THE WORK SITUATION AND CLASS POSITION OF BRAZILIAN ENGINEERS

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This thesis analyses the work situation and class position of Brazilian engineers through a Marxist perspective. The research is based on two case studies, one focused on a large German steel company based in Brazil and the other on a large Brazilian energy corporation. The fieldwork involved 114 interviews, with engineers from different hierarchical positions in these two companies. Data was also gathered through interviews with representatives from the companies, the Council of Engineering, the Engineering Education System and the engineers' Trade Unions. The findings show that the engineering profession in Brazil has shifted from its initial condition as a liberal profession to an organizational profession, with the country's industrial development. Both companies consider all salaried professionals as employees, including managers. Hence they are subject to the companies general personnel policies. The multinational company controls labour more rigidly than the national company, as well as reserving its top positions for its home country's executives. Although no deskilling process was found, engineers of both companies performed simple work, which required less engineering knowledge than they had learned from school. Engineers have little autonomy, authority and participation in decision making and are subject to direct supervision, performance evaluation, time control, overtime work, productivity and to poor working conditions in the multinational company. The majority of the engineers supervised other workers without being in a managerial position. They found that to move into management, was a good way to improve their autonomy, authority, prestige, salary, status, power and professional pride. Despite ideological divisions between capital and labour, most of the engineers were unionised and saw unions as the right way to deal with the employer. Unionisation and militancy among engineers was highly affected by the engineers ideological position, management control and union politics. The engineers' work situation differed significantly from that of the traditional working class, and the majority of them considered themselves "middle class". These work situation and class position of Brazilian engineers were similar to those of engineers in developed nations. The general conclusion is that the engineers in the sample can be regarded part of the "new middle class" as argued by Poulantzas, Carchedi and Wright.

KEY WORDS: TECHNICAL WORKERS, MANAGEMENT CONTROL, PROFESSIONALISM, TRADE UNIONISM, MULTINATIONALS.

I dedicate this thesis to all Brazilian engineers who, from their different places in the social relations of production, have helped to develop our country, and to the thousands of students whose dream it is to become an engineer in the future.

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1. INTRODUCTION

The progressive decline of traditional industry and the growing importance of so called "science-based" industries, has been the focus of attention of many social scientists, futurologists, economists and other thinkers. Much of the literature concerned with this theme has focused on the implications for social values, collective action and the class position of engineers and technicians. This group has grown with the application of science and technology to products and production, with the development of scientific management and the increasing complexity of new industry, commerce and, state apparatuses. Most of the authors of this literature, anticipate a growing resistance by technical workers to their traditional role in industry; some foresee new challenges to the legitimacy of bureaucratic authority due to the technical workers expertise; some see technical workers in a continuous process of proletarianisation within this reality, whilst others argue that they are becoming a "new petty bourgeoisie", characterised by its technical expertise and standard of living.

Sociologists have spoken about technical workers in quite broad bands of professionals, knowledge workers, experts, and technologists. However, there is a big overlap in the sets of occupations mentioned as characteristic of what Bell (1973) calls the "professional class", what Mallet (1975) and Gorz (1967) call the "new working class", Poulantzas (1975) the "new petty bourgeoisie", Carchedi (1977) the "new middle class" and Ehrenreichs (1977), the "professional managerial class". There is also a large overlap centring on the "technical employee" in all sorts of industries.

Among the few empirical studies related to the above theses we find those of Whalley (1986), Zussman (1985) and Crawford (1989) which focus on the engineering occupation to analyze changes in the work, class position, ideology and politics of technical workers in advanced societies.

Engineers seem to be a useful choice for investigating the "New Class" thesis in developed and developing capitalist societies, because as workers whose primary task is to mediate between science and production, they are sensitive to significant technological development.

The focus on engineers is also pertinent because they are one of the most important representatives of salaried professionals in capitalist society. As Meiksins (1989:2) has shown, in contrast to medicine, engineering has been concentrated within capitalist organisation for almost a century. Engineers are typically employed by profit-making corporations, which are often seen as the least hospitable environment for a professional practice, as argued by the professionalisation thesis (see chapter 2).

Kelly and Glover (1987a) have also argued, that human history is inextricably bound up with that of engineering, when defined as the making of tools and other contrivances as aids and adjuncts to life. For them, from the Stone Bronze to the Steam, Jet, Atomic and Computer ages, technical-engineering-achievements have helped to define and delimit the progress of human society. Moreover, engineers and those whose principal activity is tinkering with things technical, have played a crucial role in the historical transition from a predominantly agricultural to a predominantly industrial society. Finally, technical changes have occurred mainly because of the effort to save money, which is a typical characteristic of capitalism, and due to the more general ideology of increasing the human comfort. The engineer's and craftsman's role in this process, has been absolutely critical and central (Kelly and Glover, 1987a:6-9).

All of these arguments actually relate to the history of Brazilian society. The Brazilian economy is the eighth largest in the world and it is currently in a phase which requires modernisation and development in all of its sectors. Within this context, Brazilian engineers are important because their scientific and technical knowledge are essential for the modernization of industry, which has been seen as one of the most important sectors to promote economic development(see chapter 3). Moreover, the experience of East Asian countries has shown that technical knowledge and skills are now the key variable to increase productivity, which in turn affects economic growth (World Bank 1991:4-6; Amsden 1990; Becker 1964; Schultz 1961). So, the study of engineers, as the typical technical professional of industrial societies, is essential for Brazil, which has struggled for many years to shift from an agricultural to an industrial economy.

In addition, recent studies of American (Zussman), British (Whalley) and French (Crawford) engineers, have shown the importance of **comparative** analysis of industrialised societies. All of them argue that the engineers involved in their research, are positioned within the middle-class. Thus, the study of Brazilian engineers allows us to make further comparative analysis, between the work situation and class position of engineers in developing capitalist societies, and those in advanced stages of development.

Therefore, while Whalley (1986:15) has argued that "nowhere is the shortage of research on technical work more acute than in Britain", I contend that in Brazil and in the rest of the developing industrial societies, research is almost completely absent. In Brazil, most of the recent literature in business administration, organisational psychology and industrial sociology, has been imported, and follows mainly the American managerialist ideology. As such, it covers issues related mainly with the function of management, and to a lesser extent, issues related to the technical and the non-technical labour force. The few studies that have been conducted on technical labour in Brazil, are related to the impact of careers structures on Research & Development engineer's behaviour and why professionals orientate their careers to management (Marques, 1989; Albuquerque 1982; Fatini 1981), and on engineer,s ideology in relation to technological development (Kawamura 1979, 1985).

A recent study by Simoes (1989), has approached the question of the class position and class politics of Brazilian engineers, but within an analysis which covers only the point of view of the engineers, and their class associations, without looking at their social relations inside the business enterprise. Her analysis was based on a random sample of 403 engineers, stratified by sex, year of graduation and engineering area, and drawn from the population of engineers in the Rio de Janeiro district. Following Wright's (1985) methodology of class analysis she concluded that "engineers do not occupy the same class location, but belong to different classes" (p.226). They are to be found in the capitalist class and in the middle class or in what Wright calls "contradictory class locations" (as managers, supervisors, and non-managers). Simoes (1989:227), the majority of those who are found in these "contradictory class locations" are salaried workers, part of the collective worker but, at the same time, performing the capital functions of control and supervision. Thus, Simoes' conclusion suggests, like in Wright's view, that salaried engineers can be regarded part of the "new middle class".

The lack of research on technical labour in Brazil suggests that most Brazilian sociologists do not see engineers class position as problematic. This position is reinforced by the fact that in the eyes of society, Brazilian engineers are professionals who have gained and enjoy significant advantages over a large proportion of the waged population, and thus could be identified as typically "new-middle class". Despite unemployment, labour market decline, job insecurity, a decline in salaries, and the loss of some advantages for engineers, many middle class and working class families still believe that sending their son/daughter to obtain a diploma in engineering, is a good way to guarantee a better class position and standard of living in the future. Nonetheless, little is known about the market situation and working conditions of engineers in Brazil, and further analysis is needed. The contribution of this thesis is that, until its completion no other social scientist will have studied the work situation and class position of Brazilian engineers from an analysis starting from the social relations of production.

