplace relations.

Whilst relegating technology as an irrelevancy, this second group of analysts emphasize the dominance of social factors. One such vehement dismissal of technology comes from Haug who is categorical that even "to ask whether technology acts as a force for emancipation or for derogation with regard to human labour is to give technology a sort of self-determined place which it does not deserve. Technology is not a subject" (1985:83). According to Haug, technology is merely a means at the disposal of humans. In a similar vein, Gallie's "principal conclusion" from his refinery studies is that "the nature of the technology ... has at most, very little importance ... Instead [of] ... critical importance ... [are] wider cultural and social structural patterns of specific societies ..." (1978:295). For their part, Noble,(1979), Child (1984), and Wilkinson (1983) point to the importance of 'social choice' in technological outcomes. Similarly, Ahiauzu (1984) stresses the influence of culture in shaping attitudinal characteristics and hence behaviour in the work place. In addition, Goldthorpe and his colleagues (1968) are convinced that attitude and behaviour are not contaminated by technology.

There can be little doubt that socio-cultural factors are important. However, the view that technology is essentially irrelevant, as Gallie and others are wont to suggest, is more difficult to accept. For instance, from Blauner's point of view, the relegation of technology would be unthinkable since the "most important single factor that gives an industry a distinctive character is its *technology*" (1964:6, emphasis in the original). That is, for example, it is possible to distinguish between a refinery and a textile mill by means of their technologies of production.

When technology is seen as irrelevant, one question which arises concerns why technology is employed in production activities in the first place. Infact, it could be suggested that such a dismissal of technology is equivalent to questioning the usefulness of the industrial revolution in Europe and the subsequent developments in technology ever since. Relatedly, if technology is considered as irrevelant, the craving for alien technology, as occurs in developing countries like Nigeria, becomes rather difficult to explain. It is unlikely that these countries would borrow heavily just to invest in irrelevancy. Thus, what seems more probable is that the technological is important, just as the socio-cultural is.

Hence, a final group of analysts rejects any form of determinism, whether technological or social. However, two variants are distinguishable in this group. Firstly are those who, whilst avoiding determinist assertions, emphasize some independent influence of technology but, at the same time, recognize the importance of choice and/or negotiation between social actors. Thus, in their research, Clark and his colleagues see "technology ... as an independent variable influencing the way the outcomes of technological change in the workplace are socially chosen and negotiated" (1988:12). Also, advising against throwing away "the technology 'baby' with the determinist 'bathwater'", Mcloughlin and Clark argue that "even where ... social and political influences are found to be evident, it would be wrong to conceive the innovation process as shaped entirely by non-technical factors, since design choices also arise from, and are constrained and extended by, existing technology" (1988:100,101).

As it appears, Clark and his colleagues tend to draw particular attention to the independence of the technical. Nevertheless, another analyst who could be placed in this sub-category but who tends to place equal emphasis on both the independence and interdependence of variables is Rose. As he writes:

> the productive system has three key dimensions which are all interdependent: the technological, the social and the economic. Yet each of these possesses its own scale of independent values. To pursue one set of these and ignore the others is to invite trouble, if not disaster...(1975:215).

On the other hand, the second sub category of analysts accepts the importance of both the social and the technical but emphasizes the interdependence of factors and also stresses the difficulty of distinguishing between entirely social and technological effects. Analysts here belong to `the interactive or Actor-Network school'. From this interactive framework, Hughes (1987) advises against any distinction between the technical, social, economic, political or the cultural which, according to him, impedes understanding of the processes and outcomes of technological change. Similarly, Callon declares:

> right from the start, technical, scientific, social, economic, or political considerations [are] inextricably bound up into an organic whole (1987:84).

That is, it has to be recognised that diverse variables are linked together in complex relationships to which each contributes. In essence, no single factor would be wholly independent in its effects. A study of one variable has to be set in the context of the others.

However, it is noteworthy that the two variants of opponents of determinism together espouse the relevance of both the technological and the social and seem to recognize the interaction between them, albeit to varying degrees. In the event, this study is informed by these two sub categories which, for convenience, are together subsumed under the interactive framework.

Taking a definition of technologies as physical production artefacts which are configured in a particular way, it is presumed that a given technology has in-built 'technical rigidities' which imposes constraints on how work is organized. However, technical rigidity does not necessarily imply a subordination to the technology. Following Clark et al, the study regards "technology ... as a significant explanatory variable ..." (1988:10). Also, with them, the study recognizes the potential influence of social actors. Hence, for instance, it becomes possible to argue that whilst the skill requirements of jobs may be dependent on the technology, the content of jobs, in the final analysis, is a function not only of the skill requirements but also that of negotiated and/or chosen work design.

These congruencies with Clark et al., notwithstanding, the study deviates somewhat from their views. The study's point of departure from these analysts lies in its denial of any independent influence of technology. This denial is on the basis that to be independent implies not needing help. In so far as a given technology would not just function on its own accord in a vacuum but would need to be `activated' by social actors, it cannot safely be regarded as influencing independently. Hence, whilst accepting the ability of technology to exert influence, the study also joins interactive theorists like Hughes (1987) and Callon (1987) in suggesting the interdependence of the technological and the social.

Overall, the aim of the research is not merely to identify factors which influence work organisation. Rather, a more fundamental concern is to examine the extent to which technology influences the design and allocation of work tasks. That is, the extent to which, for instance, the technical rigidities of the technology influence managerial choice or are taken into consideration by both management and employee representatives in negotiations concerning the organisation of work.

In any event, it has to be noted that the complexity of the relationships constrain any attempt to explore the processes of interactions amongst variables. Such an attempt is fraught with difficulty. For instance, one cannot easily demonstrate that a given 'process' could be associated with particular participating elements to the exclusion of certain others. Therefore, to avoid these muddy waters, the study does not attempt to chart all the various processes or mechanisms of interactions between variables. Rather, attention is directed towards ascertaining that the technology is able to exert influence but within an interdependent relationship between it and the social. In other words, the study focuses on the tenet that all interacting variables contribute to the outcomes of a given phenomenon, in this instance, technological change. Neither the technological nor the social is irrelevant.

1.2 BACKGROUND TO THE RESEARCH

This thesis was originally intended as a comparative study of a refinery in Nigeria with another in Britain. The preference for a comparative approach, and the choice of refinery for study, were for two main reasons. First, a comparative approach was expected to enable understanding, explanation and interpretation of macrosocial similarities and variations (Ragin,1987). In the context of the intended approach a refinery was considered for the study because refineries in Nigeria are amongst the few workplaces in the country with modern technology which approximates that available in similar workplaces in the developed world. The second reason laid in the desire to find out whether the craving for technological development as well as the `foreignness' of the technological system in a Nigerian workplace would considerably affect the level of relevance of technology in work organisation. For instance, did `foreignness' make technology more determinate and significantly influence negotiation and/or choice in the organisation of work? That is, set against the outcomes in Britain where the technology could be regarded as `local'.

Furthermore, a comparative approach would probably provide useful insight into technological change in Britain which is long-matured in technology use. That is, it may be possible for `developing' Nigeria to benefit by tapping from the experiences of the more developed nations and also learn from their mistakes. In any case, it could be argued that socio-cultural and economic differences make such comparisons difficult and perhaps doubtful. However, from the presumption that refining technology is similar the world over, a determinist technology, for instance, would be expected to have similar effects at workplaces in both the `importing' and the `exporting' countries, irrespective of socio-cultural differences. On the other hand, socio-cultural and economic differences could be employed in explanation for any differences in technological change effects.

In any event, the original intention to undertake a cross-national study was not realized because my sustained attempts to gain access to a British refinery were all unsuccessful. Reasons given by some of the British refineries, for refusal of research access, included their concern not to:

i) add to the pressures already created by their involvement in preparations for major overhaul or in on-going capital projects (This would have been an interesting opportunity had access been possible);

ii) accomodate another research person in view of access earlier granted to another research student.

In the circumstance, the research inevitably became a single case study. However, some cross-national comparisons did occur, but these were only with information on Britain already available in the literature. Undoubtedly, using first-hand information would have been preferred, but the point that workplaces in Britain are, by all standards, better researched than those in Nigeria made the accessible second-hand information still very useful indeed.

Nevertheless, it needs to be mentioned here that comparison between two Nigerian refineries could be seen as a useful alternative. Such a comparison would enable the exploration of social explanations for technological change outcomes as well as the investigation of technology -oriented issues like technical rigidities and the deskilling concepts. However, internal comparison of two separate Nigerian refineries was not embarked upon because it was not considered an overarching concern in the study. Of more central concern was the `performance' of the imported technology in an `alien' environment. In any event, it is noteworthy that the chosen research site had the advantage of possessing both old and new refining plants, and hence was better suited for answering the research questions (discussed below).

Another issue that requires attention here is the suitability of a case study research. A common criticism of this approach borders on the limitations of its typicality or generalizability. Epistemologically, a case study would be seen as "a descriptive material an observer has assembled ... about some particular phenomenon or set of events", or refers to "a descriptive material ... from which some theoretical principles are to be inferred" (Mitchell, 1983:191). By the former definition, a case study could be seen as an inductively-oriented investigation, whilst the latter evidently suggests a deductive approach. However, an important commonality in the definitions is the specificity of the materials of a given case study. It is this specificity that enables critiques to charge case studies with atypicality or non-generalizability. Often, a study is adjudged as typical only if "the particular set of events selected for report is similar in *relevant* characteristics to other cases of the same type" (Mitchell, 1983:189; emphasis in the original). In other words, case study results are seen as ungeneralizable. In relation to our particular concerns, critics of the case study approach would argue that nothing guarantees that events in the refinery chosen for study would be similar to those in the other Nigerian refineries; and hence, it is not safe to use materials from there as a basis for making generalizations about technological change outcomes, not even in relation to the relatively narrow confines of Nigerian refineries, not to mention the Nigerian society generally.

This notwithstanding, many would see nothing to be diffident about adopting a case study approach. To begin with, Ragin apparently questions the presumed typicality of the survey method when he makes the following point:

> A seemingly large set of more than one hundred nation- states can be reduced by half if there are problems with missing data. Often, the remaining cases are not representative of the original [number] ... much less of all societies (or all macrosocial systems) (1987:10).

Ragin also draws attention to the fact that:

> theoretical strictures may reduce the number of relevant cases [and hence] ... the greater the likelihood that the investigator will find it difficult to evaluate an explanatory statement in a way that conforms to the standards of mainstream social science, especially its quantitative branch (1987:10).

Similarly for Freeman(1986),

> Researchers sample organisations ... in opportunistic ways. When they do achieve a modicum of generalizability, the populations from which samples are selected often are themselves defined arbitrarily...(quoted in Bryman,1988:17).

In essence, survey data is not exactly as overly generalizable as is often presumed.

Further, by distinguishing between statistical and analytical/logical generalization or inference, some analysts are able to accord some order of generality to case studies. Whilst statistical inference relates to "the confidence we may have that the surface relationships observed in our sample will in fact occur in the parent population", analytic inference "makes a statement about the confidence we may have that the theoretically necessary connection among the features observed in the sample pertain also to the parent population" (Mitchell,1983:207). Mitchell is certain that case studies make no recourse to statistical inferences. In a similar vein, Yin (1984) argues that "survey research relies on *statistical* generalization whereas case studies ... rely on *analytic* generalization" (quoted in Bryman,1988:18; emphasis in the original). For Mitchell, the essential point about making inferences from case study material is that "the extrapolation is ... based on the validity of the analysis rather than the representativeness of the events" (1983:190).

That is, inferences made from case studies are not based upon the representativeness, and hence the typicality, of the sample. Rather, here, feasible inferences could be made on the basis of linkages between events and the guiding theoretical propositions (Mitchell,1983; Ragin,1987; Bryman,1988). Hence Mitchell characterises a case study as:

> a detailed examination of an event (or series of related events) which the analysts believes exhibits (or exhibit) the operation of some identified general theoretical principle (1983:192).

Indeed for Mitchell, "what is important is not the content of the case study but the use to which the data are put to support theoretical conclusions" (1983:191). Put differently, whatever, the content of the case study, what is relevant, and in fact imbues the study validity, is the ability to relate content to theory. This, therefore, means that for our concern premium should (and would) be placed on the use of the case study data to demonstrate the interactive model, as employed in this work viz: neither technology nor social factors would exclusively account for the outcomes of technological change; the `technological' and the 'social' are both relevant.

1.3 THE RESEARCH PROBLEM AND QUESTIONS

The problem of investigating the relevance of technology in the workplace lies in teasing out its influence against the background of interacting, interdependent variables. Many studies which reject the technological determinist perspective often tend to concentrate on the processual dimension of technological change and in so doing succeed in bringing the social shaping perspective into prominence. For instance, Wilkinson's interest was to show the political nature of technical change and he therefore explored the roles of managers, engineers and workers in "the process of bargaining, negotiation, accommodation, and so on ..." (1983:22). This way, he found in his case studies that "technology has no uniform impact, but [its impact] depends on the social and political intentions of managers and engineers, and also on the way workers respond, adapt and try to influence the outcome" (1983:21).

Similarly, Batstone et al., (1987) not only looked at the organisation of work before and after the introduction of new technology but also looked at "the processes by which work organisation is shaped with the introduction of new technology, and ... highlighting particular characteristics of union organisation which shape these processes" (1987:7). From their studies, they were able to conclude that "while technology plays some roles, other factors are of greater significance in explaining changes in work organisation and labour regulation associated with technological innovation" (1987:210).

Undoubtedly, a processual approach could provide a `feel' about the change. It is quite probable that how organisational actors interpret technology and work relationships could be made clearer by adopting a processual approach. Also, it is conceivable that by this approach, the interdependence of the social and the technological which the research acknowlegdes could be further highlighted. Nevertheless, interactions between organisation variables are themselves processual and hence are rather tentative by nature. Thus, on one hand, what the researcher attempts to study is very fluid and, most probably, would be very different if reinvestigated in another time period. On the other hand, where to start or even end an investigation becomes contestable. In the circumstance, it would probably be more worthwhile to study phenomena as they exist, or existed. Besides, in relation to a developing country like Nigeria, most extant workplace technologies are essentially fully designed and developed exogenously. In effect, Nigeria could be seen as basically a consumption site of these technologies. Therefore, it seems plausible to adopt a simple `before and after' model in our investigation of the imported refining technological system.

Hence, I prefer an approach for analyzing technology `influence' which avoids the processual aspects of technological change and focuses mainly on salient aspects of work organisation before and after such a change. I am also convinced that an exploration of why a given technology is adopted in the first place may also throw some light on its relevance in the organisation of work. For instance, if a technological artefact is acquired mainly for image-making (Kling, 1990), then its level of relevance in work organisation is likely to be low. On the other hand, the reverse is likely to hold if technology is adopted for the purpose of boosting productivity. This is expected to be even more so in a developing country like Nigeria where technology is seen as a key instrument for the much sought modernization and industrialisation.

Therefore, the study is confined mainly to investigating certain aspects of work organisation before and after technical change. It is within this framework that certain research questions are generated. In any event, the generation of these questions is informed by a discernable thread of commonality in divergent views concerning technological change. This is that technological 'influence' could be located in its effect on jobs tasks and skills (Bright 1958; Hill, 1981; Cockburn 1983; Boddy and Buchanan, 1982) and in its use as a tool for control (Braverman, 1974). While avoiding the muddy waters of complex analysis of jobs, skills and forms of control, these research questions include:

1. What was/were the reason(s) for acquiring the technological system?

2. Has the content of jobs changed? If it has, when and in what ways has the change occurred?

3. Were there changes in:
   a) Organisation structure and division of labour
   b) pay systems
   c) Industrial relations patterns?

4. Where changes(s) occurred in the production system, What is/are responsible for what change?

It was hoped that the exploration of these questions would help in the assessment of the relevance of technology in work organisation.

The research data was collected via the use of questionnaires and semi-structured interviews with sections of workers including operators, lower, middle, and top-level management as well as with employee representatives. In addition, short non-participant observation sessions were undertaken. Unfortunately, the anticipated access to relevant written materials did not come to fruition essentially because of my 'outsider' status. Nevertheless, analysis of the collected data enables the assertion that technology exudes relevance. However, even in technology-yearning Nigeria, no single factor, not even the revered technology, could exclusively account for all technologically related change outcomes.

1.4 THE STRUCTURE OF THE STUDY

The research study examines the relevance of technology in the organisation of work at the Port Harcourt Refinery, Nigeria. The investigation is foreshadowed mainly by experiences in the developed world.

Chapter 2 looks at the different conceptualisations of work and the organisation of work. This is primarily in order to identify the dimensions of work organisation which the research addresses. The different reasons for organizing work are also discussed. It is argued that organisations organize work for a mixture of reasons, making use of both human and material resources, including technology.

Chapter 3 explores the various theoretical perspectives namely: technological determinism, social determinism or the social shaping approach, and the interactive model, which are presumed to underpin assertions on technology influence in the workplace. The intention is not so much to show that these perspectives are mutually exclusive. Rather, the aim is to attempt a critical examination of their persuasiveness. Beyond this, the implicit ambiguity in the tenets of the most persuasive perspective, the interactive model, provides the backcloth of the research problem.

The significance of technology in Nigeria's development efforts is the subject of Chapter 4. It shows that technology is given a pride of place in the scheme of things. Further, the extent to which this apparent reverence for technology makes it determinate is examined. It is argued that the reverence notwithstanding, technology can only claim importance not dominance.

Chapter 5 discusses methodological issues. It attempts to justify the chosen research strategy. By examining the presumed characteristics of both quantitative and qualitative research methods as well as their merits and demerits, it concludes that the distinctiveness between them is only one of degrees and agrees that the inclination to one or the other research method depends on the research problem. It justifies the study's combination of methods by arguing that interacting variables do not all lend themselves easily to observation, and that the research problem does not necessarily demand behavioural information.

Chapter 6 is devoted to discussing the background for the case study. It presents a brief history of Nigeria's oil industry generally and the Port Harcourt Refinery in particular. A review of the refinery's organisational and industrial relations structures are also presented. Finally , experiences during the fieldwork and the actual research methods that were employed are presented.

Chapters 7, 8, 9 and 10 are devoted to the analysis of the research data in the context of the three theoretical perspectives. Chapter 7 addresses the issue concerning managerial choice and strategies for technological change. It highlights the influence of the state and portrays the efficacy of managerial prerogative by showing that decisions relating to the choice and strategies for implementing the technological change were essentially managerial. It also uncovers the point that the control of labour is not the primary concern of management. Chapter 8 explores the implications of new technology on the content and character of jobs. It reveals some changes, thus recognising the importance of the \`technical'. Nontheless, the chapter also seeks to deny any unilateral control by technology. Chapter 9 considers the control and supervision implications of the change. It suggests that the effects of the new sophisticated monitoring and control devices are evident but some aspects of control have witnessed little change, if any. Chapter 10 evaluates the relevance of the new technology in industrial relations. Again, both the influence of the state and the passivity of employees and their representatives are brought into focus. It also suggests that the adoption of a new technology has very little, if any, influence on the system of industrial relations in the refinery studied. Chapter 11, which is the concluding chapter, re-echoes the interactive model by drawing on the arguments and findings discussed in the preceding chapters.

CHAPTER 2

WORK AND ITS ORGANISATION

Work is a very broad concept whose meaning is a function of individual or group ideologies as well as a function of time and place (Eyerman, 1985). This chapter begins by briefly considering the different conceptualisations of work. This is not so much to provide an in-depth analysis of the concept as it is to choose a definition most closely identified with our concerns. Thus, a definition of work as an activity is chosen essentially for its empirical orientation and hence analytic value. Subsequently, some notions concerning the organisation of work are outlined, followed by a consideration of the different rationales for organising work. It is argued that no one rationale explains what happens in real work situations. What is more likely is a mixture of rationales in pursuit of which organisations employ resources including technology.

2.1 WORK: A DEFINITION

The concept work is so amorphous that no single definition captures its varied dimensions. Hence, Eyerman sees works as:

> a `contested' concept whose meaning and interpretation emerges in the interplay between theoretical and practical, commonsensical discourse (1985:30).

In any case, Anthony concedes that "work is a thing of such richness and complexity that it defies [simple] analysis" (1977:312).

A normative view conceptualizes work as synonymous with any or all of the following: application of physical or mental effort; the result of such effort or specifically, the result of a particular task, job or undertaking. Within this framework, work has to do with activity. As

Eyerman reports, work is seen as an "economic activity, productive of use and exchange value, and of commodities" (1985:27). In other words, an activity has to be purposive and/or productive[1] for it to qualify as "work".

According to Cornell and his colleagues, the purposiveness of work is highlighted in the argument that "work is telos realization, i.e., to reach a goal formulated in advance of the action" (1985:16). Reaching a goal suggests the existence of some need(s) which require(s) to be satisfied. Hence, work may be conceived of as a purposive activity undertaken for the satisfaction of some need. This conceptualization stirs up questions like whose and what needs?, what and whose purpose or goal? It is presumable that these and similar questions underpin alternate definitions of work as firmly within the context of social relations. One such conceptualization sees work as having to do with coercion, exploitation and control of a factor of production - the worker - who sells his effort for pay to the employer who buys this effort for profit (Rose, N.; 1990). The difference here lies in the point that whilst recognising work as a productive activity with exchange value, this view emphasizes social dimensions of work[2] .

More philosophical conceptualisations of work are also evident in the literature. For example, following Marcuse, Cornell, et al., (1985) enunciate this view of work. For them,

> Work cannot be regarded as a specific activity. It is not just an activity among others; it is a `doing',... something that permeates the life of man and his history. Work is, on this level, not defined by its object, goal, result, content, etc, but by human existence as such." (1985:20).

Here the instrumentality of work is de-emphasized. Work is of value mainly because it is a natural necessity. In this framework, work becomes a source of meaning, structure and identity for both the individual and the society at large.

Nonetheless, whilst not disputing this ontological view of work, the study is content with the more empirically-oriented conceptualisations of work which seem more easily comprehensible and more amenable to analysis. That is, work in this perspective is regarded as a need-bounded[3] activity undertaken within the context of social relations. Presumably, the `needs' and `goals'[4] elements in "work" underlie the need for its organisation. This presumption applies in both developed and underdeveloped economies.

2.2 WHAT IS WORK ORGANISATION?

Perhaps it is not surprising that the organisation of work, like work itself, is also conceptualized in different ways. Often the concepts `work organisation' or `organisation of work' and `job design/redesign' are used interchangeable or in combination. Thus, Davis (1966) defines job design as:

> the specification of the content, methods and relationship of jobs in order to satisfy technological and organisational requirements as well as the social and personal requirements of the job holder (quoted in Willcocks and Mason, 1987:93).

On the other hand, Wild apparently distinguishes between work organisation and job design, the former being a prerequisite for the latter. For him, work organisation refers to the "manner in which work is planned and controlled" (1975:48). Implicit here is work organisation's concern with both the content of individual jobs as well as the broader social context in which work is performed.

Similarly, with Francis' suggestion that work "requires the application of effort ... the exercise of skill and knowledge [and] also demands some level of participation in relationships with other [organisation participants] and ... yields a wage or salary" (1986:40), work organisation could be seen as concerning the ways in which various aspects of work like skills, tasks, pay systems and structures of relationships are planned and managed.

In his own work, Thompson (1983) further highlights the multi-dimensional nature of work organisation when he distinguishes between "technical" and "human" organisation of work. According to him, the technical organisation of work has to do with the technological hardware or, more precisely, the equipment and process layout. On the other hand, the human aspect comprises a division of labour as well as a social organisation of work. The social organisation of work, in turn, consists of formal and informal components. Its "formal components deal with the structure of command and cooperation while informal aspects refer to the work groups and their behaviour patterns" (1983:19). Thus, like Wild and Davis, Thompson ties together the design of jobs at individual and group levels as well as the establishment and management of the network of relationships in the workplace.

In effect, analysts adopting a multi-dimensional approach see work organisation as concerning a conscious effort at the distribution of tasks among organisation participants; organisational accomplishment of these tasks; as well as the often unplanned but obvious informal relations. Of these concerns, the first two respectively relate to the content of jobs and labour regulation - an aspect which for Batstone et al., includes "the totality of forms of control, reward, and sanctions which exist in the workplace" (1987:8). That is, the dimensions of work organisation may be located in the content of jobs, and the control and reward systems in the workplace.

Implicit in the construct "organizing" is the structuring of activity. "Structure" itself suggests `order' and as Silverman observes, it seems "a certain order in any social relationship is necessary so that the participants themselves may make sense of each other's action" (1970:8). The question, then, is: is the organization of work mainly about achieving order? Or, put differently, why organize work?

2.3 SOME RATIONALES FOR ORGANIZING WORK

Debates on the organisation of work have often focussed on its `human' components even though the `technical' components also get some mention (Thompson, 1983). The rationale for organizing the `technical' aspect is typically for system efficiency but also for health and safety which are the main concern of ergonomists. On the other hand, the suggested or implied rationales for organizing the `human' components include control, `humanisation' and profit optimization. These are explored in some detail below.

Work Organisation for Control:

According to Edwards, "work relations are concerned with the control of the process wherein workers' capacity to labour is translated into actual work" (1986:1). And for Hill (1981), the control of work processes and the people involved is two-dimensional - the structural and normative control forms. Whilst the normative aspect has to do with organisational values which regulate the conduct and performance of organisation members, the structural dimension concerns the "coordination of activities and direction of employees" (1981:16). Apparently, the structural aspect relates to the achievement of `order' and this probably explains why it underlies much of the debate on the issue.

The structural dimension of control may be located in the bureaucracy and the systems of discipline and reward as occur in the workplace. Thus, Storey notes that "the key dimensions of bureaucracy - hierarchy, specialisation and division of labour, impersonality and formalised rules - are expressive of its essential control function" (1983:134). These "techniques of control"[5] according to Zuboff, "are used for monitoring, surveillance, detection, or record-keeping" (1988:313). Bureaucracy seems to epitomize the pursuit of `structure' or more simply, `order' in the workplace. Under bureaucracy,

> the direction of work, the procedures for evaluating workers' performance, and the exercise of the firm's sanctions and rewards ... become subject to the dictates of "company policy". Work becomes highly stratified; each job is given its distinct title and description; and impersonal rules govern promotion (Edwards, R. 1979:21).

Similarly, the disciplinary system itself takes care of "acts of challenge, recalcitrance, and resistance..." (Storey, 1983:129) which inherently threaten `order' whilst the pay system is a "subtle control device" (Storey, 1983:137) which rewards compliance. Implied here is the purposiveness of `control' and since `purposes' could differ, it follows that the differences in rationalisations concerning the control of work becomes readily explicable. Thus, `control', seen as a reason for organising work may itself be interpreted either as an attempt to find the most efficient mode of operation or as indicative of struggle and/or domination.

Under a Marxian and, its offshoot, the labour process framework, the rationale for organizing work is located in capital's effort to retain control of the workplace inorder to ensure a continued realisation of surplus value. This view is aptly expressed by Storey thus:

> It is the essential function of management ... to control; that is to translate labour's power into labour and thereby to realise surplus-value (1983:123).

Similarly, Marglin (1982) and Landes (1986)[6] explain the shift away from the `putting-out' system to the factory in terms of the early industrialists' desire for control of the factors of production. For Marglin, the factory system "guaranteed to the entrepreneur an essential role in the production process as integrator of the separate efforts of his workers into a marketable product" (1982:287). The factory system made it easier for employers to co-ordinate and direct the activities of their workers and hence greater certainty of increased production. Besides, Marglin is sure that "the factory system afforded ... a system of discipline and supervision that was impossible, under the putting-out system" (1982:294). Support for this view is also provided in Fox's argument that "the emergence of the factory system owed ... much to the desire for closer co-ordination, discipline and control of the labour force..." (1974:180).

Furthermore, the control of labour is claimed to be the outcome of a struggle between labour and capital over the effort bargain. Storey (1983) seems to be an ardent suporter of this view. As he elaborates:

> Labour power comes in a form ineluctably attached to the worker. Hence, unlike other `commodities', labour is an uncertain factor intrinsically possessing all the vagaries of the subjective individual. Management must render the potential of labour power actual in a form which is malleable (1983:82-83). [Further] steering the labour process

> along the straight and narrow of valorisation demands real control to ensure that other substantive objectives do not confound its realisation (1983:124).

That is, to be sure of surplus value, capital has to win the battle over the control of labour. Also, managerial control could be explained in terms of the low trust and conflictual relationship between management and employees (Fox, 1974). And, workplace strategies such as hierarchy, job design, redundancies etc, are all attempts by management to exert control over the labour process.

The view that conflict is the basis of control in the workplace apparently permeates the labour process literature. Braverman (1974), who provides the main text for the labour process school, recognizes the conflictual workplace relations and sees the planning and coordination of work as having to do with the "habituation of the worker". He argues that capital's exploitation of labour power for the accumulation of surplus rather than for the satisfaction of human needs results in antagonism between the two parties. Therefore, for capital to be able to extract its needed maximum effort from antagonistic labour, adoption of labour control strategies becomes necessary. Management achieves control by means of Tayloristic principles which enables it to separate the conception of tasks from their execution. It is presumed that management retains the `superior' conception aspects of tasks whilst labour is consigned to the rather `inferior' execution aspect. Hence Braverman contends that capital uses its "monopoly over knowledge to control each step of the labour process and its mode of execution" (1974:119). Labour control is achieved by the fragmentation of tasks on one hand and their reintegration on the other hand by managerial planning and coordination. In other words, management is able to specify tasks and determine exactly how they should be carried out.

Braverman's analysis is riddled with a number of problems. Aside from his reliance on speculations rather than empirical evidence (Kusterer, 1978; Batstone et al., 1987) which casts doubts on his analysis, his apparent emphasis on conflict as the source of managerial control needs is problematic. There is no systematic evidence to suggest that the relationship between managers and workers is always and inevitably conflictual. It could, for instance, be argued that when the wage-effort bargain is complete and accepted by all sides, it is highly probably that relations between employers and employees become harmonious, at least for a while. In any event, management strategies like investments in training which may actually be in the interest of both management and workers are not indicative of perennial subjugation.

Furthermore, a suggestion of a mutual dependence between capital and labour seems plausible. Arguing along this line, Latour (1988) points out that the `Prince'[7] which for our present concerns refers to the contemporary employer, does not have only his worker as `enemy.' Also in the list of enemies are other Princes. Since the Prince thus has to struggle "on many fronts at once, he might from time to time need ... collaborators to resist, for instance, other Princes" (1988:25). That is, competition has many fronts. It could be employers competing with each other[8] or combined in competition with their employees. Just as it is conceivable that managements may combine against employees, individual employers may similarly cooperate with their employees for mutual advantage in the competitive marketplace. In essence, workplace relations are characterised by a duality - conflict and cooperation. The existence of one does not mean the preclusion of the other, as Braverman's thesis tends to suggest.

Further, Braverman's assumption that control of recalcitrant workers is the central concern of management is questionable. Also questionable is the implicit assumption that managerial control is unilateral. With regard to the former assumption, Littler and Salaman take the view that "surplus value has to be produced but also *realized* in the market" (1982:257; emphasis in original). They are not convinced that control of labour for `surplus value' is more important to management than their concern for the much higher returns available via healthy relations with the capital market, innovation, and finding a market for their product[9]. Hence, they conclude that "the first priority in capitalism is accumulation not control" (1982:265).

Similarly, Hill (1981) stresses that control is significant "in as much as it enhances accumulation and profitability, and it is this over-arching concern that accounts for capitalism's incessant transformations of the productive apparatus within industry" (1981:112). In essence, it is not necessarily the presumed conflictual relations in the workplace that necessitates control, nor is it the case that control is directed only at recalcitrant labour.

If one assumes unilateral control by management, one wonders how collective bargaining could be explained. The notion of collective bargaining as an exchange relationship[10] does not seem to be compatible with the unilateral control argument. It seems certain that Clegg was right in suggesting that "the mere existence of a collective bargaining relationship creates power resources for the negotiators (1979:251) on either side. Even if collective bargaining is seen merely as a means of social or specifically managerial control (as many Marxists do), there is no reason to believe that control is always one-sided. Presumably, trade unions or other employee representatives are able to pursue and advance the interests of their members mainly as a result of their ability to exercise some power and control. Even a threat of withdrawal from the bargaining relationship could in itself be seen as an effective weapon. Hence the process of work regulation is undertaken jointly by management and labour and "a structure of control should be seen as the result ... of past interactions between employers and workers..." (Edwards,1986:3). Perhaps it is also noteworthy that work rules arising from these interactions serve as an instrument of control for both management and labour. Following from these, it seems erroneous to assume unilateral control by management. If both management and labour are able to pursue their separate interest, the argument that one or the other assumes permanent control seems rather untenable.

Further, to impute unilateral managerial control unfortunately suggests that management can now be seen "as omniscient, conspiratorial and able... to get its own way - that is, to solve successfully its problems of control" (Wood, 1982:16). That is, Braverman ascribes unprecedented rationality and power to management and at the same time underrates the position of workers in workplace relations. These are problematics. If workers are as passive and perhaps naive, and management as powerful and rational, as Braverman appears to presume, the adoption of different control strategies as well as policies for the retention of workers become more difficult to explain.

Although Braverman observed that "Taylorism raised a storm of opposition among the trade unions" (1974:136), he marginalised the potentials of this opposition, showing little confidence in the ability of workers to influence work relations. However, there is considerable evidence to suggest that "Management intentions can ... be modified or changed either by the influence of trade unions or the informal influence of workgroups and individual workers" (McLoughlin and Clark, 1988:130). In this regard, Edwards (1979) draws attention to the compromises and adjustments that management have had to make in its attempt to minimize opportunities for workers' resistance. Similarly, Hill understands Volvo's Kalmar plant to be the result of resistance by workers. This resistance, he claims, forced management "to redesign production in order to increase the variety of job tasks and restore some limited degree of control to operatives" (1981:114). Also for Littler (1982), different strategies of work design "must be seen ... not as consequences of the unilateral imposition by management on a passive workforce of specifications and prescriptions, but a two-way exchange in which an accomodation ... is achieved" (1982:42).

Quite apart from the influence derived from resistance to management strategies, Batstone et al, also draw attention to the implicit control workers are able to extract from the management control system itself. As they argue, while rules provide the basis for labour control, they also "provide a gauge for the actions of management, as well as providing a form of workers defence against changes in management demands" (1987:20). For example, entrenched custom and practice may become a handicap for managerial decision.

In the light of these consideration, it is quite possible to argue that the rationale for organising work may well be for purposes of control but that this control is neither always labour-oriented nor is it always uni-directional, from management to workers. That the control of labour may not be the key reason for organizing work is illustrated by the general lack of its consideration at the strategic level in the organisation (Buchanan, D. and Boddy, D., 1983; Edwards, P. K., 1986; Batstone, et al., 1987; McLoughlin, I. and Clark, J., 1988). Besides, Grint makes the point that since "the capitalist is coerced into ... stitching up alliances where possible [so as to] limit the damage inflicted by foes where necessary" it is quite conceivable that the capitalist may at different points "seek reduced overt control and enhanced working conditions" (1991:198). This argument in itself suggests an alternative reason for work organisation.

Work organisation for "Humanisation":

In principle, humanisation of work encompasses the tenets of both the human relations and human resource management traditions. Here recognition and respect for the subjectivity of the worker are seen as key determinants of organisation success and the object therefore is to make work more humane. Thus, the approach emphasizes the importance of satisfying inherent social needs of individuals for self-actualisation, status and belongingness. Work has to be organized in such a way that individual and organisational needs are properly integrated (Maslow, 1958; Agyris, 1957). This would supposedly result in "a more `satisfied' work force, higher morale, higher output, and more profit" (Storey, 1983:138).

In accord with this view, McGregor (1960) denounces what he calls `Theory X' (which according to him reflects assumptions that the average human being must be directed at work because he or she is lazy and dislikes work, and is only motivated to work through monetary incentives), and he proposed a `Theory Y'. `Theory Y' is based on the assumption that a human being craves for satisfaction of ego and self-actualisation. He or she therefore accepts job responsibility and is capable of generating self-motivation as well as exercising ingenuity and creativity at work. These theories represent contrasting beliefs about human nature and hence send contrasting signals in relation to work organisation.

While `Theory X' suggests managerial prerogative in organisation's direction and control, the assumptions of theory Y point to the principle of seeking and securing employee commitment to organisational goals even though management prerogative is maintained. Further, whilst the former apparently approves of formal control of the labour process, under the theory Y framework, `order' in the workplace is achieved not by the control of labour but by providing conditions for fulfilling individual social needs, and achieving social integration. Hence in this latter framework, organisation structure becomes less hierarchical, supervision is limited, and relationships between organisation participants are as between peers. Thus, while labour process theorists see organisational conflict as logical and inevitable, despising only the edge management has over labour, `humanisation' theorists believe that

> industrial discontent, strikes, absenteeism, low productivity and so forth do not derive from fundamental conflicts of interest but from ameliorable properties of the psychological relations of the factory (Rose, 1990:58).

In essence, these theorists point to the possibility of overcoming organisation conflict through improving interpersonal relations.

Perhaps the various `participaton' schemes as well as job design techniques like job enlargement, job enrichment and group working would derive justification from the humanisation perspective (Storey, 1983; Davies, 1986). For instance, participation is deemed to encourage the redistribution of power[11] so that workers become able to play more influential roles in the management of the enterprise (Tannenbaum et al, 1974, cited in Davies, 1986:74) and hence "more satisfied..." (Lewin, Lippitt, and White, 1939, quoted in Davies, 1986:77). Through participation, the worker as a factor of production is taken into account not by coercive control but by `involvement'. Presumably, workers' participation improves the overall efficiency of the enterprise as "more effective utilisation of the human resources in the organisation will be achieved" (Davies, 1986:77).

Similarly, Willcocks and Mason see job enrichment as "concerned with giving the job-holder more of the planning, decision-making and control functions" (1987:99). To these attributes, Buchanan (1979) would add social interaction and recognition, continuous learning as well as more desirable future. Also Wild (1975) had pointed to job enrichment's potential to increase the motivational content of jobs particularly when the technique also includes the provision of increased worker involvement and participation. It is argued that the higher order needs (Maslow, 1943) are better satisfied through such job enrichments rather than through simple enlargement of the content of jobs.

Presumably, the need to communicate and interact with others is met through group-working, and the `need to belong' is satisfied via different forms of participation. On the organisation's side, working in groups, particularly in autonomous or semi-autonomous work groups, supposedly reduces the need for close supervision and inspection and "produces more versatile and flexible working arrangements, thus speeding-up workflows and securing lower levels of work-in progress" (Storey, 1983:139). These, perhaps, explain Emery and Trist's (1960) recommendation in their Tavistock Institute study that work should be organised on a group basis and work groups given discretion to work, with little managerial interference.

Furthermore, Herzberg (1966) similarly sees a high likelihood of motivation and satisfaction in a job whose content offers opportunity for personal achievement, recognition, responsibility and growth. Herzberg also concedes the relevance of the job context. However, while he agrees that the absence of what he calls `hygiene factor'[12] - which are derivatives of the job context - is dissatisfying, he still insists that their presence is not necessarily a positive motivating force.

Humanisation theorists, and particularly job enrichment advocates, operate against a background of assumptions which cannot be proved or disproved objectively. Quite apart from the point that the concept of `inherent social needs' cannot be objectively defined and proven, the presumption that a satisfying job has to meet these human social needs is purely a moral judgement. As Grint (1991) has argued, the "criteria of satisfaction ... are seldom explicit and even less grounded in normative consensus" (1991:279). Also contentious are, the assumption that all workers necessarily desire `enriched' jobs; and the linkage between enriched jobs and job satisfaction. It is doubtful that every individual is moved to performing well and is delighted when his or her job offers challenge. Convincingly, Willcocks and Mason (1987) remark that job enrichment would be ineffective or even counter-productive when directed on individuals with little desire for self-actualisation and high status at work.

Besides, there is no systematic evidence to suggest a causal link between job content and satisfaction or between satisfaction and productivity. Irrespective of the content of job, satisfaction may well be derived from factors in the job context like pay, working conditions, and the quality of interpersonal relationships. Support for this argument is found in Goldthorpe et al's Luton studies. Goldthorpe et al., (1968a) distinguished between `solidaristic' and 'instrumental' workers. While the former sought intrinsically satisfying work which provided opportunity for participation in the community, the latter preferred extrinsic economic rewards such as high pay and job security. Goldthorpe and colleagues claim that the Luton workers they studied had an instrumental orientation to work[13] and were unconcerned by the intrinsic content of work. Aside from the argument that there is no neat connection between job satisfaction and motivation to work, there is little evidence of a necessary link, whether positive or negative, between individual job content or job performance and organisational performance. Performance is a function not only of employee motivation but also a function of variables like workers' skills, abilities, training, and the efficiency of the production system (Willcocks and Mason, 1987).

In any event, it is noteworthy that this behavioural orientation for work organisation also has other limitations. For example, by underplaying the need for control[14], it ignores what Dubois et al., label "sins of omission" (1976: cited in Batstone et al., 1987:16). This refers to the adverse effects workers' failure to act according to prescribed rules could have on production. In addition, humanisation programmes have been criticised for their apparent managerialist orientation[15]. For instance, Storey sees them as "techniques which seek to channel the dynamics of inter-personal relations towards the serving of managerial ends" and which are put into use "only ... when managerial problems are manifest ..."(1983:138-139). Similarly, Hill reckons that humanisation schemes arise from management's concern "to find new ways of raising efficiency and profitability by minimizing ... the dysfunctional consequences of the dominant forms of control and employment" (1981:45). He surmises that by adopting these "alternative forms of control..." management seeks to salvage itself from the problems created by the adoption of scientific management principles[16]. In effect, under humanisation programmes, classical production goals persist. It is only the means to these ends that are presumably altered. Apparently, it is hoped that a humane job would translate into increased employee effort.

Another notable criticism of humanisation is the implicit subscription to a unitarist view of organisation. Conflict is seen as unnecessary and effort is channelled towards the achievement of harmony. Thus entrenched is the conviction about the right of management to rule. Evidence Hill's agreement that "managerial prerogative seems scarcely to have been challenged let alone altered in these experiments" (1981:49).

To summarize, since the relationship between management and workers often tends to be more conflictual than harmonious, job design that takes `inherent social needs' of workers into consideration does not guarantee improved performance. Besides, since it is possbile that workers seek both intrinsic and extrinsic rewards, it is not likely that `humanisation' would be adopted as the sole criterion for organising work. A more coherent reason for work organisation needs to be sought elsewhere.

Work organisation for profit optimisation:

Neo-classical economics would point to the need for profit optimisation as the basis for organising work. Profit is considered important because of its implications both for organisational and individual growth. For instance, without profit, internal financing of growth could be difficult in the short term and chances of securing external finance would be grim (Hill, 1981). For the individual, lack of organisation growth would have an impact on job security and personal income. It therefore seems reasonable within a market economy for management to seek the most efficient way to organise resources, including human resources, so as to generate profit, even perhaps sufficiently to increase surplus value. In this respect, Hill points out that decisions concerning profitability are foremost in the list of organisation decisions and "other considerations are taken into account only as far as they are compatible with profitability" (1981:84). Similarly, Storey, whose work tends to be Marxian in outlook, states:

> The pursuit of profit remains an undiminished guiding force. It is the underlying principle defining `rational' action. Even the supposed alternative goals of growth and higher market share can be viewed as interlinking ones which allow a sounder base for profitability (1983:77).

Hence control strategies, like the division of labour and specialisation, hierarchical arrangement of tasks and authority, as well as humanisation programmes like job enrichment and/or enlargment, could all be seen as means for enabling or increasing productive efficiency, and hence improved profitability[17]. That is, profit optimisation becomes a function of the ability of management to control and coordinate the work process as well as cater for the social needs of workers.

In summarizing the reasons for organising work Wild (1975) includes: (i) greater productivity, (ii) improved quality, (iii) lower cost, (iv) fewer grievances, (v) improved worker attitudes, and (vi) better absenteeism and turnover records. These reasons are largely economic but control and humanisation dimensions are also implicated. In essence, while labour process theorists tend to marginalize organisations' economic needs, and the humanisation perspective underestimates both individual and organsiations' economic needs, the profit optimisation approach would ideally recognize all these needs, although it appears the economic dimension gets the most attention. Indeed, it is possible to argue that by underplaying the importance of other rationales, both labour process and humanisation theorists ignore important realities of the workplace. If, for example, direct control of work by management is all that organizing work is about, unattended individual social needs would duly cause such instability that the control ojectives could not be achieved.

2.4 CONCLUSION

Work is an essential human activity whose organisation entails the planning and management of its various elements. Involvement in the organisation of work presumably creates `order', and gives a leverage to the enterprise in its competition in the external market. However, the exclusivity of labour control, humanisation or profit optimisation as lone reasons for organising work is denied. What is more probable is that in real work situations, the organisation or `ordering' of work results from a mix of rationales. Nonetheless, it is conceivable that some rationales may be more dominant than others at different points in organisation life. Furthermore, once the rationales are seen as underlying the planning and management of work, it becomes clear that organisations would target this mixture of reasons as they mobilize a variety of resources, including human and physical resources, for the accomplishment of organisational goals. However, for our concerns, the physical resource of particular interest is the technology. In this regard, it is presumable that questions concerning why a given technology is employed in the first place would help to prove the existence, or otherwise, of the rationales for organizing work. However, of more importance here is the interest to find out whether these rationales are implicated or implicate technical change. If it could be shown that a rationale or rationales is (are) implicated during technological change, then the relevance of technology could be claimed.

Further, work organisation, as stated earlier, could be seen as having to do with the ways in which various elements in work like skills, tasks, and the control systems generally, are planned and managed. Hence, interest in the role of technology in the organisation of work could translate into interest in the extent of technology influence in the planning and management of these elements in work activity. Furthermore, a technological change context directs attention to the extent of changes in the skill and task contents of jobs and in the control systems. For our present concerns, this begs questions regarding the extent of technological influence in changes in these elements in work. That is, is the technology the primary explanatory variable for the changes, if they occur? Is the technology simply inert? Do other factors play any part in change? The next chapter begins to address these questions.

NOTES

1. Thus recognized as forms of work are unplanned or accidental inventions/creations as well as unproductive efforts. Although this differs from the physiocratic thesis that only productive agricultural engagements could be regarded as "work", it is compatible with Marxian distinction between productive and unproductive activity.

2. What this view actually highlights is aspects of social relations in the capitalist mode of production. Its defect stems from its failure to give due attention to the need of the worker to earn a living. Besides, productive endeavours of the self-employed are apparently excluded.

3. Need is considered an essential element in the conceptualisation of work. For the individual, involvement in work may be in response to the need for self-actualisation, for survival or indeed the need to satisfy the employer in order to earn a living. The survival need is equally relevant to organisations and even the society as a whole.

4. Whilst apparently accepting that individual goals are identifiable, some analysts deny the existence of separate organisation goals. For example, Silverman is of the view that "to say that an organisation has a `goal' may be to involve oneself in some of the difficulties associated with reification - that is, with the attribution of concrete reality, particularly the power of thought and action to social constructs" (1970:9).

5. Competing typologies of control inundate the literature. Amongst these are Friedman's (1977) distinction between `Direct Control' and `Responsible Autonomy'; and Edwards' (1979) `simple', `technical' and `bureaucratic' control types. It is not the intention here to review the different typologies but suffice it to state that non would effectively accomodate all the possible control issues that arise at work. At best, each provides a framework for analysing either techniques, strategies or forms of control.

6. Landes is not Marxist but some of his works lend themselves to such categorisation.

7. It appears the 'Prince' corresponds to the locus of power within a given context at a given point in time. As Latour emphasizes, "The dimension of the Prince ... varies in time from being a whole country

to being just one man in the crowd ... it is never certain whether the Prince ... is an individual, an assembly, a techno-structure, a nation or a collective" (1985:25).

