TECHNOLOGY AND WORK ORGANISATION IN THE INDIAN ELECTRICAL ENGINEERING INDUSTRY

by

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To my parents,

Shri Vishwambar Dutt Sharma

and Shrimati Santosh Devi

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ABSTRACT

This thesis analyses the different factors that influence the organisation and control of industrial labour processes under capitalism. At a theoretical level, this study points to inadequacies in existing methodologies for studying industrial labour processes and their relationship to technology, both within the organisational theory and the Marxist traditions. Analytical categories including technology, technical change, skills, organisation of work, managerial control strategies, and workers' responses to them are developed on the basis of a critique of existing methodologies. It is pointed out that there can be no universal definitions of technology; and that technology and technical change need to be defined in relation to workers and to specific production processes. It is argued that skill is not a homogeneous category and technical change can have different impact on the different attributes of skill.

Workshops from five firms in the capital-goods sector of Indian electrical engineering industry have been studied with the emphasis on the division of labour on the shopfloor. At a descriptive level, this thesis presents a picture of technology and work organisation in these firms. The empirical analysis goes on to show the structure of jobs in the firms as predominantly hierarchical. Technology is found to be related to the division of labour but it does not determine it. A study of managerial control and workers' responses to it (both in trade union and non-trade union forms) shows that capitalist control over the labour process operates through a set of strategies rather than a single homogeneous strategy and that some of these strategies are influenced by non-workplace factors.

In general, this study demonstrates that universal frameworks either of 'de-skilling' or of technological determinism are inadequate for understanding changes in the organisation of labour processes.

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CHAPTER 1

INTRODUCTION

1. STATEMENT OF OBJECTIVES

The aim of this study is to analyse the different factors that influence the organisation and control of industrial labour processes under capitalism. This has been attempted in the following two ways. First, the analytical insights and shortcomings of existing methodologies for studying industrial labour processes and their relationship to technology under capitalism are examined. By examining both the Marxist and the organisational theory traditions, a set of analytical categories is developed for analysing the factors that influence the labour process under capitalism. Second, the analytical categories developed in the pursuit of the first goal are used to present a picture of the labour process in a specific industrial sector. The industrial sector chosen for analysis is the capital goods sector of Indian electrical engineering industry which is a specifically capitalist industry and does not involve handcraft-based organisation of production. In the context of this industrial sector, various hypotheses about the labour process arising out of the Marxist and the non-Marxist studies are tested.

2. ORGANISATION OF THE STUDY

To develop a set of categories for analysing the labour process in the capital goods sector of the Indian electrical engineering industry, first the methodologies put forward by the relevant Marxist and non-Marxist theorists are examined (see Chapters 2 and 3).

In order to assess the contribution of those who lay claims to a Marxist tradition, the contribution of Marx to analysing the labour process at the level of individual firms is examined. The insights provided by Marx are then used in examining the work of the 'de-skilling' theorists. This is followed by analysing the conceptual frameworks of those theorists who tried to go beyond the notions of 'de-skilling' to put forward a set of categories of managerial control within capitalist firms. The discussion of managerial control over the labour process is extended by assessing the work of the French philosopher Michel Foucault on elements of disciplinary power. Although Foucault does not work within a Marxist framework, his work can nonetheless be seen as a part of a radical tradition of analysing institutions under capitalism (see Chapter 2).

In the next chapter, the major features of the work of those organisational theorists who have made an explicit attempt to link the technology of an organisation with its structure are examined. More emphasis has been placed on assessing the contribution of those theorists who have specifically examined the implications of technology and technical change for the organisation of work on the shopfloor (see Chapter 3).

After having assessed the methodological insights and shortcomings of both the Marxist and non-Marxist theorists, a set of categories of

analysis based on them for use in this study are defined in Chapter 4. The span of validity of these categories, the levels of analysis at which they can be used, the methods used for operationalising them, and the specific hypotheses about the labour process that would be tested by using these categories are also discussed in this chapter. The reasons for choosing the Indian electrical engineering industry and the five firms within it are also presented in this chapter.

In Chapter 5, the specific historical context of this study is presented. This is done, by first discussing the performance of the capital goods sector of Indian industry since the mid-sixties and the performance of the capital goods sector of the electrical engineering industry within it. This is followed by discussing the industrial relations scene during this period. Finally, the five firms chosen for analysis are situated in the above context.

Chapters 6, 7, 8 and 9 present the results of this study. In Chapter 6, the organisation of work in the firms studied is presented in terms of the structure of jobs in these firms. In Chapter 7, a qualitative and quantitative analysis of the links between technology, technical change and the skill and other aspects of the jobs of workers are presented. Chapters 8 and 9 present an analysis of the forms of managerial control strategies used on the shopfloor and the responses of workers to these strategies. In Chapter 8 only those managerial control strategies that are constituted in terms of workplace factors and workers' responses to them are discussed. In Chapter 9, managerial control strategies formulated in terms of non-workplace factors are discussed along with non-workplace responses of workers to the labour process.

And lastly, in Chapter 10, the conclusions drawn in the above chapters are brought together. The shortcomings of this study along with some further areas of research for understanding the organisation and control of the labour processes under capitalism better are also discussed in this chapter.

CHAPTER 2

INDUSTRIAL LABOUR PROCESSES UNDER CAPITALISM: FROM MARX TO FOUCAULT

1. INTRODUCTION

In this chapter an attempt is made to examine critically some of the major Marxist theses on the labour process under capitalism and also to assess the implications of Foucault's (1979) contribution to the study of disciplinary power for analysing the capitalist labour process.

There are three sections in this chapter. In the first section, the contribution of Marx in analysing the capitalist labour process at the level of individual firms is examined. The discussion in this section shows that while Marx offers interesting insights into the analysis of labour processes under capitalism, his conceptions of technology and technical change are historically limited. An implication of this is that these notions of technology and technical change cannot be used meaningfully to analyse the links between technology and the organisation of work on shopfloors within individual firms.

In the second section, the contributions of those claiming to work within a Marxist framework are examined. These include the 'de-skilling' theorists like Braverman (1974) and Gorz (1972; 1978) as well as those who tried to go beyond the 'de-skilling' hypothesis like Friedman (1977) and Edwards (1979). In each case, a summary of their key arguments is followed up by critical assessment. An examination of the 'de-skilling' hypothesis shows that not only are there theoretical problems associated with its conceptualisation but that subsequent

empirical studies have thrown doubts on the conclusions it leads to. The frameworks of Friedman and Edwards are also shown to be methodologically inadequate for the analysis of labour processes under capitalism.

The third and final section deals with the contribution of the French philosopher Foucault in analysing disciplinary power within capitalist institutions. An analysis of his framework shows that even though he does not work within a Marxist tradition, the conceptual categories put forward by him may perhaps lead to far greater insights into the actual working of disciplinary control within a labour process than the categories provided by either the 'de-skilling' theorists, Friedman, or Edwards.

2. THE CONTRIBUTION OF MARX

Marx defines a labour process in its simplest form as an interaction between human beings and nature. It represents a purposive (as opposed to instinctual) transformation of the materials of nature by human labour. Marx defines the three basic elements of a labour process as follows: (a) Purposeful activity; i.e. the work itself, (b) the object on which work is performed; i.e. the raw materials, and (c) the instruments of work; i.e. tools, machinery, etc. (Marx, 1976: 284).

Thus in a labour process the object of labour is transformed in a pre-determined way by the workers using the instruments of labour. The object of labour and the instruments of labour are called the means of production or the objective conditions of labour, which help in producing products which have use-values. The object and instrument of labour can both be use-values produced in previous labour processes.

At this point, it must be noted that the labour process is not the same as the production process. The distinction between the two

becomes clear when it is understood that while working time is always production time, the converse is not true. The entire time a product or an object of labour exists in the production process is not necessarily the working time too because of the interruptions in the labour process conditioned by the nature of the product or its production[1]. This is true of both capitalist as well as non-capitalist production.

What distinguishes the capitalist production process from others is that under capitalist production a labour process is also a process of production of surplus-value. Marx refers to this as the "immediate unity of the labour process and the valorisation process" (Marx, 1976: 991). He is basically pointing out the fact that the interaction between human beings and nature, i.e. the labour process, under capitalism is directed towards the production of surplus-value.

Marx and the production process - organisation and control:

More generally, every production process can be analysed from two points of view: the labour process and the aims of the production process. This can be understood better by taking into account the analytical distinction Marx makes between the organisation of a labour process and its coordination or control. The principles of organisation of a labour process and the way it is controlled would depend upon the objective conditions and social relations of production. For example, cooperation as a principle of organisation of work, in its extremes, may take the form of simple cooperation or complex cooperation. While

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1. Thus, Marx points out, for example: "In the raising of timber, once planting and the preliminary work connected with this is completed, the seed may need 100 years to be transformed into a finished product; during this time, only a relatively insignificant intervention of labour is needed" (Marx 1978: 316).

the former involves a number of workers working in parallel to each other with each one of them performing all the operations necessary to complete a piece of work, the latter involves one piece of work being divided among many workers with all their operations being complementary. Both these extreme forms of cooperation may exist as principles of organisation of labour processes with different aims. In the case of simple cooperation being a principle of organisation of labour processes, Balibar (1979) explains:

> "In simple cooperation, there is a juxtaposition of labourers and operations. 'Numerous labourers work together side by side whether in one and the same process, or in different but connected processes'. This form of cooperation is still found, particularly in agriculture. In the workshop of the guild master, the labour of the journeymen is usually performed in simple cooperation. The same is true of the primitive forms of manufacture, which consist simply in gathering the artisans into a single place of work" (Balibar, 1979: 237).

Thus, the point being made here is that the same principle of organisation of labour processes may be used in different modes of production[2] - depending upon the objective conditions and social relations of production in existence, the labour processes may be directed towards different aims.

Commenting on control of the labour process, Marx pointed out that all social or communal labour processes organised on a large scale required, to varying degrees, a directing authority to ensure the

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2. Used in this study in the sense in which Laclau defines it, "The logical and mutually coordinated articulation of: 1. A determinate type of ownership of means of production; 2. a determinate form of appropriation of economic surplus; 3. a determinate degree of development of division of labour; 4. a determinate level of development of productive forces" (Laclau, 1977: 34). As Laclau points out, "This is not merely a descriptive enumeration of isolated factors, but a totality defined by mutual interconnections. Within this totality, property in the means of production constitutes the decisive element".

coordination of the activities of the individuals (Marx, 1976: 448-9). That the social labour process is controlled by the capitalists and their managers in the capitalist mode of production can be seen from its twin aspects - first, that as all social labour processes require coordination and control, so does the social labour process under capitalism; and second, because it is a labour process under capitalism, it is controlled to serve the needs of capital. However, the basis for control of the labour process has changed since the early stages of capitalism.

Marx points out that in the early stages of the capitalist mode of production the form of cooperation changes from simple cooperation to one based on the division of labour in production; i.e. complex cooperation. This is the period of Manufacture. However, the division of labour in Manufacture is quite different from that in large scale industry and machine based production and this has important implications for controlling the labour process. Under Manufacture, with handicrafts still providing the basis for the division of labour in production, the problem of control is basically one of subjecting "the previously independent worker to the discipline and command of capital" (Marx, 1976: 481). This means that the labour process cannot be performed independent of the craft-skills of the workers, who use their skills to resist the aims of capital.

However, Marx points out that the objective conditions under Manufacture were such, that: "It towered up an artificial economic construction, on the broad foundation of the town handicrafts and the domestic industries of the countryside. At a certain stage of its development, the narrow technical basis on which manufacture rested came into contradiction with requirements of production which it had itself created" (Marx, 1976: 490).

This contradiction was resolved, according to Marx, with the introduction of machines. Machines, on the one hand, removed the predominantly craft-skill based resistance of the workers to the command of capital and, on the other hand, they also removed craft-skill as the basis for organising the labour process. Marx tends to over-simplify the relationship between machines and skill requirements by not considering in detail the new skills[3] that might be created by machines. This is closely related to Marx's conception of technology and technical change which is taken up later in this section.

Two forms of production within capitalism:

To appreciate the significance of these changes in the labour process, Marx's distinction between labour's formal and real subordination under capital must be understood. Marx uses these concepts to describe two historically distinct forms of production within the capitalist mode of production (a distinction important in critically examining the 'de-skilling' theories in the following section of this chapter).

Marx points out that the subordination of the labour process to capital does not at first affect the actual form of production. Initially,

> "capital subsumes the labour process as it finds it, that is to say, it takes over an existing labour process, developed by different and more archaic modes of production. And since that is the case it is evident that capital took over an available, established labour process.... If changes occur in these traditional established labour processes after their take over by capital, these are nothing but the gradual consequences of that subsumption. The work may become more intensive, its duration may be extended, it may become more continuous or orderly under the eye of the interested capitalist but in themselves these changes do not affect the character of the actual labour process, the actual mode of working" (Marx, 1976: 1021).

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3. Marx, however, did make some general comments about large scale industry creating the need for "variation of labour, fluidity of functions, and the mobility of workers in all directions" (Marx, 1976: 617).

Marx refers to this form of production within capitalism as the phase of "formal subsumption of labour under capital". The basis for formal subordination of labour under capital is provided by the existence of wage labour (workers with no access to the means of production being forced to sell their capacity to work for subsistence), and the existence of the products of the labour process, means of production, and the means of subsistence of the workers in the form of commodities. During the phase of labour's formal subordination to capital, the valorisation of capital takes place through the appropriation of absolute surplus-value; i.e. extending the duration of labour time as well as through the general gains from the division of labour. This phase is the phase of manufacture.

Real subordination of labour under capital or the specifically capitalist form of production comes into being,

> "When the individual capitalist is spurred on to seize the initiative by the fact that value = socially necessary labour time objectified in the product and therefore surplus-value[4] is created for him as soon as the individual value of his product falls below its social value and can be sold accordingly at a price above its individual value. With the production of relative surplus-value the entire real form of production is altered and a specifically capitalist form of production comes into being (at the technological level too)" (Marx, 1976: 1023-4).

This stage of the capitalist mode of production is marked by extraction of relative surplus-value (i.e. by changes in productivity and/or intensity of labour), employment of machinery, the conscious application of science and technology to production, unprecedented increase in scale of production and the productive power of labour appearing as the productive power of capital embodied in the machines.

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4. Strictly speaking this should be "additional surplus-value" as there is some surplus value being created already in the production of commodities by labour above the value of labour power.

One of the aspects of this change in the form of production is that the organisation of the labour process, unlike in the period of manufacture, does not have to be adapted to the craft-skills of the workers. As Marx points out, this becomes possible because, "the capabilities of the tool are emancipated from the restraints inseparable from human labour power" (Marx, 1976: 545) as a result of the introduction of machinery. Thus the "subjective" principle of the division of labour; i.e. based on craft-skills of workers, is replaced by the "objective" organisation of work. The latter principle means that the whole of the labour process can now be analysed and organised to suit the needs of capital without the constraints of artisanal skills and the forms of resistance that went with it[5].

The role of machinery in this is two-fold: First, machinery is used to fragment the skills that were required in the jobs of the manufacturing period. This removes to some extent the control workers exercised over their jobs. And second, by changing the nature of the jobs to be performed, it creates a new basis, not dependent upon craft-skills, for organising work in ways best suited to the needs of capital. This may mean either using the same workers but with the jobs not requiring all of their erstwhile skills to be used or creating of new skills. The new division of labour and its control get embodied in the codes and procedures of the factory. Marx points out that, once the capitalist relations of production have been embodied in the design of machines as well as in the codes and procedures of the factory, "the overseer's book of penalties replaces the slave-driver's lash" (Marx, 1976: 550) in the phase of the real subordination of labour under capital.

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5. This does not mean that new bases for resistance will not evolve in this phase of capitalism. Marx, however, does not point to these explicitly.

Thus, it can be seen, as the accumulation process of capital changes, so too does the organisation and control of the social labour process, in the transition from formal to real subordination of labour under capital. Marx, however, does not go into the details of how the subordination of labour under capital may change in the second phase and the changes this might entail in the organisation and control of the labour process[6]. Since Marx sees the use of machinery and, hence, of technology as defining features of this stage of the capitalist mode of production, it might be asked in general as to what role do the changes in technology play in changing the organisation and control of the labour process in the phase of real subordination of labour under capital? Before this question can be answered, the ideas of Marx on technology and technical change need to be examined.

Marx and technology:

Marx uses the terms "technology" and "machinery" to denote the instruments of labour in the labour process. While the term technology is used in a generic sense to denote the instruments of production, by definition, Marx limits the use of the term machinery to mean rotary-machines. Thus, while all machines would form part of a technology, not all technologies of production are comprised of machines.

Marx's notions of production technology under capitalism are quite primitive, shaped as they were by the scientific and technological developments of his times. It was because of this historical limitation on his vision that Marx described capitalist technology as only "machinery" and "chemical processes etc.".

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6. What Marx did envisage were tendencies within the social production process under capitalism that would transcend the boundaries of capitalism with the development of large-scale industry (Marx, 1977: 704-706). These tendencies, however, were specified at a very general level.

Marx defined machinery as follows:

> "All fully developed machinery consists of three essentially different parts, the motor mechanism, the transmitting mechanism and finally, the tool or working machine. The working mechanism acts as the driving force of the mechanism as a whole. It either generates its own motive power, like the steam-engine, the caloric-engine, the electro-magnetic machine, etc., or it receives its impulse from some already existing natural force, like the water-wheel from the descent of water down an incline, the windmill from the wind, and so on. The transmitting mechanism, composed of fly-wheels, shafting, toothed wheels, pulleys, straps, ropes, bands, pinions and gearing of the most varied kinds, regulates the motion, changes its form where necessary, as for instance from linear to circular, and divides and distributes it among the working machines. These two parts of the whole mechanism are there solely to impart motion to the working machine; using this motion the working machine then seizes on the object of labour and modifies it as desired. It is this last part of the machinery, the tool or working machine, with which the industrial revolution of the eighteenth century began. And to this day it constantly serves as the starting point whenever a handicraft or a manufacture is turned into an industry carried on by machinery" (Marx, 1976: 494).

Notice that the machine seems to have been described only in relation to itself. It is the working machine which "seizes on the object of labour and modifies it". There is no mention of the worker or the interaction of the worker with the machine which seems to have a life of its own. The lack of relevance of the above conception of machinery to studying, say, electronics technology or some chemical processes is also evident.

Marx's ideas of technology were also influenced by the fact that the machines he was conceptualising were largely those that had their basis in appropriating the skills of the manufacturing period worker (except in parts of The Grundrisse where he discusses automatic factories). Thus he writes,

> "On closer examination of the working machine proper we rediscover in it as a general rule, though often in highly modified forms, the very apparatus and tools used by the handicraftsmen or manufacturing worker" (Marx, 1976: 494).
>
> "If we...look at the part of the machinery which is employed in the construction of machines, and forms the actual operating tool, we find that the manual implements re-appear, but on a Cyclopean

> scale. The operating part of the boring machine is an immence drill driven by a steam-engine...The machine lathe is only a Cyclopean reproduction of the ordinary foot-lathe; the planing machine is an iron carpenter that works on iron with the same tools as the human carpenter employs on wood; the instrument that cuts the veneer on the London wharves is a gigantic razor; the tool of the shearing machine, which shears iron as easily as a tailor's scissors cut cloth, is a monster pair of scissors; and the steam-hammer works with an ordinary hammer head, but of such a weight that even Thor himself could not wield it" (Marx, 1976: 507).

And from all this he concludes that "The machine, therefore, is a mechanism that, after being set in motion, performs with its tools the same operation as the worker formerly did with similar tools" (Marx, 1976: 495).

Thus, Marx did not conceive of the design of technology which would generate new types of skills suitable to it and which would not have any basis in appropriating the skills of the manufacturing period worker. As pointed out earlier, in the Grundrisse, Marx does envisage what he terms the "automatic system of machinery" (Marx, 1977: 692). Remarkable as they were in retrospect, his comments about automation remain speculative and offer little analytical insight into the different dimensions of automation.

Marx also seemed to have the notion that the size of machinery increases with increasing complexity:

> "An organised system of machines to which motion is communicated by the transmitting mechanism from an automatic centre is the most developed form of production by machinery. Here we have, in place of the isolated machine, a mechanical monster whose body fills whole factories, and whose demonic power, at first hidden by the slow and measured motions of its gigantic members, finally bursts forth in the fast and feverish whirl of its countless working organs" (Marx, 1976: 503).

If it is the "automatic centre" that represents "the most developed form" of production machinery, then this by itself may not imply an increase in size of the system of machines; i.e. there can be small automated systems of machines or big ones. If not, then one finds that

Marx conflates the increase in size because of increased scale of production - whereby a greater number of the same type of machines or a bigger version of the same may be used (where economies of scale exist) - with the increase in size because new machines are added as more and more operations in the factory get incorporated in machines. However, there is a distinct possibility that Marx was referring to a specific change in machinery - big steam boilers running a central rotary machine which transmitted motion via belts and wheels to a large number of machines. In such a case, Marx's statement would be true for only a particular type of development in the specific historical phase prior to the use of electric power.

Finally, there is little possibility of using Marx's conception of specific changes in machines to explain changes in organisation and control of industrial labour process at the level of individual firms or workshops and plants within them. As the above discussion shows, this is so primarily because of two reasons: one, because most of Marx's analysis is at the level of a mode of production; and two, because Marx's analysis of technology and technical change itself is limited.

To summarise, the key analytical insights of Marx into the labour process were the following: First, each labour process comprises of three elements - work, object of work and the instruments of work. Second, each labour process can be analysed from the point of view of its principles of organisation and control and that all social labour processes require a certain amount of coordination and control. Third, the social labour process under capitalism is used for the production of surplus-value. Fourth, corresponding to the two distinct phases of valorisation, two forms of production within the historical development of capitalism can be distinguished; i.e., the phases of <u>formal</u> and then

real subordination of labour under capital. And finally, in the phase of the real subordination of labour under capital, machinery revolutionizes the basis of the organisation and control of the labour process.

The shortcomings of Marx's analysis were as follows: First, there is little analytical insight offered into the possible changing needs of organisation and control of the labour process in the phase of real subordination of labour under capital. Second, Marx's conception of technology and technical change are analytically limited and consequently they may have little value in analysing the labour process in advanced stages of capitalism. And third, since Marx limits most of his analysis to the level of a mode of production, his categories of analysis may not provide the same insights when analysing specific labour processes in different industrial sectors of a capitalist economy.

Between Marx and the 'de-skilling' theorists:

After the work of Marx, there was a long gap in Marxist analyses of labour processes and the division of labour in production.

In the Soviet Union, after the October Revolution, there were attempts to use principles of "scientific management" with Lenin himself recommending the use of Taylorism (Lenin, 1965: 257-9). This and the research on the use of Taylorist principles carried out by Alexei Gastev at the Central Labour Institute in Moscow (Bailes, 1977: 373-94) represented a relegation to the background of the insights of Marx into the capitalist labour process[7]. Taylorist principles of organisation and

7. Lenin's acceptance of Taylorist "rationalisation" of production was linked with his endorsement after the Revolution of "a stage of state capitalism that amounted to trustification under proletarian auspices" (Maier, 1970: 50). For details of development of this thesis and its links with post-war German Social-Democratic ideas of planning, see Maier's (1970) excellent article.

control of the social labour process were not seen as both products and producers of social relations specific to the capitalist labour process. This retrogression in Marxist insights was equally true of the views of Bukharin on technology. Bukharin was criticised by Lukacs (1966: 29-31) both for equating technology with the forces of production in society and for his technologically deterministic view of social relations. These studies did not contribute in any way to either a better understanding of organisation and control of the social labour processes in general or to understanding factors that influence the capitalist labour process specifically.

It is only in the work of Antonio Gramsci (1971) that some interesting insights are offered into both Taylorism and "Fordism". The latter, Gramsci pointed out, was an attempt to create stability in production through a combination of high wages and tight controls over how the workers spent their wages. Thus, Gramsci pointed to the use of non-workplace intervention in order to increase control at the workplace. However, he did not develop any analytical framework for studying the organisation and control of work on the shopfloor.

In general, therefore, it seems that after Marx a proper analysis of the labour process and the division of labour in production dropped from Marxist analysis. While Lenin did not seem to have grasped the significance of Taylorism and its use, Bukharin misconceived the role of technology. It was only in the work of Gramsci that some new insights into changes in the organisation and control of the capitalist labour process were offered. These comments, unique as they were, nonetheless remained at a very general level and did not lead to any kind of renewed interest amongst Marxists for studying the capitalist labour process.

3. THE 'DE-SKILLING' THEORISTS AND BEYOND

After Marx, the major contribution to the study of the capitalist labour process has been made by the 'de-skilling' theorists. Though some French sociologists, like Friedmann, Naville and Touraine[8] had written about skill changes in the capitalist labour process in the late nineteen fifties and early sixties, they arrived at conflicting conclusions about the impact of technology on skills of workers. It was only after the intervention of Braverman[9] (1974), that an unprecedented resurgence of labour process studies in Marxist frameworks suddenly took place. Along with the work of Braverman, another contribution that has provided the theoretical underpinnings for the 'de-skilling' hypothesis in the development of the capitalist labour process has been that of Gorz (1972; 1976). These two contributions have been taken up here for analysis.

Braverman and 'de-skilling':

Braverman, like Marx, argues that the capitalist labour process represents a unity of the labour process and the valorisation process. And he puts forward the explicit aim of his work as the consideration of "the manner in which the labour process is shaped and dominated by the accumulation of capital" (1974: 53). The following discussion examines whether he adheres to this perspective or not.

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8. For a discussion of the work of French sociologists on division of labour, see Rose (1974). See also Friedmann (1955 and 1961) and Touraine (1962). Their work, however, does not seem to have had any significant impact on British or American Marxists.

9. The extent of enthusiasm amongst Marxists at Braverman's intervention can be judged from the reviews of his book. See, for example, Heilbroner, 1975; Young, 1976; Schwarz 1977; Davies and Broadhead, 1975; Lazonick, 1977; and Coombs, 1978, to pick a few.

Though formerly a craft-worker himself - having worked as a pipefitter and sheet metal worker among other jobs - Braverman denies having any romantic notions about craftwork (1974: 6). However, as will become evident, the conception of an "ideal" worker - a craftsman who has both a complete knowledge about and control over a job - is very crucial to understanding Braverman's notion of 'de-skilling'.

Braverman traces the origins of 'de-skilling' to the division of labour in manufacturing, where the constituent operations of a labour process were first separated and assigned to different workers. By dividing a production process into separate operations, capitalists fragment knowledge about the process. In assigning these fragmented jobs to different workers the capitalist "dismembers" the workers because "in destroying craft as a process under the control of the worker, he reconstitutes it as a process under his own control" (Braverman, 1974: 78). The former cheapens labour as a commodity and the latter transfers control over various steps of the labour process to the capitalist.

These tendencies of capital, according to Braverman, ultimately found their most coherent expression in the Taylorist conception of "scientific management" which provided the dominant framework for the organisation of the capitalist labour process in the twentieth century (see, Littler, 1978, for a critical analysis of Braverman's view of Taylorism).

Braverman summarises the three major principles of Taylorism as follows. The first of these is the principle of 'dissociation' through which the "labour process is rendered independent of craft, tradition, and the workers' knowledge" (1974: 112-3) and comes to depend instead on the practices of management. The second principle concerns the separation of a task's conception from its execution -

which enables capital to force upon the workers its own methodological efficiency. The third principle of Taylorism is the use of the monopoly over knowledge, which the first two principles grant to the agents of capital, to control each step of the labour process and its mode of execution.

Braverman points out that the organisation of the labour process according to simplified tasks, conceived and controlled by the managers, has "a clearly degrading effect upon the technical capacity of the worker (1974: 127) when compared to craft form of labour. And as the capitalist advance takes place, even though there are,

> "short term trends opening up the way for the advancement of some workers in rapidly growing industries, together with the ever lower skill requirements characteristic at entry level where large masses of workers are being put to work in industrial, official and marketing processes for the first time, (these) simply mask the secular trend towards the incessant lowering of the working class as a whole below its previous levels of skill and labour. As this continues over several generations, the very standards by which the trend is judged become imperceptibly altered and the meaning of "skill" itself degraded" (Braverman, 1974: 129-30).

As for the argument that scientific and technological innovations tend to increase "average skill", Braverman points out that the tendency is not towards "averaging" but towards "polarisation". Braverman claims that this happens both because of an "absolute" fall in skill levels, as workers lose their craft skills, and a "relative" fall in skills as "more science is incorporated into the labour process" (1974: 423).

In relating the incorporation of science and technology in the labour process to skills of workers, Braverman uses certain notions of technical change. He rejects what he calls the "scattergun approaches" of sociologists like Woodward (1965) and Blauner (1967) in conceptualising technology (see next chapter) to take up the seventeen levels of mechanisation developed by Bright (1966). Bright developed his scheme

of studying technical change to analyse the ways in which machines supplemented human labour. Like Marx, Bright (and hence, Braverman) too equated technology with engineering machinery.

Using this view, Braverman puts the relationship between the worker and the means of production in focus in trying to study technical change. He sees the development of machinery as a method of divesting control from the workers. Thus, he points out:

> "The capacity of humans to control the labor process through machinery is seized upon by management from the beginning of capitalism as the prime means whereby production may be controlled not by the direct producers but by the owners and representatives of capital. Thus, in addition to its technical function of increasing the productivity of labor - which would be a mark of machinery under any social system - machinery also has in the capitalist system the function of divesting the mass of workers of their control over their own labor" (Braverman, 1974: 193).

Bright's seventeen levels of mechanisation, then, are supposed to represent the various stages in the process of divesting the workers of their control over the instruments of labour (see Table 1). The three elements that Bright has tried to combine in one single scale are: the source of control, type of machine response, and the power source. It is these three elements that structure the whole scale, starting at the level of source of control and going up to differentiate the levels of mechanisation in terms of the type of machine response and power source (Bell, 1972: 59).

Bell (1972) points out that Bright's scale does not take into account technical characteristics concerned with the differences of the handling functions in production. Within the category of mechanisation of control, Bell argues for analysing the different elements of the control cycle (e.g. input and the feedback elements). Failure to do this, he points out, would result, for example, in a manually controlled centre-lathe equipped with a digital readout device being classified as both level 4 and level 9 on Bright's scale.

Table 1: Levels of Mechanisation and their relationship to power and control sources - the scheme put forward by Bright

Iniating control source	Type of Machine Response		Power Source	Level Number	Level of Mechanisation
From a Variable in the Environment	Responds with Action	Modifies own action over a wide range of variation	Mechanical (Non Manual)	17	Anticipates action required and adjusts to provide it
				16	Corrects performance while operating
				15	Corrects performance after operating
		Selects from a limited range of possible pre-fixed actions		14	Identifies and selects appropriate set of actions
				13	Segregates or rejects according to measurement
				12	Changes speed, position, direction according to measurement signal
	Responds with Signal			11	Records performance
				10	Signals preselected values of measurement (includes error detection)
				9	Measures characteristic of work
From a control mechanism that directs a pre-determined pattern of action	Fixed within the Machine			8	Actuated by introduction of work piece of material
				7	Power tool system, remote controlled
				6	Power tool, program control (sequence of fixed functions)
				5	Power tool, fixed cycle (single function)
From Man	Variable			4	Power tool, hand control
				3	Powered hand tool
			Manual	2	Hand tool
				1	Hand

Source: Bright, 1966: 210.

Thus, it can be seen that Braverman's conception of technical change was like Bright's - limited and incomplete. It is only in the work of Martin Bell (1972) that some of these problems are sorted out (see next chapter).

Braverman uses two case studies to support his hypothesis of technical change leading to 'de-skilling'. He takes the cases of machine shops where numerically controlled machines had been introduced and of clerical work where the introduction of new office technology was also fragmenting jobs. In the first case he tries to show that the introduction of numerically controlled machines 'de-skilled' the job of skilled machinists. In the second case, he attempts to show that clerical work, which at one time represented a total occupation was being fragmented using both the principles of "scientific management" and new machinery.

To summarise then, the key aspects of Braverman's description of 'de-skilling' are the following. (1) Though Braverman tries to locate the dynamic of changes in the labour process in the needs of capital accumulation, he equates the accumulation strategy of capital with degradation of skills of workers. (2) Taking "skill" to mean a unity of knowledge about and control of the worker over the job, Braverman makes a distinction between two different aspects of 'de-skilling': As a degradation of the craft tradition leading to a fall in skills in an <u>absolute</u> sense, and second, 'de-skilling' as a fall in skills in a <u>relative</u> sense; i.e. a process by which less and less skills are required on part of the workers as more and more scientific and technological innovations are incorporated into the labour process. (3) Braverman posits a secular trend towards 'de-skilling' at the levels of individuals, occupations, and the working class as a whole. (4) Though Braverman

tries to explicate the nature of technical change and its links with the labour process, in using Bright's classification he conflates different dimensions of technical change on to a single scale. And lastly, Braverman seems to see the advance of capitalism as the advancing hegemony of capital over labour. His framework of analysis does not consider the possibility of effective and continuing resistance by workers to the accumulation strategies of capital.

Gorz and 'de-skilling':

The 'de-skilling' thesis is also to be found in the work of Andre Gorz (1972 and 1978). According to Gorz, the whole history of the technological development under capitalism can be seen as the history of the "dequalification" of workers. Gorz does not see this as a linear process because "at the beginning of each technical revolution it seems partially inverted" (Gorz, 1978: 57). New skills are created but they are soon decomposed into "subspecialisations" which do not offer any autonomy to the workers, with control over the production process having been transferred to non-workers or managers. While Gorz sees mechanisation fragmenting the jobs of workers he sees automation as fragmenting the control functions of supervisors, too. However, unlike Braverman, he does not attempt to provide any framework for analysing technical change.

He also recognises the possibility of the partial inversion of the "dequalification" process - job enrichment programmes, creation of autonomous work groups, etc. Thus Gorz says:

"Capital encounters a fundamental contradiction stemming from the fact that, step by step with the dequalification of work, there is an increased social qualification of workers and a social disqualification (or devaluation) of all work as a productive force" (Gorz, 1978: 57).

When the "rigorous predetermination of tasks turn against its authors" and productivity drops, the agents of capital are forced to consider redecomposition and enrichment of jobs (Gorz, 1978:57). It must be noted here that these tendencies hardly find any place or are summarily dismissed in Braverman's analysis (Braverman, 1974: 39).

Gorz, unlike Braverman once again, also considers workers' initiatives in bringing about changes in the labour process. Though Gorz does not specify exactly what he means by "social qualification" of workers, it is clear that he does not have increased educational qualification of the workers in mind but something like the growth of a counter-culture among the workers as a result of their explicit recognition of the exploitative nature of the capitalist labour process.

Thus, what Gorz has to say about the tendencies of "dequalification" in the capitalist labour process can be summarised as follows: (1) Even though, unlike Braverman, Gorz's concept of "dequalification"/ 'de-skilling' is not based on the conception of an idealised craftsman, he, like Braverman, also takes it to mean an erosion in the worker's knowlege about and control over the job. He too relates it to technical change but, unlike Braverman, says nothing about how exactly technical change is linked with the labour process. (2) Gorz deals with two distinct concepts - "dequalification" and "disqualification" of work under capitalism. The first refers to the erosion of knowledge and control over the labour process experienced by workers, and the latter refers to the meaninglessness of all work under capitalism. (3) Unlike Braverman, Gorz does see counter tendencies to 'de-skilling'. These, Gorz recognizes, may be either the result of managerial initiative or due to working class initiative or resistance to the capitalist labour process.

'De-skilling' and the framework of Marx:

Having thus summarised the views of the two major theorists of 'de-skilling', one might wonder whether they offer any greater analytical insights than Marx himself. To understand the meaning of the concept of 'de-skilling', at this point the distinction Marx made between the formal and real subordination of labour under capital has to be kept in mind. What Braverman refers to as the "absolute" fall in skills because of the destruction of the craft tradition can then be understood as the transition from the formal to real subordination of the labour process under capital (see, Brighton Labour Process Group[10], 1977; Elger, 1978; and Aronowitz, 1978). But even then it is a problematic concept because the development of real subordination of labour under capital may not necessarily reduce skills in a linear sense. It can by-pass established craft skills, destroy them with other forms of organisation of labour or even incorporate them in modified forms in a totally transformed organisation of the labour process (Elger, 1979). In fact, as Elger points out, there is enough evidence to show that by making skilled craftsmen intermediaries and preserving their skills, real subordination of labour under capital can actually increase (Foster, 1974; and Elger, 1979).

The only reason why Braverman is able to put forward his thesis of an "absolute" fall in skills is because of his conception of ideal workers as craftsmen who had complete knowledge and control over their jobs. The erosion in this ideal conception because of the development of real subordination of labour under capital is seen as 'de-skilling' in an absolute sense. Such an absolute measure of skill is quite meaningless because the position of craft workers is a transitional one and specific to a particular form of production under capitalism.

10. Cutler (1978), rejects the framework of Braverman as well as that of the Brighton Labour Process group. Cutler's criticisms, however, also arise from his rejection of the labour theory of value.

In the phase of real subordination of labour under capital, the introduction of machinery may affect the jobs workers do in a variety of ways. It may fragment jobs by building in some operations in the machines themselves. By the same process it may eliminate some jobs. And it may create new jobs suitable to its own skill requirements. From none of these changes can the 'de-skilling' argument be derived in advance - either at the level of individual workers, industrial sectors or the working class as a whole.

If the capitalist labour process represents a fundamental conflict of interests between labour and capital then depending upon the changing nature of their relationship, the strategies of capital to subordinate the labour process to its aims would also change. These strategies would also be contingent upon the market and non-market factors that influence the process of capital accumulation. In such a perspective, it would be impossible to posit in advance any secular tendencies of 'de-skilling' because of technical change.

Empirical evidence and 'de-skilling':

There is also a growing body of evidence which questions the analytical value of the 'de-skilling' hypothesis (see, for example, some articles in Zimbalist, 1979; Wood, 1982). Given the fact that this study is primarily concerned with the engineering industry and that Braverman took the case of mechanisation of machine shops to support his hypothesis, the studies of Bell and Tapp (1972), Noble (1979) and Jones (1982) are of particular importance.

Bell and Tapp (1972) in a report prepared for the Engineering Industry Training Board in Britain on automation and employment structure in machine shops, analysed the possible impact of introduction of numerically controlled machines on skill levels. They showed that in firms

with smaller installations of numerically controlled (NC) machines, there was a persistence of "craft-trained" workers at a level higher than would be expected given the nature of work on NC machines. They attributed this, in the case of small installations, to the following factors: Union pressure to prevent de-skilling; the management not being very concerned to investigate the possibilities of employing less skilled workers on NC machines; and manning levels on these small set of machines being determined by existing manning patterns on the majority of conventional machines on the shop floor. They concluded that NC machines did not require a particular employment pattern. In drawing this conclusion from their data, they emphasised that there are other factors than automation that help in determining the skill levels of workers. However, they also added[11] that once the shortage of "engineering craftsmen and apprentice trainees" in Britain is taken into account along with greater demand for craft-trained workers to carry out functions off the shop-floor, they thought that "the future skill structure of employment on NC in the long term is likely to be increasingly less skill intensive" (Bell and Tapp, 1972: 111). Thus, Bell and Tapp's study, by making a distinction between small and large installations of NC machines, and by pointing to other technical as well as non-technical factors that might influence the distribution of skills in jobs, throw doubts over Braverman's unequivocal hypothesis of all kinds of automation leading to 'de-skilling'.

Noble (1979) studied the introduction of NC machines but from the perspective of managerial motives for introduction of NC machines and workers' resistance to managerial attempts to increase control through

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11. Jones (1982: 198) tends to overstate the conclusions of Bell and Tapp (1972) by not pointing out that for large installation of NC machines, Bell and Tapp (1972) actually think that skill levels would go down.

this process. He analysed the historical development of NC machines and the reasons for the development of NC machines while alternative production methods like "record playback" were already available. He found that even though managers initially believed that the introduction of NC machines would remove control of the workers over their jobs, tape-times for NC machines would lead to better monitoring of job performance and that tape-times could be used to set base rates for piece-work, their aims were not quite realised. One reason for this was the unreliability of machinery necessitated the use of operators who knew what they were doing. Furthermore, because workers resisted the lowering of grades through stoppages and strikes. And finally, tape-times could not be used for pacing work as the need for human intervention implied that tapes could not force feed and speed of machines to determine rates of production. Thus, even though Noble (1979) does not deny the motivation of managements to divest workers of control over their jobs, his analysis shows that aims of the managers cannot be equated with the results of their attempts to control the labour process. And in showing this, he provides empirical evidence that casts doubts on the 'de-skilling' hypothesis.

The study of Jones (1982) also contradicts the 'de-skilling' hypothesis by taking the example of the introduction of NC machines in British engineering industry. Jones shows that in his sample, there were enough variations amongst firms to show that product and labour markets, the structure of individual organisations and the positions taken up by trade unions were independent influences on skill deployment. He also concluded that there was nothing inherent in the hardware of NC or its conception that would necessarily lead to 'de-skilling' (Jones, 1982: 198). Jones makes it clear that he is not suggesting that the

influence of the factors he had identified was random, but only that his evidence showed that their influence on skill levels varied from one firm to another. And he argues that because this is likely to be so even across industries, no process of general reduction in skill could be said to be taking place.

Thus it can be seen that not only are there theoretical problems associated with the concept of 'de-skilling', but that empirical evidence in one of the main cases taken by Braverman also seems to cast doubts upon its over-simplistic formulation as the defining characteristic of the labour process under capitalism. Two theorists who have tried to go beyond the analysis of Braverman are now considered.

Theories of managerial control - Friedman:

Questioning Braverman's analysis of the capitalist labour process as being controlled through the 'de-skilling' of workers, Friedman (1977) has put forward an alternative analysis of managerial control over the labour process under capitalism.

Friedman argues that around the end of the nineteenth century the capitalist mode of production entered the phase of monopoly capitalism. Monopoly power allowed the top managers in these firms a certain amount of discretionary power. Firstly, they could pursue goals other than that of profit-maximisation as they may choose to maximise growth, or sales, or staff functions, or some combination of these. Secondly, they may satisfice rather than maximise in the pursuit of their goals. Thirdly, top managers in these firms could afford to make mistakes and go on making mistakes for a considerable period of time while still surviving in the market. And finally, it became possible for top managers to choose different routes to reach their goals, e.g. they could sacrifice short-run profits in order to increase profitability later on.

Thus, according to Friedman, in the phase of monopoly capitalism, considerable attention needs to be paid "to types of managerial strategies for dealing with suppliers, with customers, and particularly with workers whose organisational strength for resisting managerial initiatives increased significantly during the transition to monopoly capitalism" (Friedman, 1977: 26).

In analysing worker resistance to managerial control strategies, Friedman points out that it must be seen as a force which affects the capitalist development rather than simply a force which may eventually result in the destruction of the capitalist mode of production. The manner in which worker resistance gets accommodated, according to Friedman, would depend upon the form of the resistance. Worker resistance could be individualistic or collective and collective resistance may be further subdivided into organised and spontaneous collective assistance. Collective and individual forms of resistance co-exist in firms and may either be complementary or alternatives.

Friedman points out that there are two analytically separable aspects of managerial authority over workers that must be kept in mind: "First, top managers try to mould labour power to fit in with the changes in overall organisation or techniques more or less dictated by market conditions. Second, top managers try to subdue or limit workers' independent control over their actions once particular tasks have been assigned or general orders given" (Friedman, 1977: 78).

There are two major types of strategies which top managers use to exercise authority over workers - "Responsible Autonomy" and "Direct Control". The responsible autonomy strategy attempts to harness the adaptability of labour power by giving workers a certain degree of freedom and responsibility and encouraging them to adapt to changing

situations in a manner that is beneficial to the firm. The control strategy, on the other hand, tries to master the 'variability of labour power' through coercive threats, close supervision and by minimising individual worker responsibility.

Friedman claims that the responsible autonomy strategy is used with privileged workers in the firm while the direct control strategy is used against the rest of the workers. Friedman views Taylorism as an advanced form of direct control through the division of labour. But he points out that the direct control strategy is limited in its scope because by removing any intrinsic interests the workers may have had in the work they perform, it increases dissatisfaction among workers. The responsible autonomy strategy is designed to combat the undesirable effects of the direct control strategy. But responsible autonomy strategy is also limited in its scope because ideally its aim is to have workers behave as if they were partners in a process which reflects their own needs, abilities, and wills, rather than a labour process whose primary aim is the accumulation of capital. This contradiction of the responsible autonomy strategy becomes apparent when its ideal is approached and when at the same time market conditions are depressed and managers have to lay-off some workers. Managers then try to overcome this contradiction by dividing workers in the firm into those who are central to the operations of the firm and those who are peripheral. Peripheral workers would then be laid off while central workers would be retained.

Central workers, according to Friedman, are those who because of their skills or because of their contribution to the exercise of managerial authority are essential for securing long term profits for the firm. Or they may be highly organised groups of workers who because of the strength of their resistance force managers to regard them as essential. Peripheral workers are those who perform tasks that can be

easily performed by the remaining workers if they were to be laid off in slack periods, are easily replaceable if need be, would not cause disruption among remaining workers when laid off because of lack of solidarity with them, and finally, do not contribute to the maintenance of managerial authority. Friedman points out that workers may be peripheral not only at the level of the firm but also at the level of a particular industry because they may work for a peripheral firm within that industry (Friedman, 1977: 114-5). While the responsible autonomy strategy is more likely to be used with central workers, managers would use direct control strategy with peripheral workers.

On the notions of workers' control, Friedman briefly points out that in an absolute sense, unless capitalist relations of production are changed, workers' control has no meaning. Even if the notion of workers' control is used in a relative sense, Friedman points out that its meaning is complicated by the desire to identify 'progressive' changes from the workers' point of view. He points out that changes initiated by the workers are more likely to be controlled by them in their detailed implementations and would weaken overall managerial control. However, when such changes are initiated by managers, then by loosening direct control over worker activity to reduce their resistance, they may actually increase the overall control of the production process.

This briefly is the framework that Friedman puts forward to analyse the labour process under capitalism. There are many methodological problems associated with Friedman's analytical framework, and these are discussed in the following section.

Critical assessment of Friedman's methodology:

First, if the model of behaviour of capitalist firms put forward by Friedman is taken up, it becomes clear that it represents a mixture of competing theories of corporate behaviour. Friedman takes up the "satisficing" theory of the firm put forward by Simon (1959 and 1964), Cyert and March (1963), the sales maximisation theory of Baumol (1967; Baumol and Stuart, 1971) managerial utility maximisation theory of Williamson (1967), and Marris's (1971) dynamic theory of maximising the rate of growth, mixes them up and puts them forward as the behaviour of large firms under monopoly capitalism. These theories are to a large extent competing theories of corporate behaviour and except for the theories of Baumol and Williamson (which are applicable only to oligopolistic firms), they have been put forward as general theories of corporate behaviour.

All these theories are behavioural theories of the firm which try to take into account notions of uncertainty in a firm's environment as well as the internal decision-making processes in organisations - two factors that were absent from the neo-classical theory of profit-maximising behaviour of firms. However, none of these theories says anything about the labour process in firms. In fact, nothing specific about the increased discretionary power of managers in firms is derivable from these theories. The "satisficing" theory of the firm emphasises the "uncertainty" associated with the decision making processes within a firm rather than increased discretionary power of managers. The other managerial theories of the firm, either the maximisation of sales revenue in the long run subject to a minimum level of profit (Baumol, 1967 and Baumol and Stewart 1971), or maximising the rate of growth of the firm subject to minimum rate of profit (Marris, 1971), or Williamson's

managerial discretion theory (based on the assumption that managers conduct the affairs of the firm so as to attend to their own best interests with the constraint of positive discretionary profit) do not have specific implications for managerial control strategies at the workplace.

If Friedman accepts the categorisation of Baran and Sweezy (1966) of Monopoly Capitalism, which he does with a few reservations, then he should have noted the rejection of behavioural theories of the firm by them within the first few pages of their book. Their rejection of these theories was based on the ideological uses these theories were being put to, i.e. creation of the image of the 'soulful corporation' (Baran and Sweezy 1973: 33-40). They showed a marked preference for James Early's description of corporate behaviour which he presented at the annual meeting of the American Economic Association in 1956 as a critique of Herbert Simon's theory of corporate behaviour. Early tried to demonstrate that the big corporation, if not more profit oriented than the individual entrepreneur, is at any rate better equipped to pursue a policy of profit-maximisation (Baran and Sweezy, 1973: 40). As for those theories that place primacy on managerial motivations, Baran and Sweezy point out that it is the "character of the system that determines the psychology of its members, not vice versa" (Baran and Sweezy, 1973: 53).

From the argument of greater discretionary power of managers, Friedman puts forward two strategies of controlling the workers in big firms. But in contrast he has little to say about managerial control strategies in small firms. However, let us see if they can be derived from his analysis at all. The two groups of workers Friedman defines as central and peripheral workers can be defined in small firms too - as Friedman points out the peripheral workers in these firms are peripheral

on two accounts of the firm and the industry. If this is true, then the corresponding control strategies - responsible autonomy (applicable to central workers) and direct control (applicable to peripheral workers) - would exist in small firms too. If so, then discretionary powers in controlling workers would also have to be ascribed to managers in small firms. In such a case then the initial assumption of monopoly capitalism making greater managerial discretion possible only in big firms would be quite superfluous.

More importantly, Friedman also ignores the fact that in peripheral firms it may well be possible to have control exercised via the labour market and not so much by managers. In general, Friedman does not consider the possibility that control of the labour process may be achieved by managers using strategies constituted in terms of non-workplace factors (see, Littler and Salaman, 1982: 264).

Basically the two types of strategies of control mentioned by Friedman and the two additional categories he defines in terms of the first two - that of central and peripheral workers in a firm - are analytically limited because of the lack of distinction between these two sets of categories.

As far as the role of technology is concerned, Friedman has no analysis of how changes in technology could specifically be related to the managerial strategies in operation. This is so because he has no framework to relate technical change with the organisation and control over the labour process.

And lastly, Friedman also assumes that managerial control strategies are always distinguishable from other managerial decisions like levels and areas of investment, types of products and raw material, marketing strategies, etc. (Littler and Salaman, 1982: 265).

Edwards and the "contested terrain":

Another analysis of the capitalist labour process that has some parallels with Friedman's work is that of Richard Edwards (1979). Edwards, like Friedman, tries to classify the managerial strategies of control open to capitalist managers into a fixed set of categories.

Defining "control" as the ability of capitalists and their managers to obtain desired work behaviour from workers, Edwards lists the three basic elements of any system of control as: direction, evaluation and discipline. Through the first mechanism, employers specify the sequence, precision and the time required for the performance of work. Through the mechanism of evaluation, employers supervise and evaluate the work being performed and identify individual workers or groups of workers with unsatisfactory performance. And through the mechanism of discipline, employers punish and reward workers in order to elicit cooperation and enforce compliance with the aims of capital.

Edwards sees the changes in systems of control in firms being caused by changes in the firm's size, operations, environment, and the resistance of workers to the goals set by managers/owners of the firm. Edwards delineates three different forms of control in the history of the capitalist mode of production: Simple control, technical control, and bureaucratic control.

Simple control, according to Edwards, may take the form of entrepreneural or hierarchical control. It existed initially in the form of entrepreneural control in firms where the personal power and authority of the capitalist constituted the primary mechanism of control. However, simple control took the form of hierarchical control with the growth in the size of the firm. According to Edwards, hierarchical control was based on the concept that each foreman, supervisor, or manager, would recreate within his shop the situation of the capitalist under

entrepreneural control. Though this form of control was not adequate to deal with the problems of management that developed along with the advance of capitalism, Edwards points out, it continues to exist in peripheral firms even today.

The crisis of simple control, according to Edwards, was precipitated by further increase in the size of the workforce and the rising socialist challenge to capitalist hegemony[12] (Edwards, 1979: 36, 56-57). Capitalists sought to solve the crisis of simple control through the imposition of technical control. Technical control, which is embedded in the technology of the firm, emerges, according to Edwards, only when the entire production process of the firm or large segments of it are designed to pace and direct the labour process. According to Edwards, one of the effects of technical control was that it spread workplace conflicts into broader and ultimately more dangerous plantwise struggles. This happened along with the rapid unionisation of the workers in the 1930s in the USA.

From the need of accommodation of unions arose another form of control - bureaucratic control. However, Edwards adds that in the new areas of investment, "The South and the Third World, for example - technical control remains a first principle of factory organisation" (Edwards, 1979: 129). While technical control is based on the physical and technical structure of production, bureaucratic control is embedded in the social and organisational structure of the firm and built into job categories, work rules, promotion procedures, discipline, wage scales, etc. Bureaucratic control institutionalises hierarchical power in the firm and establishes the force of "company rules" as the basis for control. While technical control, according to Edwards, did not

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12. Curiously, Edwards does not directly mention the limits on productivity placed by these factors.

incorporate the elements of evaluation and discipline in it, bureaucratic control does incorporate them. While workers are evaluated in terms of their job descriptions, those evaluating the workers are also subjected to similar evaluation. It also provides structures of rewards and sanctions to discipline the workers.

But in the long run, Edwards points out, for capitalists "bureaucratic control threatens to become a pact with the devil" (Edwards, 1979: 157), which offered only temporary respite from trouble. This is so because bureaucratic control speeds up the process of converting the wage bill from a variable to a fixed cost. The employment guarantees of bureaucratic control present real threats to a firm's survival in times of crisis[13].

Edwards also relates the various forms of control in firms to the analysis of labour market segments. He defines three types of labour markets: The secondary, the subordinate primary, and the independent primary labour market. The secondary labour market (see also Piore, 1969 and 1975) contains low-paying jobs of casual labour, jobs that provide little employment security, dead-end jobs with little opportunity for promotions and which are likely to require low skills. The subordinate primary market jobs involve long-term stable work with promotions prospects and some job-security. The jobs in this market are usually distinguishable from secondary market jobs by the presence of unions. In the independent primary market, the jobs offer stable employment with job security, established patterns of career progression and relatively high pay. But it contains jobs involving firm-specific skills requiring relatively high levels of training, jobs not based on operating machinery, jobs with greater autonomy, and career ladders that imply movement across firms. These jobs span both blue collar and white collar work.

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13. Edwards ignores the fact that in times of crisis firms do sack workers!

From this analysis of labour market segmentation, Edwards goes on to assert that "the fundamental basis for division into three segments is to be found in the workplace" (Edwards, 1979: 178). While simple control leads to secondary types of employment, technical control leads to subordinate primary market type of employment, and bureaucratic control moves the firm towards primary market employment patterns. Carrying his analysis further, Edwards defines three fractions of the working class - the 'working poor', the 'traditional proletariat', and the 'middle layers'. The workers in each of the fractions, according to Edwards, can be identified with the labour market segments - the first fraction comes from the secondary labour market, and the other two from the subordinate primary and independent primary labour markets, respectively.

Finally, Edwards points out that while the "market segment fractions" of the working class are solely derived from the analysis of the capitalist accumulation process, such an analysis cannot explain racial and sexual discrimination in the capitalist labour process as these divisions would require a separate analysis.

Critical assessment of Edwards' methodology:

Having thus summarised the views of Edwards, it can be seen that his analysis is marred by an attempt to fit a neat categorisation of the systems of control with the history of capitalist development. If the case of the development of technical control is taken then according to Edwards himself, it developed mainly (except in the case of textiles) from continuous flow production (Edwards, 1979: 116-7) - ranging from the "dis-assembly line" in meat-packing to the assembly lines of the car industry. But then, not all production processes can be adapted to continuous-flow production. So by its very nature such a system of

control would have been historically limited in its use. In the transition from simple to technical control, as Edwards sees it, there must have been a substantial number of firms where the production processes were not amenable to the same kind of technical change as in the assembly line industries. And these firms would have continued to use hierarchical control - a form of simple control. Edwards would be hard put to prove that either most of such firms belonged to the periphery in the earlier parts of this century or that they do so now.

One of the problems with the analysis of Edwards is that he implicitly seems to assume a linear process of historical evolution of the various forms of control. But such an assumption is not without problems as the above criticism of evolution of technical control shows. Similar criticism can be made once again of Edwards' analysis of bureaucratic control . According to Edwards, bureaucratic control arose out of an attempt to resolve the contradictions of technical control. But the non-assembly line industries have also adopted systems of bureaucratic control. In their case then, bureaucratic control would seem to have evolved out of simple control.

By not considering explicitly the possibility of a firm's having more than one system of control within it, Edwards also seems to assume one type of labour market for each firm. Perhaps this too is an over-simplification. Given the diversity of jobs in modern firms, it seems more than likely that firms would tend to hire from more than one labour market depending upon the nature of the job. The activities of a single firm may be so diverse as to include the use of more than one type of production system - say, unit production and continuous flow production - so that it may become necessary to use a set of control systems to deal with various groups of workers.

Within bureaucratic control too there may be differentiation - depending, for example, on the type of job classification used. The possibility of workers using job descriptions to restrict work would depend upon whether only key-tasks or all the constituent tasks of a job are specified in the job description. Thus, one type of bureaucratic control system may be more efficient than another from the point of view of the employers.

As far as the attempts of Edwards at defining three fractions of the working class are concerned, he assumes that everyone in the labour market belongs to the working class - without ever specifying what he means by the working class in his analysis (Nichols, 1981: 154).

Though Edwards realises that sources of control of the labour process may actually emanate from outside it also; i.e. inasmuch as he identifies racial and sexual discrimination in the labour process, he is not able to relate this insight with his analysis. Thus, he too limits the view of the "contested terrain" to the workplace.

4. FOUCAULT AND THE NETWORKS OF DISCIPLINARY POWER

Another theorist whose analysis of the constituent elements of disciplinary control has direct relevance to the study of the capitalist labour process under capitalism is Michel Foucault (1979). While Friedman and Edwards have tried to theorise about the capitalist labour process specifically, Foucault has put forward a general theory of the growth of disciplinary power. Not only is Foucault's conception of disciplinary power quite different from that of both these theorists, his analysis of the constituent elements of exercise of disciplinary power also goes quite beyond that of Edwards who specifies only three elements of control. However, it must be pointed out here that Foucault's

problematic was quite different from that of Edwards'. But even though Foucault theorises about disciplinary power in general, his analysis of it can be used to provide interesting insights into disciplinary control exercised within the labour process under capitalism.

Nature of disciplinary power:

Foucault does not view disciplinary power as being possessed by a dominant class and exercised over a passive, dominated class. He claims that power is neither unitary nor its exercise binary. It cannot be reduced either to its functions or to its possession by a particular class (see, Fine, 1979: 76). Disciplinary power, according to Foucault is not exercised merely as a "repressive" form of power. That, he points out, is only the "terminal" or "repressive" form of disciplinary power. Disciplinary power exists as an infinitely complex network of power relations that permeate every aspect of social life.

According to Foucault, the aim of all forms of disciplinary power is to produce 'docile' bodies by increasing the forces of the human body in terms of their economic utility while at the same time diminishing them in political terms of obedience. He points out that in the late eighteenth century a general method of disciplinary power emerged in society. With the development of capitalism in this period, a great deal of attention was paid to the human body as an instrument that could be trained and manipulated so that its forces could be extracted and increased (see, Sheridan, 1980: 148). In the context of the capitalist labour process, Foucault sees the growth of disciplinary power being spurred by the increase in scale of production and the size of the workforce (Foucault, 1979: 221).

Procedures of disciplinary power:

The exercise of disciplinary power, Foucault points out, requires and develops four procedures for its implementation: (1) The distribution of individuals in space; (2) The control of their activity; (3) Accumulation of their individual times through the use of "exercise" and "training" to develop individual abilities; and (4) The composition of forces through "tactics" or combining the abilities of the individuals subjected to its control.