In fact, not only in Brazil, but also within developed societies generally, little is known about how technical work is organised, how the technical job market is structured and still less about technical employee's perception of their role in the workplace, their class position in capitalist society, and their class politics.

The interest and research in engineers is a relatively new development, and consequently, publications in this area of knowledge are few and all recent. Only three recent empirical studies approach comparatively the work situation, careers, values, politics and class position of technical workers in advanced capitalist societies: Whalley's (1986) study of British engineers, Zussman's (1985) work on American engineers, and Crawford (1989) treatment of French engineers. Smith (1987) has also studied the work situation, unionisation and class position of British technical workers in a aerospace company, but not in comparative perspective. Boltanski (1987) has studied the formation and socio-political representation of technical managers, **les cadres** - in France; Gispen (1990) and Millard (1988) have studied respectively, the history and politics of professionalism of German and Canadian engineers

(Cf. Smith, 1990a). Finally, Glover and Kelly (1987) have studied the education and training system, collective representation, careers structures, and the place of British engineers in the managerial hierarchy.

This thesis builds upon and extends the important work of these writers, mainly those of Whalley, Zussman, Crawford and Smith. It analyses the work situation and class position of Brazilian engineers. In terms of work situation, it focuses on the location of engineers in the labour process, their relationship with managers and manual workers, and how they experience the strategies of integration and control used by management to direct their labour to profitable results. In terms of class position, I will analyze the place capitalists locate engineers within the capitalist social system through the economic, political and ideological apparatuses used to produce, employ and reproduce this labour force; and determine how engineers position themselves in the class structure as a result of their absorbtion of capitalist values. I will also analyze engineers' professional associations, unionisation and class politics. In short, I will be answering three general questions: 1) How are engineers produced, used and reproduced in developing capitalist society?; 2) How does the capitalist firm manage technical labour?; 3) What are the consequences of these two forces on the work situation and class position of Brazilian engineers.

The research base is drawn from a sample composed of 114 engineers in technical and managerial positions. They are drawn from two large corporations, one national and one multinational, operating in the State of Minas Gerais, South Eastern Brazil. The Multinational company was included for two basic reasons. Firstly, Brazilian industrialization and economic development has been heavily based on foreign capital and foreign companies. Secondly, it has been assumed that subsidiaries of multinationals tend to adopt the policies and strategies designed by headquarters management. This is likely to distort the host country's economic, political and labour relations (see chapter 4). Thus, due to the multinationals' importance and influence in the Brazilian economy and society, an analysis of the work situation and class position of engineers working in national and a multinational company is necessary to examine similarities and differences in these two settings.

This research aims to contribute to a systematic social analysis of engineers in Brazilian society, and a clarification of the class identity and class relations of Brazilian engineers. It also contributes, hopefully, to future comparative analysis between advanced and developing capitalist societies, and adds to our increasing knowledge on technical labour in capitalist society.

The thesis has 12 Chapters. Chapter 2 reviews the main literature on the class position of technical labour. Chapter 3 provides both a background to the discussion of the work situation of engineers in Brazilian industry, and also supports some assertions made concerning the positioning of engineers within the "middle class" of capitalist societies. It starts with an examination of the current approaches towards capitalist development in the Third World, and then focuses on an account of industrialisation in Brazil and the impact this has had upon employment. Special emphasis is given to the issue of engineer employment in Brazilian industry. This chapter also includes an account of the interrelationship between class interests, alliances and industrial development. By showing that engineers form a very significant segment of technical workers in Brazilian industry, the chapter concludes by highlighting the importance of studying their case.

Chapter 4 establishes the research design and the procedures for data analysis. It defines the sample composition, and the basic strategies for data collection at the company level, at the engineers level, the State level, and the professional institutional level. Special focus is given to the reasons why a comparative study, involving national and multinational companies, is necessary. It also discusses the advantages and disadvantages of the case study method for this sort of analysis.

Chapter 5 examines the evolution of the Brazilian education system. Special references is given to the way engineering education has been transformed within Brazil, in order to shift the engineering profession away from its initial condition of a liberal profession, to that of an organizational profession. It also examines the extent to which the educational and social background of engineers involved in this research matches the patterns designed by the Brazilian education and economic systems, to satisfy market needs.

Chapter 6 describes the characteristics of the two companies studied, in terms of their origins, products, environment, technology, organizational structures, management style, and human resource policies. It also shows that to understand the work situation and class position of engineers it is necessary to look at the way employers perceive employees, since this affects the way companies organize their human resource policies and practices, in order to manage, control and to direct their labour force to profitable results.

Chapter 7 examines the way the two companies have organized engineer's work and for what purposes. It also describes the nature of engineers's work and working conditions, such as the work environment, status hierarchy, supervisory relations, technical autonomy and career opportunities associated with the nature of engineers' work in the various areas of the company.

Chapter 8 focuses specifically on how engineers experience the internal labour market of their companies, in terms of professional mobility, career opportunities, promotion, salary equity, security on the job, and their levels of satisfaction with their career. It also examines to what extent the two companies are similar or differ on these issues.

In the light of the theories discussed in Chapter 2, Chapter 9 examines the authority relations between managers and engineers; the legitimation of management by engineers; the degrees of technical authority and professional autonomy enjoyed by engineers and engineers' attitude to business values. Examination is also made of some of the managerial strategies adopted by the two companies, to mediate the predicted conflict between engineers and management.

Chapter 10 examines the place of engineers in the labour process, according to the way it is structured into supervisory and non-supervisory functions. It also analyses the engineer's career orientation, and highlights the advantages and disadvantages the engineers face when moving into a technical or a managerial career. The extent to which the labour process is strategically organized to make engineers the controllers of manual labour within the enterprise is also studied. Finally, it discusses the relationship between the engineers' place in the labour process, their working conditions, and class position.

Chapter 11 approaches the case of unionization and class politics of Brazilian engineers from an analysis which covers not only their organization and politics nationwide, but also brings the engineers' voice to these issues from inside the social relations of production. It starts with an examination of the main theories about "while collar unionism" and professional associations. The focus then shifts to the involvement of engineers with the Council of Engineering and the Engineer's Union. It then looks at the extent to which engineers legitimate the role of these institutions to represent their interests. This chapter also analyses how organizational constraints, ideological formation, political positions, and social and educational background, affect engineers' attitude towards, and involvement with, their professional association and trade union, as well as their attitudes towards the working class movement, and political parties.

The final chapter summarises the main findings of the work situation and class position of Brazilian engineers, and comments on the limitations of the existing theoretical approaches to technical labour in capitalist societies. It also discusses the importance of empirical research starting with the social relations of production in order to better understand the work situation, and class politics in capitalist societies.

2. THEORIES OF CLASS AND TECHNICAL LABOUR

1. Introduction

The explanation for the work situation and class position of professional workers is divided broadly between Weberian and Marxian positions. Thus, the objective of this Chapter is twofold. Firstly, is to review the key arguments of these two positions and; secondly, is to grasp amongst these arguments those more relevant for the analysis of the work situation and class position of Brazilian engineers.

Despite its historical relationship with capitalist development, the issue of technical workers has only received sustained attention from sociologists in the last three decades. Their rapid expansion in the post 2nd World War period, has been part of a general growth of white-collar workers. This has been a universal phenomenon of all advanced and developing societies. The term "technical", embraces graduates, professionally qualified and specialised manual workers. It includes groups engaged in development, design and planning of work, and commodity production. Equally it involves those engaged in maintenance and post production functions (Smith 1987:2).

The development of professions as a result of the growth of white-collar employment, appears to have altered the existing occupational structure of capitalist society, and produced many consequences for the sociology of occupations and for the theories of class. It has also produced other consequences for organization theory in terms of how to manage professionals.