8. Competition also occurs between different groups of managers within an organisation (Pettigrew, A., 1973; Ahlstrand, B., 1990). Mangement cannot be seen as an eternally coherent group, for in reality, it exudes different alliances and coalitions over time and over issues.

9. For instance, labour control issues are likely to be of secondary importance in an organisation where profit is a function of the sales effort or is dependent on fluctations in the market.

10. Collective bargaining means different things to different people. Farnham and Pimlott (1986) distinguish: (1) the `marketing' concept which sees collective bargaining as an exchange relationship between labour and capital focusing on substantive issues like remunerations and hours of work; (2) the `governmental' concept of collective bargaining as a rule-making institution in which rules governing relations between management and workers or other representatives are made; (3) the `industrial relations' concept highlights the participation of unions in organisational decision-making (Farnham and Pimlott, 1986:114-116).

11. According to Davies, the ideals which underpin the concept of participaton are "political, humanistic and efficiency..." (1986:75). She points to "practical problems and difficulties..." which undermine the translation of these ideologies into reality. Examples are issues like workers'desire and ability to participate all of which could stall the practicalisation of these ideologies.

12. Subsumed under Herzberg's `hygiene factor' are categories like pay and working conditions.

13. Goldthorpe et al's (1968a) `The Affluent Worker' was indicative of the reaction against technological determinism. For Goldthorpe and colleagues, workers' morale and integration to the organisation are not determined by technology, but by their "orientation" - a function of their social experiences outside work. Instrumentality corresponds to the need for a job and a decent wage to support dependents. It is conceivable that workers with such needs would be motivated and satisfied if the workplace caters for these needs. That the Luton workers had instrumental orientation may be expected because they were relatively young and middle-aged men with dependent

families (Hill, 1981). However, Goldthorpe et al have been criticized for failing to recognize that the concern with the nature of work never completely disappears and considerably accounts for workers' attitudes and reaction to work. In any event, Blackburn and Mann (1979) found no significant support for distinct orientations amonst workers;and where `orientations' were found, they were multi- rather than uni-dimensional. That is, instrumental workers with mainly economic concerns also indicated a desire for non-economic rewards.

14. A very contentious view. In the labour process literature, humanisaton programmes have been seen as control devices albeit of an indirect kind (Hill, 1981; Storey, 1983).

15. It is difficult to reconcile this view with the reported cautious rate of uptake of humanisation schemes in work organisations. For example, Storey declares that many managements in Britain "have displayed a marked suspicion of the new working methods" (1983:139). If these programmes are really pro-management, a question which arises concerns why their uptake is so slow. One explanation could be the uncertainty surrounding their utility in the effectuation of `order' in the workplace. Aside from the problems arising from Dubois et al's `Sins of Omission', managements could soon find themselves saddled with escalation in demands by workers for even more rights and say.

16. Hill (1981) distinguishes two sets of problems arising from scientific management. In the first place, the effectiveness of scientific management is reduced by workers' resistance to its consequent task fragmentation. Secondly, and perhaps more importantly, "technical inefficiencies" which also arise from task fragmentation sometimes increase rather than reduce organisation costs. As Hill explains, these techincal inefficiencies have to do with underutilisation of labour. This is in view of the limited discretion at work; slow-down in the speed of problem-solving which is consequent upon increased organisational complexity and the increased need for coordination of overly fragmented tasks; and finally, difficulties in changing ossified structures when the need arises.

17. Case studies evidence (Sayles, 1974, cited in Hill, 1981) suggests that not all categories of management make profit optimisation their major focus. Hill (1981) agrees that while profit maximisation may be a major concern for top level managers, some others lower down the management hierarchy "adopt sub-optimal strategies regarding accumulation, aiming

more for personal comfort and security than for entrepreneurial profit maximisation that involves some element of risk; they `satisfice' rather than maximise in order to regulate their personal environments against the vagaries of the market system" (1981:76).

CHAPTER 3

PERSPECTIVES ON TECHNOLOGY AND WORK ORGANISATION

It is evident in the literature that there are conflicting views about the meaning of technology and the nature of its relationship with work and work organisation. This chapter seeks to analyse these views. It begins with an examination of the various conceptualisations of technology and suggesting that the apparent lack of consensus in the definition deprives the concept of much clarity. Further, the different perceptions concerning the place of technology in work relations are then analysed within the context of three theoretical perspectives. These include the technological determinist, social determinist and the interactive perspectives. Based on the premise that technological outcomes cannot be convincingly explained in terms of the rather extremist determinist models, the interactive model is seen as more persuasive. This latter model thus provides the background against which the attendant research problem and question are stated.

3.1 DEFINING TECHNOLOGY

The elasticity of the concept `technology' is evident in the many perspectival variations in its conceptualisation. Winner notes the rather historical progression from "a very specific, limited and unproblematic meaning" to an ambiguous one such that technology "is now used to talk about an unbelievably diverse collection of phenomena - tools, instruments, systems and the totality of all these and similar things on our experiences" (Winner,1977:8).

Hence definitions of technology range from its narrow view as a physical object or artefact through the inclusion of a process dimension to its conceptualisation as some vague and imprecise phenomena covering diverse actions and situations[1]. The physical dimension of technology is captured in its definitions as "apparatus" (Thompson,1983) or "hardware" (Child,1984). On the other hand, definitions which highlight the process dimension of technology include its consideration as "process layout", "patterns of operation" (Winner,1977) and "workflow process" (Woodward, 1980).

A rather universalistic definition is provided by Ellul (1954) who defines "La Technique" as:

> the totality of methods rationally arrived at and having absolute efficiency (for a given stage of human development) in every field of human activity (Quoted in Theobald R, 1981:389).

By this definition, "La Technique" comprises of more than simple machines. It also has psycho-sociological, organisational as well as process dimensions, although Ellul failed to state the position of each dimension in relation to others. In any event, Blauner reckons that:

> Technology signifies *primarily* the machine system, the level and type of mechanization, but it includes also the technical "know-how" and mechanical skills involved in production (1964:6, emphasis added)

On the other hand, Hill argues that technology "embraces all forms of productive technique, ... the physical organisation of production, the way in which the hardware of production has been laid out in a factory or other place of work". And in the circumstances, the term "implies the division of labour and work organisation which is built into, or required for efficient operation by the productive technique" (1981:86). Put simply, technology involves machines and people as well as their organisation.

More recently, Clark et al (1988) offer a systems view in their contention of technologies as "engineering systems". Here technology is more than pieces of equipment. It is seen as an artefact but whose "pieces" are systematically arranged in a particular way in accordance with "system principles, an overall system configuration, and a system implementation ..." (Clark et al, 1988:13). The systems approach notwithstanding,[2] this definition avoids a notion of technology as an imprecise phenomena.

The more universalistic definitions demonstrate the different levels of meaning of technology and would be endorsed by some analysts (eg Latour, 1988) as an appropriate unit for analysis. Nonetheless, it must be emphasised that their ambiguity could be problematic when they are used as analytical tools. For instance, by failing to isolate technology from the social organisation required to use it, a conflation of dependent and independent variables is inevitable. In addition, when technology is presented as a process, a picture of continuity, incompleteness or temporariness is projected. This presents a problem in so far as where to start and/or end the analysis becomes contentious. To avoid these analytical problems, this work adopts a restrictive definition of technology as a physical artefact made up of systemic parts.

Developments in technology have resulted in the emergence of systems with features which delineate them from the earlier technologies and have earned them the label `new technology'[3]. As Jonas (1981) suggests, classical technology remained stable and unaltered for considerable periods of time, equilibrating means and ends, and representing an optimum of technical competence. This, he argues, contrasts with revolutionary changes in modern technology brought about by continuous research. Research has resulted in new systems which are based upon `older' mechanical and electro-mechanical systems but are distinguished from these `old technologies' because of their instability (Jonas, 1981) and because they "informate as well as automate" (Zuboff, 1988:10). As Zuboff explains, while the former depicts the generation of information, the latter refers to the ability of new technology to "displace the human presence" (1988:10).

Similarly, Buchanan D and Boddy D (1983) point to new technology's information handling capabilities and control over work processes. They conclude that the newness of technology has to do with its "widening range of applications, the conventional computer information handling features, extensions of control capabilities and the encouragement of convergence and integration of function and process stages" (1983:13). For present purposes, `new technology' and `technology' are used interchangeably but more specifically, it is the presumed capabilities of the newer technologies that will guide analysis. Accordingly, the following sections look at the relationship between this `new' artefact and work.

3.2 TECHNOLOGY AT WORK

As already noted above, there is an apparent lack of consensus in views regarding the functions of technology and the nature of its relationship with work. While some analysts see technology as a key factor in workplace relations (Blauner, 1964; Woodward, 1965), some accord a more or less neutral position to technology (Gallie, 1978), and still others contend that technology neither possesses overwhelming determinate qualities nor is it neutral in human-machine relationship (Latour, 1988; Callon, 1987). The differences in these arguments provide the basis for their categorisation into technological determinist, social determinist and interactive (or network) perspectives. An analysis of each of these approaches follows.

3.2.1 Technological Determinist Approach:

Like technology, technological determinism is a concept which means different things to different people. According to Bimber (1990), three levels of meanings are identifiable,[4] namely: "Norm-based Accounts", "Unintended Consequences Accounts" and lastly the "Logical Sequence Account" which he suggests is its purest form. In this `pure' form, technological determinism claims that technology independently dictates the course of social and organisational relationships. The `logical sequence Accounts' foreshadows the analysis that follows.

The technological determinist doctrine apparently stems from a `world view' of technology also referred to as `technological rationality'. This line of reasoning accords technology immense powers deriving from a dualism that effectively sets technological rationality distinctly aside from human action (Gulick, 1984). As Murphy and Pardeck (1986) note, technological rationality is appealing because, apart from emphasising objectivity and control over nature, it shuns ambiguity and the caprices of human action. The underlying presumption appears to be that human behaviour is irrational and the technical capacity of `rational' technology enables co-ordination and control of individual action for the `general good'. Whelchel (1986) seems also to authenticate this presumption in his suggestion that objectivity, quantification and utilitarianism are the hallmarks of technological rationality. As he explains, objectivity is valued because it places the "universal" above the `second rate' individual experience; quantificative value excludes the rather subjective qualitative thought and discourse; whilst utilitarianism clearly rejects the frivolous.

Hence, Ellul (1981) argues that "La technique" cannot be abandoned since this would mean an abandonment of rationality. After all, "technique" is "a totality ... rationally arrived at...". Ellul can therefore declare that `technique' is "autonomous ... self determinative independently of all human intervention" (1981:205) and "techniques proper motion tends irresistibly towards completeness. To the degree that this completeness is not yet attained, technique is advancing, eliminating every lesser force" (1981:389). Hence Ellul makes a case for a determinist and an autonomous technology. Seeming support comes from Winner who argues that "If [technology] were not determining, it would be of no use and certainly of little interest" (1977:75)[5].

Further thrust for technological determinism is provided by Forsyth et al., (1982). Using the engineering characteristics of manufacturing technology as a reference point, they identify "fundamental physical barriers" and therefore contend that "technical rigidities" provide the basis for technological determinism. In their view, technical rigidities, inherent in the nature of the technology, may considerably shape the nature of tasks and the organisation of work itself. Further, Forsyth and colleagues distinguish between "inherent rigidities" and "rigidities imposed by the availability of techniques"(1982:33). The former mode of rigidity refers to technological constraints which can be removed only by a shift in the `architecture' of the technology, for example, a change from one product/process to another. The latter relates mainly to unadapted techniques usually imported along with a given technological system as well as to the restrictions on the availability of capital goods. This latter mode of rigidity may be more obvious in developing countries where technologies are largely imported. Although this issue would be discussed in more detail in the next chapter, suffice it to state here that `importing' countries like Nigeria experience this mode of rigidity because the designs of the imported technologies are stipulated by situations in their countries of origin. These conditions are often very different from those of the countries to which the technologies are exported.

Another case for technological determinism has also been made by Meissner. As he remarked:

> The technology of a workplace ... consists of physical objects which constitute the stage on which workers play their parts and which set the boundaries for the range of their performances (1969:16).

He also refers to a "teleology of production" which in similarity with Forsyth's `technical rigidities' implies that the configuration of the technology in the workplace determines the events which must occur in a certain sequence in order that a specific outcome is realised. Further, Meissner suggests three forms of technical constraints as well as behavioural adaptations which are necessitated by technology. The technical constraints include spatial, functional and temporal/perceptual constraints. Spatial constraints have to do with technologically-determined location of workers at work stations. Functional constraints refer to the technical connections between work stations which might make tasks dependent on one another. In essence, the technical design regulates the relationships among work stations in the production system. Temporal/perceptual constraints concern the acts which individual workers must necessarily perform at specified times as they carry out their job tasks.

Moreover, Meissner (1969) categorises behavioural adaptations in terms of those which are technically required and those permitted by the technology. For instance, technically required behaviour includes the required co-operation and communication between individuals or groups of workers if the objective of the work process is to be achieved. By and large, Meissner sees technology as an independent variable which shapes the workplace.

Several studies seem to give credence to the technology determinist position, although both enthusiasts and pessimists of technology provide a wide range of views. Robertson (1923) for example stressed that the leading feature of technology in the factory system "is the regimentation of large bodies of work people under conditions of routine and discipline" (1923:12).

Similarly, Landes (1969) notes how factory work was done "at a pace set by tireless inanimate equipment" (quoted in MacKenzie and Wajcman, 1985:12). Also, studies of automobile industries in the 1950's showed that in assembly-line technologies, as in the early factories, the pace of work was set by machines and the workers had no control over their work (Walker and Guest, 1952; Chinoy, 1955: cited in Hill, 1981:87).

Investigations which include other forms of production systems also strengthen the determinist notion of technology, and suggest effects on organisational arrangements and the experience of work. For instance, by locating her dimension of technology at the control level, Woodward (1959) claimed a link between technology and variables like authority structure, spans of control of supervisors, and production control procedures. Her findings suggest that while in unit or small-batch production systems much of the control is exercised by the worker, greater managerial control is exercised in more complex production systems. In a later work, Woodward reports that "the technology of process industry and the situational demands associated with it establish conditions particularly conducive to the development of harmonious and contributive social relationship" (1965:199)[6].

For Blauner, "technology, more than any other factor, determines the nature of the job tasks ..." (1964:8). As he further argues, it is "the character of the machine system [that] largely determines the degree of control the factory employee exerts over his sociotechnical environment and the range of limitations of his freedom in the work situation" (1964:169-170). However, unlike[7] Woodward, Blauner is convinced that technology, as in continuous process plants, would make work more meaningful as it eliminates many sources of resentment about work and "gives workers a great deal of control over their immediate work processes" (1964:135).

Of course, many analysts in the labour process school would not subscribe to these views. For instance, Braverman seems to be certain that whatever the type of technology,

> The capacity of humans to control the labour process through machinery is seized upon by management ... as the prime means whereby production may be controlled not by the direct producer but by the owners and representatives of capital. Thus ... machinery ... in the capitalist system [has] the function of divesting the mass of workers of their control (1985:81).

What seems clear from this argument is that Braverman subscribes to the view of technology as a vital tool for control. But he differs from Blauner in emphasising that the control is managerial. Besides, whilst Blauner tends to see technology as an independent variable, Braverman seems satisfied with it as an intervening variable.

Another strand of argument, which could also be seen as having a technological determinist tone, comes from Bright (1958) who found that "automation had reduced the skill requirement of the operating workforce, and occasionally of the entire factory force". As he reasons:

> the machinery become virtually self-sufficient in terms of needing no worker-input. Such work that does remain is subject to more centralized control and closer supervision even though the tasks to be performed may have been sophisticated (quoted in Francis 1986:44).

Perhaps the most influential argument concerning the deskilling effect of technology was put forward by Braverman (1974). Braverman claims that Tayloristic principles, adopted by management in order to tighten control over labour and reduce dependence on worker co-operation, involve `deskilling' of workers by the removal of knowledge and autonomy from the shop floor and putting these in the hands of management. Braverman argues that in its pursuit of Tayloristic principles, management finds a ready ally in technology. Management acquires production systems into which skills[8] divested from workers are incorporated. The performance of tasks thus requires little human input as machines take over. Braverman is convinced that deskilling is a continuous trend; workers become appendages of machines as they "function as cogs and levers" (1974:136) and may ultimately be denied the right to work.

Hill (1981) gives similar credence to the deskilling theory in his reference to new microelectronic systems. These systems he elaborates:

> entirely removes the element of human skill ... Thus the cognitive planning element of craft work is now increasingly to be given to machines and not even to technicians. Designing, for example, is now heavily automated in large engineering firms with a consequent loss in the draughtsman's control and the opportunity he has to use his skills to say nothing of his increased prospects of unemployment. The search for profitability which results in the

> continual transformation of the instruments of production implies the abolition of human intervention and control (1981:117).

Some studies seem to confirm the deskilling[9] thesis. In his case study on the use of robots in a West German factory, Wobb-Ohlenburg (1982) discovered that robots had taken over the skilled elements of tasks in the welding operation. Before robotisation, the welding job required a considerable level of skill and welders set the pace of work. However, with robots, the job became less skilled and work was paced such that the cycle-time became dictated not by operatives but by the speed at which the robot did the welding. Cockburn (1983) reports a similar trend. In her detailed account of the replacement of "hot metal" by computer-based methods in typesetting, she reveals how new technology transforms typesetters' work and reduces the requirement for traditional manual craft skills. In her words:

> men ... feel helpless before computer technology ... [and] have moved from an active and interactive relationship to a passive and subordinate one (1983:102).

Boddy and Buchanan similarly concluded from their study of the computerisation of biscuit making that "the skilled and varied crafts of the doughmen had been replaced by the computer" (1982:151).

Nevertheless, it must be noted that there is no universality in the `deskilling' phenomenon. For example, in the same study, Boddy and Buchanan (1982) also found a contrasting set of computer effects on another group of workers in the same factory - the ovensmen. As they write:

> the ovenman felt that the new system had reduced the pressure on him ... He also felt that the package had increased the challenge and interest in his job because it gave him a goal that he could see and influence (1982:153).

This report runs counter to the rather simplistic deskilling thesis. Also debunking the thesis is Swords-Isherwood and Senker's (1980) conclusion from their survey of the engineering industry. They found no clear evidence of deskilling and in fact suggested an increasing demand for skilled technicians as more and more industries acquire new technological systems.

Similarly, Fong, writing on the newly industrialising countries, takes the view the "computer technology and automation have weakened the demand for unskilled and semi-skilled workers, and increased the demand for specialists, technicians ..." (1985:95). As it appears, this argument is not incompatible with experiences in the under industrialised countries where for instance Edquist finds that "mechanization of cane cutting led to a considerable generation of technical skills ..." (1985:77). Besides, Colombo refers to "new jobs and skills that will in time add to the traditional ones, and replace them" (1991:25) as a result of an anticipated extension of the `technological revolution' to the third world.

Aside from these indications of a possible `enskilling' effect of technology, it is perhaps also necessary to note that `deskilling' may not be the dilemma it is often made out to be. In the first place, it is not the case that all workers must necessarily require manual and intellectual skills (as Braverman's argument seems to suggest) nor is it proven that the acquisition of these skills is desired by all workers. Besides, it is presumable that what is happening is essentially a substitution of one skill for another. In this context, Batstone and his colleagues note that "under automated systems the traditional link between worker effort and output is broken. What becomes important is a set of skills associated with monitoring the production process" (1987:16). Similarly, in reference to their study of the replacement of the `strowger' exchange by `TXE4' - semi-electronic telephone exchange system - in British Telecommunication, McLoughlin and Clark state:

> The new skills required to accomplish TXE4 maintenance tasks showed a qualitative change in contrast to strowger ... On one hand ... manual dexterities and elements of tacit knowledge ... were no longer needed. On the other hand, there was now a strong emphasis on mental diagnostic skills (1988:109).

Thus, it is possible to argue that a certain degree of deskilling may be going on but, at the same time, reskilling and/or upskilling are equally evident. Hence, suggestions concerning reskilling/upskilling or deskilling seem to be dependent upon individuals' notions of skill and the significance they attach to the various modes of skill.

The presumed capabilities of new technology have provided the context for other determinist-ladden assertions concerning organisation life more generally. As Zuboff sees it:

> Computer-based technologies are not neutral; they embody essential characteristics that are bound to alter the nature of work within our factories and offices, and among workers, professionals and managers (1988:7).

Zuboff observes that new technology provides transparency to previously opaque work activities as well as enables continuity and control. Using her impressive distinction between `informating' and `automating' capabilities of modern technology, she opines that the former alters the intrinsic character of work while the latter tends to decrease the dependence on human skills. On the other hand, Buchanan and Boddy (1983, 1986) stress the potential for changes in job profiles, roles and functions as a result of the "Convergence" capabilities of new technology. They also point to the integration potential of new technology which generates inter-dependencies and cooperation between previously autonomous sections, units or departments in the workplace.

In a similar vein, McLoughlin and Clark (1988) suggest that organisational integration enables "faster and more precise knowledge on work operations" (1988:78). Also implicit in the integrating capability of technology is the blurring of traditional job boundaries and consequently, changes in the organisation of work as well as attitude to work. In essence, new technology may influence organisation structure, the number of available jobs, the way work is done, the content of the jobs, the skills and training requirements, the control systems, payment systems, and the productivity potential of individuals and organisations.

Furthermore, it also needs to be mentioned that these perceived changes in organisational life raise important industrial relations questions. In this regard, Davies observes that "changes in skills, whether an upgrading or a deskilling, have already led to industrial relations problems"(1986:14). She points to demands for "increases in pay to either compensate for the monotony or to reward the acquisition of new skills" (1986:14). On the other hand, Clark et al., (1988) draw attention to questions regarding the extent to which existing collective bargaining arrangements could cope or would be altered in the face of technological change. Also notable is the extent to which trade unions participate and are able to influence change. As Willman puts it, "important questions surround the managerial intentions behind change, the characteristics of industrial relations institutions prior to change, and the nature and extent of bargaining and consultation" (1987:135).

Evident in the preceding analysis are the graded meanings of technological determinism, from causal to simple associational links. While some accounts are categorical in their ascription of autonomy and independence to technology, others are satisfied with a simple recognition of some technology influence. However, technological determinism and technology determinist accounts generally have been widely criticised.

To begin with, the view of technology as "rational" while human beings are "irrational" is objectionable. Quite literally it does not seem logical that the "irrational" human being produces rational human-made technology. Also questionable is the supposed objectivity of technological rationality and its separation from human action. If it is accepted that technology has meaning, then technological rationality cannot be treated as value free; and if it is not value free, it cannot be regarded as objective. On the other hand, the validity of technological rationality is doubtful since, in emphasizing objectivity and distance from ambiguity, the view makes assumptions about rationality which are themselves value-laden. Thus predicating technology are meanings and values - human dimensions which cannot be rightly overlooked. As Murphy and Pardeck also argue, "human action [indeed] creates the context that supplies technological rationality with its meaning" (1986:1). Hence it is presumable that since human values underpin technological rationality, technology which it subtends can neither be autonomous nor deterministic.

In a similar vein, Hughes (1987) rejects autonomism for technology. Using the metaphor "momentum" he contends that:

> Technological systems, even after prolonged growth and consolidation, do not become autonomous; they acquire momentum [and] they display a rate of growth

> suggesting velocity. A high level of momentum often causes observers to assume that a technological system has become autonomous (1987:76).[10]

Arguments against `autonomous technology' enable Ellul's extremist view, that social phenomena are "situated in" and are in fact defined by "la technique", to be seen as an exaggeration and highly contentious. It is difficult to see how, for example, the politics and economics of technological development are embedded within technology itself rather than being considerably human-influenced. Bimber attempts to clear this confusion be explaining that Ellul's "technique is not merely technology, it is the domination of social, political and economic life by the adopted goals of logic and efficiency" (1990:337). But this explanation implicitly supports Ellul's view that humans are now helpless captives of technology, a view which unfortunately suppresses both the fact that technology does not have a life of its own and the point that the ultimate direction of technological development is determined by human decision and choice.

Further, although the `technical rigidities' concept could explain similarities in technological change outcomes, it fails to explain variations in these outcomes in different organisations with similar technology. These variations suggest the influence of factors other than technology. As Kling concludes from the study of two clerical work groups exposed to a similar technology, "different management approaches have resulted in very different changes from the computerisation projects" (1990:12). On the other hand, Stewart and James do not find the technical rigidities argument acceptable. They stress that these rigidities are not "iron physical laws but are also products of human endeavour and organisation" (1982:5). In effect, rigidities are, in fact, alterable.

Relatedly, it is possible to argue that human intervention, though in some cases very infinitesimal, is still essential, at least for the activation of the technical procedures. That is, "the existence of assembly-line facilities does not determine who controls its operation" (Grint, 1991:280). Also arguing along the same line, Noble had stressed that:

> In reality NC [that is Numerical Control] machines do not run by themselves ... the new equipment, like the old, requires a spectrum of manual intervention and careful attention to detail ...(1985:120).

In essence, technical rigidities notwithstanding, technological systems have to be put into use by people who may not necessarily be compelled by them. Therefore, technology cannot be justifiably seen as exerting a determinate or even an independent influence. In so far as technological determinism fails to pay due attention to the question of human choice and that concerning "what shapes the technology in the first place, before it has `effects'? (Mackenzie and Wajcman, 1985:6) it remains unconvincing.

3.2.2 Social determinist or the `social shaping' Approach:

This perspective denies technological determinism. In its extreme, it assumes that technology is unimportant, if not irrelevant. Here social factors are given primacy and are seen as determining or shaping workplace relations. This view gets much inspiration from the social constructivist approach, a major theme in the sociology of scientific knowledge. Drawing on the Kuhnian tradition, the basic tenets of the social constructivist approach are that from the outset, there is no one interpretation to scientific findings. Competing interpretations undergo "stabilization rituals", that is, negotiation between social participants. Hence, ultimately this "interpretative flexibility" gives way to a consensus. As

Pinch and Bijker write, "social mechanisms ... limit interpretative flexibility and thus allow scientific controversies to be terminated ..." (1987:27). In the circumstance therefore, they argue that scientific knowledge, and indeed all knowledge, are social constructs.

Pinch and Bijker (1987) endorse the extension of the social constructivist perspective to sociological analysis of technology. They argue for the adoption of "a perspective that attempts to show that technology, as well as science can be understood as a social construct" (1987:25). Using their detailed study of the development of the bicycle, they sought to demonstrate that technological artefacts are culturally constructed and interpreted. They insist that the ultimate design and indeed the `technical content' of a technological artefact is agreed upon through negotiations among and between relevant social groups. In other words, the technology arising from the `stabilization rituals' do not therefore have an "objective existence independent of the accounts given to it by individuals" (Grint, 1991:283). Further, if, as Woolgar argues, `interpretative flexibility' could be seen along the lines that "apparent `self-evidence' and `incontrovertibility' are social accomplishments which are subject to change" (Woolgar, 1990:19), then it follows that technological artefacts are unstable and indeterminate (Woolgar, 1990; Grint, 1991).[11] It also becomes conceivable that technological outcomes are socially determined.

At a more empirical level, the social determinist approach appears to have found support in studies carried out by some analysts and researchers. For example, Singer (1958: cited in Bruland, 1985) suggests that the imbalance created by the invention of the spinning-machinery stimulated effort to speed up the technological development of the textile industry as a whole. Also Bruland (1985) charts how the invention of the `self-acting mule' was engendered by the need to curb the excesses of spinners. Spinners reportedly always took undue advantage of their strategic position and strength in the production process to carry out strikes and stoppages in order to secure their ends. Thus the self-acting mule was the employers' answer for spinners challenge to their power and authority. This could be seen as a case of social need determining or shaping an invention.

In his own account, Noble (1985) also highlights the import of management strategy and choice. He shows how the design of numerical control (NC) tool was literally determined by management in the American Airforce. As he remarks:

> Machine-tool builders were simply competing to meet `performance' `competence' specification for government-funded users in the aircraft industry (1985:113).

Moreover, in his analysis of the development of the APT (Automatically Programmed Tools), Noble made the point that the airforce helped to ensure that the APT computer language became the industry's norm in spite of its disadvantages. He similarly suggests the social, or more precisely managerial, determination of the adoption of numerical control (NC) in place of record-playback.

Further credence for the socio-cultural determinist thesis is provided by Gallie (1978) in his comparative study of refineries in Britain and France. Gallie found that in spite of the similarities in technology, there was neither behavioural nor attitudinal similarities between French and British refinery workers. He therefore concluded that:

> the nature of the technology per se has, at most, very little importance ... [of more] critical importance are wider cultural and social structural

> patterns of specific societies for determining the nature of social interaction within the advanced sector (1978:295).

Similarly, Wilkinson argues that "production technology and its associated working practices can only be understood by reference to the social actors involved in its design and use" (1983:20). Hence he points to how job rotation practised in an optical firm he studied was management's choice of work practice in response to the undesired deskilling effect of the new technology it introduced. The technology did not demand that job rotation must be practiced. Apparently making a similar point, Buchanan and Boddy reckon that "the changes to job characteristics that accompany technological change reflect partly the capabilities of the technology, and partly the objectives and expectations of management" (1983:246). Implicit in Buchanan and Boddy's remark however is an underestimation of workers' influence. This flaw is remedied by McLoughlin and Clark in their contention that "outcomes [of technological change] are not only chosen but can also be `negotiated'..." (1988:130). Similarly Wilkinson draws attention to the relevance of "the way workers respond, adapt and try to influence ... outcome" (1982:165).

In essence, the outcome of technological change is socially determined, but not only management is involved in the social shaping process. Another important implication of these arguments is that the observed differences between organisations with similar technologies become explicable under a social determinist framework. [12]

Nonetheless, the exchange of one mode of determinism for another, as is the case in the socio-cultural determinist framework, is unpersuasive. To accord socio-cultural conditions primacy whilst suggesting the neutrality[13] of technology is hard to justify. It is difficult to see how technology would be inert during technological change. Besides, if one draws on a criticism of technological determinism, it is one thing to say that social factors constitute an active force in the development and use of technology and a completely different point to insinuate that social factors intractably determine technological outcomes. Hence criticizing Gallie's conclusions, Grint makes the point that "oil refineries are not composed of human-less oil refining technologies any more than technology-less workers comprise an oil-refinery" (1991:285).

It needs to be noted in passing that remarks from many analysts who reject the technology determinist thesis do not give credence to pure social determinist claim. In fact their remarks unwittingly confirm technology influence. For example, in his research on computer numerical control (CNC) machine tools in the engineering industry, Wilkinson accepts that technical constraints "do exist [built in during the design process] and do place some limits on the amount of control an operator can exert" (1983:66). Similarly, Child agrees that workplace technology "may exhibit short-term rigidities and perhaps indivisibilities and will to that extent act as a constraint upon the adoption of new workplans" (quoted in McLoughlin and Clark, 1988:100).

Furthermore, one finds difficulty with the argument that technologies are unstable entities and therefore do not have "fixed and determinate uses" (Woolgar 1990; Grint, 1991). It is conceivable that the design of technological artefacts is socially determined and that all such artefacts are subject to "stabilization rituals". But, it is equally conceivable that these artefacts have definite or fixed uses. To take a rather mundane example, the personal computer, as it is, has a variety of `fixed' uses. It cannot be used on the production line for crude oil refining for instance. Besides, following Pinch and Bijker's (1987) account of the development of the bicycle, `stabilisation rituals' can only result in new or modified artefacts with new or modified uses. A technological artefact would therefore have `fixed' use(s) at least for the brief period that precedes its modification. In the event, Woolgar and Grint's argument becomes more persuasive if by imputing that a given technology does not have a determinate use, they simply imply the possible modification of its use over time.

Furthermore, a point has to be made in passing that it is not always that `stabilization rituals' are directed at the fine details in the design of the artefact. As Pinch and Bijker's account also shows, the `technical content' need not be the basis for stabilization. Stabilization may simply mean that substantive or potent technical entities are competing for acceptance by those involved in the stabilization process. This does not necessarily mean that the technical entities, which do not earn acceptance, are non-viable or unusable.

It also needs to be noted that the social constructivist approach suggested by Pinch and Bijker (1987) tends to focus on how a technology comes to be accepted not necessarily what happens after its acceptance. In their scheme, social groups would determine the shape of a technology during its design. However, once the design is complete, there remains some probability of escape from this mode of determinism to another, quite possibly technological. This effectively suggests the existence of delimiting boundaries for socio-cultural determinism. It also provides a credible basis for what Grint sees as the `technicist' notion that "irrespective of the social construction of technology, once the technology is constructed its technical capacity is to a large extent inscribed or encased into its fabric such that it operates as an independent variable" (Grint, 1991:292).

Considering the foregoing, it seems erroneous to suggest that technology itself does not matter and that what counts in the explanation of technology impact is the social system in which the technology is embedded. It is equally problematic to "fail to look behind technical things to notice the social circumstances of [technological] development, deployment, and use" (Winner, 1985:26). Put succinctly, both technological determinist and socio-cultural determinist perspectives are one-sided accounts and are therefore seriously flawed. A more persuasive approach is therefore required.

3.2.3 The Interactive Approach

This represents an extension of Barnes (1982) proposal of an interactive model for science and technology and the avoidance of hard analytic categories such as technology, politics and economics. This is necessary because a complex interrelationship exists between these categories which together form a complex `whole'. Therefore, these "Parts simply cannot be understood separately from their relationship to the whole; in turn the totality is reflected in each part" (Storey,1983:49).[14] As Storey further emphasizes, "The whole is in the parts and the parts in the whole" (1983:170). Hence a central argument in this approach, which has been variously referred to as a network (Latour,198; Law,1988) and as a systems (Hughes, 1987,1988) approach, is that the distinction between technology, social, economic, cultural or political factors does not reflect what occurs in the `real' world. All these factors interact with one another and thus need to be treated as mutually interdependent. Delineating this approach therefore is the total rejection of any form of determinism which is seen as representing only a partial view and is thus likely to be defective.

Hence Hughes (1988) emphasizes the "seamless web" of political, cultural, technical and economic factors. Law (1991) takes a similar view. As he aptly puts it;

> what appears to be social is partly technical. What we usually call technical is partly social. In practice nothing is purely technical. Neither is anything purely social. And the same may be said for the economic, the political, the scientific, and all the rest (1991:10).

Thus according to Law, "wherever we scrape the social surface we will find that it is composed of networks of heterogeneous materials" (1991:10). Also for Law (1987, 1988), organisational success is a function of the ability of "heterogeneous engineers" to mobilize and juxtapose heterogeneous elements like scientific theories and skills, organisations and technological artefacts.

Similarly, Latour (1988) considers purely technical or social explanations for technological outcomes as untenable. He recommends "get[ting] rid of these twin artefacts, society and technology..."(1988:22) since according to him, " humans, non humans... are never sufficient in themselves"(1988:305). Latour suggests the assumption of "a socio-technical position in which we see the innovators, or entrepreneurs, appealing from one set of alliances with human actors to another set of alliances with non-human actors..."(1988:22). For Latour, "machines are lieutenants; they hold the places and the roles delegated to them..."(1988:309) and, as he sees it, technology "has insinuated itself in such a way that ... it spreads in a painless, quiet and necessary way ..." (1988:31). This notwithstanding, these `non-human allies' have been socially `woven'. What therefore results are `social-technical stratagems', products of confused overlaps, which he claims defy social explanation. On the other hand, technology cannot be seen as inexorably determining because its usefulness depends on "the solidarity it offers with other human struggles" (1988:32).

In essence, technology is socially constructed but it is still important. However, technology is not independently important since it needs other `allies'[15]. As Law would put it, it "is recursively woven into the intricate dance that unites the social and the technical" (1991:18). In his part, Latour concludes that the only relevant question when analyzing the relationship between the social and the technical is whether "this association [is] stronger or weaker..."(1988:27), not the primacy of one over the other.

An appeal for the interactive approach is demonstrated in the socio-technical systems design, the origin of which is associated with the Tavistock institute and is also propagated by the human-centred systems school.[16] However, it must be noted in passing that the socio-technical system design does not fall neatly within the framework of the interactive model since it does not necessarily emphasize a coalition between the interacting actors. Nonetheless, both the interactive and the socio-technical system approaches share some commonality in so far as neither of them accords primacy to any factor, whether technological or human. The socio-technical systems approach recognizes the interactive mode between technology and people and hence differs from both technological determinist and social determinist models. However, the approach seems to imbibe elements of the determinist models in so far as, for instance, it is able to accomodate the argument that:

> [whilst] those in control of society may legitimate the rationality of technological progress through the rhetoric that denies human choice ... or through a

> rhetoric which purports to conflate `common sense' to technological progress, [it remains the case that] the subordination of choice to technological progress is itself socially determined (Grint, 1992:57).

Under a socio-technical framework, the relationship between technology and people is bilateral rather than unilateral. In other words, the technical or social are not sufficient in themselves. For instance, technical efficiency alone would not guarantee the effective utilization of technological artefacts. Mediation by humans is of a necessity. Probably arguing along similar lines, Hill (1988: cited in Grint, 1992) takes the view that a culture-technology alignment is a necessary condition for a technological system to be deemed viable.

In making a case for socio-technical design, Rice, one of the early advocates of the model, explains that:

> the concept of a production system as a socio-technical system ... [refers to] the interrelations of the technical and socio-psychological organisation of industrial production systems ... The concept ... arose from the consideration that any production system requires both a technological, organisation-equipment and process layout - and work organisation relating to each other and to those who carry out the necessary. The technological demands place limits on the type of work organisation possible; but a work organisation has social and psychological properties of its own that are independent of technology. A socio-technical system must also satisfy the financial conditions of the industry of which it is a part. It must have economic dimensions, all of which are interdependent but all of which have independent values of their own (quoted in Kelly, 1968:104-5).

In essence, the main theme of the socio-technical systems design is joint consideration and optimisation of both technical and social components in the human-machine relationship (Mumford, 1979). However, a problem with the model lies in its implicit assumption that the precise capabilities of a given technological system as well as the optimum social efficiency can be estabilished. With regard to the former, Grint (1992), for example, gives a graphic account of the contested nature of the technical capabilities of technology. He makes the point that "what counts as a `black box' and what the `black box' will do are themselves social constructions" (1992:60). Hence, determining optimum technical efficiency is problematic and indeed doubtful. Similarly, from an interpretivist perspective, different models of social efficiency would exist, depending on individuals interpretation of reality, particularly the dominant and most persuasive interpretations. Further, even if the most persuasive interpretation prevails, it still remains the case that what is regarded as socially efficient or optimum would vary from one social context to another. In essence, there can be no one universally applicable socio-technical system.

One expectation of some advocates of the socio-technical model (notably Mumford, 1979; Ehn, 1988) is that its adoption would end the domination of humans by machines which then become no more than tools to augment rather than replace human skills. This is particularly notable because implicit here is a technology shaping process which effectively underscores the subjectivity of socio-technical design approach itself. Therefore, Law (1988) can justifiably argue that socio-technical systems are a function of tactics - "tactics for the mobilisation and juxtaposition of heterogeneous elements" (1988:45) - rather than dependent on the availability of the various heterogeneous elements themselves. According to Law, it is important to analyse these tactics used by systems builders. In a similar vein, Wilkinson (1983) indicates a preference for an exploration of the roles of engineers, managers and workers when the technology and the working practices are contested and chosen. This strategy would tend to draw attention back to the social-determinist thesis but would possibly also highlight the existence of options and constraints and the role of negotiation and choice when deciding on options.

Overall, the attraction of the interactive model lies in its recognition of input from all the `heterogeneous actors'. That is, variables are neither neutral nor deterministic. Also, whilst discouraging the treatment of variables as distinct entities, the interactive approach does not suggest that the `actors' are lost in the `web' nor does it clearly deny the capacity of these `actors' to `influence'. It is this underlying ambiguity that provides the platform for the research. Admittedly, the social and the technological are not "two estranged communities" (Latour,1988:23) and, the mechanisms of stitching up alliances between them are largely obscure. But, does these necessarily mean that the `allies' are not able to exercise discernable, though not independent, influences? A notable point is that the all-embraciveness of the interactive model generally tends to drown the feasibility of this direction of enquiry. Nevertheless, there is reason to believe that research in this direction is plausible. After all, that allies are interacting and, more specifically, the presence of the human ally per se do not alter the point that a crude oil refining plant would produce refined petroleum products whilst a steel mill churns out only steel bars. In any case, even Latour himself is able to convincingly chart out the function or influence of his `door-closer'.

Therefore, from the premises that: `actors' are not necessarily lost in the web; that each is able to exert influence without necessarily being deterministic; that this influence is not exerted independently since each ally needs the others; and that to exert influence suggests relevance, the research interest is to explore the areas of influence, and hence relevance, of an actor, specifically technology, in a given phenomenon (in this case, the organisation of work), the `actors' coalition network notwithstanding. Also of interest is to find out whether the importance attached to imported technology in a developing country like Nigeria makes it a dominant partner in its coalition with the `social'.

3.3 CONCLUSION

As suggested in the preceding analysis, many perspectival variations in the definition of technology are evident in the literature. However, for analytic investigations, a more restricted definition is preferred to a rather universalistic one because of the conflation of variables which is inevitable in the latter. Further, it was stated that the function of technology, particularly the `new' variety, and the nature of its relationship with work has been an area of wide ranging speculations and assertions. For convenience, these varied views are grouped into three categories.

Views which tout essentially `technical' explanations for all that happens in the workplace are crudely[17] categorised under the technological determinist approach. For instance, within this framework, technology would be claimed to determine or unilaterally influence the content and character of jobs, as well as the mode of control in the labour process. In the technological determinist model, much seem to be made of the `technical rigidities' which are presumed to enable technology to become the main explanatory variable. In the event, the inherent technical rigidities means that such thing like the spatial location of workers and, incidentally, their social relationship; the job tasks that must necessarily be performed, perhaps in a specific order and time; would all be determined by the technology. Furthermore, in relation to developing countries, technical rigidities would presumably guarantee that the imported technology would meet the expectations of the importing country. Put differently, from a technological determinist perspective, a given technology would have the same effects no matter where it is employed. Hence, a developing country can be rest assured that a technology that supposedly enhances output would perform the same `fits' for it. By the same token, a technology that is claimed to reduce manning level or deskill jobs would manifest exactly the same effects everywhere, both in its `home' environment and in a foreign one. However, that technical rigidities are not iron physical laws is evidenced by reported variations in the outcomes of technological change in organisations with similar technologies. Hence, technological determinism, which is apparently sustained by the inherent technical rigidities of technology, is flawed.

Another group of views, categorised as the social shaping or social determinist approach, proffer entirely social explanations for all work relationships. In this model, both the technology and any changes that accompany its deployment are socially determined. An essential argument here is that "the critical tool that led to the assembly of the megamachine were inventions of the [human] mind..." (Miller,1990:155). Besides, technological artefact comes into being only after `stabilization rituals' and final acceptance by social participants.

Under the social shaping approach, the deployment of skills and the `systems' of control, as well as any changes in them, would be seen within the context of social relations and would be explained only by social means. For example, the divesting of control from the worker to the machine (Braverman,1985) would, in no uncertain terms, be a socially or, more specifically, management determined phenomenon. Similarly, variations in technological change outcomes in organisations with similar technology, as well as instances where the `smart machine' has not delivered its promises, would be easily explained along social lines.

However, one wonders, for instance, how the inability of a textile mill to process crude oil could be explained by purely social means. In other words, the social shaping approach fails to recognize the point that "men are never completely free to define their situations independently of structural constraints" (Rose 1975:244).

Finally, middle ground arguments which project the plausibility or rather viability of both technological and social explanations are grouped together under the interactive model. Although this model suggests a processual relationship between the social and the technological, its tenet of critical importance here is its recognition of contributions, and hence relevance, of all variables in the interaction. In other words, under the interactive framework, neither the technological nor the social is seen as `the' determinant of all workplace relations. Rather, each could be seen as `a' determinant in its own right. That is, each has the ability to exert influence.

Furthermore, the interdependent relationship between the social and the technical suggests that their influences are not always unilateral. Neither of them exclusively determines all workplace relationships whilst the other remains permanently on the sideline. For instance, decision makers are not able to divest control from workers vacuously any more than technology is able to unilaterally control work. Put differently, management cannot possibly deploy or redeploy skills in a technologyless environment. Similarly, the capacity of technology can be manifest only when it is socially decided to be put into use. Therefore, from an interactive perspective, whatever the reasons for organizing work, both technological and social factors are implicated, one way or another. Hence, in these relationships, Latour would "see only actors - some human, some non-human ... - ... entities that do things ... " (1988:303).

In summary, both technological determinism and the social shaping approaches are rejected for their one-sidedness. On the other hand, the interactive model is found generally more persuasive principally because of its denial of any form of determinism. However, its all-embraciveness tends to result in a situation where, to borrow Rose's words, "Nobody wins the race but everybody gets a prize" (Rose,1988: cited in Mcloughlin, 1992:34). But then, it is difficult to discount the view that making distinct claims about `actants' like technology, for example, "are of central importance to both academic audiences, organisational practioners, and public policy makers, in evaluating both the implications of new ... technologies and the opportunities and constraints that they pose"(Mcloughlin,1992:25). But, as it appears, thoroughgoing interactive model seems to be dissuasive of such claims. In any event, by not clearly denying the ability of the various actants to exert discernable influence, the interactive model provides the leeway for the research. Thus, on one hand, I subscribe to the interactive view that actants are all relevant but not independent. On the other hand, one is persuaded by Clark et al's., recognition of "technology ... as a significant explanatory variable ..."(1988:10), that is, in so far as this means a discernable technological influence. However, am unconvinced by these analysts contention that this influence could ever be independent. Recognized is the essential dualism surrounding technological influence in the extent that technology possesses potentials which it cannot manifest on its own accord and in a vacuum. Therefore, it is considered worthwhile to explore the extent to which a factor, in this case technology, is able to exert influence whilst within the interactive network. This is the research issue.

NOTES (3)

1. This is much in line with MacKenzie and Wajcman's (1985) identification of three layers of meaning for technology - physical objects; human activities; and "what people know as well as what they do" (1985:3).

2. A `systems approach' posits that a system is only part of a wider environment upon which it is dependent and is itself made up of subsystems. The problem in systems analysis therefore lies in the possibility of accurately identifying the critical boundaries as well as the areas of interdependencies between the system and its external environment on one hand and, on the other hand, between the subsystems which make up the system under consideration. Such an analysis can only be tentative. In any event, one advantage of a systems viewpoint is that it tends to place more emphasis on the utility of the artefact rather than on the artefact as a tool in itself (Whelchel, 1986).

3. Not all would accept this distinction. For example, Berggren rather cynically remarks that "it is often the interest in the new technology rather than the technology in itself which is new" (1985:62).

4. Bimber's (1990) attempt to rid Karl Marx of an alleged technology determinist cloak provides a useful analysis of the different perceptions of technological determinism.

5. Winner's ambivalence in this issue is noteworthy. While on one hand he apparently takes a technology-determinist stance, on the other hand he argues: "The idea that technology or anything else could be the primary determinant ... is impossible to prove" (1977:76). It must be noted however that in his seeming technology determinist stance, Winner seeks to make the point that technology shapes technology. Quite simply, technological invention does not result from a spontaneous flash of inspiration. New ideas are often a function of existing ideas. In this regard, MacKenzie and Wajcman (1985) are convinced that "Existing technology is ... an important precondition of new technology. It provides the basis of devices and techniques to be modified, and is a rich set of intellectual resources available for imaginative use in new settings" (1985:10). Also notable is Hughes' (1983) work on Thomas Edison which demonstrates that an invention may depend on the modification of existing devices.