Disciplinary power, according to Foucault, proceeds from the distribution of individuals in space. To this end a variety of techniques are employed. "Enclosure" and "partitioning" of the disciplinary space into more or less self-contained units are two architectural techniques that can be used. "Functional sites" may be used to codify a space that could architecturally be utilised for several different purposes. While these three methods only individualise the bodies in the disciplinary space, they do not give them a fixed position in that space. This is achieved by the use of "ranks" which transforms the fragmented space into a network of operational relationships. Thus, the art of disciplinary distribution consists of creating "complex spaces that are at once architectural, functional, and hierarchical" (Foucault, 1979: 148).

The individuals subjected to disciplinary power are controlled mainly through the mechanisms of the time-table, the temporal elaboration of their activity, the correlation of body and gesture, the articulation of the body and the object of activity, and finally, through methods that ensure exhaustive use of the desired gestures and movements.

The time-table aims at establishment of systems, imposition of particular occupations, and regulation of the cycles of repetition. While the time-table provides the general framework for an activity,

through its temporal elaboration the position of the body, limbs, movements, the direction,duration and order of performance are specified. And in doing so, Foucault says, "Time penetrates the body and with it all the meticulous controls of power" (Foucault, 1979: 152).

Through the correlation of the body and the gesture, disciplinary control tries to impose the "best" relation between a gesture and the overall position of the body. The articulation of the body and the object, which involves defining all the linkages between the body and the object being manipulated is termed by Foucault "the instrumental coding of the body". And the aim of the principle of "exhaustive use" is to maintain maximum speed and efficiency of activity.

The third procedure employed for the exercise of disciplinary power is what Foucault calls the "organisation of geneses" or "accumulation of individual times". This basically means developing individual abilities to a level at which they can be appropriated for the aims of those exercising disciplinary control. To achieve this, the training of the individuals subjected to disciplinary control has to be organised according to a planned time-schedule. First of all, optimum training time before normal performance can be commenced has to be decided. Secondly, the various stages of training and the methods of progression along the successive stages have to be specified. Thirdly, the time and the criteria for evaluation at the end of each stage have to be laid down. And finally, the different training schemes for individuals with different abilities, rank, etc. have to be combined together. These mechanisms, according to Foucault, help in "accumulating" the time of individuals in a useful form.

But discipline, Foucault points out, is not only "an art of distributing bodies, of extracting time from them and accumulating it,

but of composing forces in order to obtain an efficient machine" (Foucault, 1979: 164). In this "machine", the individual body becomes an element which can be placed, moved, and articulated with other elements. Then the various elements are combined in a way so as to obtain the optimum result through the use of a precise system of commands. Foucault calls this arranging "tactics".

Through the use of the four procedures mentioned above, according to Foucault, discipline "makes" individuals because not only is it a technique of power that is exercised on individuals, but it is also exercised through them. And it is in doing so that it changes individuals subjected to it into 'docile' bodies.

The success of disciplinary power depends on hierarchical observation, normalising judgement and the combination of the two into a system of evaluation or examination. Hierarchical observation not only specifies the type of surveillance but also makes it functional.

Disciplinary power, though invisible itself, imposes a certain visibility on those subjected to it. Through examination or the evaluative procedure it reduces each individual to a 'case' and through regular observation of each individual, documents the progress of each case. It is the examination, says Foucault, which "by combining hierarchical surveillance and normalising judgement, assures the great disciplinary functions of distribution and classification, maximum extraction of forces and time, continuous genetic accumulation, optimum combination of aptitudes and, thereby, the fabrication of cellular, organic and combinatory individuality" (Foucault, 1979: 192).

Since disciplinary power exists as a network of relations, according to Foucault, its overthrow would require the formation of new relations. A simple appropriation of power by the working class or just assigning

the existing forms of power with new functions leaves the forms of power themselves untouched (see also Fine, 1979: 76).

This briefly then is a summary of the views of Foucault on disciplinary power. Before critically commenting on Foucault's analysis of disciplinary power, it may be worth looking at Table 2, where an attempt has been made to compare the procedures listed by Foucault with their approximate equivalent forms in the capitalist labour process. It can be seen that the general categories of analysis developed by Foucault have a more or less analogous relationship with various work-place and non-workplace practices that help maintain the organisation and control of the labour process under capitalism. The point to be kept in mind, however, is that the individuals entering the "network" of power relations of the capitalist labour process have already been subjected to the procedures of disciplinary power in other institutions (like the school) and still are part of power relations of some other institutions (like the family).

Critical assessment of Foucault:

While Foucault's contribution in terms of providing new analytical insights into the forms of disciplinary power cannot be denied, two basic criticisms of his analysis can still be made.

Firstly, Foucault has little to say about the development of specifically capitalist form of the social labour process as compared to pre-capitalist social labour processes. His analysis of disciplinary forms in the labour process is basically an analysis of only the developed form of the capitalist labour process. Foucault sees the origins of this form of control in the growth of large scale production and the growth of the workforce it entails (Foucault, 1979: 221). But, as Fine (1979) has pointed out, these are only effects of the development of capital

Table 2: "Deciphering" Foucault's procedures of disciplinary control

Elements of procedures of disciplinary power according to Foucault	Approximate equivalent forms in the capitalist labour process
1. Distribution of disciplinary space	
a. Enclosure	Industrial architecture
b. Partitioning	"
c. Functional sites	Workflow planning
d. Rank	Job evaluation
2. Control of activity	
a. Time-table	Work/leisure division, shift work
b. Temporal elaboration of activity	Time and motion studies
c. Correlation of body and gesture	Method studies
d. Body-object articulation	Job description
e. Exhaustive use	Intensification of labour
3. Organisation of genesis	
a. Separation of training and practice	Apprenticeship, qualification requirements
b. Planning progress of training	Technical training schemes, engineering education in schools, colleges, etc.
c. Time-schedule of training and examination procedures	
d. Combining training streams	Laying down bases for job classification
4. Composition of forces	
a. Constituting the body as an element of a multi-segmentary m/c	Structural organisation of labour under capital
b. Optimum combination of various elements	Organisation of work
c. Evolving precise systems of command	Managerial command structure

accumulation. Foucault does not make an attempt to link capital accumulation itself with forms of control within the capitalist labour process.

If one takes the case of the disciplinary procedure of control of activity (historically, Taylorist ideology being one of its most articulate forms), then the development of this procedure of control cannot be understood merely in terms of increasing scale of production. As Sohn-Rethel (1978) has pointed out, this development must be understood against the background out of which it grew. He points to the Great Depression, the falling rate of profit (felt most acutely in the heavy industries), mass unemployment in the 1880's and the organisation of unskilled and semi-skilled workers into new type of trade unions, as providing the background to the growth of Taylorist ideology. It can thus be argued that because of his failure to conceptualise the historical development of the capitalist labour process, Foucault's analysis of the development of disciplinary procedures in the labour process is limited as he cannot relate them to the specific conditions that led to their growth.

Secondly, Foucault confuses cooperation in general with the form it takes under capitalism (Fine, 1979: 89-90). Thus he fails to distinguish analytically between the principle of organisation and that of control of the labour process which was one of the major insights of Marx.

These criticisms notwithstanding, Foucault's analysis has some distinct advantages over that of various theorists, including Marx, described above. And these advantages relate to Foucault's ability in providing detailed conceptual categories to analyse the functioning of disciplinary power within the capitalist labour process. As Table 2 shows, the categories provided by Foucault would lead to far greater

insight into exercise of control within the labour process than the two categories of Friedman or the three categories of Edwards.

By pointing out that disciplinary power is not merely exercised in its "repressive" form, he points to the fact that it is not always recalcitrant individuals that are being subjected to disciplinary power all the time. And in saying that disciplinary power is not only exercised on the individuals but through them, Foucault points to the necessity of certain amount of consent for the functioning of disciplinary control (in this connection see also Littler and Salaman, 1982).

In general, Foucault's overall analysis cannot be subsumed under a Marxist framework. However, the categories of analysis he has put forward can be used to identify those aspects of control within the labour process which other theorists do not even point to.

5. CONCLUSIONS

In this chapter, the contribution of those working within a framework critical of capitalism were analysed in studying the capitalist labour process. In analysing the views of Marx, the 'de-skilling' theorists, and those who tried to put forward an analysis of managerial control strategies to control the labour process, three major gaps were found in their analyses. One, they do not provide any clear and adequate definition of technology and technical change. Two, they do not provide an adequate analysis of the relationship between technology and the organisation of work on the shopfloor. And three, both the 'de-skilling' theorists and those who categorise managerial control strategies into a limited set of categories oversimplify the functioning of managerial control at the workplace. In trying to theorise about the nature of disciplinary power in society, Foucault sets out to list the different

procedures of disciplinary power. However, he does not explicitly relate their growth to the growth of capitalism. But it is quite clear that he is analysing the developed form of the capitalist labour process and that his categories of analysis provide greater insights into the functioning of disciplinary power at the workplace than that of the other theorists. While Foucault's framework cannot be subsumed under a Marxist framework, his categories of analysis may nonetheless be used within such a framework.

Besides the theorists discussed in this chapter, attempts at analysing the factors that influence structure of organisations and the forms of organisation of work within them have also been made in Organisation Theory. In the next chapter, the contributions of some of the relevant theorists of this tradition are examined to take into account the insights offered by their analyses.

CHAPTER 3

TECHNOLOGY AND STRUCTURE OF ORGANISATIONS: THE ORGANISATIONAL THEORISTS

1. INTRODUCTION

The last chapter examined the contribution of those working within a framework critical of capitalism to analysing the structure of the capitalist labour process. It was pointed out that one of the major gaps in these studies was their inadequate conceptualisation of technology, technical change and their relation to organisation and control of the labour process.

Questions related to technology and the manner in which it interacts with organisation of work have also been posed in the area of Organisation Theory. In this chapter, some of the relevant contributions of organisational theorists have been examined in order to analyse the insights they provide into the factors that influence organisation of work.

It would be difficult, if not impossible to summarise the views of all those organisational theorists who have written about industrial organisations. Indeed, such an exercise could be quite unfruitful, given the fact that this study focuses only on studying changes in labour processes in industrial organisations. So only those studies have been selected for critical examination where explicit attempts have been made to link the technology of an organisation to its structure - and more specifically, where emphasis has been put on the implications of technology and technical change for the organisation of work on the shopfloor.

The discussion of technology and organisations in this chapter has been divided into two sections. In the first section, the contributions of those organisational theorists who have theorised about technology and organisations in general have been examined. The second section of the chapter deals with those studies that have focussed more specifically on understanding the relationship between production technology and the immediate division of labour on the shopfloor.

The first section begins with a brief discussion of the two extreme views of the relationship between technology and organisations - the views of Williamson as espoused in his book "Markets and Hierarchies" where no links are seen to exist between the two and the views of Kerr et al. as presented in "Industrialism and Industrial Man" where technology is seen as necessarily leading to hierarchical structure of organisations. This is followed by a detailed analysis of the contributions of the contingency theorists (concentrating on Woodward, Perrow and Thompson) and the researchers of the Aston Programme (Pugh and Hickson). It is shown that while the contingency theorists do identify different dimensions of technology, with the exception of Woodward (1965) they do not limit their definition of technology and organisations only to industrial organisations. This was so because they were not specifically concerned with the articulation of technology and the organisation of work on the shopfloor but only with interaction of technology with the structure of the organisation as a whole. The Aston researchers differentiated between the various aspects of technology identified by the contingency theorists. However, in relating the shopfloor organisation of work to work-flow aspects of technology they compressed different dimensions of technology onto a single scale.

In the second section, the contributions made by the socio-technical systems theorists, along with that of Blauner, Bright and Bell are

discussed. It is shown that the importance of socio-technical systems theory lies in pointing out the influence of non-workplace factors on organisation and control of work on the shopfloor. Even though Blaumer identifies factors such as the technology, methods of division of labour, economic and social structure of the firm, and the type of trade union activity as being important in influencing the organisation of work, his work, however, remains purely at a descriptive level and he does not use these factors in an analytical way. The work of Bright and Bell is shown as providing important analytical insights into the nature of technical change and its relationship to skill and labour requirements.

2. TECHNOLOGY AND STRUCTURE OF ORGANISATIONS

The two extremes - Williamson and the technological determinists:

Two extreme views of the relationship (or the lack of relationship) of technology and organisational structure have been presented by Williamson (1975) and Clark Kerr et al. (1973). While Williamson has argued that the structure of organisations is independent of their technology, Kerr et al. have argued that technology determines the organisation of work.

Williamson's argument, in effect, runs as follows. Markets and firms are alternative instruments for completing a related set of transactions and whether a set of transactions in a profit-based economy ought to be executed across markets or within a firm would depend upon the relative efficiency of each mode of transaction. The efficiency of transactions in the market is limited both by the "bounded rationality" and "opportunism" of the decision makers as well as the uncertainty inherent in the market environment. Faced with these

problems and the high costs associated with market transactions, "the firm may decide to bypass the market and resort to hierarchical mode of organisation. Transactions that might otherwise be handled in the market are thus performed internally, governed by administrative processes, instead" (Williamson, 1975: 9).

According to Williamson, transactions and not technology, are the decisive factors in determining the efficacy of a particular organisational structure. In general, Williamson's concern is not so much with the factors that influence the division of labour on the shopfloor as with the evolution of structure of corporations - from the unitary form of the firm to the emergence of holding companies, multi-divisional firms and giant conglomerates. However, in his study of the evolution of these structures he begins by a study of simple hierarchies and argues that hierarchical forms of work organisation are superior to collective or cooperative activity because they overcome the transactional problems associated with the latter forms of organisations. Technological inseparabilities of tasks and increasing returns are rarely decisive, according to Williamson, in the emergence of internal organisation mode of transactions. However, Williamson neither defines what he means by technology nor does he attempt an analysis of the interaction between technology and organisation of firms or the nature of transactions. Such an interaction is simply assumed as non-existent. Thus, while Williamson's work may be useful in studying internal labour contract systems and emergence of corporate structures, it does not seem to provide any insights about technology and organisation of work on the shopfloor.

Kerr et al. (1973) also saw the hierarchical structure of organisations as inevitable. In their attempt to put forward a general theory of industrialisation and industrial societies, they gave a determining role to the advances in technology. It was the logic of industrial

process that was seen as determining hierarchical structure of organisations with inevitable divisions of industrial men into managers and the managed. From this technologically deterministic point of view was also derived a tendency towards general consensus amongst all sections of society about the aims of production as well as other socio-cultural values.

Technology at the workplace was seen as determining the occupational structures. Thus, they wrote: "The same technology calls for much the same occupational structure around the world - in steel, in textiles, in air transport" (Kerr et al. 1973: 266). They also thought that changes in technology invariably lead to a rise in skill-levels of the workforce as a whole. Thus, while they saw technology creating similar occupational structures everywhere, they also saw it creating higher and more complex skills than before. The simple deterministic equation they were working with was that as technology becomes more complex so do the skill-levels of workers. However, neither technology nor the concept of skill were very clearly defined. It does seem, though, that "skill" was equated with the training or qualification requirements for a job.

Even though the thesis of Kerr et al. does take into account the different social contexts within which industrialisation processes may occur, it considers technology and the changes in technology as being independent of social relations. The latter aspect of their analysis, in fact, follows from the first. Even within their own framework of analysis, there is no way their hypotheses about technology and organisation of work can be tested.

In the frameworks of both Williamson (1975) and Kerr et al. (1973), discussed above, the assumptions made rule out many interesting questions about the labour processes under capitalism. While Williamson does not address himself to the problem of the immediate division of

labour on the shopfloor directly and is more concerned with the emergence of particular forms of corporate structures[1], Kerr et al. limit themselves to making assertions about industrial societies. Not only have the assertions of Kerr et al. come under close scrutiny by 'de-skilling' theorists like Braverman (1974) but a large amount of literature also exists in Organisation Theory which throws doubt on such simplistic assertions about links between technology and organisation of work. Of particular relevance here is the work of the contingency school and the Aston researchers who have tried to theorise about the relationship between technology and organisation in great detail.

The Contingency Theorists:

The major relevant theorists of the Contingency School are Woodward (1965 and 1970), Perrow (1970), and Thompson (1967). The common theme underlying the contingency theory is that for an organisation to maintain good performance, its structure must be designed to fit its technology, product diversity, size, market position and other relevant factors. Yet there are significant differences between the approaches of Woodward, Perrow, and Thompson. And this becomes evident in the following discussion of their contributions.

Woodward's emphasis was largely empirical. She made a study of a hundred firms in South Essex to find out how and why industrial organisations vary in structure and why some structures appear to be associated with greater success for the organisation than with others. What she found was that though there was no 'one best way' to structure organisations, those industrial organisations where design of the formal

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1. Williamson (1975) can actually be seen as providing sophisticated arguments against anti-trust laws by showing the emergence of conglomerates as "efficient" and to that extent necessary.

organisational structure fitted the type of production technology in use, were also the commercially successful organisations (Woodward, 1965). However, no clear theory of causal links was provided and the conclusions drawn were correlative conclusions.

Woodward (1965) classified the organisations she was studying into eleven different production systems (see, Table 1). Firms were also differentiated according to the type of products they were making. Three types of product classifications were used: Firms making integral products (or manufactured products), firms making dimensional products (products of process industry measured by weight or volume), and firms where a combined system of making both integral and dimensional products are in operation (categories 10 and 11 in Table 1). While Woodward admitted that there were eight firms in her sample which,

> "could not be fitted into any of the eleven categories: One was a...factory operating under special conditions, another was concerned mainly with storage and service operations. In a further four production was extremely mixed, and the other two were in transition, radical technical change bringing them out of one category into another" (Woodward, 1965: 40).

This, however, did not lead Woodward to change her system of classification. Putting firms with "combined systems" into a residual category, Woodward claimed that the first nine categories of her classification were "listed in order of chronological development, and technical complexity; the production of unit articles to customers' individual requirements being the oldest and simplest form of manufacture, and the continuous-flow production of dimensional products the most advanced and most complicated" (Woodward, 1965: 40). Thus, positing a linear scale of technological change, she claimed that a movement along the scale increased the possibility of prediction and control of production as the physical limitations of production became better known and understood.

Table 1: Woodward's classification of production systems

Integral products	1. Production of units to customers' requirements	Unit and small batch production
	2. Production of prototypes	
	3. Fabrication of large equipment in stages	
	4. Production of small batches to customers' orders	
	5. Production of large batches	Large batch and mass production
	6. Production of large batches on assembly line	
	7. Mass production	
Dimensional products	8. Intermittent production of chemicals in multi-purpose plant	Process production
	9. Continuous flow production of liquids, gases and crystalline substances	
Combined systems	10. Production of standardised components in large batches subsequently assembled diversely	
	11. Process production of crystalline substances, subsequently prepared for sale by standardised production methods	

Source: Woodward, 1965: 39.

Based on empirical associations Woodward concluded from her study that firms with similar production systems had similar organisational structure - despite the variety of products involved. She found that moving from unit production firms to process production firms, there were increases in the length of lines of command, the span of control of the chief executive and some personnel ratios, while there was a decrease in the proportion of the wage costs to total costs. She also found that unit and process production firms employed a larger number of skilled workers than large batch and mass production firms.

In a subsequent study (Woodward, 1970), Woodward and her colleagues tried to relate technology, managerial control systems, and organisational structure. In this study it was admitted that Woodward's earlier definition of technology was limited and that a new definition of technology would have to be developed to take into account degrees of variation in the production range, the extent of standardisation of components, and the number of production stages (Rackham and Woodward, 1970). Even though a marked movement towards Perrow's definition of technology (see the following discussion) was made, no new definition of technology was provided.

An important aspect of the second study of Woodward was that it put forward managerial control system as an intervening variable linking technology and organisational structure. Woodward found that while unit and small batch production firms were likely to have managerial control systems based on personal hierarchy, in process production firms managerial control was likely to be impersonal - based on administrative or mechanical controls. Interestingly, she also found that there seemed to be "more freedom for the management of batch production firms than for other categories, in deciding what kind of control processes to use"

(Woodward, 1970: 55). This led her to suggest that "the control system may be the underlying variable linking organisational behaviour with technology" and that the classification of control processes "might provide a better instrument for predicting certain facets of organisational behaviour than the classification of technology" (Woodward, 1970: 55). This clearly represents a departure from her earlier conceptions of the relationship between technology and organisational behaviour (Woodward, 1965). However, before discussing the implications of Woodward's views, the contributions of Perrow (1970) and Thompson (1967) - the other two major theorists of the contingency school - need to be discussed.

Perrow (1970), towards whose definition of technology Woodward and her colleagues seemed to be moving (Woodward, 1970), argued that both bureaucratic[2] and non-bureaucratic organisations can be understood in terms of their technology. Technology is conceived of by Perrow "as a means of transforming raw material (human, symbolic or material) into desirable goods and services" (Perrow, 1970: 75). Just as his conceptions of technology and raw materials are very broad, so is his concept of an organisation. An organisation may be producing, "entertainment and social interaction in the West End Ladies Monday Evening Club, foreign relations that protect our country's interests in the State Department, slim buttocks and poise in a charm school" (Perrow, 1970: 51). In all the cases, the organisations would make use of their technology to transform "raw materials" into desirable products.

Bureaucratic and non-bureaucratic organisations, according to Perrow, may be conceived in terms of their technology which may be

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2. Defined as organisations with rigid rules and regulations, a hierarchy of offices and narrow specialisation of personnel (Perrow, 1970: 50).

either routine or non-routine depending upon the kind of response procedure the technology involves while dealing with raw materials. If, because of sufficient knowledge about designing, producing and marketing goods and services, and the possibility of mass production, the technology can be made routine, then a high degree of structuring and bureaucratisation becomes possible. If, on the other hand, the technology is non-routine, then the organisation would be forced to forego the advantages of clear and elaborate structure and it would be less bureaucratic.

Examining the concept of routineness and non-routineness further, Perrow points out that there are two basic aspects of technology: the degree of variability (number of exceptions encountered) and the analysability of search behaviour in transforming raw materials into finished products. Perrow then goes on to say that those organisations that have a routinised technology are likely to be those with little variability in production and analysable search behaviour in dealing with raw materials. On the other hand, organisations using non-routinised technology would be those with high variability in production and which use unanalysable search methods for dealing with raw materials. He then defines two more types of organisations - "craft" and "engineering" organisations. The former are defined by low variability and the use of unanalysable search methods in production and the latter by high variability and the use of analysable search methods. Thus, in effect, Perrow defines four types of organisations based upon two aspects of their technology - number of exceptions encountered and the search procedure in dealing with raw materials.

Perrow goes on to point out that in his thesis, the main point is not that there are three or four or more types of organisations but the fact that firms differ according to the kind of work they do and this

accounts for their different structure. He argues that organisations which fail to match technology and structure in such matters as personnel assignment, organisation and control, run into trouble.

Another major theorist of the contingency school who, like Perrow, does not limit his definition of technology and organisation to only industrial organisations is Thompson (1967). Thompson examines variations in organisational technology in terms of three categories: long linked technology, mediating technology, and intensive technology.

Long linked technology involves serial interdependence of tasks in the sense that a task can be performed only after completion of a series of previous tasks. Long linked technology, according to Thompson, approaches instrumental perfection when it is used to produce a single type of product, repetitively and at a constant rate. Coordination of long-linked technology, Thompson points out, takes place best through planned schedules.

Mediating technology refers to activities that link clients or customers who are or wish to be interdependent; e.g. activities of commercial banks to link depositors and borrowers. Thompson points out that complexity in mediating technology comes from the fact that it requires operating in standardised ways and extensively. Where mediating technology is being used, bureaucratisation of the structure of organisation is beneficial, according to Thompson.

In the case of intensive technology, a variety of techniques is drawn upon in order to affect changes in an object. The selection, combination of techniques, and their order of application are determined by the feedback from the object. Intensive technology can be found, for example, in hospitals, research laboratories, construction industry and in maintenance work. Successful use of intensive technology depends on the availability of all capacities potentially needed and the optimum

combination of selected capacities as required by the individual case.

The core of Thompson's argument about structure of organisations is that organisations face the constraints inherent in their technologies and work environments. Since these differ for various organisations, and the structure of organisations is contingent upon them, there can be no "one best way" to structure complex organisations. Within the constraints, organisations seek to minimise contingencies and to handle contingencies by isolating them for local disposition. The organisational variables that can be controlled by the organisation are subordinated to the constraints and contingencies it cannot escape. The more its technology and task environment tend to tear it apart, the more the organisation must guard its integrity.

Critical assessment of contingency theory:

Having thus examined the views of the major theorists of the contingency school, the insights and shortcomings of their contribution can now be analysed.

The contingency theorists distanced themselves from the technological determinists inasmuch as they argued that there is no "one best way" to structure organisations. Unlike the technological determinists, the contingency theorists made attempts to conceptualise technology and its links with the structure of organisations. However, it must be noted here that except Woodward (1965 and 1970), their definition of technology is not limited to industrial production systems.

As far as Woodward's attempts at linking technology to the structure of an organisation is concerned, there are at least four basic criticisms that can be made. Firstly, technology is considered by her as an independent variable in studying organisational structure. Thus, her scheme rules out that the technology of an organisation may itself be

a product of the demands made by the social and economic environment of the organisation. An autonomous status is granted to technology and methodologically it is considered "important to guard against the selection of any means of classifying technology that could only be expressed in terms which were themselves social" (Woodward, 1970: 20). It could be plausibly argued that technology can be described meaningfully only by viewing it as both a product and producer of social relations (see for example, Chapter 2). In the contingency school, only Perrow tries to define technology in terms of the environment of the organisation. He does not, however, relate it explicitly to the predominant social relations of production.

Secondly, Woodward puts forward the first nine categories of the classification of production systems as a "scale" of increasing technological complexity. She, does not, however, make it clear what she means by "technological complexity" or how it can be measured. Thus, for example, it is difficult to say on the basis of her framework whether the production of a custom-made nuclear reactor or a satellite, though classifiable under unit production, should be considered less or more technologically complex than an ordinary chemical processing plant.

Thirdly, though Woodward recognises that technical change may have impact on the structure of organisations, she does not develop any methodology to study either the nature of technical change or its linkages with organisation of production. Even when she tries to link technology with organisational structure, she concentrates on correlations rather than causal factors.

And lastly, in Woodward's analysis organisations are assumed to have a single homogeneous technology of production. This may indeed be true

of small firms but not in the case of modern industrial corporations where diversity in production may be such that different plants/ workshops may use different production systems within Woodward's classification of them. However, in this connection it must be pointed out that in her second study (Woodward, 1970), Woodward was moving towards the conception that perhaps it was the control system used by the management that was crucial in determining the structure of the firm rather than just its technology. In such a case differences in control systems would be more important than differences in technology in studying the structure of organisations.

The criticism of the assumption of a single homogeneous technology within a firm is also applicable to the classifications used by Perrow and Thompson of the technologies of organisations. Like Woodward, they also do not consider the possibility that different levels or subsystems within an organisation may have different technologies (see also, Mileti et al., 1978: 83-92). It is not being suggested that the various types of technological systems as listed by these theorists can be combined at random but that a combination of them is never considered explicitly. Thus, Thompson for example, does not consider the possibility that maintenance of a long linked technological system would require the use of intensive technology (e.g. maintenance work on a long line assembly).

So, although the contingency theorists distance themselves from the technological determinists, they do not really provide an adequate methodology to study the causal links between technology and organisational structure. The reasons for this shortcoming are the following. First, they did not develop an adequate framework to analyse industrial technology and technical change. And, second, by focussing on the structure of the whole firm they did not consider the possibility that

technology may not articulate in the same way with the organisation of work on the shopfloor and the structure of the whole firm. This latter point has been recognised in Organisation Theory and one of the main attempts to deal with this has been in the Aston studies (Pugh and Hickson, 1976) and it is their contribution that is now discussed.

Technology and the Aston researchers:

The Aston group was set up in 1961 to study the factors that affect behaviour in organisations. Their aim was to define a set of concepts, using the existing literature on organisational behaviour as well as interviews with managers and administrators, which could then be operationalised to compare structure of organisations. The Aston group isolated three important variables in studying organisational structure: size, technology, and structuring of activity. In discussing technology and its impact on organisational structure, they tried to clarify the various conceptions of technology that existed in the organisation theory literature. According to them, the concept of technology has three facets, which taken together encompass the range of meanings that have been developed in literature relating to technology: Operations technology, materials technology, and knowledge technology.

The concept of operations technology is basically defined by the Aston researchers as workflow planning. They point out that serial interdependence of acts in Thompson's "long linked technology" and Woodward's view of technology are both based on this conception of technology, i.e. the techniques that an organisation uses in its work-flow activities. The concept of materials technology encapsulates the conceptions of Perrow about analysability of search while dealing with raw materials as well as Thompson's conception of "intensive technology" which deals with those situations where what is done is determined by the state of the object or the material itself. The concept of knowledge

technology, according to Pugh and Hickson, deals with the knowledge used in workflow. This is basically the same as the concept of "variability" or "the number of exceptions encountered in production" referred to by Perrow.

The Aston researchers then made attempts to measure the variables related to "operations technology" and link them to the structure of organisations. The concept of technology was seen to consist of a number of subconcepts relating to (i) automation of the equipment, (ii) workflow rigidity, (iii) interdependence of the workflow segments, and (iv) specificity of evaluation of operations. Each of these subconcepts of operations technology was then further itemised into a scale; e.g. the automaticity scale ranged from hand tools and manual machines at one end to self-measuring and adjusting feedback machines on the other. All these scales were then integrated to construct a new overall variable called "workflow integration" - a measure of the degree of automated, continuous, fixed sequence operations in the technology.

Pugh and Hickson found that as far as their sample of organisations was concerned, operations technology had little explanatory value in accounting for differences in organisational structure. However, they noted that "a few specific configuration variables can be seen to be conspicuously correlated with workflow integration; and not with size or other contextual variables. These are subordinate-supervisor ratio, and the percentage of total personnel who are workflow super-ordinates, or who are in design, or methods, or inspection. All are simple job count variables, none deal with the wider administrative or hierarchical structure" (Pugh and Hickson, 1976: 143). From this they concluded that "Associations with operations technology will be found only among variables of structure that are centred on workflow. Such variables

are likely to be job counts of features of the wider administrative and hierarchical structure" (Pugh and Hickson, 1976: 153).

Unlike the contingency theorists, Pugh and Hickson postulated that the articulation of operations technology with structure of organisations was at the level of shopfloor organisation of work as size of the firm increased. However, the results of Pugh and Hickson have been criticised by Aldrich (1972) who claims that they did not view the technological variables in a proper theoretical context. Aldrich argues that size of a firm is a function of its technology and structuring of activities of the firm. He claims that technology has a direct impact upon structure because sophisticated technologies such as automation constrain organisations as regards specialisation and standardisation. Structure has "a positive impact on size because the more structured firms, with their greater degree of specialisation, formalisation and monitoring of role performance, simply need to employ a larger work-force than less structured firms" (Aldrich, 1972: 38). It must be noted, however, that Aldrich's criticism, though valid to some extent, actually plays down the choice of a particular technology as a result of the size of a firm.

While Pugh and Hickson do manage to separate out the different aspects of the concept of technology, they do not specify how each of these aspects of technology articulates with the organisation of work on the shopfloor. They take up only the workflow aspects of technology for such an analysis and in relating those to the organisation of work only correlative links are examined without providing any theoretical insight into the causal relationships, if any.

The four major aspects of the work of the contingency theorists and the Aston researchers can be summarised as follows. First, no distinction is made between profit-making productive industrial

organisations and non-productive organisations and nor are any reasons given for not making such a distinction. Only Woodward limits herself to industrial firms. Second, as a consequence of this (once again with the exception of Woodward), attempts are made to theorise universally about organisations and their activities - the latter being termed "technology". Third, attempts to relate technology and technical change to organisation of production are limited by the general definition of technology used. Only in the case of Woodward and the Aston researchers, where the definition of technology is limited to production technology and "operation technology", respectively, were these studies able to say something about the relationship between technology and organisation of work. And lastly, none of these studies provide a clear theory of causal links between technology and organisation of work.

While the contingency theorists did not separate the articulation of technology with the structure of the whole firm and with the organisation of work on the shopfloor, there have been other studies which set out to theorise specifically about the latter link. The foremost among them are the theorists of the socio-technical systems, the work of Blauner (1967), Bright (1958 and 1966) and Bell (1972). These studies did not evolve out of the theories discussed above. In fact, they represented a parallel, though perhaps related, development about understanding changes in organisation of work due to mechanisation and automation. These studies are discussed in the following section.

3. TECHNOLOGY AND WORK ORGANISATION

Socio-technical systems theory:

The socio-technical systems theory was developed at the Tavistock Institute of Human Relations, London, in the Fifties, as a method of conceptualising, investigating, and changing the organisation of production. It was developed through a series of case studies by Trist and Bamforth (1951), Rice (1958), and Trist, Higgin, Murray and Pollock (1963). Trist and Bamforth analysed the effect of mechanisation on work organisation at the Durham coalfields, and their work was followed up by Trist, Higgin *et al.*, Rice used the socio-technical approach while helping in the reorganisation of production at the textile mills of the Ahmedabad Manufacturing and Calico Printing Company in India.

The socio-technical systems theorists were attempting to take into account the interrelations of the technical and socio-psychological aspects of industrial production systems. This led them to argue, in direct contrast to the technological determinists and the proponents of "scientific management", that while the technology being used by a firm may place limits on the type of work organisation possible, the work organisation has social and psychological properties of its own that are independent of technology. They argued for "joint optimisation" of the social and the technical systems for "efficient" production.

Basically, they made four important points. First, given a particular technological structure, jobs could be designed around it in more than one way. Second, the technological structure may itself be changed so as to facilitate a new form of work organisation. Third, the coercive forms of control as envisaged by the proponents of "scientific management" can be counter-productive, a realisation which led them to the conceptualisation of "semi-autonomous" work groups. And fourth,

they argued that there are non-workplace influences that shape the attitudes of people to work to a significant degree. While it is not possible to examine all the studies carried out by the theorists of the socio-technical systems school, some of the pioneering studies, which attempted to use the above insights, are now briefly examined.

In the coal mining study of Trist and Bamforth (1951), it was argued that mechanisation in coal mines had disrupted the "handgot system" of work organisation in which a team of two or three workers performed all the tasks necessary for the extraction of coal, by replacing it with the longwall method. This disruption of what was considered to be a psychologically "effective" form of organisation, was seen to be originating from the management's perception of the production system being purely technical in character, while it should have been seen as having both social and technical characteristics. From this analysis, it was proposed that effective work performance was a function of matching, or "jointly optimising", the social and the technical systems. Trist and Bamforth also pointed out that there was a possibility of choice in work organisation and that for a given technology several social systems were possible.

In the follow up study of Trist et al. (1963), it was found that the introduction of mechanisation had specialised the labour process in coal-mining in terms of a greater division of labour which in fact had led to a fall in productivity. This was seen as the result of a "mismatch" between the social and the technical systems. It was suggested that the problem could be solved by the formation of "composite" workgroups based, not around one skill - such as filling or cutting - but around all the skills necessary for the task of extracting coal. This was termed the "composite longwall system", as it combined features of both the single place system as well as the conventional longwall

system of coal-getting.

It was an explicit recognition of the crisis of control over the labour process that led to the formation of the "composite" workgroups. As Trist et al. pointed out, "coercive control ... would be unsuitable and impracticable in the high risk situation of the coal face environment. Without a foundation in group self-regulation, management lacks the means to weld the miscellaneous collection of task groups into an effective team" (Trist et al.,1963: 290). In the composite longwall method of organisation of coal production, a scheme of group payment, based on a fixed rate, to which a bonus was added, depending upon the quantity of coal produced, was used to ensure group self-regulation. Shifting to the composite longwall method yielded higher output, lower absenteeism, and led to the various groups performing their duties on, or even ahead of schedule.

In the case of the textile mills of Ahmedabad in India, two studies were conducted by Rice (1958) - one with automatic and the other with non-automatic looms. In both the cases the diagnosis of problems and the solution offered were identical. It was suggested that the organisation of sheds was based on a mismatch between the social and the technical systems. Rice's solution was to create work-groups based on interdependent work roles. Each worker, even though ordinarily performing one task, was to be responsible for all the activities of the group. Interdependence was enforced through a group-payment scheme.

According to Rice, workers spontaneously created their own work groups and responded enthusiastically to the new organisation of work. Such was the enthusiasm of the workers in the automatic loom sheds, for example, that, "Members of the weaving sub-group ran to the stopped looms; even gaters carrying looms weighing over two hundred pounds on their shoulders were seen trotting. Except when members of the gating

and maintenance sub-groups were actually engaged in their assigned tasks, they too ran to stopped looms to help the weaving sub-group. The workers in the rest of the shed asked for permission to re-organise themselves in the same way as the experimental groups. They were asked to wait until more results were available" (emphasis added, Rice, 1958: 74). The reorganisation was also accepted quite enthusiastically by workers in the non-automatic loom sheds.

Rice claimed that the enthusiasm among the workers was due to the greater psychological satisfaction that the Indian workers from agrarian backgrounds derived from the opportunities for greater task performance and the security of small groups - a security, which according to Rice, they had lost by leaving their villages and their families to enter industry.

It has been pointed out by Kelly (1978) that the pioneering studies of Trist and Bamforth, Trist et al. and Rice represented a stream of socio-technical theory which was quite different from that represented in the Norwegian studies of Emery and Thorsrud (1975) and the Dublin public transport study of Van Beinum (1966). The latter studies, though still operating within the context of semi-autonomous work-groups, placed a greater emphasis on individual job design. The concept of semi-autonomous work-groups, originally developed to satisfy the socio-psychological needs of workers as "advanced" technology precluded performance of whole tasks was now applied to cases where technology was considered "medium" (assembly work in the case of Emery and Thorsrud's study) or even "insignificant" as in the case of the Dublin public transport study of Van Beinum. These studies were also different from the Tavistock studies inasmuch as they did not try to reduce the social system to a psychological system comprising attitudes, beliefs, etc. (Kelly, 1978).

Of the experiments with socio-technical systems, the reorganisation of production at Volvo's Kalmar plant in Sweden has perhaps been the most successful one. However, this was also perhaps the only case where the production facilities were completely redesigned before the formation of semi-autonomous groups of workers (see, Lindholm and Norstedt, 1975, and Aguren et al., 1976) - thus representing both social and technical innovations.

A critical assessment of socio-technical systems theory:

Having thus had some fleeting glimpses of attempts at using the socio-technical systems approach, it might be asked to what extent were the socio-technical systems theorists actually making use of their insights about "jointly optimising" the social and the technical systems? It has been claimed by Kelly (1978), that the researchers at Tavistock Institute did not actually jointly optimise the social and the technical systems either in the coal-mining case or in the case of the textile mills of Ahmedabad. What actually took place, according to Kelly, was intensification of labour; i.e. increase in work loads and/or a faster pace of working. The organisation of "semi-autonomous" work groups was necessary to do this because they permitted an equalisation of work loads. Kelly supports his arguments with evidence from both the coal mining and the textile mill studies (Kelly, 1978: 1084-7).

Along with the intensification of labour, the earning-levels were also higher for those workers who were in semi-autonomous work-groups. In this context, Rice's conclusion that "the workers in the rest of the shed asked for permission to reorganise themselves in the same way as the experimental groups" (Rice, 1958: 74) because of the greater psychological security of small groups appears rather dubious. From the

data presented by Rice relating to the average earnings of workers (see Table 2 for the earning levels in the automatic loom-shed), it is evident that working in the semi-autonomous groups offered the workers a chance to increase their average earnings by a minimum of 23 per cent in the case of line-jobbers, to as much as 73 per cent in the case of some weaving jobs in automatic loom sheds. In the case of non-automatic loom sheds average earnings in the experimental groups were on average 55 per cent higher than in other groups. Admittedly, the workers would have to work much harder to increase their earnings but working in semi-autonomous groups at least offered them the opportunity of pushing their average earnings to a new and higher level than ever before.

The argument of Rice that Indian workers from agrarian backgrounds found the lost security of the family in the semi-autonomous groups created by him is at best a post-hoc explanation of the "success" of these groups. Nowhere is the articulation between the agrarian background of the workers, the nature of the joint family system and factory work made very clear (see Chapter 8 on how such links could be made through particular structures of the internal labour markets). Rice simply assumes that the power relations of the joint-family unit are reproduced in some benign way in semi-autonomous work-groups. After underplaying the effects of higher earning levels on semi-autonomous groups, the reasons for their "success" are sought to be explained in terms of a residual category of socio-psychological factors.

On the other hand, however, the studies of socio-technical intervention cannot be reduced only to a process of intensification of labour and incentive payment schemes, which is the tendency in Kelly (1978). Analytically, it would be difficult to separate these aspects of socio-technical systems from the fact that semi-autonomous work groups

TABLE 2: Comparison of earnings of experimental shed and other loom sheds weaving identical cloth (automatic loom sheds)

	Experimental shed (1)				Other sheds (2)				
Grade	Basic wage Rs.	Average bonus Rs.	Dearness allowance Rs.	Total Rs.	Equivalent occupational role	Average earnings Rs.	Dearness allowance Rs.	Total	Difference in total earning between (1) and (2) %
A	145	41	62	248	Line jobber	139	62	201	23.38
B+	125	35	62	222					73.43
B	115	32	62	209	Weaver	66	62	128	63.28
C	90	25	62	177					38.28
D	55	15	62	132	Oiler	28	62	90	46.67

Source: Calculated from Rice, 1958: 283.

did offer some respite to the workers from coercive forms of control. There is no reason why this particular aspect of organisation of work in the coal-mining studies or the textile mills study should be underplayed.

Kelly, however, is quite correct in pointing out that except in the case of Volvo's Kalmar plant, where the technology was completely redesigned, socio-technical intervention did not change the technical system in any way. The socio-technical systems theorists never actually developed a theory of studying technical systems or the nature of technical change. Technological systems were of marginal concern to them because what they were attempting was to organise work around a given technological structure.

Finally, it must be noted that the aims of the socio-technical approach were limited to removing "inefficiencies" from the existing production systems. As Silverman (1970) has pointed out, the consultancy framework within which most of the socio-technical systems analysis has been carried out, necessarily implies a commitment to the aims of management. This, coupled with the fact that they do not consider the possibility that the workers might have a different perspective about the aims of production, leads them to take an unitary view of the organisation as axiomatic.

Another theorist, who tries to cover similar grounds as that of the socio-technical systems theory, but instead of assuming a unitary view of organisations tries to derive a tendency towards it from the nature of technical change is Blauner (1967), whose views are discussed below.

Blauner - from 'alienation' to 'freedom':

Blauner (1967) saw the conflicts between capitalists and the workers as a result of the implications of the developments in technology which further developments in technology would rectify. Blauner's major thesis was that unlike those in craft based work or mass production, the worker in an automated factory regains "a sense of control" over his work because work in automated factories provides greater free time to the workers, encourages individual responsibility and gives the workers a sense of meaningfulness in the work being done.

Blauner studied four different types of production systems before he reached these conclusions. These four production systems were: craft technology, machine tending technology, assembly line technology, and continuous process production. According to Blauner, these categories represented the long term trend towards mechanisation. Work organisation in each of these forms of technological processes was illustrated with a case study of an industry where these forms were predominant. Thus, work organisation in craft technology was illustrated with a case study of printing industry, machine tending with textiles, assembly line with the automobile industry, and continuous process production with the chemicals industry.

Blauner identified four aspects of an industry that determine the relation of the workers to their jobs: Technology, methods of division of labour, social organisation, and economic structure. He recognised that for the same technological system different organisations of the work process may be possible. By social organisation, Blauner refers to the system of general standards and specific rules that govern workers within the organisation. And by economic structure, he refers to such economic factors as competition in product markets, concentration, profit margins of firms, their cost structure, growth rates and trends in

demand. It is in this context then, that he tries to study the reaction of workers to the jobs they do in the four industries he chose.

Printing was historically the oldest of the four industries chosen by Blauner - a craft industry with craft technology, totally dependent upon the special skills of the workers. Blauner found that the economic and social structure of the industry was more 'traditional' than 'bureaucratic' - small firms without elaborate hierarchical chains of command. The essential feature of craft technology, Blauner points out, is that there is no standardisation of the product. This inhibits the standardisation or 'rationalisation' of the work-process because the work cannot be sub-divided easily or made repetitive.

Blauner found that craft work implied a high degree of control by the workers over their work. There was freedom to determine the techniques of work, to choose one's tools, and to vary the sequence of operations. There was also a lack of close supervision. Blauner saw the characteristics of craft work as resulting from the nature of technology. Although he thought they were reinforced by the power of the unions, he did not see them as resulting from the strength of craft unions and the lack of technical change.

The next type of technological process he examined was in the textile industry. Five features were identified by Blauner as being basic to the relationship between workers and the work-process in textiles: A machine tending technology, a low level of skill, a traditional social structure, location in areas where cheap and relatively subservient labour is available, and economic sickness of firms. In machine tending technology such as textiles, according to Blauner, skills are built into the machines and the workers require little knowledge, training and experience to do their jobs. Such workers have relatively little control over their jobs because unlike the craft workers they do not possess any

scarce skills which would give them a special bargaining power.

As far as the immediate work process is concerned, Blauner found, work in textiles is characterised by a constant work pressure, an absence of physical movement, and with the workers having no control over the pace or rhythm of work activity or over choice of technique of work.

In contrast to printing and textiles, Blauner found that the economic and social structure of the automobile industry was more bureaucratic and more concentrated. He noted that the "assembly line continues and intensifies the trend towards greater division of labour, rationalisation and efficiency, which began with the machine industries, the most advanced form of manufacturing in the nineteenth century" (Blauner, 1967: 89).

Blauner found that the industrial operations necessary to complete a car were organised into an uninterrupted time-space series, and the jobs of the individual workers were almost as sub-divided as the thousands of parts they assembled. Workers lacked control over their work as the pace of the work was determined by the speed of the assembly line, which according to Blauner, was also responsible for high degree of work pressure and the lack of free movement of workers. Once again, Blauner does not see the organisation of work into an assembly line or the determination of its speed as a result of social relations of production but ascribes everything to the technology itself which is itself not seen as a product of social relations.

Blauner notes that it is the automobile worker who has been "the 'proletarian hero', the hope of Marxist intellectuals, who saw in the working class the possibility of a revolutionary organisation of society. And there is some justice in this image, for the conditions of his work sometimes make him the prototype of the militant worker as well"

(Blauner, 1967: 123). However, with the coming in of the "automated factory" Blauner sees these Marxist hopes being dashed to the ground. And the example he takes of the "automated factory" is the case of continuous flow production in the chemical industry.

Blauner found that workers in continuous process industries are far more secure in their employment than workers in most other industries. Volume of production is not a function of the number of production workers, but depends largely on the capacity of the technical equipment. According to Blauner, since the number of workers necessary to operate and maintain the equipment has already been reduced by automation to the minimum, wage costs tend to become a fixed cost rather than a variable cost and the workers tend to have a high degree of job security[3].

Blauner found that very little of the work of chemical operators is physical or manual as practically all physical production and material handling is done by automatic controls. The job of workers is only to monitor these automatic processes. He noted that unlike textile workers and automobile workers, chemical workers were free from constant pressure in their jobs and had a great deal of free time. They could control the pace of their work, though not the pace of production. Blauner concluded that continuous process technology reduces the powerlessness of the blue-collar worker by giving the worker control over the immediate work process. They have "more of a sense of purpose, understanding, and function in their work than workers in the machine tending and assembly-line technologies" (Blauner, 1967: 143). This led, according to Blauner, in the workers having a greater control over their jobs

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3. Blauner clearly ignores market factors in making such an assertion about job-security of workers.

but not on a craft-basis as in the case of craft technologies.

Blauner's study provides an interesting description of the relationship between workers and their jobs in four industries in the USA. But the conclusions that are drawn seem to be more of a justification for automation under capitalism, as well as for capitalism as such, rather than anything else.

Four production systems are chosen and presented by Blauner as a scale representing the historical development of capitalist industry. These are then transplanted to the present and an onward march towards the "automatic factory" is assumed. But without going into the social context of choice of production technologies such a movement cannot be assumed in advance. As far as Blauner's description of work in continuous flow industries is concerned, recent studies of chemical process production firms have shown that greater automation does not necessarily make work more meaningful and satisfactory (Gallie, 1978) and that in fact, work in chemical industry is not as Blauner described it as a lot of jobs still require high exertion of physical effort (Nichols and Beynon, 1977).

While the contingency theorists, the Aston researchers and the socio-technical theorists limited themselves to dealing with problems posed within the academic and/or consultancy framework of organisation theory, Blauner goes beyond them championing the cause of automation under capitalism. In effect, he says that not only does capitalism work but that come automation, it will work better - notwithstanding the Marxist nonsense about alienation.

Blauner's contribution to studying organisation of work is interesting only inasmuch as he delineates factors such as technology, division of labour, economic and social structure of the firm, and the extent and type of trade union activity as influencing the organisation

of work. However, having identified these factors his analysis remains at a descriptive level as he does not provide any method for analysing the factors he had identified as influencing the organisation of work. Even though he gives technology a predominant place in determining the relationship of workers to their jobs, he does not provide an analytical framework for studying these links. It is only in the work of Bright (1958 and 1966) and Bell (1972) that an attempt is made to link changes in technology with the jobs of the workers. These two studies are discussed in the following section.

Conceptualising technical change - from Bright to Bell:

Bright's research came out of a programme at the Harvard Business School of studying the mangerial implications of automation. Bright (1958 and 1966) focussed on the skill requirements associated with increasing automation. And his general conclusion was that the skill required of workers decreased with increasing automation. His seventeen level mechanisation profile represented the gradual wresting away of skills from the worker as mechanisation proceeded from the lowest to the highest level (see also, Chapter 2).

Compared to Blauner's work, Bright's research represented an advance, in the sense that instead of generalising at the level of particular technologies, it tried to analyse specific aspects of technical change and their impact on the control workers had over the machine.

Even though Bright's study is perhaps the first one that explicitly stated that production processes could be automated to varying degrees and that the nature and extent of labour requirements would vary with the level of automation, it too had its shortcomings.

As pointed out in the last chapter, Bell (1972) pointed out that Bright equates mechanisation of the control function with automation or mechanisation as such. Mechanisation of the control function is further conflated with the sources of power being used and both are measured along a single linear scale. Further, Bell has pointed out that Bright's scale of technical change does not concern itself with "technical differences of the handling function in production" (Bell, 1972: 59).

Bell proposed that not only was it necessary to think of different "levels" of mechanisation but also of different "forms" of mechanisation. Bell, by examining metal cutting technologies, identified three integrated functions or systems of a production technology which could be used to analyse changes in that technology. They were: The system that carries out the transformation process changing the state of the material being processed; the system that transfers materials through the transformation process; and the system which controls the operations of the transformation and the transfer processes.

Within the material transformation process, Bell identified two distinct types of changes - those changes that increase the rate of output and those which improve the precision and repeatable accuracy of the transformation process. These changes come about because of technical developments in the application of non-human power, the use of large quantities of power, and the perfecting of powered mechanisms such as bearings, slides, structures, gears, etc. The use of non-human power sources, according to Bell, may result in furthering the division of labour, by eliminating the unskilled work required, and an increase in the output per head of the workers who remain performing the skilled labour functions. The impact of further changes which increase productivity would virtually leave the skill-structure roughly the same.

In improving the precision and repeatable accuracy of the production technology, the human skill input previously required gets built into the machine and consequently, other things being equal, less labour is required in the process. Bell points out that it would be difficult to predict how this change would show up in the employment structure. On the one hand it may mean skilled workers are replaced by less skilled ones, but on the other hand, if the job consists of a bundle of tasks (see, Davis et al., 1972, for the distinction between tasks and jobs), it may mean that some tasks may now require less skill or may disappear completely. This would mean that the skilled worker would remain with a changed job-description.

Further, Bell points out that as far as the employment pattern is concerned, the reduced skill requirements in the operating process may be offset by the increased skill requirements for maintenance. The maintenance tasks may either be incorporated in the operator's job or may constitute a separate job.

The transformation process requires that materials be brought to it, loaded on to the machine, manipulated, unloaded, and then carried away. These five elements constitute the material transfer process and any change in these elements will mean a change in the level of mechanisation or automation.

Since usually it is unskilled labour that is likely to be used for material transfer processes, any mechanisation of the process is likely to imply a reduction in the employment of unskilled labour. But Bell also points out that in cases where a skilled operator's job may also consist of some unskilled handling tasks, then mechanisation of material transfer would mean elimination of these unskilled tasks from the job. This in turn might mean that fewer skilled workers would be required to carry out the remaining functions. Thus, while mechanisation of

transfer function may eliminate unskilled tasks, its effect may be to reduce the number of skilled workers required.

The control systems consists of various elements for processing the information required to perform the manufacturing operations. These elements can be classified into two groups: the input instructions to the process and the feedback system which monitors the performance of the process and produce corrective action. The input system consists of at least the following elements: an information processor, a memory for holding information about particular operations as well as programmes for transferring this information, and an information transmitter. Similarly, the feedback system also consists of at least three elements: a means of measuring the performance of the process, a means of transmitting information about the state of the monitored conditions to an information processor, and finally, an information processor capable of handling information from the process monitor and of outputting corrective instructions. Bell points out that while at the one extreme all the information processing may be done by human neuro-muscular systems, at the other, all the control functions can be carried out by mechanisms.

The effect of automating the control functions on employment patterns will be that gradually the requirement of skilled workers employed in direct association with the production process will be reduced if not eliminated. Bell admits that definite statements can only be made about labour requirements at the two extremes. It is not possible to say that any particular step in increasing the level of automation will reduce the requirement of skilled labour. A change, for example, from a less automated stage to a more automated stage of the control system may result in employment of comparatively less skilled workers. A subsequent change to a more automated stage may result in the

elimination of the unskilled workers. Bell points out that an observer of the first change may conclude that automation increases the proportion of unskilled workers to skilled workers. An observer of the second change may reach an exactly opposite conclusion; i.e. automation increases the proportion of skilled to unskilled workers in the workforce.

Thus, Bell concludes that any analysis of increasing mechanisation or automation must not only distinguish between various forms and levels of automation but also the specific context within which such changes occur.

4. CONCLUSIONS

To sum up, it can now be seen that limited as they are in certain respects, the attempts of organisational theorists nonetheless provide some important insights to understanding the factors that influence organisation of work. The contingency theorists and the Aston researchers tried to link factors like volume of production, type of products, variation in products, extent of linkages between production stages, and type of managerial control systems with the structure of organisations and organisation of production. And even though they were not able to provide a coherent framework of analysis, the relative importance of their contribution lies in the fact that there is hardly any recognition of these factors in the Marxist studies of the labour process under capitalism. They also go beyond some of the studies in the latter category by recognising that linear ideas of change may not always be applicable in studying changes in structure of organisations.

Similarly, the socio-technical systems theorists pointed to the fact that the immediate division of labour in production and the control

of organisation of work may be influenced by non-workplace factors. While Marxist studies have pointed to factors such as labour markets, racism and sexism as influencing the labour process, the socio-technical systems theorists have ignored these factors but have instead pointed to other non-workplace factors which influence organisation of work.

In the case of Blauner, even though it is clear that it may be easy to dismiss him as an ideologue of capitalism, once again, he does at least delineate factors such as technology, division of labour, economic and social structure of the firm, and the type of trade union activity as being important influences on the organisation of work.

Similarly, the attempts of Bell (1972), and before him Bright (1958 and 1966), provide insights into understanding the relationship between technical change and organisation of work which the Marxist studies do not provide.

The question then is whether these insights along with those of the Marxist framework can be used to understand the capitalist labour process in a coherent and a critical manner? In the next chapter it is argued that some of these insights can indeed be useful, without suggesting a theoretical synthesis of any kind between organisation theory and Marxism, in studying the dynamics of the capitalist labour process at the level of workshops within individual firms.

CHAPTER 4

METHODOLOGICAL CONSIDERATIONS AND STATEMENT OF OBJECTIVES

1. INTRODUCTION

In the last two chapters both the Marxist and non-Marxist analyses of the labour processes under capitalism were examined. In this chapter, the insights and shortcomings of these contributions are used as a basis for defining the categories of analysis used in this study.

This chapter has been divided into three sections. The first section presents a brief summary of the methodological problems associated with the earlier studies showing that most have arisen due to: (a) the use of inadequate and incomplete definitions of concepts, (b) insufficient attention being paid to the limited historical validity of these concepts, (c) the use of these concepts across different levels of analysis, and (d) the attempt to provide far too neat a picture of the dynamics of the capitalist labour process. In the second section, the set of categories of analysis used in this study are defined based on the criticisms made earlier. The methods of operationalisation of these categories are also presented in this section. In the final section, the choice of the context of this study and its scope are discussed.

2. METHODOLOGICAL PROBLEMS OF THE EARLIER STUDIES

Before discussing the specific methodological problems associated with the Marxist and non-Marxist studies examined in the previous chapters, it is necessary to specify briefly the general aims of this study to set the context for such a discussion.

The aim of this study is to understand the different factors that influence the organisation and control of the labour process under capitalism. "Labour process" has been understood in the way Marx (1976) defined it - a process of production of useful products through the action of human labour on raw materials by using the requisite instruments, tools or machines. However, labour processes based on craft-work under capitalism are not going to be analysed in this study as its focus is on that phase of capitalism in which craft-based labour processes are no longer the dominant defining characteristics of production[1]. Also, this study does not deal with labour processes in general under capitalism but limits itself to industrial labour processes. And within the industrial labour processes, it is the immediate division of labour on the shopfloor that will be analysed. Thus, for example, the analysis of structure of firms or corporations will not be covered in detail and such analyses will be used only as references to understand the organisation and control of work on the shopfloor better. Having thus specified the general aim of this study, a brief summary of the methodological problems associated with earlier studies can now be presented in the context of this aim.

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1. That is, the phase of "real subordination" of labour under capital as compared to the phase of "formal subordination" (see Marx, 1976).

As the last two chapters have shown, there are vastly differing viewpoints about how the division of labour on the shopfloor is shaped. While some theorists like Braverman seem to have tried to derive a tendency of linear change in the skills of workers from the type of technical change that occurs under capitalism, others like Friedman and Edwards have questioned his analysis and have tried to link the organisation and control of the labour process with the historical development of different managerial control strategies with factors such as changes in the size of the firm, labour markets, forms of workers' resistance, etc. On the other hand, Foucault, who works within a framework critical of capitalism but does not claim to be a Marxist, sees the origins of factory discipline as a part of the growth of "disciplines" in general in society relating to prisons, schools, hospitals, army, etc.

All the organisational theorists examined in the previous chapter, with the exception of Williamson have emphasised the relationship between technology and organisational structure. But not only do they differ in their definitions of "technology", they have also drawn differing conclusions about the types of links between technology and organisation of work.

Thus, while Kerr et al. see the developments in technology invariably leading to hierarchical organisation of work, the contingency theorists see technology as being one of the important factors on which the structure of an organisation is contingent. The socio-technical systems school emphasises the joint-optimisation of the technical system with the social system thereby pointing to the importance of non-workplace factors in determining an "efficient" division of labour on the shopfloor. Then there are Pugh and Hickson who try to show that technology affects only the structure of work organisation on the shop-

floor and not the overall structure of the firm. While the grounds for rejecting certain conceptions of these and other theorists have been pointed out in the last chapter, it was also shown that it is only in the work of Bell that interesting analytical insights into how changes in technology may affect skill content of the jobs of workers are to be found.

Despite the diversity in the Marxist and non-Marxist approaches, the major themes that emerge out of these studies are that the organisation of work on the shopfloor is shaped by (i) the technology in use, (ii) the managerial control systems, (iii) forms of workers' responses to managerial control, and by (iv) non-workplace factors. However, these are also the areas where most of these studies have run into methodological problems. These problems relate not only to the definitions of the concepts used in each analysis, but also to the historical validity of these concepts, the levels of analysis, and the methods of operationalisation of the concepts.