For the purpose of this research, I will concentrate in the main positions over the debate created by the expansion in technical labour. These are: the "professionalisation thesis", the "proletarianisation thesis", the "new working class thesis", the "new middle class thesis" (with its various schools); and the "orthodox perspective" on technical labour.

2. Professionalisation thesis and the legitimacy of the capitalist management

The term **<u>profession</u>** refers to an occupation that typically requires knowledge and highly specialised abilities, acquired mainly through courses of a theoretical nature and proved by exams under the responsibility of Universities and authorized Institutions. The possession of a professional credential, gives its owner considerable authority over his/her clients or customers. This professional authority is guaranteed by a professional code of ethics, which regulates the levels of knowledge, abilities, professional behaviour and professional status (Gold and Kolb, 1964:542). In Brazil, a professional is an individual who has a university degree, for example engineers, and whose profession is recognised by its Professional Association or Professional Council, and by labour Legislation. The engineering profession in Brazil, is controlled at the national level by **CONFEA** - Conselho Federal de Engenharia, Arquitetura e Agronomia (or Federal Council of Engineering, Architecture and Agronomy), and at the regional level, by the **CREAs** - Conselhos Regionais de Engenharia, Arquitetura e Agronomia (or Regional Councils of Engineering, Architecture and Agronomy), which are the regional branches of CONFEA. However, with the development of industrial societies, the meaning of the term **profession** has been extended to include occupations that require some scientific training and knowledge, and a diploma or certificate (usually based on examinations, though not necessarily of university standard), for the exercise of their specific occupational skill. This group of professions are called "minor professions", or "auxiliary professions" (Gold and Kolb, 1964:542). In Brazil, technicians and qualified workers, with secondary level education only, are included in the "minor" or "auxiliary professions" categories.

The term **Professionalisation,** is seen by Parsons (1968) as synonymous with rationalisation. For Larson (1977) it means

> "the process by which producers of special services seek to constitute and control a market for their expertise. Because marketable expertise is a crucial element in the structuring of modern inequality, professionalisation appears also as a collective assertion of special social status and as a collective process of upward mobility....professionalisation is thus an attempt to translate one order of scarce resources - special knowledge and skills - into another - social and economic rewards".
>
> (Larson, 1977 pp.xvi-xvii).

The "professionalisation thesis" is particularly associated with American writers, who have emphasized the importance of occupational categories rather than social classes in stratification theory. In American society, law and medicine have achieved enormous power and prestige, and have become a model for other professions to follow (Hall 1975; Ritzer 1986; Caplow 1954). The basic argument of the "professionalisation thesis", is that professional values and norms differ significantly from those of business enterprises and bureaucratic organizations. Professionals are distinguished not only by the complex and codified character of their knowledge, but also by their exceptional **autonomy** and **authority** in the use of that knowledge. Such autonomy and authority stem in part, from the public's **trust** in professional claims of commitment to client and public welfare, and from the public's confidence in occupational self-regulation (Cf. Crawford 1989).

These alleged differences in professional values and norms, are said to generate "value conflict" and "role strain" for professionals who work in bureaucratic settings. Kornhauser (1965), identifies several such conflicts among scientists in industrial research laboratories, related to the fact that industrial research is shaped and scheduled by company executives who are not scientists and whose goals are profits. Furthermore, the reward for faithfully serving the bureaucracy is promotion to managerial posts, but mobility to management is of little interest to professionals for whom success involves broader recognition within their occupation. Nevertheless, other researchers have shown no conflict between professional and organizational values. Goldner and Ritti (1967:491) argue that "engineers generally enter industry with non-professional goals... are oriented towards entrance into positions of power and participation in the organization rather than simply practising their original specialities... and strongly identify with the organization and its goals". Noble (1977) also found in his study of the career-patterns of American engineers, that within fifteen years of graduating from college, about two thirds of the engineers who graduated from 1884 to 1924, had become managers. Such mobility into management represented **professional success** in the eyes of engineers. Contrary to the predictions of the professionalisation thesis, engineers' notions of professionalism "embraced corporate positions as the mark of status within the engineering profession" (Noble, 1977:41). Torstendahl (1982) also argues that industrial engineers emerge as both "professional men" and "new bureaucrats", and that professionalisation and bureaucratization does not in any obvious way prevent each other's development. Perucci and Gerstl (1969) emphasized the lack of professional community among engineers, and the relative absence of major conflict between organizational and professional norms concerning autonomy.

Theorists of the post-industrial society have also reinforced the ideology of professionalism and highlighted the growing technical authority of professionals as knowledged-based workers for all spheres of society. Their expertise and professional values are expected to create some problems for the legitimacy of capitalist management (Bell 1973; Freidson 1973; Galbraith 1967). Based on the characteristics of American society, Bell (1973) argued that within advanced societies, power rests with the possessor of knowledge rather than with the possessor of capital. Both Bell and Freidson assume, that unlike other workers, salaried professionals maintain exclusive control over their own knowledge base, and are thus able to resist managerial attempts to reduce their autonomy because, as masters of this knowledge, they have power to exclude others from its secrets.

Freidson (1973a:52) argues that in the emerging-post industrial society, a growing number of production workers are "knowledge- based workers whose increasingly abstract skills require long periods of formal training in specialised schools. Thus, "such higher vocational education does not merely insert knowledge into people's heads, but also builds.... occupational identities and commitments". The result is the development of "occupational solidarity" among the workers practising the same specialised skills. For these reasons, management is unable to fully control the labour process. Rather, knowledge-based workers and their occupational associations will increasingly define tasks and determine who is qualified to perform them, as well as who will control and evaluate their performance.

Many other writers have also argued about the power of knowledge-based workers. For Gouldner (1978), professionals are a "new class" whose knowledge constitutes a kind of cultural capital, which represents a growing base of power. For Galbraith (1967), professionals are the core of the "new technocracy" which is usurping the power from the capitalist class. Illich (1977) and Stainfels (1979) see professionals who work in public sectors, as powerful agents of social control over the whole of society.

In short, these approaches predict that as technical knowledge is so important, and professional values and technical authority so strong, it is likely that a crisis of legitimacy in management takes place, because it will generate a conflict between the value systems of technical expertise and those of private business. Engineers' commitment to the rational pursuit of knowledge is likely to conflict with employers' pursuit of profit maximisation. Bureaucratic authority may be undermined, if engineers only accept orders related to technical exigences rather than to managerial requirements. And their desire for autonomy, necessary if the company is to maximise their usefulness, may conflict with the employers' requirement of control. Thus, the integration of technical staff into the capitalist firm, is much more complicated than that of clerical and administrative employees (Cf. Whalley 1986).

In the light of these approaches, I will analyze; a) the authority relations between managers and Brazilian engineers; b) the legitimation of management by engineers; c) engineers' attitudes to business values; d) the values of the engineers and the politics of their professional association; e) the degree of technical authority and professional autonomy enjoyed by engineers within the capitalist firm, and; f) the managerial strategies adopted to mediate the predicted potential conflict between engineers and management, and to integrate engineers into the business values.

3. Proletarianisation Thesis

When we talk about proletarianisation, we are referring to shifts towards a working class position. Thus before approaching the issue of proletarianisation, we need first to define social class. For some sociologists, class is understood as categories of people occupying common positions within status hierarchies (Warner 1960; Parson 1970:24). To others, classes are defined as conflict groups, determined by their positions within authority or power structures (Dahrendorf 1959:38; Lenski 1966:95). Within the Weberian tradition, classes are identified as groups of people with common economic "life chances", determined by market relations (Weber 1968:927; Giddens 1973; Parkin, 1971:18-23). Within the Marxist tradition however, classes are defined in terms of positions within capitalist social relations of production (Bukharin 1969:276; Lenin 1969:486; Rattansi 1985:644).