6. Woodward cannot be strictly categorised as technology determinist. She recognises that situations might change and technology becomes a dependent rather than an independent variable. As she makes clear, she does not suggest that "the research proved technology to be the only important variable determining organisation structure, or that such factors as the history and background of a firm and the personalities of the people who built it up ... were unimportant" (1965:50). Indeed, she later expressed the possibility that "the variations in organisational structure and behaviour ... are more dependent on the nature of the control system than on the technology itself" (1970:xii).

7. The reason for this discrepancy in interpretation between Woodward and Blauner is not very clear. However Meissner (1969) suggested that it may derive from their differences in focus. While Woodward was particularly concerned with control over the production process, Blauner focused on social relations at work and on performance. In any event, the discrepancy notwithstanding, both analysts accord some order of determinism to technology.

8. It appears many analysts share the view that the crucial significance of technology at work is its effect on workers' tasks and skills. But there also appears to be little clarity and specificity in the conceptualisation of skill. Skill has been variously defined as control, education, training and even process. For example, Broadbent sees skill as "the whole process of organizing a flexible series of actions ... the control system that makes work effective" (1987:9). Similarly, Blauner (1964) and Braverman (1974) see skill as synonymous with control. Braverman's notion of skill derives from his holistic impression of traditional craftwork as involving both `conception' and `execution' so that craftmen have complete control over work. For Braverman, a job can be labelled as skilled only if the unity of `conception' and `execution' is maintained since, as he sees it, that is the only condition under which workers would be seen as having control. Thus in his critique on technology, Braverman uses the unity or otherwise of conception and execution as a basis for describing tendencies in the workplace. A different perspective is provided by Beechey (1982) who distinguishes between `objective skill' and `conventionally defined skill' depending on the method of acquisition. According to her, while the former refers to competencies acquired through eduction, training and apprenticeship, the latter is acquired via collective bargaining or conventional definition of occupational status. Implied here is the likelihood of changes in skill to

be a function of changes in training, education and/or apprenticeship. Also implied is that any "series of actions" can be regarded as a skill if it is so socially defined. However, Rolfe stresses the danger of conceptualizing skill in terms of education or training. She draws attention to the point that "work groups may be educated beneath or above the skill level of their work; ... [and] training time may be artificially extended by employers or by trade unions and professional associations" (1990:110-111). Rolfe goes on to suggest a model of skill in which skill consists of two dimensions: technical complexity and discretion. Each has three `substructural' measures. Technical complexity is measured by complexity of tasks; knowledge; and range and variety of tasks. Similarly, the measures for discretion include: decision-making and judgement over the work process or product; control over the organisation of work; and supervision. Using Rolfe's scheme, it is probably possible to assess the effect of technological change on skills by looking at changes in the substructural measures.

9. Three models of technological change effect on skill are discernable namely: The skilling theory; the de-skilling theory and the compensatory or polarity thesis. The central argument in the `skilling' thesis is that advanced industrial societies require increasingly skilled workforces (Penn and Scattergood, 1985) as new technology will open up many opportunities for people to do meaningful work (Gershuny, 1978). On the other hand, the `de-skilling' theory, which is prominent in many discussions arising from the labour process school, is couched in the claim that through time, technology has been used to fragment and derogate jobs. Finally the compensatory theory proposes that technology (i) has the potential to generate both skilling and de-skilling (ii) provides threats and opportunities to different categories of workers and (iii) places certain demands on skills and these demands vary depending on the type of technological system.

10. Although in much of his work concerning technology Hughes clearly disagrees with the technology determinist thesis, he does concede that "Large systems with high momentum tend to exert soft determinism on other systems, groups and individuals in the society" (1987 : 55). It is not entirely clear whether by "soft determinism" Hughes simply means "influence".

11. Woolgar S (1990) prefers to construe technology as text which may then be analysed along three dimensions he labelled (i) the instrumental response, (ii) the interpretivist response and (iii) the

reflexive response. For details see Woolgar (1990), "The turn to Technology in Social Studies of Science (Draft 1.2 Jan 1990 :27-38).

12. Actually, this need not be so, Kling (1990) for instance stresses that the differing effects could be explained in terms of the argument that technological software "is not cut from common cloth". As he explains, information systems differ in their capabilities and in their operations, some not requiring pre-programming before their databases could be navigated by users. It is this `navigatory' opportunities which enable individual organisations to use the technology to meet their specific needs and hence observed variations in organisations with similar technologies.

13. The neutrality of technology appears to be a rather ambiguous concept. On one hand it suggests complete inertness. But as Whelchel points out if being neutral means "having no effect" then technology is not neutral because it "profoundly affects our world" (1986:3). However on the other hand, the neutrality of technology could be seen in the extent that technology does not have definite effects; its effects are a function of what, how and presumably where it is used. This argument is located in the conception of technology as merely a means "at the disposal of the social actors..." (Berggren, 1985:61). Thus, Winner argues that "technologies are neutral; they are simply tools that can be used one way or another; the benefit or harm they bring depends on how men use them" (1981 : quoted in Whelchel, 1986). This enables Whelchel to distinguish between moral and causal neutrality. This view of technology as purely a means earns it moral neutrality. On the other hand, technology is not causally neutral because it does affect our world (Whelchel 1986).

14. An elaborate treatise of the concept of `Totality' can be found in Lukacs (1971) work, `History of class consciousness'. For Lukacs, knowledge of facts can become knowledge of reality only when the isolated facts of social life are integrated in a totality.

15. Jorges (1990) has criticised the apparent romanticization of machines when both man and machines are understood as `actors' in the interactive equation, thus portraying "non-humans" as humans.

16. In any case, the tenets of the human-centred system school tends to run against the grains of the interactive approach. Whilst the former seeks

elimination of that which, tends to `dehumanize' humans, some `interactive' theorists would frown at this "speciesism" (Law, 1991) - the distinction between man, plant and machines. Thus Law contends that "our discrimination against machines hurts us just as much as it hurts the machines that we confine, in a second-order way, to the mechanical margins of our human civilisation" (1991:17).

17. Categorisation is crude because arguments which see technology as determining and those that simply suggest influence are lumped together.

CHAPTER 4

THE TECHNOLOGY FACTOR IN THE `DEVELOPING' NIGERIA

In the last chapter various presumptions on the effects of technology were examined within the context of three theoretical models namely technological determinist, socio-cultural determinist and interactive or network models. This foreshadows the issue of technology and technological development in Nigeria addressed here. A central concern in this section is to highlight the importance attached to technology in `developing' Nigeria. The chapter begins with an attempt to locate the basis of the concept, `developing' and examines how countries come to be categorized into `developed' and `underdeveloped' or `developing'. Production efficiency is identified as a major criterion in this classification. The presumed relationship between efficiency of production and technology enables the latter to be brought into focus. Following this, the technological situation in Nigeria is examined in some detail. This is mainly descriptive. From the standpoint that government is the representative of society, the focus is on government's attitude to technology and its technological development efforts. This is followed finally by an appraisal of these efforts and their outcomes in the context of the three theoretical models. It is suggested that in Nigeria, as in much of the developed world, technology could still be seen as essentially a "means...at the disposal of social actors... who have the privilege of outlining production systems" (Berggren, 1985:61). But, it is not of `very little importance' as Gallie(1978) suggests. In Nigeria, technology is of immense importance but it is not determinate.

4.1 THE CONCEPT `DEVELOPING', AS USED FOR COUNTRIES, AND THE LINK WITH TECHNOLOGY

Although there does not seem to be any precise definition of the word development, and what development is about is not entirely clear, it still does seem to be a universally desirable phenomenon. Often implicit in the various conceptualisations of development is a directed change over time. In the context of a nation, development would be seen in terms of qualitative "changes in the socio-economic patterns of relationships, ideas and values in a society..." (Anya,1989:69). Within this context, development is processual, continuous and eternal and it would seem in order to suggest that every nation is "developing". However, from an international perspective, development relates to some notion of industrialisation, economic growth, wealth accumulation and mass consumption. This notion underlies the classification of countries into "developed" and "underdeveloped".

Under the international framework, development has a processual dimension but also apparently implied is a phenomenon that reaches completion in time. In other words, whilst the developed countries have experienced this state of completeness, those in the underdeveloped category are still down the lower rungs of the development ladder. These countries have either commenced the process - that is "developing" - or are yet to begin the development journey. Although it could be argued that no society has or would ever reach a state of completeness, the demarcation into developed and underdeveloped or undeveloped countries is, in principle, generally accepted.

The developed countries are advanced industrialized societies. They comprise countries in Europe, North America as well as Japan, Australia etc. These countries are seen as having far more efficient modes of production and are more able to mobilize resources to meet their socio-economic needs. On the other hand, the underdeveloped[1] countries include countries like Nigeria, Kenya, India, Argentina and Mexico which neither possess the wherewithal for efficient production; nor the capability to meet their socio-economic needs effectively. The underdeveloped countries are therefore considered to be industrially and economically backward and inferior to their more affluent counterparts in the developed world. They are construed as `developing' when they make attempts to reduce these contradictions between them and the developed countries.

For development economists of the 1950's and 1960's like W W Rostow, underdeveloped countries are generally characterized by the dominance of agriculture in the economy and the absence of a capital goods sector. The unequal exchange in their internationally traded commodities means that income is comparatively too low and so would not support required level of savings for investments in capital goods. Rostow and his colleagues were convinced about the existence of a definite economic growth path through which all countries must pass in their process of development. The developed countries have successfully traversed this path[2]. The underdeveloped must necessarily follow the same "stages of economic growth, with assistance from the developed countries, if they are ever to become developed. Thus, these theorists saw development problems along economic lines and development itself was essentially seen as synonymous with economic growth. As Yahaya (1989) remarks:

> The development theorists ... tended to see economic growth as a process of steady increase in GDP which was to be realized through the development of manufacturing. This sector was perceived as the only truly productive and dynamic sphere in the economy (1989:73).

However, this school of theorists have been variously criticized on a number of grounds among which are that:

(i) when making their prescriptions, they apparently ignored environmental and idiosyncratic differences between societies. That is, they failed to acknowledge the socio-cultural and political dimensions in development.

(ii) capitalism has not completely eradicated the problems of unemployment and poverty even in the centres of the capitalist system (Fadahunsi,1986).

The criticisms notwithstanding, prescriptions made by the development theorists for transition from traditional to modern society have remained attractive to development planners in the underdeveloped countries. Thus in these countries, development has been understood to mean "being like" the industrialised societies and,

> The core of development strategies...was concerned with rapid economic growth. This resulted in a predominantly larger allocation of resources to capital goods essential for accelerating the pace of growth. Emphasis was laid on production so that, as a result of increased productivity, more would be later available to be spent on social welfare activities ... Industrialisation in this strategy tended to be identified with economic development. Planning, social, political, institutional, cultural and other dimensions were taken into consideration but the goal was to maximize capital formation (Yahaya,1989:73).

It has to be remembered that capital formation and accumulation in the form of technological innovation, invention and acquisition remain the cornerstone of growth in the developed world. For instance, the industrial revolution in Europe was made possible by technological developments in machinery which enabled the creation of new wealth through increased production and productivity (NISER, 1988). In fact, it is possible to argue that industrial revolution would not have been possible without technological inventions. More recently, developments in new technologies have helped to ensure sustained economic growth and hence a comparatively high level of material well-being amongst people in the developed world.

Apparently with this in view, underdeveloped countries have accepted neoclassical prescriptions for industrialising and modernizing along the path charted and followed by the West (Fadahunsi,1986; Jayaweera,1987); and it appears, have similarly located change and development in the production process. One therefore expects underdeveloped countries to pay attention to technology and have a desire for technological development. Apparent validation of this expectation comes from the United Nations which confirms "a greater awareness in developing countries of the need for acquiring ... technology in order to produce on an internationally competitive basis"(1973:3). Of interest is the extent to which this observation holds for Nigeria.

4.2 THE TECHNOLOGICAL SCENE IN NIGERIA

4.2.1 General Background

As already indicated, Nigeria fits into the underdeveloped but, in any case, "developing" category. Over 70% of her estimated population of 112 million[3] are engaged in agriculture producing food crops such as maize, cassava and yam and cash crops like cocoa, groundnut and oil palm. At the time of independence in 1960, agricultural produce was the main revenue earner and singularly accounted for 70% of the Gross Domestic Product (GDP). However, the position shifted in the 1970's - the oil boom years - when Nigeria became a monoproduct economy relying solely on crude oil as the foreign exchange earner. The abundance accruing from the oil wealth attracted many to seek wage employment in the fast-growing urban centres thus leaving only a few to work the land. This neglect resulted in a sharp decline in agricultural productivity. Nigeria moved from a position of a major exporter of agricultural produce and self-sufficiency in food supplies to one of an importer, even of food items. The contribution of agriculture to GDP at current prices fell from 61% in 1962 to 28% in 1976 (Ubeku, 1983:43). However, the devastating collapse of oil prices added to the instability of the oil market itself served to draw attention back to agriculture which continues to be an important sector in the economy. Hence, after the slump in the 1970's, agriculture started showing signs of positive growth. Its contribution to GDP increased from 25.5% in 1981 to about 40% in 1988 (First National Rolling Plan 1990-92, Vol. 1 page 4).

Nonetheless, the technology and methods of agricultural production in Nigeria had been for the most part primitive. For example, bushes are still cleared with machetes and cutlasses; the land tilled with hoes; both sowing and harvesting of crops are still carried out by manual labour; and preservation and storage of agricultural produce is essentially by traditional airing and/or sun-drying methods. Furthermore, the traditional farm implements namely hoes, cutlasses etc are still fabricated using the primitive method of metal smelting and then manually beating the hot metal to shape (Koleoso and Nwosah 1988:3). Thus, indigenous technologies and methods of agricultural production in Nigeria are "labour-intensive, time consuming, energy-sapping and often fail to respond to the demand and supply forces of modern markets" (Sodipe,1981:2). Only recently, the Nigerian government had blamed "low technology employed by the majority of the small-scale farmers who constitute the bulk of [the] farming population" for the difficulty in achieving desirable levels in productivity (First National Rolling Plan, 1990-92 Vol.I:71).

The industrial sector is only just beginning to take root. There was very little, if any, industrial enterprise during the colonial days in spite of the abundance of raw materials. The late take-off of industrialisation in the country had been explained in terms of the British colonial masters' preference to use her colonies merely as providers of raw materials for her industries at home. The raw materials, bought at low prices, were then processed and sold back to the colonies at very high prices (Ubeku, 1983). Apparently, from Britain's point of view, it made no business sense to establish industries in her colonies for processing these raw materials. An alternative explanation for the late industrial take-off in Nigeria could be found in the argument that neither sufficient market nor skilled manpower nor technology nor even capital to finance industrialisation existed (Okigbo,1987). Nevertheless, few industrial enterprises were established shortly before independence but, there was complete adherence to import - substitution industrialisation strategy prescribed by neo-classical economics. This strategy endured well after independence. As Igbani (1982) explains:

> Given the low base for industrialisation in the country and the existing demand for imported consumer goods, it was, therefore, simple and logical to base the rationale for industrialisation on the domestic replacement of these finished goods by importing the components or semi-finished materials and engaging in the final assembly process (1982:7).

In any case, the high level of dependency on importation of machinery and even raw material feed stocks could only aggravate the pressure on the balance of payment. This became evident with the collapse in the price of oil which, as indicated earlier, is the main source of foreign exchange earning in Nigeria. The manufacturing sector was thus unable to secure sufficient foreign exchange for the importation of the required raw materials and other industrial inputs. As a result,

> many manufacturing establishments shut down while others operated at ridiculously low level of their installed capacities. Labour was laid off and the level of unemployment grew.
> (First National Rolling Plan, 1990-92, Vol.I:105)

Presumably no government would be complacent with these conditions in its society. This thus raises the question of how Nigeria confronted these problems in both her agricultural and industrial sectors.

4.2.2. Technological Development Efforts:

The theory that technology holds the key to modernisation seems to have found support in Nigeria. As Anya (1989) argues, Nigeria is classified as a developing nation precisely because of her limited potential to utilize science and technology to increase national productivity or to sustain a scientific and technological transformation of the society. Similarly for the Nigerian government,

> The adoption of science and technology in national life marks the difference between development and underdevelopment. The classification of countries according to their economic status reflects the state of scientific and technological development ... The developed world has attained technological sophistry by exploiting science and technology to create wealth, save human energy and provide technical services ... The developing countries on the other hand have economies which are very dependent on the industrialised world because they have not ... been able to use science and technology adequately to exploit their national resources
> (National Policy On Science and Technology, 1986:7)

Science and technology are thus recognized as "the catalysts in national development..." (First National Rolling Plan, 1990-92:143) and different Nigerian governments since independence have had to adopt policies and strategies geared towards the development of science and technology in the country.

The first significant move towards science and technological development was made in 1970[4] when government established the Nigerian Council for Science and Technology (NCST) by Decree No 6 of 1970. The NCST was charged with the responsibility of co-ordinating research and development activities in the country. It was, however, replaced by the National Science and Technology Development Agency (NSTDA) established by Decree No 5 of 1977. The Agency was given "executive responsibility for the promotion and development of science and Technology ..." and its long list of duties included amongst others,

> - to advise the Federal Military Government on national science policies and priorities and on scientific and technological activities generally;
>
> - to prepare periodic master plans for the development of science and technology ...;
>
> - to take steps necessary to facilitate the application of the results of scientific and technological research ...; and
>
> - to advise on scientific and technical manpower requirements of Nigeria.
> (NSTDA Decree No 5, 1977).

Also formally established by Order 1977 of the same Decree were seven research institutes[5] all of which came under the direct supervision of the NSTDA. The research institutes were mandated to conduct research into various areas of national interest, a major objective being to achieve greater self-reliance by increasing the capability of indigenous technologies. It is hoped that the growth of domestic technology and possibly engineering consultancy services would ultimately improve the chances for successful adaptation and development of acquired technology.

The need to curb the hitherto uncontrolled technology transfer[6] and to facilitate the acquisition of the necessary foreign technology led the Federal government to set up the National Office of Industrial Property (NOIP) by Decree No 70, 1979. NOIP is a corporate body which serves as a technology regulatory agency. Sections 4(a) and 4(c) of the Decree which established it respectively provide that NOIP functions for "the encouragement of a more efficient process for the identification and selection of foreign technology" and for "the provision of a more efficient process for the adaptation of imported technology". Probably the underlying aim is to closely dovetail foreign technology inflow with the desired pattern of industrial growth. In fact NOIP has indicated that the Office

> ... ensures that there are adequate safeguards for effective transfer and adaptation of know-how to indigenous entrepreneurs through provisions in the technological agreements for maximum use of local raw materials, increased local value addition, employment generating capabilities increased research and development and adequate manpower development by Nigerian enterprises.
> (NOIP: Annual Report, 1989:7)

As a further help to Nigerian entrepreneurs, NOIP provides advisory services and supply information on the selection, sourcing and acquisition of relevant technology. Besides, Decree 70, 1979 also provides that all Technology Agreements between Nigerian enterprises and their foreign partners must be registered with NOIP which is therefore able to monitor these agreements. The essence of monitoring is to ensure that the terms and conditions of Contracts are complied with during the execution of projects. Hence a two-pronged attack on technological backwardness has been launched - conducting research locally while monitoring the acquisition of foreign technology.

To achieve better rationalisation and co-ordination of technological development efforts, the Federal government created the Federal Ministry of Science and Technology by the Science and Technology Act No 1 of January 1980. By the Act, the NSTDA was formally dissolved and its functions, assets and liabilities transferred to the new ministry. NOIP also became a parastatal of the Ministry. The statutory functions and mandates of the Federal

Ministry of Science and Technology include:

(i) Formulation and monitoring of National Policy on Science and Technology;

(ii) Promotion and administration of technology transfer programmes;

(iii) Promotion and co-ordination of scientific and technological research and development activities in agricultural, industrial, medical, road and building, energy research and basic sciences;

(iv) Promotion and co-ordination of scientific and technological innovation, development, adaptation and production; and

(v) Establishing relations with the 24 national research institutes; with scientific, technical and technological research bodies of the O.A.U. (Organisation for African Unity), and with science and technology programmes of UNESCO and other United Nations Agencies, the ECOWAS (Economic Community of West African States) as well as other regional bodies and bilateral arrangements.
(Fact Sheet on the Federal Ministry of Science and Technology, Vol I, 2nd Ed. pgs. 3-4).

In pursuit of mandate (i), the Ministry was able to formulate a "blueprint on Science and Technology" which was formally adopted in 1986, and launched in July 1987. The policy is a very detailed document that not only defines national objectives for science and technology but also provides policy guidelines and states strategies for achieving the objectives which include:

- increasing public awareness in Science and Technology and their vital role in national development and well-being;

- directing science and technology efforts along identified, national goals;

- promoting the translation of science and technology results into actual goods and services;

- Creating, increasing and maintaining an endogeneous science and technology base through research and development;

- motivating creative output in science and technology;
- increasing and strengthening theoretical and practical scientific base in the society; and
- increasing and strengthening the technological base of the nation.

The priority areas of technological pursuits mapped out in the policy are agriculture, agro-allied industries, health and industry.

Important developments, arising from the National Science and Technology policy, which are geared towards meeting the stated objectives have been recorded. There is the launching of the National Science and Technology fund (NSTF). The NSTF is a co-operative set up primarily for the "judicious management of the funds" (National Science & Technology Policy, 1986:30) expected as contributions by government, both public and private sector industries, and made available for science and technology activities such as research etc. Another significant development is the setting up of the National Council for Science and Technology. This consultative body is "to foster closer collaboration among the Research Institutes, the private sector and the individual ministries which are involved in the implementation and development programmes in the various sectors of the economy" (Guidelines for the National Rolling Plan, 1990-92,:59). It is noteworthy that research institutes have been reorganized and restructured, the objective being

(i) to enhance the focus of each institute on specific areas of research (Guidelines to Rolling Plan, 1990-92,:59)

(ii) to promote interaction between them through collaborative research so as to make the institutes less isolated and to avoid wastages that arises through duplication of research efforts.

As also envisaged from the national policy, a Raw Materials Research and Development Council (RMRDC) was created to ensure effective utilization of local raw materials. The RMRDC is therefore mandated to promote research geared towards raw materials development; and to advise on ways of adopting available machinery for more efficient processing of local raw materials. Besides, there is the creation of the National Centre for Agricultural Mechanisation with the responsibility of standardizing farm machinery and equipment and the production of locally designed prototypes (National Rolling Plan, 1990-92,:73). This apparently arises from the policy that the "Production of machinery equipment and their spare parts shall be, as far as possible, local-based" (National Science and Technology Policy,1986:15). The Federal government has generally encouraged the development of capital goods production industries. This is in recognition of the crucial role these industries would play in ensuring "a solid and stable technological base for a self-sustaining industrialization process" (National Science & Technology Policy,1986:15). The government therefore holds substantial interests in key industries like iron and steel and petrochemicals. Furthermore, governments introduction of the Structural Adjustment Programme (SAP) in 1986, amongst other things, also encouraged the direction of efforts towards the development of local capability in design and fabrication of equipment and spare parts (NISER 1988; Osinowo,1991).

Another area of government interest for the achievement of the science and technology objectives is general manpower development. Hence a range of policies on education, public awareness and motivation have been adopted. Here the central objective is to "promote effective interaction between the society and science and technology" (First National Rolling Plan, 1990-92, Vol I:145) and "To attract and retain a substantial percentage of the society in the mainstream of science and technology activity in the country" (National Policy on Science & Technology, 1986:14). To this end, science education is encouraged at all levels in the educational system. The government has set a target of 60:40 enrolment ratio in the universities in favour of science-based disciplines. To achieve this, efforts have been directed towards improving science and technology laboratories and workshops in secondary schools from where University entrants graduate.

Probably in realization that "the economy is still in short supply of certain categories of critical manpower, particularly those possessing scientific and technical knowledge and skills" (First National Rolling Plan, 1990-92, Vol. I:187), the establishment of nine additional Federal Technical Colleges in the country was approved in 1987. Futhermore, the course content of technical education is "geared towards acquisition of practical and applied skills as well as basic scientific knowledge that are directly relevant to industrial as well as technological needs of the country" (First National Rolling Plan, 1990-92, Vol, I;215). In addition, the government has set up special employment and skills acquisition programmes like the Industrial Training Fund and the Industrial Development Centre. Moreover, a scholarship scheme for girls in senior secondary schools has been instituted primarily to encourage the education of women in science and technology. Also launched is the Nigerian Association of Women in Science, Technology and Mathematics. Presumably, these strategies are expected to aid the permeation of science and technology in the society.

It is noteworthy that, although government has shown enormous interest in the acquisition and adaptation of technology, there does not seem to be a similar level of interest in how technology is used in the workplace. The government is apparently content with the development of required manpower by its encouragement of science-based education, as well as training, for the acquisition of relevant skills. However, different forms of incentives such as tax rebates etc are offered to employers who provide training for their employees. Moreover, Trade testing services for the standardization and certification of various categories of skilled labour have been organised with the help of International Labour Office. Perhaps the moves most closely linked with how technology is worked are those by the National Productivity Centre established in 1987. This centre has been able to prepare the "Self Instructional Manual for Maintenance Productivity" to guide plant maintenance and an "Instructional Manual" for spare parts improvement (First National Rolling Plan, 1990-92, Col.I:253). Thus, government leaves the formation of strategies for the day-to-day working of technology, whether indigenous or imported, to individual employers. In any case, it has to be noted that government itself has huge investment interests and is the largest single employer of labour in Nigeria.

The foregoing is indicative of Nigeria's commitment to science and technology. A crucial question however is: what is the outcome of these multi-faceted efforts? An examination of this is considered necessary.

4.3 APPRAISAL OF THE CURRENT TECHNOLOGICAL SITUATION IN NIGERIA

While it is true that many of the policy statements and efforts towards the development of science and technology are yet to bear fruits, some significant changes are discernable, particularly in the agricultural[7] sector. In this sector, research and development efforts had led to improvement of different varieties of crops. This, coupled with the increasing use of fertilizers and pesticides, had improved yields from the farms. The storage and preservation of farm produce have improved following the adoption of up-graded versions of traditional methods and adapted technologies.

Although the use of traditional equipment and tools still persists, some degree of agricultural mechanisation has taken place. For instance, in accord with the desire to upgrade traditional technologies in order to improve their capacity and efficiency, Nigerian Research Institutes have designed and fabricated equipments such as planters, shellers, pelleters, graters, dryers, and fryers (NISER, 1988). As Osinowo,(1991) also remarks:

> It is now possible to obtain locally designed an fabricated plants for cassava processing, vegetable oils, fruit juice processing, cereal processing and different forms of dryers for plant and animal products (1991:12).

In addition, two research institutes - The Federal Institute of Industrial Research Oshodi (FIIRO) and Projects Development Agency (PRODA) have acquired metal working capabilities which include foundry, structural and sheet metal fabrication, machining as well as electroplating facilities (Osinowo,1989).

Nonetheless, the dependence on imported technologies has continued. The materialisation of the country's aspiration to build up considerable local capabilities in science and technology seems to be a considerable distance away. As a report of NOIP's sponsored survey of Nigeria's manufacturing sector indicated, there is "a complete lack of local capability to perform [Engineering and Design] functions [which] has invariably made the disaggregation of imported technology packages extremely difficult if not impossible" (Toffs Consultancy, 1985:97). In as much as this report is relatively dated[8] and the problem seems to be exaggerated, it is plausible to suggest that Nigeria is still far from possessing the ability to effectively unpackage and adapt imported technologies. In fact, the Federal government itself recently confirmed that "very limited capacity currently exists in the country for local fabrication of even the simplest machines and equipment" (First National Rolling Plan, 1990-92,Vol.I:107). This begs the question concerning why there had been so little progress in technological development in Nigeria in spite of concerted effort by government in this connection.

As was apparent in the literature, the answers to this question were often located in the mode of technology transfer. For instance, it had been asserted that many of these imported technologies arrived in forms that made `unpackaging' and adaptation difficult (Toffs, 1985; NISER, 1988) even though government had stated that "imported technology shall be procured in an `unpackaged' form (National Policy on Science and Technology, 1986:19). This casts doubt on the efficiency of NOIP in carrying out its function of helping local entrepreneurs in the identification and selection of foreign technology.

Furthermore, it is argued that many of the enterprises were established under the turn-key arrangment in which overseas suppliers often provided technical assistance including basic engineering services (Toffs,1985). This reduces the level of local participation in projects thus limiting the use of local skills as well as delayed the acquisition of the technological know-how[9]. Put succinctly, "the process of learning-by-doing, which is just as important now as it was at the beginning of the European Industrial Revolution [is] not open to most Nigerians" (NISER,1988:4). In any case, many of the enterprises in the capital goods sector were basically involved in the local assembly of completely-knocked-down (CKD) components (Igbani,1982). In the circumstances, it is difficult to see how this strategy of putting "final touches" to semi-finished products would have helped in any meaningful development in design engineering and fabrication, so crucial in the establishment of a meaningful technological base.

Another related problem is the local entrepreneurs' continued preference for foreign trade marks[10] and the services of foreign experts[11]. This preference could be explained in terms of the general apathy of Nigerians to "Made-in-Nigeria" goods (First National Rolling Plan, 1990-92,Vol.1:144) and the lack of confidence in the credibility of Nigerian engineering designers (Osifo,1982). This situation inevitably frustrates the indigenization efforts of local researchers while at the same time enables foreigners to make considerable input in local technological decisions. In essence, Nigeria seems unable to strike a balance between the necessity of developing indigenous technology and that of embracing foreign technology for her industrial sector. Thus, although some would claim that "Nigeria has definitely gone beyond the first steps towards industrialization" (Igbani,1982:14), some others take the view that:

> behind this facade of industrial development, is the reality of lack of an industrial base, as regards the local sourcing of raw materials, adaptation of exogenous technology, the application of upgraded local technology and the local design and manufacture of processing equipment and machinery (Osinowo, 1989:58).

While Osinowo thus tends to blame both endogenous and exogenous technologies, some analysts have directed attention specifically to the exogenous variety, raising the issue concerning the appropriateness of transferred technologies. Some analysis of this issue is considered necessary at this point.

4.3.2 THE APPROPRIATENESS OF TECHNOLOGY

The issue concerning the appropriateness of technology has attracted attention over the years, underpinned by massive unemployment in many developing countries. It is proposed that the way out of these problems is the deployment of "`appropriate', in the sense of more labour-intensive, techniques ... instead of capital-intensive ones" (Edquist, 1985:78). The United Nations (UN) has seen the transfer of "new technologies and techniques [as] a prerequisite for an accelerated rate of growth in various industrial sectors in developing countries" (UN, 1973:39) and recommends that:

> The flow of technology should be adequate to meet the basic needs of industrialisation ... be such as to cover the major technological and production gaps in a country's industrial programme; be effectively absorbed within the shortest possible period and adapted to local conditions (UN, 1973;3).

Presumably, the transferred technology is regarded as appropriate if it satisfies these conditions. However, while this view sounds impressive and in order, its attendant caveat has not been that agreeable. The UN surmises that in view of the need to link technology with available local raw materials and local skills, "certain highly sophisticated capital-intensive techniques ... appropriate primarily in very large scale production ... may be unsuitable in developing countries". Besides,

> Certain labour-saving techniques, developed because of the high cost of labour in industrialised countries, have little relevance in developing countries and may prove expensive to acquire and to maintain. In general, enterprises in developing countries should avail themselves of labour-intensive techniques, provided that a basic competitive level of productive efficiency can be maintained (UN, 1973:15).

It is noteworthy that the industrialised countries from whom these technologies are imported generally have high incomes, a more educated and better skilled labour force and, to a great extent, have internalized applied science and technology for sustained industrial and economic growth (Fadahunsi,1982:22). In contrast, the `importing' underdeveloped countries are characterised by low incomes, shortages of capital, abundance of technically unskilled work force, "lack of a developed infrastructure to support and maintain sophisticated equipment, lack of management experience..."(Bessant,1987). With regard to Nigeria, Ubeku writes:

> The bulk of the population is unskilled in the modern sense of the word ... the job seeker ... comes to the urban area for industrial employment with no experience of modern machinery and a general lack of rigid discipline which modern industrial employment demands (1983:50-51).

Hence the circumstances that prevail in the developing countries seem to make the less sophisticated labour-intensive technologies more suitable for these countries. Labour intensive technologies provide employment for a vast majority of the unemployed and at the same time require comparatively little capital outlay. It should therefore be attractive to the underdeveloped countries most of whom are plagued by massive unemployment, a predominantly unskilled workforce as well as sparse financial resources. Thus, for advocates of labour-intensive technologies, maximisation of employment takes priority over outstanding increases in productivity associated with the more sophisticated but more capital-intensive technologies. Also apparent is the relegation of technical progress as a prime issue of concern.

However, some analysts find this circumscription to labour-intensive technologies rather enervating. For example, Chijioke (1982) is dissatisfied with the very idea of compartmentalizing technology into levels - the more advanced and sophisticated fitting the developed world whilst the less sophisticated is appropriate for the underdeveloped. He insists that this approach, wittingly or unwittingly, implies the perpetuation of the technology gap. As he asks:

> If any group with potential for development were to be so sequestered to exist a half-century behind some others ... by what mechanism would it ever bridge the gap to the more advanced world? (1982:25).

Chijioke agrees with Hasan that developing countries must:

> develop [the] capacity for the most sophisticated research effort,[and] simultaneously think of simple solutions to simple problems which can be repeated and multiplied for the benefit of millions of our people so that their suffering and poverty are alleviated (Hasan,1976; quoted in Chijioke,1982:26).

Chijioke is convinced that technology is a monolith to which all nations aspire and each must be left to choose the `mix' best suited to its development and advancement. Presumably, reliance on prescriptions from `the outside' would only foster the condition of dependence as satellites of other economies. In view of global market competition and given that labour-intensive technologies are often associated with inferior economic efficiency and low productivity, it is doubtful that these technologies would be efficient enough to generate sufficient income for its users (Edquist, 1985). Besides, Edquist argues that:

> The strategy of appropriate technology does coincide with the interests of the workers, but only with the short-term interest of workers in capitalist countries with a high rate of unemployment. In the long run, ... the workers have very different interests. Thus the advocates of the appropriate technology strategy are trapped by capitalism in a very different sense. They are simply unable to think in terms of other socio-economic systems than the capitalist one. Their minds are trapped for ideological reasons since they implicitly consider this system as the only possible one and since they think of unemployment as exclusively technologically determined within this context (1985:80).

In any event, Igwe et al., (1985) have noted the tendency for these foreign technologies to arrive in wrapped up packages which often "call for mere robot-like activities, and as a result, the human skill of the indigenous people are required merely for routine operations" (1983:13). This contention apparently enables Anya to query even the concept of `transfer' of technology. As he argues:

> Since a given technology ... bears the imprint of its social and ecological origin, the concept of technological transfer is philosophically and ideologically suspect especially as we know that we cannot also transfer the social dynamics and ecological constraints of the originating culture which guarantee its efficient function ... talks of technological transfer are merely co-terminous ... with ... the transfer of machines and industrial artefacts stripped of the creative potential of the autonomous human stimulus, acting in full integration with the peculiar social and ecological circumstances of the country (1989:76-77).

It appears Anya does not reject the transfer of technology in toto. Transfer of technology, it seems, becomes acceptable under certain conditions. According to him:

> Only the human definition of what our real needs are can determine whether we need machines and which type. If, however, the needs are defined against the background of foreign preconceptions, the machines we get will not be related to the tasks at hand but [are] alien artefacts (1989:77).

This argument implicitly suggests that a technology is worthy of transfer, and by implication appropriate, if it could be used to satisfy predetermined needs. However, Anya emphasizes the importance of carefully ascertaining what and whose needs a given technology is appropriate to and for.

Nonetheless, it may be argued that the objectivity of needs-determination is doubtful. Besides, the variability as well as relativity of needs make their determination extremely difficult. For instance, a technology which may be considered inappropriate from the point of view of government because of its huge import demands may be seen differently by an entrepreneur whose foremost consideration is profitability. On the other hand, this capital-intensive and hence inappropriate technology may later be seen by government as appropriate if there is evidence that it contributes to the development of needed technological skills and/or resources are available for its procurement. Further, bearing in mind the tendency of government to respond to pressures from powerful interest groups (Stewart,1984; Edwards, P. K., 1986), the presumed needs at a given period in time may well be those of these dominant groups rather than of the society at large.

In view of the inherent subjectivity in the determination of so-called needs, a more embracing conceptualisation of appropriate technology is required. Fadahunsi provides one such conceptualisation when he defines appropriate technology as:

> One that is suited to the ecological and socio-cultural environment of the people having optimally subsumed traditional and modern production practices and taking cognizance of the resource endowment of the country (1986:31).

Similarly, Nigeria's National Office of Industrial Property (NOIP) sees appropriate technology as that "contributing most to the economic, social and environmental objectives of a country, especially those relating to its applicable resource endowment" (NOIP, Annual Report, 1989:8).

It is noteworthy that these definitions of appropriate technology differ from the United Nation's conceptualisation in the extent that they seem more willing to sanction a combination of both sophisticated and traditional technologies. Here, choice does not have to be as between sophisticated capital-intensive or labour-intensive technologies. Rather, either or both technologies would be appropriate and acceptable so long as the available resources - materials, manpower, etc - and the socio-cultural requirements of the society are taken on board. However, these conceptualisations of appropriate technology are similar to the United Nation's view in so far as they implicitly recognize the need to match technology with the prevalent local conditions.

In essence, at least some of the reasons for success or failure of Nigeria's technological development efforts could be located in the extent to which this `match-making' is successfully carried out. A mismatch results in difficulties and suggests inappropriateness of the technology employed. Hence NISER could point to "technologies ... often constrained by irregular and insufficient availability of ... raw materials"(1973:20) and Koleoso refers to the "sophisticated equipment we can never repair nor find the spare parts ..."(1982:3). Presumably, these difficulties occur because the employed technologies are inappropriate.

However, it seems plausible to argue that perfect linkage between technology and local conditions may not always be possible in the real world and its pursuit may be more wasteful than it is rewarding. In a situation where much of the technology is imported and is desperately needed for modernisation, the acquisition and use of foreign technology, even if this is later found to be inappropriate, is likely to be preferred to inaction. Does this then mean the primacy of technology?

4.3.3 Determinist Technology?

An issue which emerges from the preceding is the apparent tendency to accord a determinist status to technology. For example, the classification of countries in terms of levels of technological development tends to portray technology as determinist and so also does the yearning for technological development by countries like Nigeria. Technology is clad in a determinist cloak when it is seen as "the cornerstone of progress upon which Nigeria can depend to attain self-reliance and self-sustaining development" (national Policy on Science and Technology, 1986:10). Similarly, technological determinism is apparently indicated when "low technology employed by the majority of small scale farmers" is blamed for the low levels in productivity (First National Rolling Plan, 1990-92). Thus, there is a general inclination to relate both success and failure to technology. It seems socio-cultural conditions are seen as neutral, the apparent presumption being that all desired changes in these conditions could be effectuated so long as technology permitted. This presumption is contestable.

To begin with, the view of technology as improving the chances of successful industrialisation is very different from any contention of technology as determining success. Indications that the acquired technologies often did not yield `intended consequences' (for example, efforts on mechanization have not eliminated the problems of low productivity in Nigeria) do not smack of a determinist technology, neither does the point that there are still problems in spite of concerted effort of government on technological development. These failures, which enable a perception of foreign technology in Nigeria as the proverbial square peg in a round hole, could be explained along social lines. Explanations would include the inability of social actors to make the appropriate match between existing conditions and the chosen technology as well as the dearth of skilled manpower.

Furthermore, that efforts were also directed towards other areas like human resource development is indicative of the recognition of factors other than technology in Nigeria's modernization efforts. Although the establishment of technical colleges etc indicates government's appreciation of the relationship between technology and skills, it also points to the fact that skilled manpower is required to `work' the technologies.

A very crucial point that cannot be over-emphasized is the fact that interest in technology, particularly the foreign variety, apparently stems from the desire to satisfy social needs and wants. That is, social needs are the driving force of technological development in Nigeria. Whilst technological development could be seen as the end or goal, technology serves as a means to this end. Put differently, the case here is that of social ends requiring technological means for its effectuation.

The acquisition process itself is a social phenomenon laced by human decision and choice. Hence, the idea of matching technology with the prevalent local conditions seems to suggest that the adopted technology, in the final analysis, is socially determined. Besides, it is perfectly feasible to contend that the acquisition process, during which decisions concerning the appropriateness of a range of available technologies are taken, could be seen as involving `interpretative flexibilities' which are undergoing `stabilization rituals'.

Nevertheless, a purely social explanation for technological development outcomes in Nigeria is equally doubtful. Just as the failure of technology to provide the anticipated outcomes suggests social constraints, so also does the technology impose constraints such as its demands for unavailable or scarce technical skills. Further, the issue regarding a mismatch between technology and socio-cultural conditions suggests inappropriateness not only of the technology but also of the inability of the social actors to make appropriate matches. Thus, a bilateral relationship between the social and the technical, or what Latour has described as `social-technical strategem', seems apparent. Similarly, Law (1987, 1988) would see Nigerian government's efforts - its decrees, policies, establishment of agencies - as modalities or tactics for the juxtaposition of the heterogeneous elements in the coalition.

Put together, the above tend to add credibility to an interactive model. As is apparent, and in congruence with the interactive approach, neither the social actors, who define the social needs, nor the technologies for meeting these needs, can be said to be irrelevant; but nor would any be safely seen as autonomous. The acquisition of foreign technology does not on its own wipe away underdevelopment. Similarly, mere social recognition of development needs is not enough to ensure development. Technology is important because of its presumed capabilities to enable development. However, the technology has to be put into use by social actors. Only then could its importance or usefulness be manifest. In essence, the technological and the social are involved in an interaction to which each contributes. Both are therefore relevant. These point to the inadequancy of the technology determinist and social determinist models in explaining Nigeria's technological scene.

4.4 CONCLUSION

In this chapter, an attempt has been made to highlight the importance attached to technology in Nigeria, and the point that this has not made it the determinate factor. It began by suggesting that for developing countries, development along Western lines is seen as the key to a successful transformation of their rural societies into modern industrialised nations. In these countries, the yearning for modernisation and the link between it and technological development enables technology to assume a strategic role. Thus in Nigeria, a developing country, technology is regarded as "the cornerstone of progress". Also, there, low productivity of the labour force is blamed on the "low technology". Hence, upgrading of traditional technologies as well as extensive importation of Western technologies, as much as resources permit, have been embarked upon as important steps towards modernisation. Moreover, attention was given to manpower development in the effort to produce the necessary skilled labour force.

However, the appraisal of Nigeria's development efforts revealed that these efforts notwithstanding, industrialisation as in countries in the West has remained a dream, still a long distance yet. This begs the question concerning why efforts towards modernization have not produced the expected results. The technologization strategy has yielded very limited success. It was suggested that the apparent `failure' was not because the presence of foreign technologies was not a necessary condition for modernisation along Western lines. Rather, the presence of imported technologies is not a sufficient condition for modernisation or development to occur as desired. As the analysis attempted to show, modernisation is also predicated upon social factors. For instance, Anya recognises the relevance of social conditions in the exporting countries when he emphasises that it is not possible to "transfer the social dynamics and ecological constraints of the originating culture which guarantee its [that is, the technology's] efficient function ..." (1989:76).

In essence, what could be seen as *social rigidities* are built into the technology and exported with it. Presumably, the differences between the `social dynamics' of both exporting and importing countries account for the limited success of the imported technology. Accordingly, the appropriateness of many of the foreign technologies is queried. Hence, the UN notes that some of the technologies "have little relevance in developing countries"(1973:15). Many analysts (Anya 1989, Hassan, 1976; Osinowo,1989; UN 1973) therefore stress the necessity of adapting the foreign technologies to local conditions. However, whilst some propose (UN,1973) or prefer (Osinowo,1989) labour - intensive technologies to help tackle unemployment, and other problems of the underdeveloped, others like Chijioke (1982) reject this confinement to what they believe ensures the perpetual dependence on the West.

Furthermore, it was also suggested that aside from the imported *social rigidities*, there are indigeneous social factors which also impede success. Relevant here is the point that choosing the technology is a social phneomenon. In the light of this, failure or limited success with modernisation efforts in Nigeria could be rationalised in terms of the inability to determine the \`real' social needs and selecting the appropriate technologies for meeting these needs. As Anya (1989) contends, the \`alien' artefacts are often chosen against the background of misguided conceptions of what the local needs really are.

On the other hand, Ubeku (1983) and Bessant (1987) note the inadequacies in the labour force such as the dearth of technically skilled workers and competent managers. It is conceivable that improvements in these aspects would enhance the chances for better utilisation of the technology.

Evidently, the importance of the \`social' for technological development outcomes in Nigeria is implicated. However, in direct contrast to Gallie's (1978) proposition that technology is essentially irrelevant, it is argued that technology is a very relevant factor. Mere social recognition and desire for development, as well as the prerogative to pick and choose, will not automatically ensure that development proceeds. Technology is needed as an essential enabling tool. However, that the technologies have not done for the underdeveloped countries, what they did, and continue to do, for the West clearly shows that no matter what the level of reverence and importance attached to it, technology is not the sole determinant of technological development outcomes. Various social elements exert influence. On the other hand, recognition and adoption of technology as a tool for development, and the fact that some effort was directed towards meeting the skilled demands of the imported technologies, suggest that outcomes cannot be pinned exclusively to the `social' either.

The overall conclusion therefore is : technological development is a social phenomenon the direction of which is determined by social actors at whose disposal are enabling instruments of which technology is a crucial one. This case of social `ends' requiring technological `means' suggests a coalition or network of interacting `allies' rather than any clear supremacy of one ally over the others. It follows therefore that both technology determinist and social determinist models are inadequate.

NOTES (4)

1. This is a catch-all phrase. Considerable variations in the paces and stages of development are apparent in countries within this group. For instance, South Korea, India and Argentina are far ahead of others like Nigeria, Kenya and Tanzania.

2. The route is from traditional farming through mechanized agriculture to manufacturing and thence to the current computer/microelectronics age.

3. The latest population figures in Nigeria have been derived from estimates and projections. Nigeria is yet to carry out an acceptable and reliable census.

4. This is not to say that nothing was done before then. As far back as the 1950's, the government had made moves to encourage industrialisation. An example is the Aid to Pioneer Industries Act 1952. Industries that satisfied its provisions were relieved of Company tax payment for a period up to five years. However, concerted efforts towards science and technological development was noticed for the first time in the 1970's. For this to have waited ten years after independence may have been due to disruptions caused by the Nigerian Civil War in that period.

5. Many research institutes were already in existence before that date. These, among others include the Federal Institute of Industrial Research Oshodi (FIIRO) established in 1956 and the Projects Research Agency (PRODA) established in 1973.

6. There was indiscriminate and unrestricted import of foreign technology without reference to costs and needs. It is not uncommon to see similar technologies acquired under different terms and conditions, and even costs, by different enterprises.

7. Agriculture has apparently received the most attention. This is probably because of the need to be self-sufficient in food production. Added to this is the necessity of sourcing industrial raw materials locally in order to save scarce foreign exchange.

8. This 1985 Report is considered only in view of the fact that many government policies and strategies for technological development were adopted later.

9. Often, the only technical skills available to the locals are biased towards operation and maintenance rather than skills for design and fabrication of

capital goods (Toffs, 1985).

10. In some cases however, entrepreneurs do not necessarily prefer but are compelled by their foreign partners to retain the trade marks.