Consider, for example, the concept of "skill" in Braverman's work. He does not at any point define "skill" very clearly in his book and the meaning he attaches to it has to be derived from his various operational uses of the concept. Craft-based skill is taken by him as an absolute measure and then he grants this concept of skill a universal historical validity under capitalism and sees the progress of capitalism as the degradation of "skill" relative to this absolute measure. However, he also recognises that new machines or techniques of production may also lead to creation of new skills, but methodologically he does not distinguish these skills from his definition of craft-based skills. And all that he can say is that they are also subject to the same process of degradation and 'de-skilling'. While analysing the process of 'de-skilling', Braverman uses the concept of skill to mean the

skill of an individual worker, the skill of workers in a particular occupation, and the skill of the working class as a whole. However, it is difficult to know what Braverman means by skill at these different levels of analysis. This then is an example of an ill-defined category of analysis which cannot be operationalised easily, is ahistorical, and is used across different levels of analysis without distinguishing between the meanings it might have at the different levels.

Similarly, the concept of technology is another example of how the use of a concept can be historically limited as also of how different dimensions of technology can be mistakenly taken up separately as "complete" definitions of technology for studying the organisation of work. Marx, for example, being limited in part by the developments in the application of science to production in his own times, restricts his analysis of technology to rotary machines. And his definition of machines is basically an engineering definition which defines machines in relation to themselves; i.e. as consisting of a motor mechanism, a transmitting mechanism, and a working tool. This definition of technology clearly has little relevance to analysing electronics or chemicals technology. Marx's concept of technology was also based on a conception of machines which had their basis in appropriating the skills of the manufacturing period workers. Marx had little conception of the development of machines not trying to replicate craft-labour. This definition, thus, besides being a historically limited definition of machinery, has limited analytical value in determining the possible ways in which technology impinges on the division of labour on the shopfloor.

If, however, Braverman's conception - or more precisely, Bright's conception - of technology is taken up, then, as pointed out in the previous chapters, it can be seen that it conflated the different

dimensions of technology onto a single scale. The organisational theorists identified dimensions of technology such as the volume and type of output, analysability in search behaviour and variability in dealing with raw materials, workflow linkages, etc. and assumed that one or more of these dimensions were sufficient definitions of technology for analysing structure of organisations. Some other theorists like those of the socio-technical systems school, in fact, did not define clearly what they meant by the technical system at all.

The case of "technology" then is an example of either assuming that a single dimension or a few dimensions of a concept define the whole concept or that more than one dimension of a concept could be conflated onto a single scale of measurement.

Like the concept of technology, the concept of managerial control strategies also suffers from oversimplification. The conceptions of Friedman and Edwards about managerial strategies of control seem to be partly descriptive - a process which in itself is not to be rejected. However, for these descriptions to be meaningful, they must also be able to lead to a process of analysing how and why these strategies evolve over time. Both Friedman and Edwards provide no answers to why managerial control strategies should be limited to two or three strategies only. In the case of Edwards, it is not clear why each firm should have only one control strategy and not a mix of more than one.

From the above examples, it seems that most of the conceptual problems in these studies have arisen for the following reasons. First, non-rigorous definitions of the categories of analysis; second, a lack of recognition of the limited historical validity of these categories; third, extending the validity of these categories across different levels of analysis; and fourth, an attempt to provide too neat a picture of the dynamics of the capitalist labour process.

The key issues for further study that emerge out of the above studies are: The changing relationship between technology and the organisation of work - especially the skills required from the workers, the role of managerial control strategies in the creation and maintenance of particular forms of organisation of work, the linkages between forms of workers' responses to managerial control and the organisation of work, and the linkages of non-workplace factors with the above relationships.

Before going on to state how these issues have been tackled in this study, it is essential to define the categories of analysis that will be used and the span of their validity.

3. DEFINING THE CONCEPTS

Depending upon the use the concept is to be put to, there could be various definitions of "technology". In this study "technology" has been used to mean the combinations of the tools, machines, etc. with raw materials, and the abilities required in using them to produce useful products. This definition of technology is based on production processes and not on the overall organisation of industrial firms or on the division of labour between them. Thus, for example, if a firm decides to increase or decrease a number of its middle-level managers or if a firm decides to subcontract "excess" work, this would not involve a change in its technology[2]. This concept of technology is meaningful only at the levels of workshops, plants and to an extent at the level of an industrial sector. It is difficult, if not impossible,

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2. Of course, this would be contingent on how "excess" work is defined. Here it is taken to mean work in excess of the normal work-load.

to use this concept at the level of multidivisional corporations whose operations may span more than one industrial sector.

Two dimensions of this concept of technology - a historical dimension and a spatial dimension - are of special interest in studying industrial labour processes. The historical dimension of technology can be understood in two ways. Like all definitions of technology its analytical value is limited historically but it is not a static concept. Two types of dynamics of technology can be postulated in the capitalist industrial labour processes - a short run dynamic and a long run dynamic. In the short run, the instruments of work, raw materials, and the abilities required in using them cannot be seen as changing in a manner that alters the structure of the technology of a firm fundamentally as firms choose these different elements from an existing set of possibilities which only change incrementally. In the long run, however, it is difficult to derive any tendencies in advance about how the different elements and their combinations would change[3].

The spatial dimension of technology refers to work-flow planning. Work-flow depends not only on the arrangement of machines on the shopfloor but also on the means by which materials are transferred from one work-station to another. Given a "set" of machines, raw materials, and workers, not only can there be various configurations of work-stations but the flow of materials around them may be organised in more ways than one. While the arrangement of machines may depend to some extent on factors such as architecture of the workplace, size of machines, etc., the material flow around them, for example, may be manual - say, using wheel-barrows - or through conveyor belts.

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3. This is also because the technology of a firm and the changes in it cannot be deduced from the concept of the capitalist mode of production (see Cutler, 1978).

Technology defined in this way can be seen as generating constraints on the organisation of work. But at the same time given the context of these constraints work may still be organised in different ways. However, the constraints placed by technology on the organisation of work are not constant and change as the elements that constitute technology change over time.

Understanding the relationship between technology and organisation of work also requires a definition of the concept of "skill". "Skill" has been used in this study to mean all those conceptual and executional abilities that are actually used by a worker in production. At any time the skill of a worker consists of a set of abilities such as manual dexterity, the ability to visualise shapes and the consequences of a particular process, the ability to concentrate, the ability to read and write, the ability to read technical drawings, the ability to remember rules, routines, etc[4]. The concept of skill thus defined has a number of dimensions and the abilities listed above are by no means an exhaustive list of all the dimensions of skill. Skill defined as a multi-dimensional category cannot be measured along a single scale. For example, it would be difficult to measure the extent to which the ability to read technical drawings, the ability to coordinate physical movements, etc. are used by a worker in a set of production operations on a single scale. Thus, it makes no sense to say that skill <u>in general</u> has gone up or down unless a uni-directional change occurs in all its elements or unless they can all be weighted. Skill can only change as the combination of its different dimensions change. And the combination and the extent to which the different abilities are used would depend upon not only the technology in use but also on the variability in product-range and managerial decisions about the immediate division of labour on the shopfloor.

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4. See, Blackburn and Mann (1979).

This concept of skill is valid at the levels of individual workers and groups of workers doing a particular job in a workshop or a plant in an industrial sector. It can only have limited use for making comparisons across industrial sectors as jobs in different industries may require different combinations of abilities in production[5].

Before attempting to specify a method for studying the dynamics of skill within changing technology, technical change itself has to be conceptualised. In this connection, first of all, it must be pointed out that this study deals with only those production technologies that either involve changes of "measurement" or changes of "measurement and order"[6]. The former refers to those processes where after undergoing the production process the raw materials change their overall dimensional measurement; e.g. component manufacturing, wire drawing, fabrication and other metal-cutting processes. And the latter type of change refers to processes such as component assembly, wiring, maintenance, packing, etc. These two categories exclude, for example, production processes that involve chemical reactions and processes which may change the chemical order of the components but not the overall volume; i.e. changes of "order" only.

Having pointed this out, it now becomes easier to conceptualise changes in technology. The scheme put forward by Bell has been used to study changes in technology; i.e. in terms of changes in the material transformation process, changes in material transfer process, and changes in the systems of control for the above two processes. But to this must be added changes in technology in terms of changes in arrangement of machines and methods of workflow if technical change is to be studied at the level of a workshop.

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5. In this connection, see also Cutler (1978).

6. For a discussion of differences in the concepts of "measurement" and "order", see, Foucault (1974) and Sheridan (1980).

To relate the changes in technology to changes in skill and, therefore, to the organisation of work, a distinction has to be made between "tasks" and a "job" (see, Davis et al., 1972). To produce a desired product, the raw materials have to undergo a certain number of operations which constitute a production process. Each of these operations is being referred to here as a "task". These tasks may then be combined into various sets and assigned to different workers or groups of workers. It is thus a bundle of tasks that constitutes a job. However, there may be "jobs" in industrial firms where the tasks are not specifiable in advance, e.g. some maintenance jobs. In general, though, the skill component of the organisation of work on the shopfloor refers to the combination of tasks into jobs and the abilities required in performing the jobs. Changes in technology may change the number of tasks or the type of tasks to be performed. This would lead to a change in the task bundles that constituted the jobs before technical change - either because of elimination of some tasks or because of creation of new tasks or both. In some cases this might mean complete elimination of some jobs. The new tasks may be recombined and distributed among the existing set of workers or to a reduced number of workers if some workers are made redundant or transferred because their jobs have been eliminated or some new workers may be hired and the new tasks may be constituted into new jobs for them (see, Bell, 1972). In all the cases the organisation of work would have changed after the technical change because of changes in the skill structure. But what would have determined the skill structure is the manner in which the new set of tasks are recombined into jobs and how they are assigned to the workers. And this is where managerial decisions come in. Managerial decisions relate not only to the generation and choice of technology but also to the distribution of tasks into jobs once the former decisions

have been implemented. There are also other aspects of work organisation besides skill levels of jobs that are influenced by managerial decisions. These are; e.g. the autonomy workers have in performing their jobs, working conditions, promotion prospects of workers, etc. But not all of these are completely determined by managerial decisions.

The basic problem faced by managers in the capitalist labour process is to extract a desired amount of work and ensure desired work behaviour among the workers. What the capitalist can buy while hiring a worker is only the capacity to work over an agreed period of time and not an agreed amount of work (see also, Braverman, 1974). So the capitalists and their managers are faced with not only a problem of extracting[7] a desired amount of work but also of manufacturing this process over time. This is reflected in their aim to maximise profits. It is in maintaining the dynamic of the valorisation process that the capitalists and their managers have to ensure desired work behaviour among the workers. All those strategies, which managers use to ensure desired amount of work and to maintain and encourage desired work behaviour among the workers are referred to in this study as managerial control strategies.

Managerial control strategies can be best understood in terms of the various elements of the disciplinary procedures listed by Foucault (see Chapter 2, Table 2). However, the point to be remembered is that Foucault's procedures of disciplinary control do not exhaust the possibilities of all the control strategies that may be used by managers. In Foucault's scheme, for example, strategies such as using racial

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7. Strictly speaking, "extracting" is a wrong term to use for the valorisation process. Valorisation of capital does not involve a choice; e.g. "extracting" surplus-value only on alternate working days and not doing so on other days. Valorisation is the defining characteristic of the capitalist labour process.

and sexual discrimination, religious and regional consciousness among workers, inter-union rivalry, etc. are not taken into account.

In this study, using the ideas of Foucault, managerial control strategies are seen as a network of strategies ranging from the creation of a particular form of division of labour to policies aimed at maintaining that division of labour over time and ensuring optimum levels of task performance by the workers. Managerial control over the labour process may also be aided by a variety of non-workplace factors. Those managerial control strategies that are constituted in terms of non-workplace factors are referred to in this study as "non-workplace" managerial control strategies. An exhaustive list of these strategies cannot be presented in advance as they would vary with industrial sectors, geographical areas, types of links of the firms with the Government, type of the workforce, etc. Both the "workplace" and "non-workplace" managerial control strategies may be formulated at the levels of a plant, a firm or even an industrial sector.

Workers may respond to managerial control by either accepting it (e.g. imposing self-discipline in work groups) or resisting it. In analysing workers' responses no assumption has been made about their necessarily resisting managerial control. Subsumed under the forms of workers' responses - both at the collective and individual level - are a variety of tactics used by workers to restrict or threaten managerial control; e.g. restriction of production and supervision, sabotage, striking in critical areas, etc. (see Goodrich, 1975).

Having thus defined the categories of analysis used in this study, in the following section the methods of operationalisation of these categories and scope and limits of the analysis are discussed.

Operationalising the concepts:

The concepts that need to be operationalised are that of technology, technical change, skill, organisation of work, managerial control strategies, and forms of workers' responses.

The concepts of technology and technical change were operationalised at the levels of work-stations and workshops. Information was collected about the material transformation process, the material transfer process and the control systems for these two processes at the level of work-stations. Details of patterns and methods of work-flow, and the architectural determinants of work-flow, were collected at the level of the workshops. The sources for information about technical change included interviews with workers, supervisors, managers, company reports, work-flow charts of the workshops being studied and the brief history of the operations of the firm given in the Stock Exchange Official Directory (1980) of the Bombay Stock Exchange. The reliability of the information, ascertained through cross-checking the different sources, did not go back to more than ten years.

So as to be able to analyse aspects of the organisation of work and the skill components of it in a quantitative manner, each job in the workshops being studied was analysed in terms of twenty-eight relevant job attributes and each job attribute was ranked on a five point scale. For this purpose, the job attributes defined by Blackburn and Mann (1979) were adopted with minor modifications. The list of job attributes used in this analysis is given in Table 1. As can be seen from this table, the first four attributes refer to working conditions, and the next two to the physical effort required. Job attributes 7 to 9 in the table refer to the executional abilities required in the job and attributes 10 to 15 refer to conceptual abilities. These are different elements of skill referred to earlier. The next four

attributes refer to the autonomy in the job, the next two to the position in the hierarchy and the two after to the promotion opportunities in the job. The last five attributes - required interaction (with other workers), work cycle length, object variety, responsibility for men and machines, and the irregularity of working hours are attributes that refer to different aspects of organisation of work and they cannot be grouped together meaningfully as the other characteristics above. This set of job-attributes then, provides a framework for specifying the different dimensions of organisation of work and measuring each of them.[8]

As pointed out above, in this set of job attributes, those that refer to executional and conceptual abilities represent the different dimensions of skill. Thus, the extent of the use of these different abilities can now be measured for each job in a workshop or a plant. Admittedly, such a measurement would be comparative and would depend upon the subjectivity of the investigator. But as there can be no absolutes to measure from, one can only hope to standardise the measurements, to whatever extent possible, in a normative sense.

The information regarding the measurement of job attributes was collected by interviewing workers at the different work-stations and by observing each job being performed. However, changes in job attributes have not been studied over time largely because of lack of information and the methodological problems associated with gathering such information.

Managerial control strategies were studied in terms of job classification schemes, methods of recruitment and promotions (including internal labour market structures), methods of setting up optimum levels

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8. See Appendix I for the scoring methods used.

Table 1: List of job attributes

1. Exposure
2. Fumes, dirt, etc.
3. Noise
4. Danger
5. Quantity of physical effort
6. Pace of physical effort
7. Manual dexterity
8. Visualisation
9. Concentration
10. Mathematical calculations
11. Reading, writing
12. Reading technical drawings
13. Memory for rules, routines, procedures
14. Complexity of decision making
15. Learning time
16. Autonomy of decision making
17. Pace choice
18. Supervision (absence of)
19. Optional interaction
20. Promotion time
21. Future promotion chances
22. Position up pay-status hierarchy
23. Promotion from outside
24. Required interaction
25. Work-cycle length
26. Object variety
27. Responsibility for men, materials and machines
28. Irregularity of working hours

of task performance (e.g. time and motion, and method studies), production-incentive schemes, etc. Workers' responses to managerial control were studied in terms of their acceptance of these strategies and their attempts at modification or rejection of these strategies. At the level of a workshop, plant or a firm, this meant analysing the charters of demands submitted by a union and trying to find out the response of managers to them or even those managerial decisions that might have led to some of the demands being made by the workers. General information was collected in a semi-structured manner about managerial control strategies and workers' responses using a variety of sources. These sources ranged from the publication of the employers' organisations, trade union publications, newspaper reports, annual reports of the firms, industrial relations files of the firms, minutes of union-management negotiations, charters of demands put forward by the unions, to interviews with managers, supervisors, trade unionists and other workers. More specifically, at the level of workshops, information was collected about the history of job-classification schemes, incentive payment schemes, time and motion studies, etc. and the response of workers to them. Managerial control strategies which were constituted in terms of "non-workplace" factors were studied in terms of the use of religious and regional consciousness of workers by managers, the links between employers and the Government, etc. Information on these strategies was also collected from some of the above sources.

A summary of the methods used in operationalisation of the different categories of analysis is given in Table 2. The specific context in which these categories of analysis have been operationalised is that of the Indian electrical engineering industry. The choice of this industry and the firms within it are now discussed.

Table 2: The methodology of operationalisation of the categories of analysis used

Category	Type of information needed	Level of information collection	Sources of information
1. Technology/ Technical change	Material transformation process, material transfer process, control systems, arrangement of machines, and methods of workflow	Workstations, workshops	Interviews with workers and managers, company records, workflow charts, and Stock Exchange Directory
2. Organisation of work - incl. skill levels	Job characteristics	Workstations and workshops	Interviews with workers and observation of jobs
3. Managerial control strategies	Organisation and control of work	Industry, area, firm, plant, workshop	Employers organisations, trade unions, newspaper reports, industrial relations files, job classification documents, documents relating to incentive schemes, general observations on the shopfloor, interviews.
4. Workers' responses to managerial control	Response of workers to the organisation and control of work	Industry, area, firm, plant, workshop, trade union	

4. CHOICE OF FIRMS AND SCOPE OF THE STUDY

The Indian electrical engineering industry has been chosen mainly for two reasons. Firstly, because most of the studies of the labour process under capitalism have centred around the industrially advanced countries of Western Europe and North America. The result of this has been that there are hardly any studies of industrial labour processes in countries such as India[9]. And secondly, given the author's training as an electrical and electronics engineer, it seemed a good idea to study the labour process in the electrical engineering industry. Yet another reason was that the electrical engineering industry is a specifically capitalist industry not surrounded by debates about the type of mode of production in existence like studies of agricultural production in India where most of the debates have centred around whether the mode of production is "colonial", "semi-feudal" or capitalist (for a critical survey of the literature see Rudra, 1978; see also Bhaduri, 1973, Patnaik, 1976, and Banaji, 1977).

Be that as it may, the predominant state of the Indian engineering industry is specifically capitalist. Not only do Indian engineering firms export their products to a wide ranging market which includes the Western Capitalist countries (see, for example, Wadhwa and Sharma, 1975), they also compete with other advanced capitalist countries to set up production facilities abroad (for a regional distribution of Indian joint ventures abroad, see Balakrishnan, 1979). The international nature

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9. Except studies like that of Rice (1958) which has been carried out in a consultancy framework and those of Holmstrom (1976) and Sheth (1968) carried out in a social anthropological tradition. While Rice's main concern was the labour process, the latter studies did not explicitly set out to analyse the organisation and control of the labour process.

of capital in the Indian engineering industry along with the preponderance of wage labour, the use of modern techniques of production, and the forms of division of labour all point to a specifically capitalist form of industrial production. Attempts such as that of Mandel (1978) to classify industrial production in India as "semi-colonial" or "dependent" are erroneous. As Banaji (1980) has pointed out, such attempts fail to show why industrial production in India should be classified in this way or what kind of empirical basis has been used for this classification or, more importantly, how such a classification would add to the analytical insights about the accumulation and restructuring patterns of industrial capital in India and the labour processes that go with it.

The scope of the study:

In this study, five electrical engineering firms have been chosen for anslysis. They were "chosen" from the firms listed in the electrical section of the official directory of the Bombay Stock Exchange for 1980. The element of choice was basically quite limited. More often than not, in sociological research of this kind, necessity is made to look like choice. In reality, however, ungovernable factors like managers not wishing to let sociologists loose in their factories - often, not even when they happen to be working in a consultative capacity to the firm - and talk to the workers on the shopfloor or look through company records, constrain whatever choice the researcher might have wanted to exercise in choosing a particular combination of firms according to a set of criteria decided in advance. So in this specific sense, this study is by no means an exception.

In all forty three firms listed in the Bombay Stock Exchange Directory (1980) were asked for access - thirty six of these had their

production facilities within a commutable distance of Bombay, three were in Poona and the other four were in Gujarat. Out of these only eleven agreed to give access to their production facilities and company records. Seven out of the eleven firms were in Bombay. The five firms that were chosen had their production facilities within a commutable distance of Bombay. All of them produce capital goods and at the outset they seemed to offer interesting comparisons between their technology and organisation of work. Two of them were subsidiaries of multi-national corporations, one had been set up with foreign collaboration but had ended it quite sometime before this study was carried out, and the other two were totally indigeneously owned with no collaboration with any foreign firms. At least two of them were market leaders in their field (i.e. the two subsidiaries of multi-nationals) and were basically in a sellers' market. Another of them was planning to diversify its production, while yet another had tried it and failed. And one of them had undergone a protracted industrial dispute over sub-contracting and job-classification less than a year before the field-work for this study was carried out. So, all in all, they seemed an interesting set of firms to study. However, not all the workshops in all the plants of the firms selected were studied. Eleven workshops were chosen from these five firms in a way that would allow interesting and balanced comparisons to be made (see Chapter 5 for details).

In discussing the scope of this study, the first thing that must be noted is that a study such as this one cannot hope to provide a complete theoretical framework to study the labour processes under capitalism. The reasons for such a limitation are the following: First, the time bound nature of the study; second, the lack of required information on the history of technology, organisation, and control of work in Indian industry over a sufficient period of time; and third,

the limited ability of the author in trying to understand different industrial processes. This study does, however, provide grounds for testing some aspects of existing methods of analysing the capitalist industrial labour processes. Within the context of the Indian electrical engineering industry, this study hopes to provide a limited picture of the forms of technology and organisation of work in the industry. Such a picture would be limited because of differences between firms based in the different States of India with different labour-legislations, different histories of workers' struggles, etc. While not denying the specificities of each situation, in the long run, the major trends in the use of technology, organisation of work, trends in managerial control strategies, etc. tend to get generalised in an industrial sector either through employers' organisations, management consultancy firms, trade journals, "area practice" or "industry practice" in industrial relations, or even through the trade unions.

However, it must be pointed out that the investigations in this study are of an exploratory status. There is no attempt - not even for the electrical engineering industry in India - to provide answers to all the possible questions relating to the labour process, or to provide a full picture of changes in the industry. However, this study could provide a valuable starting point towards a better understanding of the labour process in the electrical engineering industry.

There are basically two aspects to this study - a descriptive and an analytical one. At the descriptive level it presents a picture of the work organisation in the capital goods sector of the Indian electrical engineering industry. This has been done by examining, first of all, the job structure in existence. The relationship between the different job-characteristics has been examined to see whether the job-structure is hierarchical or compensatory. Hierarchical job-

structure refers to both desirable job characteristics being found together as well as undesirable job characteristics being found together in a job. Compensatory job structure refers to different jobs having their own attractions; i.e. undesirable job characteristics being compensated by desirable characteristics (see Chapter 6 for details). This, in a sense, provides a picture of the shopfloor jobs in the industrial sector being studied and its relationship to the differences/ divisions within the working class. Attempts have also been made to outline the technology in use, the type of technical changes that have taken place in the last decade, managerial control strategies and their influence on the labour process, and workers' responses to these managerial practices.

At the analytical level, in this study the specific problematic areas of industrial labour processes under capitalism are analysed using the different categories of analysis developed above. The electrical engineering industry in India is used as an illustrative example for this purpose. While, as pointed out earlier, a complete alternative framework is not provided in this study, what is distinctive about this analysis is the assumption that neither the forms of technical change, nor the other managerial control strategies or the forms of workers' responses they might lead to are logically deducible from the concept of "real subordination of labour under capital". Thus, no specific tendencies about the changes in the labour process can be derived in advance (see, Cutler, 1978). This, of course, should not be taken to mean that no trends in the relationship between labour and capital can be specified at all at any historical conjuncture. All that is being said is that no necessary and/or universal trends can be specified.

Working with this assumption, a number of issues relating to the linkages between technology, organisation of work, managerial control strategies and workers' responses to them have been examined. This has meant referring invariably to the existing views of the dynamics of the capitalist labour process.

In studying technology, first the implicit assumption of the Contingency theorists of the existence of a single homogeneous technology within a firm is examined. Even though they do not always specify what they mean by an organisation, their assumption of a homogeneous technology is tested at the level of the firm and plants within the firm. As Blauner's descriptive categories of technology also involve the above assumption, it is also tested for his scheme of classification of technology. In studying technical change, one of the implications of its not being derivable from the concept of real subordination of labour under capital is that specific types of technical change have to be viewed in the dynamics of the market and non-market factors that affect the valorisation of capital. Whatever technical change had occurred in the firms being studied and the types of technical change planned are examined in this context and an attempt is made to test the hypothesis that technical change may be triggered off by workers' resistance.

In examining the linkages between technology, technical change and the organisation of work, the major working assumption was that technology and technical change provide a set of constraints - neither fixed nor determinable in advance - within which work can be organised. The validity of this assumption is examined by analysing both the qualitative and quantitative information related to the firms being studied. In this connection, the conclusion of the 'de-skilling' theorists about the effect of technical change on skills is also

examined by testing the following hypothesis: Technology and technical change affect the organisation of work and the skill components of it in more ways than one. This hypothesis is tested only on a micro-level; i.e. at the level of workshops, using both qualitative and quantitative information. Using job-characteristics data, two more hypotheses related to 'de-skilling' at the level of workshops are also tested. The first of these is that workshops with similar level of mechanisation and making similar products do not have similar organisation of work (including similar skill requirements in jobs). And the second hypothesis is that a higher level of mechanisation does not necessarily mean lower skill requirements.

In analysing managerial control at the workplace, first an attempt is made to point out the operational inadequacies of the categories of managerial control strategies put forward by Friedman and Edwards. In the case of Friedman, it is shown that both the set of categories; i.e. of responsible autonomy, direct control and of central and peripheral workers cannot be easily operationalised. In the case of the framework of Edwards, the hypothesis that a firm may use a combination of the categories of control put forward by him is tested. This is followed by testing the hypothesis that managerial control operates through a set of control strategies rather than through a single homogeneous strategy. Both "workplace" and "non-workplace" strategies are examined in this context. In analysing workers' responses to managerial control, the assumption that workers may not always resist managerial control is examined along with the tactics used by the workers to threaten managerial control.

Thus, in this chapter, beginning with a brief critical examination of the relevant Marxist and the non-Marxist methods of analysing the organisation and control of the industrial labour processes under

capitalism, a set of categories of analysis for use in this study have been developed. These categories, as has been pointed out above, have been operationalised in the context of the capital goods sector of the Indian electrical engineering industry. In the following chapter an attempt is made to provide a background to the operations of the firms in this sector during the nineteen seventies.

CHAPTER 5

THE INDIAN CONTEXT: THE ELECTRICAL ENGINEERING INDUSTRY IN THE SEVENTIES

1. INTRODUCTION

In the previous chapter, a set of categories of analysis were developed to study the organisation and control of industrial labour processes under the specifically capitalist mode of production. These categories of analysis were operationalised in the context of the Indian electrical engineering industry. Before applying these categories to the firms being studied in this chapter an attempt is made to provide the background to the in dustry in terms of the underlying trends in its economic performance and to present a picture of the industrial relations scene in the industry in the context of industrial politics in and around Bombay as well as India as a whole. The period chosen for analysis is the decade of the nineteen seventies for which the relevant information was comparatively easy to obtain.

There are three sections in this chapter. In the first section, the general performance of the Indian engineering industry and within it the capital goods sector of the electrical engineering industry are discussed. It is pointed out that like the rest of the capital goods sector of Indian industry, the capital goods sector of the electrical engineering industry also showed a slowing down of the rate of growth of output and of reduced capacity utilisation in the seventies. The limited evidence available about intra-sectoral differences in profitability and the strategies of firms to overcome the crisis of profitability seems to point to the conclusion that, compared with

the smaller firms, the bigger firms had more choice in restructuring their production. While the smaller firms were in general forced to cut down their levels of production in the seventies, the bigger firms were changing their product-mix by diversifying into specialised and/or higher power rated equipment besides using other methods of restructuring production to keep up their levels of profitability.

In the second section, a brief history of the trade unions in India is presented, followed by a discussion of the industrial relations scene in the seventies. It is pointed out that the failure of the 1974 Railway Strike and the period of internal emergency which followed in its wake, changed the face of trade unionism in the State of Maharashtra - particularly in the Bombay/Thana-Belapur industrial belt. The post-1977 period saw the growth of violent trade unionism in this area with many of the traditionally established unions losing the support of the workers.

In the final and concluding section of this chapter, the five firms chosen for analysis are situated in the context of the capital goods sector of the electrical engineering study and their performance in the seventies analysed. The type of trade unions and changes in union affiliations in these firms during this period are also discussed in this section.

2. INDIAN ENGINEERING INDUSTRY SINCE THE MID-SIXTIES

The organised industry (engineering units covered by the Indian Factories Act of 1948)[1] in India since the mid-sixties has been marked by a slowing down of the rate of growth of output and investment,

1. Units employing 10 or more workers with the aid of power or twenty or more workers without the aid of power on any working day during the year (Majumdar, 1972: 35).

accompanied by vast underutilisation of capacity and only a marginal increase in employment (see, for example, Raj, 1976, and Shetty, 1978).

As Shetty (1978) has pointed out,while sizable capacities had been created in a wide range of organised industries during the Second and Third Five Year Plan periods (1956 to 1961 and 1961 to 1966, respectively), since then the structure of output has moved against the "secondary sector", the registered manufacturing sector, with a substantial part of the capacities created earlier remaining unutilised. The share of this sector in the net domestic product (at 1960-61 prices) has not exceeded the peaks it reached in the mid-sixties - 23.3 percent in 1965-66 and 23.4 percent in 1966-67. Since then this share has moved in favour of the "tertiary" or the services sector within which it is the share of "public administration and defence" which rose fastest between 1965-66 and 1975-76. Moreover, Shetty (1978) has argued that the industrial sector has been marked by two important trends during this period. First, the growth of the basic and capital goods sector has been slower since the mid-sixties than in the preceding decade. And second, where growth has been moderately high, the industries have tended to belong directly or indirectly to high income group oriented consumption goods sectors.

For a large number of capital goods industries, which had shown impressive growth rates during the first half of the sixties, the annual average increase in the decade following 1965-66 was almost insignificant[2] compared to the average from the previous five year period. This was especially so for ferrous metal group industries, industrial machinery manufacture, machine tools, railway equipment,

2. Shetty's (1978) analysis showed that the share of investment goods industries in the total net value added in the registered industrial sector at 1960-61 prices which increased from 31 percent during 1951-53 (average) to a peak of 46.6 percent in 1965-67 (average) declined to 44 percent in 1970-72 (average) and virtually remained at that level till 1974-75.

cement manufacturing, paper mills, etc. The performance of the electrical engineering industry in this respect is shown in Table 1. It is clear from this table that the above observation also holds good for the capital goods sector of the electrical engineering industry; i.e. firms manufacturing power transformers, electric motors and conductors. Compared with the investment goods industries, during the same period, however, there were disproportionately large increases in the output of high income-group consumer goods like synthetic fibres, beverages, perfumes and cosmetics, watches and clocks, and finer varieties of cloth (Shetty, 1978: 18).

In the period of internal emergency in India[3], 1976-77, while the output of the consumption goods sector catering to higher income groups saw tremendous increases, the capital goods and intermediate goods sectors witnessed either an absolute reduction or only moderate increases. Thus, while production of railway wagons declined by 1.6 percent and of railway locomotives by 8.9 percent, the production of cars shot up by 67.6 percent, scooters by 39 percent and jeeps by 17.3 percent (Shetty, 1978). In the electrical engineering industry, in the year 1976-77, when the output of power transformers rose by 8.37 percent and that of electric motors by 1.97 percent, the output of domestic refrigerators rose by 34.9 percent and that of air-conditioners rose by 108.43 percent, (see Table 1).

Admittedly, like the rest of the capital goods sector of the Indian industry, the capital goods sector of the electrical engineering industry also showed a slowing down of the rate of growth of output and capacity utilisation, but it cannot be concluded from this that all the firms in this sector were performing badly in this period. To see how different firms were performing during this period, it is necessary

3. See the following section of this chapter for more details about this period.

Table 1: Trends in industrial output in the electrical engineering industry

Items	Unit	1960-61	1965-66	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	Annual average increase 1965-66 over 1960-61	Annual average increase 1970-71 over 1965-66	Annual average increase 1975-76 over 1970-71	Annual average increase 1976-77 over 1965-66
1. Power transformers	1000 kwa	1413	4458	8086	8871	9712	12418	12533	13927	15092	+43.10	+16.28	+14.45	+21.69
2. Electric motors	1000 hp	728	1753	2721	2348	2768	3239	3644	3610	3681	+28.16	+11.04	+6.53	+10.00
3. Electric fans	100 nos.	1059	1358	1716	2067	2467	2118	2249	2140	2627	+5.65	+5.27	+4.94	+8.50
4. Electric lamps	Mn. nos.	43.5	72.1	119.3	120.6	143.6	120.6	134.0	132.8	161.9	+13.15	+13.09	+2.62	+11.32
5. Radio receivers	1000 nos.	282	606	1794	2004	1826	1765	1949	1536	1684	+22.98	+39.21	(-)2.88	+16.17
6. i) Aluminium conductors	1000 tonnes	23.6	40.6	64.2	79.7	70.0	46.4	28.6	60.9	85.4	+14.41	+11.63	(-)1.03	+10.03
ii) Bare copper conductors	"	10.1	3.1	0.7	0.7	1.0	1.4	1.3	1.3	1.8	(-)13.86	(-)15.48	+17.14	(-) 3.81
7. Domestic refrigerators	1000 nos.	10.1	34.1	NA	86.8	97.7	110.7	106.9	93.2	125.7	+47.52	+25.76**	+ 1.84***	+24.42
8. Air conditioners	1000 nos.	12.1	12.6	17.0*	22.7	22.6	27.7	22.5	8.3	17.3	+0.83	+6.98	(-)10.24	+ 3.39

Notes:

*Includes output in Railway Workshops

**Annual average increase of 1971-72 over 1965-66

***Annual average increase of 1975-76 over 1971-72

Source: Shetty, 1978: 16-17.

to look at the intra-sectoral differences within the capital goods sector of the electrical engineering industry.

Intra-sectoral differences in the capital goods sector of the electrical engineering industry:

In attempting to present a picture of the capital goods sector of the electrical engineering industry in the seventies, two separate points need to be noted at the outset. First, there are in this sector firms of different sizes with different product mixes and thus, it may not be possible to posit a single trend in the output and capacity utilisation for all the firms in the sector. And second, there hardly seem to be any studies of the capital goods producing firms in the electrical engineering industry for the seventies. This makes it extremely difficult to present a definitive picture of what was happening to these firms during this period. However, an attempt has been made here to provide an outline picture based on individual case histories of the firms and the industrial surveys published in the Stock Exchange Official Directory (SEOD) of the Bombay Stock Exchange (1980). A brief discussion of the broad product groups (i.e. motors, transformers, and switchgears) followed by an analysis of the histories of various firms in the capital goods sector of the electrical engineering industry is presented below.

Electric motors are produced in India by both big and small firms. However, there are some types of motors in the lower horse-power ranges that have been reserved exclusively for manufacture in the small scale sector by the Government of India (GOI). These are: A.C. single phase or three phase squirrel cage induction motors up to 10 h.p. and A.C. single phase or three phase squirrel cage fractional horse-power motors

in the range of 1/8 h.p. to 1 h.p.[4]. At the end of 1978-79, the target production for motors was 45 x 10^5 h.p. while the installed and approved capacity was 69.7 x 10^5 h.p. by 1980. There was an overall underutilisation of capacity in the second half of the seventies because of the slackening of the demand for motors (SEOD, 1980). However, along with this must be considered the fact that in 1975, the GOI had permitted diversification in the manufacture of electric motors. Existing firms were allowed to diversify into electric motors up to 1000 h.p. as well as into production of special types of electric motors within their overall licensed capacity[5]. Because of a lack of information about the demand for motors in the greater than 10 h.p. range and the state of the output of the small scale sector, it is difficult to say much about the trends in the capacity utilisation in different size of firms. However, it can be hypothesised that the bigger and technologically advanced firms would be the ones that would have gone in for higher capacity utilisation through diversification in the mid-seventies.

Like the market for motors, there was also a slackening of demand for transformers in the mid-seventies. This slackness continued till the late seventies. Thus, for example, in 1978-79 the production target

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4. Both categories exclude (i) flame proof motors, (ii) specially designed motors for specific duties, (iii) variable speed motors such as poly-changing motors, (iv) loom/textile motors and (v) motors for hermetically sealed and semi-sealed compressors.

5. Industrial licensing was introduced in India to check the pattern of investment and production by attempting to keep them in line with the Five Year Plans and the annual plans formulated by the Government. Industrial licensing is for the creation of a capacity and licensed capacity may not be equal to the capacity used. However, it has been argued that the relaxations in the licensing system in the Seventies made it a totally ineffective instrument of planning (see, for example Economic and Political Weekly 18 January 1975, p.44, and 17 July, 1976, pp.1049-50. See also, Shetty, 1978: 70-73).

was 20 mkVA while the installed capacity in transformers was 24.05 mkVA. In 1975, the GOI allowed diversification into the manufacture of special type of transformers such as flame-proof transformers, dry-type transformers, furnace transformers, rectifier transformers, booster transformers, and reactor transformers up to the range of 220 kV by existing firms. It also permitted the manufacture of 400 kV class transformers by those firms that had already satisfactorily established the manufacture of 220 kV transformers over a period. In either case, given both the type of diversification and the high voltage range of the transformers, it would be unlikely that the smaller firms would have been able to diversify into new type of transformers in the mid-seventies. One of the major reasons for their inability to diversify would have been that their production facilities are suitable mostly for distribution transformers of small ratings.

In the production of switchgears, the capacity in existence for low tension and high tension circuit breakers, motor starters, and contactors has been sufficient in the seventies to meet the demand. However, this seems to be an expanding area and there is scope for both an expansion of existing capacity as well as increasing the production capacity by starting new ventures (SEOD, 1980).

From the above examples, it can be hypothesised that in the capital goods sector of the electrical engineering industry bigger firms had a greater number of strategies open to them in overcoming the slackness in demand for capital goods. An attempt is made below to test this hypothesis using a case study approach. Individual histories of firms are examined to see how they were restructuring their production in the seventies.

Restructuring plans of big and small firms:

Some support for the above hypothesis, though not enough to justify it, can be found by examining the history of some of the big (in terms of net sales and market shares), technologically advanced (continued foreign technical collaboration) and mainly capital goods producing firms in the seventies. Table 2 provides an outline picture of nine such firms and the various strategies used by them to restructure their production. The criteria for selection of these firms are that they are the market leaders in the capital goods sector of the electrical engineering industry, all of them had a net sales exceeding Rs. 200 million in 1979 and all of them had been in operation in India for at least a decade. Between them they shared almost 30 percent of the total value of the sales of motors and 45 percent of the total value of the sales of switchgears in 1979 (CMIE, 1980). It can be seen from Table 2, that not only were these firms expanding their production capacities in the mid-seventies, but also they were modernising their plants and equipment, diversifying into new products, taking over other firms as well as closing down unprofitable plants and subsidiaries.

If the history of diversification of the firms listed in Table 2 is examined in the light of the policies of the GOI for this sector (discussed above) then it does seem that most of the diversification in the mid-seventies was in larger sized and/or special motors and transformers along with newer type of switchgears. This can be illustrated by taking up a few outstanding cases. In the case of the General Electric Company, for example, the 1976-77 diversification was into larger size of transformers, while its 1978-79 diversification was into flame-proof switchgears and other switchgear products (SEOD, 1980). Jyoti Ltd's 1975 diversification and expansion was into D.C. motors

Table 2; Production restructuring in the seventies in some of the big firms in the capital goods sector of the electrical engineering industry*

Firm (net sales in 1979 in mRs)	Product-mix in 1979	Foreign collaboration	Capacity** expansion	Reported modernisation of plant and equipment	Diversification*** into new products	Mergers and take-overs	New ventures $ /investments	Closure of plants/ subsidiaries	Work-reorganisation
1. G.E.C. of India Ltd. (447.12)	Motors, pumps, transformers, switchgears, meters, furnaces, induction heating equipment, fans	GEC, U.K. Radyne Ltd. U.K. (1976-77 only)	1976		1970-71, 73-74, 76-77, 77-78, 78-79	1969	General contract work in Europe, Far East, Africa, Australia, New Zealand		
2. Hindustan Brown Boveri Ltd. (299.90)	Transformers, motors, furnaces, circuit breakers, panels, switchboards and aluminium conductors	Brown Boveri & Co.Ltd. Switzerland	1977		72-73, 75-76, 76-77, 77-78, 78-79		1976-77, 78-79	1977-78	
3. Indian Cable Co. Ltd. (462.09)	Electric cables and wires	British Insulated Callenders' Cables Ltd., U.K.			71-72, 72-73, 74-75, 1978	1972-73	1978		1971-72
4. English Electric Co. of India Ltd. (201.97)	Fusegear, electric distribution equipment, relays and control panels, electronic test equip.	English Electric Co. U.K. (1962-70) Marconi Inst. Ltd. U.K. (1969) GEC, UK, (1970-75)	1974,75, 76	1976	1972, 76-77, 77-78, 78-79				

Firm (net sales in 1979 in mRs)	Product-mix in 1979	Foreign collaboration	Capacity expansion	Reported modernisation of plant and equipment	Diversification into new products	Mergers and take-overs	New ventures /investments	Closure of plants/ subsidiaries	Work-reorganisation
5. Jyoti Ltd (214.6)	Rotating electrical m/cs., switchbears, switchboards, static power convertors, static invertors, furnaces, solar hot water systems	Six different collaborators, at different times between 1959 and 1980 from U.K., France, Austria, Switzerland	1969, 73-74, 74-75, 75-76	1969, 77-78 78-79	1975,76, 77,80		1974-75,76, 77-78,79, 80		
6. Siemens India Ltd. (938.6)	Motors, switchboards, switchgear, railway signalling equipment, electro-medical equipment, marine electrical equipment	Siemens AG, W. Germany	1976,77, 78-79		1969-70, 72-73,73-74, 74-75,75-76, 76-77,78-79		1971-72, 75-76, 78-79		
7. Crompton Greaves Ltd. (896.2)	Transformers, motors, switchgear, motor control gear, metal cased plugs and sockets, power driven pumps	Crompton Parkinson Ltd. UK. Westinghouse Electric Corp. USA	1971-72	1977-78			1977-78 Contract and consultancy work in Libya and Iraq		

Firm (net sales in 1979 in mRs)	Product-mix in 1979	Foreign collaboration	Capacity expansion	Reported modernisation of plant and equipment	Diversification into new products	Mergers and take-overs	New ventures /investments	Closure of plants/ subsidiaries	Work-reorganisation
8. Kirloskar Electric Co Ltd. (336.1)	Transformers, motors, generators, alternators, control equip.	Five different collaborators between 1961 and 1979 from UK and USA	1976-77		76-77, 78-79		1968-69, 76-77, 78-79		
9. Larsen & Toubro Ltd.$$ (1143.4)	Switchgear, motor starters, circuit breakers, nuclear equip. chemical and agricultural equipment	Many different collaborators from USA, France, Denmark and Switzerland	1977-78	1969-70, 72-73, 74-75, 78-79	Every year since 1969-70	1969, 70, 72	1970-71, 72-73, 73-74, 77-78, 78-79	1979	1976-77

Notes: *This table is bound to be an underestimate of the plans of these firms as it relies only on published information and not on the internal documents of the firms,

**Given the kind of information available it is not possible to distinguish between expansion of capacity for existing products from capacity expansion due to diversification.

***This category does not provide details of the number of new products as in any given year firm may have diversified into more than one product every year.

$ Includes starting new plants/subsidiaries, and investing in other firms either in India or abroad.

$$ Larsen and Toubro is not listed in the ""Electrical Equipment and Cables" section of the SEOD (1980).

Sources: 1. SEOD (1980).
2. Various issues of Economic and Political Weekly from 1970 to 1979.
3. Various issues of The Economic Times, Bombay from 1970 to 1979.
4. Annual reports of the firms.

and centrifuge motors for sugar industry. Its 1976 diversification was into ceramics, high tension motors, 33 kV outdoor current transformers, static excitation units for generators and air-blast circuit breakers. In the case of Siemens India Ltd., nearly twenty new types of motors were introduced between 1975 and 1980 along with the introduction of Thyrister controlled drives, explosion-proof starters for motors and variable speed drive systems. Hindustan Brown Boveri Ltd. diversified in 1975-76 into production of slip-ring motors, in 1976-77 into high voltage air-blast circuit breakers and instrument transformers up to 420 kV, in 1977-78 into medium voltage minimum oil circuit breakers, and in 1978-79 into protective relays.

The limited evidence available seems to point to the fact that during the seventies, and particularly in the second half of the decade, the more competitive and technologically advanced firms were not only expanding their production but were also using other methods of restructuring it.

To get a picture of the smaller firms in the capital goods sector of the electrical engineering industry, individual histories of firms with a net sales of less than Rs. 100 million in 1979 were examined in the Stock Exchange Official Directory (SEOD, 1980). They show that the smaller firms had to bear the brunt of the recession in the motor and transformer market in the mid-seventies. Most of them had to cut down their production and had to offer higher rates of discount on whatever amount they could sell because of the increased competitiveness in the market. This, coupled with their inability - both financial and technical - to diversify into specialised and/or bigger motors and transformers led them to make either net losses or barely break even in the latter half of the seventies[6]. In switchgear production, there

6. See, for example, the case of Jyoti Electric Motors Ltd., Biecco Lawrie Ltd., and National Electrical Industries Ltd. (SEOD, 1980).

are very few small firms. And these manufacture items like iron-clad switches and switch-fuse units which do not require the same kind of high tecnological input as the different types of low tension and high tension circuit breakers, motor starters and contactors manufactured by the bigger firms. For these and other products manufactured by smaller firms, e.g. single and poly-phase meters, they have to rely largely on the State Electricity Boards (SEBs) as their customers and they can be quite unreliable. In the seventies, cancellation or suspension of orders by the SEBs meant retrenchments, industrial strife and gross underutilisation of the installed capacity for some of these firms. To survive in the market, some of them had to diversify into consumer goods like wall-clocks.[7]

As far as the winding wires and cable manufacturing firms are concerned, they seemed to have been plagued by the problems of non-availability of aluminium, PVC and polythene in the period 1972-73 to 1975-76 and thereafter by a fall in demand for power cables and winding wires. For this group of products it seems that the ability to maintain profit levels depends upon the ability of a firm in changing its product mix both in volumetric and qualitative terms. Once again, while the larger firms had both the flexibility to diversify as well as change the volumetric composition of their existing products according to varying market conditions both at home and abroad, the smaller firms had to suffer the vagaries of the market. It is difficult to single out any small firms manufacturing cables or wires in the seventies, that made any substantial net profits during this period.[8]

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7. Two classic cases being that of Electrical Instruments Manufacturing Co. Ltd. and Baroda Electric Meters Ltd. (SEOD, 1980).

8. See especially the cases of Gangappa Cables Ltd., Omega Cables Ltd. and Deepak Insulated Cable Corporation Ltd. Of the smaller firms only Traco Cables Company Ltd. seems to have come out of its troubles in the mid-seventies because of diversification into dry-core paper-insulated lead-sheathed telephone cables and jelly-filled telephone cables (SEOD, 1980).

To summarise this section then, it was seen that the aggregate trend for the output and capacity utilisation in the capital goods sector of the electrical engineering industry was the same as that for the capital goods sector of the Indian industry as a whole since the mid-sixties. A disaggregated picture of the capital goods sector of the electrical engineering industry showed that at least during the seventies, the bigger and technologically advanced firms were actually expanding their capacity utilisation while the smaller firms were cutting down on it. Given the slackness in demand for capital goods of the electrical engineering industry in the mid-seventies, it was seen that the two types of firms had different strategies open to them to overcome market pressures. Because of the policies of the GOI in allowing diversifications into specialised and/or higher power rated capital goods, the bigger firms used this as a major strategy of restructuring their production. The other strategies of restructuring production used by the bigger firms were: Modernisation of plant and equipment, work reorganisation, mergers and take-overs, starting new ventures and investing in other firms, and closing down unprofitable plants and subsidiaries. The smaller firms had to bear the brunt of the recession in the market and had extremely limited choices in trying to overcome market pressures. The strategies used by them ranged from cutting down production levels, offering greater discount to their customers, and retrenching some of their workers.

Having thus described the market conditions within which the capital goods producing firms of the electrical engineering industry were operating during the seventies, an attempt is made below to describe the industrial relations scene to the context of industrial politics for these firms.

3. INDUSTRIAL RELATIONS SCENE IN THE SEVENTIES

Although an attempt is made in this section to provide an outline picture of industrial relations for the whole of India, the specific focus of this discussion is Maharashtra. This is so not only because the firms chosen for analysis in this study are situated in Maharashtra but also because it has been the most important site in India in terms of setting the pattern for industrial relations in the rest of the country.

As compared to the other states of India, Maharashtra is fairly important in terms of its industrial base. If only the capital goods producing firms in the electrical engineering industry are considered, Maharashtra ranked second after Karnataka in terms of the relative regional concentration of this sector (see Alagh et al., 1971). The measure used by Alagh et al. for assessing the relative regional concentration of an industrial sector was an employment percentage ratio called "location quotient". The numerator of this ratio was the percentage of a State's total employment accounted for by the given industrial sector, and the denominator of the ratio indicated the percentage of the total manufacturing employment of the country accounted for by the same sector. No such information is available for this sector in the seventies. However, if the geographical distribution of the manufacturing facilities is examined[9], then it becomes evident that nearly thirty-six percent of them are based in the

9. Based on a regional classification of the location of "factory and works" of the electrical engineering firms listed in the SEOD (1980), it was found that there were 45 electrical engineering factories in Maharashtra and 81 in the rest of the States of India. Of the 45 in Maharashtra, 30 were in the Bombay/Thana-Belapur area. A single firm may have a number of factories spread over the different states of India. All of them have been counted separately unless they happen to be in the same city or town.

State of Maharashtra. And of those in Maharashtra, more than sixty-five percent are based in the Bombay/Thana-Belapur region of Maharashtra. Thus, it can be seen that Maharashtra and particularly the latter region in Maharashtra are relatively quite important in terms of the electrical engineering industry in India. And it is in the Bombay/Thana-Belapur region of Maharashtra that the firms chosen for analysis in this study are located. In terms of industrial relations too, this region is quite important. It is said that Bombay has always set the pattern for industrial relations in India (see, Economic and Political Weekly, June 4, 1975: 904-906). And this is not without any basis. For example, the continuing influence of the Maharashtra Recognition of Trade Unions and Prevention of Unfair Practices (MRTUPUP) Act of 1971 on the labour legislations in the rest of India cannot be easily denied (see subsequent discussion).

Before going on to discuss the industrial relations scene in the seventies, at this point it may be interesting to present a chronology of the emergence of different central trade union organisations in India.

Structure and emergence of trade union organisations:

While at the level of factories, trade unions are organised according to the provisions laid down in the Trade Unions Act of 1926, whereby any seven workers in a factory can come together, adopt a standard constitution and get themselves registered as a union with the Registrar of Trade Unions[10]. However, most of these factory level unions tend to align themselves to a central organisation of trade unions. The history of these organisations has been one of continual splits (see Karnik, 1978).

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10. In Maharashtra, however, only the majority union in a factory/firm can be recognised as the negotiating union.

Before Independence; i.e. before 1947, there were two central trade union organisations in India - the Indian Federation of Labour (IFL) and the communist dominated All India Trade Union Congress (AITUC). After the partitioning of India at the time of Independence, the IFL split into two, retaining only a small membership in India. With the coming into power of the Congress Party, a new trade union organisation affiliated to it came into being - the Indian National Trade Union Congress (INTUC). The period following 1947 saw the decline of AITUC. This decline was the result of the imprisonment by the Indian Government of many of the leading communist activists of the AITUC for 'anti-State activities'. These activities followed from the Communist Party of India categorising the Congress Government in power as fascist (Karnik, 1978: 180).

Some Socialists who were in the Congress Party before the Independence broke away from it and formed their own national trade union organisation called the Hind Majdoor Panchayat which merged with the IFL to form the Hind Majdoor Sabha (HMS) in the latter half of 1948. In the same year a breakaway group from the AITUC formed itself into the United Trade Union Congress (UTUC) but its support amongst the workers was limited largely to the two states of West Bengal and Kerala.

In 1955, the Bharatiya Majdoor Sangh (BMS) was formed. The ideology of this trade union organisation came very close to that of the Rashtriya Swayamsevak Sangh (RSS - literally, the National Volunteers Organisation), which has a strong Hindu-Chauvinistic tradition, and its virtual political front the Jana Sangh[11] (literally translated it means

11. Now, most of its members are in the Bharatiya Janata Party and the Jana Sangh no longer exists. The Jana Sangh merged into the Janata Party in 1977 which later split into the Janata Party and the Bharatiya Janata Party.

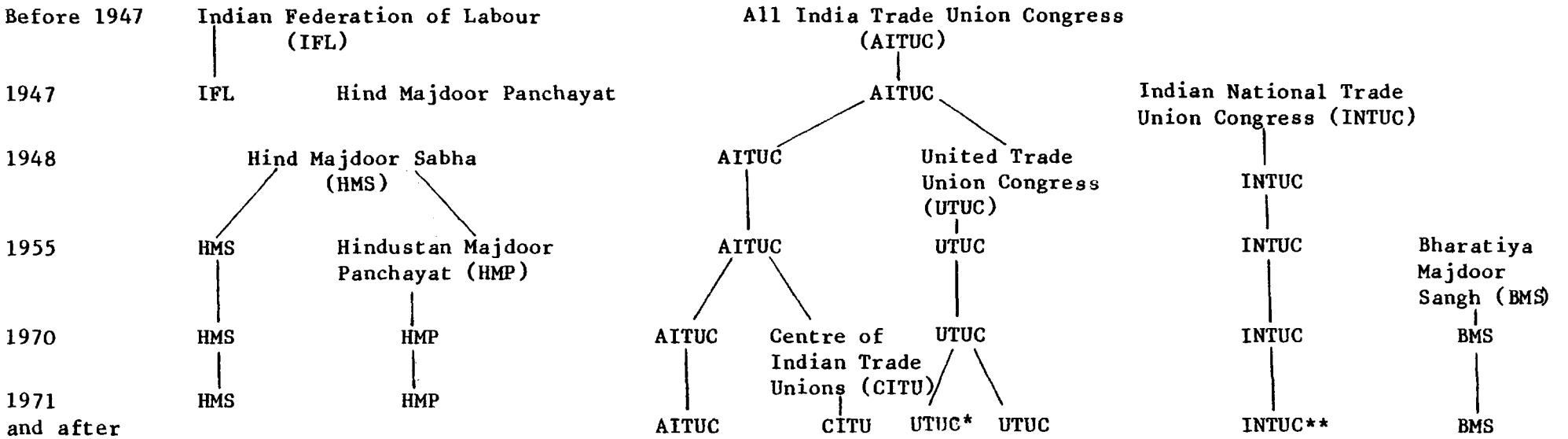
the People's Organisation). In the meantime, the Socialists had walked out of the HMS to form yet another trade union organisation called the Hindustan Majdoor Panchayat (HMP). In the sixties, the HMP became one of the most powerful unions in Maharashtra.

With the split in the international communist movement; i.e. between the USSR and China, the CPI also split into two - resulting in the formation of the Communist Party of India - Marxist (CPI-M). Although the CPI remained in overall control of the AITUC, factional fights began in the AITUC, and as the CPI-M sympathisers could not get overall control of the organisation in 1970 they formed the Centre of Indian Trade Unions (CITU). In 1971, UTUC split into two and this year also saw the emergence in Maharashtra of the Bharatiya Kamgar Sena (BKS) backed by a chauvinistic political party called the Shiv Sena (see Table 3 for the schematic family trees of the major national trade union organisations).

The seventies also saw the emergence of the Association of Engineering Workers (AEW) and other related unions led by Dr. Datta Samant in Maharashtra. While it is difficult to keep a track of the ups and downs in the membership of the different unions, in 1982 the claimed (and unverifiable) membership of the five big unions was as follows: INTUC, 2.4 million, BMS, 1.8 million, CITU, 1.7 million, AITUC, 1.4 million, and Dr. Samant's unions, 1.4 to 1.6 million (see, India Today, 28 February 1982: 50).

Having thus described briefly the emergence of the major trade union organisations in India, it must be pointed out briefly that there exists in India an elaborate machinery set up by the Government for the "prevention and settlement" of industrial disputes (see, The Indian Labour Year Book 1977, 1979). This can be broadly classified into

Table 3: Evolution of the major national trade union organisations in India since 1947



Notes: *This split took place in 1971 with both the factions claiming to be the real UTUC. Both had their head offices in Calcutta but on different streets - one on Lenin Sarini and the other on Ganguly Street (Karnik, 1978: 378).

**Exists as more than one organisation with different groups affiliated to the different Congress Parties.

Source: Karnik (1978).

(i) consultative machinery and (ii) conciliation or arbitration machinery. The consultative machinery exists at the levels of the firm, industry, state, and the nation. At the level of the firm, there are Works Committees and the Joint Committees; at the industrial level, there are the Wage Boards and Industrial Committees; at the State level, there are the Labour Advisory Boards and at the National level, there are the Indian Labour Conference and the Standing Labour Committee. The Industrial Disputes Act of 1947, lists the provisions for adjudication and arbitration of industrial disputes through the conciliation machinery. The provisions of this Act range from setting up codes of conduct to setting up industrial tribunals and labour courts (for details, see The Indian Labour Year Book 1977, 1979).

In order to give an idea of the extent and type of labour laws applicable to workers in Maharashtra in particular, a list of the major labour laws has been presented in Table 4. As can be seen from this table, the extent of these laws is quite wide and the area they cover most intensively is of wages and benefits to workers. While it is not possible to go into the detail of all these labour laws, some of the relevant laws have been referred to in this study as and when necessary.

Industrial disputes in the seventies:

While it is not possible to go into great detail about the changing nature of Government intervention in industrial relations, to understand the nature of the industrial disputes in the private sector of the Indian industry in the seventies, it would perhaps be worthwhile to begin by examining the trends in the different indicators of the formal or reported industrial disputes (strikes and lockouts are combined together) in this sector during this period (see Table 5).

Table 4: List of the major labour laws applicable to industrial workers in Maharashtra.

1. The Trade Union Act, 1926.
2. The Industrial Disputes Act, 1947.
3. The Maharashtra Recognition of Trade Unions and Prevention of Unfair Labour Practices Act, 1971.
4. The Factories Act, 1948.
5. The Industrial Employment (Standing Orders) Act, 1946.
6. The Contract Labour (Regulation and Abolition) Act, 1970.
7. The Employment Exchanges (Compulsory Notification of vacancies) Act.
8. The Payment of Wages Act, 1936.
9. The Minimum Wages Act, 1948.
10. The Workmen's Compensation Act, 1923.
11. The Maternity Benefit Act.
12. The Employees' Provident Funds Act, 1952.
13. The Employees' State Insurance Act, 1948.
14. The Employees' Deposit-Linked Insurance Scheme Act, 1976.
15. The Employees' Family Pension Scheme Act, 1971.
16. The Payment of Bonus Act, 1965.
17. The Payment of Gratuity Act, 1975.
18. The Bombay Labour Welfare Fund Act, 1970.
19. The Income Tax Act.
20. The Maharashtra State Tax on Professions, Trades, Callings and Employment Act, 1975.
21. The Employment Guarantee Tax Act.