Smith and Willmott (1990) have shown that proletarianisation as constituted by Marx means:

> "simply shifts in the character of labour into a wage-labour form: the transition of a non-wage producer, such as peasant, slave, indentured labourer or petty bourgeois, to a wage-labourer. In other words, proletarianisation describes the dispossession of direct producers, such as a peasant farmer, from the means of production and their transformation into wage workers".
>
> (Smith and Willmott 1990:8-9)

However, they argue that the Marxian definition of proletarianisation has been "unselfconsciously" reconstituted to include changes "within formal wage-labour position", and in particular, "changes in the condition of work and social position experienced by white-collar workers" (p.16). This new version of proletarianization is based on:

> "deskilling of particular jobs; socio-political radicalism amongst white-collar workers; changes in the composition of the class structure, with an expansion of working class positions; and reducing career opportunities or trajectories in white-collar jobs".
>
> (Smith and Willmott, 1990:17)

According to this version of proletarianization, "proletariat" is not the equivalent of wage-labourer, but a category of labour composed of de-skilled, routine and supervised functions. From this perspective,

> "if movement towards the conditions associated with this category can be demonstrated through the de-skilling of workers, then they can be said to be proletarianised. Conversely, if it can be empirically demonstrated that the careers opportunities, skills and political attitudes of non-manual workers remain distinct from manual workers, then these groups cannot be said to have been proletarianised"
>
> (Smith and Willmott 1990:17).

Orthodox Marxist theorists of proletarianisation, have criticised the exaggerated importance attributed to professional workers by professionalisation and post-industrial writers. They themselves argue, that the old order of self-employment among professionals has been changing, and professionals are increasingly becoming employees. Since professional markets are attracting more and more private capital, salaried employment is increasing. As production and marketing are dependent on sophisticated technology and institutional resources, professional workers are becoming vulnerable to the process of industrialisation in a way that was experienced by craftsmen in the nineteenth-century. Thus, lacking the resources to maintain economic independence, professionals are increasingly becoming employees in large-scale corporations and state bureaucracies. As a result they have become subject, like other employees, to managerial authority and control, and the slow degradation of their status and rewards. Within this context, professional autonomy is said to assume only a symbolic meaning, for despite the freedom of professionals from time clocks and close supervision, they are nevertheless subject to many of the same constraints applied to all non-professional workers. For example, their work has been conceived and enforced by management according to the rhythm of organizational procedures and technology, and they are now subject to administrative approval and evaluation. It is also argued, that in many cases professional workers are subject to close and direct supervision (Larson 1977; Oppenheimer 1970, 1973; Aronowitz 1973).

Braverman (1974) by adopting a mixture of the orthodox view of proletarianisation and the notion of the deskilling process, has argued that "having become a mass population, engineering has begun to exhibit, even if faintly, some of the characteristics of other mass employments: rationalisation and division of labour, simplification of duties, application of mechanisation, a downward drift in relative pay, some unemployment, and some unionisation" (1974:243). Derber (1982) has also adopted the deskilling perspective to argue that, "like other workers", professional employees "have become detail workers, unable to choose their own projects or tasks and to work at the rhythms and procedures institutionalised in the job descriptions and standard operating procedures of the organisation" (p.8). More importantly, professional workers suffer from "ideological proletarianisation". Engineers, he argues, have been "deprived of their right to select and formulate their own research objectives", and have experienced "a loss of control over the organisational uses and application of their technical investigations" (1983:319-321). Bauer and Cohen (1982) also emphasize the organisation's appropriation of technical knowledge and the "crystallisation" of such know how in manuals of procedure which specify precisely all areas of work of the firm, structuring exactly how engineers formulate and resolve the problems they meet.

This approach of proletarianisation through levels of deskilling has been strongly criticised. Its basic problem is related to the assumption that "skill" forms a basis for class distinction. Braverman himself found difficulty in defining the term "skill". He also found the distinction between skill levels to be extremely vague and difficult to draw. Thus, it raises the question of how should we draw the line between skilled and de-skilled workers? For example, one could ask just how de-skilled does one have to be, to be categorised as working class or proletariat?. The answer to this has not yet been given (Smith and Willmott 1990; Meiksins 1986).

Despite different starting points, the two previous approaches to proletarianisation support the view that there is a trend towards the proletarianisation of professional workers within capitalist societies. However, it is Ross (1978) who explains the consequences of the objective proletarianisation for working-class politics. It is said, that deskilling and wage-reductions do not make professional employees members of the proletariat as long as they remain engaged in unproductive labour, but do make them more disposed to ally with the working class. Ross argues that for certain white-collar workers, routinisation of their work is associated with the emergence of the collective labourer in technically advanced sectors, by virtue of which many engineers and technicians "become productive workers and hence bona fide members of the working class" (1978:168).

My position in relation to this topic, is that what distinguishes professional workers from a traditional working class condition is the fact that, despite being both salaried workers, and subject to the general policies of personnel management, professional workers are given certain status provisions, different salaries, benefits, and career opportunites. In Brazil, the majority of professional workers are engaged in supervisory activities from an early stage in their career. Although these differences in conditions can been seen as artificially constructed as managerial strategies to deal with organizational professional workers, they are at the same time one indication that people in organizations play different roles, have different functions, responsibilities and activities, and as such they are given different status and rewards. The division of work, and the division of power in a hierarchy, implies that different managerial strategies have to be used to deal with different people within the hierarchy. The consequences of these differences are explored in this thesis.

My research problem here will be to identify to what extent the case of Brazilian engineers supports or questions the proletarianisation thesis assumptions about the following issues: the nature of engineer's work; their degree of technical autonomy; the nature of rewards; their dependence on wages to survive; their degree of submission to managerial authority and control; and their unionisation and political alliances with the working class, in response to their experience as wage-labourers within companies.

4. The New Working Class Thesis

The "new working class" thesis was developed mainly by the French writers Serge Mallet and Andre Gorz, and is related to the French socio-political events of the 1960s. Paradoxically, it is in part an extension to the "proletarianisation thesis" whilst at the same time lending support to the "professionalisation" and "post-industrial" stand points. The "professionalisation thesis" argues that professional values are likely to conflict with business values. Thus, a professional revolt against the bureaucratic authority and management pressures, is likely to occur within capitalist firms. Following this view, Mallet (1975) assumes that the commitment of technical employees to the "higher rationality of science", will create problems for capitalist organisations and for the legitimacy of management, due to their employment in companies. Based on this, he predicted the emergence of a **new working class**, in which engineers and other technical staff would ally with the manual workers of the company, to demand "control over production at all levels", as a reaction to the contradictions, conflicts and distortions perceived by them within the capitalist firm due to its search for profits (p.188)

Similarly, Gorz (1967) argues that technical workers will increasingly demand control over production for themselves and manual workers, both as a response to the discovery "that they "discover that they are wage earners like other workers and are paid for work which is "good" only to the degree that it is profitable in the short run" (p.104), and because their knowledge and abilities are unfulfilled by the narrow commercialism of profitable production.

For Mallet (1975), the major contradiction experienced by technical workers is that between the job and the organisation. While the technical job entails autonomy, involvement and participation in production, the organisation is bureaucratic and hierarchical, and gives technical workers little or no autonomy or participation in meaningful decision-making. This powerlessness in the work situation of technical workers, creates an inconsistency that gives rise to greater frustration and militancy than commonly found among traditional manual workers.

The strategic position of technicians in high-tech industries, is said to be another major contradiction. Due to their technical knowledge and central role in production, the technical staff understand the techniques of manufacturing well enough to manage it without guidance from managers. Aware of their technical and political capabilities, the technical staff perceive management as unnecessary and intolerable (Crawford, 1989).

Moreover, the legitimacy of capitalist management is put into question by value conflict. Veblen (1965) argued that the relationship between engineers and capitalist managers is inherently conflictual. It is because by "training, capability, and native bent, the technologists find it easy and convincing to size up men and things in terms of tangible performance, without commercial afterthought", and thus "are beginning to understand that commercial expediency has nothing better to contribute to the engineer's work than so much lag, leak, and friction" (p.74). Following this view, Gorz (1967:103-104) argued that the subordination of research, development, and knowledge diffusion to the capitalist profit-making process, violates the "higher rationality" and service orientation in technical work emphasized in the education process. Thus, by virtue of the culture of their technical education, engineers are anti-capitalist.