11. There is no doubt that the presence of these foreign experts, at least at the initial stages, is necessary for the transmission of relevant skills.

CHAPTER 5

METHODOLOGICAL CONSIDERATIONS

Methodology has to do with the logic and general principles guiding social science investigation. It is concerned with the question of how social knowledge is established, and how the researcher could make his `discovery' accepted by others (Bulmer, 1977). For Hindess, "methodology lays down procedures to be used either in the generation or in the testing of propositions by those who wish to obtain valid knowledge" (1977:3). These views inform the usage of methodology here to refer to the examination of the methods that could be used in the analysis of the relevance of technology in work organisation.

In this chapter, the debate concerning the relative nature of quantitative and qualitative research is first discussed. Attention is given to the perceived `technical' and philosophical differences as well as the connection between methods and underlying philosophies. Also addressed are the relative virtues and vices of the methods. It is, however, argued that the supposed distinctness between the two methods, particularly along philosophical lines, is not that clear-cut. Against this background, the preferred research strategy is then outlined having examined the feasibility and the benefits of integrating both methods. As would become evident, the preferred research method is neither purely qualitative nor quantitative but triangulation - a mixture of both approaches. For our concerns, the adoption of a purely qualitative method, which stresses the subjective definition of a situation, would tend to be much in line with the social constructivist approach, for example. Similarly, an endorsement of a determinist framework could be levelled against any pursuit of `objective facts' often associated with pure quantitative method. Hence, the preferred integration of research methods could be seen as representing an attempt to escape a determinist tag. It is presumable that the combination of research methods would enable better exploration of the varied social and technical dimensions of work organisation. This also seems to be much in tune with the more persuasive interactive model which, as indicated in chapter 3, guides the research.

5.1 RESEARCH METHODS

Procedures for investigation in the social sciences are broadly classified into quantitative and qualitative research methods. Experimental investigations as carried out mainly by social psychologists, and sociologists' survey techniques (involving mainly sampling, administering questionnaires and structured interviews) come under the quantitative approach. On the other hand, qualitative research is typified by observational methods, particularly participant observation (Bryman, 1988). Also in this category is unstructured in-depth interviewing.

The debate concerning the differences in the procedures of quantitative and qualitative research, as well as their relative merits and demerits, are wedded in both technical and philosophical issues. Bryman (1988) remarks that earlier discussion on research methods focussed only on their technical adequacy. Quantitative research methods were given prominence and the preoccupation was mainly on technical issues, like how to draw up and use questionnaires, etc. Not until the 1970's did the debate witness a "systematic and self-conscious intrusion of broader philosophical issues ..." and quantitative and qualitative research methods "came to signify much more than ways of gathering data; they came to denote divergent assumptions about the nature and purposes of research in the social sciences (Bryman 1988:2,3). In a similar vein, Evans (1979) had suggested that the differences between the research methods are in terms of:

i) the nature of description
ii) the nature of explanation and
iii) the procedures for testing theories.

It seems therefore that the different research methods represent competing views concerning how best to acquire knowledge about social processes and indeed what is acceptable knowledge of the social world. That is, differences between the methods do not revolve only around the technical adequacy of techniques but also derive from differences in epistemological assumptions concerning the nature of individuals and society. As Rist (1977) emphasizes:

> when we speak of "quantitative" or "qualitative" methodologies, we are in the final analysis speaking of an interrelated set of assumptions about the social world which are philosophical, ideological, and epistemological. (quoted in Bryman, 1988:50)

The broad philosophical perspectives which underlie the assumptions are identified as positivist and phenomenological philosophies. Whilst quantitative research techniques are usually identified with positivism, qualitative research is associated with phenomenology. It is considered worthwhile to look at the nature and assumptions of the research methods within the context of their technical, philosophical and ideological underpinnings.

5.2 THE NATURE OF QUANTITATIVE RESEARCH

As noted above, survey and experimental techniques are the main examplars of quantitative research. Also included in this genre are structured observation, analysis of previously collected data as well as content analysis of documents for the purpose of possibly making statistical comparisons (Bryman, 1988). The epistemology which is presumed to constitute the backcloth of quantitative research is rooted in the notion of positivism.

The Positivist Perspective

The term `positivism' is given wide ranging expositions in the social science literature. It is used variously as a methodology, a philosophy or an epistemology. According to Kolakowski(1972: cited in Bulmar,1984; Bryman,1988) positivism is a philosophy which says nothing about the origin of knowledge but then aims to delineate between the knowledge that deserves the name of science and that which does not.[1] This epistemology, it is claimed, presents a definite conception of the forms of knowledge which are warrantable and the conditions for the validity of claims to knowledge. From the wide expositions of the positivist philosophy, Kolakowski identifies four principles which he suggests represent the essence of positivism:

1. the rule of phenomenalism[2] which asserts that there is only experience, and which rejects all abstractions be they `matter' or `spirit';

2. the rule of nominalism, which asserts that words, generalisations, abstractions are linguistic phenomena and do not give us new insight into the world;

3. the separation of facts and values;

4. the unity of scientific method.
(quoted in Bulmer, 1984: 87).

Hence, positivism seeks to define a system of rules for knowledge (Hindess,1977) which could be regarded as scientific.

On the implications of the rule of phenomenalism, Bryman explains that:

> only those phenonomena which are observable, in the sense of being amenable to the senses, can validly be warranted as knowledge ... such a position rules out any possibility of incorporating metaphysical notions of `feelings' or `subjective experience' into the realms of social scientific knowledge ...(1988:14)

Also commenting on Kolakowski's cannons of positivism, Bulmer notes that the first three principles are unacceptable as "a rational basis for knowledge". For instance, phenomenalism and nominalism reject cognitive knowledge. This he suggests "would lead sociologists to deny the search for underlying personality or social structures which have got dynamics which affect the world as perceived but which themselves are not directly perceivable." (Bulmer,1984:87). One relevant issue which could arise from Bulmer's argument is whether sociologists should rather search for these `underlying social structures' instead of being concerned with the conditions and consequences of social interaction. It appears that if these latter concerns more appropriately depict the preoccupation of sociologists, then the rule of phenomenalism in particular becomes more persuasive. Nonetheless, in the social sciences, the central tenet of positivism is often considered to be the acceptance of the logic, methods and procedures of the natural sciences and their applicability in the study of humans. This, in effect, ties in with Kolakowski's fourth principle - the unity of the scientific method. The question then concerns what constitutes the logic and assumptions of the scientific method.

Natural scientists assume that the behaviour of matter, which is the subject of their investigations and explanations, are regularities governed by unalterable natural laws; every event has a cause which could be revealed by systematic observation, experimentation and measurement(Bryman,1988; Bulmer,1984; Haralambos,1985).

The results of scientific investigations are "objective facts", correct for all times and all places and independent of the values or ideology of whosoever discovers it. From such 'objective facts' theories are constructed with which to explain the behaviour of matter. On the other hand, scientific theories structure scientific observations in the sense that hypotheses subjectable to empirical tests are derived from them. In essence, scientific knowledge is derived by both inductive and deductive strategies.

Similarly, an idealized account of quantitative research often portrays a picture of a strategy which entails defining research problems against a background of general theories. Research problems guide the definition of research hypotheses which themselves often consist of constructs that could be operationalized and hence rendered observable and measurable, even if imperfectly. Data collected are analysed in order to demonstrate or refute causal relationship between constructs as specified by the hypotheses. In the circumstance, researchers in this bent are seen as accepting the positivistic scientific approach for the study of humans and thus ostensibly accepting that social behaviour and events, like those in the physical world, are largely determined by externalities. Accordingly, social behaviour and events can be objectively quantified and explained in a value-free way and in terms of regularities and causal relationships between variables.

Interestingly, Durkheim (1974: cited in Silverman,1985) recommends that the study of the workings of society should begin with the identification of regularities in people's actions and beliefs. Similarly, Weber (1940) contends that social science knowledge is derived via the establishment of "rules" and "regularities". He also lends support to the search for causal relationships when he advises that a social phenomenon "must be causally explained in order to render its cultural significance understandable" (quoted in Silverman, 1985:41). Nonetheless, it is difficult to regard Weber as positivist. He clearly rejects any "`objective' analysis of cultural events which proceeds according to the thesis that the ideal of science is the reduction of empirical reality (to) `laws'...". As he reasons "the knowledge of social laws is not knowledge of social reality but is rather one of the various aids used by our minds for attaining this end;..." (quoted in Silverman,1985:42). However, by this argument Weber effectively maps out two forms of knowledge in sociology -- of social laws and secondly, that concerning social reality. It appears the construction of social laws derives from scientific `discovery' of causal relationships while social reality is rather more intangible, possibly more metaphysical and more sophisticated. In any case, how knowledge of social reality is actually acquired is not made very clear by Weber.

It needs to be noted that the `ideal of science' is not necessarily empiricist or positivist. Indeed, against the background of the essences of positivism, it could be argued that empiricism or more specifically positivism is a poor account of the nature of science. Relevant here is Hempel's (1952: cited in Evans,1979) argument that many of the terms which natural science (and indeed social science) is concerned with are not directly observable characteristics but are either dispositions or theoretical constructs. Similarly, Harre (1972: cited in Bryman,1988) observes that many scientific theories contain hypothetical concepts which may not be directly observable. Therefore, natural science is unable to satisfy the prescriptions of positivism's doctrine of phenomenalism and nominalism. Furthermore, both Popper's (1968) contention that scientific observations are theory

- impregnated and Kuhn's (1970: cited in Bryman,1988; Silverman,1985; Smith,1981) argument that scientific knowledge is socially constructed highlight the difficulty of separating facts from values, even in science, and thus, draws science further away from logical positivism. Similar arguments may be made in relation to quantitative methodology. Hence, quantitative research may be scientific in terms of its methods and, like natural science, is not necessarily positivistic.

Whether or not quantitative research is positivist, it does have merits and demerits, some of which are briefly analysed here. It must be noted, however, that the focus is on the survey method. Experimental method is excluded because it is more often used in social-psychologically oriented studies and it was never the intention of this study to delve into the psychological dimensions of work.

Survey research entails the systematic collection of data through the use of interviews and/or questionnaires. In effect, the researcher decides what is important and tends to impose his/her own mode of rationality on those under study. Often survey questionnaires are close-ended, the rationale being to elicit similar ranges of responses from participants (Richardson et al,1965: cited in Smith,1981). This aids the quantification of results. However, when such a data collection instrument is used in a `one-shot' survey, the implicit assumption seems to be that meanings and interpretations are fixed entities. But this is not exactly true of the real world where, as ethnographers would argue, individual meanings and interpretation vary and may change over the course of social interaction (Kelly 1955: cited in Bryman,1988). This casts doubts on the appropriateness of survey method for the analysis of complex human interaction. As Denzin rightly argues:

> when sociologists find themselves in settings where the meanings and forms of interaction are relatively ritualized, it is quite probable that their

> structured methods will satisfactorily record elements of the interaction. But in situations where symbolic meanings are in flux and where interactional forms are continually being redefined, the survey method will be found lacking because of its structured and relatively inflexible nature (1989:146).

Thus a "one-shot" data collection and analysis may prove wanting in validity.

One attribute of survey research is that it is the foremost method for retrieving information about respondents' past history. Further support for the method comes from Selltiz et al (1959: cited in Smith,1981) who pointed out that survey techniques are adapted to collecting generalizable information. Generalizability, as well as reliability of survey results, are afforded by the high data structuredness and collection efficiency. A caveat, however, is the tendency of survey research to make the individual the focus of inquiry thus apparently treating society, or a group, as a simple aggregate of individuals. Phillips (1971: cited in Smith,1981) had clearly questioned the usefulness of such individual data. He argues that it does not apply to, or at best applies only indirectly to, inter-individual phenomena like social organisation or social interaction more generally. There is no evidence to suggest that social interaction between organisation members per se, or between the researcher and respondents are unproblematical. Therefore, survey methods may provide an efficient means of collecting large volumes of individualized though quantifiable data but again, it is doubtful whether this data is of much relevance in the analysis of complex social interactions. Thus, Denzin agrees that "While the survey permits statements to be made about large aggregates of individuals clustered in social units, it does not always provide clues about interaction" (1989:146).

The nature of data collected also introduces another question mark on the validity of survey results. Questionnaires and interviews are subject to the influence of memory and view point bias (Smith,1981). Respondents are unlikely to recall events accurately. Therefore, either valuable data are inaccessible to the researcher or aspects of the available data are inaccurate.[3] Besides, interview data are influenced by factors like the interview context, the participant's definition of the situation and the interaction between interviewer and interviewee. Also noteworthy is Deutscher's (1966: cited in Bryman,1988) observation that what people say they do is often radically different from what they actually do. Thus by relying on attitudes and people's report of their behaviour, survey data is likely to produce spurious results. In addition, intrinsic variables like the time elapsed, the nature of the information and the circumstances in which it is collected, affect questionnaire data and generate rival causal factors. Inevitably, the reliability and even the validity of survey results become questionable.

These criticisms notwithstanding, Denzin reckons that survey instruments can be used to measure the nature of "clusters of routinized meanings and interactions..." (1989:154) which exist in social groups. However, according to him, this measurement is possible only if such "clusters" are predetermined by means of intensive field work and close observation.

5.3 THE NATURE OF QUALITATIVE RESEARCH

The growing influence of qualitative research in the social sciences owes much to various intellectual currents[4] which, because of their considerable congruency but also for convenience, are here given a fairly general treatment within the framework of the phenomenological perspective. Phenomenology provides a different approach to the study of humans. Its central thrust is that people are fundamentally different from objects in the natural world. Positing an essential unity of the subject matter of the sciences, as positivism does, is therefore erroneous and unacceptable. This important difference between the subject matter of the natural sciences and social sciences is stressed by Weber (1949) in his essay on "`objectivity' in social sciences and social policy", which could be seen along phenomenological lines. As he writes:

> in the social sciences we are concerned with psychological and intellectual phenomena the empathic understanding of which is naturally a problem of a specifically different type from those which the schemes of the exact natural sciences can or seek to solve. (Quoted in Silverman, 1985:41)

Mainstream phenomenologists argue that human beings have consciousness and human action is purposive. A logical gulf therefore separates social science from the logic and method of natural science.

In his work, `The idea of a social science', Winch (1958) argues that social science is primarily about discovering the intelligibility of human action. Individuals construct their meaning systems based on their experience and interpretation of the world. Also for Schutz (1964: cited in Haralambos,1985; Silverman,1985), serious social science has to take cognizance of the view that human action is governed by subjective meanings. To understand human behaviour we must understand the meaning systems which shape individuals' interpretation of the social world. These subjective meanings can neither be observed nor be investigated as `objective facts' according to procedures appropriate to the natural sciences. Besides, social meanings are not static but are negotiated and generated during social interaction between individuals. Rather than being `objective facts', "social reality" is seen as inter-subjective. That is, it is more a construction by `actors' based on their perceptions and subjective rather than objective interpretation (Atkinson 1971, 1978).[5]

In essence, it is pointless to treat social phenomena or human actions as objective facts and proceed to explain their causes as positivists may suggest. A preferred approach is one which seeks to explore and understand the procedures used by individuals to construct their `social reality'. Qualitative researchers claim this approach. Thus Bryman notes the general view of qualitative research as "an approach to the study of the social world which seeks to describe and analyse the culture and behaviour of humans and their groups from the point of view of those studied" (1988:46).

Consequently, qualitative researchers often favour participant observation[6] as a data collection technique. This demands that the researcher shares and participates in the world of those under study. By participating in the forms of life which constitute and are constituted by human behaviour, the qualitative researcher hopes to be better able to understand and describe that behaviour in-depth. That is, studying social phenomena in their natural setting presumably brings the observer face to face with `social reality' which (s)he is thus better able to understand and interpret. It is suggested that in a bid to check the imposition of their meaning systems on their subjects, participant observers, unlike their quantitative counterparts, often try to avoid an explicit formulation of theories until much later in the research process (Bryman, 1988:68-69).

Perhaps, it needs to be emphasized that the connection between perspectives loosely labelled phenomenological and the qualitative research is borne out by the latter's commitment to the point of view of the people being studied. This commitment leads the researcher to detailed descriptions and also accounts for the flexibility, openness and unstructuredness often associated with this mode of research. Also accounted for is the apparent preference for contextualism, that is, a commitment to "a style of research in which the meanings that people ascribe to their own and others' behaviour have to be set in the context of the values, practices, and underlying structures of the appropriate entity (be it a school or slum) as well as the multiple perceptions that pervade that entity" (Bryman, 1988:64). Put more simply, there is a predilection for understanding events and activities within the context of the specific milieu being investigated.

Of course, qualitative research, or more specifically the participant observation method, is not bereft of problems. To begin with, although the presumed closeness to social reality accord some degree of validity, the adequacy, accuracy and hence acceptability of the researcher's observational and interpretation skills is problematic. Indeed Denzin (1989) agrees with Clifford and Marcus (1986) that participant observers construct culture. As Denzin argues:

> They do not simply record an objective reality that is "out there". They create ... the worlds that they study and then write about it (1989:156-157).

Implied in this argument is the point that distortion of `reality' occurs during the course of any study as the researcher, probably unconsciously picks out what makes sense to him/her. It is infact feasible to argue that there is no objective `reality' other than individuals' construction of their `realities'.

Furthermore, in reference to and in agreement with Hammersley and Atkinson's (1983) view, Silverman writes:

> Observation is not a pure, "uncontaminated" activity. The observer may influence the setting and/or may miss the effects there of temporal cycles. Hence his conclusions may be contingent and invalid for that setting at other times and/or for other settings (1985:115).

This comment suggests an inherent prejudice in the ability of the researcher to see through the eyes of his/her subjects and hence points to the tentativeness of research accounts.

Another related issue concerns idiosyncratic differences between individuals which cause variations in researchers' observations and interpretations (Bennet,1960; Blalock 1970: cited in Smith,1981). Hence different researchers exposed to the same situations may not make similar observations. Aside from the idiosyncrasies of individual researchers, it is also logical to presume that individuals in the group studied would have different meaning systems. Thus "the injunction to take the perspective of the people you are studying may mean needing to attend to a multiplicity of world-views" (Bryman, 1988:6). The feasibility of handling this commitment is in doubt.

Doubt on the authenticity of the researcher's observation and interpretation is further highlighted by Moerman (1974: cited in Silverman,1985) who is apprehensive of "trusting the native". In this regard, Moerman questions the excessive faith in the behaviour of people studied. It is presumed that the presence of the researcher may itself influence the action of those under study. Individuals may begin to behave in ways they believe the researcher would want them to. The crucial issue, then, is the researcher's ability to distinguish the actions which are faked from those which are not. Also related is the difficulty of handling beliefs involved in an "alien" social setting.

A point could also be made in passing that the participant observer's apparent craving for contextualist understanding inhibits comparative analysis and thus further discourages the development of theory. In any case, it has to be emphasized that not many would see any mode of research as atheoretical. For instance, Kidder and Judd are clear that:

> It is simply not possible to conduct research as pure discovery or to proceed purely inductively. Even when research is used primarily to generate hypotheses, the researcher inevitably makes theoretical assumptions in deciding what to observe or where a potential cause may lie (1986:24).

Similarly for Denzin, "theory ... organizes the research act" (1989:38). According to him, the use of theory does not necessarily lie in its utility in explanation, prediction and control as logical positivist would suggest. Also important is "theory's use in the realm of understanding, making sense of, writing about, or interpreting a phenomenon"(1989:38). In essence, contemplating a theory-free research, even in relation to participant observation for that matter, is erroneous. What is called into question is the ability of the researcher to suspend (until a later stage in the research) his/her awareness of relevant theories and concepts.

Furthermore, even if one accepts the doubtful presumption that participant observation shuns the utilisation of theory as a precursor to research, other doubts still emerge. Bryman's comment illustrates one of these doubts. As he puts it:

> how one deals with the oncoming flood of data, or how one holds theoretical considerations in abeyance, or how one chooses a research site in the first place,

> constitute practical difficulties for such an approach (1988:87).

Moreover, resulting from the supposed atheoretical and flexible approach is the generation of unexpected but interesting issues. This presents the researcher with the dilemma of delimiting the scope of research (Whyte 1984).

Participant observation methods tend to assume that the acceptance of the observer and the establishment of appropriate trust relationship between him and his/her subjects is unproblematic. But apart from the obvious difficulty in achieving this, there is the problem that an observer who gains the acceptance and trust of the observed faces either one of two risks -- the danger of "going native" or that concerning role conflict between his/her normal and assumed roles. All these concerns are symptomatic of the considerable pressure on the reliability and validity of qualitative research or more specifically participants observation method.

To summarize, while quantitative research is associated with positivism and an inclination to a natural science approach, qualitative methodology draws considerable inspiration from a distinctly different phenomenological approach. As a result, qualitative research is associated with emphasis on:

- 1) adoption of actors' perspective
- ii) contextual understanding of events and activities and until recently
- iii) a relatively theory-free investigation.

However, much as these features may be ideally desirable, their practicability is problematical.

5.4 THE DISTINCTNESS OF QUANTITATIVE AND QUALITATIVE RESEARCH

As the previous sections attempt to show, quantitative and qualitative procedures are acknowledged as distinct methodologies, tied up with different intellectual traditions. While avoiding a critique of these traditions per se, the issue addressed here is whether these methods can actually be defined along distinct philosophical and ideological lines. The argument here seeks to suggest that the presumed philosophical underpinnings are not strait-jackets into which the methods fit perfectly. Besides, differences between these methods are not that neatly cut out. The main thrust of the argument centres on how scientistic and indeed positivistic (or otherwise) both are. Also addressed is the extent of "technical" differences between the two methodologies.

The view that observation of `objective facts' is fundamental to the construction of scientific theories conveys an impression of a distinction between theory and observation. In other words, scientific observation is uncontaminated by theory. What seems pertinent here is that although qualitative research strives to dismiss the notion of "objective facts", it could still be regarded as scientistic in so far as it is sometimes seen as favouring observation which is allegedly uncontaminated by theory. Similarly, quantitative research is equally scientific, though on different grounds--its preference for objectivity. It thus appears that the dualism in the nature of scientific theories (wherein theories are seen as being generated from observation as well as shaping observation itself) implicitly brings both quantitative and qualitative research methods together within a `scientistic' category and ostensibly closes the gap between them.

Furthermore, analysts suggest that scientific method does not necessarily imply the reduction of all empirical statements to statements of physical movements within a single set of space-time coordinates. From this premise, Bhaskar (1979) reasons that although "social objects are irreducible to natural objects and so possess qualitatively different features from them, [and] cannot be studied in the same way as them ... they can still be studied `scientifically'" (Quoted in Silverman, 1985:43). Further, Bhaskar sees similarity between human and natural sciences in terms of the concern of both for explanation, both differing only in relation to what is explained and how explanation is achieved. Therefore in Bhaskar's view, any explanatory procedure is scientific. On the other hand, for Silverman, studies become "scientific by adopting methods of study appropriate to the data at hand" (1985:20). From these standpoints then, both quantitative and qualitative research methods are scientific. This is because researchers in both traditions seek to explain and use "appropriate methods" in their investigation.

From the premise that quantitative and qualitative methods are scientific and, taking the view that to be scientific is synonymous with being positivist, it is logical to argue that both methods are positivistic. It is also noteworthy that the premium both methods place on observation satisfies the doctrine of phenomenalism - one of the essences of positivism according to Kolakowski. Hence, the distinction between qualitative and quantitative methods become even more blurred.

Another dimension of commonness between the research methods could be located in the empiricist view -- the doctrine that factual knowledge derived from `untainted' sense data alone is enough for social understanding. Put differently, that empirical data alone are a sufficient condition for knowledge about society. That both quantitative and qualitative research have empiricist tendencies is borne out in their techniques. Qualitative researchers seem to have a preference for categories which are amenable to the senses. For example, in a text of qualitative research in sociology of deviance, Douglas (1976) writes:

> We begin with direct experience and all else builds on that [we] begin with and continually return to direct experience as the most reliable form of knowledge about the social world (quoted in Bryman, 1988:119).

Thus to the extent that it seeks to establish connections between observed categories, qualitative research, and in particular, participant observation is empiricist (Willer and Willer 1973: cited in Bryman,1988). Similarly, Atkinson (1980) would argue that in qualitative research, the apparent tendency towards atheoretical investigations or the postponement of theoretical issues until much later during the research renders this mode of study considerably empiricist. With regard to quantitative research, its empiricist tag also has to do with its strategy. This refers to its particular strategy of rendering theoretical problems either directly or indirectly observable by means of hypothetical propositions which are subsequently submitted to empirical testing.

The phenomenological dictum of understanding and interpreting meanings of actors cuts out qualitative research as an interpretivist methodology. Similarly, quantitative researchers also claim concern with the meaning systems of their respondents. March (1982: cited in Bryman,1988) draws attention to the use of social surveys to solicit respondents' views and reasons for their action. To buttress this point, Bryman (1988) also cites Morse and Weiss's (1955) classic study of a sample of adults in the USA. Using the survey method, these researcher "found that work does not simply mean the ability to earn money, but has a number of other meanings for people" (Bryman, 1988:121). If, as thus claimed, the quantitative researcher is able to tease out the range of respondents' meaning systems via quantitative means, then quantitative research could be seen as interpretivist. In any case, by even adopting the mundane meaning of interpretation, the analysis of statistical data, a major element in quantitative research, can be conceived of as a form of interpretation.

The above analysis attempts to give credence to the view that categorization of research methods along distinct epistemological and ideological lines is misleading. Nonetheless, areas of contrasts do exist. But then, these contrasting dimensions do not necessarily suggest that the research methodologies are mutually opposed ideal types. It thus appears worthwhile to undertake a brief comparison of some of the discernable differences with a view to highlight their relativeness.

As indicated previously, whereas investigations within the quantitative framework often begin from theories and concepts, qualitative researchers often avoid the use of theories as starting points for their studies. That is, while researchers adopting a quantitative approach generally seek to verify theories, those in the qualitative tradition are more concerned with the construction of theory. In any case, this view lacks universal support. First, there is evidence to suggest that quantitative research is not only concerned with theory-testing. For instance, in reference to their quantitative research study of the International Typographical Union in the USA, Lipset (1964) indicates that the:

> analysis did not merely test hypotheses already held before the survey was conducted. Rather, the earlier hypotheses pointed to a fruitful line of enquiry, but many of the ideas and insights regarding the bearing of shop size on union politics emerged only in the

> course of the analysis of the survey data (quoted in Bryman, 1988:98).

On the other hand, qualitative research is not necessarily an endeavour strictly concerned with theory-discovery. As Bryman contends "some qualitative research is showing an explicit concern with theory, not solely as something which emerges from the data, but also as a phase in the research process which is formulated at the outset" (1988:98). In the light of these, Bryman concludes that "the contrast between quantitative and qualitative research in terms of verification of theory against preferring theory to emerge from the data is not as clear-cut as is sometimes implied" (1988:98).

The tendency to focus on specified issues from the outset, and the employment of prior-constructed data gathering instruments, mark out quantitative methodology as a highly structured approach. By contrast, qualitative research is characterised by unstructuredness possibly because of its emphasis on the subjects' point of view and a recognition of the situated and processual nature of human interaction. In addition, whilst in qualitative research observation is directed towards "linking interaction patterns with the symbols and meanings believed to underlie ... behaviour" (Denzin 1989:158), observation seems to be for a different concern in quantitative research. Here, the apparent assumption of a pre-constituted world of phenomena that needs to be investigated makes the focus of observation that of recording frequency distribution of events.

Furthermore, the specificity of participant observation, for instance, makes findings in this approach unrepresentative, less generalizable but more valid. On the other hand, random sampling of the study population makes survey results more representative, more generalizable but less valid. In any case, it is noteworthy that this distinction is also only relative. Bryman points out that "Surveys are often not based on random samples and, even when they are, they refer to highly restricted populations ... Further, the consistency of findings over time is rarely given much attention" (1988:101).

A plausible contention from the preceding discussion is that distinction between quantitative and qualitative research methods is not as rigid as some analysts suggest and that differences are more `technical' than they are epistemological. Specifically, the distinction between the methods appears to be mainly in relation to their strategies for the collection and treatment of data which in turn underscores the ability of each method to answer only certain types of questions.

5.5 THE INTENDED RESEARCH STRATEGY

Implicit above is the point that the choice of research method is dependent on the research intention and on the premium placed on validity or reliability rather than on purely epistemological considerations. In this vein, Bryman suggests that "the decision over whether to use a quantitative or qualitative approach should be based on `technical' issues regarding the suitability of a particular method in relation to a particular research problem"(188:106). This argument implicitly conveys an "either/or" impression and thus tends to overlook the feasibility of usefully combining both approaches when the research problem so invites. Although such a combination is inconceivable from an epistemological stand point (Guba 1985), there is increasing evidence in literature that many writers clearly recommend the strategy and many research studies are carried out along this line (Bryman, 1988).

Two main arguments underline the case for triangulation[7] - - the employment of more than one data collection technique. Firstly, the different methods have their strengths and weaknesses and often the strength of one method seems to be a weakness of the other. Therefore a blending of the methods is thought to enable the researcher to tap most of the strengths while minimizing, if not completely eliminating the flaws. Besides, Webb (1966) emphasizes that:

> Every data-gathering class - interviews, questionnaires, observation, performance records, physical evidence - is potentially biased and has specific to it certain validity threats. Ideally, we should like to converge data from several different data classes, as well as converge with multiple variants from within a single class.(quoted in Denzin 1989:244).

Secondly, it is argued that multiple research methods enable the researcher to gain a "total" or more complete picture of the phenomena under study. Presumably each method, which "implies a different line of action toward reality - "(Denzin,1989:235), captures only certain aspects of a given phenomenon. Therefore,

> if each method leads to different features of empirical reality, then no single method can ever completely capture all the relevant features of that reality; consequently, sociologists must learn to employ multiple methods in the analysis of the same empirical events (Denzin 1989:13).

Hence the different research methods are seen as different ways of examining the same research problem. Thus in Newby's (1977) study of Suffolk farm workers, he combined a structured interview survey with participant observation in order "to make valid inferences from survey data, while insights gained from the participant observation could be checked for representativeness against knowledge gained through the survey" (quoted in Bryman,1988:154). Similarly, Gallie (1978) used survey, documentary material and "longer and deeper interviews" in his study of oil refineries in Britain and France. As he contends, bringing different types of data to bear on a research problem provides "The best chance of grasping the reality of the situation" (1978:48).

Furthermore, Webb et al(1966) see triangulation as a viable strategy for reducing the problem of rival interpretations when causal propositions are being developed. For them:

> when a hypothesis can survive the confrontation of a series of complementary methods of testing, it contains a degree of validity unattainable by one tested within the more constricted framework of a single method ...(quoted in Denzin 1989:26).

It may also be added that by enabling comparison of data generated from different techniques, triangulation helps to reduce bias. This adds to triangulation's positive implication for validity claims and, as Webb and colleagues also suggest, is likely to increase the confidence of social scientists on research findings.

While accepting that triangulation seeks to overcome the seeming partiality of single methods of data collection, critics point to some weaknesses. For example, Garfinkel (1967: cited in Silverman,1985) had argued that triangulation reduces the researcher to an "ironist". This he says is because the researcher fails to recognize the contextual nature of action and hence proceeds to use one account to undercut another. Similarly pointing to the "situated character" and uniqueness of action, Silverman (1985) stresses the point that presenting a complete picture of a phenomenon is more problematic than advocates of triangulation will concede.[8] Silverman also points to underlying elements of positivism evident in the hypotheses testing orientation of Webb and his colleagues. As he argues, triangulation in principle "assumes a single (undefined) reality and treats accounts as multiple mappings of this reality" (1985:105).

Of course Silverman has an appeal for "non-sectarian versions of research practice" (1985:114) but in place of "positivistic" triangulation he recommends analytic induction. Analytic induction "is a strategy of analysis that directs the investigator to formulate generalizations that apply to all instances of the problem" (Denzin, 1989:165-6). For Silverman, analytic induction enables the avoidance of "fine-sounding [epistemological] polarities", and its logic "adds rigour and comparative flavour"(1985:111) to research. Although his profound rejection of positivism filters through much of his work, Silverman's support for analytic induction suggests support for research that combines "elements of both positivism and ethnomethodology" (1985:116). This view of analytic induction as a strategy for epistemological blend of some sort differs somewhat from Denzin's (1989) treatment of analytic induction. According to Denzin, analytic induction involves six steps:

1. A rough definition of the phenomenon to be explained is formulated.

2. A hypothetical explanation of that phenomenon is formulated.

3. One case is studied in light of the hypothesis, with the object of determining whether or not the hypothesis fits the facts in that case.

4. If the hypothesis does not fit the facts, either the hypothesis is reformulated or the phenomenon to be explained is redefined so that the case is excluded.

5. Practical certainty can be attained after a small number of cases have been examined, but the discovery of negative cases disproves the explanation and requires a reformulation.

6. This procedure of examining cases, redefining the phenomenon, and reformulating the hypothesis is continued until a universal relationship is established, each negative case calling for a redefinition or a reformulation.
(Denzin, 1989:166)

Denzin's model of analytic induction thus places much premium on hypothesis testing and on this ground is more positivistic than it is a blend of epistemologies. More important, however, is the point that the strategy can be envisioned as that which encourages rigorous tests for theories or hypothesis by virtue of its emphasis on a search for negative cases. According to Denzin, analytic induction relies more on theoretical than on statistical sampling models but at the same time provides a means by which both models can be brought together. He adds that the strategy leads to the development of what he calls "processual theories" as well as allows the movement from substantive to formal theories.

While the concern here is not to offer a critique of analytic induction, suffice it to state that since:

i) the aim is not to search for universal propositions (which in any case can never be beyond doubt since absolute proof seems untenable),

ii) the study is not longitudinal or intended to be long term; and

iii) not many cases are involved,

the research would not subscribe to analytic induction in its ideal or rather more complete form.

Gallie's research informs the preferred strategy for the research study. Following Gallie, the intention is to adopt some degree of triangulation but excluding participant observation. This is for a number of reasons. Participant observation seems suitable for research in workplace relations by virtue of its commitment to direct observation and interpretation of social interactions. However, weighed against the background information from literature that workplace processes are influenced by extraneous cultural, political and economic factors, which are not directly observable, the suitability of this method becomes doubtful. Also noteworthy is the point that unlike Gallie's, the study would not necessarily seek behaviourial information. The attention is on the perceptions of individuals.

Implicit in the research topic is a technology which is already in place. If the reverse were the case, that is, that the technology is about to be introduced, then a longitudinal study using participant observation method may be a useful strategy for monitoring change. Even then, it would be difficult to tease out the influence of the other factors mentioned. Besides, a longitudinal study is not feasible in view of limitations on time and resources as well as the scope of the research. On the other hand, to the extent that both technology (already in place) and work organisation at a given point in time can be seen as stable, interviews and questionnaires administration seem appropriate for the investigation. Undoubtedly, some information on the existing structure in work organisation could be obtained by direct observation. But, relevant past histories on the organisation of work obtained from secondary sources, cannot be observed in the present.

Given the above circumstances, a case study approach, in which a mixture of data-gathering techniques would be utilized, is preferred. The intention is to combine questionnaires and semi-structured interview data with those obtained from secondary sources for analysis. Also, short non-participant observation sessions would be undertaken mainly for the purpose of verifying information obtained through survey techniques and secondary sources.

Analysis will involve theoretical sampling but this will not mean going the whole length of seeking cases that would invalidate hypotheses, as obtains in analytic induction. Rather it is limited to a focus on the extent to which each hypothesis or observation "fits the facts".

The result of this would be the basis for any inferences that may be made. For instance, inferences on any changes in the content of jobs may be made by assessing the level of association between technology and the changes and then, consideration of management as well as workers' influences in the changes. In effect, this also means taking cognizance of a major theme in the research, namely, a tacit recognition of the interactivity between organisation `actants'.

Furthermore, this strategy nearly approximates what Denzin labels "causal-interpretive" (see Denzin 1989:98-9). In a way, the approach may be seen as tending towards causal explanation since theoretical guidance is employed. However, much depends upon whether or not "cause" is seen along "scientific" lines or as bounded by time and space. As Denzin argues, if cause is seen as residing in social experience or in social interaction and hence is bounded by time and space, then it is in order for research to address "both the why and the how problems of everyday life" (1989:37).

Nonetheless, the concern of the study is not necessarily the pursuit of causal explanations; the interest is to reveal associational links by means of logical inferences. That is, interest is on the extent to which, and how, technology is relevant rather than an attempt to make predictions concerning the conditions under which technology would or would not be relevant. Further, it needs to be added that investigation of `technology relevance' does not seek a determinist position for technology. Rather it is more an attempt to show the unpersuasiveness of pure technological determinist and social determinist explanations whilst, at the same time, show that both the technological and the social do matter and hence are relevant in the organisation of work. In any case, like many case studies, the research would neither lay claims to representativeness nor to limitless generalizability.

NOTES (5)

1. For logical positivists, demarcation between scientific and non-scientific knowledge is correspondingly as between the meaningful and sensible and the meaningless and non-sense. Logical positivists take the view that no norms or ideas would dictate to humanity; that is, if a convention is agreed which delimits the scientific or the meaningful (Gellner, 1985)

2. It seems necessary to distinguish between the doctrine of phenomenalism and the phenomenological perspective. The former refers to the positivist belief that those "...phenomena which cannot be observed either directly through experience and observation or indirectly with the aid of instruments have no place [as warrantable knowledge]" Bryman, (1988:14). On the other hand, Phenomenology similarly endorses observation but goes further to insist that such observation from the "outside" may be suitable for the subject matter of natural scientists but certainly inadequate for that of the social scientist. The consciousness and purposiveness of human action makes it mandatory that the internal logic which directs human actions must be explored and interpreted by the social scientist.

3. An elaborate list of sources of error in survey research is provided by Demmings (1944).

4. The intellectual traditions include phenomenology, symbolic interactionism, Verstehen, Naturalism, and Ethogenics. See Bryman (1988:51-61) for an analysis of these traditions.

5. In rejecting the logic and procedures of positivist methodology, Atkinson maintains that there is no reality beyond the meanings given to it by social actors.

6. Participant observation takes many forms. Denzin (1989) has given a detailed account of the different identities which participant observers assume. These

include: complete participant; participant as observer and participant, and complete observer.

7. Although triangulation is more often seen as the use of multiple methods, Denzin (1989) has identified different types and subtypes. (See Denzin, 1989: 236-240).

8. Advocates of triangulation insist that the aim is not primarily to produce a coherent picture of reality but to enable different pictures of reality to emerge (Denzin, 1989; Trend 1978). But the nagging question which remains unanswered is how to achieve convincing and coherent interpretations of these multiplicity of pictures.

CHAPTER 6

THE CASE STUDY BACKGROUND

Oil refining is one sector where the craving for technological development in Nigeria has made its mark. From a very humble beginning, the sector has changed dramatically to the use of very modern refining technologies. This chapter starts with a brief historical overview of the development of Nigeria's oil industry generally and the Port Harcourt refinery in particularly. This will help explicate the prominence of government agents in the industry. As will be seen, all refineries in Nigeria are government-owned, contrary to what applies in most Western developed countries. Discussed next are the general operations and the organisational structure in the Port Harcourt refinery. Finally, the particular research methods employed are described.

6.1 THE DEVELOPMENT OF THE OIL INDUSTRY IN NIGERIA

Oil prospecting in Nigeria dates back to 1908 when exploration activities were undertaken by a German Company, the Nigerian Bitumen Corporation. However, it took almost five decades, barring interruptions by the First and Second World War, before oil was discovered in commercial quantities by Shell Diarcy[1] in 1956. This major find was at Oloibiri in Nigeria's Niger delta, from where production of crude oil started in 1958. While Shell remains the dominant producer, accounting for 50% of Nigeria's oil production (Lukman,1989), other multinational companies like Mobil, Elf, Gulf etc secured exploration rights and have made considerable contribution in crude oil production. Crude oil production in Nigeria rose from 5100 barrels per day (bpd) in 1958 to a peak of 2.4 million barrels per day (MBD) in 1979, after which it plummeted to as low as 1.4MBD in 1989, mainly because of the collapse of oil prices. However, production is gradually picking up and now stands at 1.85 MBD (Amino,1991:7).

In Nigeria, government's role in the oil industry varied according to the perceived importance of the product in the national economy. Before the late 1960s when oil played a relatively insignificant role in the country's economy, government's interest was only in the collection of royalties from oil companies and its role was mainly that of making regulatory laws binding on the oil companies. As Amu remarks, "the primary concern of government was to provide the right climate for the smooth operation and development of the industry ..." (Amu,1982:7).

However, with the progressive dominance of oil in the country's economy since the early 1970s, the government needed more than just token benefits from her natural resources. To be able to finance its development objectives, government's direct involvement and active participation became a matter of necessity. From government's point of view, if the goal of rapid industrial development of the country was to be achieved, it seemed necessary "to develop a sound petroleum policy to broaden ... [the] production base, enforce appropriate conservation policy, exercise control in the operational activities of producing companies and to attain equitable values for our crude oil ..."(Lukman, 1989:2). As an immediate step, Nigeria, in 1971, joined the Organisation of Petroleum Exporting Countries (OPEC) which is apparently perceived as a useful, protective umbrella for its now mono-product economy. It is noteworthy that OPEC's principal objectives as spelt out in Article 2 of its statute, include:

- the coordination and unification of the petroleum policies of member countries and the

> determination of the best means for safeguarding their interests ...
>
> - [to] devise ways and means of ensuring the stabilization of prices in international oil markets with a view to eliminating harmful and unnecesary fluctuations
>
> - [have] regard ... at all times to the interests of the producing nations and the necessity of securing a steady income to the producing countries ...
>
> (OPEC statute, June 1989).

In essence, OPEC member countries are able to price their own oil, that is, along guidelines set by the organisation. This is quite unlike before the creation of the organisation when the "seven sisters" multinational companies namely Exxon, Texaco Royal Dutch/Shell, Mobil, Gulf, British Petroleum and Standard Oil of California "created `states-within-states' in the oil producing countries, controlling the amount of oil extracted, how much was sold, to whom it was sold and at what price". (OPEC at a glance, Undated:7). Furthermore, in its Resolution XVI Article 90 of June 1968, OPEC enjoined all member countries to acquire participating interests in oil companies operating within their territories. It also prescribed that member countries achieved 51% equity participation in their oil industry by 1982.

Subsequent to its OPEC membership, the Federal Military Government of Nigeria established the Nigerian National Oil Corporation (NNOC) by Decree No 18 of 1971. Unlike the Ministry of Petroleum Resources (MPR) which was established before it and whose role was mainly regulatory, the NNOC was charged with the responsibility of participating in both `Upstream and downstream' activities in the industry. Under this new arrangement, government successfully negotiated and increased its level of participation interests in the oil companies. Hence, by 1982, government's share of crude oil production in

Nigeria rose to about 70% having acquired 80% interests in Shell and 60% in each of the other oil companies namely Texaco, Gulf, Mobil, Agip, Elf and Pan Ocean (Agbejule;1987). Meanwhile, to enhance efficiency and optimize the use of scarce human resources, government merged the MPR and the NNOC by Decree 33 of 1977 to form the Nigerian National Petroleum Corporation (NNPC) which then combined their respective regulatory and participatory functions.

The NNPC strives to manage government's participating interests in the oil producing companies and as Lukman R (1989) explains, engages in purely commercial and profitable ventures. That is, all of governments's share of crude oil produced is managed by NNPC. It is responsible for processing the crude oil for local consumption as well as responsible for the sale of the portion for export. Consequent upon a reorganisation exercise in 1988 in anticipation of brighter prospects (Lukman;1989), NNPC is now made up of 12 subsidiary companies, among which is the Port Harcourt Refinery.

6.2 THE PORT HARCOURT REFINERY

Concerted effort to establish a petroleum refinery in Nigeria began when the production of crude oil in the country reached the 0.5 MBD target[2] in 1959. After preliminary surveys by foreign experts, Alesa-Eleme near Port Harcourt was chosen as the most suitable of six alternative sites. In December 1960, the Shell-BP Petroleum Refining Company of Nigeria was formed and charged with the responsibility of constructing the planned refinery.

In 1962, the Nigerian government concluded an agreement with the two parent corporations of Shell-BP which enabled it to acquire a 50% equity share in the refining company while the remaining 50% was shared equally between Shell and BP. As a result, the name of the refining company was changed to The Nigerian Petroleum Refining Company Ltd (NPRC). Construction work on the refinery began soon afterwards and in 1965 the refinery became fully operational. The initial refining capacity was 35000 barrels of crude oil per day but this was later increased to 60000 bpd following a plant `debottlenecking exercise' in 1970/71. Further, the government increased its equity participation to 60% in 1972, This was followed by a complete buy-out in 1978 by the Federal Military Government of Nigeria in conjunction with some state governments in the Federation. As a result of the buy-out, ownership rested with different Nigerian government agents thus:

Nigerian National Petroleum Corporation (NNPC)	40%
Ministry of Finance Incorporated (MOFI)	30%
Odua Investment	10%
Other State Governments	20%

However, state governments and MOFI relinquished their shares to NNPC in 1979 and 1984 respectively. Thus NNPC became the sole government agent, responsible for the running of the refinery which was renamed NNPC Refining Company. The refinery mainly served the domestic market producing: Premium and Regular motor spirits; liquid petroleum gas for domestic cooking; dual purpose kerosene for aviation and domestic uses; gas oil for fuelling heavy duty engines; and high and low pour fuel oils for industrial use (Amu,1982). NNPC purchases crude oil from government at less than the international market price (Lukman,1989), refines the crude and sells products to marketing companies.

Nevertheless, the production of refined petroleum products in the refinery was outstripped by the nation's consumption requirements for these products. This, added to the need to export refined petroleum products, resulted in the commissioning of two other refineries in the West (Warri) and the North (Kaduna) of Nigeria, both also solely owned by NNPC. In any event, ever increasing demand led to the addition of a new plant to the refinery in Port Harcourt. Both the old and the new plant together make up what is currently called the Port Harcourt Refining Company (PHRC). PHRC is a subsidiary of NNPC. Although the extent of its autonomy from NNPC is not very clear, PHRC has its own board and chairman.

6.2.1 THE TECHNOLOGY

The process of crude oil refining basically involves the passage of crude through distillation columns at specified temperatures and pressures. The old plant had[3] the traditional refining technology, that is, a basic crude distillating unit (CDU) and had capacity for refining 60,000 barrels of crude per day. On the other hand, the new plant, commissioned in 1989, has the most modern refining technology in Nigeria and has a refining capacity of 160,000 bpd. Apart from having a much larger CDU than old plant, it also has additional units. As a senior manager (Anah*:June,1991) explained, much of the "atmospheric residues", like high-pour fuel oil which was produced in the old plant, had to be exported because of the lack of facilities to crack and fractionate it further. But the new plant, is a more integrated outfit. In addition to the CDU, it also has a Vacuum Distillation Unit (VDU) Naphta hydrotreating Unit (NHU) Catalytic reforming Unit (CRU), Kero hydrotreating unit etc. These additional facilities enable further processing of crude oil for increased yield and purer products.