It can be seen from Table 5 that there was a drop in the number of disputes from 1970 to 1971. This can be explained in terms of the war with Pakistan in 1971 - a situation in which the appeal to nationalism is likely to have been used to keep the disruptions in production down. While the number of disputes increased in 1972, thereafter they followed a downward trend till 1976. In the period 1972-74, from the increase in the number of man-days lost coupled with a decrease in the number of disputes, it would seem that this was the combined effect of disputes in 1972-73, in particular, being in firms with a larger number of workers as well as of the fact that they became more protracted during 1972-73. The unusual decline in all the indicators of industrial disputes in 1975-76 can be explained by the state of internal emergency proclaimed by the Indian Government which made strikes virtually impossible but did not affect the number of lockouts and retrenchments in the same way. The sudden increase in the number of disputes in 1977 was because of the lifting of the state of internal emergency. Table 6 shows that virtually the same trend was followed by industrial disputes in Maharashtra.

As pointed out earlier, the case of Maharashtra remains special inasmuch as the industrial relations scene in Maharashtra has prefigured the events in the rest of India. To take an example, it was in 1975 that the Maharashtra Recognition of Trade Unions and Prevention of Unfair Labour Practices Act of 1971 came into effect. The provisions of this Act were realised in their fullest when strikes were made virtually impossible during the "emergency"[12]. Even as late

12. Of course, this is not to suggest that the state of internal emergency was imposed on the whole country because of this Act. That would be an absurd suggestion. However, a lot of what was hinted at in this Act became realisable in the conditions prevailing in 1975-76.

Table 5: Industrial disputes in the private sector of the Indian industry (1962-77)

Year	No. of disputes	Change over the preceding year (%)	Maximum no. of workers involved (10^5)	Change over the preceding year (%)	No. of man-days lost (10^6)	Change over the preceding year (%)	Average no. of workers per dispute	Change over the preceding year (%)
1962	1314	-	5.71	-	5.59	-	439	-
1963	1354	+3.04	4.95	-14.21	2.99	-46.51	365	-16.86
1964	1897	+40.10	8.49	+71.51	6.97	+133.11	447	+22.47
1965	1637	-13.71	8.90	+5.77	5.77	-17.22	543	+21.48
1966	2211	+35.06	11.70	+31.46	12.57	+117.85	529	-2.58
1967	2374	+7.37	11.23	-4.02	14.61	+16.23	473	-10.59
1968	2390	+0.67	12.35	+9.97	15.27	+4.52	516	+9.10
1969	2238	-6.36	14.90	+20.64	17.62	+15.39	666	+29.07
1970	2443	+9.16	13.89	-6.78	18.50	+4.99	569	+14.56
1971	2367	-3.11	12.51	-9.94	14.29	-22.77	529	-7.03
1972	2705	+14.28	13.21	+5.60	17.20	+20.36	488	-7.75
1973	2656	-1.81	17.57	+33.00	17.23	+0.17	661	+47.54
1974	2341	-11.86	14.85	-15.48	27.17	+57.69	634	-4.08
1975	1581	-32.46	8.22	-44.65	19.75	-27.31	519	-18.14
1976	1306	-17.39	5.89	-28.35	11.87	-39.90	451	-13.10
1977	2454	+87.90	12.43	+111.03	20.85	+75.65	507	+12.42

Sources: 1. 1962 to 1967: Calculated from The Indian Labour Year Book 1970 (1972).

2. 1968 to 1977: Calculated from The Indian Labour Year Book 1977 (1979).

Table 6: Industrial Disputes in Maharashtra

Year	No. of disputes	Change over the preceding year (%)	Maximum no. of workers involved (10^5)	Change over the preceding year (%)	No. of man-days lost (10^6)	Change over the preceding year (%)
1969	646	-	2.08	-	1.27	-
1970	704	+8.98	3.88	+86.54	2.36	+85.83
1971	717	+1.85	4.65	+19.85	2.18	-7.63
1972	881	+22.87	4.36	-6.03	3.61	+65.60
1973	833	-5.45	5.27	+20.87	3.62	+0.28
1974	732	-12.12	5.53	+4.93	10.49	+189.79
1975	519	-29.10	1.51	-72.69	1.40	-86.65
1976	351	-32.37	1.66	+9.93	0.56	-60.00
1977	553	+52.54	5.00	+201.20	3.09	+451.79

Sources:

1. 1969: The Indian Labour Year Book 1970 (1972).
2. 1970: The Indian Labour Year Book 1971 (1973).
3. 1971: The Indian Labour Year Book 1972 (1974).
4. 1972: The Indian Labour Year Book 1973 (1976).
5. 1973: The Indian Labour Year Book 1974 (1977).
6. 1974 and 1975: The Indian Labour Year Book 1975 (undated).
7. 1976 and 1977: The Indian Labour Year Book 1977 (1979).

as 1981, the provisions made in this Act were used to formulate a national bill banning strikes in "essential services" - which included defence production, railways, atomic energy, posts and telegraphs, water supply and any other sector declared an "essential service" sector by the Government. However, in 1975, this Act was used by the Government in an attempt to reduce inter-union rivalry in firms by laying down guide-lines for the recognition of a single union for negotiations with the management of every firm in Maharashtra. Through this Act the Government of Maharashtra also sought to curtail the activities of the workers by defining strategies such as "go-slow", "work-to-rule", "gherao"[13], occupying the workplace after working hours, staging demonstrations at the residences of the employers or the managerial staff, etc. as unfair labour practices. By trying to make these tactics of workers punishable, the Government of Maharashtra sought to remove from the workers some of the most effective methods of threatening managerial control at the workplace.

However, the context of industrial relations in Maharashtra in the latter half of the seventies was determined not only by the above Act but also by the failure of the railway strike in 1974. The show of "strength" by the Government in dealing with the railway workers and their families in May 1974, determined the level of working class resistance for the next few years in India.

It was on 23 April 1974 that the Socialist-dominated All India Railwaymen's Federation served a strike notice on the Government threatening to go on a nationwide strike from 8 May 1974. They were demanding a higher annual rate of bonus payment, need-based minimum wage,

13. Literally, "encirclement". A practice of encircling managers in their offices till they conceded the demands of workers developed in the sixties.

an eight hour working day, and the treatment of railway staff on a par with industrial workers. Although the strike limped along for 20 days, here is how the situation was described during the first two weeks of the strike:

> "Reports received from practically all over the country indicate the thoroughgoing manner in which the Railway Protection Force, the Border Security Force, and the Territorial Army, apart from the regular units of the Police, have raided the workers' colonies, terrorised the inmates, tortured relatives of railway employees in order to bully them back to work: physical belabouring, summary evictions, and indiscriminate arrests have been the order of the day" (Economic and Political Weekly, 25 May 1974: 817).

By the fourth week of May, 15,000 railway workers - mostly union activists - had been served with dismissal notices and nearly 50,000 had been arrested. In that week, India also exploded its first nuclear device, thus joining the exclusive nuclear club (see, Economic and Political Weekly, 8 June 1974). These two events can be said to have been used by the Government of Mrs. Gandhi to reassert its power at a time when its credibility was being questioned by a growing political movement. It was definitely in the buoyant mood following the breaking up of the railway strike that the Government was able to make confident statements about the need and feasibility of an unqualified wage freeze (see, Economic and Political Weekly, 15 June 1974).

It was to be nearly a year before the Government was able to do that in the wake of the declaration of a state of internal emergency on the night of 25 June 1975. This led to mass arrests of the leaders and activists of the political parties in opposition and trade unionists.

What implications did the "emergency" have for industrial relations? According to a colloquium organised by the Indian Society of Labour Economics in February 1976 on "Emergency and Labour", during the period July to October 1975 there were sixteen percent less industrial disputes as compared to the corresponding period for 1974. But more importantly,

it was pointed out that a "significant aspect of the disputes between July-October 1975 was that the number of workers involved and as a result man-days lost declined by over sixty-six percent and forty-two percent respectively as compared to the corresponding period of 1974" (Ashraf, 1975-76: 523). It was agreed by the colloquium that there was greater industrial peace because there were no strikes[14] even though there were lockouts and retrenchments. It was also reported that during this period the productivity had gone up and the wages of workers had remained constant. In fact, it was pointed out that in some cases workers had not been paid their wages for the "past several months" (Ashraf, 1975-76: 521-523).

Thus, it can be seen that the state of emergency provided employers with a new set of strategies to control workers as any disruption in production could easily be construed as a threat to the internal security of India. In an environment where a mere casual anti-Government remark could land a person in jail under the Maintenance of Internal Security Act and the Defence of India Rules, it was not surprising that employers were not only able to "discipline" workers by methods ranging from lockouts and retrenchments to lay-offs (see, Economic and Political Weekly, 30 October 1976) but at times when they could not control their union activists they sought the help of the Government to do so[15].

After the state of internal emergency was lifted and Mrs. Gandhi's Government was defeated in the general elections in March 1977, the

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14. Refers only to the period till 22 February 1976 when the colloquium was held.

15. This happened at least in one of the firms chosen for analysis in this study (see the subsequent chapters on managerial control of the labour process).

industrial relations scene changed once again as it became possible for the workers to go on strike without the fear of being put into jail without a trial as would have happened during the "emergency". Although the number of industrial disputes went up in 1977 compared to the previous two years, the magnitude of the change was not as dramatic as made out by some industrialists[16]. In fact, the level of all indicators - the number of disputes, the number of man-days lost, and the number of workers involved - remained lower than their pre-"emergency" levels in the private sector. Only in the public sector did the number of workers involved and the number of man-days lost exceed their pre-1974 levels[17] (excluding 1974 as a statistically exceptional year because of the nationwide railway strike).

16. For example, the Chairman of Mukund Iron and Steel Works Ltd., Bombay, Mr. Viren J. Shah, M .P., said in his statement for 1977-78: "Industrial relations in India touched their nadir in 1977-78. A wave of labour unrest swept across the country soon after the Emergency. Both in range and fury it was unprecedented. Lockouts, strikes and violence made daily headlines in newspapers" (Chairman's Statement 1977-78, Mukund Iron and Steel Works Ltd., Bombay, 21 October 1978).

17. Industrial disputes in the public sector in the seventies were as follows:

Year	No. of disputes	Maximum no. of workers involved (10^5)	No. of man-days lost (10^5)	Average no. of workers per dispute
1970	446	4.39	20.62	984
1971	385	3.63	22.53	943
1972	538	4.16	33.46	773
1973	714	7.89	33.92	1105
1974	597	13.69	130.88	2293
1975	362	3.21	21.45	886
1976	153	1.48	8.72	967
1977	663	9.50	44.71	1433

Sources: Same as Table 5.

There were perhaps some qualitative differences in the industrial relations scene that emerged in the post-"emergency" period in the Bombay area. One of the unions that emerged stronger in this period was the Association of Engineering Workers (AEW). In the smaller firms, some of the traditionally recognised unions began losing grounds to the AEW. While it is difficult to provide a detailed history of the emergence of the AEW, it can be reasonably concluded that one of the major reasons for the rise of the AEW was the spectacular wage settlements negotiated by it for the workers. It has a reputation for quick and successful wage settlements even though its successes have been accompanied by charges of intimidation, physical assaults and murders of not only managers but also of activists of rival unions.

If the industrial relations situation in the Bombay/Thana-Belapur area is analysed for the period immediately following the "emergency" - April to December 1977 in this case - then it becomes evident that the AEW played a leading role in the industrial disputes that occurred in this period in this industrial area (see Tables 7 and 8). The AEW, which was initially more successful with smaller firms, by 1982 had started making inroads into the bigger firms in this area and had become one of the most powerful unions in the whole of Maharashtra (see, India Today, 28 February 1982).

Although the President of the AEW has been described as "the biggest redistributor of income since trade unionism started" (India Today, 28 February 1982), the spectacular wage settlements of the AEW must be seen in the specific contexts of the firms concerned. In the case of the bigger firms where the AEW has been able to increase the wages of its members, such wage increases have gone together with

Table 7: Strikes, lockouts and closures in the Bombay/Thana-Belapur industrial belt* (April to December 1977)

(1)	Total (2)	Share of the Association of Engineering Workers (AEW) (3)	% share of AEW in (2) (4)
1. Total no. of units directly affected by industrial disputes	114	56	49.1
Of which:			
(a) Strikes	75	39	52.0
(b) Lockouts	29	12	41.4
(c) Closures	10	5	50.0
2. Number of workers affected	53,473	25,118	47.0
3. Number of man-days lost ($x10^6$)	2.57	1.41	54.9
4. Approximate production losses (million Rs)	101.87	66.54	65.3

Notes: *The figures given include 32 small firms for which the value of loss of production was not readily available. The value of loss of production for these firms was calculated on the basis of number of workers employed, days lost and norms of production in similar industries. This comes to approximately Rs 1.80 million out of the total production loss of Rs 101.87 million.

Source: Unpublished data. Collected by the office of the Chairman of an engineering firm in Bombay.

Table 8: Industrial disputes in the Bombay/Thana-Belapur industrial belt by trade union affiliations (April to December 1977).

Union affiliation	No. of firms	No. of workers affected	No. of mandays lost (10^5)
1. Indian National Trade Union Congress	9	4585	2.73
2. All India Trade Union Congress	2	195	0.05
3. Centre of Indian Trade Unions	25	9700	4.34
4. Hind Majdoor Sabha	5	1020	0.22
5. Sarva Shramik Sangha	4	912	0.16
6. Bharatiya Kamgar Sena	4	6695	1.76
7. Association of Engineering Workers	56	25118	14.10
8. Engineering Majdoor Sabha/ Kamgar Sabha*	5	1838	1.17
9. Internal Union	1	20	0.02
10. Others	3	3390	1.11
Total	114	53473	25.66

Notes: *Both the unions are part of a single structure led by the same person.

Source: Same as Table 7.

higher productivity in the post-strike period[18]. Production linked wage increases - though the link may not be directly specified - have in general been on an increase in the seventies. According to the President of two other independent unions in Maharashtra - the Engineering Majdoor Sabha and the Mumbai Majdoor Sabha, assurances of high productivity in return for wage increases and job security have become the distinguishing feature of trade unionism in Bombay[19]. Banaji (1980) has pointed out that such settlements have tended to characterise the bigger firms in the seventies: "In the sector of modern large firms the classically repressive and authoritarian strategy of resisting wage increases at any cost has slowly given way to a more flexible, and for capital, more rational, strategy of conceding wage increases against concommitments on productivity and discipline. Today agreements signed with unions will typically have a clause announcing: Union and workmen shall fully co-operate with the company to achieve maximum production and to maintain and promote discipline and industrial peace" (Banaji, 1980: 11).

Thus, it would seem that the spectacular wage settlements of the AEW may be a result both of the allegedly violent methods used by it as well as of the high wage strategy of bigger firms to control workers. In general, however, it seems that in the seventies the successful unions have been those that managed to negotiate high wages for their

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18. In the case of Premier Automobiles Ltd., the production level went up to 74 cars a day compared to 62 before the strike and the truck output doubled to 10 a day. At W.G. Forge Ltd., production doubled to 900 tonnes a day after the AEW settlement. Similarly at Associated Capsules, the productivity increased after a wage-settlement with the AEW (see, India Today, 28 February 1982).

19. Based on an interview with Mr. R.J. Mehta, President of the Engineering Majdoor Sabha and the Mumbai Majdoor Sabha.

members[20] (see, Sunday, 7 September 1980). Wherever these high wages have gone together with increases in productivity because of intensification of labour, they are likely to aid managements in making firms more productive. The limited evidence available, points to this being happening in the bigger firms. For the smaller firms, there is very little evidence of the nature of industrial relations that exist in them. However, given the growth of subcontracting activities in the seventies it seems unlikely that they would have followed a high wage strategy (Banaji, 1980). It is more likely, as Banaji points out that would "show a strong resistance to unionisation - invariably threatening to close down, often actually closing down, or otherwise attempting to smash the union prematurely through wholesale victimisation that might cut their workforce by half" (Banaji, 1980: 13).

The three important aspects of industrial relations in Indian industry that have been pointed out in this section are the following. First, most trade unions in India are affiliated to political parties. Second, the Government plays an important role in industrial relations both in terms of legislations covering wages and other benefits for the workers as well as formulating laws regarding recognition of trade unions and declaring certain practices in industrial disputes as legal or illegal. And third, the late seventies showed tendencies towards a major shift in trade unionism in India with the emergence of independent trade unions like the Association of Engineering Workers (AEW). The implication of the first aspect is that because of the

20. "We can't eat ideology", was how some activists of the AEW described their approach to trade unionism. These activists apparently had left the Centre of Indian Trade Unions (affiliated to the CPI-M) to join the AEW. This statement more or less sums up the AEW approach to trade unionism (see, Sunday, 7 September, 1980).

political affiliations of the unions, the national or state-level politics seems to affect trade unionism at the level of an industry or a firm. The implication of the second aspect, i.e. the involvement of the Government in industrial relations, is that Government policies may directly affect the forms of workers' responses to the labour process as well as the nature of managerial control strategies at the workplace. And lastly, the emergence of new and independent unions like the AEW with their allegedly violent methods not only points towards the increasingly economistic demands of the workers but the success of the AEW with the larger firms, where high wage increases have gone together with assurances of increased productivity, may point towards a high wage strategy being used by these firms to control the workers.

Having thus sketched a brief outline of the industrial relations scene in the Indian industry in the seventies in this section and of the output and market trends in the previous section, now an attempt can be made to situate the firms chosen for analysis in this study in the above context.

4. THE FIRMS BEING STUDIED

The manner in which the firms that are being analysed in this study were chosen has already been described in the last chapter. As is common in sociological research of this kind, access to company records and workshops was granted on the condition that the identities of the firms would not be divulged. Hence the five firms being analysed here have been called A, B, C, D and E. Details about the foreign technical collaboration of these firms in the seventies, their major products, and the plants and workshops studied in them are listed in Table 9.

Table 9: Some general details about the firms chosen for analysis

Firm	Foreign collaboration in the 70s	Major Products	Plant(s) studied	Workshops studied
A	None	Transformers, motors, alternators	Motor	a. Machine b. Assembly
B	Swedish (financial and technical)	Switchgears, transformers, control panels, induction furnaces	Switchboard	a. Fabrication b. Assembly
C	French (technical only)	Switchgears, power distribution equipment, recording instruments	Switchgear	a. Fabrication b. Assembly
D	W. German (financial and technical)	Switchgears, control panels, motors, transformers	Motor	a. Press b. Assembly
			Switchgear	a. Plastics b. Assembly
E	None	Winding wires, winding strips, cables	Ferrous wire	a. Wire-drawing

The workshops were chosen so as to allow interesting comparisons between technologies of production and organisation of work. Thus, a set of component manufacturing/fabrication workshops and assembly workshops were chosen such that they could be further differentiated according to the type of products as well as type of work organisation, e.g. long line assembly and single station assembly. Wire-drawing was included as the only "process" technology in electrical engineering industry.

Financial performance and restructuring choices in the seventies:

The financial performance of these firms (see Table 10 for details) both in terms of the market demand for their products in the seventies and the strategies used by them to restructure their production during this period is now discussed. If the performance of these firms is analysed in the context of their individual positions in the market, then it seems that the financially successful firms were those that were either in a very special position in their product markets and/or were able to restructure their production to overcome the recession in the market for capital goods like motors and transformers. The successful firms in this respect were firms D and B as the following discussion shows.

The only large firm - both in terms of assets, net sales and market share - in this sample is firm D. In 1980, firm D had a share of 12 percent in the total value of the sales of capital goods sector of the electrical engineering industry. It was the highest for any firm in this sector. Within the motor market, its share was 5 percent of the value of the total sales and within the switchgears market it was 13 percent of the total value of sales[21]. Being a market leader

21. Based on market-shares data collected by the Centre for Monitoring Indian Economy, Bombay.

Table 10: Financial statistics of the firms being studied (all assets and sales figures in 10^6 Rs.)

	Firm A				Firm B**				Firm C				Firm D				Firm E			
	Total assets	Net sales	Net profit %	Return on capital employed %	Total assets	Net sales	Net profits	Return on capital employed %	Total assets	Net sales	Net profits	Return on capital employed %	Total assets	Net sales	Net profits	Return on capital employed %	Total assets	Net sales	Net profits	Return on capital employed %
1970	23.46	18.26	-20.0	-15.7					41.11	12.59	-5.0	4.2	215.08	244.31	5.0	15.2	32.98	32.84	3.0	9.8
1971	25.67	33.37	-1.0	8.2					47.61	18.00	1.0	7.4	241.70	324.82	5.0	14.8	31.31	40.13	4.0	11.5
1972	27.30	33.43	3.0	23.2					52.48	28.23	3.0	8.6	244.94	389.64	4.0	14.8	33.93	51.88	4.0	12.4
1973	28.08	35.54	1.0	21.6	N.A.	N.A.	N.A.	N.A.	55.86	26.76	-5.0	4.5	273.35	441.01	3.0	12.3	39.72	52.62	4.0	12.6
1974	31.17	32.34	-4.0	5.4					62.68	37.68	0.0	7.8	368.74	542.11	5.0	16.7	43.86	62.94	3.0	10.3
1975	30.95	39.37	0.0	35.3		67.7	.9		69.54	38.37	-15.0	0.1	442.18	717.86	4.0	18.0	50.17	75.97	2.0	11.2
1976	29.64	34.83	0.0	39.0		64.2	1.0		68.51	40.36	-7.0	5.8	431.33	745.22	4.0	17.8	54.63	81.57	1.0	10.1
1977	37.85	47.76	2.0	17.5	38.71	63.3	1.6	16.1	67.33	25.85	-32.0	-5.1	479.57	777.41	3.0	12.1	51.72	67.92	-2.0	6.2
1978	37.39	59.33	2.0	20.3	64.39	64.3	1.9	11.9	64.86	37.95	-7.0	6.1	448.88	727.29	3.0	9.8	54.96	73.62	-2.0	6.7
1979	56.66	65.77	-23.0	-592.3	78.53	79.3	1.2	11.0	76.04	57.83	-22.0	-14.3	585.84	938.57	3.0	15.1	51.95	126.58	2.0	18.8

Notes *Net profits are profit after tax given as a percentage of the net sales.

**Though Firm B started its manufacturing activities in Bombay as far back as 1952, it did not become a public limited company till 1977. It is only from 1977 that published accounts for this firm became available.

in switchgears, the demand for its products is so high that there is alleged to be a thriving black market for them. In the seventies, the major restructuring strategies used by it were (a) diversification into newer types of motors and completely new product lines, (b) reorganising work in some plants, (c) starting three new plants, and (d) making financial investment in two indigeneous firms. Despite set-backs in industrial relations in the period following 1977, it was able to maintain substantial profit levels.

The reasons for the successful operations of firm B, even though it is a comparatively small firm, are to be found in the special type of switchgears it produces. Its market share in the total value of the sales of the switchgears market was only 3 percent in 1980, but its leading switchgear products were distinguished from those of other firms by the fact that they were modular products; i.e. when the ratings requirements changed for a circuit breaker, another module(s) could be added to the previous one(s) instead of having to buy a completely new unit with the required rating. This aspect of technical innovation imported from Sweden was the major reason why firm B was able to make net profits in the seventies while a firm like firm C, while also manufacturing switchgears, made net losses for most of the decade (see subsequent discussion). The only evidence of firm B restructuring its production in the seventies comes from the fact that it introduced specially designed tools in one of its plants to reduce production times.

The other firm that made profits for most part of the early seventies through to 1976 was firm E which manufactured winding wires and cables. In the early seventies, there was a high demand for enamelled wires and even though the cost of raw materials had started to go up, it did not affect the profitability of the firm till about 1975. However, after that this factor combined with a fall in demand for winding wires and

cables, and power shortages, began to seriously undermine the performance of the firms in this sector. Yet another reason for firm E's losses from 1976 onwards was its attempted diversification into products totally unrelated to its production facilities and its subsequent financial inability to go through the diversification programme. The attempt was to diversify into electronic calculators and telephone answering machines. However, this diversification programme did not go beyond the stage of manufacture of prototypes because of financial problems and was abandoned in 1977. Thus, firm E's restructuring plans failed because of an ill-planned innovation strategy.

Firm C's profitability record was the worst in the seventies amongst the firms chosen for analysis. As ninety percent of the customers of this firm are the State Electricity Boards (SEBs) for whom it manufactures custom-made equipment, throughout the seventies it faced the problem of the SEBs staggering deliveries of equipment manufactured and ready for supply - affecting the profitability of the firm adversely.

In 1971-72, because of the small beginnings it had made in the area of exports, its financial performance was satisfactory. However, in 1973, the management declared a lockout and suspended operations for two months because of labour unrest and this resulted in a set-back to its financial performance.

In 1975, the management of firm C sought to use the following strategies to restructure its finances: (a) retrenchment of 80 workers and 20 staff members, (b) freezing the wages of workers for a year, (c) withdrawal of good attendance bonus, subsidised breakfast and free coffee for all workers, and (d) cancellation of all increases in the Dearness Allowance[22] to all employees. However, the firm was not able

22. A variable part of the wages which is linked to the consumer price index.

to implement any of these strategies as there was a tremendous opposition to them from the trade union in the firm. In 1979, another lockout was declared by the firm because the workers opposed the sub-contracting of work. Thus, it would seem that firm C tried to restructure its production but having failed in that, it tried to shift the problem outside the boundaries of the firm by attempting to subcontract work.

Firm A, which is basically a small firm in the motor and transformer market performed badly in the seventies entirely because of the recession in its product market in the second half of the seventies and material shortages before that. The two major restructuring strategies used by this firm were: (a) diversification into higher horsepower motors in 1976-77, and (b) intensification of work on the shopfloor in the same year by as much as 30 percent. As a result of these two strategies, its financial performance improved considerably over the next two years. However, in 1979, it received a major set-back because of the low prices at which orders for transformers had to be accepted.

Thus, in general, it would seem that a big firm like firm D by being a market leader and by being able to exercise a greater choice in restructuring its production was able to perform satisfactorily in the seventies. In contrast, except for firms in a special position in their product market like firm B, for the smaller firms the going was much tougher as their restructuring choices were limited and the market factors affected them the most. This picture is in keeping with the general trends in the intra-sectoral differences between firms in the capital goods sector of the electrical engineering industry presented earlier.

Unions in the firms:

In order to see how the unions in these firms aided or hindered the restructuring of production, now the industrial relations in them are briefly examined.

In firms A and B, the recognised union (and the only union as it ran a closed shop) was the Engineering Majdoor Sabha (EMS). As pointed out above, in firm A intensification of work occurred in 1976-77. This was, in fact, done with the consent of the union. The EMS actually helps the firms where it represents the workers in restructuring production if it also means an increase in wages and security of jobs for its members. As Mr. R.J. Mehta, the President of the Union pointed out, "In the late 70s all the agreements I have signed have been linked with productivity. And all agreements since 1970 make provisions either on an ad hoc basis for increase in productivity or after necessary work study by engineers. We have for this purpose some engineers in our employment who undertake a work study and make the necessary recommendations".[23] The Chief Executive of this firm had high praise for the practices of the EMS: "R.J. Mehta's union has very straight dealings. He believes in discipline and production". When asked, "Well, who disciplines whom?", he replied, "Mehta disciplines the workers and we get the production". Even though in firm B, the only restructuring of production was in terms of minor changes in technology, it seems doubtful whether the EMS would come in the way of such plans as long as they fulfill its criteria of job security and increased wages.

In firm C, the recognised union in 1980 was the fourth one it had had since 1971. The workers in this firm had an extremely militant

23. All quotations from trade union leaders and managers, unless specified otherwise, are based on personal interviews conducted with them in the latter half of 1980.

Table 11: Recognised trade unions in the firms studied

Firm	Recognised union (1980)
A	Engineering Majdoor Sabha
B	Engineering Majdoor Sabha
C	Engineering Workers' Union (affiliated to CITU)
D	Company based union
E	Engineering Employees' Union

tradition. Till 1979, firm C had not been able to implement any of its production restructuring strategies because of the opposition from workers, given that they either affected the jobs of the workers or were intended to take away important facilities and benefits from them. However, after the union opposition to subcontracting (see Chapter 9) led to a lockout in 1979, the management was able to force the workers to agree to its terms; i.e. no restrictive practices on the shopfloor and no objections to subcontracting. In firm D, the only time the union objected to any of the management's plans was in 1980 when a new machine was being introduced and the union refused to allow any of its members to man it because they saw it as leading to loss of jobs in the long run. There were rival unions to the recognised union in this firm throughout the decade of the seventies but their demands were centred around wages and promotions. In 1978, the activities of the then rival union (AEW), led to disruption in production and the murder of some activists of the recognised union and this led to a fall in production. In firm E, there was no opposition to the attempted diversification by the union.

Thus, it would seem that except in the case of firm C, the unions did not make a major inpact on the restructuring plans of the firms in the seventies in any way.

5. CONCLUSIONS

In this chapter it was shown that in the seventies the capital goods sector of the electrical engineering industry, like most others, suffered from a falling rate of growth of output and under-utilisation of capacity. Study of individual firms pointed to the fact that the bigger firms did not suffer as much from the recession in the market as did the smaller firms. The former also had a larger set of production

restructuring strategies open to them as compared to the latter.

In discussing the industrial relations scene, it was shown that the failure of the railway strike and the declaration of the state of internal emergency led to oppressive measures against the workers. After the lifting of the "emergency", new unions like the AEW gained grounds in Maharashtra cutting away the support of the "traditional" established unions. In the late seventies, it was pointed out, in the bigger firms there was a tendency for production linked wage settlements with the unions resulting in both higher productivity and higher wages.

Finally, it was shown that the firms chosen for analysis broadly followed the same trend as the rest of the capital goods sector. In all but one of them, the unions did not oppose the restructuring plans the firms tried to implement in the seventies. So it seems that larger firms like firm D did have a greater choice in restructuring their production in the seventies than the smaller firms. For such a firm, restructuring of production need not be limited, and was not limited in this case, merely to changes internal to the firm. In the smaller firms, unless they happened to be in a special position in the market because of their technological innovation strategy and the recessionary markets did not affect them much (as was the case with firm B), restructuring attempts were confined more to internal restructuring in the firm; i.e. they could not start new plants or new financial ventures like firm D and nor could they always diversify their production easily. Only in firm A did the recessionary pressures result in a successful diversification of products. But in firm A this also went along with an intensification of labour with the help of a trade union which co-operated with the management in its restructuring plans. In firm C, however, when the attempts at reorganising the labour process through retrenchment and reorganising the finances of the firm through a

wage freeze in 1975 were opposed by the union, the firm later tried to restructure production by attempting to change the boundaries of the firm in trying to subcontract work outside the firm. The other small firm, firm E, tried to overcome the recessionary pressures of the wires and cables market through a diversification into completely unrelated product lines and miserably failed. While the sample of firms considered here is far too small to make any generalisations, it would seem that the implications of the expansionary restructuring plans of the larger firms for the labour process would be quite different from those of the restructuring plans of the smaller firms.

As far as the challenge of the new unions like the AEW is concerned, in the firms studied here, only firm D was affected where in 1978 clashes between the AEW and the recognised majority union of the workers led to deaths of some activists of the recognised union. The fact that the AEW gained a ground in firm D points to the existence of divisions between the workers in the firm. As Chapter 9 shows these divisions were a result of a particular form of organisation of work on the shopfloor which put a section of the workers in a position of comparative disadvantage as far as promotion opportunities were concerned.

Thus, in general, it can be concluded that the production restructuring plans of the firms being studied were a result of the interaction of the market position of the firm, the managerial decisions of choosing between a set of options of production restructuring, and the response of the workers' union to the restructuring plans. It can also be reasonably concluded that the growth of unions like the AEW must have been facilitated by the existing divisions within the workers both at the level of the industry and the firms (see also Chapter 9).

Having thus attempted a contextualisation of the firms being studied, in the next few chapters, an analysis of the organisation and control of

the labour processes in these firms is made. The next chapter begins with the anslysis of the types of jobs available in the firms considered. This is followed in the subsequent chapters by an analysis of how particular forms of organisation of work come into being.

CHAPTER 6

WORKERS AND THEIR JOBS

1. INTRODUCTION

In this chapter, the organisation of the labour process in the capital goods sector of the electrical engineering industry is analysed in terms of the structure of jobs available.

There are two sections in this chapter. In the first section, a description of type of jobs available in the firms considered is presented. By contrasting jobs in terms of their characteristics such as the working conditions, skill requirement, promotion prospects etc. it is shown that the labour process in this sector of the electrical engineering industry contains a wide variety of jobs including some ranking at the extremes of some of these characteristics. However, the analysis of jobs in this section is purely qualitative. A quantitative analysis of the job-structure is presented in the second section of the chapter. By considering both weighted and unweighted pattern of jobs, it is shown that the job structure is predominantly "hierarchical", i.e. desirable job attributes tend to bunch together as do undesirable job attributes.

2. TYPE OF JOBS AVAILABLE IN THE FIRMS

The jobs in the firms analysed in this study were varied. These variations can be described in terms of different job attributes. The job attributes used here to analyse the variations in jobs can be categorised as follows: Exposure to weather, working conditions, physical effort required, work cycle length, object variety, conceptual abilities

required, executional abilities required, autonomy, responsibility, promotion opportunities, pay status, and irregularity of hours. These are basically the same job attributes as those used by Blackburn and Mann (1979) in their study.

As pointed out earlier, variations in job attributes do not arise accidently. All job structures in industrial labour processes are results of attempts by managers to create to whatever extent possible, a division of labour that is suitable to the needs of profit maximisation of a firm at any point in time. This, of course, should not be taken to mean that the structure of jobs keeps changing every day or every week. Just as the dominant aims of firms do not change from day to day, there are also short-term rigidities involved in the job structure contingent upon the environment of the firm, the type of technology in use, the volume and type of products being manufactured, managerial decisions taken in the past about combining different tasks into jobs, the effectiveness of the workers' unions in influencing managerial decisions, etc. In the short-run then, job structures in industrial sectors can be described and if the direction of change in any of the factors that affect it is known, then predictions can be made about their effects on the job structures. The availability of different types of jobs, by contrasting jobs at the extreme ends of a job attribute, is now described for the firms under consideration.

In presenting an outline picture of the jobs that were studied, the first marked difference in jobs that can be mentioned is the extent to which a job involves exposure to weather and the working conditions peculiar to that job. Some jobs such as cleaning huge coils of wires/ strips by dipping them in vats full of chemical solutions are not only dangerous in terms of the kind of tasks involved but the work-stations

have to be situated in well-ventilated areas. This requirement in this particular case meant that the work-station was situated in a partially sheltered enclosure next to the main work-area thus subjecting the workers to the vagaries of the weather. There are other jobs such as winding and assembling jobs which involve relatively safe working conditions even though they might have some disadvantages of their own. It must once again be pointed out, however, that there is nothing immutable about the working conditions and much depends upon the management and the trade unions in improving the working conditions. Use of proper masks, for example, can considerably reduce the health hazards associated with spray-painting where there is a considerable danger of breathing in paint particles. Yet in none of the firms studied here were there any proper masks provided for spray-painting jobs - in most cases the workers just used a handkerchief for a mask[1].

Jobs in the firms considered also differed in terms of the quantity and pace of physical effort required. At one end there are jobs like that of packers which require considerable physical effort. As one such worker put it, "To put every nail in, you have to hammer it at least six times. When you are young and after you have got used to it you don't even feel the pain. But if you are above thirty-five and every evening you go home with pain in your arms, you curse the day you were born". At the other end, there are jobs like that of a spotchecker or a charge-hand which require comparatively little or no physical effort.

As far as work cycle length is concerned, there are jobs like the long line assembly jobs in switchgear assembly which involve a very

1. In some firms, those involved in spray-painting were given a glass of milk to drink in every shift. The workers, however, thought that the milk was watered down by the management to save costs.

small cycle length with a high degree of repetition within each cycle. On the other hand, once again, jobs of spot checkers and charge-hands have long and undefined cycles. Jobs of machinists and fabricators, while involving well-defined and medium work-cycle lengths, have a comparatively greater object variety than many of the other jobs like wire-drawing jobs, deburring jobs, etc..

The abilities required to perform a set of tasks also vary with jobs. Jobs in machining, fabrication, and wiring, for example, require more of some conceptual abilities like reading technical drawings or circuit diagrams but others like deburring of plastic moulds for contactor switches, moulding of plastic switches, or long-line assembly jobs require comparatively little of these abilities to be used. A job in testing, on the other hand, would require application of even greater technical knowledge and a greater ability to remember rules, routines, etc. than the jobs mentioned above. This attribute in jobs is a result of how various tasks are combined into jobs and is thus a direct reflection of the division of labour.

Different jobs may also offer different degrees of autonomy and the amount of supervision involved. Long line assembly jobs, for example, involve very little autonomy of task performance or pace choice and they also involve strict supervision. On the other hand, jobs such as those of machine setters involve comparatively greater autonomy and very little supervision. Then there are senior workers who are often co-opted into quasi-supervisory jobs such as that of group-leaders. These jobs involve a relatively high degree of autonomy even though the group leaders perform more or less the same tasks as the other workers in their section or group - the only difference being that they are senior workers who are being groomed for supervisory staff functions and may fill in for the supervisor or the foreman when they are not around.

Promotion opportunities also differ with the type of the job and the position of the job in the hierarchy of the grade-structure. The higher a job is within the hierarchy, the more likely it is that the promotion chances would be less for the worker occupying such a job. This is so because of the combined effects of two factors: First, the reduction in promotion chances as fewer jobs are available as an upward movement occurs along the grade structure. And second, because of the form of the internal labour markets. Since the position in the grade-structure is linked with the pay-status of the workers, the blocking-off of promotion chances can lead to a considerable amount of bitterness and cynicism among the workers. An example of this is the following comment from a worker in firm A: "Recently someone died of cancer, so one person got promoted. I don't think anyone in the grades above me is going to die in this department for the next eight to ten years. If someone dies of T.B. or cancer, then only will I get a promotion".

Having thus contrasted in a sketchy way the different attributes of the jobs studied, an attempt will now be made to briefly set the context for a detailed analysis of the structure of jobs. Table 1 presents a list of workshops studied, the number of jobs in each workshop and the number of workers in each workshop. A simple method of studying the structure of jobs would be to classify the jobs into a set of broad categories often used by managers/industrial engineers and see how many of the jobs fall into each category (see Table 2). Such a method runs into three major problems: First, there is an assumption that category labels adequately define the content of the jobs; second, a high percentage of jobs fall into the categories of Fitter, Assembler, and Machinist; and third, at least a quarter of the jobs cannot easily be classified into any of these conventional categories.

Table 1: Number of jobs studied in the workshops analysed

Workshops analysed	No. of jobs studied	No. of workers
Firm A - Motor Plant:		
Machine shop	13	69
Assembly shop	22	92
Firm B - Switchboard Plant:		
Fabrication shop	6	11
Assembly shop	7	44
Firm C - Switchgear Plant:		
Fabrication shop	15	45
Assembly shop	11	11
Firm D - Motor Plant:		
Press shop	11	65
Assembly shop	14	140
Firm D - Switchgear Plant:		
Plastics shop	8	83
Assembly shop	16	16
Firm E - Ferrous Wire Plant:		
Wire-drawing shop	10	34
Total	133	610

Table 2: Types of jobs studied

Job category	No. of jobs
Fitter	14
Assembler	26
Machinist	21
Painter	2
Carpenter/Packer	3
Welder	5
Die-caster	3
Setter	1
Group-leader/Chargehand	7
Spot checker/Tester	4
Helper	13
Unclassified*	34
Total	133

Notes *Not classifiable in any of the preceding job categories.

The first problem is clearly a theoretical problem while the latter two refer to the operational uses of these categories in this particular study. One of the implications of the first problem is that these categories do not tell us anything about the actual distribution of job characteristics like working conditions, skill, autonomy, etc. among the categories, no comparative picture of job structures can be presented using these categories. And the implication of the operational problems associated with these categories is that if, for example, Table 2 were to be examined in isolation, then there would be no way of knowing if these jobs were from the electrical engineering industry or not as most of the winding and connecting jobs actually fall into the residual category of "unclassified".

To overcome these problems, it becomes imperative to study the individual job attributes, their relationships and compare them. This is attempted in the following section of this chapter.

3. ANALYSIS OF THE JOB STRUCTURE

Relationship between job attributes:

As outlined in Chapter 4, to compare jobs and study their attributes as well as their interrelations, each job was broken down into a set of common attributes and comparative measurements of the different attributes were made for each of the jobs studied.

An attempt was then made to analyse the job-structure in terms of examining whether or not 'good' or 'bad' attributes in jobs tend to bunch together. Good qualities in jobs were defined as those job attributes that are likely to be viewed as desirable by the workers. Thus, it was assumed that workers would prefer higher wage-levels, regular working hours, a quieter and cleaner working environment, higher levels

of the different components of skill, and lower physical effort among other characteristics. The other variables listed in Table 3 have also been interpreted in the same way. If it were found that desirable job characteristics tend to bunch together in jobs then the job structure would be called hierarchical. If, however, undesirable characteristics were to be found balanced by desirable characteristics, then the job structure would be compensatory (see, Blackburn and Mann, 1979). In general, the implications of a compensatory job structure would be that, in principle, workers would be able to exercise some amount of choice about their jobs whereby "rewards on less salient aspects can be sacrificed for those that are most desired" (Blackburn and Mann, 1979: 62). A hierarchical job structure, on the other hand, would not entail such a choice.

A hierarchical or compensatory structure of jobs, thus, has implications for the type of the labour market; i.e. it could reflect a correspondingly hierarchical or compensatory labour market. However, in the case of the jobs available in the capital goods sector of the electrical engineering industry, caution would have to be used in drawing conclusions about the labour market from the job-structure for the following reasons: First, this sector does not define a self-contained labour market; and second, given the fact of unemployment among industrial workers in Bombay, it cannot be shown that there exists a "free choice" between a good job and a bad job. The implication of the first point is that this sector has a lot of jobs in common with other sectors of the electrical engineering industry as well as with other engineering industries. Thus, while there are also winding, connecting, and press shop jobs in the consumer goods sector of the electrical engineering industry; e.g. in the manufacture of fans; jobs such as those of machinists, painters and carpenters can also be found

in other industrial sectors. And the latter point is also applicable to those jobs that require little or no skill, e.g. that of helpers. Jobs that can be found in other industries form a third of the jobs studied here. The implication of the second point is that the choice in the labour market is likely to be highly constrained and in some cases the choice before a worker may be between working in any job or remaining unemployed. In this case then, hardly any conclusions about the labour market can be drawn from the type of the job structure.

The structure of jobs, however, may have important implications for the divisions within the working class. A hierarchical job structure may lead to either managers adopting different control strategies towards different sections of workers or using the divisions between the workers (e.g. inter-union rivalry) to increase control over the labour process. Hierarchical job structures may also mean that given the different interests of the different sections of the workers, it may not be possible to analyse the responses of workers to the labour process in terms of a homogeneous collective response (see the discussion in Chapters 8 and 9).

To see whether the job structure was hierarchical or compensatory, from the job scores only those characteristics were chosen that could easily be seen as desirable or undesirable by the workers (thus, for example, "required interaction with other workers" and "concentration" were dropped). To these were added job attributes related to wage levels and irregularity of working hours. These characteristics were then intercorrelated for the 133 jobs studied.

This method of analysing the structure of jobs is basically the same as the one used by Blackburn and Mann (1979). There is only one additional variable - the ability to read technical drawings - and that has to do with the conceptual aspects of skills. However, only limited

comparisons can be made with Blackburn and Mann's analysis. One reason is that the sampling frames in the two studies are quite different - while they studied the labour market characteristics for a whole town covering different industries and sampled not only firms but also jobs within each firm, in this study not only were the firms chosen deliberately, but also the workshops within them. The different subjectivity involved in the rank order measurements of the different job characteristics are also bound to limit the comparisons with Blackburn and Mann's study.

At this point, it must be mentioned that the data collected about the jobs consisted of ordinal measurements rather than interval measurements. Thus, while the job characteristics measurement data collected in this case does assume a rank order in the measurement scale (i.e. on a scale of 1 to 5 in each case), it cannot be argued that the intervals on the measurement scale are equal throughout the range[2]. This raises the statistical problem that parametric statistics, which are more highly developed than non-parametric statistics, cannot be used for analysing ordinal data. Hence, if methodological purity is to be maintained then parametric statistics should not be used for analysing data collected using ordinal measurement scales.

However, it has been argued that non-parametric techniques of regression have severe shortcomings in multi-variate analysis and that "the merits of ordinal strategy, if there are any, cannot be claimed on the basis of its presumed conformity to the underlying measurement

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2. Thus, for example, in ranking the manual dexterity required in jobs, "manual movements of fair precision" is ranked higher than "continuous simple manipulation" and "manual movements of high precision" is ranked higher than both. However it cannot be argued that the interval between the three scores is equal (see, Hawkes, 1971, and Kim, 1975).

assumptions of ordinal variables" (Kim, 1975: 280). In this study then, non-parametric statistics have been used where it was possible to do so (for example, in comparing job attributes across different or same level of mechanisation as in the next chapter) and parametric statistics were used where it was easier to do so - as in the case of correlations of job characteristics using Pearson coefficients.

Non-parametric correlations (Spearman rank correlation and Kendall rank correlation) were also carried out to see whether they gave any substantively different results. In fact, they also showed the job structure to be predominantly hierarchical in a similar way. Thus, Pearson coefficients have been presented here and used in the subsequent factor analysis because it is simpler to carry out data reduction through factor analysis using parametric methods. The job characteristics correlations are presented in Table 3. Correlations which indicate hierarchical relationships and compensatory relationships are marked differently. It can be seen that the hierarchical relationships predominate (100 to 17).

The hierarchical relationships in Table 3 are not only proportionately higher than those in the analysis of Blackburn and Mann (1979), but in most cases the level of the correlation coefficients is almost double as compared to their study. Keeping the limitations of comparisons pointed out above in mind, the implications of this are that there seems to be a greater and stricter hierarchy among the jobs in the capital goods sector of the Indian electrical engineering industry than the jobs studied by Blackburn and Mann in Peterborough firms.

The significance of each of the correlations must be seen in the context of the meaning of each variable taking into account the high intercorrelations between the measures of conceptual ability which tend to overweight the matrix.

Table 3: Job characteristics correlations[(a)], 133 jobs, unweighted

	(1)											
1. Exposure	1.00	(2)										
2. Fumes, dirt, etc.	.18*	1.00	(3)									
3. Noise	n	.07	1.00	(4)								
4. Danger	.20*	.20*	.28*	1.00	(5)							
5. Qty. of phyl. effort	.05	.15*	.03	.34*	1.00	(6)						
6. Pace of phyl. effort	-.02	.14	.13	.41*	.33*	1.00	(7)					
7. Manual dexterity	-.12	.16†	-.14	.15†	.11	.04	1.00	(8)				
8. Work cycle length	.07	.03	.03	-.04	.20†	-.15*	.08	1.00	(9)			
9. Object variety	-.17*	.11	-.10	-.02	-.02	-.04	.20*	.16*	1.00	(10)		
10. Math. calculations	-.15*	-.10	-.16*	-.02	-.13	-.20*	.12	.19*	.26*	1.00	(11)	
11. Reading, writing	-.02	-.07	-.21*	.04	-.01	-.15*	.12	.28*	.09	.39*	1.00	(12)
12. Reading techl. drawings	-.13	-.06	-.06	.05	-.02	-.15*	.25*	.31*	.10	.46*	.37*	1.0(
13. Memory	n	-.09	.17†	.06	-.32*	-.10	n	.41*	.10	.27*	.29*	.2(
14. Visualisation	-.09	.06	-.10	.16†	.04	-.05	.47*	n	.17*	.38*	.25*	.2
15. Complexity of decisions	-.16*	.01	-.03	.17†	-.25*	-.08	.22*	.22*	.26*	.42*	.42*	.4
16. Autonomy of decisions	-.28*	-.16*	-.08	-.13	-.30	-.22*	-.11	.31*	.24*	.29*	.37*	.2
17. Pace choice	-.12	-.20*	.17†	.08	n	-.13	-.08	.42*	.08	.26*	.22*	.3
18. Responsibility	-.20*	-.16*	-.12	-.16*	-.29*	-.25*	-.11	.29*	.31*	.28*	.33*	.1
19. Supervision: absence of	.12	-.11	-.14	-.11	-.17*	-.01	-.05	-.02	-.10	-.06	.17*	.0
20. Optional interaction	-.07	-.09	-.07	-.24*	-.11	-.19*	-.22†	.32*	.14	.23	.28*	.2(
21. Promotion chances	.09	n	-.09	.08	.08	.07	-.13	-.05	-.10	.03	.08	-.2
22. Hours: irregularity	-.15†	.07	.06	.12	.09	-.10	-.03	.17†	.10	.33†	.26†	.2
23. Pay status	-.10	-.08	-.14	-.22*	-.17*	-.45*	.05	.32*	.26	.32*	.28*	.2

Table 3 (continued)

12. Reading techl. drawings	(13)											
13. Memory	1.00	(14)										
14. Visualisation	.01	1.00	(15)									
15. Complexity of decisions	.46*	.33*	1.00	(16)								
16. Autonomy of decisions	.45*	-.06	.48*	1.00	(17)							
17. Pace choice	.45*	.06	.48*	.51*	1.00	(18)						
18. Responsibility	.39*	-.08	.32*	.79*	.37*	1.00	(19)					
19. Supervision: absence of	.08	.04	.10	.08	-.09	.10	1.00	(20)				
20. Optional interaction	.33*	-.16†	.22*	.56*	.43*	.52*	.07	1.00	(21)			
21. Promotion chances	-.03	.01	-.04	-.08	-.09	-.06	-.06	.04	1.00	(22)		
22. Hours: irregularity	.10	.08	.19†	.11	.18†	.09	-.16*	.04	.08	1.00	(23)	
23. Pay status	.30*	.14	.23*	.40*	.24*	.34*	n	.30*	-.03	.07	1.00	

Notes: (a) In analysing hierarchical and compensatory relationships, only those correlation coefficients with an absolute value of greater than or equal to 0.15 have been considered. Though it would be methodologically wrong to use significance tests in this case, 0.15 approximately corresponds to a 5% significance level.

n denotes negligible correlation, i.e. less than ±.007 in this case.

* denotes hierarchical relationship

† denotes compensatory relationship

Having pointed this out, now the analysis of the various correlations in Table 3 can be attempted. If the variable "exposure to weather" is considered, then it can be seen that except for its compensatory relationship with "irregularity of hours", it is highly correlated with both an unclean working environment (fumes, dirt, excessive heat, etc.) and dangerous working conditions. This characteristic is also inversely correlated with the variables "object variety", "mathematical calculations required", "complexity of decision making", "autonomy of decision making" and "responsibility for men and machines". Typical jobs that fit such a description are that of helpers on the shopfloor, jobs in fabrication shops involving straightening of metal sheets using hand-held tools, jobs of pickling coiled wires/strips in vats full of chemical solutions in wire mills, and arc-welding jobs. While a helper on the shopfloor is a general dogsbody being shunted from one task to another and from one work-station to another, the other jobs usually not only involve working in the relatively exposed parts of the workshops but they also involve considerably more danger to life and limb. They involve dealing with a limited number of tools, do not require any mathematical ability on the part of the worker, hardly involve any complex decision making or autonomy in task performance and involve virtually no responsibility for men and machines.

The next group of variables in Table 3 refers to working conditions - "fumes, dirt, etc.", "noise" and "danger". Working in an unclean environment on dangerous work varies directly with the opportunity to use manual dexterity. Dangerous work also seems to require a greater degree of certain conceptual abilities in the worker like visualisation and the ability to make complex decisions. It can also be seen from

Table 3 that noisy work goes with greater ability of memorisation[3] of rules and routines of task performance and a greater control over the pace of work by the worker.

From these compensatory relationships, it seems that the opportunity to use manual dexterity and a few aspects of conceptual ability vary directly with those undesirable aspects of working conditions which are not under the worker's control. However, lest this be generalised too quickly to claim that unpleasant working conditions have their own rewards, the hierarchical relations of these job characteristics representing working conditions must also be taken into account. And once this is done, almost at once it becomes clear that the compensatory relationships are far outweighed by the hierarchical relations these variables have with other undesirable characteristics. It can be seen that unclean working environment typically involves a higher quantity of physical effort, low autonomy of decision making in task performance, and low pace choice. And dangerous work not only involves a high pace of physical effort but also a low responsibility for men and machines, lesser chances of interacting with other workers and most importantly, also low wages. And if noisy work had as one of its compensations the demand it makes on the memory of a worker, it certainly does not make similar demands on other aspects of conceptual abilities like the ability to read and write, and to do mathematical calculations.

From the above picture of these specific job characteristics correlations, two points become clear. First, no generalised statements

3. Strictly, it would be difficult to say whether this is a "desirable" characteristic in a job. This characteristic basically must be examined along with other attributes of conceptual ability (see subsequent discussion).

about the relationships between unpleasant working conditions and skills can be made (see also, Blackburn and Mann, 1979). This, of course, does not rule out the possibility that there may be a set of jobs for which unpleasant working conditions may go with a comparatively greater opportunity to use some aspects of conceptual and executional abilities, e.g. in some fabrication jobs and machining jobs in unpleasant areas of the workshops. And second, jobs in unpleasant working conditions are also likely to be those that require a greater physical effort and lesser responsibility for men and machines. The latter relationship besides implying relatively little responsibility for other workers also means that such jobs are not likely to involve working on expensive equipment or machines or taking care of them (unlike the jobs of setters and chargehands).

If the physical effort variables - "quantity of physical effort" and the pace of "physical effort" are considered, then it can be seen that the only compensatory relationship they have is between the "quantity of physical effort" required and the "work cycle length". In other words, jobs that require a greater quantity of physical effort may have an ill-defined sequence of operations or largely indeterminate work-cycles with some repetition within each cycle; e.g. jobs of workers specifically engaged in manual transfer of materials on the shop-floor. If, however, the "pace of physical effort" is considered, then as would be expected, it seems to increase with shorter work-cycles.

From the other hierarchical relationships of the physical effort variables, it can be seen that jobs that require a greater expenditure of physical effort are also those that require low conceptual abilities, lesser autonomy, lesser responsibility, and they are also likely to be badly paid.

Along with the physical effort variables, the biggest set of hierarchical relationships occur in the group of job characteristics concerning autonomy, variety, conceptual abilities and executional abilities. As can be seen from Table 3, where several different measures of a broad characteristic have been used, these measures are also highly intercorrelated (once again, this is similar to the results of Blackburn and Mann, 1979). This is the case, for example, with the measures of executional ability, conceptual ability, and autonomy. The implication of this is that it is unlikely that a job on the shop-floor which requires a relatively high complexity of decision making would not require either the ability to read technical drawings/circuit diagrams, or the knowledge of some mathematics. Moreover, these broad categories representing skill and autonomy also tend to go together - with the exception of only manual dexterity. These characteristics also have a hierarchical relationship with wages.

If the variable "promotion chances" is considered, then a seemingly interesting fact emerges. And that is the inverse relationship between promotion chances and the ability to read technical drawings - implying thereby that jobs in which less of this ability is required, the chances for promotion are relatively higher. This can be easily understood in terms of the point already made about promotions getting blocked off as an upward movement occurs along the grade-structure of jobs as well as because of the forms of the internal labour markets. The implications of the latter are that while jobs at the lower end of the grade-structure involve recruitment through internal promotions, the higher grades involve direct recruitment from outside. Jobs that require little or no ability to read technical drawings tend to be in the lower grades where the chances of promotion are higher. And as an upward movement in the grade-structure occurs, the chances of further promotions tend to

diminish. Thus, for example, it may be easier to move up from the job of a helper in a motor assembly shop to that of an assembler over time, but it may be impossible to move from the job of an assembler to that of a tester.

"Irregularity of working hours" in Table 3, represents a major set of compensatory relationships with the measures of conceptual abilities and autonomy. That is to say, irregularity of hours is compensated by a greater opportunity to use conceptual abilities and by higher autonomy in the methods of task performance.

Analysis of the job structure with constructed factors:

To analyse the job structure further, factor analysis was used. Factor analysis is a data-reduction technique where the basic assumption is that if correlations exist between a set of variables then this is due to an underlying pattern in the data. Thus, if it is analytically difficult to handle a large set of variables which are correlated with each other, then these variables can be reduced to a small set of constructed variables (factors) which would be linear combinations of the initial set of variables. Further analysis can then be carried out with the new and smaller set of variables.

In its most common applications, factor analysis is either used for exploring underlying patterns in data or for testing hypotheses about significant number of factors and factor loadings[4] or for data-reduction through construction of indices for further analysis. It is the latter use of factor analysis - data reduction for further analysis through construction of meaningful indices - that has been attempted here.

4. Loadings of the factor matrix are correlation coefficients between factors and the initial set of variables and are an indication of how well a factor represents a variable. Higher factor loadings for a variable imply a close relationship between the variable and the factor (see, Blackburn and Mann, 1979: 72).

It makes a significant methodological difference how the "indices" for further analysis are constructed. These indices are basically a set of analytical categories. One way of getting to them would be to begin with no conceptual categories of any kind and hope that the underlying pattern in the data would reveal the requisite categories in terms of a set of meaningful factors. A second method would be to define beforehand a set of indices in terms of the given set of variables and then reduce the data accordingly using factor analysis. While the first approach views the data as hiding a theoretical pattern which is waiting to be discovered by techniques such as factor analysis, the viewpoint implicit in the second approach is that data acquires a meaning only in a theoretical context. It is the latter approach that has been followed in this analysis[5].

A series of factor analyses were carried out including only meaningful variables in each factor. Thus the "physical effort" factor is derived from those job attributes which could be regarded as aspects of the physical effort required in a job; e.g. the quantity of physical effort and the pace of physical effort. Similarly, the "working conditions" factor is derived using those job attributes that are indicative of working conditions (see Appendix II for details). There were some job characteristics that could not be combined with others to form a factor; e.g. "work-cycle length", "object variety", "responsibility for men and machines", and "irregularity of hours".

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5. Here, once again, the analysis of Blackburn and Mann (1979) has been followed (notice, however, that their first analysis using orthogonal factors has been dropped). The variables "length of working hours" and "wages per week" used by Blackburn and Mann have not been used. While the wage levels were taken into account in the factor "position in the hierarchy", the length of the working hours was the same in all firms; i.e. 8 hours a day for six days a week.

These variables were considered separately[6].

Defined in the way described above, these factors are clearly not orthogonal to each other. Thus, they can be used along with the other job attributes to analyse the structure of jobs further. The correlations between the new factors and those relevant variables that are not included in the factors are presented in Table 4.

It can be seen from Table 4 that the most important compensatory variable is "promotion opportunities". Working in an unclean environment on jobs which require exertion of comparatively high physical effort, lower conceptual abilities, shorter work cycles, and involve less autonomy and responsibility is compensated by high chances of promotions. The reasons for this, as pointed out earlier, are the existence of an internal labour market and the fact that jobs with the above mentioned attributes are likely to be at the lowest rungs of the grade structure on the shopfloor.

There are very few other compensatory relationships besides the one mentioned above. Low autonomy and responsibility seem to go with higher executional abilities. Exposure to weather conditions is compensated by regular working hours as are jobs with longer work-cycles. Working under unpleasant conditions seems to be compensated by the chance to use greater executional abilities (in this regard, see also the earlier discussion of job correlation without factor analysis).

The most important hierarchical variable seems to be the one representing "object variety". Jobs with a greater object variety

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6. At this point, it must be pointed out that "absence of supervision" which has been defined as a part of the factor representing autonomy, in fact, showed a very small loading with respect to this factor (see Appendix II). An implication of this is that supervision is perhaps independent of other aspects of autonomy for the jobs considered.