Both Mallet and Gorz argue that the essential problem experienced by the "new working class", is organisational alienation rather than economic exploitation. It is for this reason that the "new working class" is less concerned than the "old one" about wages, and much more concerned about control.

Autogestion - that is workers' self-management - is the characteristic demand of this "new working class". The interest in democratic control, is also manifest in the forms of anarcho-syndicalism and plant specific unionism (syndicalism d'enterprise). The class character of this movement, means changes to capitalist rule both in the political arena and in the workplace (Crawford 1989).

After the general strike of May 1968 in France, Gorz changed his view about the politics of technical workers. He argued that "more often than not the rebellion of intellectual workers is profoundly ambiguous: they rebel not as proletarians but against being treated as proletarians. They struggle not against the capitalist system but to reinstate the privileges they once enjoyed as members of the professional middle class" (Gorz 1976:178-80).

Despite its great influence, mainly in France, the "new working class" approach has been strongly questioned. Mallet and Gorz are criticised for not presenting a clear indication of who they call the "new working class", of what they call "technical labour", and for having a technologically deterministic view of society (Smith 1990). Contrary to their predictions of a better relationship between technical and manual workers in high- tech settings, powerful educational and technical barriers between workers have been found (Gallie 1978; Nichols and Beynon 1977; Halle 1984). Others have questioned whether the group referred to, in any way constitutes a class (Giddens, 1973).

Despite such limitations this appears to be a helpful approach to analyze the case of Brazilian engineers. The labour movement in Brazil has strengthened since the 1970s, to the point of the creation of the **Workers Party** (Partido dos Trabalhadores) in the 1980s. This has been strongly supported by professionals and those termed "intellectuals". The strength of the **Workers Party** has increased such that it won forty-eight per cent of the votes in the November 1989 election to elect the Brazilian President. In many strikes, professionals have struggled along side the old working class for common objectives.

With the above issues in mind, I will explore the following questions developed from the "new working class" thesis: have Brazilian engineers led the working class?; Are they a vanguard as this "thesis" implies?; Do Brazilian engineers rebel against capitalist control and values?; How do Brazilian engineers organise in terms of unionisation and class politics?.

5. The "New Middle Class" Thesis

Weberian and many neo-Marxist writers have argued, that professional workers occupy a middle class position. However, they have adopted different perspectives in support of this. I will briefly summarise these positions below.

5.1 The Weberian Perspective

For Weber, "property" and "lack of property" are the basic categories of all class situations. Within these two categories, classes are differentiated according to the sort of property that is usable for returns, and according to the kinds of services which can be offered in the market (Cf. Snipp, 1985:476). In this sense "capital, specialised knowledge or skills provide the criteria for drawing the boundaries between different classes" (Cf. Smith 1990:234). Among workers who do not own capital, classes are also differentiated along occupational lines (Snipp 1985). Thus, for Weberian writers, since salaried professional workers enjoy a different work environment, delegated authority, autonomy, technical knowledge, different status, market and economic capacities, they have to be located in classes different from those of the capitalist and working class. Nevertheless, these writers have not yet accorded with a general class theory of intermediate workers. It is in part, because they have adopted different units of analysis to define class position.

Following Weber, Sorokin (1927) locates professional workers between the upper class of entrepreneurs and the working class, due to their involvement with professional, technical and managerial aims. Dahrendorf (1959) locates professional workers as the command class, because they exercise authority regardless of whether they are subject to it themselves. Giddens (1973) identifies professionals as "middle class" due to their possession of technical/or educational credentials. Parkin (1971) locates professional workers in the dominant class due to their educational credentials. Collins (1979), using the Marxian concept of productive labour and the Weberian notion of social closure, attempts to locate professional workers in the dominant class. Finally, Goldthorpe (1982) locates professionals and managers in a "service class" due to their work situation, which involves delegated authority, specialised knowledge, autonomy and discretion, and due to the distinctive level and types of rewards.

Despite its great influence on class analysis in the United States, Britain and elsewhere, these approaches have been criticised by Marxists and non-Marxist writers alike. Smith (1990) has shown how Marx saw the "fundamental weakness of any model based on market criteria 'because of the infinite fragmentation of interest and rank into which the division of social labour splits labourers as well as capitalist and landlords'". As Smith (1990) puts it: "Marx went on to say that 'any attempt to relate the identity of revenues and sources of revenues would imply the existence of an **infinity of classes**'" (p.234).

Smith has also stressed that "the central focus of Weber's analysis concerns the view that capacities or properties, be they capital, specialised knowledge or skills, provide the criteria for drawing the boundaries between different classes" (p.234). For him "while this may appear more refined than Marx's attention to ownership and production relations, Weberians tend to produce a very "fragmentary class structure", one that does not correspond with the institution of political and economic action within capitalism" (p:234).

The neo-Weberian Giddens, supporting the same criticism, argues that "since for Weber, class refers to any aggregate of individuals who share a common market situation in terms of goods and capabilities which they possess, and considering that the range of goods and capabilities possessed by individuals is highly variable, it could lead us to the conclusion that there are as many classes as there are concrete individuals participating in market relationships" (1973:78). Carter (1986:44) argues that "by concentrating on the differences between marketable skills and the gradation of ownership, there arises the problem of whether it is possible to conceptualise class collectivity at all" in a Weberian way. In fact, Weber himself recognised these limitations, and to impose some order on his model of class structure he "was forced into adopting conventional descriptive rankings of skilled, semi- skilled and white-collar into his class analysis" (Smith 1990:234). Despite criticism, this is a very helpful model to analyze the differences between the work situation of the various occupational groups, within capitalist organizations.

5.2 The neo-Marxist Perspective

In the Marxian model of class analysis "the ownership and non-ownership of the means of production provides the axis for identification of classes, and the form of property constitute the defining element of the relations of production" (Cf. Rattansi 1985:644). Basically the capitalist system is composed of two classes: the capitalist and the working class. However, Marx noted that at a certain stage in the development of capitalism, the function of capital was placed in the hands of a special kind of wage-labourer - the professional manager (Carter:1985:64). Carter shows that, according to Marx, these changes had two profound effects on the two main classes. On the one hand, it altered the relationhsip of labour to capital, subordinating it through changes in the division of labour. This process led to the development of an increasing number of types of labour including managers, engineers and technologists. "The capitalist withdrew from the workplace and abandoned supervision of the productive process, choosing to leave his previous functions to hired employees" (Carter, 1985:65). As a result of these changes, Carter shows that:

> "the social structure of the factory has become far more complex. Although it is still analytically possible to distinguish the function of capital and the function of labour within the production process, fewer occupations correspond with one function or the other in a pure way. An increasing number of people perform jobs the composition of which is made up of part function of capital, part function of labour (Carter, 1985:65)".

As a consequence of these changes, Carter argues that, "it is even less credible to view the capitalist class structure as being composed of two classes defined by a unity of oppositions - owner/non-owner, labourer/non-labourer, exploiter/exploited or oppressor/oppressed (1985:65)".

There now exists a relatively large group of employees in capitalist societies, who share both sides of the opposition. This large group of workers, including professionals, technicians, managers and bureaucrats, are what Carter (1985:65), Poulantzas (1975), Carchedi (1977) and Wright (1985), call the **new middle class**.

5.2.1 - Poulantzas

For Poulantzas, this class is composed of "agents" who lack ownership or control over capital, but are implicated by political or ideological relations in serving capital. The defining characteristic of this middle class, what he called a "new petty bourgeoisie", is that paradoxically it can assume an ambiguous position. On the one hand it exercises control, and on the other it is submissive to capital. Poulantzas recognises technicians as part of productive labour, but "excluded from membership of the working class because of their role as agents of capital in politically supervising the labour process and operating within the ideological apparatus of mental labour" (Cf. Smith 1990:239).