* *This, and all other names given to respondents in the study are fictitious.*

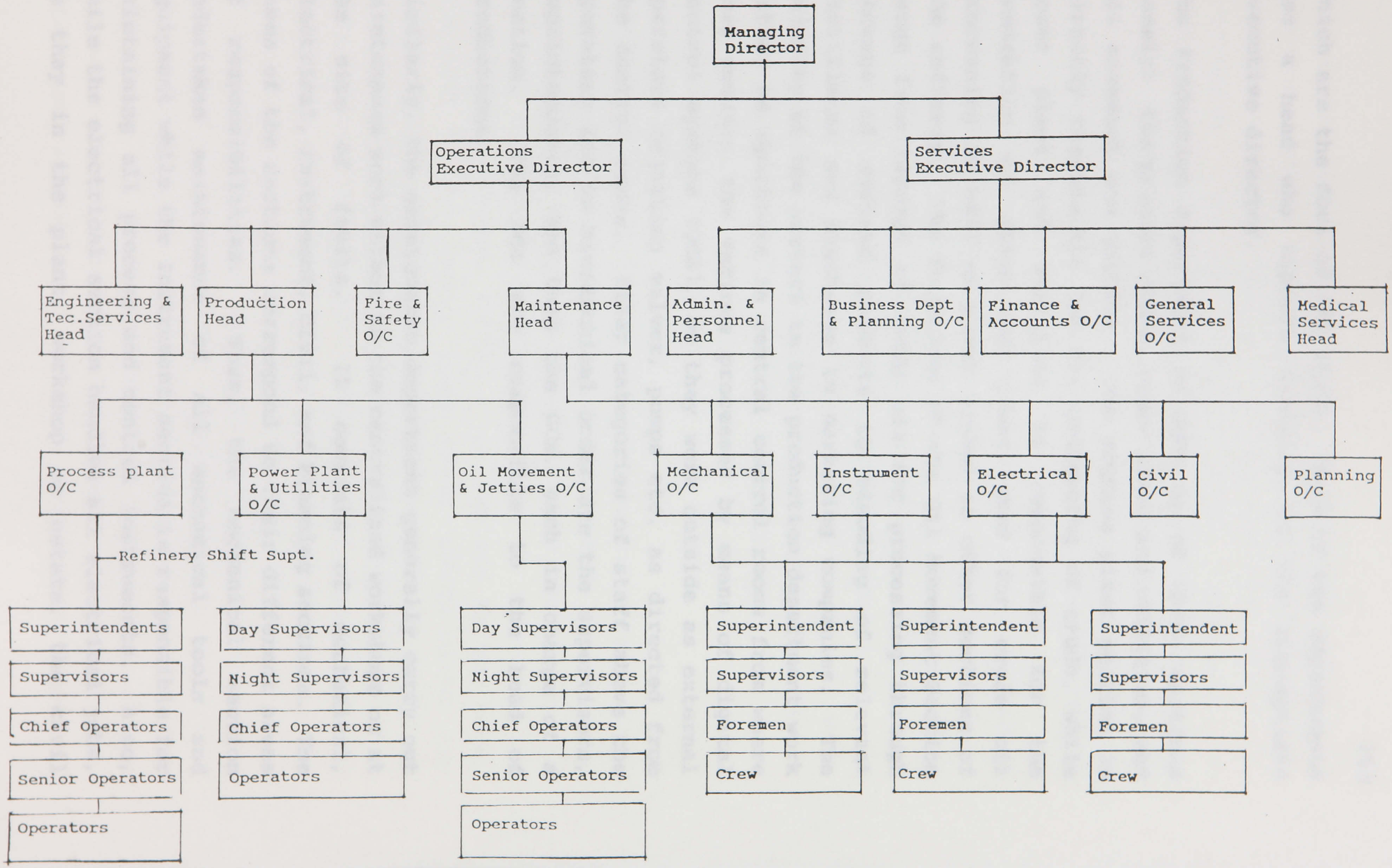
Besides, in the old plant, pneumatic control systems were in use and these were located partly on large panels as well as at various locations in the plant itself. On the other hand, in the new plant, control of production processes was effected through electronic monitoring and control devices located in control rooms. Hence, another distinctive feature of the new plant is its high level of technological sophistication. Thus a top manager (Anah: June,1991) aptly described it as the only refinery in the country which is "controlled almost centrally and 85% of equipment is started and stopped from one spot".

The existence of new electronic monitoring and control devices, coupled with the suggested relative centralisation of these controls, bring to mind issues like the structure of authority, the patterns of supervision, and the content and character of jobs. A crucial question is whether changes in them were experienced as a result of the acquisition of the new plant.

6.2.2 THE ORGANISATION STRUCTURE:

The total workforce in the old plant was approximately 800 and has almost doubled since the addition of the new plant. As at July 1991, the total workforce was put at 1558[4]. As figure 6.1 indicates, these are shared between the two main divisions: operations and services. At the head of each division is the executive director who is answerable to the refinery's managing director. The services division comprises: Administration and Personnel, Business Development and Planning, Finance and Accounts, General Services, and Medical departments. Similarly, the Operations division includes Engineering and Technical Services, Fire and Safety departments as well as Production, and Maintenance departments both of

Figure 6.1: Part Organogram of Port Harcourt Refinery



which are the foci of the study. Each of the departments has a head who reports directly to the appropriate executive director.

The Production department is made up of three sections namely: the process plant, power plant and utilities, and oil movement and jetties. The process plant section is directly responsible for the processing of crude, while power plant and utilities is responsible for the generation of steam and power used for crude oil processing as well as power needed in other sections of the refinery. The functions of the Oil Movement Section range from receipt of crude oil for processing through storage of refined products to blending of relevant distillates and discharge to marketing companies. The majority of the workers in the production department work either as operators in central control rooms from where they monitor the various processes by means of digital control systems (DCS), or they work outside as external operators adjusting valves, pumps etc. as directed from the control rooms. Other categories of staff above the operators and in hierarchical order are the supervisors, suprintendents, and then the OCs, each in charge of a section. The OCs are responsible to the head of productions.

Similarly, the maintenance department generally carry out maintenance work either in the centralized workshops or at the site of faults. It consists of mechanical, Electrical, Instrument, Civil, and Planning sections. The names of the sections correspond to their different areas of responsibilities. Thus, the mechanical section undertakes maintenance of all mechanical tools and equipment while the Instrument section is responsible for maintaining all process and control instruments. Also, while the electrical section handles all electrical jobs, be they in the plant, workshop or estate, the civil maintenance section takes charge of all civil works. The planning section is responsible for planning and co-ordination of the jobs of all the sections within the department. In the sections, those lower down the hierarchy are categorized as crew. Above the crew are the foremen, supervisors, suprintendents and the OCs who are the head of sections. All heads of sections in maintenance report to the head of maintenance department.

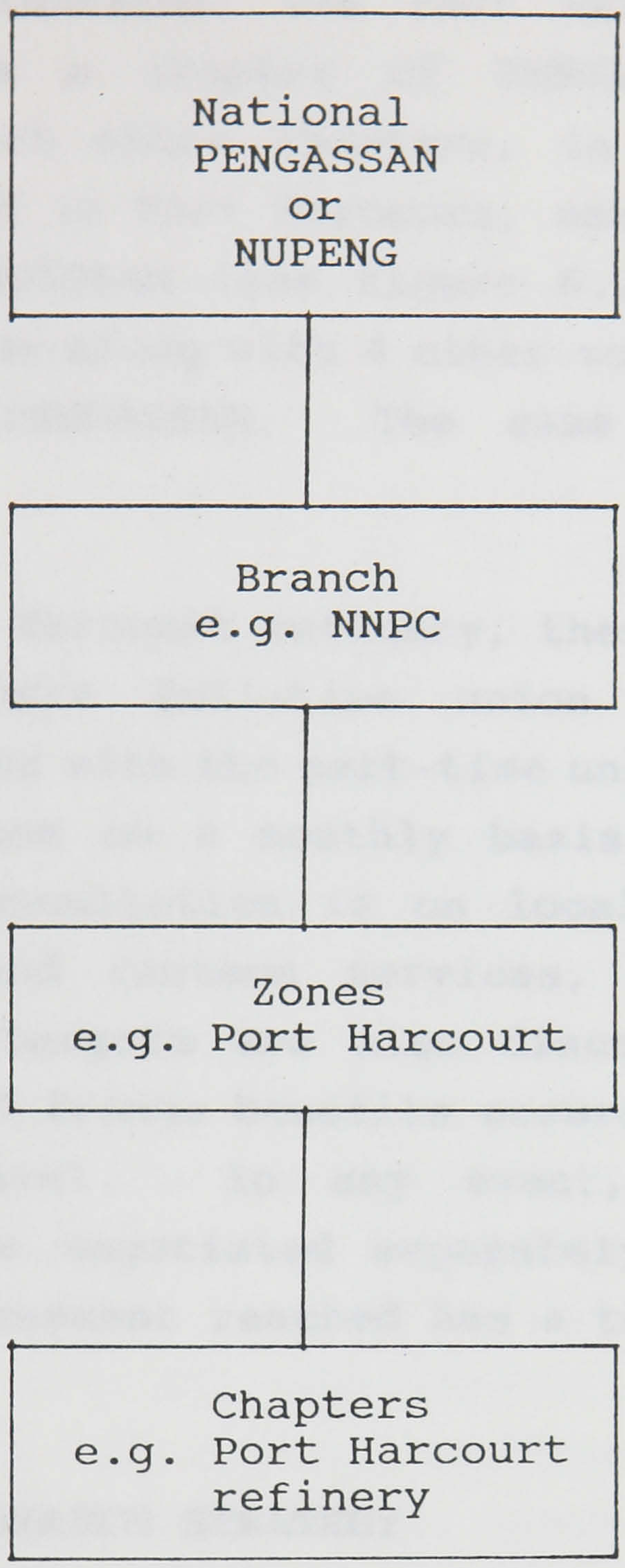
Production and maintenance workers run a four-shift system. While one shift is off duty, the three others operate: morning (7.00 a.m.- 2.00 p.m.), afternoon (2.00 p.m - 10.00 p.m.) and night (10.00 p.m.- 7.00 a.m.) duties. However, there are also permanent day staff, the majority of whom are senior staff. After hours, all shift workers are under the Refinery Shift Suprintendent who in theory then becomes the overall refinery boss.

6.2.3 Industrial Relations:

Workers are organised but on seniority rather than along occupational lines. They are represented by two bodies - Petroleum And Natural Gas Senior Staff Association of Nigeria, PENGASSAN and National Union Of Petroleum And Natural Gas Workers, NUPENG. As implied by the name, PENGASSAN is for senior staff while NUPENG caters for junior staff. Apart from Chief Officers who are inhibited from joining, membership of the body appropriate to ones level is open to all staff. There are no closed shops and membership of the association or union is optional.

It is noteworthy that these two bodies serve the entire oil industry in Nigeria. Hence each has a central national body under which are the branches. The branches correspond to the individual oil organisations or companies in the industry like NNPC, Shell, Gulf etc. Each branch is made up of zones and each zone of chapters.

Figure 6.2: Unions Structure



Thus, for instance, the Port Harcourt Refinery senior staff forms a chapter of PENGASSAN. This chapter, together with other chapters, in other subsidiaries of NNPC located in Port Harcourt, make up the Port Harcourt zone of PENGASSAN (see figure 6.2). Further, the Port Harcourt zone along with 4 other zones constitute the NNPC branch of PENGASSAN. The same structure applies to NUPENG.

In the Port Harcourt refinery, there are no shop stewards nor are there full-time union officials. However, consultations with the part-time union/association leaders do take place on a monthly basis. At this level, the focus of consultation is on local welfare issues, like transport and canteen services, but issues concerning production targets are also discussed. Bargaining for salaries and fringe benefits occurs at the NNPC corporate (branch) level. In any event, salaries and fringe benefits are negotiated separately at different periods and each agreement reached has a two-year duration.

6.3 THE RESEARCH STRATEGY

The choice of Port Harcourt refinery for the study was mainly for two related reasons. First was the presence of a new technology by western standards. Second, the Port Harcourt refinery offered the opportunity to compare experiences with both old and new technologies on the same site. The two other refineries in Nigeria started off with relatively modern technologies and therefore may not provide similar opportunities. Besides, a key question in the study was whether the foreignness of the technology, and the apparent reverence with which it was held, made it determinate. Since all the Nigerian refineries used foreign technologies it was assumed that the research question could be reasonably answered with data from one of the refineries.

Research access was secured without many difficulties through management but it was never completely open access. For example, my ambition to make use of documentary information was nipped in the bud when, at the commencement of the study, it became clear to me that access to company documentations was not possible. As already indicated, the refinery is government-owned. Consequently, staff of the refinery are government employees and the apparent forbiddance of government workers from speaking to the press (which it seemed included all outsiders) resulted in staff being overly reluctant to `expose' what they considered as sensitive government records. Hence the research relied mainly on primary data. The study took place from June to August 1991 in addition to a further 3 weeks in April,1992. During the first period of the study, fieldwork was carried out on all the weekdays including Saturdays. Since access was through management, it followed that managerial staff cadres were reached first. It therefore seemed logical and more feasible to start off with the collection of data from this category of employees. Besides, this strategy gave me a bit of time to make some informal contacts with some lower level staff, at least for a short while, before approaching them for information more relevant to the research.

The interest in the process technology meant that the central focus was on operations staff, that is, production and maintenance workers. The selection of the study sample was random and data were collected through (1) Semi-structured interview (2) Administration of questionnaires (3) Non-participant observation.

Interviews were the first and main data collection technique. This was because, considering that documentary materials were inaccessible and that time constraint inhibited prolonged observation, talking to people on a personal basis seemed the quickest and best way to begin to learn about work in the organisation. Moreover, information from the interviews provided insights useful in the other data collection techniques. The main sources of the interview data were managers and supervisors connected with the operation and maintenance of the refinery technology. In production, 3 senior managers, 3 suprintendents and 7 supervisors were interviewed. Apart from this 6 operators were also interviewed. Similarly, 1 top manager, 5 senior managers, 4 suprintendents and 5 supervisors were interviewed in the maintenance department. Moreover, there were interviews with 2 top managers, 2 senior managers and 4 middle managers in administration and Personnel. Also interviewed were Officials of the employee organisations. Altogether 3 top managers, 10 senior managers, 11 middle managers and 12 supervisors were interviewed. These are apart from the staff organisation leaders and the operators.

The length of interviews varied from 45 minutes to 1½ hours and took place at respondents' offices or work stations. In some cases, respondents demanded, and were provided with, a preset list of issues to be covered. Apart from two managers who refused the recording of the interviews with them, one for reason of his being a government employee, all the other participants agreed to be recorded. In any case, some agreed only after persuasion and guarantees that the tapes were for my personal use. Generally, the interview procedure was to first explain my research interests. This was then followed by asking respondents open-ended questions about their sections/units and functions. As the dialogue progressed I was then able to ask more specific questions aimed at providing insights on:

(a) management considerations on choice and acquisition of technology

(b) work tasks, skills and content of jobs

(c) supervision and control of work and

(d) industrial relations.

A number of respondents were interviewed on more than one occasion but second interviews were considerably shorter and were mainly to clarify unclear points that arose from the first interviews. Besides, useful information were derived from informal chats with a cross-section of staff. In addition, I returned to the refinery in April, 1992 and spent another 3 weeks in the effort to literally plug holes discovered at the preliminary stages of data analysis.

Another source of data was questionnaires distributed to a sample of operators and maintenance staff. The questionnaire, which comprised of both closed and open-ended questions, mainly provided information for assessing changes in work and job tasks etc. Perhaps, it needs to be noted that maintenance workers in Civil and planning sections were deliberately excluded because of the presumption that they are not in direct contact with the technology under study. Here again respondents were requested to contribute in the research by filling in the questionnaires. I urged them to be frank with their responses stressing that the questionnaires were for my personal use and pointed to the underlying anonymity since names were not requested.

Altogether 220 questionnaires were distributed, 140 and 80 to operators and maintenance workers respectively. Of these, 117 completed questionnaires were received, 79 from operators and 38 from maintenance staff. That is, overall response rate was 53% whilst the response rates of operators and maintenance workers were 56% and 48% respectively. I pin the relatively high non-response to an emergency that occurred during the period when the questionnaires were distributed. There was a breakdown in two process areas and the urgent need to identify and rectify the faults meant that workers had a busy schedule, some having to work round the clock without going home. In any event, there was reason to believe that workers had little interest in what they saw as a non-management initiated project which they felt would not affect their jobs in any way.

The third source of data which largely played a complementary role was non-participant observation. Some time was spent observing control room operators and maintenance workshop technicians at work. Besides, the breakdown which occurred in the process plant provided opportunity for watching some external operators and maintenance technicians at work. However, for security and safety reasons, access to the plant was highly restricted and so permission for such observation sessions had to be sought separately. Simple observation combined with informal chats when possible enabled me to have a better feel of the workers experiences and perceptions of their work.

Nonetheless, in spite of efforts to draw data from as many sources as possible, there is no doubt that sources of bias exist. For instance, the study, to a great extent, relied upon respondents' memories for information about past experiences at work. This brings to mind Smith's (1981) argument (discussed in chapter 5) concerning memory and view point bias which essentially draws attention to the point that aspects of the available data may be inaccurate. This is because of the probability that respondents would not recall events exactly as they occurred in the past. As indicated earlier, access to documentation was not possible. Aside from the fact that some potentially valuable data, thus, became inaccessible, this also meant that the corroboration of some of the memory-based information, via such historical sources, was virtually ruled out.

In any event, since the technology was acquired fairly recently, it seems in order to assume that responses from the respondents are fairly accurate accounts of the past. Also, in the extent that written documents "do not tell the whole story (as) ... some important observations ... never reach the point of formal recording ..." (Ahlstrand, 1990:71), documentation has not necessarily been accepted as a source of reliable data. As Gallie (1978) also stresses:

> documentary sources can be misleading because it may be difficult to know the unwritten rules of the way in which they are compiled, and it is often impossible to assess whether the events they recount are anything other than a specific version seen through the eyes of elites with their own particular interests at stake (1978:46)

However, a further source of bias is discernable from a phenomenological point of view. As discussed in chapter 5, this view posits that meaning systems and interpretation of events differ amongst individuals. Therefore, it is probable that some respondents may have defined phenomena differently from me and interpreted the questions very differently from the meaning I intended. On the other hand, the period of fieldwork was relatively brief so that `longer and deeper' interaction with respondents and their workplace was not possible. Therefore, my inability to share and actively participate in the world of those under study, as Schutz (1964) and Atkinson (1971,1978) would recommend, may have impeded my understanding of the respondents' `reality'. Besides, my `outsider' status may have also meant an added difficulty in deciphering factual information from those which were given simply to please the `outsider' but camouflage `reality' in the refinery. Thus, implicated here is the bias arising from what Moerman, (1974) describes as "trusting the native".

Hence, although the use of different research techniques might generate complementary data, I can neither claim to have understood the procedures used by individuals to construct their `social reality' nor claim to have "accurately captured the workplace reality ..." (Clark et al., 1988:8) nor even claim the generalizability of the findings to other workplaces in Nigeria or elsewhere. In any event, analysis was against the background of the three theoretical models namely, technology determinist, social determinist and the interactive models. And, Mitchell (1983) and Ragin(1987) have argued that inferences from case studies are valid in so far as they are based upon linkages between events and the guiding theoretical propositions. Therefore, even though the study was not a pure "uncontaminated activity" (Silverman, 1985) in so far as I may have picked on aspects that made sense to me, I still remain convinced that useful insights into the extent of relevance of technology in a third world workplace has been provided.

In the next chapters, the extent to which technology is determinate in various dimensions of work organisation is evaluated. For instance, if change in a given aspect of work organisation occurs with technological change, the relevance of technology, with regard to that aspect, could be presumed. On the other hand, technology is not relevant for any dimension of work organisation which remains stable or unchanged inspite of a technological change. In this regard, social factors are seen as more influential. By this mode of analysis, the tenability of the interactive (or network) model would, hopefully, become evident. Moreover, it will also become clear that even in a Third World workplace, which depends mainly on external sources for much of its technology at work, technology can only claim importance not dominance.

NOTES (6)

1. Shell Diarcy was an Anglo-Dutch consortium which became the forerunner of Shell-BP in Nigeria.

2. One of the terms of agreement when Nigeria granted Shell-BP oil prospecting rights was that a refinery would be built in Nigeria when crude oil production reached 0.5 MBD mark.

3. There was an on-going refurbishment of the old plant during the period of the fieldwork.

4. This figure is very tentative because recruitment exercises were still going on as at the period of study. Besides, in view of the enormous difficulty I experienced in obtaining this figure, one can only presume a lack of seriousness with keeping accurate statistical data on staff. This makes the figure even more suspect.

CHAPTER 7

CHOICE AND STRATEGIES FOR THE APPLICATION OF THE NEW TECHNOLOGY

This chapter explores how the new refining technology was chosen and employed at the Port Harcourt refinery. The chapter begins with an examination of the way the technological change was decided upon and the conditions under which the decision was made. Following this `strategic' decision stage was the decision implementation stage. This second stage is shown to involve the appointment of a project team, choosing the new technology, and manpower development arrangements. As the analysis would show, it was at the implementation stage that attention was given to the potentials of the technology. Concomitantly, attention was also given to the presumed skill demands of the chosen technology. This was by way of extensive training programmes. As will be evident, neither at the initial decision stage nor at the implementation stage was labour control or the `humanisation' of work an issue. Furthermore, profit optimisation was only implicit at the initial decision stage. Finally, the operation of the acquired technology is examined. This is against the background of the often suggested integrative and control potentials of new microelectronic technologies (Buchanan and Boddy,1983, 1983; Wolfe,1988). As the analysis attempts to show, the new technology was relevant to the extent that it provided opportunities as well as inhibitions to social actors. In conclusion, it is suggested that both social and technical factors mediated the choosing of, and the application of the new refining technology.

7.1 TECHNOLOGICAL CHOICE DECISION

As stated in Chapter 6, the need for a new refinery arose because the production capacity of the existing refineries could not meet the national demand. The decision to build the refinery in Port Harcourt to help ease shortages of petroleum products was taken by top corporate managers in the Nigerian National Petroleum Corporation (NNPC) in consultation with the Federal government. The intention was to eliminate, or at least reduce, the dependence on imported petroleum products and subsequently, to export any surplus. Previously, local production of these products had to be augmented with imports.

Being a governmental unit, NNPC's choice of technology for the new refinery had to be within the context of institutionalised government guidelines. Aside from the basic government requirement that the imported technology had to be strictly for the production of goods and services associated with it (NOIP, 1989), an important consideration was the estimated cost of acquiring the plant[1]. Therefore choice did not necessarily mean choosing between alternative technologies[2]. Rather, choice was mainly a matter of selecting between alternative vendors whilst putting the prices, guarantees and general conditions of sale of each vendor in perspective. In any case, this does not mean that technical considerations were ignored. The confidence in the capacity of modern technology to assist in economic development programmes meant that technical factors were also considered. This concerned the assessment of the varied potentials of the various machinery available in the market in the context of national needs for refined products.

In effect, socio-economic, political and technical factors affected the technological choice decision. This is consistent with what obtains in advanced economies (Davies A. 1986; Batstone E. et al., 1987; McLoughlin and Clark,1988). As in Britain, technological choice "decisions were not purely a matter of commercial calculations in response to technological imperatives but rather a product of political processes ..." (McLoughlin and Clark 1988:48). For instance, here, choice had to be made against the background of government regulations for importation of foreign technology, availability of funds, estimated needs for refined petroleum products, and capabilities of the refining technologies on offer in the marketplace.

Nonetheless, unlike in Britain, the focus of commercial calculations was not profitability, reducing production costs or improvements in product quality. In this case, the central concern was with quantity, that is, with increasing the availability of the products[3]. Also, much of the political processes involved in the decision-making were not carried out within the organisation in which the change was to occur but was outside it. It is possible to argue that the "change masters" (Kanter, 1984) had to be external to the firm because strictly speaking, this was a case of a new government-owned organisation coming into being. But then, there was nothing to suggest that the corporate decision makers intended to set up a new management. Essentially, what happened was that the existing management in the old plant took over the running of the new plant when it became operational. In other words, senior managers in the old plant were hardly involved in the decisions even though the responsibility for running the new plant rested on them. Similarly, there was little evidence of the involvement of middle-level managers in the decisions.

Furthermore, it needs to be noted that the personnel function was not a party to the decisions at the `strategic' level just as is generally typical in Britain where "personnel specialists are marginal to managerial decisions and planning over technological change" (McLoughlin and Clark, 1988:56). What is remarkable in Port Harcourt is that personnel staff did not even expect to be involved in such decisions. Therefore, as was apparent, there was no feeling of alienation amongst members of that function for non-participation. Hence, a top manager in personnel blandly confirmed that their "participation was nil"(Uche:June,1991). He took the view that technological change was a corporate development and decisions to that effect were within the portfolios of the corporate Planning and Development, and the Engineering and Technical Services divisions. Whilst the former was involved in determining whether a refinery was necessary, the latter was responsible for technical design considerations.

Nonetheless, whilst personnel issues may have been "squeezed out at the design stages ...", this does not correspondingly mean that there was "no coherent strategic planning concerning the human aspects of the new system ..." (McLoughlin and Clark, 1988:57). As would be seen below, alongside the technological choice decision was that concerning extensive manpower development programmes which came within the ambit of personnel. In any event, the non-participation of the personnel function during the initial decision stages effectively reduced the likelihood of due consideration to the finer human aspects of change like tasks and the content of jobs.

It is also noteworthy that the staff unions made no input in the technological choice process nor was there direct-employee involvement. Apparently, such decisions were taken for granted as belonging to management. That is, management, as representatives of owners of the firm, reserved the right to determine the factors to be used for production. In some settings, non-involvement of workers may be expected to result in some resistance[4] to technological change or to unsuccessful implementation of the new technology (Mumford,1983; Kanter,1984; Hirschheim, 1985; Francis,1986). For instance, Kanter (1984) insists that involvement would build consensus and commitment to change. Similarly, Francis (1986) posits decreases in workers' motivation and commitment as a result of non-involvement.

However, from all indications, change was welcomed and the implementation was successful in so far as it was claimed that intended outcomes of the technological change were realized. The whole-hearted acceptance of change could be explained by the general interest in foreign technology, particularly that which did not threaten jobs but instead provided opportunity for acquiring new skills and for enhancement of technical knowledge. Besides, union organisation provided little room for any resistance to change. As stated earlier, union organisation was not along occupational lines, a situation that would have enabled workers, whose jobs or skills could be adversely affected, to oppose technical change. In any event, the actual employer here was the military government whose orders, apparently, must be obeyed unquestionably, and hence, quite possibly ruled out the feasibility of resistance. Besides, it is also noteworthy that, as would be seen in the next section, many of the workers expected to work the new plant were yet to be recruited. Thus, as a top management respondent clearly put it, "They did not exist [in the first place] to resist"(Uche:June,1991).

The dominance of corporate management in the decisions notwithstanding, there was no explicit concern with the regulation of labour in the technological change decision[5]. In fact, the non-participation of the personnel function at the initial stages of the technological change decisions does seem to effectively rule out any interest of the top decision makers in labour regulation by means of technology. In reference to their decision on the chosen technology, a top manager who was involved in the decision-making emphasized that "although you have to optimize the number of people you have, this was not an impelling condition"(Eke:June,1991). Evident here is another similarity with Britain where decisions at this level often focus on `strategic objectives' (Buchanan and Boddy,1983) and "Labour regulation ... is rarely the subject of serious deliberation at this highest level within management" (Batstone et al., 1987:31).

It is possible to argue that these are two different lines of argument here. Whilst the Nigerian manager articulated labour regulation in terms of reductions in staff strength, Batstone and his colleagues were referring to the control of job tasks and the deskilling of jobs. However, as would become evident in the next chapter, even these aspects of labour regulation were hardly on the Nigerian agenda. In fact, whereas there is evidence to suggest that in some British establishments, labour control objectives do exert considerable influence in the choice of technology (Martin, 1984;Jones,1985: both cited in McLoughlin and Clark,1988), it seems the relative cheapness of labour[6] in Nigeria made such a consideration in the new refinery project unnecessary. Besides, it was, and still is, considered the responsibility of the government to provide jobs and improve the skills of its workforce. In view of the high rate of unemployment and the dearth of skilled manpower in Nigeria (National Rolling Plan, 1991-93 Vol. 1:132), it seems inconceivable that a government-owned organisation would contemplate the elimination of jobs or skills with the acquired technology. Hence, just as in Britain, although presumably for different reasons, there was "no overriding objective to introduce new technology in order to control labour"(McLoughlin and Clark,1988:49). And certainly, the suggestion that "new technology may enable managers to bring about reductions in the overall employment levels ... [and] eliminate and deskill jobs" (McLoughlin and Clark,1988:52) would not apply. As one superintendent aptly puts it:

> Even though we have a system that really requires less manpower, the situation in the country demands that we have to employ more people not sack them (Umanna: July,1991).

It therefore seems safe to suggest that social circumstances intervened in the technological change decisions.

In any case, taking a decision is quite different from its execution. Whilst corporate management dominated the initial decisions, it could not execute the decisions on its own. At some point, other organisation participants had to be let into the change process. Having decided to adopt the new technology, corporate management proceeded to effectuate the decision by involving a spectrum of other organisation participants. This commenced with its setting up of a project team. This "top-down" approach could be rationalised in terms of `situational factors' like the dearth of experts, and possibly the relative indifference, or rather complacency, of workers and their representatives. On the other hand, since the experts amongst the workers were so relatively few in number, selecting a group of them to work together seemed more likely to produce better results.

The project team consisted mainly of senior engineers from different areas of the Corporation and also some foreign consultants in specialized areas. In addition, a few personnel as well as accounts staff were members. It is presumable that concern for the unknown resulted in members of the team being drawn from different areas of talent within the Corporation and in the use of foreign experts. At this level, priority was apparently given to the technical aspects of the change. This was evidenced by the preponderance of engineers and technical experts in the team. In any case, to the extent that different areas of interest in the organisation were in the team, what Francis (1986) refers to as a `centralized participative approach' could be posited, although here, lower level `users' of the technology, like operators and maintenance technicians, were not represented.

The team appeared to have enjoyed a considerable degree of autonomy[7]. It was involved in the site survey, `design' of the processes, inviting bids from international contractors, and even in sourcing of foreign finance for the project. They were also responsible for choosing the machinery from an array of designs presented by the numerous vendors. By its composition, the team was made up mostly of members who apparently understood the characteristics of the refining technology and were aware of the latest developments in that field. The major development in refining technology at the time was the incorporation of highly automated production monitoring and control systems. Hence, according to respondents who were also members of the project team, the team settled for a design which featured highly automated starting-up and turn-down procedures as well as sophisticated production monitoring controls. This was seen as the technology of the future which developing countries, that could afford it, necessarily have to embrace. Moreover, it was believed that such a sophisticated system would boost production performance. The gain in time-utilization which the system would enable was deemed helpful for beefing up overall productivity. In effect, the technical characteristics of the technology was given priority at this stage. As one respondent enthused, "The attraction of the technology kind of reigns supreme"(Uche: June,1991). However, choosing the technology was only a first step. The human side of the technological change subsequently attracted attention as the team turned to the implementation of the chosen technology[8].

7.2 IMPLEMENTATION STRATEGY

Having chosen the new refining technology, the next stage was its implementation. This refers to the installation of the machinery and the arrangements for the workers who would operate the plant. The installation of the machinery was left with its suppliers but the project team maintained close contact by regular inspection of work progress. Inspection was considered necessary to ensure that the installations were carried out according to specifications. With the help of foreign consultants, the team embarked on manpower development programmes. A member of top management had noted that before then, there was no concerted effort towards manpower development in the corporation. Hence, although technical considerations guided the choice of technology, plans were made early enough for the supply of the required manpower to man the machines.

Much of the manpower planning was left in the hands of the consultants who were also part of the plant installation group. It was thought that having been using similar machinery in their home countries, these consultants were more conversant with the machinery and were therefore better placed to know the skill requirements of the new system and how best to go about meeting these requirements. Thus, to a considerable extent, the technology also influenced the parameters within which manpower development arrangements were made.

With the identification of the presumed staff and training needs, a massive recruitment exercise followed. Most of the new intake had never worked in a refinery before. These were sent for formal training at the Petroleum Training Institute, Warri, Nigeria. For this group, the training period varied from between 6 to 12 months, depending on an individuals educational background and the area of deployment after training. At the completion of formal training, many were initially deployed to the three existing refineries in the country for more training whilst on the job. Those who would work in units in the new plant which did not exist in any of the refineries were sent abroad to train on those units.

The staff in the old plant in Port Harcourt were not left out of the training exercise. Most old members of staff were sent for one form of training or the other. However, because the plant was fully operational at the time, training had to be offered to groups of workers at different periods. Many were offered general training or refresher courses as they were called. The major objectives of the courses were the general development of staff knowledge about the industry in order to "improve performance standards of staff ... [and] ... meet possible changes in products, production techniques and technology" (NNPC conditions of service, undated:87). In addition to the anticipated general `appreciation' of modern microelectronic systems, training was also intended to update the skills of some of the participants. For some others however, the purpose of training was to reskill. For instance, a number of middle and senior level managers were sent abroad to update their skills. Similarly, many supervisors were sent for management training courses. Also, some of the experienced workers were sent abroad for more specific training on how to operate and/or maintain the new system.

It is notable that for staff in the old plant, the criteria for determining who went for what training were not made clear enough. A top manager stated simply that "those who are able ... are identified ..." (Eke:June,1991) and sent for training geared towards specific skills required for working certain units and equipment. Further, there was little evidence to suggest that the skills profile of the workers was the basis for planning and provision of training. Since not all aspects of the new plant were really novel, such data would have enabled planners to determine the exact areas of need more closely[9]. But here, the starting point seemed to be the usual assumption of a dearth of skills. This approach could only be wasteful in time and resources. A considerable number of workers ended up with training programmes the content of which were either what they already knew or were of little relevance to their jobs. An incident concerning laboratory workers, which occurred during the study, further buttresses this point. These workers had been nominated at the corporate level for administrative training. However, they had considerable difficulty in securing their release from work and in getting the usual allowances which were often provided at the local level for those going on training. This was because local management failed to see any relevance for such training to the jobs the workers performed. For them, the intended training was more destabilizing than useful. In any event, they ultimately gave in to the directive of the corporation for whom "the training policy will be geared more to the needs and initiatives of the corporation ... and training activities must arise from recognized corporate needs" (NNPC Conditions of Services, Undated:87).

Broadly speaking, however, success with regard to manpower provision for the new plant could be claimed in so far as much of the staff to run the plant were already in place by the time its installation was complete. Most of the staff for the new refinery who were either deployed in the older plants or sent abroad for specific training were withdrawn and were available for the trial runs by the vendors. This interaction with the foreign experts helped to reinforce learning and increased workers' confidence in their ability to operate and maintain the new plant.

7.3 OPERATING THE NEW PLANT

The concern here is on how the new system had been operated and maintained in order to achieve the intended improvements in organisation performance. Buchanan notes that "the key decisions that affect organisational performance are those concerning the reorganisation of work that accompanies technical change"(1986, quoted in McLoughlin and Clark,1988:67). However, an important question is why it is so necessary to embark on work reorganisation in the context of technological change. Explanations, which are clearly managerialist in orientation, are technology-linked and rest mainly on the integrative and control potentials of the production technology (Buchanan and Boddy,1983). The former offers the opportunity for the convergence of previously distinct tasks into the same job and/or the overlapping of roles. Implicit in task convergence is the intensification of effort and hence desired increase in labour productivity. Similarly, role overlap has important implications for manning levels like reductions in the number of required hands.

On the other hand, the control potentials are manifest in the possibility of substituting electronic for manual controls; obtaining direct feedback on results and/or performance; and the use of the more reliable technical control instead of the more conflict-prone direct personal control (Storey, 1983). Also offered by the technology is the possibility of choice in control-related centralization and/or decentralization in decision-making. Thus, if as it appears, the acquisition of new technology opens up prospects for work reorganisation, we need to examine the extent to which attention was given to the way work was organized in the new Port Harcourt refinery.

Although the personnel department was represented in the project team and were thus involved right from the early stages of implementation, this did not result in the consideration of issues concerning the way work would be done as well as other industrial relations matters as might have normally been expected. When the new plant became operational, there were no set guidelines with regard to issues like the design of jobs, manning, and how the operation of the system would be organised. Hence, in as much as the personnel function played an active role by virtue of its involvement in the manpower development for the new plant, it was not sufficiently `proactive' to ensure that the other human dimensions of the change were attended to. In essence, McLoughlin and Clark's conclusion, from their review of empirical evidence in Britain, that "the introduction of new technology has not been accompanied by significant innovations in policies of the regulation of labour ..."(1988:70) is equally applicable in the Port Harcourt refinery's case.

Furthermore, Woodward's proposition that "there was a particular form of organisation most appropriate to each technical situation"(1980:72) seems to suggest that for any given change in technology, there has to be a corresponding change in the social organisation of the workplace if commercial success is to be achieved. From this premise, one would expect differences in the organisation structure and practices in the old and new plants. In broad terms, this had not happened. What happened was that practices in the old plant were carried over to the new. The fact that most structures and practices persisted suggest that they were not determined by technology.

In spite of the process innovation[10] which was the essential difference between the old and new plants, there was little evidence of any new modes of job design or of social organisation of work. For instance, the structure of authority did not change, evidenced by the stability in the levels of management. Also, the pattern of shift work in the old plant had persisted in the new. Besides, just as the rotation of jobs was not widely practised in the old plant, there was nothing to suggest that the extent of its practice had been significantly affected by the application of the new technology. For example, commenting on their practice in Oil Movement Section in the old plant, a supervisor noted:

> before you sat down on the panel and call yourself a panel operator, you must be ready to know all that happens outside (Ngo: July,1991).

That is, workers were moved around jobs within the section. The main motive of this strategy was to acquaint individuals with the different job tasks. Similarly, in the new plant, the supervisor stressed that although at the initial stages, "if you belonged to the control room you remained there", the section had recently reverted back to its old system of moving staff around.

In any event, it is necessary to emphasise that there was no clear evidence to suggest that the practice of job rotation was a conscious effort on the part of management of `humanize' work. In fact, it had never been a uniform strategy in the organisation. Hence, for instance, whilst some job rotation occurred in the Oil movement section, the reverse was the case in the power plant and utilities section. According to a supervisor in the latter section:

> Although these external operators can move from one unit to another, we try to give them specific units. This is so that at any given time you want grassroot information, you know exactly who to ask (Sule: August,1991).

What is notable for our concerns is that the non-uniformity of the practice continued in the new plant. Similarly, the sub-contracting of maintenance jobs requiring specialized skills, which were not available in-house, had endured. The persistence of these structures and practices could be explained from the premise that the new technology was not radically different from the old, both being refining systems. But then, there were still subtle differences between them, like the ability of the new technology to handle `atmospheric residue' unlike the old, and the former's electronic monitoring and control capabilities which were lacking in the latter. Hence, change in structures has to occur if Woodward's technological determinist suggestion of a distinct organisation form for every technical situation is credible. The transfer of old structures and practices to the new plant in Port Harcourt, therefore, casts doubts on Woodward's view and, more importantly, represent an indictment of technological determinism. This persistence, or "organisational conservatism", as Child explains, builds up "through progressive sedimentation [of] a solid structure of statuses, rules and practices, which now present a formidable barrier against organizational change" (1987:128). For Child therefore:

> the difficulties of evaluating the cost and benefit of new technology in the short-term, and the degree of learning required...speak for the wisdom of leaving the organisation well alone in the meantime (1987:129).

This view is consistent with the feelings of many respondents one of whom was emphatic that "established norms and traditions of the refinery should not be destabilized because of new technology".

Nevertheless, areas of novelty were discernable. For example, `convergence' seemed to have occurred in the roles of chief and senior operators as many supervisors noted the possibility of dealing directly with the senior operator, side tracking the chief operator, even though this was not officially encouraged. However, on the other hand, instead of a cross-functional integration of roles which the convergence thesis suggests, there was dichotomisation of some roles and functions. For instance, the Oil Movement and jetty had one supervisory chain in the old plant but, in the new plant, two supervisory groups existed, one for oil movement and the other for the jetty. Also, in the new plant, an instrumentation unit was carved out as a distinct unit within the maintenance department. Although dichotomisation was attributed to the size and complexity of the new plant, it is still possible to argue that splitting of the functions was embarked upon for convenience of operations and was not a demand imposed by the new plant.

Another area of novel practice was the use of `technical back-up staff'. These were foreign experts who were hired to assist with the operations. The rationale for their hire can be found in the comment by a respondent in production thus:

> You see, operating an equipment is one thing and being able to operate an integrated plant of this nature is another. So this is where the back-up man comes in with his experience and expertise ... what our people have been doing over this two years is to under-study the back-up men because they are supposed to be people with experience who have a lot of knowledge and who have operated similar plants in their countries (Umanna: July,1991).

In essence, the complexity of the technology is the reason for the use of technical back-ups. However, this is again different from suggesting that the technology had imposed the use of back-up staff. The technology can function without back-up staff if the local staff are able to come to terms with its complexity. In fact, this was already happening. There was a reported decrease in the numbers of back-up staff from 90 at the commissioning of the plant to 60 as at the period of study. It was hoped that their services would no longer be needed in the next few years. In the event, the use of back-up staff can be seen both as a deliberate social choice as well as a technological demand in so far as the technology required its `handlers' to possess certain skills. The control potentials of the new technology seemed to have been more extensively exploited. Whilst this would be discussed in greater detail in chapter 9, suffice it to state here that in Port Harcourt, manual controls had been effectively displaced by the electronic variety. Also, improvements in production performance feedback mechanism were reported. These developments could be considered as indicative of technology influence.

7.4 CONCLUSION

In the preceding, the stages in the application of the new refining technology in Port Harcourt were examined. Firstly was the strategic decision stage in which the decision to adopt the technology was taken. Then was the implementation stage during which the project team was set up and mandated to choose the technology, make arrangements for the needed manpower and see to the installation of the new plant. The final stage corresponds to the period from when the new plant was commissioned to date.

It was stated that the decision concerning the technological change resided exclusively in top corporate management in liaison with the Federal government authorities. It was at the implementation stage that the decision base was widened to include more professionals.

The choice of technology, at the implementation stage, was guided by the technical characteristics and potentials of the technology. These included electronic controls, which enable automatic start-ups and turn-downs; as well as electronic monitoring of production processes. These features were expected to enhance time-utilization, reduce wastages and, hence, improve production performance. As was apparent, the technology was chosen essentially because of these characteristics and potentials. As the analysis in chapter 3 suggested, it is by virtue of its capabilities that a given technology is able to exercise some degree of constraint over what is, and is not, possible in the workplace.

In any event, it was also evident that social actors "have influence over its [the technology's] utilization and the ends to which it is applied"(Willcocks and Mason,1987:10). For instance, although the extensive training arrangements were actually in preparation for the new technological system, the modalities of the training were socially determined. The new technology may have pointed to the need for training in certain specialized skills but nothing in the technology stipulated that certain groups of workers should be sent locally or abroad for the specific training. These were social decisions just as social considerations, like satisfying national needs for refined petroleum products, influenced the choice of technology in the first place. Besides, not all the training programmes were technologically-oriented. For instance, the general training programmes as well as the management training courses for supervisors, which were all on offer, could not be seen as technically-based. In any case, since generally both technical and human aspects of the change were considered, one could presume the adoption of a socio-technical approach, even if rudimentary.

Furthermore, as was apparent, structures and practices persisted. The persistence, which Child describes as `organisational conservatism', increases the feasibility of the argument that technological change does not, as a matter of course, lead to changes in the design of work or organisational restructuring generally. Opportunities for restructuring may be thrown open by technological change but its actuation depends upon socially-determined preferences and concerns as well as actions.

This does not imply that technology is of no consequence. The technology may not have an objective existence outside that provided by humans (Grint,1991), but the opportunities it clearly offers cannot realistically be discountenanced as the social determinist model tends to suggest. At the Port Harcourt refinery, the relevance of the technology is located in these opportunities it offers. Undoubtedly, the technological system has to be operated by humans. But on the other hand, the purpose for which it is operated, which in Port Harcourt was to produce petroleum products, cannot be achieved outside of the technology. The technology has to exist to provide the locus for work or operation. In other words, at the refinery, an interdependent relationship existed between the technological and the social. This observation is in line with the interactive model. However, in contrast, neither technological determinism nor social determinism seems to recognize this relationship. Indeed, nor are arguments which suggest independent technological influence truly compatible with the recognition of this interdependent relationship between the social and the technical.

NOTES (7)

1. The cost of acquisition really has to be distinguished from the running cost. Bureaucratic measures for controlling the former may exist, although these may not necessarily be effective. For instance Ejiofor and Osiji note how "equipment ... are usually imported at highly inflated cost and ... are too old to function profitably ... and supplied to technically unqualified public officials, or even technically qualified, [who] are rendered gullible by debilitating Kickbacks" (1987:37). In contrast, similar controls for running costs are not apparent. In Nigeria there is a general (unfortunate) tendency for government owned organisations not to bother much about running costs.

2. Of course, baring subtle differences, refining technologies are similar.

3. This is not to say that the other factors, which were considered elsewhere, were not considered in this case. Rather, these factors were background considerations which seemed to be of secondary importance. Without doubt, the hope of being able to export surplus products, at some point, meant that the quality of products was not totally ignored.

4. `Resistance to change' may be manifest in many ways including rejection/non-use of the technology; high labour turnover; excessive fault finding; strike activity or work slow-downs.

5. Perhaps, the apparent relegation of labour control in the change decisions could, at least in part, be explained in terms of the non-involvement of middle-level managers for whom, according to Boddy and Buchanan (1983), control objectives are often a priority.

6. A manager justified over-manning in certain sections of the refinery in so far as "They don't pay so much ... like Shell". However, he conceded that "if a Company like Shell owns this refinery, surely they would have fewer staff".

7. A rare occurrence in Nigeria where constant government interference in such activities is often the norm.

8. This strategy corresponds to what Nadler and Robinson (1987) describe as `hard systems approach'in which there is a dichotomy between design and implementation, the former coming before the latter. They argue that this demarcation creates `implementation problems' which could be avoided by the adoption of a holistic approach in which planning, design and implementation are integrated. However, their recommendation would not quite fit the Port Harcourt refinery situation where the design was more or less pre-packaged by the foreign vendors who supplied the technology. It is presumable that the modifications, which many respondents claimed were carried out in the plant after its commissioning, would have been avoided if a `holistic approach' had been adopted.

9. This view finds support in Buchanan and Boddy's (1986) recommendation of a training strategy which systematically
(i) identifies workers who require training, their present skills and the relevance of these skills to the proposed new system
(ii) identifies the new skills required
(iii) determines the content of training and
(iv) determines the time and phasing of training and how training would be conducted.

10. The change could be regarded as such in so far as it entailed the introduction of new processes for further cracking of crude `residues'.

CHAPTER 8

THE IMPLICATIONS OF TECHNOLOGICAL CHANGE ON THE CONTENT AND CHARACTER OF JOBS

As noted in Chapter 3, a plethora of views concerning the implications of technology in the workplace abound in literature. On one hand are views that the new technology makes jobs less tedious and more pleasant; and also upskills or enskills work. On the other hand, technology is seen as an instrument for the dehumanisation of work as well as for deskilling. Whilst some tend to take a technological determinist stance, attributing much of what accompanies technological change to the technology itself (Ellul,1981; Meissner,1969; Walker & Guest,1952), others (Child,1984; Gallie,1978; Wilkinson,1983) stress that technical change outcomes are dependant upon social choice and/or negotiation between social actors. Nevertheless, all seem to agree that the adoption of new technology is accompanied by changes in the content and character of jobs, whether negatively or positively. Further, the content of a given job is seen as including such dimensions as: the variety of tasks, the complexity of tasks and the skill requirements of the job (Mcloughlin and Clark, 1988; Rolfe, 1990). The analysis which follows focuses on broad patterns of change in the job content in the Port Harcourt refinery. However, an attempt is also made to look at salient changes in the content of jobs even though detailed analysis of jobs is avoided. For ease in analysis, production and maintenance jobs are considered in separate sections. The approach is to compare the nature of some jobs in the old and new plants in order to identify changes and differences between them. Finally, the extent to which differences could be attributed to the technology, to human factors or both is examined. The hub of the argument here is that, in the

Port Harcourt refinery, the technological system employed does significantly influence the content of jobs but not unilaterally.