Table 4: Job characteristics correlations[(a)] - constructed measures and other variables, 133 cases, unweighted

1. Exposure	1.00 (1)
2. Working conditions (F)	.33*1.00 (2)
3. Physical effort (F)	.02 .45*1.00 (3)
4. Work cycle length	.07 -.0 .03 1.00 (4)
5. Object variety	-.17*-.04 -.04 16 1.00 (5)
6. Conceptual abilities (F)	-.12 .03 -.23* .44* .27*1.00 (6)
7. Executional abilities (F)	-.13 .23† .11 -.07 .19* .32*1.00 (7)
8. Autonomy (F)	-.23*-.19*-.27* .40* .22* .55*-.19†1.00 (8)
9. Responsibility	-.20*-.21*-.33* .29* .31* .38*-.17† .74*1.00 (9)
10. Promotion opportunities (F)	.08 .20 .18 -.21 -.07 -.18†-.01 -.16†-.24†1.00 (10)
11. Position in hierarchy (F)	-.10 -.24*-.39* .32* .26* .46* .03 .40* .34*-.28†1.00 (11)
12. Hours: Irregularity	-.15† .10 -.01 .17† .10 .35† .04 .13 .09 .06 .07 1.00 (12)

Notes: (a) In analysing hierarchical and compensatory relationships only correlation coefficients of absolute value greater than or equal to 0.15 have been used. Though it would not be methodologically correct to use significance tests, 0.15 corresponds approximately to a 5% significance level.

(F) denotes a constructed factor.

* denotes hierarchical relationship.

† denotes compensatory relationship.

(types of parts, tools, controls and dials, etc. that have to be learnt for performance of the job) are those that also require high conceptual and executional abilities. These are also the jobs that carry with them comparatively greater autonomy and responsibility.

Examining the other hierarchical correlations, it is clear that jobs which involve working in a cleaner environment with comparatively non-repetitive or longer work-cycles, less physical effort, and greater responsibility are the ones that offer the opportunity for using greater conceptual abilities and a higher autonomy of task performance. And although, the factor representing "position in the hierarchy" is specific to each firm, it is interesting to see that if this factor is included in the analysis, it has a strong positive correlation with the "desirable" job attributes just described.

On the other hand, jobs that require the expenditure of comparatively more physical effort under unpleasant working conditions with little responsibility for men and machines are also those that require little use of conceptual abilities and offer fewer opportunities for exercising of autonomy in task performance. And once again, if the factor measuring position in the hierarchy is included, then it is clear that such jobs are also at the lower levels of the hierarchy.

Analysis of "weighted" jobs:

Till yet the analysis has been in terms of each job counting as equal, i.e., the jobs were not weighted according to the number of workers per job considering that a job may occur more than once on a shopfloor and a different number of workers may be doing the job in different shifts. If the jobs have to be considered in terms of their relative importance in the job structure, then each job needs to be weighted in terms of the number of workers per job.

The job characteristics correlations for the constructed factors and other variables are given in Table 5 for jobs weighted in terms of the number of workers per job per shift. It can be seen that there is a substantial similarity in the correlations given in Table 5 and those for unweighted jobs in Table 4. It is important to note that none of the correlations change their directions after weighting. Table 5 shows a greater number of hierarchical correlations than Table 4. However, this may be purely due to a higher sample size. Among the new important correlations with weighted jobs, hierarchical correlations equal the new compensatory ones. All these new correlations are at quite a low level compared to the ones that exist for both the unweighted and weighted data.

An important compensatory relationship is evident between "physical effort" required in performing a job and "executional abilities"; i.e. greater the physical effort required, greater is the opportunity to use executional skills. "Promotion opportunities" comes out as an even stronger compensatory job attribute than before - with a new compensatory relationship with "object variety". The variable "irregularity of hours" also shows up as a stronger compensatory job attribute with weighted jobs - showing that higher "autonomy" and higher "responsibility" have a compensatory relationship with it.

The new hierarchical relationships show that: (a) if a job involves comparatively greater exposure to weather conditions then it is also likely to have fewer opportunities for exercising conceptual and executional abilities; (b) jobs that have unpleasant working conditions are also those that have shorter and repetitive work cycles with little object variety; and (c) while lower object variety goes with a higher expenditure of physical effort, higher object variety goes with longer or indeterminate work-cycles.

Table 5: Job characteristics correlations[(a)] - constructed measures and other variables, 610 cases, weighted

	(1)											
1. Exposure	1.00 (2)											
2. Working conditions (F)	.26*	1.00 (3)										
3. Physical effort (F)	.01	.43*	1.00 (4)									
4. Work cycle length	.04	-.12*	.11	1.00 (5)								
5. Object variety	-.14*	-.07*	-.07*	.17*	1.00 (6)							
6. Conceptual abilities (F)	-.13*	.05	-.14*	.41*	.33*	1.00 (7)						
7. Executional abilities (F)	-.12*	.28†	.14†	-.06	.14*	.35*	1.00 (8)					
8. Autonomy (F)	-.26*	-.25*	-.29*	.36*	.20*	.46*	-.23†	1.00 (9)				
9. Responsibility	-.23*	-.22*	-.33*	.25*	.30*	.31*	-.22†	.72*	1.00 (10)			
10. Promotion opportunities (F)	.05	.19†	.23†	-.23†	-.09†	-.13†	.05	-.21†	-.31†	1.00 (11)		
11. Position in hierarchy (F)	-.04	-.33*	-.41*	.12*	.33*	.30*	-.01	.30*	.29†	-.17†	1.00 (12)	
12. Hours: Irregularity	-.18†	-.02	.04	.15†	.22†	.36†	-.02	.13†	.11†	.06	-.13†	1.00

Notes: (a) In analysing hierarchical or compensatory relationships only correlation coefficients of absolute value greater than or equal to 0.07 have been used. This corresponds approximately to a 5% significance level. However, significance tests cannot be used in this case.

(F) denotes constructed factors.

* denotes hierarchical relationship.

† denotes compensatory relationship.

(_) Underlined correlation coefficients denote signigicant relationships that exist only in weighted jobs.

If the size of correlations in Tables 4 and 5 - for unweighted and weighted jobs are examined along with the new relationships in Table 5, then the following interesting points emerge. Both exposure to weather conditions and bad working conditions become stronger hierarchical variables with weighted jobs. There is an increase in the strength of the inverse relationship between the factors representing working conditions and autonomy (from r = -.19 to r = -.25). There is a weakening of the relationship between the conceptual abilities factor and the physical efforts factor (a decrease from r = -.23 to r = -.14), as well as with the autonomy factor (a decrease from r = .55 to 4 = .46) thus making the conceptual abilities factor less of a hierarchical variable with respect to these two factors. However, considering that with weighted jobs this variable has shown a new hierarchical relationship with "exposure to weather conditions" and a stronger relationship with "object variety", it is difficult to say whether over all it shows up as a less hierarchical factor when the jobs are weighted.

The picture is clearer in the case of the factor representing "executional abilities". All its earlier compensatory relationships (i.e. with unweighted jobs) become stronger with weighted jobs. The most significant increases being in the strength of its positive relationships with the working conditions factor (r = .23 to r = .28) and its inverse relationship with the variable measuring "responsibility" (r = -.17 to r = -.22). As pointed out earlier, it also shows a new compensatory relationship with the physical efforts factor.

The variables measuring "autonomy" and "responsibility" show an increase in the strength of their hierarchical relationship with exposure to weather conditions, working conditions, and the physical effort required. But at the same time they also show a decline in the

strength of their hierarchical relationship with the variables measuring work-cycle length, object variety, and conceptual abilities. Once again, therefore, it is difficult to interpret this in terms of these two variables becoming less or more hierarchical when the job structure is being analysed with weighted jobs. Overall, however, it is clear that even when jobs are weighted, the structure of jobs remains hierarchical.

4. CONCLUSIONS

To summarise then, it can be seen that whichever way the job structure is analysed, it shows up as predominantly hierarchical. Desirable job attributes go together as do undesirable job attributes. This is true when relations between individual job characteristics are analysed and remains equally true when meaningfully interrelated job characteristics are constructed into factors and the job structure is analysed in terms of the relationships between these factors and other variables. Initially, only the individual jobs were analysed and later the actual job structure was analysed by weighting the jobs in terms of the number of workers per job. There was no substantial difference in conclusions about the type of job structure between unweighted and weighted jobs.

Compared to the jobs studied by Blackburn and Mann (1979), hierarchical relationships amongst some of the attributes of the jobs available in the capital goods sector of the Indian electrical engineering industry seem to be stricter; i.e. the value of the correlations is higher. However, there are limitations to making such comparisons because of the use of different sampling frames and differences involved in the subjective rank order measurements of the different attributes of the jobs studied.

As far as the implications of the hierarchical job structure are concerned, it would be difficult to interpret them in terms of the labour market because the sector under consideration does not constitute a self-contained labour market. However, the analysis of jobs presented above shows that the only "choices" available are in terms of jobs with bad working conditions, higher physical effort, lesser use of conceptual and executional abilities, lesser object variety, lesser autonomy and responsibility (i.e. "bad" jobs) being compensated by relatively higher promotion chances and regular working hours. More importantly, the predominantly hierarchical structure of jobs in the capital goods sector could mean that a strong division may exist within the workers in this sector, i.e. between those occupying the "good" jobs and those in the "bad jobs".

To understand how job-structures are created, in the next chapter, the impact of technology on work organisation is discussed, followed in the subsequent chapters by an analysis of how the organisation of labour on the shopfloor is created and maintained.

CHAPTER 7

TECHNOLOGY AND THE SHOPFLOOR DIVISION OF LABOUR

1. INTRODUCTION

In the previous chapter, the structure of jobs in the five firms chosen from the capital goods sector of the Indian electrical engineering industry was analysed. This was attempted, first, by analysing the relationships between different job attributes and later by constructing factors out of meaningfully interrelated variables and examining the relationships between them. In both cases it was found that good and bad attributes in jobs tended to bunch together; i.e. the job structure was hierarchical. A further analysis of the jobs weighted in terms of their availability once again showed the job structure to be predominantly hierarchical.

Job structures, however, are only reflections of how work has been organised on the shopfloor and the methods used by the management to maintain control over the particular forms of work organisation. As mentioned earlier, organisation of work is also linked with the technology in use. Technology, for the purpose of understanding its relation to the labour process in industry was defined as representing a set of combinations of the instruments of work, objects of work and the abilities required in using them to produce useful products. Technology defined in this way was seen as providing constraints on the organisation of work; i.e. within a set of technological constraints work could be organised in more ways than one.

In this chapter, an attempt is made to explore the links between technology and organisation of work. In the first section of this chapter, the technology in use in the firms being studied is examined in the light of the concepts developed by organisational theorists. Such an analysis shows that the operational uses of their concepts in analysing the links between technology and organisation of work are quite limited. It also shows that notwithstanding the perspectives within which the different analyses of the organisational theorists were carried out, they provide significant pointers towards the different aspects of technology. In the second section, using the concept of technology developed in Chapter 4, the relationship between technology and organisation of work is examined in the firms chosen for analysis. Both qualitative and quantitative analysis shows that the different aspects of technology only act as constraints on the organisation of work. At the level of individual workstations, it shows that none of the technical changes necessarily imply 'de-skilling' or a reduction in the abilities required to perform a job. Statistical comparisons within two sets of workshops - those making similar products and with similar levels of mechanisation, and those making similar products but with different levels of mechanisation, also cast doubts over the 'de-skilling' framework at the micro-level.

The evidence from the firms considered also shows that technical change was more a result of market factors than that of any form of workers' resistance to managerial control at the work-place.

2. "TECHNOLOGY" AND ORGANISATIONAL THEORY: SOME OPERATIONAL INADEQUACIES

While the views of the relevant organisational theorists regarding technology and organisation of work have already been discussed in earlier chapters, in this section an attempt will be made to operationalise their conceptions of technology in the context of the firms being studied.

Of the three major theorists of the contingency school, the case of Woodward is taken up first. Woodward had classified technology both according to the type as well as volume of output. First, firms were classified into three major product types: Firms making integral products, dimensional products, and those with combined systems; i.e. making both integral and dimensional products. These three product types were then broken down into eleven categories of different production systems (see Table 1 in Chapter 3).

In terms of the product classification all the firms except firm E would fall into the category of firms manufacturing integral products. Firm E manufactured wires, and thus its products cannot be classified as integral products in the same sense as that of firms A to D. Wire-drawing can be considered similar to process production and the finished products as dimensional products measured by weight or length. Thus, firm E can be put under the product category of firms manufacturing dimensional products.

When the three broad production systems categories of "unit and small batch production", "large batch and mass production" and "process production" are used, then firms A, B and C fall quite clearly into the first category, firm D in the second, and firm E in the last category. However, using Woodward's eleven detailed categories of production

systems is more problematic. Table 1 shows the results of an attempt to classify the workshops within the firms being studied into the eleven categories of Woodward. It also shows the classification of these firms according to the common production engineering classification. The problems associated with operationalising Woodward's categories are discussed below.

In firm A, which produced motors and transformers, only the motor plant was studied. The motors produced ranged from 15 h.p. to 150 h.p., While the normal batch size for the 15 to 20 h.p. range motors at the lower end of the spectrum, was about forty motors per batch, for the greater than 100 h.p. range the normal batch size was five[1]. These batch sizes were in terms of the output of the motor assembly shop but quite obviously they were also reflected, in differing proportions, in the batch sizes of components manufactured in the machine shop. All production was carried out according to the orders from customers; i.e. production was not against stock position. Thus, in both the machine shop and the assembly shop, the production system according to Woodward's classification would be "production of small batches to customers' orders".

In the case of firm B, where the switchboard plant was chosen for study, the production seemed to vary between production of units and small batches depending upon the requirements of the customers. Control panels and cubicles for comparatively low voltage switchgear

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1. The normal batch sizes for the motors manufactured in firm A were as follows:

h.p. range	Normal batch-size
15-20	40
25-30	20
30-40	10
40-50	20
50-100	10
100-150	5

Table 1: Classification of workshops into Woodward's categories of production systems

Firm	Product-type	Plant	Workshop	Possible production system classifications		Production engineering classification
A	Integral	Motor	1. Machine	(iv) Production of small batches to customers' orders	unit & small batch production	Jobbing Batch
			2. Assembly	(iv) Production of small batches to customers' orders		Jobbing Batch
B	Integral	Switch-board	1. Fabrication	(i) Production of units to customers' requirements ↕ movement	unit & small batch production	Jobbing
			2. Wiring and assembly	(iv) Production of small batches to customers' orders		Jobbing
C	Integral	Switch-gear	1. Fabrication	(iv) Production of small batches to customers' orders	unit & small batch production	Jobbing
			2. Assembly	(i) Production of units to customers' requirements		Jobbing
D	Integral	Motor	1. Press	(v) Production of large batches	large batch & mass production	Mass Batch
			2. Assembly	(vi) Production of large batches on assembly line		
				(v) Production of large batches		Batch
		Switch-gear	1. Plastics			Mass
			2. Assembly	(vi) Production of large batches on assembly line		Batch
E	Dimen-sional	Fessons Wire	1. Wire drawing	(Unclassifiable in Woodward's 11 categories)	process produc-tion	Batch

Figures in brackets refer to the category number of Woodward's eleven categories of production systems.

were made in small batches, while for high voltage switchgear, production was in units, i.e. one or two units to a customer's requirements. Thus, depending upon the nature of the product and the size of the demand for the product, production in the switch-board plant of firm B may be seen as a movement between unit production and small batch production to the requirements of customers.

Table 2 gives the normal batch sizes for the different products manufactured by firm C. It can be seen from this table that batch sizes vary in this firm from 5 to 100. In this firm only the low-tension circuit breakers are manufactured against stock-position while the rest of the products are custom-made. While the fabrication shop selected for study provided the requisite components for a whole range of products, the assembly shop studied was engaged in the assembly of air-blast circuit breakers (ABCB). ABCBs are quite large products and were assembled at a single work station. In firm C, normally it took three weeks to assemble a single ABCB. Though the normal batch size for ABCBs, as Table 2 shows, is given as five, it would take nearly four months to assemble them and their production can only be classified as unit production to customers' requirements. The assumption made here is that batch sizes must be seen over a fixed period of time. Thus, for example, a batch size of five per month would perhaps come under the category of "small batch" but one unit per month would be classified as "unit production". Production in the fabrication shop of firm C, on the other hand, could be classified as production of small batches to customer's orders. In the case of firm C, then, the overall batch production system can be classified as "unit and small batch production" while the two different workshops have to be classified under two different production systems once Woodward's more detailed categories are used.

Table 2: Normal batch sizes of products manufactured by firm C

Product	Normal batch size
1. Isolators	25-30
2. Air blast circuit breakers	5
3. 11 kV/6.6 kV Panels	20
4. 11 kV/6.6 kV Circuit breakers	25
5. Low tension Panels	20
6. Low tension circuit breakers	50-100
7. Interrupters	5-10
8. Instrument transformers	100

At this point it must be remembered that Woodward thought of the first nine categories of her classification as being "listed in order of chronological development, and technical complexity" (Woodward, 1965: 40). While the sample of firms considered here is not large enough to prove or disprove this claim, cases such as that of firm C cast doubts on such assertions by suggesting not only that more than one level of "technical complexity" may be found within a firm but also that the production of large units such as the ABCBs may be technologically more complex as compared to smaller custom-made units.

In the case of firm D, once again not all the workshops fall under the same production system classification using Woodward's scheme. Even though the production in the press shop can be classified as production of large batches, there was a considerable difference between the batch sizes at different work stations. The batch size on jobs such as shearing, notching, blanking, separation and deburring of laminations for motors ran into thousands. However, these jobs formed only half of the total number of the type of jobs in the press shop. On the other jobs like welding and brazing, die-casting, rotor and stator packeting, the batch sizes were comparatively smaller. The overall output of the workshop was in terms of packeted rotors/stators of motors. However, the laminations that were packeted to make the rotors and stators were made in batch sizes substantially higher than the rotors or stators they went into. This was so because for each rotor and stator of a motor, hundreds if not thousands of laminations - depending upon the size of the motor - go into them. Thus, the volume of output of the whole workshop reflected the output of only half the work-stations in the workshop.

The motor assembly shop of firm D could be classified into two different categories - "production of large batches" and "production of large batches on assembly line". The reason for this is that while large batches of motors were actually assembled on an assembly line, the operations required before final assembly like insulation cutting, insulation folding, coil winding, winding wire insertion, connections, pressing and housing and varnishing were not done on the assembly line. Similarly, operations that needed to be carried out after assembly like testing and painting of motors were not assembly line operations. In the switchgear plant of firm D, however, the classification of the plastics workshop into the category of large batch production and of the contactor assembly into "production of large batches on assembly line" was relatively easy.

In firm E, where only the wire-drawing shop was studied, none of Woodward's eleven categories could be used. Broadly, it could be termed "process production" but beyond that nothing much could be said using the Woodwardian scheme.

The above attempt at making operational uses of Woodward's classification of technology lends support to the criticism of Woodward made earlier that she assmes a homogeneous technology of production within a firm (see Chapter 3). Such an assumption can be made only if it is assumed that the volume and type of output of a firm is a fair indication of the volume and type of output of different plants and workshops within the firm. This assumption is not explicitly recognised by Woodward in her work. The case of the wire drawing shop in the above analysis also shows that in Woodward's scheme, the "scale" of technological complexity can be used, if at all, for integral products only and not for some of the dimensional products.

Woodward's important contribution is the recognition of the volume and type of output as being factors that may significantly influence the organisation of work. While they are not the determining factors in the formulation of a particular division of labour, at the level of individual work-stations within a workshop they may provide some of the constraints to the possible forms of work organisation inasmuch as they limit or open up a set of possibilities for organisation of work.

Two other relevant theorists of the contingency school who have been discussed earlier (see Chapter 3) are Perrow and Thompson. Perrow identified two aspects of technology: first, the response procedures required in using raw materials, and second, the variability encountered in carrying out the required response procedures. Further, the required response may involve either analysable or unanalysable search behaviour and the variability in either case may be identified as involving a few exceptions or many exceptions. On the basis of this framework, Perrow classified the technology of organisations into four types: craft, non-routine, engineering, and routine technology. All the work-shops studied come under the category of "routine" technology; i.e. the search behaviour is not only analysable but it involves little variability.

Perrow's scheme of classification does not tell us much about the skill structure on the shopfloor even though it does point to the knowledge required in production as an important aspect of technology. As pointed out earlier, the reasons for this are: first, the level of analysis is that of the whole organisation, and second, the definition of technology is limited only to the knowledge required in using raw materials and the extent to which their transformation into useful products can be standardised. Such a definition says very little about

how the raw materials are transformed, how the process of transformation is controlled, and by whom, or indeed what determines the standardisability of production methods. Merely being able to say that the technology is "routine" is not enough if the attempt is to show the links between technology and organisation of work because within a "routinised" technology there can be more than one form of division of labour.

Yet another related point that must be made in relation to using Perrow's categories is that if all the workshops chosen here fall into the category of "routine" technology, it is because of the choice of workshops as well as because of the fact that only shopfloor work organisation was chosen for analysis. This classification as "routine" technology would have little explanatory value if it were found that there were differences in work organisation between the workshops. If, however, the design departments of the firms were also considered along with shopfloor work, then they would perhaps fall under the category of "non-routinised" or "engineering" technology. This would further go to show how Perrow, like Woodward, conflates different subsystems even according to his own definitions.

Most of the workshops broadly fall under the category of "long linked technology" when Thompson's method of classifying technology is used. Thompson, it must be remembered, had classified technology into three categories - long linked, mediating, and intensive. Long linked technology involved serial interdependence of tasks, mediating technology referred to activities that linked clients or customers who wanted to be interdependent, and intensive technology referred to the technology of those organisations whose activities involve drawing upon a variety of techniques (see Chapter 3).

The production of all industrial products involves some degree of serial interdependence of production stages. This may mean serial interdependence at the level of different workshops within a plant and/or between different jobs within a workshop. The latter form of serial interdependence in its extreme form takes the shape of a long line assembly but that is not the only form it may take. Understood in this way, all the workshops being studied here could be broadly classified under the category of "long linked" technology. However, this is not a satisfactory classification when the other categories of Thompson are also examined. There exist at different levels within industrial firms subsystems whose activities can only be classified under the category of intensive technology. Design departments and maintenance jobs, for example, would fall under this category. Thus, even Thompson's classification is quite inadequate because once maintenance, repair and setting jobs are considered, his classification basically cannot be used easily for the workshops being studied.

Thus, out of the contingency theorists considered here, while Woodward seems to point towards the volume and type of output as relevant factors that may constrain the work organisation on the shopfloor, Perrow's contribution is in terms of considering the knowledge required in production as an aspect of technology. Thompson, on the other hand, points to the work-flow aspects of technology. All three of them look at different aspects of technology but do not quite manage to say adequately how or why these aspects of technology are linked to organisation of work.

As was noted in Chapter 3 some of the conceptual confusion of the contingency school was cleared by Pugh and Hickson by identifying three different facets of technology: materials used in production, knowledge used in production, and workflow planning or operations technology.

While they operationalised the concept of operations technology they did not show how the other two aspects of technology could be operationalised. However, their analysis of operations technology will not be repeated here because of its limited use in analysing the links between technology and organisation of work in general.

Blauner's four categories of technology - craft, machine tending, assembly line, and continuous process technology - were again descriptive categories used at the level of the firm. Blauner also does not provide any method of relating them to the skill structure. Table 3 shows the operational uses of Blauner's categories in the context of this study. It illustrates the fact that different workshops within a firm may fall in different categories. But there are also other problems associated with Blauner's classification which are illustrated in Table 3. In the case of the motor assembly workshop of firm D, the classification could either be as craft technology or assembly line technology. The wire drawing shop, similarly, could go in the category of machine tending or process technology. Thus, this attempt at operationalisation of Blauner's categories also supports the criticisms made earlier (see Chapter 3).

To summarise, both at the theoretical and operational levels, the attempts of the organisational theorists discussed above do not quite manage to relate technology with organisation of work adequately. However, these attempts cannot be dismissed as utterly useless as they do provide significant pointers towards the different aspects of technology. Their frameworks of analysis lack proper theoretical synthesis and this reflects in the operational uses of their categories of analysis. Using only a study of eleven workshops from five firms, the conclusions of these theorists cannot be "proved" or "disproved" as most of their conclusions are correlative conclusions. However, the examination of

Table 3: Classification of the workshops studied into Blauner's categories

Firm	Plant	Workshop	Type of technology
A	Motor	1. Machine	Craft
		2. Assembly	Craft
B	Switchboard	1. Fabrication	Craft
		2. Assembly	Craft
C	Switchgear	1. Fabrication	Craft
		2. Assembly	Craft
D	Motor	1. Press	Craft?
		2. Assembly	Craft/Assembly line
	Switchgear	1. Plastics	Craft?
		2. Assembly	Assembly line
E	Ferrous Wire	1. Wire drawing	Machine tending/ Process?

their theoretical frameworks and the subsequent operational uses of their concepts within the boundaries of their own frameworks attempted above, do cast doubts on their usefulness in studying the organisation of work at the shopfloor level. This, however, does not mean that the aspects of technology they point to cannot be used in a different framework of analysis.

3. LINKS BETWEEN TECHNOLOGY AND THE JOBS OF WORKERS

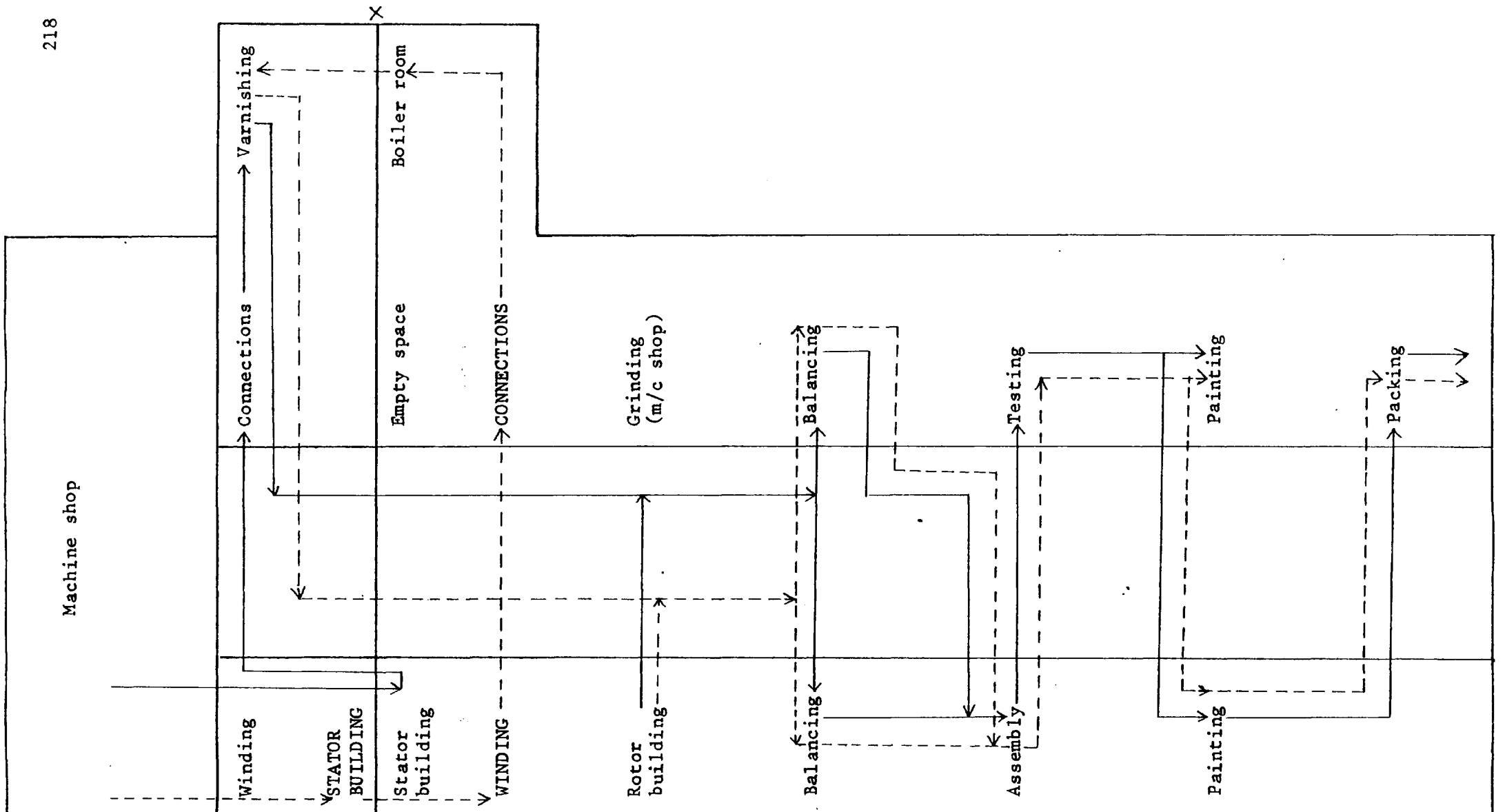
In attempting to analyse the links between technology, technical change and the work organisation on the shopfloor, first the impact of the spatial aspects of technology, i.e. work flow arrangements, on the work organisation are analysed. This is followed by exploring the impact of different aspects of changes in technology on the organisation of work on the shopfloor.

Methods and patterns of workflow:

There were three firms out of five where changes in the workflow have either occurred in the past decade or were in the process of being implemented. The context within which these changes occurred or have been planned are now analysed along with their impact on jobs.

To begin with, the case of firm A can be considered. Before 1970, both the transformer and motor manufacturing operations were carried out in the same building. Till 1969, firm A manufactured motors only in the horsepower range going up to 50 h.p. which it expanded up to 150 h.p. in 1969-70. While this decision did not entail buying any new machines, it did mean space restrictions in the old building. And thus in 1970, motor operations were shifted to a different building adjacent to the old one. In one part of the building the machine shop was situated and in the other, where the roof was at

DIAGRAM 1: Proposed workflow changes in the motorplant of firm A



Notes: 1. Small letters represent the existing positions of
2. Capital letters represent the proposed position of the different workstations
3. Solid arrows represent the existing workflow pattern
4. Dotted arrows represent the proposed workflow pattern
5. XY represents the change in roof elevation

a slightly lower level, the motor assembly shop was situated[2].

The difference in roof elevation between the two workshops had an important bearing on the workflow between them. It meant that the overhead cranes which were used for transporting components between work stations in the machine shop could not be used to transfer the components directly to the assembly shop because of the difference in roof-levels. These cranes which moved along a rail fixed to the roof of the workshop could not change levels and the architecture of the building was such that no single rail for the overhead crane could be fixed across the two workshops.

This is an example of work flow across workshops in a plant being constrained by the inherited inflexibilities in the fixed capital of the firm which are results of the decisions taken by the management in the past. In other words, the spatial dimension of technology may be limited historically, as in this case.

Given this architectural inflexibility, designation of "functional sites" (see the discussion on Foucault in Chapter 2) or workstations may still involve a certain amount of choice. And this becomes clear to some extent when the present and the proposed work flow in the motor assembly shop are examined (see Diagram 1). Both the present and the proposed work flow would require negotiating the problems associated with changes in roof-levels three times. But the proposed work flow would make better use of space by making more space available for the connections and the winding section.

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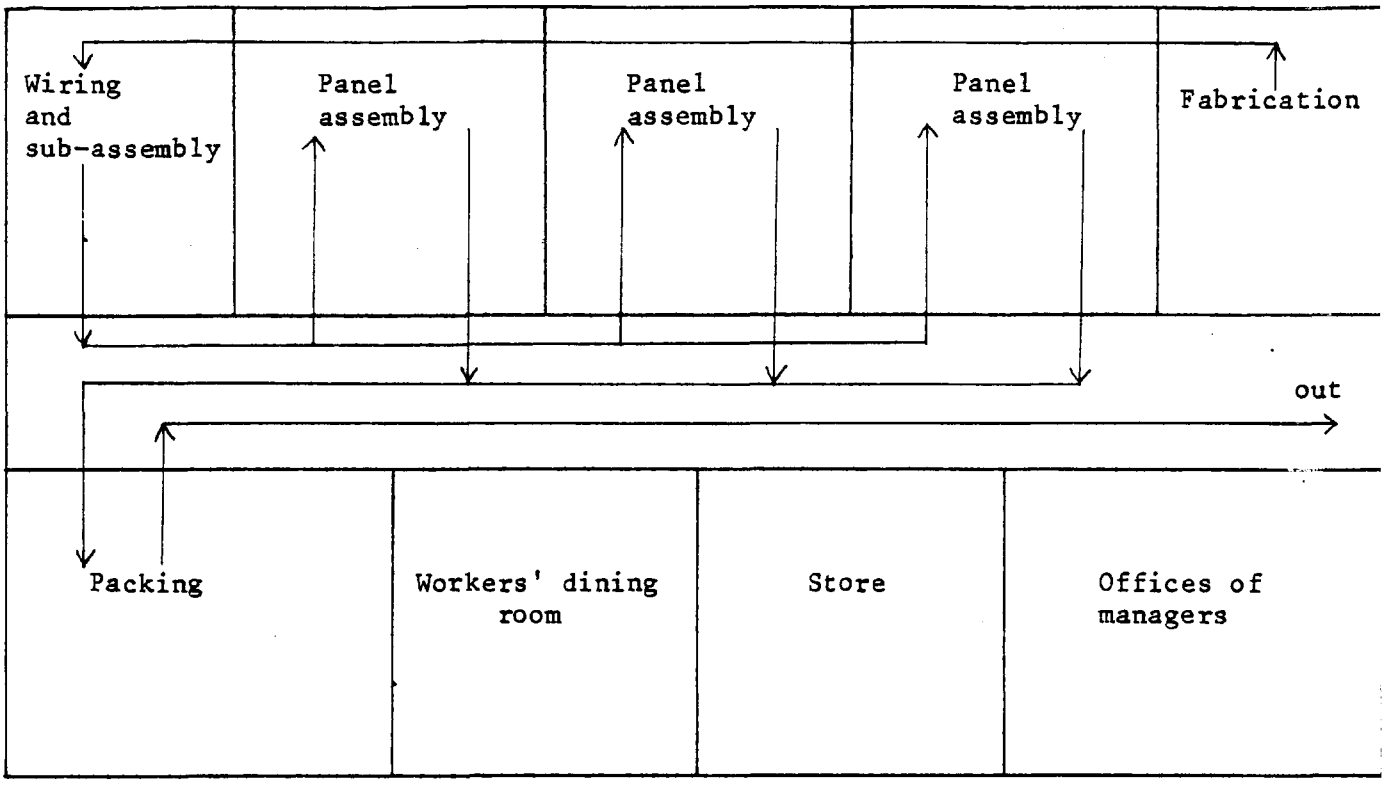
2. This building was already there and was not a new building. Alterations in the architecture of the building were not a simple matter as planning permission from the Government would be required which could take quite some time. Alterations would also involve disruptions in work for substantial periods of time.

It might be asked which constraint does this change as far as work organisation is concerned. If the production capacity for motors were to be expanded, more space would be needed for all sections of the assembly shop. And while the other sections like rotor building, assembly, balancing, etc. had extra space available, no such expansion in area was possible in the winding and connections section if the existing work flow was to be maintained. So when firm A decided to increase the horsepower range of its motors, it became necessary to plan for overcoming this space constraint. The proposed workflow shown in Diagram 1 was the result. However, the new workflow, as pointed out earlier, would not change the constraint imposed on the organisation of work by differences in roof elevation; i.e. materials and components would still have to be transferred manually whenever they have to be taken across the two levels. The implication of this for the jobs in this workshop is that either a separate job of manual material transfer would have to be maintained or material transfer of this type would have to be included in the jobs of workers doing jobs like winding, connecting, etc. At present, however, it is a separate job carried out by a helper.

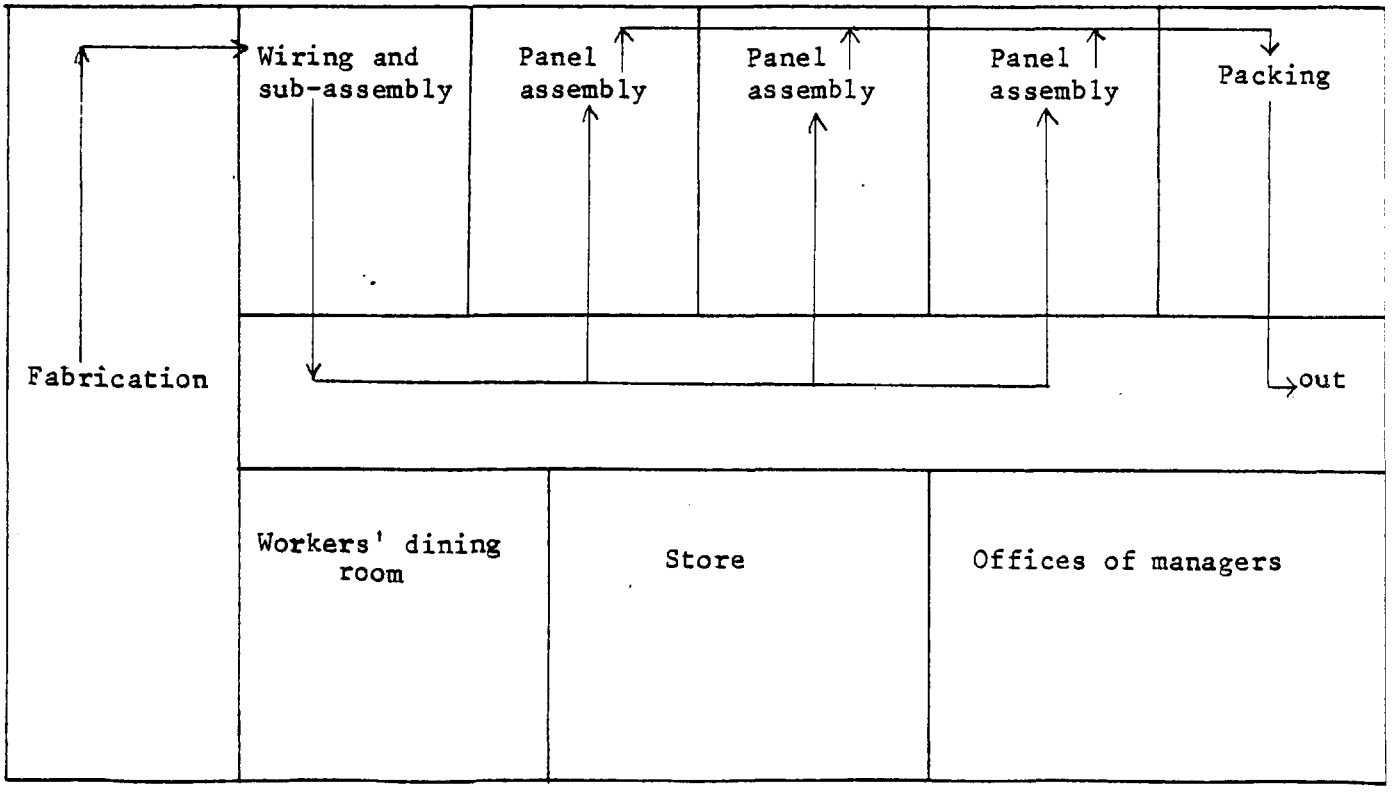
For firm B, the present and proposed workflow in the switchboard wiring and assembly shop are given in Diagram 2. All the transfer of materials is done manually in this workshop. The present workflow requires a certain amount of back-tracking and leads to congestion. According to the management, the reorganised workflow would not only lead to less congestion, but would require five workers less in transferring material between workstations. These workers, according to the production manager of firm B, would then be moved to direct production.

Diagram 2: Changes in workflow in the assembly shop of firm B

(i) Existing workflow



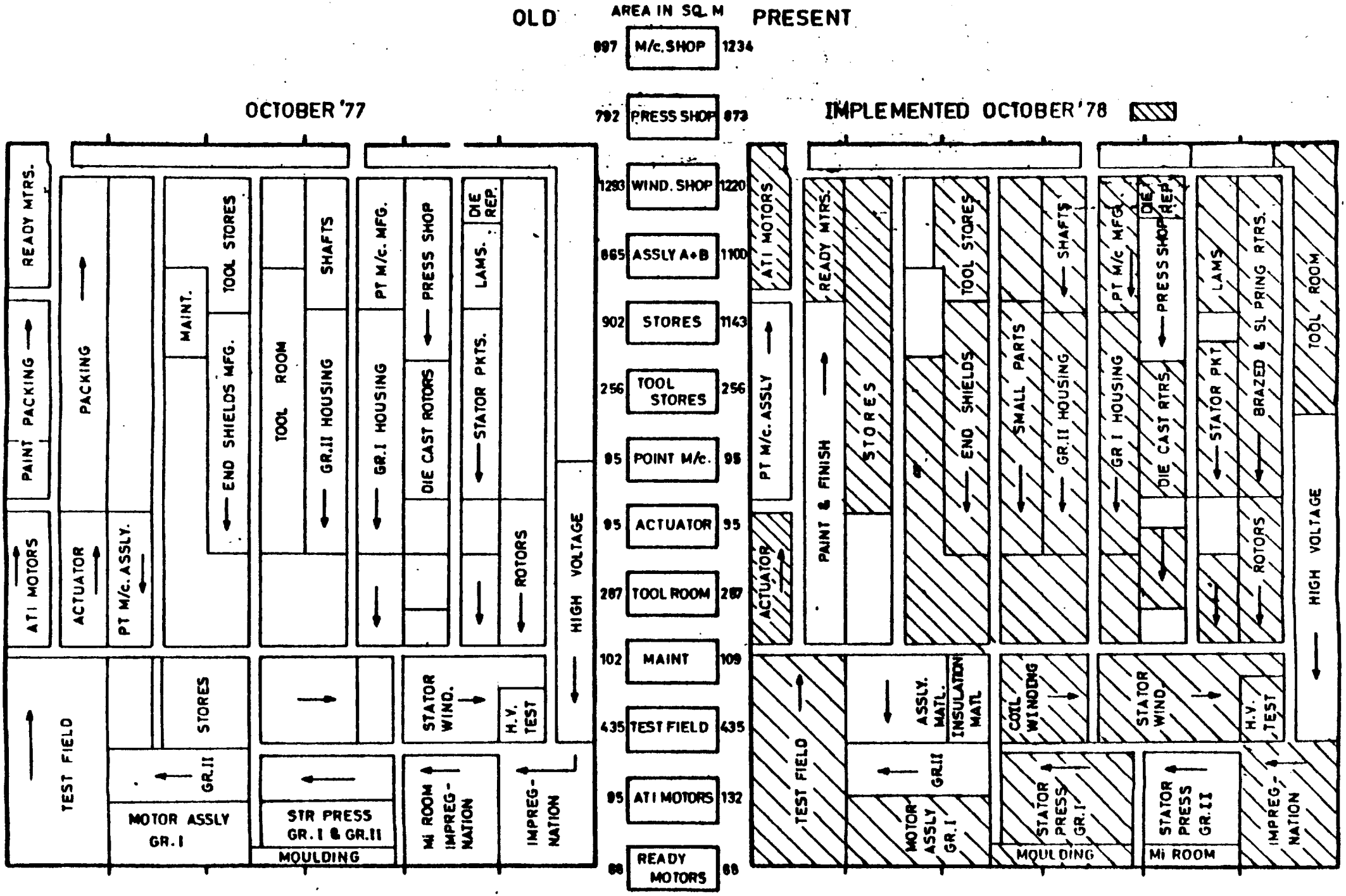
(ii) Proposed workflow



While once again it can be seen that within a particular architectural space workflow may be organised in more ways than one, the new workflow besides saving labour time would also change the jobs on the shopfloor. Employing the extra workers released from manual material transfer in other productive jobs in the workshop would mean that both their executional and conceptual abilities are likely to increase. The physical effort component of their job may go down compared to the earlier job while object variety in the job would probably increase. At the level of the workshop, more workers would be doing jobs requiring higher conceptual and executional abilities than before. Thus, this is once again an example of changes in workflow affecting the jobs on the shopfloor - in this case leading to a greater specialisation. Diagram 3 shows the old and new workflow patterns and the area of different sections in the motor plant of firm D. According to the management, by changing the position of various work-stations, e.g. of the tool-room from the middle of the work-area to one corner of it, workflow was smoothened as well as area of component manufacturing workshops like the machine shop and the press-shop was increased. While smoothening of workflow would clearly save labour time, it is difficult to comment upon the significance of increase in areas of some workshops in the absence of additional information.

However, in the case of the proposed reorganisation of workflow in the switchgear assembly shop, the implications and aims of workflow pattern changes are much more clear. At present contactors are assembled on a long assembly line. Management is not happy with the arrangement because of the following problems inherent in the long line assembly technology. First, in long line assembly the speed of the line can be controlled by the workers at the beginning of the line. Second, jobs are so minutely sub-divided and specialised (but not necessarily

Diagram 3: Old and new layout of the motor plant in firm D



"skilled" thereby) that product variants cannot be easily introduced without changing the task composition of the jobs along the line each time this is done. Third, long line assemblies tend to lead to high fatigue levels among workers because of a high pace of physical effort. Fourth, there are problems of supervision because long lines do not offer a good view of material flow to the supervisors. And lastly, because of the extreme rigidity in the division of labour on the long line assemblies, if a worker is absent, his tasks cannot be distributed among the rest of the workers and replacement has to be found for his position on the line. This leads to a series of operating allowances or standing-in allowances to be paid to the officiating workers.

To overcome the problems mentioned above, the management of firm D set out to design a new structure for the assembly lines[3] and in doing this it sought the help of its principals in West Germany. The criteria used for choosing the new structure and the different alternatives considered are now discussed[4].

Five different structures for the assembly line were considered. Some basic information related to these five structures is given in Table 4. But this data by itself does not tell us very much. What is needed is information about the criteria used by the management to choose one or the other of the alternatives. And the criteria used were: Line flexibility with respect to different variants, flexibility in terms of output target adjustments, accurate functioning of the assembly line, clear view of the workshop, flexibility in terms of adjustment of

3. This experiment was to be limited to only one type of contactor. However, this also happened to be the type which had a very high demand in the market.

4. The analysis is based on a document prepared in West Germany by the principals of firm D with the help of the planning manager of the Switchgear Division of firm D.

Table 4: Some basic data related to the different assembly line structures considered for contactor assembly in firm D.

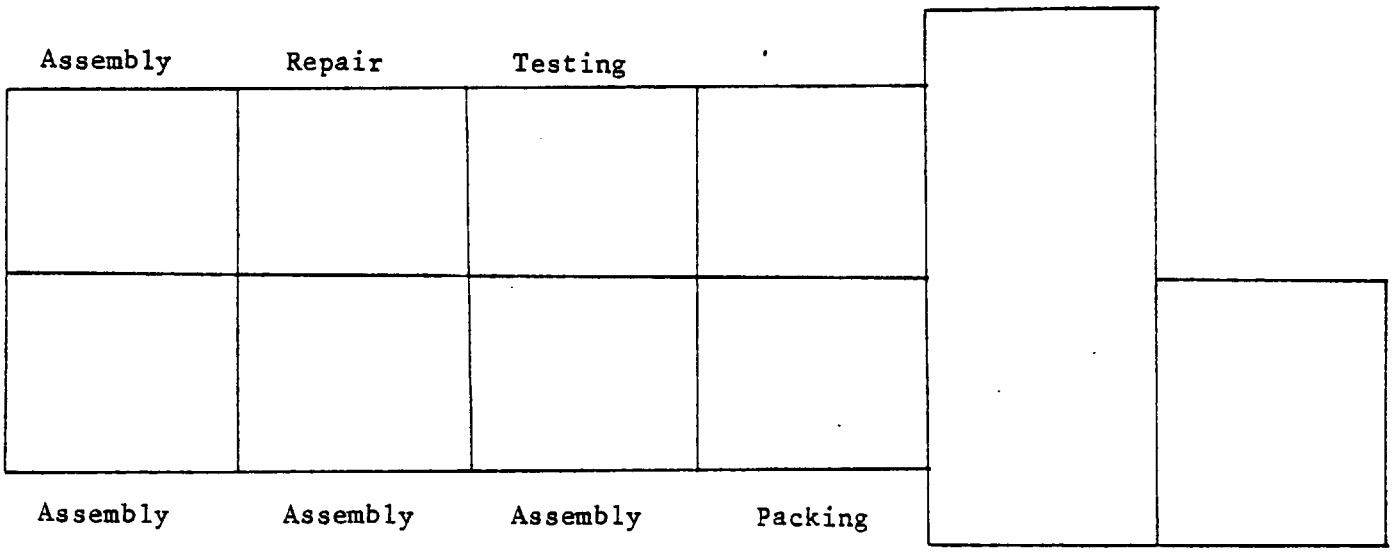
	Assembly line structure	Required work area (sq.m.)	Investment for installment	Cycle time (min./switch)	No. of productive workers required
1.	Single long line	66	375	0.309	12
2.	Same as above but the line goes back on itself	62	375	0.309	12
3.	Two smaller lines which go back on themselves	64	507	0.618	12 (6 per line)
4.	Three smaller lines which partially go back on themselves	77	546	0.925	12 (4 per line)
5.	Three smaller lines which go back on themselves completely	79	546	0.925	12 (4 per line)

workers, workplace layout, motivation of workers through effective work content, extent to which number of productive workers can be reduced, clear view of material flow, and reduction in total running time to reduce dust.

The three major related aims that the management was trying to achieve by changes in structure of workflow were the following. First, increasing control over the work-process by making the assembly line more flexible to changes in product type, fluctuations in output, and absenteeism. Second, increasing control over workers by increasing supervision through a better layout which would offer a better view of the workshop and a clearer view of the material flow. And third, reducing the number of productive workers and distributing their tasks among the remaining workers thus increasing their job content. The criterion about reduction in dust-level is also important because dust would affect accurate functioning of the contactor being assembled.

After a series of evaluative exercises using the criteria listed above, plus the availability of space and investment required, alternative 4 was chosen (see Table 4); i.e. three smaller assembly lines which partially go back on themselves. The structure of these assembly lines is given in Diagram 4. According to the management, the advantages of this system were the following. First, smaller lines lead to better supervision. Second, more than one assembly line brings personnel flexibility; i.e. if a worker is absent then at least some of the assembly lines can be worked effectively "by moving the workers around without paying extra operating-allowances. This would ensure that output is not affected to any significant extent. Third, if there are changes in output targets then not all the assembly lines need to be worked and some of the workers can be put to other jobs. Fourth, at a given time more than one product variant can be assembled. Fifth, if

Diagram 4: Proposed structure for switchgear assembly in firm D*



Notes *The structure of only one of the three assembly lines has been presented here.

there is any problem between workers on any one of the lines, then the trouble-spot can be isolated and the workers regrouped, thus leading to better utilisation of manpower. And lastly, with increased cycle-time, fatigue amongst workers can be reduced considerably.

The disadvantages, according to the management, were that this structure requires more working space, more investment as greater number of similar tools are required, and that scope for automation may get reduced because of smaller groups. However, it was claimed that the advantages of the new systems would far outweigh the disadvantages and the new assembly line structure was to be implemented by the financial year 1982-83.

Thus, as far as the workflow aspects of technology are concerned, it can be concluded from the above examples that whatever the constraints on the workflow, the actual workflow implemented is a result of conscious management decisions. These decisions may arise out of the perception of the present or projected market demand for the products being reflected in expansion of production as in the case of firm A, or because of the desire to save labour time as in the case of firm B, or a more complex set of reasons which lead to changes in the workflow as in the case of firm D. The above examples also show that in none of the cases was the change in workflow brought about to overcome workers' resistance to managerial control, although in the case of firm D the change in technology would not only provide a greater flexibility in production but also increase the managerial control over the labour process.

But what general implications that can be drawn about the linkages between workflow aspects of technology and organisation of work? First of all it must be remembered here that there are two aspects of workflow - the pattern of workflow and the method of workflow. Changes

in either may lead to elimination/modification of tasks related to material transfer. This in turn leads to a modification in the total number of tasks to be performed in a particular workshop. And it is the specific ways in which these tasks are combined into jobs that would determine the implications of workflow changes for the organisation of work on the shopfloor. Having made this general observation, some specific implications of changes in workflow for the organisation of work can also be drawn in the context of the firms we have studied.

There are at least four ways in which the set of tasks to be performed in a workshop can be influenced by changes in patterns of workflow and methods of workflow. First, inflexibilities in the architecture of the workplace may lead to awkward workflow patterns which in turn imply the creation and maintenance of some specific tasks. In this case, in the motor assembly shop of firm A, these were the tasks related to manual transfer of materials across workplaces at different elevations within the same workshop. Second, changes in workflow patterns that lead to smoothening of the workflow may result in reduced labour requirements as in the case of material transfer in the assembly shop of firm B. Absorption of the extra workers in other productive jobs in the workshop, as the management claimed they wanted to do, would lead to greater specialisation in the workshop by increasing both the executional and conceptual abilities of these workers. However, if these workers were either to be shifted to another workshop or made redundant, this would not be the case.

Third, changes in the method of workflow (and more of this in the subsequent discussion as at times this may also have implications for material transfer <u>through</u> the material transformation process at individual workstations) may modify the tasks of material transfer thus changing the task content of the jobs of workers involved in work-

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flow and may also reduce the number of workers required for workflow activities. An example of this would be a change from manual to mechanised material flow.

And lastly, workflow changes as in the case of the contactor assembly in firm D, may also lead to greater flexibility in production as well as greater control over production while at the same time increasing the skill components of the jobs of individual workers. However, workflow aspects of technology may not always articulate with organisation of work in the same way as in this specific case. So while this is indeed a very good example of how control and organisation of work are linked with technology, it must be kept in mind that this is perhaps an exceptional case.

Until now the discussion of technology or, more specifically, of the workflow aspects of technology, has been limited to the level of plants or workshops within plants. However, within workshops, technology and technical change can also be studied at the level of individual workstations or machines. As pointed out earlier, using Bell's scheme, aspects of technology at this level which affect the organisation of work are: changes in material transformation process, material transfer process, and changes in the methods of control for the above two processes. A discussion of the links between these changes and organisation of work is presented below.

Changes in technology at individual workstations:

In discussing the implications of changes in the different aspects of technology for organisation of work, a simplifying assumption has been made. It has been assumed that where changes have occurred in more than one aspect of technology, each of them would affect the task composition of jobs independently of the other(s). Of course, in reality this would not be so. This simplifying assumption has been

made purely for analytical purposes. It is a reasonable assumption since the attempt is only to try and delineate different articulations of these changes with the division of labour on the shopfloor to show that these linkages are neither simple nor specifiable in advance irrespective of the specificities of the workshop/firm under consideration.

To study the material transfer through the material transformation process, the handling operation was broken down, according to Bell's scheme, into five basic operations: transport to the work station, loading the work-piece onto the machine/workplace, manipulating the work-piece, unloading the work-piece, and transporting the work-piece from the work-station. Then for each work-station, in the workshops considered, information was collected on how each of these operations was performed. The details for all work-stations in the workshops studied are presented in Appendix III. Information about the material transformation process and the control systems for the transformation and transfer process, as well as changes that have occurred in them, have also been listed in this Appendix. However, in the following pages an attempt has been made to discuss the nature of the above mentioned aspect of technical change wherever they have occurred and the possible ways in which they can affect the organisation of work.

Changes in technology that have taken place or are planned for at the level of individual workstations in different workshops studied are listed in Table 5 along with the possible implication of each change for tasks/job performance. This table merely presents an outline picture of the possible impact of the various changes in technology in eliminating/modifying tasks at the workstation where the change has occurred or at workstations with which it has forward workflow links. It does not go into details of how the new modified set of tasks can be combined into jobs thus changing the organisation of work. These

Table 5: Technical changes at individual workstations and their possible impact on tasks/jobs

Firm	Workshop	Technical change	Implications for tasks/job performance
A	1. Machine	a. Tool-bits introduced (1971-72).	Elimination of retooling tasks.
		b. Overhead cranes introduced (1971-72).	Modification of material transfer tasks at work-stations and between them.
	2. Motor assembly	a. Overhead cranes introduced (1971-72).	" " "
B	1. Fabrication	a. Introduction of special purpose tools on piercing machine (1978).	Quantity and pace of physical effort, danger would go up as would manual dexterity and concentration at the piercing work-station. Lesser physical effort, lesser object variety, lesser manual dexterity in the jobs of fitters in assembly shop.
D	1. Press	a. Introduction of compound dies on blanking machine (proposed).	No impact on task composition in the press shop.
		b. Sorting operation would be built into the notching press (proposed).	Sorting tasks would be eliminated.
		c. Introduction of robot-mechanism for feeding laminations at the notching press (proposed).	Loading tasks would be eliminated. Higher pace, lesser quantity of physical effort, lesser manual dexterity in the job.
	2. Motor assembly	a. Higher speed on h.t. coil winding machine (proposed).	No impact on tasks unless breakages increase.
		b. Introduction of multi-frame coils on coil winding machines (proposed).	No impact on tasks in coil winding. Increased pace at "connections" work stations. Possible reduction in number of jobs in "connections".
		c. Introduction of dies to cut interphase insulation (proposed).	Reduction in number of tasks. Mathematical calculations required eliminated. Possibly higher pace.
		d. Spray-painting of endshields and fans of motors (proposed).	Increase in health hazards in the job as no masks are provided.
	3. Plastics	a. Introduction of multi-cavity dies for moulding (1978, 1980).	No impact on jobs in moulding. Number of deburring jobs increased.
		b. Introduction of sand shot-blasting machine for deburring (1980).	Creation of a new job (see text).

Table 5 (continued)...

Firm	Workshop	Technical change	Implications for tasks/job performance
D	Plastics	c. Introduction of transfer moulding tools instead of compression moulding (proposed).	No impact on tasks/jobs if present output levels continue.
		d. Tapping/drilling operations would be incorporated in the dies (proposed).	Elimination of tapping and drilling job.
		e. Introduction of pre-plasticiser in place of the tabletting machine (proposed).	No impact on regular jobs. Possible impact on maintenance jobs.
	4. Contactor assembly	a. Introduction of pneumatic double screwdriver to fix base plates (proposed).	Reduction in number of tasks. Possible increase in pace.
		b. Introduction of pressurised air fixture to clean sockets (proposed).	Extra task added to one of the jobs on the line.
		c. Introduction of pneumatic pusher for mounting the fixed contact (proposed).	Quantity of physical effort would decrease while pace of physical effort would go up.
		d. Introduction of a name-plate dispenser (proposed).	Modification of tasks. Possible increase in pace of physical effort.
		e. Introduction of a special fixture to insert assembled contactor into a plastic bag.	Modification of tasks. Possible increase in pace of physical effort.

details are discussed for each of the workshops in the following discussion. The only general comment that can be made before detailed analysis of the changes in technology is that almost all of them resulted in saving of labour-time and that not all of them affect the jobs in the respective workshops.

Now an effort will be made to analyse the technical changes at different workstations in workshops in each firm and their possible impact on the organisation of work. At the end of the discussion of technical changes in all firms, general implications of technical change for organisation of work have been discussed.

Technical change at the level of workstations in firm A:

In the motor plant of firm A, in 1971-72, two changes in technology occurred. First, overhead cranes were introduced for material transfer between machines and for loading and unloading of work pieces onto machines or work-places. These operations used to be completely manual before 1971-72. And two, in the machine shop tool-bits with multiple cutting-edges were introduced in the same year. Before 1971-72, tools with a single cutting edge were used. When the edge became blunted, the tool had to be removed and then either it had to be retooled immediately or it was replaced by another tool. This resulted not only in delays in production but also led to loss in accuracy. With the introduction of tool-bits the situation changed dramatically. Each tool-bit had three cutting edges and could be fitted into a socket in the tool-head. Whenever an edge became blunted, the tool-bit could be turned around and another edge could be used. Thus, the worker could go on working with considerably less loss of time and with the same accuracy as before. When all the three edges become useless, the tool-bit can simply be thrown away and replaced by another tool-bit of same accuracy.

What were the implications of these changes for the organisation of work on the shopfloor? In the first case, jobs of manually transferring materials were abolished[5] and the physical effort required by the workers in loading and unloading heavy work-pieces was reduced. In the second case, besides saving production time, every time the cutting edge was blunted, tool-setters did not have to be called because the tool-bits could be turned around by the worker himself. Tool-setters would be required only for setting new jobs. This would reduce the task composition of their jobs if they were also involved in retooling. However, there is no information available to confirm this. Whether the tool-setters did the job of retooling or the machine operators did it, in either case the introduction of tool-bits would have changed the division of labour on the shopfloor.