For Poulantzas, technicians and engineers are not only "responsible for the work of management and supervision," but they also "control the efficiency of workers and the achievement of output norms" (Poulantzas 1975:239-40). According to Poulantzas' view, technicians and engineers "are also indirectly responsible for the process of separating workers from the conditions of work and subordinating them to an ideological class knowledge" (Smith 1990:239).

Poulantzas emphasizes that despite technical workers being aware or critical of their role in production, they do not negate their complicity as agents of capital. Thus, their consciousness or the content of their work is irrelevant to their role as agents of capital (Smith 1990). Poulantzas suggested that contrary to the view of Mallet and Gorz, technical workers will not ally with the working class in defence of a common interest. Instead, this class is likely to defend the capitalist interest first.

Poulantzas also distinguishes between "mental" and "manual" labour. Mental labour is concerned with the planning, organisation and direction of the production process. Manual labour belongs to the direct producers who are themselves deprived of the knowledge of mental labour. Consequently, these processes of separation between mental and manual labour, erect an "irresistible class barrier in capitalist society". Thus, Poulantzas recognises the process of social closure, monopoly and exclusivity between possessors and non-possessors of technical knowledge, present in the Weberian perspective (Smith 1990:239).

As Smith (1990:239-40) has shown, Poulantzas "makes some significant advances in our understanding of the political role of supervision and control, and the elevation of mental over physical labour under capitalist relations of production". Poulantzas's work has been criticised by Smith for having "too rigid a delineation between productive "mental" labour and manual workers, which exhibit marked variations across national and sectoral boundaries" (p.240). Smith has also argued that "British technical workers do not supervise manual workers and have historically been closely allied to skilled workers through craft socialisation, unlike the situation in France, which is Poulantzas's implicit model" (p.240).

Thus, my concern in this thesis, is to see to what extent Poulantzas' work finds support in the case of Brazilian engineers. It is known beforehand that in the majority of Brazilian enterprises, engineers do supervise other workers; technical knowledge is a symbol of status and supports a class barrier as well as being a powerful instrument of domination. Thus, in the light of this approach, I will analyze the work situation of Brazilian engineers in terms of their relationship with management and with the manual working class, their place in supervisory, intellectual or manual functions, and their technical autonomy at work.

5.2.2 - Carchedi

For Carchedi, the "new middle class" is composed of individuals who perform a mixture of what he calls functions of surveillance and control of the labour process, and functions of production of surplus values. These individuals also lack economic ownership of the means of production and are dependent on wages to subsist. Where technical workers are engaged in performing these two functions, they are part of this new middle class. Carchedi, like Wright (1985), argues that this contradiction of performing functions of capital and functions of labour, and consequently of standing between the bourgeoisie and the proletariat, is what marks the class position of intermediary technical workers. Carchedi's approach also suggests that with the advent of technological innovations, "late capitalism" is predisposed to de-qualify and replace these "middle class skills" in order to shift the balance between the global function of capital and that of labour within the "new middle classes". For Carchedi, such a threat of proletarianisation through the de-skilling process engendered by technology, is the inner logic of advanced capitalism.

The main limitation of Carchedi's approach, is said to be its assumption that class relations can be determined simply through the place people occupy within the technical division of labour. This does not consider that people in similar occupations may have divergent forms of association with other workers and managers, and different forms of socialisation and culture, which cannot be read simply though functional classification (Cf. Smith 1990). Thus, my concern here is to see to what extent Carchedi's approach finds support, if at all, in the case of Brazilian engineers, in terms of their place in supervisory, intellectual or manual labour, their autonomy at work and trends towards skilling/deskilling.

5.2.3 - Wright

Finally, by combining Weberian and Marxian conceptions of class, Wright (1985), places professionals and managers in a contradictory position between the capitalist and the working class. This is due, Wright argues, to their educational credentials and access to organisational knowledge, which enables them to control the conditions for the coordination of labour.

The concept of "contradictory class location" has been developed since its first version published in 1976, passing to a more elaborate "class map" in 1978, and the more substantial (re) conceptualisation in 1985 (Wright, 1976, 1978, 1985).

The focus of attention of Wright has been how to transform the ideological category of the middle class, into a scientific concept (1985:26). This seems to have led Wright to a continuous process of reformulation of his model of class analysis. Thus, for the purpose of this thesis, I will concentrate on his latest model of class analysis presented in **Classes** (1985).

Wright agrees with Marx that, at the level of the pure capitalist mode of production, the capitalist and workers represent the only class positions. However, with the capitalist development the group referred to by Poulantzas as the new petty bourgeoisie, for example, should not be forced into one of the two main classes because its members enter in contradictory relations within class relations. As he argued:

> "Instead of regarding all positions as located uniquely within particular classes and thus as having a coherent class character in their own right, we should see some positions as possibly having a multiple class character; they may be in more than one class simultaneously. The class nature of such positions is a derivative one, based as it is on the fundamental classes to which they are attached. Such positions are what I have termed "contradictory locations within class relations (Wright, 1985:43)".

Wright's conceptualisation of contradictory locations presented in Classes (1985), was a response to the criticisms to his earlier model of class analysis. For Wright the main conceptual problem in the concept of contradictory class relations, was the displacement of the concept of exploitation by the concept of domination in the concept of class. As he argued:

> "Managers, for example, were basically defined as a contradictory location because they were simultaneously dominators an dominated. Relations of domination were also decisive in defining the class character of "semi-autonomous employees" - locations which, I argued, were simultaneously petty-bourgeois and proletarian by virtue of their self-direction within the labour process since "autonomy" defines a condition with respect to domination. This same tendency to substitute domination for exploitation at the core of the concept of class is found in most other neo-Marxist conceptualisation of class structure (1985:56)".

In order to transform the concept of domination (the basis for the concept of contradictory class location) into a model of class analysis based on the concept of exploitation, Wright adopted the methodology of the work of John Roemer **[1]**, which offers alternative strategies to analyzing exploitation relations. As Wright put it:

> The central message of both of Roemer's strategies for analyzing exploitation is that the material basis of exploitation lies in inequalities in the distribution of productive assets, usually referred to as property relations. The asset-exploitation nexus depends in each case upon the capacity of asset-holders to deprive others of equal access to that asset, whether it be alienable or inalienable. On the one hand, inequalities of assets are sufficient to account for transfers of surplus labour; on the other hand, different forms of asset inequality specify different systems of exploitation. Classes are then defined as positions within the social relations of production derived from the property relations which determine the patterns exploitation (1985:71-7)".

Following Roemer's methodology, Wright (1985) defined class in terms of qualitatively distinct asset ownership and according to three-dimensions of asset exploitation relations: exploitation based on the ownership of capital assets, exploitation based on organisation assets, and on credential/skills (1985:148).

The exploitation relations based on the ownership of capital assets (or on the ownership of the means of production) generates two principal classes: capitalists and workers. However, workers are grouped into various positions, defined according to their possession of organization and skill assets. Organisation assets means the control over co-ordination and integration of the division of labour. Differences in the possession of organization assets generates three positions: (1) managers which are directly involved in making policy decisions within the work place and which have effective authority over subordinates; (2) supervisors, positions which have effective authority over subordinates, but are not involved in organisational decision-making; (3) non-managers, positions without any organisation assets within production (1985:153).

The possession of credential/skill assets gives rise to three categories: (1) experts: this category includes all professionals, technicians and managers (by occupational title, not by the criteria used to define the organisational asset specified above) with college degrees; (2) Skilled employees: including (a) school teachers and craftworkers; (b) managers and technicians with less than college degrees; (c) salespersons or clericals with college-degrees and whose jobs have real autonomy; 3) Non-skilled employees: including (a) clerical and salespersons not satisfying the credential or autonomy criterion for skilled employees; (b) non-craft manual occupations and service occupations (1985:153).

Within this model of contradictory locations, professionals are part of a "new middle class", which comprises people who lack assets in capital, are exploited by capital but at the same time are skill-exploiters (Wright, 1985:87)

In short, the group referred to by Wright (1985) as occupying contradictory locations within exploitation relations includes: expert-managers, expert-supervisors, expert non-managers, semi-credentialed managers, semi-credentialed-supervisors, semi-credentialed workers, uncredentialed managers, and uncredentialled supervisors.