8.1 THE CONTENT AND CHARACTER OF PRODUCTION JOBS IN THE OLD AND NEW PLANTS

As stated earlier in Chapter 6, the production department in the refinery included the process plant, power plant and utilities, and the oil movement sections. The jobs of the different categories of operators in these sections are pivotal to production work in the refinery. This view underlies the analysis which follows.

In the old plant, individual monitoring and control devices, which gave indications of what was happening in the plant at any given time, were spread on a large panel but some manual gauges were also mounted on locations inside the plant itself. The panel was manned by panel operators whilst external operators attended to the outside gauges. Manning the large panel entailed considerable physical movement on the part of the panel operator in order to reach the different control switches. It was the responsibility of the panel operator to manually select and operate the production control switches in the correct sequence. More importantly, the panel operator was relied upon to maintain the operations within the set limits. This meant frequent checks on the trends and fluctuations of these parameters. When the need arose, he was expected to undertake measures to correct any deviations from the prescribed limits or inform his superiors in more complicated situations. Mechanically driven tracks and pens provided charts which indicated to him the behaviour of different operation parameters. According to one respondent,

> you only see a pen moving and you use your experience to estimate what it is actually saying ... (Ojo: July,1991).

Thus, the panel operator's job demanded manual dexterity, and `experiential' and mental skills to read and interpret the graphic charts. Also needed was the ability to decide on the appropriate course of action. However, the probability of human error was quite considerable. This was because the frequent movements coupled with the continuous demand on his mental and manual skills made the panel operator's job strenuous and exhausting.

Similarly, the external operator went round the plant at prescribed intervals to take readings from the external gauges and to see how the pumps were performing. This on many occasions involved climbing up onto platforms. It was also the responsibility of the external operator to manually open and/or close various external pumps and valves as the need arose. This job required diligence and considerable skill to be able, for instance, to determine how many turns a pump required. The external operator's job was particularly cumbersome especially during emergencies when he had to run helter-shelter in the plant to shut or open valves and/or pumps etc. In the circumstance, operations required the involvement of relatively large numbers of operators and close supervision was of a necessity.

Conversely, the new plant showed more of what, as noted in chapter 3, Zuboff(1988) describes as `automating' and `informating' capabilities. The manual control devices of the old plant gave way to automated control gadgets. In place of the conventional panel was the keyboard and the DCS (digital control system) screen. Production parameters became electronically controlled. Deviations of these parameters from the set limits were automatically detected by the technological system which either sent out visual and/or aural alarm signals or, in certain situations, undertook the required corrective measures by itself. In effect, the control operator's (as the `inside' operator was then preferably called) job became more automated. He was relieved of direct monitoring and adjustments since much of the monitoring and control were taken over by the technology. He no longer needed to worry about achieving the proper setting for the knobs.

Hence, a qualitative change had occurred in the kind of manual skills the control operator required. This was evidenced by the fact that instead of turning knobs in order to set controls, the control operator now had to key-in operations' parameters by means of the keyboard whilst the screen served to provide instant visual feedback on his performance. Hence, the new system was more user-friendly, unlike the rather intimidating large control panel. As it appeared, skill become more dissociated from effort as little effort still yielded outstanding skill-influenced outcomes. This is very similar to findings in some work- places in more developed economies. For instance, from her research of such workplaces, Zuboff concludes that "skill and effort are no longer inextricably linked. The operator must put forward a minimum of strenuous physical exertion ..." (1988:53). Zuboff is convinced that "the new technology ... diminished [the] importance of action - centered skills ..." (1988:76). As she elaborates:

> [workers who] knew themselves to be the ones who gave their bodies in effort and skill, and through their bodies ... made things ... [and were] accustomed to gauging their integrity in intimate measures of strain and sweat ... find that information technology has challenged their assumptions ... the rules of the game had changed (1988:74).

Furthermore, in Port Harcourt, instead of having to read and interpret graphic charts, the computerised system provided most of the information required first hand. Hence, the type of interpretive skill required by the control operator in the old plant became of little use. Nonetheless, since his job now entailed the monitoring of monitoring/control equipment, he still needed interpretive skills, albeit of a new kind. For instance, he still needed to interpret alarm signals, and there was still room for him to use his own judgement at such crucial times. Besides these, the control operator now also needed new skills and knowledge to enable him to use the computer codes to call up menus required at different times. Further, there is reason to suggest that the control operators `push-button' mode of operation was not actually as straightforward as it appeared. In the words of one respondent:

> Pressing buttons is challenging in so far as you are thinking first before pressing; you are thinking about what you are going to achieve (Ugoh: August,1991).

In essence, the new system may have been easier to operate but it still demanded logical thinking and interpretative skills and action on the part of the controlman.

Profound changes also occurred in the external operator's job. For example, the manual operation of most pumps and valves became unnecessary. Concerning this, an interviewee pointed out that "you can now press a button and motorised valves are shut precisely to the level you want them" (Onye: July,1991). This new arrangement had other direct effects on the job of the external operator. The frequency with which he undertook checks on outside gauges was drastically reduced. Relatedly, the incidence of climbing platforms to take readings or check on valves etc was also curtailed. In effect, the external operator's range of tasks became narrower and much less complex and consequently, his job became easier and less demanding.

The preceding points to changes in the content and character of the jobs of operators generally. However, the mode and extent of change varied. For instance, a respondent remarked that the "new system lessens the job of those outside since the majority of operations are more or less done by the man in the control room" (Okon: July,1991). That is, external operators experienced attrition in the variety and skill content of their tasks. Automating pumps etc, in effect, meant the deskilling of this group. On the other hand, changes in the control operator's job seemed to be more of trading one set of skills for another.[1] For him, the content of his job apparently increased, in comparative terms, in so far as he tended to pick up additional responsibilities. By virtue of his role as the monitor of process control monitors, the control operator became increasingly more accountable for trouble-free operations and for the quality of the products. A clear affirmation of this tendency towards increased responsibility for the control operator could be found in the comments of a respondent that in the new plant, unlike the old "if a problem attracts a query, the man in the controlroom is automatically connected because he is supposed to be monitoring everything that happens"(Ngo: July,1991). Besides, considering a process manager's remark that:

> the new system gives the control operator more authority over his work;[and] the external operator really does not have much of a discretion [but] ... has to follow directives ...[2] (Anah: June,1991),

it is conceivable that the control operator had more influence than the external operator. As Storey (1983) would also argue, the influence of the control operator derives from his immediate control over uncertainty.

Further support for changes in the content of the jobs of operators generally is provided by the questionnaire data. As table 8.1 shows, the majority of operators reported increases in the variety of tasks; the technical complexity; and the knowledge and skill requirements of their jobs. Similarly, Table 8.2 indicates that 76% and 73% of operators respectively found their job more challenging and more interesting. At the same time 78% and 52% respectively claimed increases in the speed and physical effort required.

The claim concerning physical effort is particularly ambiguous since it is incompatible with assertions that work was less physically strenuous and more relaxing in the new plant. Perhaps these claims could be explained in terms of a possible desire by the workers to give the impression that they performed difficult tasks. The claims regarding increases in the knowledge and skill content of jobs also requires comment. On one hand, judging from the relatively high non-responses, it could be suggested that the workers were not too clear about what `skill' is. On the other hand, it is equally feasible to contend that workers would, perhaps for prestige, claim to possess the revered technical skills. This point may similarly explain the assertions that work was more challenging and interesting.

Further, whilst confirming that "skill requirements have changed ... significantly because of the additional [new] processes in the new plant" (Anah: June,1991), some respondents also emphasized that some areas in the new plant were identical to those in the old. In these areas therefore, the skill requirements had not really changed. In the circumstance, it could be argued that the supposed increase in the skill content of jobs may not be as widespread as claimed. For the old process workers, working in the `unchanged' areas in the new plant, the claim of skill increase is very probably bogus. Nonetheless, the claim may still be justifiable for the many new entrants who had to acquire the necessary new skills anyway.

Table 8.1: Changes In the content of Jobs

Ques 5b: Are your tasks increased or decreased?
6b: Are your tasks technically more complex than before?
6c: Did you require new knowlegde to be able to perform your current job tasks?
11e: Did you acquire any new skill(s) from training, which is (are) useful in performing your job tasks?

	Operators %	Maintenance workers %
Number of tasks:		
Increase	76	79
Decrease	3	3
No response	21	18
Technical Complexity:		
More	80	69
Not More	16	13
No response	4	18
Requires new knowledge:		
Yes	68	76
No	24	11
No response	8	13
Acquired new skill:		
Yes	80	76
No	2	8
No response	18	16
	n = 79	n = 38

Table 8.2 : Changes In the Character of Jobs

5c: Has the speed with which you do your work increased, decreased or remained the same?
6a: Does your current job tasks require you to exert more physical power than previously?
18: In your opinion, is your work
i Sufficiently challenging?
ii Interesting?
iii More of a routine?
iv Boring?

	Operators %	Maintenance Workers %
Speed:		
Increase	78	79
Decrease	1	3
Remained the same	3	5
No Response	18	13
More physical effort:		
Yes	52	40
No	46	45
No Response	2	15
More Routine Job :		
Yes	67	45
No	14	29
No Response	19	26
Job Boring:		
Yes	18	24
No	47	53
No Response	35	24
More Interesting:		
Yes	73	87
No	5	3
No Response	22	11
More Challenging:		
Yes	76	76
No	10	13
No Response	14	11
	n = 79	n = 38

8.2 MAINTENANCE WORK IN THE OLD AND NEW PLANTS

Maintenance work involved services on mechanical equipment and the various control instrumentations in the refinery's process plant and other utilities. Services rendered included predictive, preventive, and corrective maintenance of the facilities. Predictive maintenance involved what a respondent (Amadi: July,1991) described as "condition-monitoring" of equipment. This activity, on occasions, exposed possible future problems which were then nipped in the bud through preventative maintenance. On the other hand, corrective maintenance was carried out when actual breakdowns occurred. Whilst the mechanical section serviced both moveable and immoveable mechanical equipment like pumps, compressors, turbines etc, the instrument and electrical maintenance sections[3] took charge of the refinery's control instrumentation.

Instrumentation in the old plant was mainly pneumatic in nature. Put simply, process control was effected by the passage of air through tubes at set pressures; the signals, received from the controls and interpreted, were essentially dependent on the flow of air. The range of tasks of the instrument engineer included frequent checks for tube blockage, which could prevent the passage of air, and checking for air leaks, both of which could interfere with the quality of signals received. Hence a lot of time was spent in `trouble -shooting'. Moreover, when faults occurred, their location was often by trial and error. This involved the disconnection and testing of a myriad of tubes and cables and then carefully reconnecting them after the fault had been located and rectified. The sequences and routines required to carry out this activity represented a form of skill, and so also did equipment down-time depend much on this experiential skill and the ability of the instrument man to carry out the 'faulting' process quickly.

Similarly, the range of tasks undertaken by mechanical maintenance technicians generally included welding, pipe fitting, lubrication, carrying out adjustments and realignments, and cleaning etc. These were, principally, dirty tasks, the performance of which was physically demanding, involving a lot of exertion and discomfort. Moreover, expertise in a variety of manual skills was required.

Things were different in the new plant. Here, the replacement of pneumatic by electronic controls resulted in some changes in the tasks and the knowledge requirements of instrument men. Rather than being dependent on the flow of air under pressure, control signals became electronically generated. For the instrument men, knowledge in pneumatics was no longer a premium. Their tasks of checking for air blockages and leaks, as occurred in the old plant, became superfluous. In the new system, possession of electronic skills became more central in the performance of tasks. In addition, the new process instrumentation featured sections with self-diagnostic capabilities. Besides, more automatic testing tools and equipment were made available. This meant that the detection, diagnosis and repair of faults were made easier, took less time, and were more efficiently carried out. In other words, the trouble shooting aspect of the job was minimized and the skills for disconnecting /reconnecting cables etc; became less frequently used.

A similar change emerged in mechanical maintenance jobs. For many workers in this section, work in the new plant was mediated by more sophisticated maintenance tools. Also, for the first time, it became possible to machine some spare parts in-house. It thus became necessary to learn how to use these new maintenance tools. Moreover, changes in the character of work were reported. There were claims of tasks being made lighter, less strenuous and less filthy and that better results were achieved. Apparently, the new tools had not only reduced the pain of labour by minimizing physical exertion but had also improved the quality of performance.

Paradoxically, the questionnaire data only very narrowly corresponded with these claims. As table 8.2 indicates, whilst only 45% of maintenance workers responded that their jobs did not require more physical effort, as many as 39% claimed that it did. As with the operators, these groups were probably eager to portray their jobs as difficult and highly skilled. Another important point, however, is that many of the workers had not worked in the old plant and so did not really have a base for the comparison. This may, possibly, also account for the generally high non-responses to the questionnaire items.

In fact, a dramatic change in the content of maintenance jobs could not be safely assumed. As a manager in maintenance emphasized:

> [the] maintenance job has not really varied from what it was in the old refinery. The only thing is that the job is larger in scope ... Basically the same skills are required ... Generally, to repair a pump is carried out in the same way ... (Adah: August,1991).

Similarly another respondent noted that:

> the difference in maintenance work in the old and new plant derive only from the more specialized equipment now used. [Even so] ... the principles behind the functioning of both old and new equipment are the same ... The job itself still requires mainly manual skills (Amadi: July,1991).

Thus, it appears what had happened was a qualitative refinement in the skill requirements for maintenance job generally. The need for manual skills had persisted. Further, the claimed increase in the variety of tasks undertaken (79% of maintenance workers) or largeness in the scope of maintenance jobs seemed to have little to do with the nature or character of the technology. It was seen as more directly a function of the size of the new plant. Hence a manager stressed:

> the equipment we have here are more in number. We have more pumps, more motors etc. In fact, this refinery is more than 4 times the size of the other one and so also is the workload (Edet: August,1991).

8.3 CONCLUSION

This chapter examined the extent to which the content and character of jobs underwent changes when a new refining plant was put into use at the Port Harcourt refinery. As is evident, there were alterations in the content of production and maintenance jobs. These changes were more dramatic in some jobs than others and so also were there differences in the aspects of the job content altered. For instance, changes in the skill content of jobs were more evident in production than in maintenance work.[4] On the other hand, maintenance workers seemed to have experienced more changes in the variety of the tasks they performed. Furthermore, amongst production workers, changes that occurred in the jobs of control operators and external operators differed.

It is perfectly feasible to argue that the changes in the content of the different jobs derived from changes in the technology. With regard to the control operator, there does not seem to be any way to explain the new requirement for keyboard skills, for example, if technological influence is discountenanced; nor can the diminution in his physical movements be easily explained away without reference to the impact of the new system. The new technology took over some of the tasks previously undertaken by the control operator but, at the same time, provided new ones.

Similarly, the depletion in the skill requirements of the external operator and the point that he no longer needed to climb platforms frequently cannot be pinned onto human decision and choice alone. Presumably, the loss of skill could be better explained along the lines that the expertise for opening and closing valves which the external operator possessed previously had now been built into the technology. This in turn had reduced the need for climbing onto platforms.

On the other hand, the instrument technician in the old plant required no knowledge of electronics to be able to perform his tasks. For him, knowledge of electronics became necessary only because he now had to maintain electronic equipment in the new plant. In a similar vein, the qualitative refinement in the manual skill requirements of the mechanical maintenance man, in the new refinery, had to do with the need to use more sophisticated maintenance tools in the performance of the same or similar tasks. Besides, the recorded increases in the acquisition of new skills was likely to have resulted from the existence of novel sections in the new plant. It is doubtful that management would arrange and sponsor the acquisition of new skills for its own sake. That is, there is reason to believe that management would want to provide only skills which are purposive - relevant to the achievement of organisational objectives.

Nevertheless, the above does not necessarily imply that the technology of the new plant unilaterally determined the content of jobs. For example, nothing about the technology demanded the separation of production from maintenance work nor could the technology be used to explain the boundaries that existed even within each of the two sections. With regard to maintenance job, there was nothing to suggest that the decision to make the instrument technician solely responsible for instruments maintenance tasks, and mechanical technicians for mechanical equipment, was based on technological considerations alone. Furthermore, movements between jobs was claimed for mechanical maintenance staff. Here for instance, it was possible for workers to move on from the "maintenance of rotating equipment to work on diesel engines" (Amadi: July,1991). Nothing in the technology would account for this. All these came under the ambit of social decision and choice. Besides, it is also notable that a faulty equipment would demand repairs but it does not dictate its down-time. The duration of equipment down-time is also human-influenced.

Similarly, it is difficult to explain the distinction between the tasks of the control operator and the external operator solely on technological grounds. More plausibly, functional boundaries and specialisms are better seen as defined by social choice rather than by the demands of the technology at work. The new technology may have been instrumental or influenced the changes which occurred in the contents of jobs but it did not autonomously determine the job contents. Both the technology and humans were mutual `allies' in this endeavour. Apparently, the technology makes certain demands on the social but, at the same time, acts as a facilitator of socially- originated initiatives. Similarly, whilst generating initiatives, the social takes cognizance of the potentials and the demands of the technological. In effect, the interactive thesis is satisfied.

NOTES (8)

1. It needs to be remarked that the experience of the `older' operator (who transferred from the old plant) in terms of changes in his skill differed from the experience of the control operator who was a new entrant. The former was reskilled rather than upskilled whilst the latter, who was essentially devoid of any relevant skill base, was enskilled.

2. This view finds compatibility in Zuboff's claim of a bifurcation of skills in a computerised workplace such that "One group of operators... use the information system to learn.... about the process, while another group would make itself an appendage to the system, mechanically carrying out the computer's directives" (1988:68). Presumably, the former and latter groups correspond to controlroom operators and external operators respectively.

3. It was gathered that the instrument section was an offshoot of the electrical section. Electrical personnel became instrument men after exposure to specialised training.

4. This statement relies more on the interview material than on the questionnaire data. For instance, the latter shows only a slight difference between the skill requirement of operators (80%) and those of maintenance workers (76%).

CHAPTER 9

TECHNOLOGY AND THE CONTROL OF WORK

Many organisations adopt various structures and strategies for tackling the problem of control (Edwards,1979; Storey, 1983; Thompson,1983). According to Edwards, an organisation's "system of control" refers to: mechanisms for directing work tasks; procedures for supervising and evaluating worker's performance; and an apparatus for discipline and reward (1979:18). As it appears, his `system of control' would apply in each of his three types of control namely simple, technical and bureaucratic control. Further, whilst Edwards periodizes his types of control, each corresponding "to a definite stage in the development of the ... firms"(1979:21), Woodward's (1970) approach is some what different. For Woodward, organisations themselves can be distinguished according to the extent to which they adopt different "processes of control",[1] and, variation in the control processes is a function of technology. She thus posits a relationship between control forms and the technology of production. From her research data, she concludes that "the hardware of the technology is the major determinant of the control system" (1970:39) and also that the majority of firms with continuous process technology mainly adopt impersonal[2] administrative and mechanical controls. Woodward argues that in such plants the setting of objectives, the sequencing of activities and the mechanisms for taking corrective action, amongst others, are specified and incorporated into the technology during its design. Hence "line managers and supervisors increasingly cease to concern themselves with the day to day problems of production operations ... trouble-shooting role becomes superfluous as the control system becomes foolproof" (1970:45). In essence, personal supervision of work gives way to impersonal administrative and mechanical controls.

Edwards (1979) similarly asserts that technical control is structurally embedded in the technology of production. As he further argues, technical control is manifest when work becomes paced and directed by machinery, and workers reduced to "attendants of pre-paced machinery" (1979:20). More explicitly, the technology provides "unambiguous direction as to what operation each worker is to perform next and establish(es) the pace at which the worker ... work(s)" (Edwards,1979:118). However, it must be noted that although Edward bases this argument on assembly line technology, his position when discussing more modern technology is essentially the same. Thus, he contends that:

> The computer can send instructions ... as to what operations or activities workers are to perform, and upon successful completion of the task ... will receive feedback information that will permit it to send out instructions for the next operation. [Further] Just as foremen watch over particular shops, so microcomputers control the operations conducted on particular machines (1979:123-4).

This chapter seeks to examine whether what obtains in the Port Harcourt refinery corresponds with this scenario and the extent to which technology is implicated therein.

9.1 THE TENABILITY OF TECHNICAL CONTROL

Put succinctly, Edwards' (1979) thesis is that the technology of production is the precursor of technical control which may be indicated as machine-paced and/or machine-directed work. Similarly, Woodward's (1970) argument that the sequencing of activities etc; is built into the technology during its design ostensibly suggests that the technology would direct work when it is adopted. We need to look at this dimension of technical control in some detail.

9.1.1 Machine-pacing of work:

Often implied in machine-paced work are greater speed of operation and restricted mobility of the workers while at work (Edwards, 1979). On the question regarding any changes in the speed with which they carried out their job tasks, 79% of the respondents said it had increased, 2% said it decreased and 3% indicated that it had remained the same (see Table 9.1). Of those who claimed that the speed of job tasks had increased, 54% felt the increase was as a result of management decision; and 25% and 11% saw promotion and pressure from work mates respectively as responsible for the increase. However, only 10% of this category of respondents perceived technology as responsible for the claimed increase in the speed of work (see Table 9.2). Hence, even if one accepts the increase in speed on its face value, attribution of such increases to a technological imperative is evidently fraught with difficulty. In the light of the above analysis, what seems more tenable, though still contestable, is a social determinist argument.

Further, if restricted mobility is the yardstick for measuring technical control as Edwards suggest, then, the existence of such control in Port Harcourt is questionable. There was no evidence of restricted movement of staff or of staff confined to their equipment or work space. Admittedly, it could be argued that continuous-process technology differs markedly from the assembly line technology with which restriction of workers' mobility is more often associated. But, it is still possible to argue that continuous-process technology demands that certain procedures be carried out at definite times and to that extent would tend to restrict the movement of workers. However, this potential seems to have been effectively counteracted by management's tendency to overman facilities. Although management may have held a different intention for adopting this strategy, a spill-over effect seems to be that of enabling freer movement of workers. Moreover, it was possible for individuals to negotiate with work mates for at least brief absences. Thus, the technology may have some potential to restrict movement but management's manning strategy inhibited the manifestation of such a potential.

TABLE 9.1 : Changes in the speed of work

Ques 5c: Has the speed with which you do your work increased, decreased or remained the same?

	%
Increase	79
Decrease	2
Remained the same	3
Others	16
	(n = 117)

Table 9.2 : Reasons for increase in the speed of work

Ques 5d: In your opinion, which of the following is (are) responsible for the change?

	%
Management decision	54
Pressure from work mate(s)	11
Promotion	25
The kind of technology in use	10
	(n = 81)

9.1.2 Machine-directed work

As stated earlier, the notion of machine-directed work suggests that the sequence of work activities is technology-determined. This in turn implies a decrease or elimination of human intervention (Gallie, 1978). That is, the task relationship becomes mediated by machinery which presumably controls the work process.

In the refining process, this mediation by the technology renders the `raw material' invisible and intangible during processing. For the process worker, buttons and digital symbols on control panels replace concrete `reality'. In essence, operators are not directly responsible for making the products. They simply monitor the process via computer terminals in control rooms. That these workers are reduced to "controllers of control" (Woodward, 1970:46) suggests a reduction if not elimination of human intervention.

But, how tenable is the argument that technology is directing and hence controlling work? Being in control implies an ability to initiate informed action. But there was nothing to suggest that the technological system even initiated action. As a supervisor points out:

> If the staff does not give a correct input to the computer, start from now till tomorrow, the result would be wrong unless he goes back to check and correct the error. It is still the human being that would correct the mistake (Akpan: August,1991).

This argument clearly blights any rhetoric which posits the elimination of human intervention. In fact, a case for the need for human presence was made by a process superintendent. As he argues:

> The computer can only take some actions, for example, shut some key control valves etc. But, there is also a possibility that some of the valves do not get closed. It might indicate they are closed on the

> panel but you find that, out there, they are open. So it requires somebody to cross-check (Umanna: July,1991).

Futhermore, in the refinery, work actions were generally management-directed. For instance, many managers and supervisors stressed that they had instruction books in which they wrote out what had to be done daily and the subordinates were expected to follow the instructions strictly. In essence, subordinates were not exactly able to initiate work action. But more relevantly, that the content of these instructions, according to some managers, was largely guided by parameters like overall production planning requirements, shipping, product distribution and transfer requirements, suggests the influence of factors other than technology.

In any event, it could be argued that technology was an important `ally' since management's work-instructions took cognizance of what was permissible using the existing machinery. As a manager stressed:

> every equipment has its own performance output [and] the rate of movement of feed or product, for example, is determined by the output of the equipment (Akpu: July,1991).

Therefore, it seems, Forsyth and his colleagues (1982) were right in their thesis that technology does impose some technical rigidities.

It is tempting to cite the existence of standard operating procedures as evidence for technology-directed work. On the necessity of standard operating procedures, a manager remarked:

> the risk involved in running a plant is enormous. What separates you from disaster is very minute and it requires experience and knowing what to do. When you have an upset you should know precisely what to do to avert danger (Nnamdi: June,1991).

Nearly all workers (97%) agreed on the existence of standard operating procedure (see Table 9.3). As Table 9.3 also shows, 91% of respondents believed that the operating procedures directed the sequence of work and 89% felt that the procedures were followed strictly. However, whilst only 11% of respondents thought that management was responsible for the content of operating procedures, as many as 79% reckoned that the technology was responsible (Table 9.4).

Further illuminating responses emerged from respondents regarding why the procedures were followed strictly. Comments from many alluded to technological elements. For instance, an operator suggested that:

> non-adherence to the laid down procedures will automatically lead to damage of equipment and will eventually lead to loss of time and money (questionnaire respondent no.114).

Similarly, another felt:

> It will be mal-operation to do otherwise; and therefore would lead to damage of equipment or to producing off-spec products (questionnaire respondent no.1).

Yet another was certain that the operation procedures were "in keeping with the technology of ... the various vessels, machineries, and equipment in order to ensure successful operation and environmental safety" (questionnaire respondent no.13).

Tables 9.3 : Perceptions on standard operations procedures

Ques 12a : Do you have standard operating procedures for performing your work tasks?

12bii Do the operating procedures actually direct the sequence of work, for example,direct what tasks must be performed before others?

12iv Do you always follow the operating procedures provided?

	%
Existence	97
Directs sequence of work	91
Is followed strictly	89
	(n=117)

Table 9.4 : Determinants of the content of operation procedures

Ques 12iii What in your opinion influence(s) the content of the operating procedures?

	%
The nature of technology	75
Management's perferences and judgement	11
Attitude of workers	4
Others	6
	(n = 144)

These views, that technology more or less determined operating procedures, ostensibly suggests that work in the refinery was technologically directed. However, the preceding analysis does indicate the influence of both technical and social factors. Hence, a superintendent (Emeka: June,1991) likened the technological system to a receptacle that would hold anything that was put in it. It was the human being that knew what reactions he wanted to take place; knew the reaction processes and set the parameters for the reaction to take place. The technology provided the environment or, more precisely, the site for carrying out the reaction. It exercised influence only in so far as it was a specialised type of receptacle whose component parts or sections would accept only certain parameters and certain reactions. Failure to recognize this specialised nature could result in malfunction, non-realisation of desired products/goals or even disasters etc. This argument also finds compatibility with that of another process worker who emphasised that:

> no matter how well designed the process plant is, if the human being who is to operate it does not know what he is doing, it will not work. So also, no matter how ingenious the guy is, he cannot pass in HF[Hydrofluoride] into area I [CDU- Crude Distillation Unit] and make it work; it is impossible (Ojo: July,1991).

That is, the technology is no more important than the human operator who operates it. The technology places some conditions which have to be satisfied but, to function, it has to depend on the operator who, on the other hand, has to possess certain essential knowledge and skills. In effect, both technology and human beings work hand in hand. The technology of the refinery does not exclusively pace or direct work nor does it unilaterally dictate the quantity and quality of what is produced. Hence, we need to turn elsewhere in further search of evidence for some exclusive technological influence on the control of work.

9.2 TECHNOLOGY AND ADMINISTRATIVE CONTROLS AT WORK

Administrative controls are taken here to refer to other strategies of control which are presumably not machine-based. Specifically, the concern is on bureaucracy. As Storey suggests, the dimensions of bureaucratic control namely "hierarchy, specialization and division of labour, impersonality and formalised rules are expressive of its essential control function" (1983:134).[3] The intention here is not to venture into an analysis of the dimensions of bureaucratic control. Rather the interest is to explore the extent of influence of technological and social factors in these strategies for control.

9.2.1 The hierarchy:

According to Blauner, "The technological requirements of continuous-process production encourage a finely elaborated status structure ..." (1964:148). Any vindication of this assertion seemed to be only in the extent that levels of authority existed in the refinery. For example, the new process plant, headed by an OC (Officer in-charge), was split into 4 areas. Each area was headed by a superintendent directly below whom was the area supervisor. Under the supervisor were 4 chief operators corresponding to the 4 shift groups. Each chief operator was in charge of all operators in his shift. Directly under him were the control operators. These were followed by the senior operators and lastly the external operators. Similar levels of authority also existed in the power plant and oil movement sections which, together with the process section, made up the production department.

However subtle variations were noticed. In the oil movement section, variation laid in the existence of two categories of supervisors - day and shift supervisors, whose location in the hierarchy was a subject of conflicting reports. Whilst day supervisors claimed they directed and left instructions for their shift counterparts, the latter vigorously emphasized their direct responsibility to the OC. Furthermore, whilst in the process plant, control operators were higher in the hierarchy than senior operators, the reverse was the case in power plant and utilities. Here control operators were lower in status than some external operators. This seems paradoxical in view of the fact that control operators directed - or in the preferred word of a supervisor, "advised" - outside operators from the control rooms.

Typically, in each section of the maintenance department the lowest in the hierarchy were the crew. Further gradation existed for crews in each section. However, the crew grades did not seem to represent distinct levels of authority since, apparently, all crewmen were directly answerable to the foreman who was next up in the hierarchy. The number of crew responsible to the foreman varied from 1 to 5. Above the foreman was the supervisor who in turn was responsible to the superintendent. The superintendents themselves came directly under the OC of the section.

The preceding description may be a simplification of the `reality' but does suggest that the status structure was not as "finely elaborated" as Blauner had argued. Even so, what is remarkable for our concerns is that the status structure in the old and new plants were similar. As was apparent, the new, larger, and more sophisticated refining technology had created the need for certain new skills and hence, probably, the potential for an elaborate status structure. Nonetheless, that the status structure had remained more or less intact indicates a premium on managerial choice.

It could be argued, for instance, that the control operator in the new plant is a new category which was a `fall-out' from the new technology. However, the point that in sections like oil movement, operators were rotated such that control operators worked outside at times and vice versa eliminates the uniqueness of this category. In addition, it is difficult to identify anything in the technology that would explain variation in the status of control operators in the different sections as noted previously, given that they all performed similar functions. Furthermore, neither the overlap of the roles of day and shift supervisors in oil movement section nor the one-to-one reporting of supervisors to superintendents, as was found in the process section, could be reasonably explained in terms of the technology of the new plant. In any event, similar reporting system, and duplications in the supervisory function, existed in the old plant.

Blauner had also argued that "the existence of achievable higher positions ... serves to motivate those of lower status to accept the goals of the organisation and to act in accordance with its norms" (1964:148). In Port Harcourt however, higher positions existed but, for many, the chances of getting into such positions were slim. A multi-faceted explanation could be proffered. In the first place, many of the new entrants were similarly qualified educationally and this, coupled with overmanning, made competition into the comparatively fewer higher positions stiffer. For the less educationally qualified, their chances were that much slimmer. Furthermore, the possibility of inter-subsidiary transfers between NNPC subsidiary companies, particularly for the higher cadre staff, casts doubts on the functionality of the internal labour market (ILM). These transfers increased the possibility that many local staff would be side-tracked or forgotten and ostensibly meant that aspirations to such positions were, to say the least, cautious.[4]

An ILM, in the extent that it existed, was basically rudimentary. There did not seem to be any sustainable seniority procedure. Many of the newer employees had higher educational attainment than their `older' counterparts and were more likely to be promoted faster into higher positions. Moreover, the highly subjective nature of appraisals in conjunction with socio-political influences[5] seemed to undermine the chances of institutionalising seniority. This notwithstanding, most of the interview respondents answered that workers were committed and compliant, thus corroborating Blauner's assertion that such workers accept organisational goals and norms. In any event, this would not necessarily be attributed to the possibility of career advancement as Blauner suggests. Apparently more relevant was the desire of workers to retain their jobs.

Nevertheless, advancement in the hierarchy was still possible in the refinery. According to a number of respondents, an essential ingredient for progression along the job ladder was experience on the job. Each vertical movement was often accompanied by higher pay and status and, to some extent, higher responsibilities.[6] Advancement was internal; that is, it was always along the job ladder mapped out for the section/unit to which the individual worker belonged. For example, it was not the practice for control operators to transfer between sections. Given that these operators possessed similar skills, it is hard to see how this transfer limitation can be interpreted along technological determinist lines rather than as the choice of management. Further, since the career ladders had not changed with the installation of the new plant, it is presumable that the mapping of the career routes was not essentially technologically determined.

It could be argued that experience on the job (as a prerequisite for advancement) suggest the acquisition of relevant skills for the next higher position. However, there was nothing to suggest that these skills were necessarily technical in nature. Interviewees indicated that subjective factors like relationship with workmates were also considered during staff appraisals. Hence, `requisite' skills may well be related to those needed for effective workplace interaction. In fact, although the possession of technical skills for operating the machinery was said to be important, there was little evidence that it guaranteed attainment to higher positions as would be presumed from a technology determinist perspective. Besides, it needs to be mentioned that although some respondents earned career advancement at the end of training, this was apparently not the case for the majority for whom training was basically to "enable them perform their job better" (Edet: August,1991). Furthermore, attention also needs to be drawn to the point that, as was evident, some subordinates possessed more technical skills than their superordinate. In essence, technical skills did not actually determine an individual's placement in the hierarchy.

9.2.2 The Supervision of Work

A number of analysts posit fundamental changes in the supervisory function as a result of technological influence (Blauner,1964; Woodward,1970; Edwards,1979). For continuous-process technology, Blauner takes the view that its very nature makes supervision unnecessary, if not impossible. He argues that the technology decentralizes operations and, with much of the work done outdoors, individuals often work out of the range of their immediate supervisors. As a consequence, "Many of the co-ordinating and administrative functions of supervision fall to ... the leader of each ... work crew" (1964:147).

On the other hand, for Woodward, the transformation of the supervisory function arises from the building of "a mechanical framework for discipline and control ..." into the technology. According to her, this means that the decision concerning the quantity and quality of what is produced are an integral part of the machine design. As a result, "little discretion is left to the line supervisors responsible for the day-to-day operation of the plant" (1970:XI). It seems Woodward has taken, as her point of reference, the role of the traditional factory supervisor who, as the man in charge, had "complete authority in the workplace, without undue interference from the employer" (Child and Partridge, 1982:5). Presumably, the continuous process technology robs the supervisor of this free hand and also discretion. In a similar vein, Edwards (1979) takes the view that, by virtue of the feedback systems, more advanced technologies inevitably assume monitoring and evaluation functions.[7] That is, the technology takes over the supervisory roles of inspection of work and detection of errors.

To an extent, some support for these propositions were found in the refinery. As the analysis so far attempts to show, operations were decentralised. Also as Blauner observed, the majority of workers worked in the field; and there was evidence of team work. Generally, the state of the supervisory function in Port Harcourt seemed to be at variance with the traditional picture of that function.

It was found that majority of both production and maintenance workers worked in groups. 86% of questionnaire respondents indicated this (see Table 9.5). However, for maintenance workers, groups were small, often in twos or threes and varied according to the tasks to be done. On the other hand, there was a greater tendency towards permanent work groups amongst production workers.

It appears Gallie's conclusion that "automation is conducive to a certain degree of team autonomy" (1978:221) is equally applicable to the Port Harcourt refinery. Hence, although 95% of operators and 92% of maintenance workers who responded to the questionnaire stated that their jobs were supervised, when asked whether they were left alone to do their job without frequent supervision, 99% and 97% of production and maintenance workers respectively claimed that they were (Table 9.6). Further evidence of less-frequent supervision was also found during the interviews. For instance, a process superintendent remarked thus:

> They have a free hand to do whatever they think is right ... But you just have to be able to justify every move you make. [The unwritten rule was], If you are in doubt, do not touch (Emeka: June,1991).

Table 9.5 : Group Working

Ques 7 : Do you work in groups?

	%
Work in groups	86
Do not	9
No response	5
	(n = 117)

Table 9.6 : Supervision of work

Ques 13 : Do you have a supervisor to supervise your job?
17a Are you most times left alone to do your work without interference from the supervisor or foreman?

	Operators (%)	Maintenance Workers (%)
Supervised	95	92
	(n = 79)	(n = 38)
less frequent supervision	99	97
	(n = 75)	(n = 35)

The above, in effect, suggests a devolution of responsibilities to the workers. In this regard, some maintenance managers stressed that foremen and their work teams were left to plan their work. The foreman assigned tasks and instructed crew members on how the tasks would be carried out. The supervisor or higher level managers stepped in only when the problem was beyond the crew. Similarly in production, the chief operator and his team were given a free hand. The chief operator was responsible for allocating tasks and ensuring that they were carried out.

However, the devolution of responsibilities seemed to be more extensive in production than in maintenance. The reason for this disparity probably lies in the nature of technological change which was also mainly in the production process. Whilst, according to a maintenance manager, "maintenance work has not changed; it has been the same attending to pumps and compressors" (Adah: August,1991), the same cannot actually be said of the production worker. For instance, with regard to operators, Zuboff apparently agrees that:

> the technology ... gives them ... responsibility because it gives ... [access to] data-trends, averages, ... [The operator now has] all the data in front of him, has got to be able to understand the data to find things in it, to make sense of it,to know what to look for (1988:299).

Similarly, Child notes that the advanced technology offers "the incorporation of quality responsibilities into the production operatives role" (1987:119). As he also suggests:

> The introduction of computer process control with visual feedback to central display areas replaces the need for visual supervision and manual adjustment of plant (1987:119).

In essence, production supervisors had lost their role of providing `technical' direction to their subordinates. In fact many subordinates in the refinery were certain that they already knew all that their jobs entailed. Hence questionnaire respondents' reasons for preferring to work without supervision included remarks like:

> I have the confidence that I can discharge my duties properly (questionnaire respondent no.12);

and;

> I am confident that with the knowledge and experience I have in the job, the standard required can be achieved without his [that is, the supervisor] physically being with me (questionnaire respondent no.90).

In addition, Gallie points to the potential of the shift system to enhance workers' sense of autonomy. For Gallie the shift system meant that "for long stretches each month, there was no contact whatsoever between the main managerial hierarchy and its process workers" (1978:222). The picture in Port Harcourt was very close to this, though not exactly. There, direct contacts between the shift and day staff were minimal. Contact was almost non-existent during night shifts except for emergencies. However, during the day, managers kept tab on things by regular visits to the control rooms and to the plant work locations. Also modern communication systems aided management in control of activities. For example, a manager in process stressed that with his radio, which was left on most of the time, he was always aware of what was going on in the plant and was thus able to intervene as the need arose. Besides, the refinery shift superintendent was a visible, senior management figurehead after hours. In any case, these notwithstanding, there is no gainsaying that many operational responsibilities were devolved to work groups who developed some capacity for self regulation.

That there was less emphasis on direct personal control seemed clear enough. But, it was not entirely clear whether devolution of responsibilities resulted from a conscious pursuit of what McLoughlin and Clark (1988) referred to as "team autonomy" or from Friedman's "responsible autonomy". According to McLoughlin and Clark, "The former is an outcome which is the result of management strategy while the latter may be an outcome of both the independent technical constraints on work organisation and the informal influence of work groups as well as management strategy" (1988:144). In any event, the fact that, as was reported, management had managed not to increase the numbers of supervisors, for instance, in spite of the larger areas they now had to cover, tends to suggest the pursuit of team autonomy. On the other hand, the claim by many supervisors and superintendents that they certainly would have needed more supervisors to be able to cope, if it were the technology in the old plant, suggests that the technology served as an enabling tool, even if the pursuit of team autonomy is presumed. Thus in view of this and from the premise that `team autonomy', following McLoughlin and Clark's definition, could be subsumed under "responsible autonomy", it is conceivable that the latter was the case with regard to the Port Harcourt refinery.[8]

Increasing autonomy notwithstanding, it is notable that autonomy was still very limited. It would be recalled that, as indicated in section 9.1.2, daily activities of work teams were based on instructions from superiors. Essentially, this meant that most important decisions were taken elsewhere. For the work team, autonomy was exercised only within the context of an assigned job. The fluidity of team autonomy is also laid bare by Gallie's precise observation thus:

> During the night shift and at weekends the refinery was set for purely routine running, while important changes in the operation of the units were only carried out when day management was present. If the night shift encountered difficulties in maintaining the quality of the product, then it would be a matter

> of the operations holding on and doing their best until the experts arrived. In cases of crises -if for instance a unit had to be shut down in an emergency -then the alarm signal would be given and key members of day management would rush from their beds to the refinery (1978:224).

Therefore, for production workers, the presumed greater autonomy, or perhaps discretion, of work teams would appear to be located in the 'privilege' of tending preset production units and in the opportunity they had for "holding on and doing their best" while waiting for the experts.

In effect, management had retained the core of control while delegating peripheral responsibilities to work teams. Any decentralization of control that had occurred was mainly in the extent that functions had been divided between sections and units. In fact, there were evidences to suggest a tendency towards centralisation of control. For instance, it was possible for a manager in production to have direct access to work teams, or to information about the field, without reference to the relevant supervisor or even the chief operator. In addition to this was the increased visibility of operations. As a manager stressed:

> In the old plant you had to be on their back all the time. But here, I can just walk to the DCS [Digital Control System]; press 2 or 3 buttons and then will know what is happening. There is no point in my moving out, pursuing them (Ijah: July,1991).

Similarly, another enthused on the new system thus:

> It makes the work easy. One can easily call up past trends and locate errors. So it makes them [that is, the workers] more attentive and not do certain things because you are not there (Ojo: June,1991).

These, and many similar remarks are in congruence with Edwards' (1979) proposition that technical control enable the inspection of work and the detection of work errors. More generally, they provide further credibility to the technical control thesis. As it appears, while technology had not really shifted the control function away from management, it had significantly altered the mode of supervision in the refinery. As the various comments indicate, close personal supervision had given way to a more detached supervision. Hence a senior manager in process noted that:

> the more modern the process control instrumentations, the lesser the need for the supervisor to have frequent contact with the operators (Anah: June,1991).

Additional support for the technical control thesis came from the questionnaire data. For instance, when respondents were asked why they thought supervision was not frequent, 33% reckoned that the nature of the technology was responsible. This percentage was much higher than those who indicated other factors (Table 9.7). Presumably, the supervisor had faith in the capacity of the technology to control[9] work activities. That is, the existence of technical controls instilled the confidence that things would not go drastically wrong without detection. On the other hand, it could be seen along the lines that the technology enabled subordinates to do their jobs in such a way that, as a respondent enthused, "the supervisor has more confidence in what his subordinates are doing" (Sule: August,1991).

However, paradoxically, the question concerning what enabled the supervisor to direct work without being physically present provided a completely different picture. As Table 9.8 shows, rules and regulations, ostensibly management, took the upper hand (53%) in this case. This paradox could become more explicable if one assumes the interaction of technological and human factors instead of the primacy of any one factor.

Table 9.7: Reason for less-frequent supervision

Ques 17c: What is responsible (for less frequent supervisor)?

	%
The nature of the technology	33
Management's preference	4
Workers' preference	10
Other reasons	16
Non-response	37

(n = 117)

Table 9.8: Reason for Indirect Supervision

Ques 14b: If Yes (that is, the supervisor is able to direct the job you do without actually being with you most of the time), what enables the supervisor to do so?

	%
The technical control system	29
Rules and regulations	53
Influence of work mates	3
Other	7
Non-response	8

(n = 117)

9.2.3 The discipline and reward systems:

These are formalized aspects of an organisations's control processes. They are employed for the regulation of behaviour and performance of the workforce. Behaviour and performance standards, which are regarded as essential for the achievement of organisational objectives, are defined by rules, and are set either unilaterally by management or jointly by management and employees. Compliance to these standards are rewarded whilst the disciplinary system serves in penalizing deviance.

In Port Harcourt, non-adherence to work rules was taken seriously. Sanctions for non-compliance included warning, either oral or written, demotion or dismissal. Whilst serious offences warranted demotion or dismissal[10], minor misconduct attracted verbal warning for most first offenders. More persistent `minor' offences earned written queries and it was against the rules not to reply to a formal query. Often, a reply was followed by a warning. However, it was at the discretion of the departmental of sectional heads to retain the reply within the department/section or to send same to Central Admin and personnel department either for further action or for filing in the offender's personal file.

It is noteworthy that management provided the environment which made coping with the rules easier. For instance, although sleeping on night duty was a very serious offence, it was permissible for individuals to bring in entertainment instruments (though playing cards was prohibited) so as to reduce boredom and to ward-off sleep. In addition, overmanning probably ensured that management was able to overlook instances where members of work groups made arrangement to rest in turns. In effect, the disciplinary system was exposed to considerable social influences.

Besides, assumed in the disciplinary system is the existence of a `reality' to which all parties must be responsive. The rules that define behavioural and performance standards are social constructs employed against actions which detract from or obstruct the pursuit of the reality. To this extent therefore, the disciplinary system was socially determined. However, rules also served to ensure adherence of laid down work procedures like the operating instructions discussed earlier. The relevance of technology in the refinery's system of discipline could therefore be presumed, in so far as work procedures themselves served to protect the machinery.

Alongside the disciplinary system was the reward system. Included here are the wages, salaries, allowances, welfare facilities, sickness provisions, pensions, etc. In the refinery, pay was not determined by any objective system which rated workers or the jobs they did. Broadly speaking, salaries were unrelated to skills possessed by the individual. At the point of entry into the organisation, individuals were assigned to salary bands that were determined mainly by their educational qualifications than by the skills they possessed. Thus, workers in maintenance, production and administration, for example, found themselves together in the same salary bands, irrespective of the differences in their skills.

Also, many interview respondents indicated that exposure to training did not guarantee promotion or more pay. In other words, acquisition of new skills often made little difference to the salaries of many workers. Factors generally considered in the determination of pay included years of service, performance, and relationship with work mates. In the event, any assessment of performance in the refinery could only be subjective in view of the lack of job descriptions. For the individual worker, the lack of a clear description of one's job hampered the formulation of a clear notion of what the job expectations were. This meant that there was no criteria against which the worker could inwardly assess his performance. As a consequence, the worker was neither able to personally perceive when he needed to improve his work performance nor did he have a coherent basis for making pay demands. This highlights the one-sidedness of pay bargaining in the organisation. In any event, for our concerns, what is more remarkable is that, as with the disciplinary system, the predominant influence on the reward system was essentially social. Determining who was rewarded, how the reward was to be made, and the content of the reward are complicated socio-political undertakings. In fact, one could deny any relevance of technology in the refinery's reward system particularly since, as it was discovered, the basic tenets of the payment system had not changed with the commissioning of the new plant.