Technical change at the level of workstations in firm B:

In firm B, the workflow changes that occurred in the wiring and assembly shop have already been discussed above. However, in the fabrication shop of firm B, the changes were of a different kind. Changes occurred in the material transformation process when special purpose tools were introduced on the piercing machine in 1978. These helped, according to the management, in increasing both the speed and accuracy of the material transformation process. According to them, productivity in the fabrication shop went up by seven times with the same number of workers and machines. However, there was yet another aspect of this change in technology in the fabrication shop. And that

5. There was no information available on whether those workers who were engaged in material transfer lost their jobs or whether they were re-employed on different jobs within the workshop or outside it.

aspect was that the increase in accuracy of fabrication led to a reduction in assembly time for various cubicles in the assembly shop. The level of this reduction was as much as forty per cent in some cases (see Table 6).

The implication of this change in the material transformation process for jobs would be different for the piercing work-station in the fabrication shop and for the assembly operations in the assembly and wiring shop. At the piercing workstation, an increase in the speed of the machine would mean the following: First, in all likelihood, the working conditions would become more dangerous as increasing the speed of the machine would also imply feeding metal-sheets for piercing into the machine at a matching rate. And this is still a manual operation. And second, because loading and unloading of metal sheets is done manually, this technical change would also mean that the quantity and pace of physical effort would perhaps increase and because of the increased dangers associated with the job, greater manual dexterity and concentration would be required than before. In the assembly shop the reduction in assembly time was due to the increased accuracy in the dimensions of the different components of the cubicles coming from the fabrication shop. This meant that the fitters in the assembly shop would not have to work on them again to make them fit. The implication of this for the jobs of fitters would be that less physical effort would now be required than before. There would also be a reduction in the overall work-cycle length. And unless there is a reorganisation of the task composition of all the jobs in assembly and wiring shop, which did not happen in this case, it would also mean the use of less manual dexterity and perhaps less object-variety in the jobs of the fitters in the assembly shop. This then is an example of technical change in one workshop affecting task composition of jobs, not only in

Table 6: Changes in assembly time for switchgear cubicles in firm B

	Voltage specification of cubicles (kV)	Assembly time (hrs.)	
		Before 1978	After 1978
1.	6.6	250	150
2.	11	250	150
3.	22	300	250

that workshop, but also in another workshop with which it has forward workflow linkages.

Technical change at the level of workstations in firm D[6]:

In firm D, many interesting changes (from the point of view of their impact on work organisation) in technology were planned in the different workshops. In the press-shop of the motor plant hardly any changes had taken place in the last decade. However, the proposed changes in these workshops were likely to have important implications for the division of labour on the shop floor. As far as the material transformation process is concerned, there were plans for the introduction of compound dies on the lamination blanking machines, and for building in the sorting operation in the notching press for rotor laminations. The former would double the rate of output on blanking machines but would not affect the task composition of jobs on these machines. And the latter would reduce the number of tasks in the job on the notching press because sorting which at present is done manually by the workers would be built into the machines. Along with this change there was yet another change planned at the notching presses. And this was the introduction of robot-mechanisms for feeding laminations on the notching presses, thus bringing about changes in the material transfer process on these machines. This automation of the loading operation would further reduce the task composition of jobs on notching presses. Assuming that the overall job-structure is not reorganised, one important implication of this change and the building in of the

6. In firm C, some new machines were added as replacement for old ones in the fabrication shop. These, however, did not entail any changes in organisation of work. Because no significant changes in technology at the level of workstations took place in firm C, after firm B, firm D is being discussed.

sorting operation, would be that manual dexterity on these jobs would be decreased considerably. While the quantity of physical effort required in performing the job would be reduced, the pace of physical effort would increase with the reduction in work-cycle length. It is also likely that in these jobs, which in any case involved a limited pace choice, such choice would be further reduced. However, if the task composition of the jobs were to be reorganised while at the same time keeping the number of workers the same, and new tasks like setting the machines, then the different job attributes including executional and conceptual abilities would change in ways different from those described above.

The technical changes proposed in the motor assembly shop of firm D were the following: (i) higher speed on the high tension (H.T.) coil winding machine, (ii) introduction of multi-frame coils for reducing number of joints for stator winding, (iii) use of dies for cutting interphase insulation on hand-press, and (iv) introduction of spray-painting of endshields and fans of motors. All the four changes, thus, refer to the material transformation process.

Higher speed on the coil winding machine would increase the rate of output but would not affect the abilities required of the workers on such machines. These jobs only require connecting the various coil-rolls to the coil frames and then once the machine is switched on, the coils are wound on the frames through a rotary motion of the frames. The workers then only have to take care of breakages. Thus, unless because of higher speed, breakages increase, in which case the workers would have to stop the machine more often to reconnect the coils thereby increasing the pace of physical effort required, this change in technology is not going to affect the task composition of the jobs in any way.

The introduction of multi-frame coils would not change the task composition of the job at the coil winding machine, where these frames would be introduced. However, it would change the task composition of the job of connectors by reducing the number of connections to be made. This may further lead to reduction in total number of jobs in the connections section of the motor assembly shop unless the planned volume of production also goes up. A reduction would also occur in the work-cycle thus perhaps increasing the pace of effort at the connections workstations while also leading to saving in labour time. The reduction in total number of jobs in the connections section may either mean loss of jobs - though this is unlikely to happen in this specific case because of union pressures[7] - or it may mean shifting some of the workers to other jobs in other sections.

The introduction of dies for cutting interphase insulation on hand-press would not only increase the accuracy in the dimensions of the insulation materials but would also reduce the number of tasks in the jobs of the insulation cutters. At present, they have to use simple measuring instruments to measure the size of the insulation pieces to be cut from bigger sheets of insulation material, mark the size and then use the hand press to cut it. Since the required measurements of the interphase insulation would now be "built in" the dies, whatever little mathematical calculations that were needed in the job would now be completely eliminated, length of the work-cycle would be reduced further, and the pace of physical effort would probably go up.

The introduction of spray-painting of endshields and fans of motors, instead of the hand painting methods used at present, would

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7. See discussion of the unions and organisation of work in the next chapter.

reduce the cycle-time and therefore, once again, resulting in a saving of total labour time. It is unlikely that it would affect the skills of workers in any significant way though it might increase the object variety involved in the job. However, what the introduction of spray painting is likely to do is to increase the health hazards for those painters who paint these components by hand at present. And this is likely to be so because no masks are provided for workers engaged in spray-painting[8] with the result that workers are likely to breathe in paint particles.

All these technical changes related to the material transformation process in the motor assembly shop of firm D point to the fact that, everything else being equal, these changes may alter the jobs in more ways than one. Some changes in material transformation may either eliminate certain executional or conceptual abilities while others may not affect these aspects of the jobs at all and may affect, for example, the amount of physical effort required or change the dangers arising out of the working conditions. Some changes may achieve this by eliminating tasks, while others may achieve this by modifying the tasks. But as pointed out earlier, the impact of these change is being analysed here at the level of individual workstations. However, in effect, these changes would also change the constraints within which work is organised at the level of the particular workshops in which these workstations are situated. Thus, for example, saving of labour-time by reduction in overall cycle-time may have two important implications at the level of a workshop. One, a relative reduction in the control of the workers over the work process. And two, the saving

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8. Other parts of the motors are spray-painted at present.

in labour time may be such that through the reduction in number of tasks to be performed by the workers, the management may be able to reduce the total number of jobs in a particular section, e.g. in the connections section in the above case.

Before discussing the general implications of the different types of technical change for the organisation of shopfloor work, the changes in technology in the switchgear plant of firm D are analysed first. As mentioned earlier, two workshops were studied in the switchgear plant - the plastics shop and the contactor assembly shop.

The plastic shop made moulded components for the contactors; e.g. contactor housing, cover-plates, base-plates, setting dials, etc. All the changes in this workshop over the last decade have had to do with the material transformation process. During 1978-70, new dies were introduced on the moulding machines which had a greater number of cavities than the dies being used previously. In December 1978, four-cavity dies for making switching chambers were introduced in the place of the two-cavity dies in use at that time. In 1980, two-cavity dies replaced single-cavity dies for cover-plates, and in the same year six-cavity dies replaced two-cavity dies for setting dials, and four-cavity dies were introduced in the place of two-cavity dies for contactor housing.

The introduction of these dies increased the rate of output by keeping the number of workstations and workers the same. The impetus for these changes came from the continued high demand for the contactors made by firm D. The point to be kept in mind here is that had this increase in output because of technical change taken place without a higher planned production, then perhaps the jobs of some of the workers

on moulding machines would have been under threat because of the reduction in the number of moulding workstations required.

The increase in production due to the introduction of these dies created a further impetus for technical change. To take care of increased deburring requirements because of the four-cavity dies which doubled the production of switching chambers in December 1978, three months later in March 1979, an additional sand shot-blasting machine for removing burr from the moulded components had to be introduced. This meant creation of a new job. But this was not sufficient to cope with the increased deburring requirements because of further increase in production as more new dies with a greater number of cavities were introduced over the next two years. It was this increased work-load at deburring workstations which led the management to formulate plans for some more changes in technology. The changes proposed were the following: One, instead of compression moulding, transfer moulding tools would be purchased because in transfer moulding burr is comparatively less. And two, some of the operations like tapping and drilling would be incorporated in the dies themselves. This, according to the management, would further reduce the deburring requirements. However, this would also eliminate the jobs of drilling and tapping. This then is an example of a technical change influencing the division of labour on the shop floor by eliminating tasks at some workstations by 'building' them into workstations previous to them. In this case, this would not increase the number of tasks to be performed at the moulding workstations.

Another proposed technical change, not related to the ones listed above, was the introduction of a pre-plasticizer. At present the plastic-granules are made into tablets, for use on moulding machines,

with the help of a tabletting machine. This operation is virtually automatic, except for the material handling. A helper, who also does other material transfer work in the workshop, loads and unloads the machine. The main advantage of the pre-plasticiser, according to the management, would be that it would increase the life of the dies by as much as forty percent. The only likely impact of the introduction of this new machine would probably be on maintenance work. However, as there was no separate maintenance job in this workshop, its impact on the jobs in the workshop was likely to be insignificant as this machine would work automatically after it has been switched on and loaded with plastic granules.

The major work-flow changes that were planned in the contactor assembly shop of firm D have already been discussed above. However, along with the overall change from long-line assembly to a more flexible group-assembly, some other technical changes were also planned at the level of individual work-stations. The following changes in the material transformation process at different workstations were planned: First, introduction of a pneumatic double screw-driver to fix base-plates onto socket frames. Second, introduction of a pressurised-air fixture on the material transfer channel for cleaning sockets. Third, introduction of a pneumatic pusher for mounting the fixed contact on to the socket frame. Fourth, introduction of a name-plate dispensor. And fifth, introduction of a simple fixture to insert the assembled contactor into a plastic bag. The major implication of all these changes with the exception of the introduction of a pressurised-air fixture, would be a reduction in work-cycle length at each work-station and consequently a decrease in the running time of the assembly line.

The pressure operated double screw-driver would tighten two screws at a time and thus reduce the number of tasks in fixing the base plate of the contactor. The introduction of a pneumatic pusher for mounting the fixed contact would perhaps reduce the quantity of physical effort while at the same time increasing the pace of physical effort. This technical change, and others like that of introduction of a name-plate dispensor and a fixture for inserting assembled contactors into plastic bags, merely alter the method of task performance to decrease the work cycle length. They do not eliminate the tasks. However, they would increase object variety in the jobs. The air-fixture in the material transfer channel would add an extra task of cleaning the sockets to one of the job on the assembly line, thus increasing the object variety and the length of the work cycle on that job.

There was also a plan for using pre-formed channels instead of brass-rods for moving materials from one workstation to another. This change in the material transfer process would not change the task composition of the jobs on any workstation, it would decrease the total running time of the assembly and would thus perhaps increase the pace of effort at all workstations.

In firm E, in the wire-drawing shop studied, no technical change had taken place in the last decade and nor was any planned. The existing structure of technology, however, has been presented in Appendix III.

General implications of change in different aspects of technology for the organisation of work:

Having discussed the different aspects of technical change in the firms studied, now an attempt can be made to bring together the implications of technology and technical change for the organisation of work on the shopfloor.

Changes in workflow at the level of the workshops:

In discussing the links between technology and the organisation of work, the workflow aspects of technology at the level of plants and workshops were discussed first. In this discussion an attempt was made to demonstrate, firstly, that given a set of tools, machines, etc., the raw materials used in production, and the skill required in using them to produce useful products, workflow could be arranged in more ways than one. And secondly, it was pointed out that workflow could also be constrained by the architectural aspects of the fixed capital of the firm. This type of constraint, as illustrated by the motor plant of firm A, manifests itself in terms of introducing inflexibilities in the workflow. However, it was shown that even within inflexible architectural spaces, there was still some amount of choice in organising the workflow. Changes in both methods and pattern of workflow interact with the organisation of work on the shopfloor. For example, a change in the method of workflow, from manual material transfer to the use of overhead cranes, may require lesser number of workers than before for material transfer. A similar surplus may result from changes in workflow patterns while methods of workflow may remain the same as in the case of firm B. The resulting surplus of workers in both cases could either be transferred to other jobs in other workshops, be made redundant, or may be taught new jobs in the same workshop.

All these options would depend upon, among other factors, skill and employment requirements in other workshops/plants in the firm, the market position of the firm with respect to the products being made in that specific workshop etc. More generally, it could be said that the specific way in which the changes in workflow would alter the possibilities for formulating a division of labour on the shopfloor would depend upon the specificities of each situation in terms of the organisation of work that existed before the change: type of the components/products and their size, volume of output, market position of the firm, strength of the workers' trade union within the firm, etc. These factors may not only help in making possible the implementation of a particular technical change within a workshop but some of them may also be constituted on a different level after the technical change has been implemented. This process would also hold good in the context of technical changes at the level of individual workplaces.

The changes in workflow discussed above related to changes in technology at the level of workshops and plants. Changes in technology at the level of individual machines and workstations and their implications for the organisation of work are now discussed.

Changes in the material transfer process:

Changes in the material transfer or the handling functions at individual workstations, as stated earlier, may change the task composition of the jobs at those workstations by eliminating or partially modifying relatively unskilled handling tasks by those that require relatively higher conceptual and executional abilities. Depending upon the specific situation, the various skill components of the job may increase or decrease. In the case of introduction of overhead

cranes for loading and unloading workpieces onto the machines in 1971-72, as in the machine shop of firm A, the new tasks of operating the cranes would probably have increased the manual dexterity required on the part of the machine operators while at the same time increasing object variety in the job. However, in the case of the proposed introduction of robot-mechanisms for feeding laminations on the notching presses in the press shop of firm D, the loading part of the handling operation would be eliminated and this 'skill' would be built into the machine itself. In this case the manual dexterity of the worker would go down as would perhaps the quantity of physical effort required, while the pace of effort would probably increase.

In some other cases, like that of the proposed introduction of pre-formed channels instead of brass-rods for transferring material from one work-station to the next in the contactor assembly of firm D, changes in material transfer may have no effect on skill requirements. There the only effect of this change would be to reduce the running time of the assembly line while perhaps at the same time increasing the pace of physical effort in all the jobs in the assembly line.

Changes in the material transformation process:

In the case of changes in material transformation process too, as in the case of material transfer, the implications for organisation of work may vary with different situations. Material transformation changes that bring about an increase in the rate of output are also likely to increase the pace of physical effort[9], as in the case of introduction of tool-bits in the machine shop of firm A and the introduction of special purpose piercing tools in the fabrication shop

9. Clearly this would depend upon the pre-existing level of mechanisation.

of firm B. The use of tool-bits in the former case, while increasing precision and repeatable accuracy, would probably have eliminated the jobs of workers in retooling. If, however, retooling was done by the machine operators themselves, and no definitive information is available on this, then some of the skill components of their jobs would have been reduced. In the latter case, the increase in speed at machines such as the piercing machine would probably make the job more dangerous and the loading and unloading of finished metal sheets would require greater manual dexterity and concentration.

The changes in material transformation at a particular work-station may also affect task-content of jobs at other workstations with which it has forward workflow linkages. These workstations may be in the same workshop or in a forward-linked workshop. This was shown to be the case in the fabrication shop and assembly and wiring shop of firm B and in the motor assembly shop of firm D, where changes in the material transformation process at the coil-winding machine had effects on the jobs of connectors.

Some changes in material transformation may build in some tasks into machines, as in the case of the proposed introduction of dies for cutting interphase insulation in the motor assembly shop of firm D, eliminating the measurement and mathematical calculations aspect of the job. Such changes, besides reducing the components of conceptual abilities in the job, would also tend to reduce work-cycles and thus increase the pace of physical effort.

Material transformation changes where rate of output is increased by the use of power or use of mechanical fixtures, as in the case of the contactor assembly of firm D, the quantity of physical effort required in the job would probably go down[10] but probably the pace

10. See also the similar conclusions reached by Bell (1972), whose method of studying changes in technology is being used here.

might increase in some cases - as it certainly would in the case of the contactor assembly.

Though no changes in the control of the material transformation and material transfer processes occurred in the workshops studied here, the implications for skill-structure and other aspects of jobs are once again likely to vary according to the specificities of each situation and also on whether or not such changes occur in conjunction with changes in material transfer and transformation processes. However, it is difficult if not impossible to speculate about changes in control systems in the workshops being studied in a hypothetical manner.

With the help of examples of technical change from the workshops being analysed in this study, it has been shown that there is no simple way in which the links between technology and organisation of work can be posited in abstract. If these links are posited in a 'de-skilling' framework, then the analysis presented above shows that at the level of individual jobs at least such a framework may be quite inadequate as there is no pre-determined way in which changes in various aspects of technology can be seen as necessary leading to the lowering of the skill aspects of individual jobs. Skill-content as well as the other aspects of jobs like autonomy, object variety, work cycle length, etc. depend upon the specific articulation of technological constraints with other market and non-market factors that finally lead the management to implement a particular task-composition of jobs against another. No doubt, if all the other factors that influence the organisation of work were to be ignored, some specific technical changes could be seen as building skills into machines. But not only would this be an over-simplification of the social relations of production under capitalism, it would also mean falling prey to "technological determinism" of a different kind. However, it must be kept in mind that the above analysis

is a micro-level analysis and that there could still be a general trend towards 'de-skilling' at a macro-level but it seems unlikely that the trend would be a deterministic one.

It is also interesting to note, just as the workflow changes at the level of the workshops and plants were not triggered off by workers' resistance to the labour process, neither were any of the technical changes at the level of the workstations discussed above. Invariably all of them, from the introduction of tool-bits in firm A to the introduction of multi-cavity dies in firm D, were aimed at saving labour time. As the next two chapters will show, at least in the decade of the seventies, the workers in the firms studied accepted the legitimacy of managerial control over the labour process. The hypothesis that technical change is brought about to overcome the recalcitrance of workers does not seem to hold at least in the case of the firms studied here.

Mechanisation and 'de-skilling' - cross-sectional comparisons:

To test further the ideas relating skill levels and other aspects of organisation of work to technology, historical data about technical change and job structures would be required. However, even though in this case such data was not available, workshops with different or similar levels of mechanisation can be compared in terms of their job structure in a cross-sectional manner. Admittedly, mechanisation is only one aspect of technology. However, comparing job structures within similar or different levels of mechanisation can have important implications for aspects of the 'de-skilling' theory. A comparison of job structures in workshops with a similar level of mechanisation can be used to test the hypothesis that similar levels of mechanisation do not imply a similar organisation of work. And the comparison between different levels of mechanisation can be used to test that a higher

level of mechanisation does not necessarily mean a lower skill content in jobs. These two sets of comparisons would be valid only if the workshops concerned also manufactured similar products. Out of the eleven workshops considered here, there were two sets of two workshops each in the first category and only one set of two in the latter category.

Comparing jobs in workshops with similar levels of mechanisation:

The motor assembly shops in firms A and D made similar products with similar levels of mechanisation of the different aspects of technology. Thus, valid comparisons of different aspects of the organisation of work-using job characteristics measurements - to compare the different profiles. The other set of workshops where similar comparisons could be made were the assembly shops in firms B and C. While in the former switchboard cubicles and panels were assembled, in the latter air-blast circuit breakers were assembled. In both the cases the products assembled were large in size and involved a single station final assembly. All the operations in both the workshops were done manually[11].

Jobs were compared between the workshops in each set in terms of the scores of different jobs on a set of variables relating to different aspects of jobs. These are the same variables and factors that were used in analysing the structure of jobs in the last chapter. Central tendencies in the job scores of each workshop in a set were compared using a non-parametric test called the Mann-Whitney test

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11. Only in one job in the assembly shop of firm C - 'arc-chamber assembly', was power used to transport the arc-chambers from the fabrication shop to the final assembly workstation. However, this transportation was not done by workers from the air-blast circuit breaker assembly shop but by material transfer workers from the fabrication shop.

(see Siegel, 1956). Tables 7 and 8 show the variables whose mean-ranks showed significant differences at five percent level of significance for each case. Table 7 compares the job-characteristics of motor assembly shops of firms A and D. It can be seen that while conceptual abilities, autonomy, and irregularity of hours are higher in firm D, the amounts of executional abilities required, object variety, promotion prospects, and position in the hierarchy are higher in firm A. The reasons for these differences, depending upon the variable, relate both to how different tasks have been combined into jobs as well as the range and type of products (variation in products), the market demand for the products, and the role of trade unions in each firm.

In examining the variables related to skill, it can be seen from Table 7 that conceptual abilities are higher in the case of firm D because even though both the firms make motors the range and type of motors is higher in firm D. Thus, compared to the workers in the motor assembly shop of firm A, the motor assembly workers like connectors, coil winders, assemblers and testers would require greater abilities in reading technical drawings/circuit diagrams and remembering instructions, rules and routines for each type of motor. But then, it might be asked, why the executional abilities are lower in the case of firm D as compared to firm A? The reason for this is to be found in the different ways in which various tasks have been combined into jobs in the two cases. A significant difference is in the tasks relating to handling operations. As pointed out earlier, the handling operations are mechanised to the same extent in the two workshops. But while in the motor assembly shop of firm A the actual loading and unloading of work-pieces using the overhead crane is part of the job of the worker at each particular workstation, in firm D these tasks are a part of

Table 7: Comparing jobs between workshops with similar levels of mechanisation and making similar products

Variables	Mean rank*	
	Motor assembly shop of firm A	Motor assembly shop of firm D
5% level of significance :		
1. Conceptual abilities	90.5	137.5
2. Executional abilities	135.0	107.4
3. Autonomy	88.0	138.9
4. Object variety	134.8	107.5
5. Promotion prospects	158.4	91.6
6. Position in hierarchy	168.5	84.6
7. Irregularity of hours	68.3	152.3
10% level of significance:		
1. Working conditions	129.8	110.9
Non-significant:		
1. Physical effort	119.2	118.0
2. Work cycle length	111.6	123.2
3. Responsibility	120.7	117.0

Notes *Mean ranks have been calculated for the Mann-Whitney Test using the Statistical Package for Social Sciences (SPSS 70)

the jobs of the workers engaged in material transfer. This also accounts for the higher object variety in the former case.

Autonomy is higher in the motor assembly shop of firm D because of the special nature of trade unionism in this firm. In firm A, there was only one union of workers which ran a closed-shop. This union not only was paternalistic in its dealing with the workers but was also known to co-operate with the management on many issues, including disciplining recalcitrant workers. In firm D, there were two rival unions each competing for membership and each trying to prove itself to be more aggressive towards the management than the other. This fact coupled with a history of inter-union rivalry in the motor plant, meant that the management did not want to provoke workers by strict supervision. One of the consequences of this was that the workers had greater freedom for optional interaction as compared to the motor assembly shop of firm A. Thus, in this case autonomy was not linked to technological factors.

Promotion prospects and position in the hierarchy, which are higher in the case of firm A, once again have little to do with levels of mechanisation. They are the result of the grade-structure, promotion policies, and different structures of the internal labour-markets in the two firms (the role of the unions in determining these policies will be discussed in the next chapter). Working conditions were better in firm D, largely because of a better planned work area which not only allowed for a comparatively greater area per workstation than in firm C but it was also better ventilated.

As far as irregularity of hours is concerned, it was higher in firm D because all the workers in the motor assembly shop worked three shifts in rotation, while most of the workers in the motor assembly shop of firm A worked only in a general day shift. This

clearly is a reflection of the volume of output, which in turn is a reflection of the market demand for the firm's products.

Thus, it can be seen that even if the level of mechanisation is the same the profile of job attributes can be quite different. This is further illustrated in the case of the second set of workshops - the switchboard assembly shop of firm B and the air-blast circuit breaker assembly shop of firm C. The results of this comparison are given in Table 8.

With the same level of mechanisation, here it can be seen that the assembly shop in firm B is marked by better working conditions, higher executional abilities, and greater work-cycle lengths as compared to the assembly shop of firm C. Jobs in the latter, however, have greater object variety and greater autonomy. The working conditions are comparatively better in the former case because fumes, dirt and noise involved were relatively less. In the latter workshop these aspects of the working conditions were particularly worsened because of the fact that there were three other workshops adjacent to it in the same shed, leading to consistently high noise levels[12]. Work cycle length is higher in firm B even though the overall assembly time is almost one-fourth of that in firm C. But here it must be remembered that this characteristic measures not only the length of the work-cycle but also the extent of repetitions within each cycle. In the former case there was comparatively less repetition of tasks within each work-cycle than in the latter case.

Even though the products were custom-made in each case, in the case of firm B the variations in the products was more than in the case

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12. The worst of all being the air-blast circuit breaker testing shop. Each blast of the circuit breaker not only makes a deafening noise but actually hurts the ear-drums.

Table 8: Comparing jobs between workshops with similar levels of mechanisation and making similar products

Variables	Mean rank*	
	Assembly shop in firm B	Assembly shop in firm C
5% level of significance:		
1. Working conditions	25.2	40.5
2. Executional abilities	31.4	17.9
3. Object variety	25.7	38.7
4. Autonomy	22.5	50.5
10% level of significance:		
1. Work cycle length	30.4	21.7
Non-significant		
1. Physical effort	30.5	21.3
2. Conceptual abilities	26.8	34.7
3. Promotion opportunities	27.8	31.1
4. Position in hierarchy	29.0	26.5
5. Irregularity of hours	28.5	28.5
6. Responsibility	28.6	28.2

Notes *Mean ranks have been calculated for the Mann-Whitney Test using the Statistical Package for Social Sciences (SPSS70).

of the air-blast circuit-breaker assembly shop of firm C. It was because of the extent of variation in production in firm B that the jobs of assemblers were classified only into two categories - Fitters and Assistant Fitters. In the case of firm C, because the variation was less, the management was able to provide detailed job descriptions for each worker[13]. It is this difference that manifests itself in the use of higher executional abilities; i.e. manual dexterity, visualisation, and concentration, in the case of firm B. However, this does not affect the object variety in the job because variation in products does not mean that more tools have to be used in assembling them. Higher autonomy in firm C was largely due to the trade union activity in this firm and the type of job descriptions used.

Thus, once again, it can be seen that a similar level of mechanisation does not mean that job characteristics will be the same. Job characteristics - whether they relate to skills or other aspects of jobs, are a result of the particular form of organisation of work. And in the formulation of a particular organisation of work, no doubt the level of mechanisation is a constraining factor; e.g. it helps in determining the total number of tasks in a particular workshop along with the other aspects of technology. But this is not the only factor that interacts with the actual performance of tasks, how they are combined into jobs or how they are distributed among the different workers. The two examples above, even though they cannot be expected to prove anything conclusively, do demonstrate this fact when the levels of mechanisation are similar. And they point to some interrelated factors like product-range, specificities of composition of jobs, type of trade union activity, structure of internal labour markets, wage-structures, etc. which influence the job characteristics.

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13. The problems created by detailed job descriptions for the supervisors in firm C are discussed in the next chapter.

Comparing jobs in workshops with different levels of mechanisation:

As pointed out earlier, the fabrication shops of firms B and C were chosen for this comparison. The only difference in the levels of mechanisation of these two workshops is that the material transfer in the fabrication shop of firm C is carried out using overhead cranes, while in the fabrication shop of firm B, it is a manual process (see Appendix III). Thus, it can be said that the level of mechanisation is lower in the latter workshop as compared to the former.

Table 9 lists the job characteristics variables with their mean ranks in the two workshops. Job characteristics where the difference in mean ranks might be the effect of mechanisation are the ones dealing with working conditions, physical effort, and conceptual abilities required.

Working conditions are worse in firm C, largely because the noise levels were comparatively higher (with too many workshops in the same shed, as pointed out earlier) and as there were more welding jobs fumes and heat were greater in this workshop. Despite the use of cranes for material transfer, the overall danger involved in most jobs would be similar in the two workshops. The only job in which danger would have gone down would be material transfer but since this was a separate job by itself, it is unlikely to be of much statistical significance in determining the difference in working conditions in the two workshops.

Clearly, manual transfer of materials between the work-stations is likely to require greater physical effort than if overhead cranes were to be used. But this by itself actually does not completely explain why there should be a difference in physical effort required in the two workshops. For determining this additional information is needed about how material transfer operations are carried out and by whom; i.e. is

Table 9: Comparing jobs between workshops with different levels of mechanisation but making similar products

Variables	Mean Rank*	
	Fabrication shop of firm B	Fabrication shop of firm C
5% level of significance		
1. Working conditions	13.6	32.7
2. Physical effort	39.9	26.4
3. Conceptual abilities	10.3	33.5
4. Autonomy	6.7	34.3
5. Promotion chances	16.8	31.9
6. Position in hierarchy	38.8	26.7
7. Irregularity of hours	15.5	32.2
Non-significant		
1. Work cycle length	23.2	30.2
2. Object variety	32.5	28.2
3. Executional abilities	32.9	28.1
4. Responsibility	27.0	29.5

Notes *Mean ranks have been calculated for the Mann-Whitney Test using the Statistical Package for Social Sciences (SPSS 70).

material transfer a separate job or is it a part of the job of machine operators? In firm C, material transfer is a separate job, but in the fabrication shop of firm B it is not (though in the assembly shop it is a separate job in firm B). In the second workshop, material transfer between the workstations is done by the machine operators themselves. It is this fact then, which has more to do with how tasks are combined into jobs than levels of mechanisation, that explains the differences in the physical effort required in the two workshops than the simple fact of existence of overhead cranes in firm C.

Conceptual abilities are higher in the fabrication shop of firm C than in that of firm B. This fact, once again, cannot be explained in terms of the mechanisation of material transfer in firm C. Compared to the fabrication shop of firm B, which made components only for switchboards, the fabrication shop of firm C made components not only for switchboards but also for other electrical equipment like different types of switchgears (the air-blast circuit breaker being one such example) and allied power distribution equipment. In other words, the variation in the type of components in the latter case was higher. This meant that the workers in the fabrication shop of firm C needed comparatively greater conceptual abilities like mathematical calculations, reading blue-prints, memorising instructions, rules, routines, etc. than in the fabrication shop of firm B.

Autonomy is higher in the workshop in firm C but once again this can be better explained by reference to the trade union activity and the type of job descriptions used in this firm than mechanisation (see also Chapter 8). While in firm B, workers belong to a union which runs a closed-shop with the leadership exercising considerable control over the workers, in firm C the workers had a history of controlling their union leaders by the mere threat of changing over

to another union - since 1971, almost every three years they have changed their union affiliations. The greater militancy of the workers in firm C and the inability of the union leaders to control them has meant that management cannot use union leaders to discipline workers on the shopfloor. This coupled with the detailed job-descriptions in firm C (there were none in firm B), which the workers had "appropriated" to their own needs, led the workers to have greater autonomy. Whenever the workers wanted to protest against certain supervisory practices or against the management, they would decide to stick only to those operations that were listed in their job descriptions. These job-descriptions were obviously not very exhaustive with the result that any decision by the workers to stick to their job-description meant disruption in production. The mere threat of using this tool meant that the workers had greater freedom for optional interaction, they were not over-supervised and they had comparatively greater pace-choice. The conclusion that the autonomy factor is not dependent upon the level of mechanisation is further strengthened by examining this factor in both Tables 8 and 9 where it is shown to be higher for the workshops of firm C.

Irregularity of hours is greater in firm C as the fabrication shop in this firm works three shifts while in firm B there is only a general day shift. This, as pointed out earlier, is a reflection of market share/demand for the products of the firm.

The differences in the two workshops in the variables relating to promotion chances and the position in the hierarchy are a result of the grade structure, recruitment policies and the nature of the internal labour markets. They cannot be explained in terms of the differences in the levels of mechanisation.

Besides showing the differences in the variables discussed above,

Table 9 also shows that while there are significant differences in the conceptual abilities required in the two workshops, there are no significant differences in the executional abilities required. This casts further doubts on the 'de-skilling' framework at the level of workshops. It shows that not only does a higher level of mechanisation not mean that the executional abilities required would be significantly different across the levels, it also shows in this case that conceptual abilities may be higher in a higher level of mechanisation.

4. CONCLUSIONS

In this chapter, first the operational inadequacies of the concepts of technology used by some organisational theorists in studying the links between technology and organisation of work were demonstrated. This was followed by using the categories of analysis developed for use in this study to explore these links both qualitatively and quantitatively. Analysis of changes in workflow aspects of technology at the level of workshops and plants showed that the changes in the methods and patterns of workflow may affect jobs in more ways than one. Further analysis of technical changes at the level of individual workstations also pointed to the same conclusion. At a micro-level, the implications of these conclusions went counter to the 'de-skilling' framework as no deterministic relationship between changes in technology and the jobs of workers could be posited in advance. Given the case study nature of the study it was difficult to say whether or not a 'de-skilling' trend existed at a macro-level, although from the micro-level evidence it would seem that even at a macro-level such a trend may not be a deterministic one.

A statistical comparison of jobs across the same level of mechanisation as well as different levels of mechanisation also cast doubts on the 'de-skilling' hypothesis by showing that no determinate links between a level of mechanisation and skills required can be posited in advance. It also showed that the autonomy involved in jobs is not dependent upon the level of mechanisation.

Neither the technical changes that occurred in the firms considered nor the proposed changes in technology were spurred on by workers' resistance to managerial control. In the case of firm A, the changes in workflow aspects of technology were being planned because of a decision to expand production; in firm B, the changes in technology were geared towards saving labour time; and in firm D, they were aimed at increasing the productivity by saving labour time as well as to provide a greater flexibility in production in terms of product variation and fluctuations in the output required. Thus, it can be reasonably concluded that in the case of the firms being studied, the market factors were much more important in determining the changes in technology, and thus in the labour process, than any form of resistance on the part of the workers to managerial control. In fact, as the next two chapters will show, in all the firms considered, there was hardly any workers' resistance to managerial control over the labour process.

In the next two chapters an attempt is also made to examine the different strategies used by managers to exercise control over the labour process and to encourage the acceptance by the workers of those forms of division of labour on the shopfloor - which are most suited to the needs of the firm. And, as pointed out above, the responses of workers to these strategies are also discussed.

CHAPTER 8

MANAGERIAL CONTROL OVER THE LABOUR PROCESS (I) - "WORKPLACE" STRATEGIES AND WORKERS' RESPONSES TO THEM

1. INTRODUCTION

In the last chapter, the links between technology and organisation of work were explored. It was argued that technological structures constrain the possibilities of how work is organised on the shopfloor but they do not determine how the various tasks to be performed are combined into jobs.

In combining a set of tasks into jobs, whether before or after technical change, managers have to try and achieve two related goals: (a) to create a form of division of labour most suitable to the needs of the firm and (b) to maintain this division of labour over time while ensuring desired task-performance by the workers. As pointed out earlier, these twin goals arise from the fact that the capitalists or their managers in hiring a worker buy only the capacity to work and not an agreed amount of work.

In this study, all those managerial decisions which are aimed at the creation and maintenance of a particular form of organisation of work on the shopfloor are referred to as managerial control strategies. These strategies may evoke a variety of responses from the workers which may be either trade union based responses or non-trade union based responses. It is important to note, however, that these responses may not always be antagonistic.

In this chapter, those managerial control strategies, and workers' responses to them, that can be explained in terms of factors within an individual workplace are analysed. In the next chapter, this is followed by an analysis of those managerial control strategies and workers' responses that are constituted in terms of factors outside the workplace. However, it must be kept in mind that this is merely an analytical distinction and in some cases it may not be possible to make any clear separation between workplace and non-workplace factors.

This chapter is divided into three sections. In the first section, an attempt is made to operationalise the categories of managerial control strategies used by Friedman and Edwards. It is shown that while the categories of Friedman are difficult to operationalise, the use of the categories put forward by Edwards point towards managerial control systems consisting of different elements. It is also shown that these elements may interact with each other in such a way that the overall control system cannot be classified neatly into any one of the three categories used by Edwards. In the second section, using some of Foucault's ideas, managerial control systems are seen as consisting of a set of strategies rather than a single strategy. These strategies are shown to vary from designing the architecture of the workplace to increase supervision, to developing routinised methods of dealing with day to day problems that might threaten the smooth functioning of the labour process. In creating and maintaining an organisation of work over time, it is shown that managers used a set of strategies consisting of job evaluation and classification, recruitment and promotions policies, strategies aimed at fixing work norms, methods of task performance and monitoring adherence to these norms and methods, and strategies that are aimed at trying to push up these

norms through various methods. In analysing recruitment and promotions policies, it is shown that in this case the internal labour market consisted not only of the internal promotions route but also had provisions for hiring relatives of the workers at the direct recruitment points in the grade structure.

In the final section, workers' responses to the above mentioned managerial control strategies are analysed. It is shown that by far the most prevalent response of the workers to managerial control strategies was to accept them. However, it is also pointed out that in some cases the workers may be able to force the management to modify some of these strategies and codify in formal agreements those strategies that are used on an ad-hoc basis. Besides these responses, it is shown that the workers may use a variety of tactics to restrict or threaten managerial control over the labour process. In the firms studied these tactics ranged from restriction of production, restriction of supervision, sabotage, and striking in critical areas of production to collective strikes. Finally, it is pointed out that given the structure of unions in India, it is necessary to examine the extent to which the sectional interests of workers affect the levels of collective responses of the workers.

2. OPERATIONAL INADEQUACIES OF THE CONCEPTIONS OF FRIEDMAN AND EDWARDS OF MANAGERIAL CONTROL STRATEGIES

The different categorisations of managerial control strategies by theorists like Friedman and Edwards, working in a Marxist framework, have already been critically examined in a previous chapter (see Chapter 2). In this section an attempt will now be made to examine the operational inadequacies of these categories in the context of the firms chosen for analysis.

Friedman - Direct control, responsible autonomy and central and peripheral workers:

As pointed out in Chapter 2, according to Friedman there are two types of strategies used by managers to exercise control over the labour process under capitalism: Responsible autonomy and direct control. In the main, Friedman conceptualises the use of these strategies at the level of individual firms. Responsible autonomy strategy attempts to harness the adaptability of labour power by giving the workers limited freedom and responsibility in order to encourage them to adapt to changing situations in a manner that is beneficial to the firm. A direct control strategy on the other hand attempts to control the variability of labour power through coercive threats, close supervision, and by minimising individual responsibility. Friedman then goes on to divide the workers in firms into those that are central to the operations of the firm and those that are peripheral. According to him, while responsible autonomy strategy is more likely to be used with central workers, managers would use direct control strategy with peripheral workers.

If the category of responsible autonomy is taken up for operationalisation, then the only case where an example of this strategy can be found is in the proposed changes in workflow in the contactor assembly of firm D. This is the only case which fits at least one of the characteristics ascribed to the responsible autonomy strategy by Friedman; i.e. the creation of partially competing groups which reduce the disruptive power of the workers through strike and sabotage. However, it must be pointed out here that the proposed changes in the contactor assembly can be seen as an example of responsible autonomy strategy only if a favourable interpretation of Friedman's definition[1]

1. Strictly speaking, there is no clear definition of the responsible autonomy strategy in Friedman's work.

of this strategy is taken. This is so because the creation of three smaller assembly lines instead of a single long line assembly would reduce the disruptive power of workers. And they can also be seen as partially competing groups if the workers internalise the aims of the management. But whether or not these new groups will have greater autonomy of task performance, it is difficult to decide in advance. As pointed out in the last chapter, while the different aspects of skills required would increase with the new structure of assembly lines, along with a decrease in monotony because of increased cycle-time, supervision would be much closer because of a better view of the material flow. This, in fact, was one of the explicit aims with which the management of firm D set out to change the existing structure of the contactor assembly.

The fact that responsible autonomy strategy cannot be operationalised properly in the context of the firms chosen for analysis in this study, does not rule out the existence of this strategy. However, the operational use of this category, even though quite inadequately, in the case of firm D points to the following facts. Firstly, it seems that the responsible autonomy strategy or aspects of it could be used at the level of individual workshops rather than the whole firm. And secondly, the use of only two aspects of this strategy in the case of the contactor assembly seems to indicate the possibility that perhaps there are different aspects of the responsible autonomy strategy and that Friedman homogenises over these elements. The result of this is that he ends up using it as a descriptive category to cover all those managerial decisions that cannot be seen as minimising the individual responsibility of workers in the labour process through the direct control strategy.

In attempting to operationalise the categories of central and peripheral workers in order to separate the groups of workers within a firm that are controlled using responsible autonomy and direct control strategies, it becomes evident that in Friedman's framework central and peripheral workers can be identified in more ways than one. One such criterion is that when a firm is undergoing a crisis, peripheral workers are likely to be laid off while central workers will not be laid off. Subordinated to this criterion are two different defining criteria - central workers are well organised while peripheral workers are not; and central workers perform tasks which are essential to the long term profits of the firm. Yet another criterion used by Friedman for distinguishing the two categories of workers is that central workers contribute to the maintenance of managerial authority while peripheral workers do not.

Using the first criterion, it can be seen that even though firms A and C had been going through a prolonged profitability crisis (see Table 10 in Chapter 5), in neither of them were any workers laid off at any time during the last decade. In both the firms workers were organised into trade unions although only in firm A did a closed shop exist. In firm C in 1975 the management did put forward a proposal for retrenchment of 80 workers out of 527 workers employed at that time. However, the union flatly refused to discuss this proposal and that was the end of the matter. Thus, according to the first criterion, all the workers in firm C would be central workers because by virtue of their organised strength they could not be retrenched by the management. In all the other firms since there was no attempt either to lay off or retrench workers it is not possible to use the above criterion.

The criterion of managerial authority being contingent on central workers is even more difficult to use. In the event of total strikes,

this criterion becomes inoperative because such strikes represent a total failure, even though temporary at times, of managerial authority. So it can be used only in the context of minor crises of managerial authority or when there are no such crises. Using this criterion the group of workers who may fall under the category of central workers in firms A to E are the following: trade union officials on the shopfloor and daily-rated[2] workers in supervisory jobs such as that of a group-leader, chargehand, etc. It is these workers who help maintain managerial authority in normal circumstances as well as at times of minor crises on the shopfloor. Thus, it would seem that these workers would be controlled using responsible autonomy strategy while the rest of the workers would be controlled using direct control strategy. An implication of using this criterion would be that the existence of central and peripheral workers would have to be posited in all the firms including firm C. Yet all the workers in firm C using the first criterion seemed to be central workers.

Thus, it can be seen that not only are Friedman's categories difficult to operationalise but at times their use may lead to conflicting results as in the case of firm C. Both at the theoretical and operational levels it seems that Friedman's categories have little explanatory/analytic value in studying the functioning of managerial control at the workplace.

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2. Refers to a daily wage rate as opposed to a monthly salary.

Edwards - Simple, technical, and bureaucratic control:

As compared to the analytical framework of Friedman, the analysis of Edwards offers a considerably greater insight into the elements of managerial control systems. To recapitulate, Edwards identified three aspects of managerial control systems - direction, evaluation, and discipline. And in the history of the development of the capitalist industry he saw the evolution of three forms of managerial control - simple control (either entrepreneurial or hierarchical), technical control, and bureaucratic control (see Chapter 2). Under simple control, the personal power and authority of the capitalists and their managers constitutes the primary mechanism for controlling the workers. Under a system of technical control it is the machines that control the direction and pacing of the labour process. Bureaucratic control, according to Edwards, is built into the organisational structure of the firm through the creation of job descriptions, job categories, work rules, promotion procedures, disciplinary procedures, wage scales, etc.

Table 1 presents a summary of the manifestation of different elements of control in the various firms and the possible classification of each firm into the categories of Edwards. All the firms had a set of Standing Orders. These are a part of what Edwards refers to as the "company rules" and they govern conditions of employment, disciplinary procedures, etc. Thus, one of the major elements of bureaucratic control as defined by Edwards, existed in all the firms studied. Promotion procedures and grade structure/wage scales also existed in all firms. Thus, all the firms had a few of the elements of bureaucratic control. However, some of them also had elements of different control systems.

Table 1: Using the classification of managerial control systems put forward by Edwards

Firm	Manifestations of control elements in the firm	Managerial control systems
A	Standing orders of the firm, grade structure/wage scales, promotion procedures. Production manager has or tries to establish a personal rapport with the workers (see text).	Elements of simple control and bureaucratic control
B	Standing orders, wage scales, promotion procedures.	Elements of bureaucratic control
C	Standing orders, job descriptions, grade structure/wage scales, and promotion procedures.	Bureaucratic control
D	Same as firm C but machine paced work exists in some workshops	Elements of technical control and bureaucratic control
E	Machine paced work, standing orders, grade structure/wage scales, promotion procedures	Elements of technical control and bureaucratic control

In firm A, elements of bureaucratic control coexisted with elements of simple control. The presence of the latter was indicated by the fact that the firm's production manager's claims that he attempted to control the workers by establishing a personal rapport with them. In his own words: "A good way to curb explosive situations is to go down to the shopfloor and talk to the workers about their problems. Sometimes you might have to listen to absurd things but merely sympathising will help. Whenever I go to the shopfloor I start talking to the workers about their family, kids, etc. Sometimes I call them by their nicknames. One of the workers is called "Boxer". Now, I know that he is called Boxer but he may not know that I know this. So when I go to him I'll say, "Hello Boxer, how are you?" Similarly, there is a worker whom his friends call "Taxi". So I also call him Taxi. This way a personal rapport is established."[3] The point of this quotation is that it shows that the production manager was consciously trying to establish a personal relationship with the workers in order to increase his control over the labour process.

Yet another instance cited by the production manager was about a worker who asked for leave of absence quite often and each time the excuse would be that his wife who was not in Bombay was ill. This is what the production manager said about him: "He used to come to me almost every three months with a telegram which said that his wife was ill and his presence was required at home immediately. I granted him leave a couple of times but when he came again I told him that I would grant him leave provided he told me the real reason for wanting to go home so often. I told him that his wife couldn't be sick all the time

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3. This and other quotes in this chapter are based on interviews carried out in the different firms.

and that he must have some land back home as his wife kept falling ill either during the sowing or the harvesting season. He agreed that I was right. I told him in a friendly way that if he ever had a genuine problem I would break the leave-rules to let him go home but not otherwise. He stopped after that." This example shows that bureaucratic control; i.e. through rules governing leave of absence, etc. can be modified and perhaps be made more effective whenever it is possible to link elements of simple control with it. This became possible in firm A to some extent because the workforce was not very large and most workers had been with the firm for a long time.

In firm B, all the elements of bureaucratic control except job-descriptions were present. In firms C and D all the elements of bureaucratic control referred to by Edwards were present. In firm D, however, the existence of machine paced work in some of the work-stations of the press shop and the long line assembly for contactors showed that elements of technical control were also present. Thus, in firm D, bureaucratic control could be said to be coexisting with elements of technical control.

In the case of firm E too, elements of both technical and bureaucratic control were present. Technical control, because most of the work in the wire-mills was machine paced and bureaucratic, because the firm had its Standing Orders, disciplinary procedures, promotion procedure and a grade structure.

The general implication of the above attempt at operationalising the concepts of Edwards is that managerial control systems consist of different elements and that these elements may interact with each other in such a way that the overall control system cannot be fitted neatly in any one of the categories of Edwards.

Thus, while Friedman's categories are difficult to operationalise, the use of the categories put forward by Edwards also seems to be

limited as they tend to oversimplify the nature of managerial control systems. As pointed out in Chapter 2, it is in the work of Foucault that important insights are offered into the working of the different elements of managerial control at the workplace. A discussion of Foucault's "procedures of disciplinary power" showed that although Foucault does not strictly relate the emergence of the different "procedures of disciplinary power" to the development of the capitalist mode of production, his classification of the different elements of these "procedures" have strong equivalents in capitalist firms (see Table 2 in Chapter 2). Thus, the elements of managerial control and their interrelationships which remained undertheorised in the work of Edwards, can perhaps be studied better using the insights offered by Foucault.

In the following section, the analysis of managerial control in the firms being studied, draws on Foucault's conception of disciplinary control inasmuch as it is defined as consisting of a set of strategies rather than a single strategy. Moreover, in the operational uses of this conception of managerial control, Foucault's "procedures of disciplinary power" are referred to directly wherever relevant.

3. MANAGERIAL CONTROL AS A SET OF STRATEGIES

In analysing managerial control over the labour process in the firms being studied, those managerial control strategies are discussed first that manifest themselves in the architectural design of the workplace. This is followed by an analysis of the managerial strategies that are used to create and maintain an organisation of work on the shopfloor.

Architectural strategies of control:

Managerial control strategies that manifest themselves in architectural methods of increasing control over the labour process can be broadly subsumed under the headings of "partitioning" of the disciplinary space or "hierarchical surveillance" in the framework of Foucault. There are three firms in the sample chosen here - firms A, B and D, that can be used to exemplify this technique of control.

In firm A, though the transformer plant was not chosen for detailed analysis, the architecture of the building in which it was housed was an interesting example of enhancing control over the labour process through architectural means. The work area in this plant was in the centre of the building with the offices of production managers built at a higher elevation around the perimeter of the shopfloor. These offices opened out towards the shopfloor and managers could come out on walkways and survey the shopfloor activities. The mere fact that managers could survey the shopfloor without necessarily making their presence felt on the shopfloor meant that workers on the shopfloor would have to assume most of the time that their activities can be watched without their being aware of such a surveillance all the time.

In firm B, managers and supervisors had their offices at the same level as the shopfloor (see Diagram 2 in Chapter 7). However, they were separated from the main work area by huge glass panels. In this case too managers could survey the work area but not with the same efficacy as in the above case. The point, however, is that glass partitions would offer better opportunities of surveillance than opaque walls.

In firm D, the architectural method used was much simpler. In each workshop, the foremen and supervisors on the shopfloor have their workplaces on raised platforms. Sitting at an elevation compared to the rest of the shopfloor meant that the foremen and supervisors had

a better view of the work and material flow on the shopfloor.

Thus, the three cases discussed above represent three different architectural methods - and there could be many more such methods - of increasing surveillance over shopfloor activity. Increased surveillance means a better monitoring of the activities of workers which in turn facilitates a greater control over the organisation of work.

Architectural methods of increasing supervision depend on hierarchical organisation of work or else they are likely to be quite ineffective. The strategies used by managers to create and maintain a hierarchical organisation of work are now discussed.

Formalising the hierarchy - Job design and job evaluation:

To create a hierarchy of jobs, managers first need to combine the tasks to be performed into a set of jobs, inasmuch as it may be possible to do so (i.e. there may be jobs where the task-content cannot be easily specified in advance). In the firms considered, very little information was available on the criteria used for designing the jobs on the shopfloor. An exception to this, however, was the contactor assembly shop of firm E where both jobs on the assembly line and the workflow around them was in the process of being redesigned. As pointed out in Chapter 7, the assembly line structure that was chosen after a detailed study of various alternative structures to the existing one, reduced the number of workers on each product-line from twelve to four. The structure, with three assembly lines with four workers each, increased the task-content of the jobs of the workers, granting the management, among other advantages, a greater flexibility with respect to product-variants and absenteeism (see Chapter 7 for details).

For the workshops in other firms, the information that was available about designing jobs, because of elimination/modification of tasks to be performed as a consequence of technical change, has already been presented in the last chapter.

However, once the tasks to be performed have been combined into jobs, to create a hierarchy of jobs managers use a set of techniques which go under the generic name of job evaluation. Conventionally, four major techniques of job evaluation have been developed: the non-quantitative methods of ranking and classification and the quantitative methods of points rating and factor comparison (Livy, 1975). While the details of the working of these different methods are available in job evaluation manuals (see, for example, Livy, 1975 and Edwards and Paul, 1977), the important point to note about these techniques is that they attempt to determine the relative position of one job to another in a wage structure. The first two techniques attempt to do this on the basis of rank ordering of jobs and the latter two attempt to analyse jobs in terms of a variety of factors which are scored for each job and then these scores summed to arrive at a monetary or non-monetary value of jobs.

In the industrial relations literature, job evaluation has been viewed in four distinct ways: (a) As a scientific and objective method of constructive "fair pay" hierarchies based on a consensus that is assumed to exist amongst managers and workers on relative "worth" of various aspects of jobs (i.e. a unitary view is assumed), (b) as a method of "creating" consensus about wage structures between the managers and workers, (c) as a collective bargaining technique which helps in maintaining the status quo in collective bargaining, and (d) as a technique used by managers to assert control over workers and their jobs "by changing working practices and disrupting contours of

solidarity" amongst them (see Willman, 1978: 108-110). While the first view is to be found largely in the work of early practitioners of job evaluation (for a discussion of the different views, see Willman 1978), in practice in modern firms job evaluation can be seen as a combination of the last three approaches. Managers do hope that workers would internalise their position in the hierarchy through the acceptance of a job evaluation scheme. Demands for job evaluation may also come from the workers or their unions because they may want a codified basis for negotiation of wage rates and promotions which can then perhaps no longer be subject to the whims and fancies of individual managers (see, for example, Edwards, 1979). Building job evaluation schemes into collective bargaining agreements may also mean in some cases that workers would be able to exercise some amount of control over their jobs and wages. However, the following discussion will show that the dominant rationality of job evaluation is dictated by the aims of the capitalist labour process and the above two approaches are subsumed to it.

Job evaluation in its advanced forms implies providing a job description (i.e. the task content of the job), choosing a set of factors based on a specification of the abilities required in the workers to perform the jobs, and weighting the factors in terms of the relative importance of the abilities required. However, in non-quantitative methods of job evaluation, job descriptions are not provided. Whether or not job descriptions are a part of the job evaluation scheme can have an important bearing on the extent to which these schemes extend managerial control over the labour process.

Table 2 presents an outline summary of the job evaluation schemes in operation in the five firms studied. As this table shows, there

were no job descriptions present in firms A, B and E. These were also the firms where job evaluation was basically a ranking of jobs into a set of wage categories.

In firm A job-content had never been a matter of dispute in any major way and the workers seemed satisfied with the wages and other service conditions negotiated by their union. In firm B, job descriptions were not provided by the management because production was non-standardized. Any attempt to prepare a list of tasks for each job would perhaps have created more problems for the management than it would have solved. Also the wage levels of workers in this firm were one of the highest in the industry in Bombay and this was one of the determining reasons for workers not complaining about job-content. This gave the management a certain amount of flexibility in moving workers from one job to another. As a fitter told me when I asked him about having proper job descriptions: "I can even be sent to clean the toilets and I will have to do it." While this expresses unhappiness in fitters having to accept such management decisions, considering that the management never asked any fitters to clean toilets, this view can be taken more as a comment on the flexibility the management had in moving workers around because of a mix of a high wage strategy with no fixed job descriptions. And flexibility in this context meant greater control over the labour process.

In firm E, in September, 1980, the union demanded a reclassification of jobs with retrospective effect from July, 1980. According to the minutes of the negotiations on this issue between the management and the union, this was just a demand for higher wages and changes in the promotions policy.

Table 2: Job evaluation schemes in the firms being studied

Firm	Type of job evaluation	Type of job description	Remarks
A	Classification into five wage categories	No formal job descriptions exist.	-
B	Classification into three wage categories	No formal job descriptions exist.	Most items being custom-made. Tasks are not always predictable in advance.
C	Classification into seven grades (corresponding to seven wage categories) based on job evaluation scores of jobs	Detailed job descriptions	Job classification and job descriptions introduced on management initiative. Most products custom-made.
D	Jobs classified into eleven grades which correspond to eleven wage categories including one category of monthly rated wages	Only key tasks in each grade/trade specified.	Job classification and job descriptions introduced on union demand in 1967-68.
E	Classification into six wage categories	No formal job descriptions exist.	In September 1980 the workers' union demanded reclassification of jobs.

In firm C in November 1971, the management of the firm signed an agreement with the union to classify the jobs in the firm. The initiative for this came from the management. A mutually acceptable group of consultants from outside were appointed to, first of all, work out the job evaluation and classification procedures by holding discussions with representatives of the management and the workers. They were then to prepare a manual of job descriptions for all the jobs under reference and "to systematically evaluate and then classify the jobs into various grades, the existing wage/salary structure remaining the same".[4] They chose the factor comparison method of job evaluation to do so.

Job evaluation was defined in the report of the consultants as "a systematic method of appraising the value of each job in relation to other jobs in the organisation" which "provides a consistent procedure that sets up and maintains a hierarchy of jobs, attaching to each job a pay-rate commensurate with its status in the hierarchy".

The specific objectives of the job evaluation procedure were listed in this report as follows:

> "(a) To provide a more workable internal wage structure (than that) resulting from chance, custom, and such individual factors as favouritism and aggressive tendencies.
>
> (b) To provide an agreed upon device for setting rates for new or changed jobs.
>
> (c) To provide means whereby realistic comparisons may be made of the wage/salary rates of employing organisations.
>
> (d) To provide a base from which individual performance may be measured if so desired.

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4. This and the subsequent quotations in reference to job evaluation in firm C are from the "Report on Job Classification" for firm C prepared by the consultants employed.

(e) To reduce grievances over wage and salary rates by reducing the scope of grievances and providing an agreed upon means of solving disputes.

(f) To provide incentive for employees to strive for higher level jobs.

(g) To provide facts for wage negotiations.

(h) To provide facts on job relationships for use in selection, training, transfers and promotions."

Thus, the basic aim of job evaluation in this case seems to be to provide a more "rational" basis for the existence of hierarchy in jobs by attempting to standardize the subjectivity involved. Once the workers have agreed to this basic aim; i.e. when the workers have, to a lesser or greater degree, internalised this rationality, then the management would have moved a considerable way towards achieving the following aims: First, it would have firmed up the basis for comparing jobs both within the firm and perhaps across firms (the latter aim may assume special importance at times of major industrial disputes). Second, by providing job descriptions along with classification of jobs, it would create an agreed basis for monitoring the task performance of workers. The implication of both these points is that wage and other disputes related to job performance - whether they refer to a particular job or to all the jobs - can be settled within the legality provided by the framework of job evaluation. And having this basis reduces uncertainty attached to otherwise ungovernable factors related to maintaining a particular organisation of work over time. However, as will be demonstrated while discussing workers' responses to managerial control strategies, these are only the aims that the management hopes to achieve and at times the tables can be turned on the management by the workers even within this agreed framework of job evaluation.

As far as monitoring of the task performance of workers is concerned, this is aided by job descriptions. And in this case detailed

job descriptions were provided for each job. This, as shall be seen in discussing workers' responses to it, was to be the major failing of this scheme because not all the tasks could be listed in advance as most of the production was to customers' requirements.

In firm D, in March 1967 the workers' union submitted a charter of demands for increase in wages and fringe benefits along with a demand for job evaluation. While the wages and fringe benefits agreement was concluded in November 1967, the job evaluation agreement was signed in August 1968 and all the workers were categorised into a new grade structure.