According to Wright, such positions could also be characterised as "contradictory locations", due to their contradictory interests in the struggle between labour and capital:

> "Such positions could be characterised as "contradictory locations", for they will typically hold contradictory interests with respect to the primary forms of class struggle in capitalist society, the struggle between labour and capital". On the one hand, they are like workers in being excluded from ownership of the means of production; on the other, they have interests opposed to workers because of their effective control of organisation and skill assets. Within the struggles of capitalism, therefore, these "new" middle classes do constitute contradictory locations, or more precisely, contradictory locations within exploitation relations (1985:87)".

Despite Wright's contribution to the problem of class analysis, his work has also been subject to criticism and problems. Wright himself has recognised that the link of skill/credential asset to the concept of class has not been theorised satisfactorily. For him, experts may have distinct interests from non-experts, but they are not clearly constituted as a class in relation to non-experts (1985:93-8).

Marshall et al. (1988), who collaborated in the international project coordinated by Wright, say that they are not convinced, a priori, of the superiority of the revised framework to the original schema (p.39). The main criticism revolves around the claim that when Marxists recognise the importance of class formation they are identified as neo-Weberian. As they argued:

> "It is not class structure alone which determine people interests, nor is it the only factor affecting class formation. To recognise this is, of course, to strip Wright's account of its distinctively Marxist tenor which is presumably why Wright does not pursue the point further (1988:45)".

However, the criticism raised by Marshall et al. that Wright has tried to obscure the distinction between neo-Weberian and neo-Marxists can also be questioned. Wright himself admits that parallels can be drawn between some of the elements in his concept of class structure and those found in the Weberian tradition (1988:16). Therefore, similarities between Marxian and Weberian approaches is a common fact. The Weberian analysis of the "middle classes" carried out by Lockwood (1958), on clerical workers, derived the fundamental notions of market situation and work situation from Marxist theory. As Lockwood himself assumed:

> "Market situation and work situation comprise what Marx essentially understood as class position; status situation derives from another branch of social stratification theory (1958:15-16)".

Despite this, Marshall at al. (1978:45) keep their restrictions to the claim that Wright's definition of class places constitutes a consistent starting point for the analysis of the various dimensions of "class" in capitalist societies.

However, it is important to highlight here that most of this criticism is rooted in the fact that, a clear demarcation between Marxist and Weberian analysis of the "middle classes" has not yet been made. As Abercrombie and Urry (1985) have argued, the relationship between Marxist and Weberian theories of class is much more complex than it is presented, and any satisfactory theory of class has to solve theoretical problems that are common in both approaches.

In fact, these difficulties can be perceived even in the work of neo-orthodox Marxists on technical labour (Meiksins, 1982, 1986,1990; Smith, 1987, 1990; Smith and Willmott, 1991), who are also critics of new middle class theory. Thus, before assuming Wright's work is relevant to analyze the "new middle class" in Brazil, it is necessary to present the main contributions and limitations of the new-orthodox perspective.

6. The New-Orthodoxy and Its Criticism of the "New Middle Class"

The new middle class theories have been criticised by neo-orthodox Marxist theorists of technical labour (Cottrell, 1984; Smith 1987; 1990; Smith and Willmott, 1991) and especially by Meiksins (1986), to whom "there is no middle-class between the capitalist and the working class, but rather a small ruling class and a large heterogenous working class within which certain positions are "ambiguous" because they permit the occupants to enter the capitalist class" (Carter, 1993:16).

The basic argument is that the professional's position as wage-labour, the lack of economic ownership of the means of production and need to rent their labour power to capitalists in order to survive, indicates their class location as working class (Smith 1990; Smith and Willmott, 1991; Meiksins 1987, 1990).

The above argument is rooted in three aspects involving technical labour in capitalist societies: (1) the historical usefulness of technical labour to capital; (2) the extraction of surplus-labour from technical labour by capital; and (3) the integration and control of technical workers in capitalist enterprises.

In relation to the first point, the rise of engineering has been seen as closely associated with the development of industrial capitalism, and the increasing number of engineers employed in enterprises has consequently been associated with their utility to capital. The growth of corporate research and development laboratories has also helped to expand engineering employment. Thus, like other workers, engineers are employees of enterprises of various sizes and types. Most of them are involved not only in research and development, but also in administrative, supervisory and coordinating work. During their daily work they find themselves situated between the managerial group at the top of the industrial corporation and the factory floor below, and within the classical terrain of class conflict characteristic of all capitalist society

(Meiksins 1982; Smith 1990; Whalley 1986).

The second point - the extraction of surplus labour from technical labour by capital - is explained by the organisation of the capitalist labour process. Meiksins (1982) argues that, the basic model of the relationship established between labour and capital within this process of exploitation, is what structures the development of capitalist society. What distinguishes the capitalist mode of exploitation from other systems, is that the direct producer is formally free, ie, **he/she does not belong to the capitalist as under slavery.** Because the wage labourer does not possess the means of production and needs to sell his/her labour power to the capitalist in order to survive, the capitalist can dispose of his/her labour power and the means of production as the capitalist desires (Meiksins 1982).

Basing his work on that of Braverman (1974), Meiksins argues that the expansion of the detailed division of labour in industry, has led to a progressive separation between "conception" and "execution". This separation gave rise to various kinds of white collar-workers (including engineers), necessary to coordinate the separate elements of the production process. However, much of the work being performed by contemporary engineers, corresponds to the conceptual work of which the direct producers have been deprived. Thus, for Meiksins (1982), engineering as a distinct occupation is a result of changes in the structure of the labour process.

Therefore, within capitalist enterprises, engineers are involved not only in technical functions but also in functions of coordination, supervision and, in some cases, in strategic functions. For Meiksins (1982), at the same time in which engineers are performing the activities of quality control, testing, inspection, design, system analysis and the like, they are also helping to coordinate the labour of the workers on the shop floor, and suggest that the function of coordination is inherent to the engineer's work.

Meiksins (1982) has also criticised Carchedi (1977), on the ground that he has falsely characterized the antithesis between coordination and supervision, to later argue that these functions have become collective in contemporary capitalism.

Meiksins assumes that according to Marx (1973), the function of coordination and supervision have different characteristics, but they are fused in capitalism. The function of coordination is necessary to any labour process, be it capitalist or not, while the function of supervision is made necessary only because of the antagonistic nature of any class system of production. Meiksins quotes Marx to makes this distinction and to show how they are fused. In the words of Marx:

> "All combined labour on a large scale requires, more or less, a directing authority, in order to secure the harmonious working of the individual activities, and to perform the general functions that have their origin in the action of the combined organism, as distinct from its separate organs.... The work of directing, superintending, and adjusting becomes one function of capital, from the moment that the labour process under the control of capital, becomes co-operative. Once a function of capital **it acquires special characteristics**... The control exercised by the capitalist is not only a special function, due to the nature of the social labour process, but it is, **at the same time**, a function of the exploitation of a social labour-process, and is consequently rooted in the unavoidable antagonism between the exploiter and the

living and labouring raw material he exploits" (Marx 1973, I, pp.330-31, Cf. Meiksins 1982:128)

Thus, Meiksins (1982) says that "Marx would regard overseers (supervisors) as part of productive labour, despite the fact that much of the work they do is made necessary only by the antagonistic nature of production relations" (p.128-129).

Meiksins has also criticised Braverman's (1974) view that the function of conception has been concentrated in the hands of management, which delegates it to a group of specialised workers, and that engineers and blue-collar workers have nothing in common prior to the rationalisation of engineering work. According to Meiksins (1982), by delegating the functions of conception to a staff of white-collar employees, the capitalist has already created a new category of highly skilled detail workers. For Meiksins, engineers are only specialised participants in the labour process, concerned with various aspects of the labour of design, coordination and supervision. As participants in the labour process, engineers are similar to subordinate employees in the fundamental sense that they sell their labour power to their employers in order to survive. He also stresses that this is a convincing reason why engineers are also supervised.