9.3 CONCLUSION

This chapter examined the extent of the impact of technology on various dimensions of work control. It recognized the importance of technology in control matters. The new system had altered the nature of work supervision and control essentially by encouraging devolution of responsibilities to workers lower down the hierarchy and by being supportive of group working. On the other hand, for management, technical controls lessened the need for frequent contacts with operatives and increased the visibility of activities.

However, it was suggested that any argument of technological dominance is not sustainable. For instance, administrative control strategies like the status structure, and the discipline and reward systems experienced very little, if any, technological influence. Rather, social factors intervened. As was also suggested, placement in the hierarchy was essentially socially determined. Similarly, social considerations were significant in the discipline and reward systems.

It is possible to argue that the nature of the process technology, in which processes were interdependent, necessitated group or team work amongst workers. In this regard, Blauner notes the "collective responsibility for the total operation ..." (1964:179) since "the unique function of each operator in enmeshed in a network of interdependent relations with the function of others" (1964:173). Similarly, Gallie observes that:

> no individual team member produces something that can be seen as deriving uniquely from him. He is responsible for one of several processes that must be carried out simultaneously if the work is to be successful (1978:220).

In other words, that an individual's contribution to the work process could not be easily isolated and that workers had to work in groups are attributable to the technology.

However, there was no evidence to suggest that working in groups or teams was a new phenomenon that accompanied technical change. This mode of work organisation was carried over from the old plant. Besides, that some groups of workers worked in permanent work teams whilst grouping varied for others, suggests the dependence of such work arrangements, to a significant extent, on human decisions.

Overall, a basic tenet of the interactive thesis seems to have been satisfied. As the preceding analysis attempted to show, both social and technological factors seem relevant, albeit in varying degrees, in the different dimensions of work control. On one hand, the influence of technology is manifest in the existence of technical control systems which, most crucially, impacted on the mode of supervision. On the other hand, social relevance is evidenced, not only in its prominence in the discipline and reward systems, but also in the point that, in the final analysis, the extant control system owed much to choice - a very social endeavour. As was apparent, the technology made social choice possible by providing the opportunity for options to be chosen from. Similarly, the social enabled the existence and provided environment for the technological.

NOTES (9)

1. Conflicting typologies are apparent. For instance, it is not very clear whether Woodward's "processes of control" could be equated to Edward's "systems of control" or types of control.

2. Impersonal administrative control presumably corresponds to bureaucratic control under which all the elements of Edward's `system control' could also be subsumed.

3. This list is not exhaustive. Storey (1983) has criticized the strategy in which work control is assumed to involve only the shop floor labour process. He advocates the treatment of work control as a `totality' involving both internal and wider elements, external to the organisation.

4. It is perhaps important to mention that Gallie had similarly noted a "consequent reduction of the ambitious operator's hope of moving into management" (1978:217) in his study of refineries in more advanced economies. Gallie's conclusion is of particular interest here because it was also underpinned by his observation of an "increased tendency to recruit highly qualified engineers into lower management positions" (1978:217). This is similar to what obtained in the Port Harcourt refinery. Thus, it seems advanced refining technology demands high calibre staff, and the demand is the same no matter the level of advancement of the economy of the country in which it is put in use.

5. These influences derived mainly from the ownership. By virtue of its ownership of the company, the government is able to bring its weight to bear on certain appointments and postings. As was evident in respondents' comments, this situation was a source of considerable dis-satisfaction. Besides, attendant to this government interventions was the relatively instability of postings and positions. The negative effects therein could scarcely be over-emphasized.

6. Responsibilities, particularly for lower level employees, were often not clearly defined. In fact, as at the period of research, jobs had not been clearly evaluated and no detailed description of jobs existed. However, whilst some respondents hinted on-

going plans to evaluate jobs, clearly defined jobs roles did not seem to be an attribute of work in the refinery. As Blauner hinted, the "crew of operators ... have collective responsibility for the total operation ..." (1964:179). Similarly, Gallie observes that "work roles in a continuous-process plant are difficult to define with any precision, and in practice what is needed is a willingness to lend a helping hand where it is required rather than any rigid adherence to a specific set of operations" (1978:219). Gallie's observation corresponds perfectly with what obtained in Port Harcourt.

7. A point of difference between Blauner's argument, on the one hand, and Woodward and Edwards', on the other hand, seems noteworthy. Whilst for Blauner, the technology apparently necessitates a social arrangement which inevitably causes the change in the supervisory function, both Woodward and Edwards see technology as taking-on some of the function directly.

8. It is notable that in the Port Harcourt refinery, the view would hold in so far as "informal influence of work groups ..." is excluded in the definition of "responsible autonomy". In the refinery, there was little evidence to suggest the informal influence of workers on the work arrangements. Even the supervisors themselves, whose roles were depleted, did not seem to mind. Apparently, greater autonomy for the work groups was seen as a legitimate aftermate of adopting a sophisticated, and necessary, technology. Many supervisors generally busied themselves, and were content, with handling administrative tasks like securing job orders for maintenance technicians; procurement of materials for operators; and collecting workers' monthly dry rations - a welfare pack provided by management.

9. In any case, many managers were quick to emphasize that the technical controls were used mainly to control the performance of the plant, not necessarily the workers themselves. This view was re-echoed by a superintendent thus: "Actually the idea is not to nose around what operators were doing. The idea [of calling up information from the system] is to correct lapses or errors" (Ugoh: August,1991).

10. The use of these sanctions was rare. During the study, only one case of demotion was mentioned. But, even this affected the individual concerned in terms of status alone. His salary was unaffected. The

rarity in the employment of this sanction is hard to explain. Perhaps, management saw no opportunity for taking such draconian action. As already indicated, workers, generally, seemed to comply with the rules.

CHAPTER 10

INDUSTRIAL RELATIONS AND THE NEW TECHNOLOGY

According to Dunlop (1958), workplace industrial relations is concerned with the establishment and administration of rules by actors who include employers, employees and/or their representatives, and the state. In his systems approach, Dunlop recognizes technology as one of the external environments which play a decisive role in determining the industrial relations system. It is therefore presumable that a change in any of the `influencing' environments would impact on the rule-making and administration processes. This chapter examines the extent to which the industrial relations in the refinery was affected by the new technology. In an attempt to examine the roles and relative importance of the `actors' in these rule-making and administration processes, the chapter first explores the path of industrial relations development in Nigeria. The aim is to highlight the trend and aspects of the state's influence. As the discussion seeks to show, the government wields enormous influence and, to a significant extent, dictates the current system which permeates both the public and private sectors of the economy. Following this is an account of the industrial relations system in the Nigerian oil industry generally and the refinery in particular. This leads us to the examination of the implications of the new technology on the refinery's system of industrial relations. This is against the background of propositions and suggestions in the developed economies. Essentially, the neutrality of technology in the refinery's industrial relations arena is suggested.

10.1 THE COLONIAL LEGACY

Collectivisation amongst Nigerian workers was already discernable by the 1890s, but the earliest known formal trade unions were the civil service union formed in 1912 and the Nigerian Railway Native Staff Union in 1919. There are conflicting views regarding the reason for unionisation. Whilst according to Yesufu, "the main reason ... was merely to match the existence of such institutions elsewhere" (1962:32), some other analysts suggest the need of workers to improve their condition of work (Ubeku,1983; Imaga,1990). Whatever the reason for organising, it appears their relationship with the colonial employers was not exactly adversarial. For instance, the central aim of the Railway Union was:

> To promote official interests and welfare of the members of the staff and to inculcate in them the principles of devotion to duty and loyalty to government ... (ToKunboh,1966 : quoted in Ubeku, 1983:60).

In any case, the employers were not necessarily sympathetic to the plight of workers nor were they more accommodating. Rather it seems workers recognized their no-win position in their relations with their employers. In fact, the word `native' attached to the title of the Railway Union seems to suggest elements of friction and a search for a common identity.

The legalisation of the trade union movement by the British colonial government was the watershed in the development of trade unions in Nigeria. The government's apparent interest in labour relations culminated in the passage of the Trade Union Ordinance, 1938. This Ordinance provided legal backing to Trade Unionism. Although it did not explicitly provide for union recognition, the Ordinance specified the rights and obligations of unions in labour-management relations. Invariably, it contributed to the rapid growth of union organising which subsequently followed.

However, this was a qualified growth. Growth was only to the extent that the Ordinance created greater awareness amongst workers about the advantages of collectivisation. There was no real growth in union strength in terms of effectiveness. The failure of the Ordinance to specify both the structuring of unions in terms of types and the modalities of their functioning led to the proliferation of unions whose membership were either too few or were variegated[1], and whose leadership were unskilled and inexperienced. In the circumstance, the unions were weak and unstable and were unable to make any significant contribution to labour-management relations apart from their pursuit of bread and butter issues (Akpala, 1982). As Ubeku also comments, many unions were formed mainly for the purpose of collectively making specific demands, most unions fizzling out soon after the end of the demand. In any event, the legalization of union activity also marked the beginning of more militant tendencies amongst unions.

Another addition to the framework of industrial relations during the colonial was the passage of the Trade Disputes (Arbitration and Enquiry) Ordinance, 1941. This laid down the procedures for the settlement of disputes which collective bargaining failed to resolve. In any case, no government legislation provided a definitive framework for collective bargaining process or its resulting collective agreement. Apparently, it was assumed that the generation of collective bargaining from labour-management relations was automatic. Also, it seems the government presumed plant-level bargaining. This was in view of the fact that no Employers Association existed until 1957, when the Nigerian Employers Consultative Association, NECA, was formed.

In digression it needs to be stated that the late development of employers' association is not surprising and is quite explicable. Government in Nigeria was, and still is, the largest single employer and this enabled it to dictate the pace in industrial relations. Smaller employers were compelled to operate within the broad framework set out by government and therefore saw little need for collective action. Once the employer followed government guidelines, he was reluctant to enter into any bargaining with unions, preferring autonomy in the determination of terms and conditions of work in his enterprise.

Following the 1941 Ordinance was the creation, in 1942, of the Department of Labour, charged with the responsibility of "enforcing labour legislation in the country and of reporting to, and advising the administration on trade-union development, the state of industrial relations ..." (Ubeku,1983:108). Whilst the department favoured joint consultation, it did not interfere with negotiations. It featured only as a conciliator or appointed arbitrators when the parties in labour relations were embroiled in disputes. This state apparatus could only persuade, not compel, the different parties. In cases where the state provided conciliation and arbitration services, the resulting awards were not legally binding and feuding parties were free to go back on settlements.

Hence, the system of industrial relations in Colonial Nigeria was essentially voluntarist, fashioned after the British model but devoid of constructive collective bargaining. However, a major shift was to occur after independence in 1960 and beyond.

10.2 THE `NEW' INDUSTRIAL RELATIONS SYSTEM

It is argued that the desire for rapid industrialisation against the background of scanty resources led the Nigerian government at independence to occupy the centre stage in the country's industrial relations (Yesufu, 1981; Akpala,1982; Ubeku,1983). The dominant reasoning was that the government had to "intervene in economic matters to protect and promote the public interest and for achieving a united, strong and self-reliant nation, a great and dynamic economy, a just and egalitarian society, a land of bright and full opportunities for all citizens and a free and democratic society" (Akpala, 1982:65-66). In the country's industrial relations context, the fulfilment of these objectives was translated into the jettisoning of the pre-independence laisser-faire approach for a more interventionist stance. As Akpala also aptly puts it:

> Government would no longer remain a passive observer in the labour market, but would go beyond its traditional referee's function and discharge its leadership role both as a major employer and as the guardian of the nation's wealth (1982:66).

The first indications of a clear departure from the voluntarist ethic is provided the Trade Disputes (Emergency Provisions) Decree, 1968, and its amendment, Decree No. 51, 1969. Probably in an effort to minimize industrial unrests which was then becoming commonplace[2], the Decrees made the procedures for declaring trade disputes difficult and at the same time compulsory. That is, the procedures must be exhausted before disputes were declared. When this happened, the Decree also introduced deadlines for the settlement or, otherwise, referral of such disputes to arbitration. Hence, speed in the settlement of disputes was of the essence, understandably so in view of the emergency situation created by the Nigerian civil war then. Furthermore, the Decrees banned strikes and lockouts. It made arbitration compulsory and removed the freedom of employers and employees or their representatives to back out of conciliation agreement. However, any award arising from arbitration was still not regarded as the final stage for the settlement of disputes. All collective agreements were to be implemented only with the prior approval by the government. In a way, these provisions tended towards curtailing the capabilities of the two parties to test their strengths during disputes. They also seemed to make the bargaining strength of the two parties, to an extent, irrelevant.

Some encouragement for collective bargaining was to come with the enactment of the Trade Union Disputes Decree, 1976. By the Decree, it became compulsory that copies of all collective agreements, reached between the parties, on labour-management relations must be deposited with the government. The Decree also provided for the establishment of a permanent Industrial Relations Panel. This represents a shift away from the previous ad hoc arrangements. The new institution was expected to be more perceptive and was mandated to be more aggressive with their arbitration services so as to salvage order before it actually broke down. Arbitration tribunals were to be appointed from the permanent panel whose membership included two representatives each of employers and workers. Presumably, this arrangement would give the two parties equal chances for participation in arbitration exercises. However, in the event of an award by an arbitration tribunal which was unacceptable to any of the parties, the objecting party could appeal to a new quasi-judicial body, the National Industrial Court (NIC). Any decision by the NIC was final.

Evident in the foregoing is the Nigerian government's move from the pre-independence voluntarist approach through to a gradual but ultimately successful introduction of compulsion in the settlement of disputes. As Oribabor argues, the implications of post-independence Nigerian government's labour policies are that:

> the right to strike action, one of the necessary conditions for effective collective bargaining, is virtually outlawed. Industrial peace and harmony must now be positively created by state regulation; cooperation becomes a legal duty and employers and labour both have an obligation to collaborate at work, enforceable by the state, when necessary (1987:262).

Another area where the government also manifested its intention to shape the country's industrial relations system was in the trade union organisation. A first step in this direction was the promulgation of the Trade Union Decrees, No.31, 1973. The Decree stipulated rigorous procedures for the formation and registration of unions as well as made provisions for their recognition. With the Decree, employers were expected to accord registered unions recognition or face this being done by compulsory order. Furthermore, by a different Decree, namely, the Trade Dispute (Essential Services) Decree No. 23, 1976, employees in `essential services' like electricity, water supply, medical, police, prison and fire services were banned from joining unions. However, certain employees who were grouped in this category, namely the petroleum and banking industries, were permitted to unionize but conditionally. Such unions faced proscription if they failed to give their employers at least 15 days notice before embarking on industrial action. More importantly, the failure of workers in the petroleum industry to comply with the statutory machinery for the settlement of disputes was seen as a calculated attempt to disrupt the country's economy. It therefore attracted a death penalty as provided by the Petroleum Production and Distribution (Anti-Sabotage) Decree No. 35, 1975[3].

The Decrees notwithstanding, chaos still plagued the organisation of labour in Nigeria. This led the government to revoke all registrations and derecognized unions by its Trade Unions (Central Labour Organisations)(Special Provisions) Decree, 1976. Following this was the restructuring of the trade union organisation by Decrees Nos. 21 and 22 of 1978. The restructuring resulted in the grouping of about 1000 previously existing trade unions into 42 industrial unions (among which were 15 Senior Staff Associations, 4 Professional Unions, and 9 Employers' Associations), all with national outlook, Government also established one central labour organisation, the Nigerian Labour Congress (NLC). Moreover, it appointed a Trade Unions Registrar with the responsibility for monitoring the functioning of the unions. This was to ensure that government's labour policies were complied with. Whilst some analysts frown at this apparent hoodwinking of the labour movement (Oribabor, 1987; Imaga, 1990), the government's involvement in trade unions restructuring and organisation along industry lines seems to have won some support. Thus Akpala vigorously argues that:

> Since trade unions are economic and social organisations and are part of the industrial system and important in the productivity quest, they equally need better, regulated, structured planning. Hence the problem of choice of trade union system is not just to choose industrial unionism. It is also one of bringing planning to bear on union development. And since the state represents both enterprise and workers and other social and economic institutions, it seems to have an on-going responsibility to facilitate trade union structural planning based on industrial unionism (1982:177).

Structuring of unions along industry lines is credited with a number of advantages. For instance, Yesufu reckons that by organising along industry lines, "the process of unionisation has been simplified for the workers and the problem of courting the displeasure of the employer because of trade union activity has been greatly reduced" (1981:217). Moreover, industrial unionism has been credited with facilitating the process of economic planning, strengthening unity in trade union membership, as well as simplifying collective bargaining (Salamon, 1987). In other words, industrial unionism tends to create closer ties between a union and the industry it represents. Also, the incidence of rivalry, tension and competition between unions in the same organisation, which seems to be the case when union organisation is along craft or occupational lines, is eliminated; and the adverse effect of the dearth of trained and experienced union leaders is cushioned. With regard to collective bargaining, industrial unionism enables better integration between the two levels of bargaining - industry and plant or organisational levels - and makes negotiations simpler. Besides, productivity bargaining and agreement is made easier when only one Union acts as the workers' bargaining agent (Akpala, 1982).

In any event the government's efforts to encourage collective bargaining has consistently been at a level beyond the workplace. No machinery for orthodox collective bargaining in the workplace itself has been provided. That this is so is probably because the government did not want to be seen as directly interfering with the day-to-day affairs of organisations. Nonetheless, the government had continued to enunciate the principle of free collective bargaining. Evidence of encouragement of the principle by the government is its legislative provision of collective bargaining machineries in The Wages Boards and Industrial Council Decree No.1, 1973. The Decree provided for the establishment of Joint Industrial Councils (JICs). The JICs are industry-specific, union-management bodies set up for purposes of negotiations and consultations on substantive issues like wages and conditions of service. In any case, government is still able to influence this socio-economic process in that the Decree establishing the bodies also provided for the establishment of two Wages Boards, namely the Industrial Wages Board and the National Wages Board for the private and public sectors respectively. The principal function of the boards is the regulation of wages and other conditions of service where necessary. However, the overriding objective of the Wages Boards is to work out and recommend minimum wages payable.

In addition, the government established the Prices, Productivity and Incomes Board (PPIB). This is a tri-partite board comprising the state, employers and the unions. The emphasis here is on productivity, which government sees as of utmost importance to economic growth. By their participation in the PPIB, employers and labour are obliged to ensure the implementation of negotiated agreements arising from the PPIB deliberations.

In summary, the preceding suggests that the Nigerian government has sought to integrate the objectives of the state with those of industry and its members by means of a `new' industrial relations framework. The realisation of the national objectives is deemed possible only if industrial peace and harmony prevail. Determined to ensure that this happens, the government have had to play a more pervasive role in the country's world of work. It has systematically rationalised labour-management relations by imposing a multitude of legislative and statutory limitations on labour relations. We now turn to briefly examine how this `new' industrial relations system has filtered through to the Port Harcourt refinery.

10.3 THE CHARACTER OF INDUSTRIAL RELATIONS IN THE REFINERY

The system of industrial relations in the refinery is much in line with the government's stipulates although it may not be claimed to be an exemplar of industrial relations practice in Nigeria. In what follows, an attempt is made at an overview of the system in terms of union structure and organisation, and the labour-management relations or, more specifically, the machinery for collective bargaining.

10.3.1: Union Structure and Organisation:

Workers in the refinery belong to industrial unions - National Union of Petroleum and Natural Gas (NUPENG) for junior staff, and Petroleum and Natural Gas Senior Staff Association of Nigeria (PENGASSAN) for senior staff. As is evident, union organisation was not along occupational lines. In other words, the unions were multi - occupational. Although workers were not obliged to join, the majority of workers were union members. There were three levels of union organisation, namely, the national; corporate; and plant levels.

At the plant level, union leaders were elected, part-time officials. PENGASSAN official included the chairman, the secretary and six others, one of whom occupies a new office, the industrial relations officer. On the other hand, NUPENG had six union officials, the chairman, secretary and four others. Although union officials were not full - time officers, arrangement existed which enabled them to find time for their union duties. There were no designated shop stewards. This was probably because there were no distinct occupational groups that needed separate representation. Besides, as would be seen, there was no need for "someone who has responsibility for the conduct of the initial stages of negotiations in the workplace..." (Goodman J.,and Whittingham T.,1973: quoted in Salamon, 1987:158).

Officials of the two unions represented their respective members on industrial relations matters at the local level. Relations between the two unions appeared cordial as they saw themselves as "working in the same environment and pursuing the same course" (Nze: August,1991). The local unions gave `situation reports' to branch officials at the corporate level as the need arose. The financial security of the unions was maintained via a check-off system approved by both management and government, the latter having made statutory provisions in this regard.

In general terms, the unions at the Port Harcourt refinery represented sectional interests, possessed the means by which the different interests were reconciled, as well as enjoyed almost a 100% membership. These elements, according to Batstone and Gourlay (1986), are indicative of union sophistication. Another element of union sophistication in Batstone and Gourlay's scheme, which was also suggested by respondents in the refinery, was inter - union cooperation between the two existing unions.

However, some other elements of union sophistication, a la Batstone and Gourlay, were still lacking. For instance, when different interest groups are lumped together into only two unions, as was the case in the refinery, it is highly improbable that all the different interests would be uniformly represented. Besides, in so far as the existence of shop stewards suggests a representation of different interests, inadequacy in such representation could be claimed. This is in view of the fact that, as stated above, shop stewards did not exist in Port Harcourt. Further, from the premise that the existence of shop stewards is an essential component of union sophistication (Batstone and Gourlay,1986) and that "an effective workplace union organisation may require a hierarchy of stewards and possibly one or two full- time stewards ..." (Batstone and Gourlay,1986:25), the unions in the refinery could be seen as less sophisticated and less effective.

10.3.2 The Collective Bargaining Machinery:

Collective bargaining has been defined as:

> all negotiations and consultations which take place between the employers and/or management on the one hand and the workers or their representatives on the other hand, for determining all aspects of working conditions including wages, job security, welfare and growth of enterprise, productivity and general staff welfare (The 214th ILO Bargaining Convention,1981, No.154: quoted in Imaga, 1990).

This suggests that most forms of management-labour interactions could be subsumed under collective bargaining. In the refinery, interactions between management and workers or their representatives occurred both by formal consultation and by informal meetings and discussions. Consultation between management and labour took place on a monthly basis through the local Joint Consultative Committee (JCC). Joint consultation ensured regular communication between management and the unions and provided opportunity for both parties to submit and discuss issues which were of interest to them. As Akpala remarks, joint consultation enables "workers ... to participate in decision making over matters in which the two sides seek each others' co-operation and common understanding ..." (1982:150). Similarly, a top management participant in JCC meetings took the view that it was a forum in which management discussed production targets (Eke: June,1991).

On the other hand, a union official saw the JCC meetings as that in which:

> management makes suggestions to us on how to educate our members to be law-abiding and to make the best use of the facilities. In turn, we tell management the expectations of our members. At the end of the day, if both management and workers meet their obligations, the ultimate aim of high productivity would be achieved (Eno: August,1991).

It appears the opportunity for participation which has been provided by joint consultation had resulted in greater alignment of both union and management goals. For instance, the union leader enthused:

> We are not only asking for what management can do for us, we are also educating our members as to the responsibilities on them. In terms of their job, what is expected of them - issues such as punctuality, high productivity ... so [we are] not only asking for what the management can do, but also what we can contribute ... to make the company or the corporation ... a stable and progressive organisation.

In a similar vein, another union official stressed that they were:

> committed to see that NNPC is developed ... competes with any industry within the oil sector; committed to see that our staff work hard, dedicate themselves to duty and have a sense of belonging ... (Nze: August,1991).

Such was the level of commitment of workers to organisational goals. Thus, government's objectives seemed to be on a success path. The problems of union leaders became, not just that of winning concessions for their members but also, according to one of them, that of being able "to communicate the different aspects of management decisions to members without undue industrial unrest" (Atta: July,1991). Management seemed to have aided union leaders in the performance of this task by its strategy of sending union officials on industrial relations courses at its own expense.

During the JCC meetings, the issues that came under discussion were mainly local welfare matters like transportation, canteen and medical services, as well as other mundane matters that arose from the operations such as fire and safety (see Appendix 3). Generally, both management and the unions tended to abide by the consensus reached at the meetings. From management's point of view, employees' welfare was of particular importance. As a top manager explained:

> Apart from the fact that you get better productivity from any staff who is happy, you do not want to get staff all frustrated to the point where they could cause a lot of damage (Eke: June,1991).

In any case, although it is conceivable that more substantive issues bordering on pay and fringe benefits would probably have greater impact on the level of satisfaction (Goldthorpe et al,1968), these issues were not discussed at the local plant level. Their determination was essentially a corporate affair and was left for negotiations which took place only at the corporate(branch) level. In essence, collective bargaining took place at the refinery only to the extent that formal consultations on local matters occurred.

Substantive issues came under negotiation. The members of management's negotiation party were drawn from all the subsidiary companies under the NNPC corporate and were usually heads of personnel in these subsidiaries. Similarly, on each union's side, representatives were drawn from union officials in each of the subsidiaries and were led in the negotiations by their national secretary who was not a staff member of the corporation. As a member of the personnel staff emphasised, the secretary and the union's national president, who also attended the negotiation meetings, were "really not negotiating directly with the company as such, but are only helping the branch union officials in their negotiation with management" (Dabo: July,1991). This explanation seems confused but becomes more intelligible if it is seen from the premise that most of the union officials were relatively inexperienced and so needed the assistance of probably more skillful negotiators.

Items for negotiation included salaries, overtime rates, fringe benefits and other allowances. The two unions negotiated with management separately although the framework for negotiation remained similar. In addition, salaries and fringe benefits were negotiated separately. In keeping with the government's regulations, all agreements reached were sent to the Ministry of Labour for approval before they could be implemented. Perhaps it needs to be added that the government's system of more or less unilateral wage fixing (Yesufu, 1981; Imaga, 1990) in the public sector had the effect of upsetting negotiation agreements. This was particularly so in NNPC which, on the one hand, practised wage bargaining as occurred in the private sector but, on the other hand, was regarded as a public organisation and so within the government's wage-setting umbrella. Thus, a top level manager (Uche: May,1992) stressed that whilst other companies in the oil sector, like Shell, were more dynamic, reacting to international factors like exchange rates and hence making adjustments without prior negotiations, and were also in competition with each other, the NNPC was not responsive to such factors. Rather, it responded to "power dictates" and hence determination of workers remuneration was "very erratic, decided without reference to market fluctuations ... [This] results in extreme distortions in pay ... which do not correspond with those of other [oil] companies". Hence, according to him, during negotiations, the unions posture was often that of demanding that management should "catch up with the rest!". On the other hand, management posture was:

> I am what I am. Please compare me with others in the public sector.

The management could afford to take this stance because salaries and benefits in NNPC were said to be relatively higher, and conditions a lot better, than obtained in most public sector establishments.

Aside from negotiations on substantive issues, a JCC also existed at the corporate level. In this also, membership on both sides was drawn from all the subsidiary companies. The committee at this level met quarterly and discussed issues not normally covered during negotiation. Like at the local level, issues discussed were mainly corporate welfare issues like estates, zonal clubs and staff housing. Besides, the corporate JCC adjudicated when difficulties in the interpretation of certain aspects of the conditions of service arose at the local level. However, it is noteworthy that the distinction between negotiation and consultation becomes less clear cut at the corporate level. The JCC at this level also discussed issues that would have normally been negotiated.

In any event, a point needs to be made with regard to the multi - occupational nature of the unions and the scope of collective bargaining. As Batstone and Gourlay (1986) suggest, multi - occupation unions would be concerned with a broad range of strategic issues including interest in "the general strategies of the employer" (1986:29). In Port Harcourt, there was no evidence to suggest that the unions showed any interest in probing management strategy. But, in the extent that the unions indicated commitment to the progress of the organisation, Batstone and Gourlay's suggestion could be seen as applicable to the Port Harcourt refinery. On the other hand, a multi -

occupation union seems unable to concentrate its efforts on the welfare of a particular occupation and, therefore, is less likely to "bargain more intensively and achieve greater control over factors relating most directly to the work situation" (Batstone and Gourlay,1986:29). This argument seems equally applicable to the refinery in so far as, aside from consultation over health and safety, there was little indication that issues bordering on the content of work, for instance, were bargained for. In essence, the mode of unionisation could have indirectly influenced the scope of bargaining. Relatedly, the structure of collective bargaining whereby only consultation, rather that `hard' negotiation, occurred at the local level tended to deprive unions of a potential source of more influence.

Overall, good pay and conditions and some degree of workers participation in, at least welfare, decisions had resulted in a significant level of cooperative relationship between management and workers. In fact, it does seem conceivable that the often assumed `low trust' relationship between management and labour would be at an ebb and hence the existence of what could be regarded as a good industrial relations climate in the refinery. For our concerns, the question which arises is whether the application of new technology had affected this climate in any way.

10.4 THE TECHNOLOGY FACTOR IN THE REFINERY'S INDUSTRIAL RELATIONS SYSTEM

In the advanced economies like Britain, various suggestions have been made regarding the effect of technological change on industrial relations. Some posit the erosion of traditional job boundaries which, it is claimed, tends to result in rivalry between competing unions (McLoughlin and Clark,1988; Sorge and Streeck,1988). Also suggested are negative and/or positive implications for employment and manning levels which are thought to influence workers' reaction to technological change. In addition, effects and/or non-effects on collective bargaining are also suggested (Batstone et al.,1987; Willman,1987). These suggestions together provide the background against which the implications of the acquired new technology is discussed. Following from the preceding section, the foci of analysis are the union organisation and the collective bargaining relationship of management and labour.

Union organisation:

The adoption of the new technology had not altered the structure of union organisation or the level of their influence. As was suggested in Chapter 7, the size and sophistication of the technology had led to increases in the employment of workers who were then equipped with a variety of skills through training. However, this did not lead to squabbles between rival unions seeking to win new members. This was because the new intakes simply fitted into the two existing unions according to their positions on the seniority scale and irrespective of their occupations or skills. Similarly, the erosion of job boundaries as occurred in instances when operators carried out mundane maintenance tasks or took over some supervisors responsibilities did not lead to union conflicts. In this case, there was no need for unions to bother about the defence of the job territories of their members. Apparently, any erosions of job boundaries, as a result of the technological change, were contained because the mode of union organisation ensured that inter-union conflict did not arise.

Collective bargaining relationship:

The structure, pattern and scope of collective bargaining had remained essentially the same. With regard to the structure of bargaining, it was apparent that the government's prescribed guidelines were maintained. Further, the decision to acquire the new plant had occurred at a level beyond that in which collective bargaining normally took place. This, in effect, ruled out the possibility of any negotiations whatsoever with unions over the technological change. In addition, the bargaining structure meant that the issue was really not discussed at the local plant level. Even at the level in which negotiations occurred, terms and conditions were negotiated without reference to any inherent nature of the technology.

It is presumable that because, as noted previously, both management and the unions saw the decision over technical change as within the sphere of managerial prerogative, there did not seem to be any point in bringing it in as an issue for bargaining. As Sorge and Streeck similarly argue, when technological change is seen as a managerial prerogative, "there is in principle nothing to negotiate" (1988:32). In any case, Batstone and Gourlay make the point that "more sophisticated workplace organizations would negotiate more actively and over a wider range of issues concerning new technology than a less sophisticated organisation" (1986:36). As already indicated, the unions in the refinery were not exactly very sophisticated. This limitation may, thus, also help account for the stability in the scope of collective bargaining since the unions were apparently unable "to intrude into areas which ... would be accepted as the sole preserve of management" (Batstone and Gourlay,1986:37).

As was apparent, the technological change did not raise new bargaining issues. The scope of bargaining was still confined to issues relating to pay and benefits. Even so, the majority of questionnaire respondents as well as many interviewees stated that the technology had no influence on their pay. This seems to point to the irrelevance of technological considerations during the negotiation rounds and appears to give credence to the view that the unions were unable or reluctant to use the new technology as a bargaining chip during their pay demands.

In any event, whilst in some workplaces in Britain negotiation over technological change occur and often touch on the rationalisation of manning levels and the unions have anxiety over the training and/or retraining of their members (Davies, 1986), this was not the case in the Port Harcourt refinery. As indicated previously, management never intended to use technology to regulate labour. The issue concerning depletion of manning levels also did not arise. In fact, rather than destroy jobs, the acquisition of the new technology had created many more jobs. Besides, management's extensive training programmes for workers meant enskilling of the unskilled, and probably took care of any deskilling effects by reskilling those possibly deskilled. In essence, even though the unions were not sophisticated enough to impose control over technological change, management initiatives were quite favourable to the unions. The latter were saved from worries over preservation of skills, job losses and training provisions, all of which would have been important bargaining issues (Davies,1986; Batstone et al,1987; Willman,1987). As a union leader emphasized:

> We do not see computerisation as a threat to our employment. There would not be any reason for management to lay off some staff especially because they require skilled staff if they are to be able to completely take over operations from the expatriate

> contractors. Unless it is time for us to retire, we do not fear that management will lay off staff (Mgbeke: August,1991).

Hence, the security of jobs, coupled with training provisions meant a net gain for workers and may have contributed to the overwhelming acceptance of technical change even though change was not negotiated. Also, as a top manager argued:

> Most of these people are really products of our training programmes in preparation for the commissioning of the plant. It is unlikely that they would oppose the change (Onye: July,1991).

Besides, in a society where many are unskilled, technologically-related skills are held in high esteem, and individuals who possess such skills are regarded as bright and intelligent and have relatively high status, it is inconceivable that an opportunity which provides access to skills would be resisted. Relatedly, Bamber makes a relevant point that the acceptance of technical change as well as the right of employers to manage "may be found with unskilled workers and in new establishments ..." (1988:209).

It is notable that the unions, particularly the senior staff association, did not really feel left out in management decision making. This is evident in the following comment by a senior staff association official:

> Our members rank from fresh graduates to deputy chief officers. There is no way management can sit and work out ... a change in technology without involving our members. Our members are involved in the decisions, laying the plans, working out ... how the system will operate (Eno: August,1991).

Similarly, a top manager made the point that members of the management cadre are themselves workers and to that extent, "the differences between management and the unions [concern] differences in responsibilities and not differences in beliefs and feelings" (Uche: May,1992).

These notwithstanding, none of the unions could be said to bargain from a position of increased strength because of technological change. Members of the senior staff association who were in the position to participate in the decisions leading to technical change seemed more committed to their responsibilities as organisation decision makers rather than to the trade union to which they were members. For this category of workers, it is feasible to argue that their membership of a union had more to do with social rather than economic considerations. That is, they joined the union because of social and perhaps psychological desire to belong to an organized community rather than a desire to be part of a collective protest group (Akpala, 1982). In effect, the association's influence on organisational decisions generally was very limited, indeed, far less than some union officials preferred to presume.

The one area in which the intrinsic quality of the technology was apparently implicated was during `productivity' discussions at local JCC meetings. Even so, the presence of the new technology merely served to accentuate the productivity discourse which, in any event, had always been on the agenda long before the application of the new technology. During such meeting, management often made the point that the technology had taken over most of the manual and tedious jobs and hence, it expected that production targets should be reached with ease. On the other hand, unions agreed that they "could even beat that target" because of the new system but that this could occur:

> provided all the necessary equipment are in perfect working condition and basic welfare needs of staff are catered for by management ... The staff are not responsible for say a sudden mechanical failure of a machine which probably would require parts to be imported (Mgbeke: August,1991).

In essence, both technology and social needs were considered relevant in the achievement of productivity targets. Evidently, the new technology was not treated in isolation of other work relations issues. In Bamber's words, "Technological change [was] not ... a discrete issue which can be dealt with seperately from most other issues associated with the employment relationship" (1988:216). In Port Harcourt, the goals and interests of both management and workers were important, if not the most important, components of the productivity/technology discourse.

CONCLUSION

In the light of the foregoing, it is feasible to suggest the dominance of social-political factors in the shaping of the refinery's system of industrial relations and a general lack of effect of technology on the system. A review of the development of industrial relations in Nigeria revealed that the government more or less dictated the prevailing system. In the Port Harcourt refinery, the system of industrial relations was essentially an imposition by the government. Here, the mode of unionisation and the framework for collective bargaining were in line with government's stipulations. Also, the virtual `vetting' of collective bargaining agreements by the government probably served to instill a lot of caution in both management and the workers.

Union organisation in the refinery was along seniority lines. In the circumstance, tension and rivalry, associated with occupational or craft unions co-existing in the same workplace, were avoided. However, the two resulting unions were each multi-occupational. It was suggested that this meant the unions had rather broad based concerns and interests. This, coupled with the absence of shop stewards, made the unions less likely to uniformly protect the interests of all the different occupational groups under their fold. In essence, the mode of unionisation constrained the possibility of distinct occupational groups, possibly affected by technical change, to pursue their specific interests. Nevertheless, the mode of unionisation also meant that any violation, by the new technology, of boundaries between occupations within the same union mattered little.

Furthermore, it was suggested that the collective bargaining structure in which negotiation took place only at corporate level may have served to prevent technological change from becoming an issue for bargaining at the local plant level. Also notable is the tendency of negotiations at the corporate level to focus on issues of relevance to all the subsidiary companies. Technological change could not have been a relevant issue at this level of bargaining because not all the companies were exposed to it. In any event, it was also noted that organisational changes, including technological change, were regarded as management prerogatives and would therefore not even be brought up for bargaining.

On the other hand, only consultation took place at the local level. Since management at this level was not even involved in the technological change decisions in the first place, the technology did not arise as an issue for consultation. Even after the technology became operational, `management's right to manage' probably may have again prevented technology from being a consultation issue. In effect, even though the unions probably lacked the capacity, they also did not really have the opportunity to exert any influence on the technical change. However, in a similar vein, the technology could not influence the content of bargaining.

The inability of the technology to influence the content of bargaining could also be explained in terms of both the potentials of the technology itself and the management's initiatives. The technology created more jobs and provided the opportunities for acquiring new skills. It could therefore be argued that if the technological change had resulted in job losses, deskilling etc, then technology - linked issues probably would have been prominent in the refinery's industrial relations scene.

Implicit here is some relevance of the technology. This is in the extent that the opportunities it provided prevented potential upsets in the industrial relations climate. Nonetheless, the relevance of the social dimension is even more significant and is evidenced in, for instance, the point that management's training programmes made reskilling and enskilling possible and hence constrained any deskilling effects of the new technology. In other words, it is feasible to suggest that technology - linked issues were avoided because the management's training programmes prevented skill demands from becoming a worry to the unions and hence a potential issue to be raised during bargaining rounds. Futhermore, it could also be argued that if management's intention for acquiring the technology had been for labour regulation, then technology would have possibly come up as, at least, a consultation, if not a negotiation, issue. That labour regulations was not part of management's intention for acquiring the new technology may have therefore also contributed in preventing technology from impacting on collective bargaining.

Overall, other than the opportunities which technology enables, its effect on the system of industrial relations in the refinery was very limited. Inspite of the high premium placed upon modern imported technology, neither the mode of union organisation nor the structure or scope of collective bargaining had been affected by the applications of the new refining plant at Port Harcourt. Nevertheless, it could still be suggested that technology is relevant even if it is only in the extent that it enabled the existence of conditions like the creation of many new jobs and skills and rendering tasks less strenuous, all of which aided the sustenance of the good industrial relations climate. Similarly, the profound influence of social factors in the shaping of the refinery's system of industrial relations was very evident. In essence, it is perfectly feasible to suggest that both the technological and the social are relevant in the refinery's industrial relations system. That is, even though social factors undoubtedly appeared to have an upper hand in the system of industrial relations which existed at the Port Harcourt refinery, it is still possible to make a case for an interactive approach in the analysis of the system.

NOTES (10)

1. The Ordinance provided that 5 persons could form and register a trade union and it was permissible to organise across occupations, industry, etc.

2. Trade union leaders were turning politicians and those in Opposition were tending to use the trade unions as an instrument for sustaining their opposition.

3. Although this Decree had never been repealed, it had never really been enforced.

CHAPTER 11

CONCLUSION: THE INTERACTIVE APPROACH REVISITED

The case study examined the extent of relevance of technology in the organisation of work at the Port Harcourt refinery. From the premise that sophisticated foreign technologies are desired for modernisation in the country, a high probability of technologies being determinate in the workplace was anticipated. Against this background, the study explored the reasons and strategies involved in deciding, choosing, implementing and operating the new refining technology in the Port Harcourt refinery. Specifically, the influence of the technology on the content of jobs, the control of work activities and on management-labour relations were investigated. The study found that although the technology in Port Harcourt is `alien', the nature of its influence generally did not deviate significantly from the literature impression of what happens in its `home' environment. Very importantly, although the source of technology tended to conjour images of perfection which were seen as deserving emulation, this still did not make the imported technology overly determinate. However, some influence of technology on certain dimensions of work organisation were discernable, even though at nearly every turn, a `marriage' between the social and the technical was also evident. These give credibility to the interactive model, a tenet of which employed in the research posits, that both the technological and the social are relevant in workplace relationships. None is determinate, to the exclusion of the other nor is any a truly independent force. This chapter summarises the research findings, the arguments and the conclusions.

The technology factor in national and/or organisational development.

As was pointed out in chapter 4, technology was seen in Nigeria as an imperative for modernisation. Hence, the emphasis was on the need for it to be "adequately harnessed for accelerated industrial development in the country" (Osifo, 1992:3). Also, Osifo rightly notes that technology is "one of the composite input items used for the production of goods ..." (1982:7). Thus, if technology is just `one', then, there are likely to be others. It therefore does not seem safe to regard technology as all - determining. Certainly, the other `input items' are also of some importance. Crucially, the human beings to operate the technology are as important as the technology to be put into use.

Further, the expressed desire of the Nigerian government to adapt imported technology to the local environment is indicative of social relevance. Not only is it the case that the technology would not undertake the adaptation process on its own. Also remarkable is the point that the direction of adaptation is subject to human decision and choice. Infact, in the first place, choosing the technology is itself a social act and so also is the choice of technology mediated by social considerations. In other words, social conditions structure technological development. Besides, that the adaptation of the foreign technology to suit the local environment was suggested also tends to points to the non determinacy of technology. It thus appears feasible to argue that if the environment is not made conducive by social actors, then quite simply, the technology would not function effectively. Also, since the `environment' is multifaceted, including political, economic, social, cultural, and technological dimensions, it follows that technology cannot safely be seen as the exclusive mover of technological development.

Further, the principal reason for adopting the new technology at the Port Harcourt refinery was the desire to match the supply with the growing national demand for refined petroleum products. That is, a social need took recourse in a technological means for its satisfaction. Put differently, the new technology did not simply find its way into the refinery. The need for it had to be socially constructed first. Moreover, although the technology was chosen for its potential to enhance production, it did not by itself determine the achievement of this potential. Its achievement depended upon the decision of human `actants' (Latour, 1991)

The Choice And Strategies for the application of new technology.

The acquisition of the new refining technology in Port Harcourt was stimulated by the desire to increase output of refined petroleum products. This led to the selection of a technology which was expected to enable the increase. As was apparent, what was needed was not just a properly assembled refining system. The capabilities of the technological system also mattered and, as was emphasized, featured prominently in the considerations. It may be worthwhile to remark that this strategy is very similar to what obtains in more developed economies from where the oil refining system was imported. Writing against the background of such economies, Constant II emphasizes:

> [the] purchase or use of almost any modern technology is mediated by the complex organizations that are required to integrate the knowledge and resources necessary to produce and distribute the artifact or service (1987:231).

In Port Harcourt, the project team and their activities equate to Constant II's `complex organisations' and there can be little doubt that these are socially - oriented endeavours. Furthermore, every decision taken, which concerned the technical change, was not necessarily technological. For example, there were decisions concerning the source of finance for the project as well as regarding the manpower needs- the skill requirements; the types of training needed; and when, how and where the training would take place. Presumably, these decisions aimed to make both the technology and the human resources productive so as to optimize the returns on investment. In essence, both the `human' and the `non-human' were regarded as important.

The relevance of the human and the non-human was also evident in the implementation and operation of the technology. For example, the potential of the technology, which included automatic start-ups and shut-downs, admittedly influenced its choice. However, the `top-down' approach of the implementation arrangements was not a technological demand but, was more, a social preference. Moreover, modifications on sections of the plant which allegedly occurred after its commissioning is of significance. Respondents referred to adjustments that had to be carried out on some pumps, cables, instrumentations etc. As a respondent explained:

> If we have problems with running an equipment or in achieving our desired results from the column, the man in charge of the area may come up with some modification ideas which he thinks would help to achieve the desired objective. This proposal for modification is sent ... to our technical services section that reviews modifications, that is, the merits and demerits.If the suggestions are found to be appropriate, ... the modification is carried out (Effiong: July,1991).

That is, on one hand, the technology is relevant in the extent that it presented constraints which necessitated modification of some of its parts. But, on the other hand, social relevance is highlighted by the point that grappling with the modifications is a social activity, guided by human decision and choice. Indeed, the perception of a technical constraint which requires modification is itself a human, not a technological, phenomenon.

In addition, the social `impact' on technological change could be located in the whole hearted acceptance of change by all organisational participants. Perhaps, resistance by workers would have led to greater or lesser use of the technical control system. A pertinent point here is that the technology opened up possibilities which, in turn, suggested the existence of options as well as choice between options. Conversely, the existence of possibilities and options, albeit enabled by the technology, also highlighted the fact that the manifestation of the potentials of technology was dependent on social choice.

In any event, there were indications of what Meissner (1969) had described as the `teleology of production', and Forsyth et al., (1982) took as `technical rigidities'. Regarding this, one could point to `spatial constraints' (Meissner,1969) arising from the technical design which meant that a control operator, for example, had to perform his job tasks only in the controlroom itself. Moreover, technical rigidity would explain the point that the jobs of operators in the HF (Hydrofluoride) unit of the plant were dependent on those of their colleagues in the CDU (Crude distillation unit) which supplied, the `raw material', namely `atmospheric residue', for the HF unit. A breakdown in the CDU did inevitably mean inactivity in the HF unit.

Other examples reflecting the `teleology of production' were found in the way pumps and compressors were operated. With regard to pumps, a respondent explained that the nature of the technology required that certain procedures were followed before a pump could be taken out. As he elaborated:

> Suppose you want to take out a pump for maintenance, the first thing to do is to stop the pump. The next thing is that you isolate it, i.e. shut off the sunction and discharge lines. Then you depressurize it [after which] the pump is ready. If you bypass any of these steps, there'll be a problem. Like, if you stop the pump, isolate it but do not depressurize it, if somebody goes to do anything there, the content may splash on the person or could even cause fire. So you can't afford to jump any of the steps. They have to be followed sequentially (Umanna: July, 1991).

Similarly, handling a compressor required a series of technically-influenced procedures. However, here, social impact was also implicated. This is in the extent that, by the company's policy, the status of the worker to start a compressor must not be less than a senior operator; trainee operators were prohibited from this activity.

Furthermore, the technology demanded continuous operation and adherence to certain `start up' and `shut down' procedures. Nonetheless, the technology did not actually determine precisely when it should be started or stopped. This was largely socially determined. Infact, it is notable that in Port Harcourt, complete shut down of operations in the refinery was permissible only with prior approval by the Federal government, not just the corporate management.

It was noted that job specificity and/or rotation, as occurred in different units in the refinery, was not entirely due to the demands of the technology. Differences in the preferences of the different sections/units, with regard to the pursuit of job specificity or job rotation, is indicative of social factors at work. The new technology would neither easily explain the persistence of these practices in the new plant nor explain the non-uniformity in the practices of the different departments. Also, it would not satisfactorily explain why in the new plant, the oil movement section reverted back to its old practice of job rotation after initially having a go with job specificity for its workers. More probably, a perception of failure of job specificity to meet the section's work objectives led to the reversion to the old, and apparently better trusted, job rotation. In essence, these work practices were essentially managerial arrangements presumably intended for more efficient running of the technology.