In this firm, the job evaluation was carried out by the industrial engineering department of the firm and no outside consultants were used. Job classification in this case was based on grade/trade descriptions. Seven grades were used and grade description for each of these grades laid down the attributes required for performing jobs in that grade. These grade descriptions were used to provide guidelines for trade descriptions of nineteen different trade designations in the firm (e.g. Setter, Machinist, Assembler, Fabricator, etc.). Grade 1 was for purely manual work and Grade 7 for workers who knew more than one trade and were thus classified as "Specialists". Thus jobs in most trades ranged from Grades 2 to 6. For each grade of the trade, trade descriptions which laid down general duties, knowledge and skill required, and key jobs to be performed were provided (see Table 3 for a sample trade description sheet for Mechanics).

There were four more grades for those workers who also performed coordinating and supervisory duties. They were called group-leaders. Thus, broadly the grade structure in firm D would look like the one presented in Table 4. But this table oversimplifies the scheme because

Grade 3 workers could have group-leaders with grades L1 and L2, those in Grade 4 could have group-leaders with grades L2 and L3, and so on.

Having thus summarised the system of job evaluation in firm D, the differences between this scheme and that of firm C are now examined along with the implications of these differences.

There are three important differences between the job classification schemes of firms C and D. Firstly, in firm D the job scheme is much more complicated than that of firm C. The implication of this is that not many workers claimed to understand this scheme fully and most of the workers said that they relied on their union leaders to interpret it. Secondly, in providing grade descriptions and specifying the "general duties" and "knowledge and skill" required in each grade of a trade, ill-defined categories are used so that there is a greater scope for interpretation. The implication of this is that the management can have a wide ranging flexibility of choice in interpreting these factors while classifying or reclassifying a job. As a trade union activist said, "there are three vague terms used in the present job-classification document again and again when referring to general duties and skill required. And they are - "intricate", "accurate", and "complicated". I think all three have very close meanings." And since grades of a trade are distinguished from each other in terms of the different levels of these categories, without specifying how they are operationalised, what these different levels mean becomes a matter of haggling between the union and the management (see how "knowledge and skill" required in Table 3 are specified for each grade in terms of "elementary", "working", "good", and "thorough" knowledge). Thirdly, in firm D, unlike in firm C, detailed job descriptions are

Table 3: Sample trade description sheet for Mechanics in firm D

Title/Grade	Mechanic (Grade) 2	Mechanic (Grade) 3	Mechanic (Grade) 4	Mechanic (Grade) 5	Mechanic (Grade) 6
General Duties	Routine lubrication and dismantling, assembling fitting fabricating simple items under instructions or supervision.	Simple installation repairs & maintenance of m/cs. and equipment under instruction.	Fault detection, installations, repairs and maintenance of m/cs. & other equipment.	Detection of all types of mechanical faults and complicated repairs.	Detection of all types of mechanical faults and highly complicated repairs.
	All general and handling work in the group.	All general and handling work in the group.	All general and handling work in the group.	All general and handling work in the group.	All general and handling work in the group.
Knowledge and Skill	Refer Grade Description of Grade 2.	Understand dwgs. & instructions on maintenance manuals.	Understand dwgs. & instructions on maintenance manuals.	Understand complicated dwgs. & instructions on maintenance manuals.	Understand highly complicated dwgs. & instructions on maintenance manuals.
		Use of standard measuring instruments.	Use of special purpose instruments.	Use of special purpose instruments.	Use of all types of instruments.
		Elementary knowledge of the mechanism & use of equipment & m/c. & trade practices.	Working knowledge of the mechanism and uses of a broad range of equipment and m/cs.	Good knowledge of trade practices, mechanisms & uses of sophisticated equipment & m/cs.	Thorough knowledge of trade practices, mechanisms & uses of sophisticated equipment & m/cs.
Key Jobs	Lubricate all m/cs. as per schedule. Replace belts.	Adjust mechanical clutches on m/cs. Repair faults on portable machines, bench drills, bench grinders, lathes, etc. involving mainly replacement of parts.	Complete overhaul of compressors, pumps, presses, lathes and other machine tools.	Detect and repair complicated faults in hydraulic control circuits of sophisticated machines.	

Table 4: Grade structure in firm D.

Type of worker	Grades of non-supervisory workers	Grades of workers with supervisory duties (group leaders)	Type of wage system
Manual	G1		
Could belong to any of the 19 trade designations	G2		
	G3	L1	
	G4	L2	Daily wage rates
	G5	L3	
	G6	L4	
Specialists	G7		Monthly salary

not provided and only "key jobs" are specified. One of the implications of this is that extra tasks can be added to the jobs of workers and as long as they do not affect the "key" job specification, workers cannot demand reclassification into higher wage categories. This means that if for some reason - technical or otherwise - the management wants to reorganise the task composition of jobs it has comparatively greater flexibility in doing so than if detailed job descriptions existed.

Despite these differences, the overall aim of job classification in firm D remained the same as that in firm C. Besides creating a hierarchy of jobs, as the Head of the Industrial Engineering Department of firm D pointed out, "Job classification provides a basis for discussion with the workers". As pointed out earlier, having such a basis means that an organisation of work can be maintained over time with greater certainty.

To an extent, job evaluation also atomises workers' responses to the organisation of work. In the words of an industrial engineer in firm D, acceptance of job classification by workers means that they have to argue "within the framework provided by management which only permits comparing individual jobs within a trade". The deeper such an acceptance of this framework becomes the more difficult would it become for the workers to question the basis of the whole framework collectively. However, it has also been argued that job evaluation schemes may actually be useful to the workers under certain conditions. Some of these conditions have been listed by Edwards and Paul (1977) as follows: situations where employees feel that pay relationships are unfair, where the operation of bonus schemes or merit payments have distorted pay relationships, where new work methods have changed the nature of jobs, where there is discontent with existing grade-structure,

where different pay structures in a multi-plant company cause dissatisfaction among the workers, etc. In the case of firm D, where job evaluation demand came along with a demand for increased wages, some workers would have gained in terms of wages initially but in the long run through the job evaluation scheme the management would also have created a framework within which most discussions about the relative "worth" of a job could be held.

Perpetuating the organisation of work - Recruitment and promotions policies:

Related to creation of a hierarchy of jobs within a particular division of labour are strategies that hope to ensure the continued existence of this hierarchy as long as desired and the permissible movements along the hierarchy. Such managerial strategies attempt to take into account "natural wastage" from the labour process as workers retire, die or leave the jobs as well as providing career ladders for workers within the firm. These strategies are formalised in the recruitment and promotions policies of the firm.

In analysing these policies in the firms studied, the most important fact that emerged was the peculiar nature of the internal labour markets that existed in a majority of these firms, which consisted not only of the conventional promotions route but also had a family connections route for new entrants; i.e. family members of workers already with the firm were given preference at the direct recruitment points of the grade structure. Before going into the implications of this aspect of the internal labour market, the nature of these labour markets in each of the firms studied is now described.

In firm A, in the words of the Industrial Relations and Welfare Officer, "As a matter of policy the company gives preference in

employment to relatives of workers already with the company". But the union leaders claimed that this had not been the firm's policy till the union put forward a demand for such a policy. The specific clause related to this policy in the union management agreement, which came into effect from 14 September 1979, read as follows: "...in all future recruitments of the workmen and staff, preference shall be given to employees' children in order of the employees' seniority in the company, provided such incumbents are vocationally fit and suitable for work for which they are to be recruited". It seems reasonable to assume from discussions with the Industrial Relations and Welfare Officer that this was a mere formalisation of a policy already followed by the management. In any case, the clause from the agreement quoted above still leaves the discretionary power of judging the suitability of the candidates with the management.

The recruitment of relatives of workers for shopfloor jobs was limited to the first two grades out of the five grades of workers. For the other three grades workers were internally recruited wherever possible. Internal recruitment in this firm was limited to promotions from below (see Table 5 for structures of internal labour markets in the other firms).

Giving preference in recruitment to relatives of workers in situations of high unemployment as in India would invariably lead to increase in control of managers over workers. On the other hand, having internal promotions route is aimed at ensuring desired work performance from workers already in the firm, inasmuch as this would be a major criterion for being considered for promotions.

In firm B, too, preference was given in recruitment to relatives of workers already in employment of the firm. And there also existed an internal labour market - workers were hired from outside only for the

unskilled jobs and the jobs of assistent fitters and only internal promotions were used to fill the vacancies in the jobs of fitters (see Table 5).

It is in firm C though that an elaborate enunciation of the policy of giving workers a say in the recruitment of new workers is to be found. It is perhaps worth quoting at length from the recruitment policy document of this firm. According to this document in recruiting new workers "first preference should be given to the sons and daughters of the employees of the company subject to ten years of continuous service in the company". But if a worker had no children or they were not in a position to take up employment then the worker's "brothers/sisters will be given second preference in employment in the company on the basis of seniority in service" for which documentary proofs must be provided. And further, "if an employee does not have any son/daughter and/or any brother/sister, he/she may avail of this chance for any of his/her own close relative subject to documentary proofs".

This policy was applicable to all unionised jobs in the firm for which direct recruitment was done as well as "temporary and casual" vacancies. It was also stipulated that each employee would get only one chance for recruitment of a relative. Contingencies such as death of a worker while in employment of the firm were also taken into account. It was specified that "in case any employee expires in service, his/her son/daughter or own brothers/sisters will be given service on first priority if nobody has been recruited in his/her name previously".

In firm D there was no family connections route for direct recruitment and in firm E there was no fixed or codified policy for recruitment and promotions. Before discussing the internal market structures in these firms, an attempt can now be made to look at the implications of the family connections aspects of the internal labour markets.

Table 5: Structure of the internal labour market in the firms studied

Firm	No. of grades	Direct entry points	Internally promoted	Family connections at direct entry points
A	5	Grades 1 and 2	Grades 3 to 5	Part of the union-management agreement
B	3	Grades 1 and 2	Grade 3	Existed as an informal policy
C	7	Grades 1, 3 and 4	Grades 2 and 4 to 7	Codified in the recruitment policy document
D	7*	Grades 1 to 4 and 7 (see text)	Grades 5 and 6	Non-existent
E	6	No fixed policy	No fixed policy	No fixed policy

Notes *In addition there were four grades for group leaders who also performed supervisory duties. They were all promoted internally.

In analysing the implications of this peculiar structure of the labour market, in the case of firm C, for example, it is evident that the preference in employment to the family members of workers is contingent upon two factors: "ten years of continuous service in the company" and "seniority in service". For a worker to stay for ten years with a firm must necessarily imply complying with managerial notions of desired work behaviour most of the time. Thus it is stable work behaviour that management seeks to ensure by putting the above conditions in the recruitment policy.

To some extent there is also perhaps a hope in the formulation of recruitment policies which incorporate the family connections aspect with the internal labour market on the part of the managers that the notions of regular and stable work behaviour and the rewards associated with it would be passed on to their next of kin by the workers concerned. In hiring new workers in accordance with this policy perhaps an attempt could be seen to gear the power relations of the family to the needs of the labour process within the firm. Whether or not such an attempt is successful is another matter. The point, however, is that this strategy of the management has all the elements necessary to make a link between the two set of power relations - the power embodied in relations within the family reinforced by ingratiation in being provided employment and the power relations of the labour process in the firm.

Yet another aspect of the detailed recruitment policy of firm C is that in relation to Edwards' concept of simple control, it can be seen that this policy bureaucratises certain elements which could be considered elements of simple control. This then could be considered another example of elements of simple control co-existing with bureaucratic control elements and finally getting integrated into the latter.

In firm D, as pointed out above, there was no policy of recruiting relatives of workers. And the recruitment through the internal labour market was slightly more complicated. Out of the seven grades for workers performing non-supervisory jobs, the direct entry points for recruitment from outside were grades 1 to 4 and grade 7. However, the union had an agreement with the management that except for grade 1 workers, the management would also notify workers within the firm of the vacancies in other grades. For grades 2 and 3, notification was to be provided only in the department where the vacancy had arisen; for grades 4, 5 and for group-leaders, notification was to be provided only in the Works where the vacancy had arisen; for grades 6 and 7, notification was to be provided in all the Works of the firm in Bombay. While for grades 5 and 6, the recruitment was strictly through internal hiring/promotions, for grades 1 to 4 and 7, workers may also be recruited from outside. However, even in the latter case, "all the other factors remaining equal" those already in service with the firm were to be given preference.

As far as the internal promotions route is concerned, the structure in firm D is a more complicated one than the ones in the other firms. Within a plant or a workshop as an upward movement occurs along the grade structure, promotions opportunities get progressively blocked off. However, the blocking off effect on career ladders can be reduced if workers have opportunities to move across workshops, plants, and even factories. And the internal labour market structure in firm D had been designed to achieve this goal - the higher the grade in which a vacancy occurred, the larger was the span of internal recruitment. As to why the family connections route to direct entry points to the internal labour market was not used in firm D, it is difficult to explain. In

firm E, as pointed out earlier, there was no explicit internal labour market structure. In principle, recruitment for all the grades was open; i.e. a mixture of hiring from outside as well as internal promotions.

In most of the firms studied, the criterion for internal promotions was "seniority-cum-merit". But except in firm C, no clear guidelines were laid down in any of the firms about the share of seniority and the share of "merit" in promotions and each contentious case went through a process of negotiations between management and union.

In firm C, when the workers demanded reclassification of jobs in 1980, they also demanded an agreement on the question of time span for promotion from one grade to the next and a statement of the conditions for such a promotion. After protracted negotiations, it was decided that on the completion of four years in a job, workers should be promoted to the next grade. In those cases where a second promotion was possible in the same job, a span of five years was to be fixed for such a promotion. But this promotion was contingent upon three factors - "attendance, behaviour with co-workmen and superiors, and efficiency on the machine". Those workers who fulfilled the first two criteria but not the third would be given three months to reach the required efficiency.

The implications of the three factors listed above are quite clear. Attendance refers to good attendance; i.e. stable work habits. Regular attendance reflects an acceptance of factory discipline as a routine and it is this that makes regular attendance an important criterion for promotion in the eyes of the management. The second factor relating to behaviour with "superiors" and fellow workers once again judges the acceptance of managerial authority along with being disciplined and not behaving in a manner that may threaten disruption of work in any way. Both these factors then, have to do with stable and acceptable

work behaviour. The third criterion which has to do with the abilities required for job performance is a fairly obvious one and does not need any further explanation.

Thus, it can be seen from the above discussion that while job evaluation creates and formalises hierarchy in jobs, the existence of this hierarchy over time is dependent upon there being mechanisms which replenish the hierarchy and perhaps even expand it around a given structure. This is achieved through mechanisms of recruitment and promotions. It is also clear that having criteria like "seniority" for promotions in essence is an attempt to evaluate the reliability of the worker in adhering to the norms of desired work behaviour. It is also an attempt, at times with the explicit acceptance of union leaders, to induce desired work behaviour amongst the workers if they want to further their careers within the firm.

Attempts to ensure optimum levels of labour utilisation:

Recruitment/promotion policies are long term strategies inasmuch as it is not every day that new workers are recruited or others in the firm promoted. The exercise of managerial control also requires that, to whatever extent possible, standards for desired work performance for a normal working day be set up and also adhered to.

Setting up standards of work performance invariably means monitoring the activities of workers by comparing their actual performance with "ideal" standards set up. Thus, it is not always possible to distinguish between those managerial control strategies that only attempt to define desirable standards of task performance and those that attempt to ensure adherence to them. Often the only distinction that can be made meaningfully is in terms of the different levels at which these strategies are formulated.

At the level of individual jobs within an organisation of work, these strategies refer to managerial strategies aimed at enunciating optimum methods and levels of task performance. The word "optimum" is used here not to denote some kind of mathematical preciseness but a level that can be arrived at only through the experience of workers. It is the process of abstraction from the experience of workers by the management that leads to the formulation of optimal levels of task performance at any given time. The techniques that are used in this process of abstraction are Time and Motion Studies, and Method Studies - Foucault refers to them as "temporal elaboration of activity" and "correlation of body and gesture", respectively. The results of these techniques, and others such as attempting to move towards higher work norms without using Time and Motion and Method Studies, are used to push the use of labour of the workers to whatever limits it can be pushed to (i.e. intensification of labour) without leading to untoward consequences for exercise of managerial control and productivity. One of the methods used by managers to ensure adherence to the set work norms and even exceeding them is through production incentives. These may either be individual incentives or group incentives. And the incentives themselves may be linked either to the quantity of production or its value.

Before going on to examine the use of the above strategies in the firms being studied, the case of firm A is analysed first because in this firm the method used for pushing up the levels of the desired task performance was quite different from the other firms.

In firm A, no time and motion or method studies were carried out and there were no production incentive schemes. However, at some work-stations in the motor assembly shop fixed work norms were provided for the first time in 1977-78. According to the supervisors, these new

norms were based on estimates by them of the extent to which work norms could be pushed up with the help of the union as the new norms went along with an increase in wages. This then is an example of ensuring better task performance levels than before by increasing wages along with an intensification of labour. The details of the new work norms which were available for only the winding and the connections sections of the motor assembly shop are presented in Tables 6 and 7.

As can be seen from these Tables, the intensification of work loads was as high as thirty one percent in some cases in the winding section while the highest figure for the connections section was forty percent. In the winding section (see Table 6), for the stators of 50 h.p. motor with wire length of 230 mm, the increase in time taken for winding from 13 to 14 hours per piece may initially seem as a reduction in workload. However, this conclusion will not hold once we take into account the fact that for this stator the wire gauge of the coils was changed around the same time. The thicker wires that were introduced were comparatively more difficult to put into slots. And it is this that is reflected in allowing an extra hour per piece for winding these stators.

While the management was reluctant to provide detailed information on changes in work loads, it seems that an overall intensification of labour did occur at most work-stations in the motor assembly shop after September 1979. This can be deduced from what a painter had to say about work loads: "Previously we had to paint only about 50 to 55 motors a day. Now we have to do 65 to 70 motors a day. All these changes have come only this year". Now, as no changes in the number of jobs or technology occurred in this period, unless assembled motors are stock-piled before painting or their parts are stock-piled before assembly, it would seem that if there is an intensification of up to 27 to 30 percent

Table 6: Intensification of work in the winding section of the motor assembly shop in firm A.

H.P. of motor	Stator/ Rotor*	No. of poles	Core length (mm)	No. of slots	No. of workers	Old norm (hrs)	New norm (1979) (hrs)	Intensification of work load per worker (%)
150	Stator	4	330	72	2	50	43	7.00
	Rotor	4	330	60	1	53	48	9.43
125	Stator	4	270	72	2	45	38	7.78
	Stator	8	400	48	2	50	37	13.00
	Rotor	8	400	36	2	40	30	12.50
100	Stator	4	280	60	2	43	34	10.46
	Stator	4	240	60	2	36	31	6.94
	SR**	-	280	48	2	28	24	7.14
	SR	-	200	60	2	30	27	5.00
	SR	-	240	48	2	26	23	5.77
100	Rotor		240	36	1	27	24	11.11
	Rotor		280	36	1	28	25	10.71
40-60			280	48	2	18	15	8.33
75			260	48	2	18	15	8.33
50	Stator		230	48	1	13	14	(-)7.69
	Stator		220	48	1	11	11	0.00
	Stator		280	54	1	18	17	5.55
50	Rotor		230	36	1	15	14	6.67
			220	36	1	15	14	6.67
30-40			240	48	1	15	14	6.67
25-40	Stator		200/175	48	1	11	10	9.09
	Rotor		150	36	1	14	12	14.28
15-25			225	48	1	16	11	31.25
			200	48	1	14	11	21.43
15-20			180	48	1	14	11	21.43
			140	48	1	14	10	28.57
5-10		4	120/100	36	1	7	6	14.28
		6	135/180	36	1	7	6.5	7.14
		2	120	36	1	13	9	30.77
5		4	120	36	1	6	5.5	8.33
		2	60/100	24	1	7.5	7.5	0.00
		6	120	36	1	6	5.5	8.33
3		4	110	36	1	6	5.5	8.33
		6	110	36	1	6	5.5	8.33
		2	80	36	1	7.5	7.5	0.00
1		2	50	36	1	7	7	0.00
1.5		2		24	1	7	6	14.28

Notes: *Blanks in the column mean that stator or rotor norms are not specified separately.

**Slipring rotor.

Table 7: Intensification of work in the connections section of motor assembly in firm A

H.P. of motor	Stator/Rotor	Old norm* (hrs.)	New norm (1979) (hrs.)	Intensification of work load per worker (%)
150	Stator	25.00	25.00	-
	Rotor	20.00	20.00	-
125	Stator	25.00	25.00	-
	Rotor	20.00	20.00	-
100	Stator	23.00	23.00	-
	Rotor	22.00	22.00	-
40-60	Stator and Rotor	9.00	7.50	16.67
75	Stator and Rotor	9.00	7.50	16.67
50	Stator	11.00	10.00	9.09
	Rotor	11.00	10.00	9.09
30-40	Stator and Rotor	11.00	10.00	9.09
25-40	Stator	4.50	3.50	22.22
	Rotor	10.00	10.00	-
15-25	N.S.**	4.00	3.50	12.50
15-20	N.S.	4.00	3.50	12.50
5-10	N.S.	3.00	2.00	33.33
5	N.S.	3.00	2.00	33.33
3	N.S.	2.50	1.50	40.00
1	N.S.	3.00	2.00	33.33
1.5	N.S.	5.00	3.00	40.00

Notes:

*All norms are one worker/motor.

**Not specified.

at a workstation that comes after final assembly then there would have been proportionate intensification at other workstations before this workstation. Whatever be the case though, it seems that pushing up of work norms was the strategy used by the management to ensure that desired levels of work performance were kept up. In this case, it would also seem that this was done with the explicit consent of the union leaders in return for increased wages.

In firm B in 1977, the management and the union signed an agreement to carry out method studies to fix work norms. However, till the end of 1979, no such studies had been carried out. There were also no production incentive schemes in operation in this firm. But because of comparatively high wage levels and the availability of overtime earnings for most workers, the management had little problem in ensuring desired work performance.

In firm C, there were no formally fixed work norms in existence and nor had any work study been carried out to that end. There was, however, a production reward scheme in existence which came into effect in May 1980. The production rewards in this scheme were linked to the value of the overall production of the firm. An important implication of this is that through this scheme, the management of firm C was making the workers share its market risks. And as pointed out in Chapter 5, some of the problems of this firm arose from the type of market it was in, the difficulties it had with its buyers. As to why the union agreed to such a scheme it is difficult to say.

In firm D, there was a separate work study department which fixed the time norms for all the jobs in the firm for which such norms could be fixed. There also existed an elaborate production bonus scheme based on output of individual workers as well as of groups of workers. The

production bonus scheme in firm D used efficiency in utilisation of labour time as the basis for standard performance. And after that it provided monetary incentives to the workers to push this limit further. In addition to this scheme, firm D also had a special award scheme for those workers who kept up a 100 percent utilisation of labour time (allowing for idle time) for four consecutive months after which they were paid a reward in a lump sum. If, however, they kept it up for every month after the fifth month then they would be paid a production award at a monthly rate. These special awards were also subject to the condition that the workers should have had a minimum of 80 per cent attendance during the period and should not have been absent from work without official permission. This scheme thus not only encouraged the self-intensification of labour by the workers but also tried to link it with reduction in absenteeism.

Besides these two schemes there was also a Service Bonus Scheme designed to encourage workers to reduce the proportion of unproductive time to total time they spent in the firm. This scheme also operated on a monthly basis. However, service bonus payment was also linked to attaining an optimum level of labour time utilisation.

The aim of all the three schemes, as can be seen from the above discussion of them, was first, to set a level of accepted work performance in terms of the productive utilisation of labour time and second, to push up these levels of utilisation of labour time.

In firm E, no time and motion or method studies had been carried out but there did exist a production incentive scheme which worked as follows. Standard production was calculated at 50 percent of machine capacity (30 percent in the case of heavy duty wire drawing machines). For production higher than the standard production levels, for each percentage point rise Re 0.08 was given as incentive payment per hour.

Though in most cases it was an individual incentive payment, in the case of fine wire drawing machines where two workers work on five machines, group incentive was paid.

Thus, it can be seen that in the five firms considered, different strategies were used to set up levels of task performance and for inducing workers to achieve these levels at the minimum if not exceeding them. However, all these techniques also involve monitoring of the task performance of workers. At the level of the whole firm/plant these monitoring techniques may manifest themselves in the form of attendance cards used for clocking in and out of the factory and at the level of individual work-stations or groups of workers, they may be manifested in the form of job-cards for recording the time taken to complete a job. And there could be a variety of other techniques that could be used.

While all the firms used attendance cards for recording the clocking in and clocking out times, not all of them used job-cards.

In firm C, an attempt was made in May 1980 to introduce a job-card system. The explicit aims of the system were specified by the management as measuring "the operator's efficiency and shop efficiency and to effect improvement in the manufacturing process to reduce cost". However, the union opposed this proposal and it was not implemented.

In firm D, there were job-cards for monitoring the time taken in performance of all the jobs for which norms had been set. These recorded the productive time spent on the job along with unplanned idle-time due to machine breakdowns, power failure, etc.

In firm E, while individual job-cards at the workstations did not exist, but supervisors recorded the output of each workstation.

Strategies for dealing with routine or extreme problems:

Besides the managerial control strategies described above, there are other managerial strategies of control that attempt to ensure the day to day smooth functioning of the labour process. Those strategies that attempt to solve such problems - ranging from disputes about leave sanctions, scuffles on the shopfloor, disputes about job classification, to locker breakages, to take a few examples - within the framework of the "legality" of the firm are codified in the grievance and disciplinary procedures of the firm.

All the five firms considered here had such procedures, most of them listed in the Standing Orders of the firms. Within the framework provided by the Standing Orders and other procedures, managers may have some amount of discretion over how to deal with some of the problems. To take an extreme example, in Table 8, for firm D the routinised plans for dealing with day to day problems faced by managers in exercising control over the labour process are presented. Such routinisation of managerial control strategies necessarily implies taking into account workers' responses to managerial control over the labour process in general. Some of these responses are discussed in the next section.

However, before going on to discuss workers' responses to managerial control it must be pointed out that there are some other strategies such as declaring lockouts that might be used by managers to overcome extreme crises of control at the workplace. Of the firms considered here only in firm C was a lockout declared in 1979 when the workers' union opposed subcontracting of work outside the firm (see next chapter). In this case the management was able to re-assert its control by forcing the workers to agree to subcontracting of work and recognising it as a prerogative of the management. However, in general, lockouts can be

Table 8: Routinisation of managerial strategies of dealing with common shopfloor problems in firm D

Problems	Reasons	Managerial strategy
Work refusal	1. Classification disputed (a) New elements of work (b) Same work now disputed 2. Same grade, other work 3. Lower grade work	1. Fortnightly review and listing by Works Managers and Planning Dept. 2. Counselling 3. Talk with top leaders of the TU 4. Enforce immediate "No Work No Pay" policy 5. Disciplinary action - (a) Verbal warning (b) Written warning (c) Show-cause/charge sheet/inquiry (d) Punishment 6. Training/educating supervisors/ engineers
Transfer refusal	1. Seniority affected 2. New job to be learnt 3. New job not liked 4. Reduction in promotion chances 5. New supervisor not liked	----do----

Table 8 (continued)

Problems	Reason	Managerial strategy
Low individual output	Combination of above reasons	----do----
Mass slow down	Union direction	Settlement with union top leaders
Movement of union office bearers (a) Inside own shop (b) Other shops (c) Other places	Union work and consultation with workmen	Fix timings
Movement of workers	1. Dispensary for treatment 2. Toilets, locker rooms, roads, canteens, etc. 3. Meet other workmen	Campaign by Senior Managers
	4. Wages & Salaries Dept. (about leave balance, medical bills, certificates, salary advances, etc.) 5. Meet Union representatives	Fix timings
Promotion Procedure	Promotion according to seniority-cum-merit disputed	Time bound programme to settle the issue with the Union.
Job classification disputed	1. More promotion	1. Explain/train supervisors in job classification.
	2. New job/addition of new elements	2. Settle promptly those cases where Departmental Head is in doubt
	3. Interpretation disputes	3. Advance action by Supervisors/ Deptl. Heads
		4. Strengthen Industrial Engg. Dept. at Works
Agreement clauses not adhered to by Union	Various advantages to workmen	Reduce/plug-in such loopholes by final classification with Union

seen as extreme manifestations of managerial control and also perhaps as its "frustrated" form[5].

To summarise, in this section it has been shown that managerial strategies of controlling the labour process exist as a set of strategies. At one level, managerial control strategies may manifest themselves in the design of the architecture of the workplace and at another level in creation and perpetuation of job hierarchies. In discussing the latter aspect of these strategies, it was shown that managers attempt through the technique of job evaluation to create a hierarchy of jobs and instill in the workers the acceptance of a role within that hierarchy. And through the formulation of policies of recruitment and promotions, they seek to maintain the job hierarchies over time. These two strategies place the individual capacities of workers to work in a context from where managers can proceed to formulate methods that would attempt to ensure optimal levels of task performance. This is hoped to be achieved by attempting to fix methods of task performance, work norms, monitoring adherence to these norms, and trying to push these norms upwards through various methods. Besides these strategies, it was pointed out there may be other strategies used by managers to deal with routine problems associated with the labour process as well as dealing with extreme crises of control over the labour process.

Having thus discussed the major set of "workplace" managerial control strategies, now an attempt can be made to discuss the responses of workers to these strategies in the firms studied.

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5. In theory, there may be situations where some managements may deliberately create situations which would lead to a lock-out being declared to save paying any wage to workers for a period of time. In such cases lock-outs cannot be seen as "frustrated" forms of managerial control. Lock-outs in such cases, in fact, cannot be considered strategies to control the labour process.

4. WORKERS' RESPONSES TO MANAGERIAL CONTROL

In discussing workers' response to managerial control strategies both collective and individual responses of workers have been considered. This has been followed by discussing those tactics that might be used by workers to restrict or threaten managerial control at the workplace.

The methods used by the workers to restrict managerial control at the work-place could be analysed within a "job control" strategies framework (see, for example, Herding, 1972, Herding and Kohler, 1979, and Goodrich, 1975). While the responses of workers discussed below do not fall strictly within the definition of job control used by Herding and Kohler, who limit them only to the level of unions and to workplace influences, they can be seen in Goodrich's framework as strategies that are largely reactive or protective responses to managerial control.

The following discussion shows that workers' responses to managerial control strategies need not always be antagonistic. And even when the collective response or trade union based response of workers is one of accepting a particular strategy of managerial control, individual or group responses may still exist that go against the union response. Table 9 presents an outline of the different responses of workers to the managerial control strategies discussed in the last section. In the following discussion these responses are discussed in a greater detail.

Table 9: Responses of workers to some "workplace" managerial control strategies

Firm	Job classification	Recruitment/Promotion	Work study	Production incentives
A	Classification into wage categories accepted by the workers.	Preference to children of workers in recruitment formalised in union-management agreement. Union insistence on management hiring disabled persons. Individual withholding of knowledge about production.	Union permission required for work study. Higher work norms set with union agreement.	Piecework banned by the union. Overtime work favoured. No production incentives in operation.
B	Classification into wage categories accepted by the workers.		Union permission required for work study.	Union against overtime work. No production-incentives in operation.
C	Workers use job descriptions to restrict managerial authority by refusing to carry out tasks not listed in the job descriptions.	Restriction of production by workers who feel unfairly treated in the promotion policy.	No work study done.	Incentives linked to value of production accepted by the union, though there was a dispute on the level of incentives in May 1980.
D	Job classification on union demand. Workers don't seem to understand the scheme used.	Internal labour market structure influenced by the union	Union objected to time norms fixed by management in 1979 (see text).	Group incentives did not function because of inter-union rivalry. Shift to individual incentives in March 1980 for most jobs. Destruction of job-cards by groups of workers.
E	Classification into wage-categories accepted by the workers.	Time limit for promotions in jobs and criteria for promotions finalised by the union.	No work study done.	Existing scheme accepted by the workers.

Responses to job evaluation:

In firms A, B and E, as pointed out earlier, jobs were classified into a set of wage categories without evaluating the jobs in quantitative terms. In all these firms there was no evidence of workers objecting to the hierarchy of jobs.

In firms C and D, where the factor comparison and the grade/trade description methods of job evaluation were used, respectively, workers' responses could be seen as being dependent upon the type of job descriptions provided and their understanding of the methods of job evaluation.

In firm C, an attempt was made to provide detailed job descriptions for each job. But since most of the production was to customers' requirements not all the tasks in the jobs could be listed in advance; i.e. there was a contradiction between non-standardised production with standardised job descriptions. Once the workers realised this they started using job descriptions to resist managerial authority or restrict it whenever necessary. Thus, in the two major disputes in this firm since 1970, job descriptions were used as a method of putting pressure on the management. In 1977, in preparation for the impending wage negotiations (the earlier agreement was coming to an end) workers started adhering to performing only those tasks that were listed in their job descriptions. Thus, in March 1977, the management wrote to the union: "Certain restrictive meanings are being attached, due to wrong interpretation, to the job classification which impedes smooth working . . . On occasions, when exigencies warrant men must also do the jobs akin to their basic trade". These restrictive practices were used in a very effective way by the workers in a dispute in 1980.

The 1980 dispute in firm C was about the union opposing the subcontracting of work outside. And in order to put pressure on the management to stop subcontracting, besides shop-floor workers sticking to their job descriptions, other unionised workers like drivers of the firm's cars and medical attendants were also directed by the union to do the same. Thus, the Administrative Officer of the firm wrote to the union officials: "...it is noted with regret that Drivers have refused to deliver mail to the post-office and bring the mail back from the post-box. The Drivers have been carrying out the above incidental work for many years and it is unfortunate that they have now suddenly stopped doing it unilaterally. Medical attendants had been performing duties in connection with submission of medical claims of employees to the insurance company. They have now refused doing this work claiming that their job description does not include the above mentioned duties. It needs to be pointed out that the job description is not exhaustive and all the details cannot be mentioned". Thus, this is an example of a managerial control strategy being so well understood by the workers that they could use its contradictions and loop-holes to restrict managerial control during industrial disputes.

In firm D, where key job descriptions were provided instead of detailed job descriptions, workers could not use them to resist managerial control in the same way as in firm C. Even though job classification in firm D was done on union demand, most of the workers did not seem to have understood the basis for the classification and leave it to their union-leaders to negotiate classification of new jobs, etc. According to the industrial relations file of firm D, most of the interventions made by the Union in the classification of jobs over the last decade were within the overall framework of job classification in the firm; i.e. they centred around disputing classification of individual

jobs by comparing them with other jobs. There was, however, a group of workers in firm D who, unhappy with how their jobs had been classified, showed their displeasure by destroying their job-cards which were used by the management to monitor progress of jobs and calculate production bonus payments.

In firm D, the union did oppose introduction of a new machine that would affect jobs[6]. In 1980 the management wanted to purchase a wire-spark-erosion machine for the tool-room in the switchgear plant. This machine was numerically controlled and programmable. The union opposed the buying of this machine because they thought it would reduce skill levels of the operators[7] and also reduce the work load on other machines in the tool-room. The management did buy the machine in October 1980, but the union refused to allow any of the workers to operate it or even to discuss the classification of the new job. Till December 1980, the machine was being operated by the engineers of the firm while the workers followed the union directive.

Thus, it can be seen that in both firms C and D, workers did accept the job evaluation schemes but within the frameworks of job evaluation in each case, they responded to it in different ways. And these responses were dependent upon the type of job evaluation and the ability of workers to understand it. In the case of firm C, because of the type of job-descriptions, workers could resist managerial authority. In the case of firm D, first of all, most of the workers did not understand the job classification scheme and secondly, since only

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6. Interestingly, this was the only case in the five firms studied where the workers responded negatively to a change in technology.

7. Because the programming would be done by engineers rather than the workers.

key jobs were specified, additional tasks could be added to their jobs as long as they did not change the key job specification. The latter fact offered the management greater flexibility of control over the labour process. The destroying of job-cards by some workers shows that response to one managerial strategy - in this case job classification - may be in terms of sabotaging another strategy; i.e. monitoring the progress of a job.

Responses to recruitment/promotions:

The special nature of the internal labour market - internal promotions and hiring relatives of workers - has already been discussed above. In none of the firms considered, did the union oppose any of these aspects of the internal labour market.

The recruitment/promotions policies were formalised in written agreements in firms A, D and E with union initiative and in firm C with management initiative. It is difficult to analyse the reasons for the difference in initiatives in either case. One could, however, hypothesise that codification of these policies with union initiative would have perhaps increased the credibility of the union leadership with the workers thereby increasing their faith in collective responses to managerial control strategies. This would be all the more so in firms D and E, where union initiative did bring about changes in these policies. In firm D, the union initiative helped in increasing the span of the internal labour market as an upward movement occurred along the grade structure. And in firm E, the union was able to negotiate specific time norms and criteria for promotions.

As far as individual responses of workers to recruitment/promotions policies are concerned, in firms A and C, there were cases of restriction of production by individual or groups of workers who disagreed with the collectively accepted policies.

In firm A, there was a worker in the connections section of the motor assembly shop who thought less deserving workers had been promoted over him. He claimed that because of this he was withholding work methods that he had developed to save materials from the management.

In firm C, in the air-blast circuit-breaker assembly shop, in November 1979, the output was one-fifth of the normal output for a month. According to the foreman of this workshop, the only reason for this was that a group of workers thought they deserved promotions but had not got them. Production went back to normal when the management agreed to look into their cases. Their demands, however, got buried under the events leading to a lock-out after disputes about subcontracting.

These two examples, though not really sufficient to draw any general conclusions, seem to show: First, that individual or group responses of workers may not be in consonance with the responses of the majority of the workers; and second, that the perceived fairness of the managerial control strategies by some of the workers was in contradiction to what was considered fair by the management.

Responses to work study/setting work norms:

In firms A and B, the management could not carry out any kind of work study without the permission of the union. In both the cases this was formalised in the agreement between the management and the union. There was a provision, however, that if the union agreed to any kind of work study on the shopfloor the industrial engineers would have to be approved by the union. In firm A, the management did push the work-norms upwards with union agreement. This was done, however, simultaneously with an upward revision of the wage-scales.

In firm D, time norms were fixed for different jobs for the first time in 1969 using time and motion studies. This was done without any

objections from the union. However, in 1979, the union objected to the time norms set by the management in the motor plant. The management suggested that time and motion studies be carried out by mutually agreed consultants from outside to check the validity of the norms set by the firm's work study department. The union agreed to this. The time norms set by the consultants were found to be about the same as those set by the management and consequently, the union dropped its objections.

In firm D, there were provisions for individual workers demanding re-observation of their jobs if there were changes in "material, means or method" or production, or if they thought their job was a "bad" job which did not offer some extra-earning potential, in terms of the production bonus, as other workers in the same grade of the trade.

Response to production incentives:

Managers, as pointed out earlier view production incentives as strategies to encourage workers not only to keep up to the work norms set but to exceed them if possible. Workers and their unions, in all the firms considered, viewed them primarily as methods of increasing their earnings. However, unions may oppose certain production incentive schemes because they go against the long term interests of the workers. Thus, in firm A, the union opposed piece-work as a policy in favour of overtime work to increase the earnings of workers. As a union leader pointed out, "If we accept piece-work and the market demand for the company's products falls then there may be lay-offs because of over-production. We prefer overtime (work) whenever there is extra work".

In firm B, there were no production incentives but there was a large amount of overtime work. In firm C, the union accepted production incentives linked to the value of production. And the only time there was a dispute about production was only about the levels of the

incentives which were increased after the dispute. In firms D and E also the unions had no objections to any of the incentive schemes. In firm D, there were cases of workers destroying their job cards used for calculating production bonus and monitoring the progress of jobs. But this was in protest over the classification of their jobs rather than over the incentive schemes. In firm D, the management also had to change over from group incentive scheme to individual incentive scheme because under the former scheme, according to them, members of rival unions in the same group were competing against each other to lower the production level so as to lower the production bonus index.

Thus, it can be seen that except in the case of firm A, where the union objected to piece-work payments, in none of the firms considered did the workers show evident objections to production incentives. Their response was one of acceptance of these schemes for the simple reason that they offered opportunities to increase their earnings.

Besides the responses of workers that have been discussed above, there could be a variety of other actions of workers which attempt to undermine managerial control over the labour process. It is difficult to analyse them as responses to a particular managerial control strategy or specific combinations of them. More generally, they can be seen as tactics used by the workers to threaten the smooth functioning of managerial control whenever such a need arises. These tactics used by workers, once again can be seen in the framework of Goodrich (1975) as reactive tactics used with a protective intent. While it is not possible to exhaust the list of all such tactics, Table 10 classifies the different tactics used in the firms considered here under five interrelated categories - restriction of production, restriction of supervision, sabotage, striking in critical areas and complete strikes. They are interrelated because each one of them may have links with the others.

Table 10: Some tactics used by workers in threatening managerial control in the firms considered

Firm*	Restriction of production	Restriction of supervision	Sabotage	Striking in critical areas	Total strike by members of a union
A	-	Threatening not to obey supervisors known to harass workers. Dropping standards of work.	-	-	-
B	Restriction in production to get production manager transferred ("go-slow").	-	-	-	-
C	"Go-slow" before negotiating new charter of demands. Work-stoppage. Taking out processions during worktime in the factory. Refusing to work on components that have been sub-contracted.	Threatening telephone-calls to managers during work-time. Preventing supervisors from doing maintenance work. Cutting off all telephone links within the factory and between the factory and outside. Restricting movement of managers.	Production Register stolen/ destroyed in machine shop.	Maintenance workers refusing flexible shift timings. Telephone operators refusing to operate the switch-board. Canteen workers refusing to provide food for managers. Sweepers refusing to clean toilets/shop-floors/offices of managers.	-
D	"Tool-down" strikes. "GO-slow". Work-refusal.	"Gherao"** of supervisors. Occupying offices of managers.	Damaging machinery. Switching off machines in motion.	-	Nearly half the workers on strike. Other workers intimidated from going to the factory (1978).

Notes: *In firm E there were no strikes between 1970 and 1980. Details of other responses not available.
**"Gherao" is a Hindi word for "encirclement".

But to the limited extent to which they can be separated analytically they offer a convenient method of discussing tactics used by workers to restrict managerial control.

Restriction of production:

This tactic took a variety of forms in the firms considered. Except in firms A and E where no examples of restriction of production could be found, in the other firms slowing down the pace of work was the most common method of restricting production.

In firm B, in October 1980, workers started slowing down the pace of work in an attempt to get the production manager transferred because he was not only ill-mannered, according to them, but he also tampered with the union's mail. However, no action had been taken by the management against the production manager by January 1981.

In firm C, go-slow tactics leading to intermittent stoppage of work were used by workers in August 1975 demanding a "festival allowance"[8] as an extra lump-sum payment to all the workers. In 1980, in an attempt to stop the firm from subcontracting work outside, workers resorted to go-slow tactics as well as taking out processions within the premises of the factory. They also restricted production by refusing to work on components or sub-assemblies for which operations had been subcontracted.

In firm D, "tool-down" strikes, work-refusal, and go-slow tactics were used by a section of workers during a dispute in 1978 when the rival union in the firm put in a claim for recognition as the official union.

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8. The reason given was that the workers needed extra money to meet the expenses of the two big Hindu religious festivals in the months of September and October called "Ganapati Pooja" and "Diwali".

Restriction of supervision:

This tactic is closely linked with the tactic of striking in critical areas discussed later. However, it may not always take the form of striking only in critical areas of production.

In firm A, in 1974-75, this tactic took the form of threats to disobey a supervisor, who according to the union used to harass the workers. The management transferred the supervisor to another department. Workers were not satisfied with this and they started dropping the quality of their work while pressing for his dismissal. Management did not want to concede this demand but finally the atmosphere became so acrimonious on the shopfloor that the supervisor concerned resigned his job.

In firm C, during the subcontracting dispute, restriction of supervision took a variety of forms. Supervisors were prevented from carrying out maintenance work by the union officials who said that they should stick to their own job-description which did not mention maintenance work as a part of their jobs. Managers claimed to have received threatening phone calls on their internal telephones. As the dispute escalated, workers took over complete control of the telephone exchange within the firm and cut off all the telephone links between the firm and the outside. Managers could not communicate with each other, except by walking up to each other's offices. For a while, their movement was also restricted by the workers not letting them use company cars and by not letting taxis, called by the managers from outside, into the firm. This situation did not last more than a couple of days. But during the period it lasted, supervision was severely restricted in the firm.

In firm D, this tactic took the form of encircling supervisors on the shopfloor, during the union-recognition dispute in 1978, thus physically restricting their movements. And when the dispute escalated, workers who were members of the rival union occupied the offices of managers for one whole day till they agreed to talk to their representatives.

Sabotage:

Managerial control may also be threatened through acts of sabotage. Instances of sabotage being used to threaten managerial control were found in firms C and D. In firm C, during the negotiations for a "festival allowance" in 1975, the production register of the machine shop of the firm which recorded the daily output figures as well as idle hours etc. for different sections of the shop went missing from the foreman's desk. Despite thorough searches it was never found. The management thought it was a wilful act of sabotage. According to the industrial relations file of the firm for this period, it seems that the knowledge of the missing production register was kept among the managers and supervisors and its loss was never openly admitted.

In firm D, sabotage took the form of damaging machines. During the union-recognition dispute in 1978, a blanking die was damaged in the press shop and heavy duty grinding machines in the machine shop were switched-off while in motion. No action could be taken against anyone as the management could not find out who was responsible for these actions.

Striking in critical areas and total strikes:

Another tactic that may be used by workers to threaten managerial control is to strike in critical areas.

The only example of this was found in firm C. This tactic was used by the workers while opposing sub-contracting in the firm. Maintenance workers refused to work in flexible shift timings to match staggered maintenance of machines. Telephone operators who were also members of the union refused to operate the PABX inside the firm; cleaning workers refused to clean toilets, shopfloors and offices; and canteen workers refused to serve food to the managers. To overcome these tactics, the firm declared a lock-out.

Striking in critical areas along with all the other tactics discussed above are used in circumstances where overall managerial control over the labour process keeps functioning. Total strikes, however, mean workers bringing about a complete breakdown of managerial control. In the case of the firms considered here, this did not happen in any of the firms. However, there was a major strike in firm D in 1978. This strike was the result of inter-union rivalry. Strictly, this strike cannot be called a complete strike because legally it was the minority union that had served the strike notice to the firm. Members of this union, nearly half the workforce distributed across different plants, did not report for work and prevented other workers from going to work. Their strike lasted nearly nine months.

Except in this firm, where the sectional interests of workers were so strong that they were represented by two powerful unions, in all the other firms the collective responses of workers were channelled through the recognised trade union. Table 11 shows the list of the various recognized unions and rival unions in the different firms between 1970 and 1980. In the case of firm C where the workers changed

union allegiance every three years (see also next chapter), in the phase of transition from one union to another, the collective responses or use of different tactics to undermine managerial control cannot be seen as being channelled through the officially recognised union. In such a case, these tactics are likely to be formulated by the union that is contending for recognition. In firms A and B, because of the closed shop agreements it would not have been easy to form a rival union. But it would not be impossible for workers to form a rival union by breaking the agreement as closed shop agreements are not a part of any of the labour laws in India.

More than one union may exist in a firm because of two "non-workplace" reasons: First, the Indian Trade Union Act of 1926 allows any seven workers to come together and form a trade union which can be registered, after the adoption of a constitution, with the Registrar of Trade Unions. And second, because the Trade union wings of different political parties are in constant competition with each other and with independent trade unions for membership. These two factors provide the context within which a section of workers in a firm, unhappy with the leadership of the recognised union, can fairly easily organise themselves into a rival union. Also if there are workers sympathetic to one or the other national/regional trade union organisation in a firm, they would be quick to make use of the sectional differences between workers to form a rival union. The sectional differences among the workers may themselves be a result of "non-workplace" influences. The implications of having more than one union in a firm for both managerial control strategies and the responses workers are discussed in the next chapter which focuses on those managerial strategies and workers' responses that are constituted in terms of "non-workplace" influences on the labour process.

Table 11: Recognised trade unions and rival unions in the firms studied during the period 1970 to 1980

Firm	Recognised union(s) between 1970-80	Rival union(s)
A	Before 1974: Company based union 1974: Engineering Majdoor Sabha (external leadership)	None (closed shop)
B	1970-80 Engineering Majdoor Sabha (external leadership)	None (closed shop)
C	1971-73: Engineering and General Kamgar Union (affiliated to AITUC)	Not known
	1973-76: Association of Engineering Workers (external leadership)	Engineering and General Kamgar Union
	1976-79: Engineering and General Kamgar Union	Engineering Workers' Union
	1979- : Engineering Workers' Union (affiliated to CITU)	Not known
D	1964- : Company based union (external leadership)	1974: Company based rival union 1975: Bharatiya Kamgar Sena (affiliated to Shiv Sena) 1976: Maharashtra Shramik Sabha (affiliated to Congress-I) 1977-80: Association of Engineering Workers
E	-1980 : Engineering Employees Union (external leadership)	None

To summarise this section, in analysing workers' responses to managerial control strategies, it was seen that workers may either accept the strategies adopted by the management, as in the case of most job classification schemes, or insist on their codification in formal agreements as in the case of recruitment/promotions policies, or prevent certain strategies like work study from being carried out. They may also force the management to modify some aspects of its strategies; e.g., increasing the level of incentives in firm C. However, besides these responses, a variety of tactics may be used by workers to restrict or threaten managerial control. These were discussed broadly under the headings of restriction of production, restriction of supervision, sabotage, striking in critical areas and complete strikes. All these responses and tactics could either take a collective or an individual form.

5. CONCLUSIONS

It was shown in this chapter that managerial control over the labour process does not exist as a single homogeneous strategy but as a set of control strategies. To begin with the operational inadequacies of the frameworks of Friedman and Edwards were demonstrated. This was followed by using the scheme of Foucault, to show that managerial control strategies consist of a set of interlinked strategies which at one level may be architectural; e.g. reflected in the design of the workplace, and at another level, may consist of design of job structures, recruitment and promotions policies, strategies aimed at ensuring optimum methods and levels of task performance, and strategies aimed at ensuring day to day smooth-functioning of the labour process.

In analysing workers' responses to managerial control in the firms studied, it was concluded that the most prevalent response of workers was of accommodation and acceptance. In none of the firms considered, did the workers seem to challenge the basis of managerial control. They either accepted it or attempted to modify some aspects of managerial control strategies. However, there were a set of tactics that were used by workers to threaten managerial control at the workplace and these ranged from restriction of production, restriction of supervision, sabotage, striking in critical areas, to complete strikes. But these actions could not be seen as posing a long-term threat to managerial control. They were used largely to negotiate immediate or short-term gains to all the workers in a firm or a section of them.

In this chapter only those managerial control strategies that are constituted in terms of workplace factors were discussed. Managerial control at the workplace, however, is also influenced by non-workplace factors. These factors, along with some non-workplace responses of workers, are discussed in the following chapter.

CHAPTER 9

MANAGERIAL CONTROL OVER THE LABOUR PROCESS (II): BEYOND THE WORKPLACE

1. INTRODUCTION

In the previous chapter, those managerial control strategies and workers' responses to them that could be explained in terms of workplace factors were discussed. It was pointed out that managerial control over the labour process is exercised through a set of strategies and that the responses of workers to them may not necessarily mean challenging the aims of the management.

In this chapter, an attempt is made to analyse those managerial control strategies in the firms studied, that can be seen as being constituted through factors outside the workplace. There are two sections in the chapter. In the first section of the chapter, the contribution of labour laws, links between the employers and the Government, "area-practice" in industrial relations, and religious and regional consciousness among workers to managerial control at the workplace are discussed. In the second section, the attempt by managers to shift the problem of control outside the firm by making use of labour market factors and subcontracting work are discussed along with some non-workplace responses of workers to the capitalist labour process.

2. NON-WORKPLACE FACTORS AND MANAGERIAL CONTROL STRATEGIES

Managerial control at the workplace may often be aided by non-workplace factors. It would be difficult, if not impossible, to list all such factors that are a part of the environment of the firm and may aid the maintenance of managerial control at the workplace. A proper analysis of such an interaction would require not only a theory of the State and its interaction with production, but also of the interactions between the social background of the workers, the forms of consciousness among the workers and the organisation and control of work on the shopfloor.

Social anthropological studies (e.g. Sheth, 1968, and Holmstrom, 1976) have tried to study the interaction between the social background of workers and their response to factory work and tended to ignore the labour process aspects. In the absence of a proper theory, in the following discussion a more descriptive method is used to pick up cases from the firms studied, which could be seen as examples of non-workplace factors aiding managerial control.

Labour laws aiding managerial control:

There are basically two implications of the labour laws in India for the labour process in industry: One, there can be more than one trade union within a firm; and two, many of the rights and obligations of workers and their employers are embodied within the law and this necessarily means that a notion of "fairness" in industrial relations is also embodied in the laws. Most of the labour laws (see Table 4 in Chapter 5) may actually protect the workers against their employers and this would be particularly true of backward employers. However, the two aspects of labour laws pointed to above may at times help in the

assertion of managerial control at the workplace.

One of the implications of the Trade Union Act of 1926 and the Maharashtra Recognition of Trade Unions and Prevention of Unfair Labour Practices Act of 1971 is that a majority union, recognised as the sole negotiator for all the workers in the firm, can coexist with other minority unions. Under certain conditions, having more than one union may be used by the management tactically to increase its control over the labour process. However, a multiplicity of unions in a firm may not necessarily be a direct creation of the management. These unions may represent the various sectional interests of the workers in the firm which may be a result of their position in the job structure and their perception of "fairness" in the job hierarchy and the career ladders it provides for different workers. Analytically it is difficult to separate the extent to which these notions of fairness are determined by workplace and non-workplace factors. The point, however, is that when divisions exist between the workers, the labour laws relating to formation of trade unions in India, help in these divisions being manifested in multiplicity of trade unions in a single firm. This fact, at times, may be used by managers to increase control over the labour process, as can be shown in the firms studied.

In firms A and B, as pointed out earlier, there were no rival unions to the majority union. In firm C, however, since 1971, the workers have shifted their allegiance every three years. The significance of the three year period is that the unions in Bombay usually sign wage agreements which last for three years. In this case, because of lack of information, it is difficult to identify sectional interests of workers with the majority and the minority unions. However, in the case of firm D it is possible to do so to some extent.

In firm D, in 1974, a group of workers started a rival union based on the demand for securing greater employment in the firm for the local workers of Maharashtra. This union affiliated itself to a Bombay based organisation called "Sthanik Lokadhikar Samiti" (roughly translated, it means Committee for Local People's Rights). In 1975, this group of workers reorganised itself as a part of "Bharatiya Kamgar Sena" (Indian Workers' Army) the trade-union wing of an extremely chauvinistic political party called the "Shiv Sena" whose basic philosophy was that Maharashtra was meant only for Maharashtrians. In 1975, when Mrs. Gandhi declared a State of Internal Emergency, these workers left the Kamgar Sena and joined "Maharashtra Majdoor Sabha" - a union led by a supporter of Mrs. Gandhi. However, after the "emergency" was lifted in 1977, they joined the Association of Engineering Workers (AEW) led by Dr. Datta Samant (see also Chapter 5).

From this description of changing union loyalties over time, two questions arise. One, how does one know that it was the same group of workers who were moving from one union to another? And two, can the workers joining the rival unions be identified within the job hierarchy of the firm? The answer to the first question is that it is difficult to say with certainty that it was the same group of workers all the time. However, according to the management and activists of the recognized union, broadly it was the same group of workers. But if this was so, what characterised these workers within the firm? According to the management and the officials of the recognized union, they were a group of workers who had always been agitating for higher wages and promotions without any regard for the union-management agreements on these issues.

To further answer the question related to identifying this group of workers in the job hierarchy of the firm, the estimated support for

the two unions in the three major plants in the firm are now analysed. Table 1 presents both the estimates of the Association of Engineering Workers as well as of the management[1] of the support for the two unions. If we consider both the estimates and assume that the management estimates are likely to be nearer to truth (given their basis in voting patterns), then it seems fair to assume that most of the support of AEW comes from the Switchboard and Motor plants.

According to the AEW and the management, sections of both unskilled and the highly skilled workers tend to join the AEW. This may seem strange at first. However both these groups of workers would be united in this firm by the simple fact that both of them have little chance of getting promotions within the framework of job classification. In fact, it could be hypothesized that the high percentage of support among the workers in the Switchboard plant for AEW is explained by the fact that the workers there belonged to a comparatively higher age group[2] and that more than 50 percent of them belonged to the first three grades of the grade structure. Such workers, given their age and the nature of work in this plant, it seems unlikely that they would stand same chances of promotion as workers in other plants within the confines of the job-evaluation scheme. Thus, it is likely that AEW's major support in the Switchboard plant comes from these workers. Workers in lower grades and with similar problems in other plants are also likely to join the AEW.

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1. Based on a polling pattern in the election of Trustees for the Employees' Provident Fund held in late 1980. In both the estimates, the Central Services division of the firm is not included even though they are members of the unions. The management did not have the estimates of the polling patterns for this division or at least claimed not to have them. The AEW, however, claimed 80 percent support in this division.

2. They are the most senior workers, in terms of the years of service with the firm, as this was the first plant to be started on the present site by the firm in 1966.

Table 1: Estimated support of workers for the two unions in firm D

Plant	Management estimates (%)		AEW estimates (%)	
	AEW	Recognised union	AEW	Recognised union
Switchgear	15	75*	50	50
Switchboard	80	20	80	20
Motor	50	50	65	35

Notes: *10% undecided.

Highly skilled workers are also likely to join AEW because most of them have undergone some amount of technical training in technical colleges and they join directly at Grade 4 to find that the promotion chances offered are not up to the expectations generated by their training.

Thus, what is likely to unite the members of AEW is their common "frustration" with lack of promotion chances within the framework of job classification. Middle level workers can work within the hopes of promotions provided by the internal labour market but not these two groups of workers. At the bottom end are the workers who have neither the requisite training nor the opportunities to improve their qualifications and try for better paying jobs within the firm. At the top end are the workers who come into the firm with high expectations of moving up the hierarchy only to find that the top end of the hierarchy offers comparatively less prospects of promotions than do the middle layers. Thus, both these groups of workers would be likely to have little faith in the recognised union which accepts the framework of job evaluation and the criteria it lays down for the jobs in different grades.

One of the implications of having more than one union is that it is difficult to talk of homogeneous collective responses of workers to managerial control strategies because they may be different sectional responses among workers to them depending upon their interests (as well as organisations to articulate them). A further implication is that the responses that could have been directed towards managerial control get contained by the different groups of workers behaving acrimoniously towards each other. That the maintenance of such divisions may be used as a <u>tactic</u> by the management to maintain control over the workers is also illustrated in firm D. As long as the AEW was not a real threat to the recognised union in terms of its membership, the management was

quite happy to encourage the AEW to continue working towards building an alternative union. The rationale for this was that the divisions within the workers could be beneficial to the management inasmuch as they would reduce the level of collective resistance to its various decisions.

The attitude of the management of firm D to the AEW can be illustrated by the following example. The worker who was the leader of AEW in the firm was also a subcontractor for the firm, with work being done at a workshop he owned. It can be seen that by sub-contracting work to him both before and after the nine-month dispute about union recognition in 1978 - which resulted in three activists of the recognised union being murdered, the stabbing of its vice-president, and workers of both unions beating each other up - the management was turning a blind eye to his activities within the firm. However, the reasons for sub-contracting work to him were perhaps quite different before and after the dispute. It can be hypothesised that before the dispute, the management thought that his activities would help in preserving the divisions among the workers. And they had to continue to sub-contract work to him after the dispute because by that time the AEW had started laying serious claims to be the recognised majority union and therefore, the sole negotiator for the workers. Clearly, having one of their leaders as a sub-contractor for the firm would mean that a certain level of understanding could be assumed between him and the management[3].

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3. Of course, it need not work out this way. After all, the workers also knew about the sub-contracting activities of this person and they need not elect him as one of their leaders. But the AEW's central leadership tends to "appoint" the executive committee members rather than having elections within the firm.