In addition, the technology offered opportunity for reductions in the manning levels. But whether or not this opportunity is exploited appeared to be a social decision. As the study showed, manning levels in the refinery were more socially - than technologically - determined. For instance, according to a manager in process, "may be about 5 people would be enough to man the FCC [Fuel Catalytic Cracking Unit]" but this was not the case principally because of "so much unemployment in the country" (Anah: June,1991). That is, the need to provide jobs coupled with that to develop technical skills meant that the technology's potential to reduce manning was deliberately not exploited. At this juncture, it is perhaps necessary to remark in passing that these observations negate propositions such as that, once the design of a technological system is complete, "then social choices become frozen in [the] technology" (Clark et al., 1988:32). As was evident, although the refining system was imported as a completed design, there was still room for local choice in its deployment.

The interactive phenomenon could also be discerned in the shift work system. The shift system could be seen as a technological demand in so far, as according to a respondent,

> the technology demands continuous operation [and so] we have to run the plant on a round-the-clock basis ... turning the system on and off daily would certainly cause damage and could be a disaster (Nnamdi: June,1991).

He also noted that "nobody can work for 24 hours". Hence, on one hand, the shift system was to ensure that the technological system was kept working as technologically demanded in order to optimise its utility. On the other hand, the shift system served to ensure that the human users of the technology were not overworked. In other words, both the technological and social demands were satisfied. Moreover, that the shift system generally results from considerable social influence is further evidenced by the fact that it varies from one place to another. For example, whilst Gallie recorded that for French refinery workers, "the morning shift started at 5am, the afternoon shift at 1pm and the night shift at 9.pm" (1978:90), the Port Harcourt workers were under a different arrangement. In Port Harcourt, morning shift started at 7.00am, afternoon at 2.00pm and the night shift at 10.00pm. In essence, whilst the nature of the technology necessitates the shift system, the form which shift system takes is socially determined.

Technology and the content and character of Jobs.

In Port Harcourt, mediation of work by the technology was evident. Many workers had to perform their task by means of the new system which rendered many jobs less physically strenuous. For certain workers, like control operators and instrument technicians, the new technology created opportunities for acquiring new skills and knowledge. The new monitoring and control devices as well as the new self-diagnostic equipment had meant new skill requirements. As was suggested in chapter 8, the new technology enabled the reskilling of the controlmen who transfered from the old plant, whilst the relatively newly employed controlmen who, as it were had no identifiable production skill base, were enskilled. On the other hand, external operators saw reduction in the requirement for both their effort and skill as a result of the adoption of the new technology refining system. Also, for some mechanical maintenance workers, work became less synonymous with physical exertion. Generally, the application of the new technology resulted in changes in the character of some jobs.

Nevertheless, whilst the technology redefined the skills of many jobs, it did not correspondingly affect the `ordering' and specification of the tasks. Social elements seemed more influential in these latter dimensions of the content of jobs. Admittedly, the technology demanded the possession of certain specialised skills for its operation, and also demanded that its operation commands be inputted in a particular way. However, decisions concerning when and who inputted the command, in order to get the system working, remained within human territory. Furthermore, the varieties of tasks individual workers carried out depended much on the work instructions provided by superordinates. It seemed to have little to do with the technology.

Technological Change And The Control Of Work

The new refining technology was able to take on direct control of some production processes. Once programmed, the system was able to respond with a precision that was unmatched by humans. As it appeared, the new technology actually resulted in a considerable decrease in human intervention in the production processes. Also, it became possible for supervisors to know what subordinates were doing without being on their backs most of the time. Hence, a supervisor (Ngo: July,1991) noted how it was possible to sit back and instruct a subordinate to start a pump and run it for a certain time. The new system, in his words,

> would tell me when the pump was started; when it was stopped ... if the pump ran [for] more than was instructed, I will find out ...

Furthermore, the high degree of precision and accuracy of the technology in monitoring and controlling operations meant that, generally, it could be relied upon to get `things' right. In addition, its fault detection capabilities meant that errors would not go undetected for long periods. In this regard, the supervisor (Ngo: July,1991), in reference to an incident in which an operator kept recirculating water in a section of the system instead of running it off as was instructed, emphasised that

> the present technology has now made it possible for us to ... sit down in the control room and watch and know what is happening outside. If the incident had happened in the old plant, we couldn't have been able to notice it, unless one went outside.

That is, the new technology enabled supervision to be more indirect.

In any event, that the technology still required human intervention cannot be over-emphasized. The computerised system carried out actions and in certain cases, concluded and stopped actions. But it still required human input before it could commence action. Also, whilst the technology detected and, by itself, corrected some errors, correction of some other errors were left firmly in human hands. It is also noteworthy that, on the one hand, the technology influenced the control of work via its demands for compliance with standard operating procedures. Nonetheless, on the other hand, human influence could equally be discerned in the provision of work instructions, and hence some form of human control, by superordinates.

Further evidence of social influence in the control of work in the new technology environment was found in the stability of other control strategies like the status structure and the discipline and reward systems. These remained basically unyielding to any technological influence. Although the new system affected the mode of supervision, contrary to Zuboff's supposition, it had not made authority to "depend more upon an appropriate fit between knowledge and responsibility" (1988:6). Instead, the traditional ranking system had endured. As was apparent, whilst, for instance, many subordinates were more versed in the relevant technical knowledge than their supervisors, this did not alter their positions in the hierarchy. That is, although the technology had created possibilities for more `organic' organisational structure, humans, or more precisely, management's apparent preference for the more hierarchical structure ensured its endurance. Generally, management maintained their prerogative to manage and favoured strategies which tended to maintain the status quo.

The Industrial Relations Context Of The Technological Change.

In Port Harcourt, technological change was not an industrial relations issue. In fact, relations between management and labour appeared to be unperturbed by technical change. This, in a way, tends to suggest that technology is capable of carving a path for itself and apparently gives some credence to Ellul's argument that technology is "autonomous ... self determinative independently of ... human intervention" (1981:205). But, this view remains flawed when technology is seen merely as a chosen means. In other words, the relationship between technology and industrial relations is a function of social choice. Essentially, social actors determine whether or not, and how, technology would feature in industrial relations matters. For example, with regard to Port Harcourt, corporate management was in a position to decide what the content of collective bargaining would be. It would have been a perfectly feasible strategy for management to use the potentials of the new technology as a chip for bargaining. But, there was little evidence that it did. As was evident, management chose not to. In any event, the social organisation of collective bargaining which was such that bargaining occurred only at the corporate level, and involved all the NNPC subsidiary companies bargaining together, probably prevented the use of such a strategy. Since the technology in question concerned only one of the subsidiary companies, it seemed out of place to play up its potentials in the circumstances.

In fact, it could be argued that whilst remaining relatively impervious to technological influence, the refinery's industrial relations system actually had a significant influence on the mode, and the outcomes, of technological change. For instance, the relative strengths of the industrial relations parties possibly ensured that the comparatively weaker partner, the workers, played no part in the decisions regarding the change. Also, the nature of unionisation, whereby organisation was along seniority lines, ensured that union rivalry and quarrels concerning encroachment on occupational boundaries were non - existent. In addition, the general acceptance of technical change could be explained in terms of the non - adversarial pattern of industrial relation which had resulted largely from the government's statutory laws and regulations. All these social `shapings' seem to have contributed significantly to technological change outcomes.

In any case, as was suggested in chapter 10, an equally feasible argument is that the creation of many new jobs by the technology and its provision of opportunities for the acquisition of technical skills meant that change was not resisted. In other words, the technology aided the sustenance of non-adversarial industrial relations by enabling the creation of new jobs and desired skills. Perhaps, the reverse would have been the case if the adoption of the new technology had resulted in job losses. In any event, the prevalent social conditions meant that the potential of the technology to generate job losses was ignored. Evidently, the non - exploitation of this potential of the technology was more a social, than a technological, decision.

The Mode Of Technology Influence

From the study, the `interactiveness' of the human and the non - human could be suggested. Against the background of the foregoing, technological change outcomes at the Port Harcourt refinery could be seen as a function of the "forces of the collective and the synthetic capacity of the individual" (Callon,1991:148) actors in the network. As was evident, what seemed to be straightforward `technological' effects also turned out to have `social' undertones. Similarly, some purely social decisions also took the technological into consideration. That is, to a considerable degree, both the `social' and the `technological' were relevant and were in an interdependent, not a mutually independent, relationship.

Further, although technology "lacks whatever it is that currently distinguishes us as paradigm human beings" (Law, 1991:17), this has not robbed it of the capacity to influence. As was shown, it was able to exert influence on the technical aspects of the control system as well as influenced the skill content of jobs. Nonetheless, as the research has shown, technology's ability to influence was `woven' into the social which was itself transformed by the technological. This was the order of things even though a member of the coalition was alien - imported from the outside.

Admittedly, in Nigeria generally, foreign technology is revered and conjours a desirable image of perfection. But, this has not confered it determinacy. Evidently, technology is neither irrelevant nor is it overarchingly dominant. Certainly in Port Harcourt, the new refining technology is relevant in the organisation of work. But, explanation for its relevance does not reside in the `technological' alone. It is also located in the social. In other words, a crucial point here is not that the new refining technology did not have discernable influence but that on no account was the technological influence exactly independent, contrary to what Clark and his colleagues (1988) tend to suggest. In Port Harcourt, technology's influence was always dependent on its alliance with humans.

Moreover, neither the technological determinist nor the social determinist approach would exclusively provide a satisfactory explanation for the extant model of work organisation at the Port Harcourt refinery, following the application of new technology. In Port Harcourt, the technology was not able to influence all dimensions of work organisation. For example, it was unable to influence some aspects of the control system. This is inconsistent with the technological determinist thesis.

Similarly, that the technology evidently influenced the skill content of jobs cannot be explicated under a social determinist framework.

By contrast, the interactive model provides a more acceptable framework in so far as it recognizes the relevance of both the social and the technological. However, whilst emphasizing the importance of all `actants', mainstream interactive model theorists (for example, Latour) fail to make a statement concerning the extent of relevance of each of the `actants' in a given phenomenon. In fact, they seek to dissuade such pursuits. Here lies the point of dissonance between the study and the model. As is evident from the study, interactivity between the actants is not equilibratory such that each contributes equally in every given phenomenon. By focusing on "routine operation - where the system has been brought into service and a stable pattern of working with the technology has been [more or less] established" (Mcloughlin, 1992:6), the study attempted to show that although the social and the technological were "recursively woven" (Law,1988), each was more influential in certain dimensions of work organisation than in some others. For instance, the technological evidently had more influence in relation to the skill requirements of jobs and in the mode of supervision than it did on the status structure, the discipline and reward systems, and in industrial relations matters.

Overall, it is possible to propose that technology is relevant and has a discernable influence on aspects of work relations, even though its interdependent relationship with other organisation actants deprives its influence of any independence. However, in so far as actants do not contribute equally in all organisational phenomena, more precise measurement of the exact extent of technological influence remains problematic and begs for further investigation.

Nonetheless, as a final note, this study is considered significant for a number of reasons. It is an attempt to extend contemporary debates on technology at work to include a Third World workplace. Very importantly, it demonstrates that technological determinism remains flawed even in an environment where premium is placed on the technological. Moreover, it shows an example of where a cultural value has not been of "critical importance" in determining outcomes as Gallie(1978) would suggest. Here, the cultural belief in foreign technology as important and as the cornerstone for development has not made the technology determinate or dominant, contrary to a plausible expectation in the circumstance. Furthermore, also implicit from the study is an affirmation of the point that the acquisition of sophisticated foreign technology would not necessarily optimize productivity. Productivity seems more likely to be optimised if, along with such acquisitions, more attention is given to social elements like more carefully planned development and use of human actants.

RESEARCH QUESTIONNAIRE

The questions below relate to your work in the refinery and are purely for research purposes. Please kindly spare some of your time to answer them. Some of the questions have a list of response options from which you are requested to tick an option. Where more than one option are agreeable to you, please assign positions to your chosen options, giving the 1st position to the most preferred option.

N/B: **Management, as used here, could be the supervisor or those in higher level management cadres.**

- i How old are you?....................................
- ii Sex: (Male/Female)....................................
- iii Marital Status: (Single, Married, Widowed, Divorced) ....

---

1. When did you start working for the refinery? ....

2. What was your post when you started?...

3. What did you actually do on that job? That is, what were your main duties?

   ....

4. Do you still carry out the same job tasks as you did when you first took up the employment? **Yes/No**

5. If your job tasks have changed:..
   a. Since when did you start doing your new job tasks?.......................................
   b. Are your tasks increased or decreased?
   c. Has the speed with which you do your work increased, decreased or remain the same? **(Please underline as appropriate)**
   d. In your opinion, which of the following is(are) responsible for the change?

   Response Options:

   Management decision ☐

   Pressure from work mate(s) ☐

   Promotion ☐

The kind of technology in use ☐

None of the above ☐

Other reasons **(please specify)**..

....

Do not know ☐

6. a. Does your current job tasks require you to exert more physical power than previously? **Yes/No**

   If No, has the need for physical power decreased or remained the same? **(Please underline the preferred option).**

   b. Are your tasks technically more complex than before? **Yes/No**

   c. Did you require new knowledge to be able to perform your current job tasks? **Yes/No**

   d. Are you able to impose limits on the pace with which you work? **Yes/No**

   If yes, how? ....

   ....

   e. Please state what you think is(are) the reason(s) for the present state of your work tasks.

   ....

   ....

   ....

7. Do you work in groups? **Yes/No**

8. If you work in a group;

   a. Is the work group a permanent one or varies according to the assignment to be done?
   (Please underline the preferred option)

   b. Who selects the members of the group?..

   c. Why, in your opinion, do you work in groups?...

   ....

d. Do you have a group leader? **Yes/No**

If yes, what does the group leader do?..

....

....

e. Do you think the group leader knows more about the job than you do? **Yes/No**

f. Is the group under constant observation by a higher officer? **Yes/No**

Now, I would like to ask some questions on training.

9. Do you think you needed more training to be able to work in the refinery? **Yes/No**

10. Have you undergone any training since you were employed? **Yes/No**

11. If you have undergone some training,

a. What kind(s) of training? ....

....

b. When did you undergo training?...

c. Who selected you for training? ....

d. In your opinion, what was the reason for the training?

....

....

....

e. Did you acquire any new skill(s), from the training, which is(are) useful in performing your job tasks? **Yes/No**

If Yes, what skill(s)...

....

f. What other benefit(s), if any, did you derive from the training?

....

....

....

Back to your daily work tasks

12. a. Do you have standard operating procedures for performing your work tasks? **Yes/No**

b. If Yes:

i. Who provides it? ....

ii. Do the operating procedures actually direct the sequence of work, for example, direct what tasks must be performed before others? **Yes/No**

iii What in your opinion influence(s) the content of the operating procedures?

Response Options:

The nature of the technological system in operation ☐

Attitude of workers/work groups ☐

Management's preferences and judgement ☐

None of the above options ☐

Other reason(s) **(please specify)** ....

....

Do not know ☐

iv) Do you always follow the operating procedures provided? **Yes/No**

Why? ....

....

....

....

13. Do you have a supervisor to supervise your job? Yes/No

14. If your work is supervised:

a. Is the supervision able to direct the job you do without actually being with you most of the time? **Yes/No**

b. If Yes, what enables the supervisor to do so?

Response Options:

The technical control systems ☐

The rules and regulations which guide the job ☐

The influence of work mates/group ☐

None above ☐

Other reason(s) **(please specify)** ....

Do not know ☐

15. Do you like it if the supervisor is able to supervise your job without physically being with you? **Yes/No**

Why? ....

....

....

16. If the supervisor is always on hand, is it because:
    - i. You are not very familiar with the equipment and their operation? **Yes/No**
    - ii. You like him to be there? **Yes/No**
    - iii He chooses to be there always? **Yes/No**

17. a. Are you most times left alone to do your work without frequent interference from the supervisor or foreman? **Yes/No**

    b. Has it always been so? **Yes/No**

    If No, since when did the change occur in the supervisor/foreman's approach? ....

    ....

    c. What is responsible?

    Response Options:

Workers preference and insistence ☐

The nature of the technology in operation ☐

Management's preference ☐

None above ☐

Other reasons **(please specify)** ....

....

Do not know ☐

18. In your opinion, is your work:
    i. Sufficiently challenging? **Yes/No**
    ii. Interesting? **Yes/No**
    iii More of a routine? **Yes/No**
    iv Boring? **Yes/No**

19. a What interests you about your job? ....

    ....

    b How do you maintain the interest? ....

20. a What aspect(s) of your job, if any, do you not like

    ....

    ....

    ....

    b. Why do you not like the aspect(s)? ....

    ....

    ....

    ....

    c. In what ways do you try to contain the dislike?

    ....

    ....

    ....

    ....

21. Is your salary influenced by:
    i. the skills you have? **Yes/No**
    ii. the kind of equipment you operate or use? **Yes/No**
    iii laid down conditions of employment? **Yes/No**

22. a Do you belong to the staff association? **Yes/No**

b. If Yes, is membership optional or obligatory? ....

(underline as appropriate)

c. Does the association:

i. enable you to perform your job better? **Yes/No**

ii. help to ensure that you retain your job? **Yes/No**

iii help to improve the conditions of your employment? **Yes/No**

Thank you very much for your help.

C. **Nwuche (Mrs)**

July, **1991**

Appendix 2

QUESTIONS ASKED AT MOST OF THE INTERVIEW SESSIONS*

- What is the function of the department/unit?

- What categories of workers are in the department/unit?

- Why the new refinery?
  At which level was the decision on the adoption of the new technology taken?
  What factors were considered before the decision was taken?

- Did the technological change concern product or process innovation or both?

- Has there been any modifications to the technological design? Why?

- Are the pace of work; number and variety of tasks; skill requirements; efforts level; and the level of discretion/ autonomy of the workers whilst performing their job tasks different from what they were in the old plant?

- Do the workers like the conditions of works? Are they committed and compliant?

- What is the role of the supervisors? Did they experience any change in their role since the new refinery was commissioned? How?

- What relationship exists between effort and reward?

- Is the current reward system different from what it was in the old plant?

* *Questions were not necessarily asked in the same order and in exactly the same words during each interview session.*

PORT HARCOURT REFINING COMPANY LIMITED

(Internal Memorandum)

TO HAP

FROM INDUSTRIAL RELATIONS OFFICER

SUBJECT PENGASSAN/MANAGEMENT JCC MEETING

DATE 22/4/92

YOUR REF.

OUR REF. 162.1

The Joint Consultative Committee meeting has been scheduled for Thursday, 23rd of April, 1992 in the Conference Room, New Administration Block at 1000 hours.

AGENDA

a) Matters arising from the minutes of the meeting of 10/1/92.

b) Matters arising from the last minutes of 24/3/92.

c) Medical

d) Transport/MD's memo on lateness

e) Canteen

f) Kiosks within the Company's premises

g) A.O.B.

Barasin

D.M. BARASIN

cc: HAP/SECRETARY, PENGASSAN

DIST.

O/C PERSONNEL

O/C ADMINISTRATION

O/C SECURITY

O/C MANPOWER DEVELOPMENT

BIBLIOGRAPHY

Adesina J (1990), `The Construction of Social Communities In Work: The case of a Nigerian factory', In Capital And Class, No 40, Spring 1990

Adler P (1990), `Marx, Machines, and Skill', In, Technology and Culture Oct. 1990, Vol. 31, No. 4

Agbejule T (1987), Collection of Oil Revenue In Nigeria, A paper delivered at the Public Relations Seminar in Feb. 1987: Nigerian National Petroleum Corporation

Ahiazu A (1984), `Culture and Workplace, Industrial Relations : A Nigerian Study', Industrial Relations Journal Vol. 15, No 3, 1984

Ahlstrand B (1990), The Quest For Productivity, A Case Study of Fawley After Flanders, Cambridge : Cambridge University Press

Akpala A (1982), Industrial Relations Model For Developing Countries : The Nigerian System, Enugu, Nigeria : Fourth Dimension Publishers

Amino J (1991), Oil and Gas Industry In The Nineties In The Producer Country of Nigeria, Address delivered at the 13th Meeting of the World Petroleum Congress, held in Buenos Aires, Argentina

Amu L (1982), A Review of Nigeria's Oil Industry, Nigeria: NNPC

Anthony P (1977), The Ideology of Work, London: Tavistock

Anya A (1989), Science, Development and The Future : The Nigerian Case; Reflections and Essays On the Nigerian Socio-Cultural Experience, Enugu, Nigeria: Novelty Industrial Enterprises

Aribisala O (1990), National Policies, Strategies and Programmes for Raw Materials Research and Development Council for A Self-Reliant Industrial Growth in Nigeria : A lecture delivered by the Director, Raw Materials Research and Development Council, 5 April 1990

Armbruster A (1983), Ergonomic Requirements, In New Office Technology, Human And Organisational Aspects (ed) Otway H & Peltu M, London : Frances Pinter

Atkinson P (1979), Research Design In Ethnography, Block 3B, Research Design - Open University

Badham J (1990), Machine Metaphors and Conspicuous Production : Human Centred Systems movement and the Re-enchantment of Technology, Paper given at CRICT, Brunel University, October 1990

Bamber G (1988), Technological Change and Unions, In New Technology And Industrial Relations (ed) Hyman R and Streeck W, Oxford: Basil Blackwell

Bannon L, Barry U and Holst O (ed) (1982), Information Technology Impact On the Way of Life, Dublin: Tycooly International Publishing Ltd

Batstone E and Gourlay S (1986), Unions, Unemployment & Innovation, Oxford : Basil Blackwell

Batstone E, Gourlay S, Levie H and Moore R (1987), New Technology and the Process of Labour Regulation, Oxford : Clarendon Press

Bean R (1985), Comparative Industrial Relations London : Croom Helm

Beechey V (1982), The Sexual Division of Labour and the Labour Process : A Critical assessment of Braverman, In The Degradation of Work (ed) Wood S (1982), London : Hutchinson

Bell D (1981), From Technology, Nature, and Society In Technology and Human Affairs (ed) Hickman L and Al-Hibri A (1981), St Louis : The C.V. Mosby Company

Berggren C (1985), Industry Work, Technological development and new rationalisation strategies : the case of the Swedish Automotive Industry In Work in the 1980s (ed) Gustavsson B, Karlsson J. and Raftegard C (1985), England : Gower

Bessant J (1987), Information Technology And the North-South Divide, In Information Technology : Social Issues (ed) Finnegan R, Salaman G and Thompson K (1987), Hodder & Stoughton In Association with the Open University

Bijker W, Hughes T and Pinch T (ed)(1987), The Social Construction of Technological Systems, Massachusetts : MIT Press

Bimber D (1990), `Karl Marx and the Three Faces of Technological Determinism', In Social Studies of Science Vol 20, 1990:333-51

Blauner R (1964), Alienation and Freedon, Chicago : The University of Chicago Press

Boddy D & Buchanan D (1982), Information technology and the Experience of Work, In Information Technology Impact On The Way Of Life (ed) Bannon L et al., Dublin : Tycooly International Publishing Ltd

Braverman H (1974), Labour and Monopoly Capital: The Degredation of Work in the twentieth century, New York : Monthly Review Press

Braverman H (1985), Technology and Capitalist Control, In The Social Shaping of Technology (ed) MacKenzie D and Wajcman J, Milton Keynes : Open University Press

Broadbent D (1987), Skill and Workload, In Psychology At Work, (ed) Warr P, England : Penguin Books

Bruland T (1985), Industrial Conflict as a source of Technical Innovation : The Development of the Automatic Spinning Mule, In The Social Shaping of Technology (ed) Mackenzie D and Wajcman J, Op.cit.

Bryant G (1985), Positivism In Social Theory And Research, London : Macmillan Publishers Ltd

Bryman A (1988), Quantity and Quality In Social Research, London : Unwin Hyman

Bryman A (ed) (1988), Doing Research In Organisations, London : Routledge

Buchanan D and Boddy D (1983), Organisations In the Computer Age : Technological Imperatives and Strategic Choice, Aldershot : Gower

Buchanan D and Boddy D (1986), Managing New Technology, Oxford : Basil Blackwell

Buchanan D (1986), Using the New Technology, In The Information Technology Revolution (ed) Forester T Oxford : Basil Blackwell

Bulmer M (ed) (1984), Sociological Research Methods, An Introduction, London : The Macmillan Press

Callon M (1987), Society In the Making : the Study of Technology as a tool for sociological analysis, In The Social Construction of Technological Systems (ed) Bijker et al, Op.cit.

Callon M (1991), Techno-economic networks and irreversibility in, A sociology of monsters (ed) Law J., London and New York : Routledge

Campbell M (ed) (1990), New Technology and Rural Development, London and New York : Routledge

Chijioke M (1982), Efficient Use of Technology in Industrial Development, In The Role of Technology In the Industrial Development of Nigeria, (ed) Osifo D, Nigeria : Heinemann Educational Books

Child J and Partridge B (1982), Supervisors : The Lost Managers?, Cambridge : Cambridge University Press

Child J (1984), `New Technology and Developments In Management Organisation', Omega Vol 12, No 3, 1984

Child J (1987), Managerial Strategies, New Technology and the labour Process, In Information Technology : Social Issues (ed) Finnegan et al Op.cit.

Child J (1987), Organisational Design for Advanced Manufacturing Technology, In The Human Side of Advanced Manufacturing Technology, (ed) Wall T, Clegg C, Kemp N chichester : John Willey & Sons

Clark J, McLoughlin I, Rose H and King R (1988), The Process of Technological Change : New Technology and Choice in the Workplace, Cambridge : Cambridge University Press

Clark J (1991), `Skill changes in maintenance work in British Telecom : An alternative view', In New Technology Work and Employment Vol 6 No 2 Autumn 1991

Clegg H (1979), The Changing System of Industrial Relations In Great Britain, Oxford : Basil Blackwell

Cockburn C (1983), Brothers : Male Dominance and Technological Change, London : Pluto Press

Colombo U (1991), The Technological Revolution and the Future of the Third World, In IEEE Technology and Society Magazine Vol 10 No 1 Spring 1991

Constant II E (1987), The Social Locus Of Technological Practice : Community, System or Organisation?, In The Social Construction Of Technological Systems, (ed) Bijker et al Op.cit.

Cornell L Karlsson J and Lindgvist U (1985), Missing Concepts of Work, In Work in the 1980s,(ed) Gustavsson B et al England : Gower

Davies A (1986), Industrial Relations and New Technology Kent : Croom Helm

Decree No 5, National Science and Technology Development Agency Decree 1977, In Federal Republic of Nigeria, Official Gazette No 4, Vol 64, 27th Jan 1977

Denzin N (1989), The Research Act, Third Edition Introduction to Sociological Methods, Prentice Hall

Edquist C (1985), Technology and Work. In Sugar Cane, Harvesting in Capitalist Jamaica and Socialist Cuba, 1958 -1983, In Work in the 1980s, (ed) Gustavsson B et al England : Gower

Edwards P K (1986), Conflict At Work, A Materialist Analysis of Workplace Relations, Oxford : Basil Blackwell

Edwards R (1979), Contested Terrain, The Transformation of Work in the Twentieth Century, London : Heinemann

Ejiofor P (ed) (1987), Managing Government-Owned Companies Enugu, Nigeria : Fourth Dimension Publishers

Ejiofor P & Osuji L (1987), Problems of Managing Government-Owned Companies : Some Empirical Findings, In, Managing Government Owned Companies ibid

Elliot B (ed) (1988), Technology and Social Process Edinburgh : Edinburgh University Press

Ellul J (1981), The Technological Order, In Technology and Human Affairs, (ed) Hickman L and Al-Hibri A (1981) St Louis : The C.V. Mosby Company

Ellul J (1981), The Autonomy of Technique, In, Technology and Human Affairs, ibid

Evans (1979), Causation and Control : Block 3A Research Design -Open University

Eyerman R (1985), Work - a contested concept, In Work in the 1980s, (ed) Gustavsson B et al England : Gower

Fadahunsi A (1986), The Development Process and Technology, A case for a resources based development strategy in Nigeria, Research Report No 77, Scandanavian Institute of African Studies, Uppsala

Farnham D and Pimlott J (1986), Understanding Industrial Relations, 3rd ed London : Cassell Educational Ltd

Federal Ministry of Science and Technology: National Policy on Science and Technology, 1986, Nigeria

Federal Ministry of Science and Technology, Lagos, Nigeria (1990), Fact Sheet Vol 1

Federal Republic of Nigeria : First National Rolling Plan 1990 - 1992 Vol 1, Lagos-Nigeria : The Planning Office, Federal Ministry of Budget and Planning, Lagos, January 1990

Federal Republic of Nigeria : National Rolling Plan, 1991 - 1993 Vol 1

Finnegan R, Salaman G and Thompson K (ed) (1987) Information Technology : Social Issues, Hodder & Stoughton in association with the Open Univeristy

Fong P (1985), Employment, Skills and Technology In Work in the 1980s (ed) Gustavsson B et al England : Gower

Forsyth D (1982), Technical rigidity and appropriate technology in less developed countries, In The Economics of New Technology in Developing Countries (ed) Stewart F and James S London : Frances Pinter Publishers

Fox A (1974), Beyond contract : Work, Power and Trust Relations, London : Faber and Faber

Francis A, Snell M, Willman P and Winch G (1982), The Impact of Information technology at Work: The case of CAD/CAM and MIS in Engineering Plants, In Information Technology Impact On the Way of Life (ed) Bannon L et. al. Dublin : Tycooly International Publ.

Francis A (1986), New Technology at Work, Oxford : Clarendon Press

Freeman C (1987), The Case For Technological Determinism, In Information Technology : Social Issues, Op.cit.

Friedmann A (1977), Industry and Labour,London: Macmillan

Fuchs (1968), : cited in Penn R and Scattergood H (1985)

Gallie D (1978), In Search of the New Working Class: Automation and Social Integration within the capitalist enterprise, Cambridge Univeristy Press

Gellner E (1985), Relativism and the Social Sciences, Cambridge : Cambridge University Press

Gershuny J (1978), : cited in Francis A (1986) op.cit.

Giddens A (1982), Profiles and Critiques in Social Theory, London : The Macmillan Press

Goldthorpe J et al (1968), : cited in Hill (1981), Competition And The Control of Work

Grint K (1991), The Sociology of Work : An Introduction Oxford : Polity Press

Grint K (1992), The Sociology of work, In, Developments in Sociology, An Annual Review Vol 8 (ed) Haralambos M England : Causeway Press Ltd

Gulick (1984) cited in Murphy J and Pardeck J (ed) (1986)
Gustavsson B, Karlsson J, Raftegard C (ed) (1985), Work in the 1980s, Emancipation and Derogation, England : Gower

Haralambos M & Heald R (1985) Sociology, Themes and Perspectives 2nd ed. London : Unwin Hyman

Hassan S (1976), Inaugural address to the international conference on the education and training of engineers and higher technicians, New Delhi, cited in Chijioke M (1982), Efficient Use of Technology in Industrial Development Op.cit.

Haug F (1985), Automatization as a field of contradictions, In, Work in the 1980s (ed) Gustavsson et al. Op.cit.

Henly J (1989), `African Employment Relationships And The Future of Trade Unions', British Journal of Industrial Relations Vol XXVII, No 3, 1989

Herzberg (1966), cited in Farnham D & Pimlott J (1986) Op.cit.

Hill S (1981), Competition and Control at Work London : Heinemann

Hindess B (1977), Philosophy and Methodology in the Social Sciences, Sussex : The Harvester Press

Hirschheim R (1985), Office Automation, A Social and Organisational Perspective

Hoerr J (1991), `What Should Unions Do?', In Harvard Business Review May - June 1991

Holmes L (1987) Quest for the Real Samoa, Bergin & Garvey Publishers

Hughes T (1987), The Evolution of Large Technological Systems, In The Social Construction of Technological Systems (ed) Bijker W, Hughes T and Pinch T, Massachusetts : The MIT Press

Hughes T (1988), The Seamless Web: Technology, Science et cetera, et cetera, In Technology and Social Process (ed) Elliot B., Op.cit.

Hyman R and Streeck W (ed) (1988), New Technology and Industrial Relations Oxford : Basil Blackwell

Igbani I (1982), Industrial Development in Nigeria : Myth or Reality : A Public lecture delivered by the Hon. Minister of State, Federal Ministry of Industries to Federal Public Officers, 3rd November, 1982

Igwe B, Ndekwu E (ed) (1985), Technological Choice Decision Making in Nigeria's Public Sector, Ibadan, Nigeria : Nigerian Institute of Social And Economic Research (NISER)

Igwe B, Ndekwu E and Alli P (1985), Decision-making and Technological choice in the Public Sector, In Technological Choice Decision Making in Nigeria's Public Sector, Ibid

Imaga E (1990), Industrial Democracy In The Third World: A Study of Nigeria and India, New Delhi : South Asian Publishers

Inang E (1982), Financial Institutions and Technological Development, In, The Role of Technology In the Industrial Development of Nigeria, (ed) Osifo D Nigeria : Heinemann Educational Books

Industrial Policy of Nigeria (Policies, Incentives, Guidelines and Instututional framework), 1988, Nigeria : Federal Ministry of Industries

Jayaweera N (1987), Communication Satellites : A Third World Perspective, In, Information Technology : Social Issues, (ed) Finnegan R et al. Op.cit.

Jonas H (1981), Towards A Philosophy of Technology, In, Technology and Human Affairs, ed Hickman L & Al-Hibri A Op.cit.

John T (1990), `Management of Nigeria's Oil Industry In the coming decade', In NAPETCOR, Quarterly Magazine of the Nigerian National Petroleum Corp, Vol 11, No 3, 1990

Kanter R (1984), The Change Masters, Corporate Entrepreneurs at work, London : Unwin paperbacks

Kelly J (1968), Is Scientific Management Possible? A Critical Examination of Glacier's Theory of Organisation, London : Faber and Faber Ltd

Kidder L and Judd C (1986), Research Methods In Social Relations 5th ed, CBS Publishing Japan Ltd

Kling R (1990), Computerisation and Social Transformation, in Science, Technology & Human Values Vol 16 No 3

Koleoso O, Onyekwelu S and Olugbade E (1981), The Role of Government In the Development of Indigenous Technology : A paper presented at the Workshop On "Development of Indigenous Technology" held at Enugu, Nigeria, 28-30 Oct 1981

Koleoso O (1982), Improving Indigenous Technology for Industrialisation : A lecture to chemical society, University of Sokoto, Nigeria, June 1982

Koleoso O & Nwosah G (1988), Indigenous Development and Management of Improved Technology for Processing and Preservation of Agricultural Products : A paper presented at the 12th Annual Conference of the Nigerian Society of Agricultural Engineers held at the National Centre for Agricultural Mechanization (NCAM), Ilorin, Nigeria, 4-7 Sept 1988

Krausz E (1969), Sociology in Britain : A Survey of Research, London : B.T. Batford Ltd

Landes D (1986), `What Do Bosses Really Do?', In, The Journal of Economic History Vol XLVII, No 3, Sept, 1986

Large P (1984), The Micro Revolution Revisited, London : Frances Pinter (Publishers)

Latour B (1988), The Princes for Machines as well as for Machination, In Technology and Social Process, (ed) Elliot B Op.cit.

Latour B (1988), `Mixing Humans and Nonhumans together : The Sociology of a Door-Closer', In Social Problems, Vol 35, No 3, June 1988

Latour B (1991), Technology is society made durable, In, A Sociology of Monsters, (ed) Law J., London and New York: Routledge.

Law J (1987), Technology and Heterogenous Engineering : The Case Of Portuguese Expansion, In, The Social Construction of Technological Systems, (ed) Bijker et al. Op.cit.

Law J (ed) (1991), A Sociology of Monsters, Essays On Power, Technology and Domination, London : Routledge

Law J (1991), Introduction : monsters, machines and sociotechnical relations, In, A Sociology of Monsters, ibid

Lazonick W (1985), The Self-Acting Mule and Social Relations In The Workplace, In The Social Shaping of Technology (ed) Mackenzie & Wajcman Op.cit.

Lin N (1976), Foundations of Social Research, New York : McGraw-Hill Book company

Littler C (1982), The Development of the labour process in capitalist societies, London : Heinemann

Littler C and Salaman G (1982), Braverman and Beyond: Recent Theories of the Labour Process, Sociology Vol 16, No 2.

Lukman R (1989), Petroleum Industry and the National Ecomony, An address by the Minister of Petroleum Resources at Command and Staff Collegem Jaji, Nigeria, September 12, 1989

Mackenzie D and Wajcman J (ed) (1985), The Social Shaping of Technology, Milton Keynes : Open University Press

Mann P (1976) Methods of Sociological Enquiry, Oxford : Blackwell

Mann P (1985), Methods of Social Investigation, 2nd ed, Oxford : Basil Blackwell

McLoughlin I and Clark J (1988), Technological Change At Work, Milton Keynes : Open Univeristy Press

McLoughlin I (1992), Babies, Bathwater, Guns, Roses, and the smart machine: does technology matter in organisational analysis? : Seminar paper, University of Wollongong, Australia, November 1992

McGregor D (1960) cited in Hill S (1981) Op.cit.

McNeill P (1990), Research Methods 2nd ed, Routledge

Marglin S (1982) : What Do the Bosses Do? In, Class, Power and Conflict (ed) Giddens A and Held D.

Mayntz R, Holm K and Hoebner P (1969), Introduction to Empirical Sociology, Translated by Hammond A, Davis H and Shapiro D (1976), England : Penguin

Meissner M (1969), Technology and the Worker, San Fransisco : Chandler

Miller E (1976), Task and Organisation, London : Wiley

Millward N & Stevens M (1986), British Workplace Industrial Relations 1980 - 1984, England : Gower

Mitchell C (1983) `Case and situation analysis', In Sociological Review, New Series, Vol 31.

Mumford E (1983), Successful Systems Design, In New Office Technology : Human and Organisation Aspects (ed) Otway H and Peltu M London : Frances Pinter

Murphy J and Pardeck J (ed) (1986), Technology And Human Productivity : Challenges for the future, New York : Quorum Books

Nadler G and Robinson G (1987), Planning, Designing and Implementing Advanced Manufacturing Technology In, The Human Side of Advanced Manufacturing Technology (ed) Wall T, Clegg C & Kemp N, Chichester : John Willey & Sons

National Institute for Policy & Strategic Studies (1986), Restructuring of Nigeria's Industrial Sector, Nigeria

National Office of Industrial Properties (NOIP) : Annual Report, 1989 Lagos, Nigeria

Nigerian Institute Of Social And Economic Research (NISER), The Technological Impact of Nigeria's Structural Adjustment Programme (SAP), NISER Monograph series No 3, 1988

Nigerian National Petroleum Corporation, Conditions of Services (undated)

Noble D (1985), Social Choice in Machine Design : The Case of Automatically Controlled Machines, In, The Social Shaping of Technology (ed) Mackenzie & Wajcman Op.cit.

Nwuche C (1989), New Technology : A review of some strategies for its Introduction in the Workplace and the implications for Middle Management, London School of Economics, Unpublished M.Sc. Report

Okigbo P (1987), Essays in the Public Philosophy of DevelopmentVol 1 Nigeria : Fourth Dimension Publications

OPEC (Organisation of Petroleum Exporting Countries) at a Glance (undated)

OPEC review, An Energy and Economic Forum, Vol 4,No 4, Winter 1981 OPEC Statute, June 1989.

Oribabor P (1987), From Laissez-faire to Corporatism : The Impact of the Military On Nigeria's Industrial Relations, In, The Impact of Military Rule On Nigeria's Administration (ed) Sanda A, Ojo O, and Ayeni V, Ile-Ife, Nigeria : Univeristy of Ife Press.

Osifo D (ed) (1982), The Role of Technology In the Industrial Development of Nigeria, Nigeria : Heinemann Educational Books.

Osinowo F (1989), An Appraisal of the Adequacy of Nigeria's Technological Base and Raw Materials for Economic and Industrial Development, In : Essential Foundations for Economic and Industrial Development in Nigeria, Industrial Training Fund, 1989 Conference Proceedings.

Osinowo F (1991), Research and Development In the Nigerian Food Industry, Conference Paper, Federal Institute of Industrial Research, Oshodi (FIIRO).

Otobo D (1988), State and Industrial Relations In Nigeria, Lagos Nigeria : Malthouse Press

Otway H & Malcolm P (ed) (1983), New Office Technology, Human And Organizational Aspects, London : Frances Pinter

Penn R and Scattergood H (1985), `Deskilling or Enskilling? an empirical investigation of recent theories of the labour process', In British Journal of Sociology Vol XXXVI, No 4, Dec 1985

Pettigrew A (1973), The Politics of Organisational Decision Making, London : Tavistock

Pinch T and Bijker W (1987), The Social Construction of Facts and Artifacts : Or How the sociology of science and the sociology of Technology Might Benefit Each Other, In, The Social Construction of Technolgical Systems Op.cit.

Ragin C (1987) The Comparative Method, California : University of California Press

Raw Materials Research and Development Council, Lagos, : Report by Multi-Disciplinary Task Force on Base Metal, Iron, Steel and Engineering Services, March 1989

Research Institutes (Establishment etc) Order 1977, In, Federal Republic of Nigeria Official Gazette No 49, Vol 64, Lagos 13th Oct, 1977

Revised Guidelines on Acquisition of Foreign Technology Under Decree 70 of 1979; Prepared by National Office of Industrial Property, Lagos, Nigeria, 1989

Robertson D (1923), The Control of Industry, London: Nisbet

Robins K and Webster F (1987), Dangers of Information Technology and Responsibilities of Education, In, Information Technology : Social Issues Op.cit.

Rolfe H (1990), `In the Name of Progress? Skill and Attitudes Towards Technological Change', In New Technology Work and Employment, Vol 5, No 2, Autumn 1990

Rose D, Marshall G, Newby H, Vogler C (1987), `Goodbye To Supervisors?', In Work, Employment 7 Society, Vol 1 No 1

Rose M (1975) Industrial Behaviour, Theoretical Development Since Taylor, London : Penguin Books

Rose N (1990), Governing the Soul, The Shaping of the Private Self, London : Routledge

Salamon M. (1987), Industrial Relations, Theory and Practice, London: Prentice Hall Int.

Sanda A, Olusola O and Ayeni V (ed) (1987), The Impact of Military Rule On Nigeria's Administration, Ile-Ife, Nigeria : University of Ife Press

Sandelands L, Glynn M and Larson J (1991), `Control theory and Social Behaviour in the workplace', In, Human Relations, Vol 44, No 10, 1991

Scott M, Roberts I, Holroyd G and Sawbridge D (1988), Management and Industrial Relations In Small Firms, Research Paper No. 70, Dept of Employment, Britain.

Seibel H, Damachi U, Holloh D (1983), Industrial Labour in Africa: Continuity and change among Nigerian Factory Workers, Saarbrucken : Verlag breitenbach

Silverman D (1970), The Theory of Organisations, London : Heinemann

Silverman D (1985), Qualitative Methodology & Sociology, England : Gower

Smith H (1981), Strategies of Social Research 2nd Ed, New Jersey : Prentice-Hall

Sodipe R (1981), Acquiring Technology through Research; the role of FIIRO : A special supplement on the federal institute of Industrial Research, Oshodi

Sorge A & Streeck W (1988), Industrial Relations and Technical Change : The case for an extended perspective, In, New Technology and Industrial Relations (ed) Hyman R & Streeck W., Oxford: Basil Blackwell.

Stewart F and James (ed) (1982), The Economics of New Technology In Developing Countries, London; Frances Pinter

Stewart F (1984), Introduction, In, Sugar Processing: The Development of a Third-World technology by Kaplinsky R, Intermediate Technology Publications

Storey J (1983), Managerial Prerogative and the Question of Control, London : Routledge & Kegan Paul

Swift B (1979), Design of Survey, Block 3A: Research Design, An Open University Publication

Theobald R (1981), The House that Homo Sapiens built, In Technology and Human Affairs, Op.cit.

Thompson P (1983), The nature of work, London : The Macmillan Press

Todaro M (1989), Economic Development In The Third World 4th ed, New York, London : Longman

Toffs Consultancy (1985), A comprehensive survey of all existing technologies in Nigeria's Manufacturing Sector : Final Draft Report for the National Office of Industrial Property, Lagos, September 1985

Towers B (ed) (1987, 1989), A handbook of Industrial Relations Practice and the law in the Employment relationship, Kogan Page in association with the Institute of Personnel Managerment (publishers)

Ubeku A (1983), Industrial Relations In Developing Countries, The Case of Nigeria, London : Macmillan Press

Udo-Aka U (1982), The Management of Technology In Industrial Enterprise, In, The Role of Technology In the Industrial Development of Nigeria, (ed) Osifo D Op.cit.

United Nations (1973), Guidelines For the Acquisition of Foreign Technology in Developing Countries

Wad A (ed) (1988), Science, Technology and Development London :IT Publications

Warwick D and Osherson S (ed) (1973), Comparative Research Methods, Prentice Hall Inc

Whelchel R (1986), `Is Technology Neutral?', In IEEE Technology and Society Dec 1986 Vol 5 No 4

Wild R (1975), Work Organisation : A study of Manual Work and Mass Production, John Wiley and Sons

Wilkinson B (1982), New Technology and Human tasks: the future of work in manufacturing Industry, In Information technology impact on the way of life (ed) Bannon et al Op.cit.

Wilkinson B (1983), The Shopfloor Politics of New Technolgy, London : Heinemann Educational Books

Willcocks L and Mason D (1987), Computerizing Work: People, Systems Design & Workplace Relations, London : Paradigm Publishing

Willman P (1987), Industrial Relations Issues in Advanced Manufacturing Technology, In, The Human side of Advanced Manufacturing Technology (ed) Wall T et al. Op.cit.

Wilson M (1979), The languages of Social Science Research, Block 1 : Variety in social science research, Milton Keynes: Open University publication

Winner L (1977), Autonomous Technology : Technics-out-of control as a Theme in Political Thought, Massachusetts : Massachusetts Press

Winner L (1985), " Do Artifacts have Politics?", In, The social shaping of technology (ed) Mackenzie D and Wajcman J Op.cit.

Winchester D (1983), `Industrial Relations Research In Britain', In, British Journal of Industrial Relations March 1983

Wolfe D (1988), Socio - Political Contexts of Technological Change : Some Conceptual Models, In , Technology and Social Process, (ed) Elliott B Op.cit.

Wood S (ed) (1982), The Degradation of Work? Skill, Deskilling and the labour process, London : Hutchinson

Woodward J (ed) (1970), Industrial Organisation Behaviour and Control, London : Oxford University Press

Woodward J (1980), Industrial Organisation : Theory and Practice 2nd ed, Oxford : Oxford University Press

Woolgar S (1988), Science : The Very Idea, Chichester, London : Ellis Horwood and Tavistock Publications

Woolgar S (1990), The turn to technology in social studies of science, in Science, Technology & Human Values, Vol 15

Yahaya A (1989) Human Resources Development as an essential foundation for economic and industrial development, Industrial Training Fund, 1989, Conference Proceedings (Nigeria)

Yesufu T (1962), An Introduction to Industrial Relations in Nigeria, Oxford : Oxford University Press

Yesufu T (1981), The Dynamics of Industrial Relations : The Nigerian Experience, Ibadan, Nigeria : University Press

Young K (1986), `The Management of Craft Work : A case study of an oil refinery', British Journal of Industrial Relations 24:3, 1986

Zuboff S (1988), In the Age of the Smart Machines: The future of work and power, Oxford : Heinemann Publishing