The point being made here, though it is still to some extent hypothetical, is that the management of firm D could be seen as using inter-union rivalry as a tactic to keep its control over the workers. That it got out of hand, goes on to show that it cannot be used as a long term strategy as the ungovernable factors involved are far too many. In relation to the labour laws the point is not that they create divisions among the workers but that these divisions are facilitated by the laws in manifesting themselves in multiplicity of unions within firms[4].

A second observation that can be made about the labour laws and the legal system is that, should the management decide to take an industrial dispute to a Court of law, then given the delays in the legal machinery in India, it is unlikely that workers would gain much out of it. Law in India is used, in general, more for delaying justice rather than for ensuring justice. According to R.J. Mehta, President of the Engineering Majdoor Sabha, "This legal system cannot be of any use to the workers except in a limited number of cases like preventing a lock-out, union recognition, etc. However, when the employers take unions to courts things can be quite different. Especially in wage disputes, there are umpteen number of cases where by the time the process of law is completed either the employer is not in a position to pay the amount or the employees are not there to receive the amount because they have retired by that time or died or left the firm". The case of Calico Chemicals, a subsidiary of the Ahmedabad Manufacturing and Calico Mills

4. It can also be argued that having more than one union would keep the recognized union on its toes all the time. It may be so in some cases. However, given the violent nature of some unions in Bombay (and this is not to condone the violence perpetrated against the workers by employers in one form or the other), it seems unlikely that for quite some time to come this would be so in all cases.

(the firm that invited A.K. Rice to India in the 1950s), was cited by many trade unionists in this connection. A dispute which originated in this firm in 1965 had not been settled even by December 1980. A judgement was given about this dispute by an industrial tribunal in 1971. The firm appealed against the Tribunal's judgement to the Supreme Court which rejected it. It then filed a re-petition before the Bombay High Court. This came up before a single judge who also rejected it. Then the firm went to a Division Bench in the High Court who also dismissed it. And in December 1980, the matter was once again pending before the Supreme Court. However, in none of the firms considered here was taking the union to court used as a method of disciplining workers.

Links between employers and Government:

While it is difficult to make an attempt to theorise about the links between the State in India and the capitalists within the confines of this thesis, it is sufficient to note here that the State in India has had a history of intervening in the process of accumulation not only by attempting to control the areas and extent of productive investment (e.g. regulating and channelising investment by the private sector on the basis of the national planning priorities), but also in attempting to regulate labour in the interests of capital (e.g. through an industrial relations policy)[5]. Through the latter form of intervention,

5. A vast amount of literature exists on the links between the State and Industry under capitalism. For the purposes of the managerial strategy being discussed here it seems quite unnecessary to summarise this literature here. For some of the contributions in this area see Holloway and Picciotto, 1978; Lindberg et al, 1975; and Crouch, 1979.

the State may regulate not only labour but it may also circumscribe the role of managements in controlling labour by setting the limiting constraints to their actions. The operation of some of the links between the State and the employers in controlling the workers are demonstrated by the case of firm C.

In September 1975, when the workers of firm C were demanding a "festival allowance" the firm, hoping to make use of the emergency powers adopted by the Government at that time, wrote asking the State Government to intervene. On 4 September 1975, the Under Secretary of the Department of Industries, Energy and Labour of the Government of Maharashtra promulgated an order under the Defence of India Rules banning strikes or lock-outs in firm C. This order was specific to this firm and was called "The Prohibition of Strike or Lock-outs in Firm C Order, 1975". It also "ordered" the firm to make an advance payment to the workers for the coming Hindu festivals while also setting dates for recovering the amount from the workers' wages, the actions which the management wanted. So here is an example of State intervention, at the behest of the management of a firm, which attempted to help in maintaining the managerial control over the labour process.

In this case since the workers kept on slowing down production without going on strike, the management of firm C wrote to the Chief Minister of Maharashtra on 13 October 1975, in effect asking him to arrest all the union leaders in the firm, as the following quotation from the letter shows: "May we say Sir, that any order issued under Defence of India Rules enjoining the workmen of firm C not to indulge in go-slow or work-to-rule methods will have no effect because of the nature of the operations carried out in our factory which cannot be determined on a day-to-day basis. What is necessary is <u>the disciplining of the leaders under the powers reserved by the Government</u>" (emphasis added).

The letter also supplied the names and addresses of all the executive committee members of the union in firm C. In this case, the Government did not intervene in the manner desired by the management of the firm. The point, however, is that the very fact that the management of this firm could attempt to seek such support from the Government and see it within the bounds of possibility shows that there must have existed some basis[6] for such an action. In this case, the basis for this action of the management would also be strengthened by the fact that firm C belonged to one of the top business houses in India.

Area-practice in industrial relations:

Yet another set of factors that lie outside the firm but help in formulating managerial control strategies refer to area-practice in industrial relations. Area-practice, in effect, represents the gathering of information about the market in a way that may enhance the bargaining position of the managements or the unions.

In firm C, the industrial relations department collected detailed information on wages and service conditions in other firms in its vicinity. These were put in the form of area-practice charts for comparisons with the firm's own policies. Whenever the union made any demands, these charts were used in negotiating with the workers.

Another example of "area-practice" comes from firm D. According to its Industrial Relations Manager, firm D could "give even higher wages but in doing so it will introduce imbalances in the industry. If it were not for areawise comparisons, we could pay one and a half times more and yet be profitable".

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6. The reason why terms like "collusion of class interests" etc. are not being used is because unless backed by a proper theoretical framework, they might involve making simplistic assumptions about the nature of State actions and modalities of its functioning under capitalism.

Area-practice in industrial relations is further aided by the regional organisations of employers like the Bombay Chambers of Commerce and regional studies carried out by the Employers' Federation of India and other organisations of employers. At this point, it might be asked why area-practice in industrial relations in this case is seen benefiting only the employers? There is no reason why this should necessarily be so. If the trade unions also had a coordinated policy of sharing information about industrial disputes and managerial practices in different firms, then area-practice could become an important basis for negotiating better terms and conditions in backward firms. However, the divisions among the various trade unions come in the way of such coordinated information sharing. The managements on the other hand pay for such information sharing on a regular basis through the various organisations of employers, and, hence, are able to use area-practice to their advantage.

Using regional and religious consciousness among workers:

Forms of regional or religious consciousness that already exist among the workers may also be used by managers to maintain control over the labour process.

There is only one example from the firms considered where appeal to regional sentiments of a worker was made by the management, which was in firm C. During a disciplinary inquiry against a worker in 1974, the Enquiry Officer appointed by the management is alleged to have tried to incite a Maharashtrian worker against the unit secretary of the union in the firm who was a Bengali. According to a letter of the union to the management, he is alleged to have told the worker, "Mr. M. (the secretary of the union) is a Bengali and will not look after your interests. You are a local Maharashtrian and you should not owe allegiance to a member of an alien community". What is also interesting

is that the union protested not against chauvinism as such but in fact made use of nationalistic sentiments to criticise the Enquiry Officer claiming that whatever he said was "derogatory to the spirit of national integration". Even though unsuccessful in this case, it was, nonetheless, an attempt by the management to play upon the regional consciousness of the workers to create opposition to the union leadership. If the management were to be successful in such an attempt then such a division amongst the workers would aid managerial control.

Another example of managerial control being aided by already existing forms of consciousness among workers refers to religious consciousness.

In all the firms considered here, during the Hindu festival of "Dussera", the managements provided funds for worshipping machines. This may seem strange at first but worshipping machines is a displacement of warriors worshipping their weapons in ancient days during the "Dussera" festival. During this festival, which lasts for ten days, workers set aside a day for worshipping the tools and machines they use by putting garlands and vermillion paste on them. In firm C they even broke coconuts next to the machines as a part of the ritual of worshipping them. Except in firms C and D where the management took care of all the expenses involved, in the other firms the costs were shared equally between the management and the union.

In firm A, during yet another Hindu festival called "Ganapati-Pooja", which lasts for eleven days, and is a very important festival in Maharashtra, fifteen minutes every morning are set aside for prayers in which even the managerial staff joins in. These prayers are held on the shopfloor in front of pictures of Hindu Gods (in this firm there was also a picture of Christ on the wall) and sweets are distributed to everyone after the prayers have been said.

In firm B, besides worshipping the machines, every year in the first week of November a Thanksgiving Mass is held in honour of "Our Lady of Perpetual Succour". The leader of the union in the firm, a devout Christian, believed that after he and a fellow trade unionist, who was a Hindu, had decided to put a picture of "Our Lady of Perpetual Succour" on the shopfloor, they had had divine help in improving the condition of the workers. In both firms A and B there were colourful pictures of Hindu Gods as well as pictures of Jesus on the walls of the various workshops.

The first thing to be noted in this context is that in all the firms the demand for worshipping machines or holding prayers in work-time came from the workers. The management merely conceded the demands. But why did the management agree to waste production time on such matters? One reason could be that worshipping machines would help in maintaining the mystification of the role of the workers in production by fetishising machines. And another reason could be that by conceding demands for prayers during work-time and managers joining the workers in these prayers, managements sought to create a unitary ideology within the firm.

There are also some other methods that are used by employers in an attempt to create a unitary ideology in the firm. In firm A, for example, every year the management organises a 'cultural evening' along with the union. Workers are encouraged to stage plays and organise other cultural events for the evening. According to the Senior Industrial Relations Manager of the firm, "If we send them (the workers) big invitation cards - the same ones as we send to the managers - and if we involve the workers in organising the event along with the management then they will get a feeling of belonging to the company". This too is an attempt at encouraging a unitary view of the firm. In firm B, the same was attempted by the managers by organising a picnic for everyone in the firm once every year.

To summarise, in this section it has been shown that factors outside the workplace may at times help in increasing or maintaining managerial control over the labour process. It was pointed out that where divisions exist between the workers in a firm, labour laws in India facilitate their manifestation in multiplicity of trade unions. Having more than one union in a firm may at times be beneficial for the management of that firm as this would reduce the level of collective resistance, if any, to managerial control over the labour process. Further, it was shown that the employers may make use of the links that might exist between them and the State, the forms of regional and religious consciousness amongst the workers, and their links with other employers to increase control at the workplace. There could be many other control strategies used by managers which may also be constituted in terms of non-workplace factors and the strategies discussed above by no means form a complete list in themselves. Such strategies would depend upon the specific environment within which the firms operate. However, at times it may be economically beneficial for the firm to shift the problem of control outside the firm through sub-contracting work. In the following section, sub-contracting activities of the firms studied along with some non-workplace responses of workers are now discussed.

3. CHANGING THE BOUNDARIES OF THE FIRM AND NON-WORKPLACE RESPONSES TO THE LABOUR PROCESS

Sub-contracting - Shifting the problem of control:

Sub-contracting of work - either of components or operations - may be used by managers at times to overcome the problem of control within the firm. However, it must be pointed out here that sub-contracting may be done for a variety of reasons and in not all the cases could it be interpreted as overcoming a crisis of control at the workplace.

In general, sub-contracting of work may be done for the following reasons: Removing sudden bottlenecks in production, manufacturing small quantities of products which require special machines/materials and/or special skills, manufacturing small batches of products with many variants to customers' requirements, removing back-logs in production after industrial disputes, meeting urgent or sudden orders, and finally, making use of cheaper labour costs outside. Only the last of these is of interest here.

When managers sub-contract work for strategic reasons of control, besides saving money on the wage bill, they hope to ensure flexibility in production that might have been lost because of a rigid codification of the organisation of work and the recognition of the employment conditions of organised workers. The prerequisite for this strategy is the availability of cheap and docile labour in the labour market. Use of subcontracting under such conditions means that in effect managers can shift the boundaries of the firm in such a way that the problem of control of work to some extent is shifted on to the subcontractors.

Table 2 presents a list of components/operations subcontracted by the firms considered in this study. All these components/operations were manufactured/performed within the firms before they began subcontracting them. It can be seen that in all the cases, subcontracting began only in late Seventies. This is in keeping with the trend pointed out by Banaji (1980). According to Banaji, ancillarisation has formed the main basis for the massive expansion of "small scale"[7] industries in the nineteen seventies in India. In Maharashtra alone the number of small scale industrial units expanded by 500 percent, from 4,860 to 43,851

7. Strictly speaking, the small-scale sector is defined as consisting of those undertakings where the value of assets in plant and machinery does not exceed Rs. 0.75 million (see, FICCI, 1970).

over the period 1961-77. These ancillaries, as Banaji calls them, would include both component suppliers and subcontractors of operations rather than component manufacturing.

Thus, at the level of individual firms, two things seem to be happening: First, an increase in the number of component suppliers supplying components that were never manufactured within the firm, and second, an increasing number of component manufacturers that were manufactured within the firm at one time as well as an increase in number of operations being subcontracted. In the first case, the firms are trying to reduce uncertainties in material and component supplies and in the second case they are trying to make use of cheaper labour costs and a highly "exploitable" section of the labour market. The latter not only reduces their wage-bills but also reduces the problem of control by making labour-exploitation, exploitation-at-a-distance.

In the firms studied here, except in firm C, the workers did not object to sub-contracting. In firm C, the workers could see that the firm was trying to build up a network of sub-contractors outside the firms so that the inflexibilities introduced in production by the workers through the use of tactics such as "go-slow", "work-to-rule", etc. could be reduced. The workers thought that this could lead to lay-offs and retrenchments in the long run and started striking in critical areas to force the management to stop sub-contracting work. The management declared a lock-out and from the workers' point of view the outcome of the dispute was quite unfruitful as finally the union signed an agreement saying that they recognised sub-contracting as a management prerogative and would not object to it in the future. Their reward was a higher level of bonus in the production bonus scheme.

Just as sub-contracting can be seen as an attempt by managers to shift the problem of control outside the firm, some activities of workers outside the workplace can be seen as non-workplace responses to labour process within the firm. And even though, they do not strictly fall within the scope of this study, a brief attempt is made below to discuss such responses of the workers in the firms studied.

Non-workplace responses of workers:

While it is not always possible to segregate those aspects of the behaviour of workers outside the workplace that are a response to the labour process in the factory from those that are not, a broad classification of such responses can nonetheless be made in terms of those activities of workers that seem to reflect an internalisation of the aims of capitalism and those that do not. These are rough and descriptive categories but they do point to some interesting aspects of the behaviour of workers outside the workplace.

In most of the firms studied here, it was found that those workers who were at the higher wage levels in the firm tended to have some business of their own which they carried outside their regular work hours. While detailed information was not available on this, from discussions/interviews with these workers it did come out occasionally that they had extra sources of income. In firm A, some of these workers kept buffaloes at home to sell fresh milk.

In firm C, according to the estimates of the Personnel Manager, up to ten percent of the workers had part-time business which they ran after factory hours. He listed some of their businesses as follows: Tailoring, selling cloth, running small shops, making pickles, making sweet-drops, grinding spices, driving auto-rickshaw taxis, etc. (in this connection, see also Holmstrom, 1976). One of the members of the executive committee of the union had a tailoring-shop where he was the

master-cutter. He said he employed three other people in his shop. In fact, he carried a measuring-tape around with him in the factory to take measurements of prospective customers who would bring the cloth to be stitched to the factory. He would take their measurements there and deliver the stitched clothes a few days later. What was more interesting was that in the air-blast circuit-breaker assembly shop, there was a worker who ran a small business of selling sarees and cut-pieces of cloth for shirts on the shop-floor. He used the drawers of his work-table to store his goods. Workers would come and examine the goods, haggle over the price and deals would be sealed there and then.

In firm D, some of the workers ran their own workshops at home. At least in one case, as mentioned earlier, one of the workers was also a subcontractor for the firm.

In discussing the implications of above responses of the workers two types of analytical distinctions must be made: First, between those activities that can be seen in terms of the links of the workers with agriculture and those that cannot be seen in this way; and second, between those workers who because of their relatively higher incomes can make investments in small businesses and those workers who might take up part time jobs or make use of their family labour to supplement their regular wages from the firm. Using the first distinction, the only activity discussed above that can be seen as a result of the links of the workers with agriculture is keeping buffaloes for selling milk. The other activities like running tailoring shops, selling cloth, grinding

8. When asked how was it that no one stopped him from running a private shop within the factory, he replied enigmatically, "Where everyone is a thief, who is going to call anyone names?"

spices at home, driving auto-rickshaw taxis, etc. cannot be seen in terms of any kind of links with agriculture. However, from the limited evidence available here it cannot be concluded that workers in these firms had no links with agricultural activities. In fact in firm A, as pointed out in the previous chapter, there was a case of worker who wanted leave from the firm every three or four months because he had some land in his village. This may have been an exceptional case or there may have been many more such workers as information was not collected on the social backgrounds of the workers in this study.

Using the second distinction, it can be seen that the workers at the higher levels of the grade structure who perhaps lack promotion prospects within the firm but have access to resources to set up their own workshops are in some sense internalising the values of capitalism by trying to become small scale capitalists themselves. Their activities cannot be seen in terms of moonlighting to supplement their incomes[9]. However, on the other hand those workers that may be forced into petty commodity production, small time trading, or selling their labour further by driving auto-rickshaw taxis and taking up part-time work are responding to the capitalist labour process by further subjecting themselves to exploitation because they see no other way out for their survival. And their use of family labour in some of these activities (e.g. making pickles, grinding spices, etc.) must also be seen in this context.

Some other non-workplace responses of workers that do not represent the explicit internalisation of the aims of capitalism can be seen as

9. In Holmstrom's study (Holmstrom, 1976) of factory workers in Bangalore there were also groups of workers who were moonlighting. However, he does not make a distinction between those workers who set up workshops and may become small scale employers themselves and those that take up part-time jobs to supplement their incomes.

ranging from taking workplace disputes outside the workplace by agitating at the residences of employers and managers (a practice which the Maharashtra Recognition of Trade Unions and Prevention of Unfair Labour Practices Act of 1971 tried to ban) to showing solidarity with other workers. The latter manifests itself in the form of trade unions - either at a regional, national, or industrial level - which coordinate such responses. While there were no specific examples of the former in the sample of firms considered here, there were examples of workers in a firm showing solidarity with other workers or deprived sections of Society. In firms A and B, all the workers donate one day's earning in a year to the social work programme of their union - The Engineering Majdoor Sabha. The union then uses the money so collected to run a free mobile medical-centre for health care in villages near Bombay, and supplying clothes, books, and stationery to school-going children in the villages chosen by the union. And these were not the villages from where the workers of firms A and B came. While it is difficult to analyse these actions in terms of class solidarity, it shows an extension of working class solidarity to include other poorer sections of the society. This union also financed the rebuilding of fifty houses in a village destroyed by the bursting of a hydro-electric dam. In general, in all those firms where the workers' unions were affiliated to national or regional organisations of trade unions (which was the case in all firms except firm D), such affiliation could also be seen as a part of strengthening the solidarity among the workers.

To summarise, in this section it has been shown that both the problem of controlling the workers and the responses of workers to the capitalist labour process, in general, can move outside the boundaries of the firm. In the former case, through sub-contracting, managers change the boundaries of the firm by shifting the problem of control to small

scale capitalist enterprises. And in the latter case, the responses of workers may be such that they may either show an internalisation of the aims of capitalism or they may show workers being forced to take up part-time work to supplement their incomes. In discussing some of these responses, it was pointed out that in terms of workers taking up extra-work outside their regular working hours in the firm, this work did not show any explicit links with the countryside except in the case of the workers buying buffaloes to sell milk. Lastly, it was pointed out that at least in two firms the action of the union could be seen as going beyond solidarity with industrial workers only.

4. CONCLUSIONS

By discussing workplace managerial control strategies in the previous chapter, and the non-workplace factors that may aid managerial control at the workplace, in this chapter, it has been shown that managerial control over the labour process does not operate as a single homogeneous strategy but as a set of strategies. They were shown to range not only from architectural design of the workplace to developing routine methods of dealing with day to day problems that might threaten the smooth functioning of the labour process, but also to strategies such as making use of labour laws, links between employers and the State, coordinated information sharing about industrial relations practices, religious and regional consciousness among workers, and labour market factors. The last of these refers to the sub-contracting of work, which is an attempt to shift the problem of control outside the firm.

As the above discussion shows, non-workplace factors, which find little mention in the labour process literature, can reinforce managerial control over the labour process in the long run. In the short run too, managers may attempt to make use of non-workplace factors to assert control

over the labour process whenever it is easier to do so rather than modifying workplace strategies.

While in the previous chapter, workers responses at the workplace were discussed, in this chapter it was shown that some of these responses may go beyond the boundaries of the firm. In discussing these responses, it was shown that in some cases they may reflect an internalisation of the values of capitalism by some workers inasmuch as they attempt to become small scale producers themselves. In other cases, it was shown that moonlighting by some workers is merely an extension of their exploitation in the capitalist labour process.

CHAPTER 10

CONCLUSIONS

This study has had two related aims. The first aim has been to examine the analytical insights and shortcomings of existing methodologies for studying industrial labour processes and their relationship to technology under capitalism. By examining both the Marxist and the organisational theory traditions, a set of analytical categories was subsequently developed for analysing the factors that influence the labour process under capitalism. The second aim has been to operationalise and test various hypotheses about the labour process in the context of the capital goods sector of the Indian electrical engineering industry. This chapter brings together and assesses the conclusions reached in pursuing these two aims.

1. THEORETICAL AND EMPIRICAL CONCLUSIONS

In assessing the contribution of both the Marxist and non-Marxist theorists it was found that the analytical value of the concepts developed by them was limited by one or more of the following methodological problems: (a) Non-rigorous definitions of the categories of analysis; (b) a lack of recognition of the limited historical validity of these categories; (c) use of these categories across different levels of analysis without justifying their use at all such levels; and (d) a tendency to oversimplify the dynamics of the capitalist labour process.

In the following discussion, these conclusions are analysed in the context of the following major areas of the capitalist labour process:

The relationship between technology and work; managerial control strategies and the organisation of work; and workers' responses to these managerial control strategies.

Technology and technical change:

The analysis of the concepts of technology and technical change used by most of the theorists considered in this study showed them to be inadequate for studying industrial labour processes. Some theorists made no distinctions between technology in productive industrial organisations and other organisations under capitalism (e.g. Perrow and Thompson), others made use of historically limited categories of analysis (e.g. Marx), and some presented different dimensions of technology as adequate definitions for studying the labour process (e.g. Woodward, Perrow and Thompson).

Marx, for example, restricted his analysis of technology to only rotary machines. Braverman, who adopted the framework of Bright, conflated three different dimensions of technology onto a single scale. These dimensions were - the source of control, the type of machine response, and the source of power. The organisational theorists equated technology with one or more of its dimensions - the volume and type of output, analysability of search behaviour and variability in dealing with raw materials, and workflow linkages. And the socio-technical school's approach to work organisation failed to conceptualise technology at all.

The empirical uses of some of these concepts of technology confirmed these theoretical criticisms. They also showed that the levels at which technology was conceptualised rendered the definition useless for analysing changes in the work organisation. The use of Woodward's classification of technology, for example, showed that her assumption of a single homogeneous technology in a firm was not valid. It was

concluded that the validity of this assumption depended on the volume and the type of output of a firm being a good measure of the output of the different workshops and plants in the firm. The use of Perrow's classification of technology showed that it did not help in identifying the factors that lead to standardisability of production. The latter, it should be recalled, was the major theme of his classification of technology. Further, it was found that his framework did not provide any method of analysing the different forms of division of labour within each of his categories of technology. The use of Thompson's classification of technology showed it to be inadequate for analysing the organisation of work at the level of workshops. The reason for this was that it was not possible to classify workshops uniquely into any one of the categories of technology used by him. The use of Blauner's classification of technology also ran into similar problems.

Based on a critical review of the above theorists it was decided, on the one hand, to limit the discussion of technology to specific industrial processes, and on the other, to define technology in relation to the jobs of the workers rather than as just tools and machines. Thus, no universalistic definition of technology was put forward. Instead it was defined as the combinations of tools, machines etc. with raw materials and the abilities required in using them to produce useful products. This was a definition of technology that would be meaningful at the levels of workshops, plants and industrial sectors. In defining technical change, it was decided to look for a definition that would not be purely descriptive (e.g. Blauner), and would relate technical changes to the jobs of workers without conflating disparate aspects of technology onto a single scale (e.g. like Bright, and therefore, Braverman). Based on these criteria, it was decided to use Bell's definition of technical change at the level of individual workstations.

Bell defined technical change in terms of the changes in the material transformation process, material transfer process, and the control systems for these two processes. By taking into account the patterns and methods of workflow, this scheme could thus be used to study the relationship between technology and organisation of work at the level of a workshop or a plant. However, it was recognised that this framework of analysing technical change would be appropriate only for metal-cutting and assembly technologies.

In general, the four important conclusions reached in studying technology and technical change were the following: First, universal definitions of technology which make no distinction between profit making industrial organisations and other organisations, are unlikely to be helpful in studying industrial labour processes under capitalism. Second, within industrial organisations, technology and technical change need to be defined in relation to the jobs of the workers for analysing changes in the labour process. Third, definitions of technical change at the levels of workshops or plants need to take into account not only changes at individual workstations but also the changes in patterns and methods of workflow. And fourth, there cannot be a single universal definition of technical change applicable to all industrial production processes.

Technology and organisation of work - 'De-skilling' arguments:

To relate technology and technical change to the organisation of work, the concepts of skill and other attributes of the jobs of workers were examined. In the case of Braverman, who draws very specific conclusions about the links between technology and the skills of workers (i.e. 'de-skilling'), it was found that he does not at any point in his book define very clearly the meaning he attaches to the concept of "skill". From the various operational uses of the concept,

however, it seems that craft-based skill is taken by him as an absolute measure under capitalism and he views the changes in technology necessarily leading to a degradation of the skills of workers relative to this measure. Even though he recognises that new machines or techniques of production may create new skills, but conceptually he does not distinguish these skills from craft-based skills. And he sees a secular tendency towards the degradation of these skills too. Braverman used the concept of skill at the levels of individual workers, occupations, and the working class as a whole. His concept of skill thus represented an ill-defined category of analysis which could not be operationalised easily, was ahistorical, and had been used by him across different levels of analysis without distinguishing between the meanings it might have at the different levels.

Given the shortcomings of Braverman's conception of skill, it was concluded that the definition of skill needed for this study should fulfill the following two conditions. First, it should be applicable at the level of the jobs of individual workers or groups of workers in a plant or workshop. And second, it should make it possible to disaggregate the different aspects of skill so as to enable a better analysis of the impact of technical change on it. Such a definition was found in Blackburn and Mann's study of job structures.

Before relating the above conceptions of skill to technical change, an attempt was made to analyse the job structure in the firms studied by making use of the job characteristics measurement made on the jobs studied in these firms. Such an analysis showed the job structure to be predominantly hierarchical; i.e. good and bad attributes in jobs tended to bunch together. This was true of relations between individual job characteristics as well as when meaningfully interrelated job characteristics were constructed into factors and the job structure

analysed in terms of the relationship between these factors and other variables. Initially, only individual jobs were analysed and later, the actual job structure was analysed by weighting the jobs in terms of the number of workers per job. There was no substantial difference in conclusions about the type of job structure between unweighted and weighted jobs.

In analysing technical change, it was found that neither the changes that had already occurred nor the proposed changes in technology were spurred on by workers' resistance to managerial control. In fact, market factors were found to be determining the nature of technical change.

It was also found that changes in technology did not necessarily mean a reduction in the skill components of jobs. This conclusion was reached by carrying out a series of analyses of the links between different aspects of technical change and the jobs of workers. Firstly, the impact of the patterns and methods of workflow on jobs was analysed. It was demonstrated that given a set of instruments of work, objects of work, and skill required in the workers to use them to produce useful products, workflow could be arranged in more ways than one. While there could be a variety of ways in which changes in workflow could affect jobs, in the case of the firms considered here, there were at least four different ways in which workflow affected jobs. First, it was shown that inflexibilities in the architecture of the workplace may lead to awkward workflow patterns which may in turn result in creation and maintenance of some specific tasks. Second, it was shown that changes in workflow patterns that lead to smoother workflow may result in reduced labour requirements on the shopfloor. The impact of this on jobs on the shopfloor would depend upon whether the extra workers thus released were absorbed in other productive jobs or transferred to other workshops or made redundant. Third, changes in

the method of workflow may modify the tasks of material transfer thus changing the task contents of the jobs of workers engaged in workflow and they may also reduce the number of workers required for workflow activities. And lastly, some workflow changes: e.g. from long line assembly to shorter assembly lines, may also lead to a greater flexibility in production as well as a greater control over production by the management while at the same time increasing the skill components of the jobs of individual workers.

At the level of individual workstations too it was found that technical changes did not necessarily mean a reduction in the abilities required to perform a job. Changes in material transfer functions were found to affect jobs in two ways: (a) Eliminating certain tasks, and (b) partially modifying relatively unskilled handling tasks and replacing them by tasks that require higher conceptual and executional abilities than before. The skill components of the job so affected would depend upon how the modified set of tasks is combined into jobs. Changes in material transformation process were also found to affect jobs in different ways. These changes at a particular workstation were also found to affect the task-content of jobs with which that workstation had forward workflow linkages. As no changes in the control systems for the material transfer and transformation processes had occurred in any of the firms, it was difficult to conclude anything about their likely impact on organisation of work.

Comparison of workshops with similar level of mechanisation showed that a similar level of mechanisation did not imply similar job characteristics. When workshops with different levels of mechanisation were compared, it was found that skill components of jobs were not lower in the higher level of mechanisation.

A general conclusion drawn from the above analysis was that no determinate links could be specified between technical change and the

skill aspects of jobs at the level of workshops. Skills, as well as other characteristics of jobs depend upon the specific articulations of technological constraints with other market and non-market factors specific to a firm. It is these relationships and their interactions that finally lead to a firm's being able to implement a particular task composition of jobs. There might, however, still be trends towards 'de-skilling' at a macro-level; i.e. at the level of an industry or even the mode of production. From a case-study approach, such as the one followed here, it is not possible to conclude about trends at these levels of analysis.

To summarise, at a descriptive level, this study showed that the job structure in the capital goods sector of Indian electrical engineering industry was hierarchical. In analysing this job structure and the relationship between technology and the jobs of workers, the following major conclusions were reached. First, skill could not be seen as a homogeneous category. It consisted of different attributes which could not be collapsed onto a single scale of measurement. Second, technical change could have different impact on the different dimensions of skill. Third, technical change could not be seen, by definition, as a response to the recalcitrance of the workers in the labour process. Fourth, at the level of individual shopfloors, no determinate relationship could be posited between technical change and skill requirements of jobs. And fifth, the impact of technical change on skill and other characteristics of jobs depended upon managerial decisions related to combining tasks into jobs.

On the basis of these conclusions, it can be said that most of the analyses of the labour process discussed in this study, oversimplified the links between technology and organisation of work. The two major reasons for this were: (a) An inadequate analysis of the concepts of

technology, technical change, and skill; and (b) attempts to put forward universal trends in the capitalist labour process by ignoring the specificities of valorisation at the level of individual labour processes in different sectors of industry. As the following discussion shows, the latter shortcoming was also reflected in their analyses of managerial control at the workplace.

Managerial control over the labour process - Workplace and beyond:

While Braverman saw 'de-skilling' as the major strategy used by capitalists to control the labour process, alternative frameworks to analyse the control systems used in the capitalist labour process were put forward by Friedman and Edwards. Just as Braverman's conception of 'de-skilling' suffered from oversimplification, so did the classification of managerial control strategies by Friedman and Edwards. None of them provided any answers to why managerial control over the labour process should be limited to a set number of strategies. It was in the work of Foucault that detailed categories for analysing the nature of disciplinary control at the workplace were found. The advantages of Foucault's framework were seen in terms not only of his detailed analysis of the functioning of disciplinary control, but also of his assumption that disciplinary control did not always take a manifestly "repressive" form. The key implication of the latter point was that there was no need to assume that it was always recalcitrant workers who were being subjected to disciplinary control. Another advantage of Foucault's framework was that, unlike the other theorists, he at least pointed to non-workplace aspects of disciplinary control (e.g. the influence of school and family). While he did not discuss all the possible non-workplace influences, his importance lay in being a theoretician who tried to point towards the linkages between the different aspects of disciplinary power.

The usefulness of applying Foucault's conception of networks of disciplinary power to the labour process was demonstrated by the empirical analysis of managerial control at the workplace. In this context, an attempt was made to examine the operational uses of Friedman's and Edwards' conceptions of managerial control to demonstrate their shortcomings. While Friedman's categories were found to be difficult to operationalise, the use of the categories of Edwards showed that managerial control systems consisted of different elements. It was found that some of these elements combined with each other in such a way that the overall control system could not be classified uniquely in Edwards' classification.

Using the conception of managerial control systems as consisting of a set of strategies rather than a single homogeneous strategy, it was found that these strategies varied from designing the architecture of the workplace to increasing supervision to developing routinised methods of dealing with day-to-day problems. In designing the organisation of work on the shopfloor, it was found that through the techniques of job evaluation, managers attempted to create a hierarchy of jobs and hoped to instill in the workers the acceptance of a role within that hierarchy. This went along with the formulation of control strategies to maintain the organisation of work over time and ensure its long term acceptance by the workers. This was achieved through the formulation of recruitment and promotions policies - more specially, through the creation of internal labour markets. In the case of the firms analysed, it was found that the internal markets consisted not only of the internal promotions route but also had provisions for hiring the relatives of workers at the direct entry points in the grade structure. The latter aspect, it must be pointed out, has been ignored in the previous work on internal labour markets.

Through the strategies of job evaluation and of recruitment/ promotions policies, the individual capacities of workers to work were placed in a context, from where attempts could be made to formulate methods of ensuring optimum levels of task performance. It was hoped by managers that this could be achieved by attempts to fix work-norms, optimum methods of task performance, monitoring adherence to these norms and methods, and trying to push these norms upwards through various methods.

Managerial control strategies could also be constituted in terms of factors outside the workplace. In the firms studied, it was found that managerial control was aided by factors such as the labour laws, links between employers and the Government, area-practice in industrial relations, religious and regional consciousness among the workers, and labour market factors (i.e. sub-contracting).

Thus, the two major conclusions reached in analysing managerial control were: First, managerial control did not exist as a single homogeneous strategy but as a set of interrelated strategies. And second, these strategies could be formulated in terms of both workplace and non-workplace factors. The key implication of these conclusions is that to view managerial control over the labour process as being exercised only through 'de-skilling' or through only one or two strategies would be an oversimplification of its functioning. One of the reasons for such an approach in the work of Marxist theorists like Braverman, Friedman and Edwards was also the assumption of recalcitrance on part of the workers. The following discussion of the conclusions reached in this study about workers' responses shows that this assumption does not bear out empirically.

Workers' responses - Acceptance and accommodation:

The analysis of managerial control and workers' responses to it in the firms studied showed that the workers were inclined to accept managerial control over the labour process. Even though at times they modified aspects of some of the control strategies used by managers, they did not question the legitimacy of the control function itself. This was also true of the tactics used by workers to restrict or threaten managerial control when they were negotiating new agreements with the management. These tactics ranged, in the firms considered, from restriction of production, restriction of supervision, sabotage to striking in critical areas and collective strikes. Even though it was not possible within the confines of this study to go into the details of the non-workplace responses of workers to control within the factory, some observations were nonetheless made about such responses. For example, the non-workplace activities of some workers could be seen as an internalisation of the values of capitalist production to the extent that they attempted to become small scale capitalists themselves. In the case of some other workers, moonlighting could only be seen as an extension of their exploitation in the capitalist labour process.

On the whole, workers responses to managerial control in the firms studied could be seen within a framework of acceptance and accommodation. However, from this it cannot be concluded that there existed a harmony of interests between the employers and the workers. But it could be concluded, in a limited way, that the assumption of the recalcitrance of workers in the capitalist labour process was falacious. This does not mean that workers do not make small challenges to managerial authority in the firms from time to time. The point, however, is that in such an assumption, a class-consciousness is attributed to the workers at all times. No attempt is made to demonstrate the links between the formation of the consciousness of the workers and the

contradictions of not only capitalist production but also of other specific contradictions of capitalist society (in this context, see Mann, 1973).

A study such as this one, could not hope to answer all the questions related to the capitalist labour process in the Indian context, let alone industrial labour processes in general. However, the implications of the findings of this study for analysing the labour process, as well as its shortcomings are now discussed.

2. IMPLICATIONS FOR LABOUR PROCESS STUDIES

In terms of the studies of industrial labour processes under capitalism, this study has drawn attention to three major problem areas. First, it has pointed to the inadequate conceptualisation of technology, technical change and their relationship to the organisation of work in the existing studies. Second, it has pointed to the need to bring together the insights offered by both the Marxists and non-Marxist theorists whose work has a bearing on the analysis of the labour process. And third, it has pointed to the need to conceptualise the links between managerial control and non-workplace factors.

By pointing out that there could be no universal definitions of technology; and that technology and technical change had to be defined in relation to the workers and specific production processes, this study emphasises the need for micro-level studies. The primary implication of this is that there cannot be a single homogeneous picture of the industrial labour processes under capitalism. The concept of technical change used in this study has been limited to only those production processes that involve changes of either "measurement" or of both "measurement" and "order". This scheme of analysing technical change may not be valid for those production processes that only involve

changes of "order"; e.g. some chemical processes. Similarly, only limited comparisons can be made of skills required across different industrial sectors (see also Cutler, 1978). Thus, unless micro-level studies of labour processes in different industrial sectors are carried out, it would be methodologically unsound to posit general trends about technology and its relationship to skill levels within the capitalist labour processes.

It is for the theoretical reasons mentioned above that generalised conclusions about the labour process in Indian industry, based on this study, are bound to be severely limited. Though some conclusions about managerial control over the labour process, industrial relations, etc. may be drawn on the basis of sectoral studies, conclusions about the type of technology in use, changes in technology or the skill levels of workers for the whole of Indian industry cannot be drawn from any sectoral study because methodologically such conclusions would be quite meaningless.

This study has also drawn attention to the work of Bell and Foucault; and the importance of their contributions to labour process studies. The methodology of Bell for studying the relationship between technical change and skills of workers; and of Foucault for studying the functioning of managerial control have not been attempted before in labour process studies. Yet, as this study has shown, they provide invaluable insights into the organisation and control of the labour processes under capitalism. In this context, the work of Foucault seems to be of particular importance in understanding the functioning of managerial control over the labour process.

Finally, this study also drew attention to the role of non-workplace factors in aiding managerial control over the labour process. These factors have been largely ignored in earlier studies of the labour process.

Given the scope of this study, the treatment of these factors has been mainly descriptive. In this context, there are two important areas that require a deeper theoretical analysis than already exists: First, the disciplinary and other influences of institutions such as the family, school, religious and regional communities, etc. on workers and their attitude to the labour process under capitalism; and second, the links of the State with industry and the different forms these links can take. In the former case, the contribution of theorists like Foucault is likely to be seminal. However, the insights offered by Foucault's work are likely to be limited unless they can be theoretically integrated with social-anthropological aspects of different situations under which the influences of some of the relevant non-workplace factors on the organisation and control of the labour process are being studied. In the latter case, the nature of the State under capitalism needs to be theorised in terms of the various forms it can take and the historical determinants of the form and content of its actions which influence the labour process directly or indirectly.

Besides the lack of theorising in the above mentioned areas, this study has also suffered from two more shortcomings. The first refers to the lack of an adequate theory of the firm and the second, the lack of availability of historical data. The former relates not only to how firms calculate, but also to the very definition of a firm. At a very basic level, for example, it might be asked that when a productive unit is inextricably linked to a series of other small units through sub-contracting and component supplying relationships, then in such a case how the boundaries of a firm to be delineated? As the work of theorists like Friedman (1977) shows, instead of recognising the need for a theory of the firm, the attempt has been to adopt the existing behaviouralist theories of the firm into a Marxist framework without much justification.

At an empirical level, in this study there was a lack of sufficient historical data about the development of the labour process. To be able to delineate any tendencies either in the type of technology in use, changes in technology or changes in the skill requirements of workers, information about these aspects of the labour process is needed over a sufficiently long period of time in a set of consistent categories of analysis. Unfortunately, in this case such information had neither been collected by the firms nor by the unions. Most firms and trade unions in India did not have a tradition of maintaining archives of their records. The study of the history of technical change, skill levels, managerial decisions, etc., therefore, was necessarily limited by the information available.

In spite of the limitations mentioned above, as this study has shown, it is nonetheless possible to use the insights offered by both the Marxist and non-Marxist theorists in a methodologically consistent manner to study of labour processes under capitalism. But these studies would have to be limited to particular industrial sectors and cannot be used as a basis for generalisations about capitalist labour processes in general because of methodological limitations.

APPENDIX I

MASTER-GUIDE OF JOB SCORES

JOB SCORES: MASTER GUIDE

The following convention has been adopted in scoring the jobs on their various characteristics.
In most cases it is the same (in terms of the methods used) as the scoring technique of Blackburn and Mann (1979).
All the scores are in the range 1-5. Some scores have no values of 2 or 4.

	1	2	3	4	5
1. Exposure (Frequency of the time outside would slightly raise the score)	Indoors	Fairly well sheltered	Moderate shelter, e.g. exposed shelter, e.g. pickling jobs in wire-mills	Mixed indoors and outdoors, with normal possibility of sheltering	Often forcibly exposed
2. Either fumes or dirt or excessive heat Count the highest of the three, except where two of the three would score 4 - then score 5. If the highest score is marginal then choose lower one of the marginals. Rapid changes, e.g. in heat, increase score	Consistently normal all the time	Occasionally high (up to 25% of the time; or always medium)	Consistently fairly high or high 25-50% of the time	High, 50-90% or always fairly high	Consistently high, 90%
3. Noise	Ditto	Ditto	Ditto, i.e. difficult but possible for me to talk	Ditto; shouting necessary by me	Ditto; impossible for me to talk or understand

	1	2	3	4	5
4. Danger (2 and 4 are blank)	Normal, e.g. most jobs		Dangerous, e.g. shearing and punching jobs		Very dangerous, e.g. pickling jobs
5. Quantity of physical effort Compensate weights and degree of body movements, taking especial note of higher factor	Low, e.g. m/c watching, sitting	Fairly low: walking or standing about, moving light weights	Medium exercise and weights, e.g. lifting medium weights (5-15 kg). Considerable walking	High activity, e.g. stretching with medium weights (5-15 kg)	High whole body exertion, e.g. lifting and moving weights of 20 kg+. Heavy labouring, e.g. manual sheet metal work
6. Pace of physical effort	Easy pace, no pressure, e.g. m/c watching, rare action.	Fairly easy	Medium pace	Fairly intensive pace and effort	Continuous effort
7. Manual dexterity Physical + hand-eye coordination	Intermittent simple movement, e.g. spot checkers	Continuous simple manipulation; or between 1 and 3, e.g. rotor packers	Manual movements of fair precision. Complicated sequential coordination of mind, eye and limb	Manual movements of high precision or great variety of movement; or between 3 and 5. Fitters. Insulation cutters using manual methods of measurement and cutting	Simultaneous co-ordination of mind, eye and limbs, e.g. die-casting

	1	2	3	4	5
8. Visualising shapes and relationships, processing consequences of process	Low	Fairly low	Medium, e.g. overhead crane operators, some assemblers	Good working grasp of complex machinery, e.g. lathe operators	High, e.g. Testers, Spot checkers
9. Concentration	Low	Fairly low or intermittent	Medium, e.g. stator winders, connectors	Fairly high, e.g. precision work on the lathe	High: mind absorbing
10. Mathematical calculations (no 2 or 4)	None		Addition, subtraction, measuring diameters heights		Areas, volumes, pressures, complex calculations
11. Reading, writing and understanding English/Hindi	Minimal understanding - neither reading nor writing	Some understanding, minimal reading, no writing	Moderate reading: fairly repetitive but detailed instructions. Minimal writing: simple recording in categories	Write short structured reports or read varied reports and instructions	Complete ability e.g. reading and writing letters
12. Reading technical drawings. (no 2 or 4)	None; e.g. crane operators, blow-hole fillers, wire-drawing		Intermittently. Simple blue prints, circuits		Regular reading of blue prints, circuits, e.g. some shapers, spot checkers
13. Memory for rules, routines, procedures	Low, e.g. simple response to machine paced work	Fairly low, e.g. some helpers	Medium, e.g. connectors, wiremen	Fairly high	High, e.g. testers.

	1	2	3	4	5
14. Complexity of decision making (i.e. mental demands)	Low: simple choice between few specified alternatives, e.g. manual material transfer workers	Fairly low: simple choice between many specified alternatives. High tolerance of error. Simple use of judgement for specific objectives	Medium: simple static choice between many variables. Low or medium tolerance of error; e.g. connectors	Fairly high: feedback effects for further decisions. Medium error tolerance (i.e. important but little pressure), e.g. charge-hands, maintenance workers	High: continuous reassessment of variables interacting, low tolerance of error (i.e. some pressure), e.g. skilled machinists
15. Learning period before normal performance, i.e. training may be as previous job if specific	-1 week	1-4 weeks	1-3 months	3-6 months	Longer
16. Autonomy of decision making (autonomy in tasks more important than in methods)	Low: entirely determined	Fairly low: peripheral method decisions, or between 1 and 3	Medium: routines laid down. Standard decisions made within routine or central methods, many alternatives standardised but varied feedback	Fairly high: general problem laid down and worker translates this into operations, making central decisions in the process. Method has feedback, e.g. chargehands	High: worker determines task or problem

	1	2	3	4	5
17. Pace choice Includes both proportion of time and tightness of schedule	Mechanically or system determined at least 90% of time to rigid time schedule, e.g. wire drawing, long line assembly jobs, moulding jobs in plastic shops	Largely mechanically or system determined with a little schedule flexibility, e.g. machine operators	Mechanically or system determined 40-60% of the time, or manually determined with moderate flexibility, e.g. painters, connectors	Own pace most of the time, e.g. spot checkers	Can set own pace at least 90% of time, e.g. chargehands
18. Supervision (absence of)	Constantly observed or frequently inspected, e.g. long line assembly	Supervision constantly around, frequently observes, sometimes inspects	Supervision frequently around and never far away, occasionally observes, e.g. material handlers	Supervision normally some distance away but on site. Left to get on with job but regularly visits, e.g. chargehand	90% unsupervised
19. Optional interaction with other people	Impossible: worker must concentrate on own job	Discussion possible but difficult, e.g. noise or distance is barrier	Normal discussion with few possible	Normal discussion possible with many in area, i.e. limited movement	More freedom of movement to talk over wider area
20. Promotion time Shortest length of time between entering present employment and arriving at present job	None: immediate entry from outside normally possible	-6 months	6 months - 3 years	3-10 years	10+ years

	1	2	3	4	5
21. Future promotion chances (my estimate of it amongst the present group of workers occupying the job)	Negligible. 1 in 10 or more and more than 10 years	Poor. (a) 1 in 10 or more and less than 10 years. (b) 1 in 5-10 and more than 3 years. (c) 1 in 2-5 and more than 10 years	Medium. (a) 1 in 5-10 and less than 3 years. (b) 1 in 2-5 and 1-10 years. (c) Better than even and more than 3 years. (d) Near certainty and more than 10 years.	Good. (a) 1 in 2-5 and less than 1 year. (b) Better than even and less than 3 years. (c) Near certainty and 1-10 years.	Very Good. Near certainty and less than 1 year.
22. Position up pay-status hierarchy of the jobs 1 = lowest 5 = highest	All the jobs of the workers in a firm were divided into five hierarchical strata based upon the total monthly wages including various benefits (e.g. Dearness allowance) but not including overtime payments as they were only occasional payments. Index-linked benefits were averaged out for the three months previous to conducting this study.				
23. Proportion of next grade to this one promoted from outside (2 and 4 are blank)	Normally recruited from below		Mixture		Normally recruited from outside
24. Required interaction with other workers	Normally works independently of others except for receiving inputs and giving outputs	Work-flow close contact only, sequencial dependence, e.g. assembly line.	Intermittant team work with other(s)	Normal teamwork with one other or frequently with others	Normal teamwork with others

	1	2	3	4	5
25. Work cycle length. Variation within cycle, and determinacy of cycle	Well-defined short cycles (-5 mins); or medium (5-15 mins) cycle but repetitive within cycle; or normally inactive with short or medium action cycles	Well-defined medium or fairly long (15-60 mins) but repetitive within. Or fairly short, ill-defined cycles. Or normally inactive with fairly long action cycles	Well-defined fairly long; or long but lightly repetitive within cycle; or medium ill-defined. well-defined long (60 mins+) or fairly long ill-defined.	Sequence of cycles largely indeterminate but within cycles some repetition	Sequence and content of cycles indeterminate
26. Object-variety Types of parts, tools and controls and dial, to be learned	1-4	5-12	13-28	29-60	60+
27. Responsibility for men, materials and machines (probably not a scale as relationship between 3 and 4 uncertain)	Negligible, e.g. most manual material transfer workers	Small responsibility which could be emphasised by the worker	Responsibility for large and expensive equipment and goods; e.g. chargehand.	Some responsibility for human life, e.g. overhead crane operators	High responsibility for human life
28. Irregularity of working hours	Days	Other fixed hours	Regular rotating shifts with regular weekends	Irregular rotation	Wholly variable hours

APPENDIX II

CONSTRUCTION OF FACTORS TO MEASURE JOB-CHARACTERISTICS

Data reduction by constructing factors for further analysis

Variables	Factors			
	1. Working conditions			
	Loadings	Scores		
Exposure	.26	.07		
Fumes, dirt, heat	.29	.08		
Noise	.31	.10		
Danger	.77	.60		
	2. Physical effort			
	Loadings	Scores		
Effort: Quantity	.58	.33		
Effort: Pace	.58	.33		
	3. Conceptual abilities		4. Executional abilities	
	Loadings	Scores	Loadings	Scores
Manual dexterity	.06	.21	.61	.62
Visualisation	.18	.35	.67	.72
Concentration	-.10	.10	.81	.78
Math. calculations	.58	.62	.14	.28
Reading, writing	.57	.58	.03	.17
Reading techl. drawings	.67	.69	.08	.25
Memory	.60	.54	-.24	-.09
Complexity of decisions	.65	.69	.15	.31
Learning period	.66	.66	.01	.19

The correlation between factors 3 and 4 was .25.

	5. Autonomy	
	Loadings	Scores
Autonomy of decisions	.82	.67
Pace choice	.62	.39
Supervision: absence of	.03	.001
Optional interaction	.69	.47

Variables	Factors	
	6. Promotion Opportunities	
	Loadings	Scores
Promotion chances	.44	.19
Promotion from outside	-.44	.19
	7. Position in hierarchy	
	Loadings	Scores
Promotion time	.73	.54
Pay status	.73	.54

APPENDIX III

TECHNOLOGICAL STRUCTURE OF THE WORKSHOPS STUDIED

FIRM: A

WORKSHOP: Motor Assembly

Notes: *thermostatic feedback **hydraulic press used +spray guns used

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Overhead crane	-	M	P	M	-	Transport manual before 1971-72	-	-	Manual	-
2. Coil insertion	P/M	P	M	P	P	-	M	-	M	-
3. Connections	P	-	M	-	P	-	M	-	M	-
4. Varnishing	P	P	P	P	P	-	P	-	P/M*	-
5. Drilling/ Compensating	P	M	M	M	P	-	P	-	M	-
6. Bearing fitting	P	M	M	M	P	-	M	-	M	-
7. Balancing	P	P	M	P	P	-	P	-	M	-
8. Coil winding	M	M	M	M	M	-	P	-	M	-
9. Insulation cutting	M	M	M	M	M	-	P	-	M	-
10. Stator assembly	P	P	M	P	P	-	P/M**	-	M	-
11. Rotor assembly	P	P	M	P	P	-	P/M**	-	M	-
12. Terminal block fitting	P	P	M	P	P	-	M	-	M	-
13. Full assembly	P	P	M	P	P	-	M	-	M	-
14. Punching	M	M	M	M	M	-	M	-	M	-
15. Painting	P	P	M	P	P	-	P/M+	-	M	-
16. Packing	P	P	M	-	P	-	M	-	M	-

3 Helpers
1 Chargehand
2 Spot checkers

FIRM: A

WORKSHOP: Machine Shop

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Overhead crane	-	M	P	M	-	Transport manual before 1971-72	-	-	M	-
2. Drilling	P	P/M	M	P/M	P	-	P	-	M	-
3. Shaping	P	P/M	M	P/M	P	-	P		M	-
4. Milling	M	M	M	M	M	-	P		M	-
5. Turning	M	M	M	M	M	-	P		M	-
6. Facing the stator	P	P/M	M	P/M	P	-	P		M	-
7. Stator boring (1st operation)	P	P/M	M	P/M	P	-	P		M	-
8. Stator boring (2nd operation)	P	P/M	M	P/M	P	-	P		M	-
9. Facing	M	M	M	M	M	-	P		M	-
10. Centring	M	M	M	M	M	-	P		M	-
11. Threading	M	M	M	M	M	-	P		M	-
12. Grinding	P	P	P/M	P	P	-	P		M	-
(1 Spot checker)										

FIRM: B

WORKSHOP: Assembly shop

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Pre-assembly	M	M	M	M	M	-	M	-	M	-
2. Manufacturing bus bars	M	M	M	M	M	-	M	-	M	-
3. Terminal block mounting and internal mounting	M	M	M	M	M	-	M	-	M	-
4. PVC channel mounting	M	M	M	M	M	-	M	-	M	-
5. Laying of wires	M	M	M	M	M	-	M	-	M	-
6. Panel assembly	M	M	M	M	M	-	M	-	M	-
7. Helper (transport)	M	M	M	M	M	-	-	-	M	-

FIRM: B

WORKSHOP: Fabrication shop

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Sheet metal work	M	M	M	M	M	-	M	-	M	-
2. Piercing	M	M	M	M	M	-	P	special purpose tools	M	-
3. Shearing/Nibbling	M	M	M	M	M	-	P	introduced in 1978	M	-
4. Drilling	M	M	M	M	M	-	P	-	M	-
5. Welding	M	M	M	M	M	-	P	-	M	-
6. Straightening	M	M	M	M	M	-	M	-	M	-

FIRM: C

WORKSHOP: Assembly Shop

P = Power, M = Manual, P/M = combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Wiring	M	M	M	M	M	-	M	-	M	-
2. Control cabinet assembly	M	M	M	M	M	-	M	-	M	-
3. Moving contact assembly	M	M	M	M	M	-	M	-	M	-
4. Fixed contact assembly	M	M	M	M	M	-	M	-	M	-
5. Relay assembly	M	M	M	M	M	-	M	-	M	-
6. Arc-chamber assembly	P	M	M	M	P	-	M	-	M	-
7. Tube bending	M	M	M	M	M	-	M	-	M	-
8. Micro-chamber assembly	M	M	M	M	M	-	M	-	M	-
1 Group leader 1 Helper										

FIRM: C

WORKSHOP: Fabrication Shop

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Shearing	P	M	M	M	P	Overhead crane introduced in 1975	P	-	M	-
2. Blanking	P	M	M	M	P		P	-	M	-
3. Punching	P/M	M	M	M	P/M		P	-	M	-
4. Straightening	M	M	M	M	M	"	P	-	M	-
5. Drilling/tapping	P/M	M	M	M	P/M	"	P	-	M	-
6. Notching	P/M	M	M	M	P/M	"	P	-	M	-
7. Hydraulic press	P	M	M	M	P	"	P	-	M	-
8. Resistance welding	M	M	M	M	M	"	P	-	M	-
9. Arc welding	P	M	M	M	P	"	P	-	M	-
10. X-ray welding	P	M	M	M	P	"	P	-	M	-
11. Gas welding	P	M	M	M	P	"				
12. Helper (transport)	P	P	M	P	P	"	P	-	M	-
1 Setter 2 Group leaders										

FIRM: D

WORKSHOP: Motor Assembly Shop

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Assembler	P	P	M	P	P	-	M	-	M	-
2. Painting	P	P	M	P	P	-	P/M+	-	M	-
3. Rotor and stator assembly	P	P	M	P	P	-	P/M*	-	M	-
4. Testing	P	P	M	P	P	-	-	-	M	-
5. Terminal block fitting	P	P/M	M	P	P	-	M	-	M	-
6. Coil insertion	P/M	P	M	P	P	-	M	-	M	-
7. Connections	P	M	M	M	P	-	M	-	M	-
8. Coil winding	M	M	M	M	M	-	P	-	M	-
9. Varnishing	P	P	P	P	P	-	P	-	P/M**	-
10. Insulation cutting	M	M	M	M	M	-	M	-	M	-
11. Insulation folding	M	M	M	M	M	-	M	-	M	-
12. Winding and connections	P	M	M	M	P	-	M	-	M	-
1 Helper 1 Group leader										

Notes: +Spray gun used
*Hydraulic press used
**Thermostatic feedback

FIRM: D

WORKSHOP: Press Shop (Motor Plant)

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Welding, brazing	P	P	M	P	P	-	P	-	M	-
2. Rotor packeting	P	M	M	M	P	-	M	-	M	-
3. Shearing	P	M	M	M	M	P	P	-	M	-
4. Notching	P	M	M	M	P	-	P	-	P/M	-
5. Blanking	P	M	M	M	P	-	P	-	M	-
6. Separation	P	M	M	M	P	-	P	-	M	-
7. Deburring	P	-	M	-	P	-	M	-	M	-
8. Die-casting	P	P	-	P	P	-	P	-	P/M	-
9. Stator packeting	P	M	M	M	P	-	M	-	M	-
1 Group leader 1 Helper										

FIRM: D

WORKSHOP: Plastics Shop (Switchgear Plant)

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Deburring	M	M	M	M	M	-	M	-	M	-
2. Compression moulding	M	M	M	M	M	-	P	New dies introduced	M	-
3. Transfer moulding	M	M	M	M	M	-	P	"	M	-
4. Sand shot blasting	M	M	M	M	M	-	P	-	M	-
5. Socket framing	M	M	M	M	M	-	?	-	M	-
6. Grinding	M	M	M	M	M	-	P	-	M	-
7. Facing and drilling (1 Helper)	M	M	M	M	M	-	P	-	M	-

FIRM: D

WORKSHOP: Assembly Shop (Switchgear Plant)

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Sticking labels	M	M	M	M	M *	-	M	-	M	-
2. Fixing lugs, springs, etc.	M	M	M	M	M	-	M	-	M	-
3. Coil fitting	M	M	M	M	M	-	M	-	M	-
4. Washer fitting	M	M	M	M	M	-	M	-	M	-
5. Air pressure tightening of screws	M	M	M	M	M	-	P	-	M	-
6. Bridge plate tightening	M	M	M	M	M	-	P	-	M	-
7. Angle fitting	M	M	M	M	M	-	M	-	M	-
8. Slider fitting	M	M	M	M	M	-	M	-	M	-
9. Tightening of screws	M	M	M	M	M	-	P	-	M	-
10. Fixed contact fitting	M	M	M	M	M	-	P	-	M	-
11. Moving contact fitting	M	M	M	M	M	-	M	-	M	-
12. Mechanical testing	M	M	M	M	M	-	-	-	M	-
13. Electrical testing	M	M	M	M	M	-	-	-	P/M	-
14. Repairs	M	M	M	M	M	-	M	-	M	-
15. Packing (1 Group leader)	M	M	M	M	M	-	M	-	M	-

Notes: *Brass channels provided.

FIRM: E

WORKSHOP: Wire Drawing Shop

P = Power, M = Manual, P/M = Combination of "power" and "manual"

Machine/Job/ Work-station	Material transfer process (A)					Changes in (A)	Material transformation process (B)	Changes in (B)	Control system (C)	Changes in (C)
	Transport to	Load	Manipulate	Unload	Transport from					
1. Pickling	P	P	P	P	P	-	Chemical	-	M	-
2. Wire drawing	M	M	M	M	M	-	P	-	M	-
3. Flating mill	P	m	M	M	P	-	P	-	M	-
4. Shaving m/c	P	M	M	M	M	-	P	-	M	-
5. Annealing	M	M	M	M	M	-	P	-	P*	-
4 Helpers 1 Spot checker										

Notes *Thermostatic feedback used.

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