Meiksins recognises that engineers exercise certain authority over blue-collar workers, and that many of them do supervise and coordinate the labour process. Similarly, he supports Braverman's view that the labour of conception tends to dominate the labour of execution within the capitalist system. However, this kind of authority does not alter the fact that engineers are employees and participants in the collective labour process. Engineers, like other workers, can be discharged of their function (be it technical or of coordination or supervision), and be dismissed any time that the company finds them unnecessary.

The last point refers to the work situation of engineers under managerial control. It is argued that capitalists have long perceived that technical experts possess knowledge essential to technological development and that the development of new products and production methods are increasingly critical to the success of all kinds of enterprises. However, to get profitable results from technical labour without losing the control of the company, has not been as easy as in relation to the less skilled workforce. To deal with this dilemma, corporate management has developed sophisticated strategies to deal with its technical staff (Smith 1990; Whalley 1986; Whalley and Crawford 1984).

Corporate management has used strategies of exposing technical workers to pressures of production or to the forces of the market in order to internalise the company's values and to make labour power more profitable. Companies have also contracted out engineering consultant services to facilitate the indirect control of the technical labour force by reducing dependency upon it. The application of these strategies has led to a greater subordination of the technical labour force to the aims of capital, in the same way that it has happened with the traditional working class (Smith at al. 1990; Smith 1990, Whalley 1986).

Based on the above characteristics of the work situation of technical labour in capitalist organizations, the orthodox perspective argues that, all engineers who do not own their own means of production and are obliged to sell their labour-power to capitalist employers in order to survive are wage-labourers in relation to their employers. They are in a similar position to blue-collar and clerical workers (Meiksins 1982; Smith 1990). For Meiksins (1982), engineers in fact differ from subordinate wage-labourers in that they exercise a kind of authority within the enterprise, but this does not necessarily disqualify them as wage-labourers, or as members of the working class.

Despite the above approach being an attempt to modernise orthodox Marxism, Carter (1993), has shown its main limitations. The main criticism is addressed to the work of Meiksins and Smith involving engineers in capitalist societies. To start with, Carter (1993) argues that in Meiksins' approach the social relations of production are reduced to ownership and non-ownership of the means of production, giving no account of the internal relations within the production process (p.13). Although Meiksins acknowledges the relations of authority exercised by engineers over other workers, these relations are dismissed as irrelevant in determining features of class. Thus, in Meiksins' approach the functions of supervision and control of the engineers comprises merely differentiated tasks within a common labour process.

However, Meiksins (1990) seems to be moving from orthodoxy to the "new middle class" approach. He has recognised that although engineers are wage labourers their position in the labour process is ambiguous (1990:4). Meiksins sees this ambiguity as stemming from the fact that although engineers are employees, the nature of their work places them in conflict with subordinate workers. This ambiguity is also reflected in their self-definitions. In the United States, Meiksins argues, engineers have refused both to equate themselves with organized labour, and accept the view that their interests and the interests of business are the same. In my view, this is one indication that engineers are trying to develop their identity as professionals and possibly as a "new" class, or rather, a typically "new middle class". In fact, these tendencies led Meiksins to suggest that such employees would be better conceived as a new middle class.

As Carter has shown, in contrast to earlier work, Meiksins (1990) pays considerable attention to the work of Carchedi, in which the work of coordination is considered (also by Marx before him) to be part of the labour process, while surveillance is part of the global function of capital. Meiksins then notes Carchedi's insistence on the distinction between the work of coordination carried out by some managers and the work of surveillance. However, Carter (1992:15) argues that, although Meiksins (1990) observes that not all engineers carry out work of surveillance, a point widely accepted, he gives no account of the work of engineers in any particular work location.

For Carter (1993:15), Carchedi and Marx have never confused the concepts of coordination and control of the labour process. On the contrary, it is Meiksins who has misunderstood the concept of coordination and control, not Carchedi and Marx. According to Carter (1993:15), by using a concept of imperative coordination, Meiksins conflates coordination and control. By doing so, Meiksins is led to consider that the function of control is part of the labour process. This led Carter to raise the question of whether senior managers controlling the production process are also workers. Meiksins does not answer this question. Instead, Meiksins is said to have changed the focus of analysis to argue that "all kind of mental labour, be it supervisory or not, is pitted against other kinds of labour through the creation of a hierarchical labour process which obscures its collective character" (Carter, 1993:15-16). This leads Meiksins to conclude that the contradiction between collective character and hierarchical organisation of this labour process is the key source of ambiguity (Ibid,1993:16).

The criticism to Smith's work is similar to that of Meiksins'. However, while Meiksins seems to be moving from orthodoxy to the new middle class theory, Smith is moving in the reverse direction. Carter shows that, in his earlier work, Smith adopts the new class theories of Poulantzas and Carchedi, when he says that: "I support Poulantzas in regarding management as a function that produces and reproduces capitalist relations of exploitation and not, as some orthodox Marxists claim, a neutral or collective labour process" (Smith, 1987:53). He also adopts Carchedi's approach when he argues that: "It is important to understand the separate functions of labour and capital and to evaluate social work roles against there criteria for purposes of understanding basic class relations" (1987:60).

Secondly, Carter argues that "given his willingness to incorporate very different theoretical perspectives, it is hard to discern here a model or perspective on class which is articulated and consistent" (Carter, 1993:17). Therefore, Carter shows that Smith (1987:68-9) states that where access to particular technical jobs is closed "we see a greater emphasis on the superiority of "mental" labour, authority based on technical competence and isolation and subordination of manual workers to these positions. Qualified engineers are in such a position over manual and other technical workers. As such they tend to be closer to management, or the new middle class, and removed from working class technicians" (Smith 1987:68-9; quoted in Carter 1993:17). In short, Carter argues that in Smith's analysis "the majority of technical workers are working class and there is a clearly identified new middle class based upon the performance of control on behalf of capital" (1993:17).

Thirdly, Smith's use of credentialism as a criterion for class membership, is seen by Carter as closer to Weberian theories of social closure, specially to Parkin (1979). Most importantly, Carter argues, is that his analysis suggests that even when engaged in productive work, employees with such credentials are new middle class (Carter, 1993:17).

Fourthly, like Meiksins, Smith is said to have misunderstood Marx's and Carchedi's theories, as he conflates the concepts of coordination (which is part of the labour process) and control on behalf of capital. This enables Smith to perceive the importance of class relations within production, as criteria to define class (Carter, 1993:18-98).

For Carter, the greatest problem with both Meiksins' and Smiths' approaches, is the fact that they misunderstood the distinction, developed by Carchedi and Marx before him, between control and coordination of the labour process as respective functions of capital and labour. For Carter, in their work "there is a refusal to acknowledge that work is coercively controlled and that those coercing on behalf of capital are not themselves engaged in a labour process" (1993:20). Thus, "their emphasis insists that to be employed as wage labour is to be exploited, regardless of the function performed" (p.20). As a result, it is easy for both Meiksins and Smith, to claim that all salaried workers are exploited, and as such they are working class.

Thus, we can conclude that, in capitalist firms, managers and supervisors are the representatives of the functioning capitalist, to whom the latter has delegated its functions. Although they lack ownership of capital, they work on behalf of capital. They play the role of the representative of capital in the process of enforcing the extraction of surplus-value at the point of production, and are not merely a participant in the collective labour process. Hence, they cannot be regarded as "working class" although they are salaried professionals. As shown by Marx (1981:512), only in the case of the cooperative factory are they likely to play the role of participant in the collective labour process only.

7. Conclusion

To be consistent with the Marxist perspective, we have to admit that the condition of the wage-labourer alone is not enough to justify that those intermediary positions between labour and capital, which are both involved in the collective labour process and in enforcing the production of surplus-labour (Managers, supervisors and many technical professionals involved in technically supervising other workers), are part of the working class, or part of the capitalist class. Their employment by capital implies that they play an ambiguous role in the labour process. They are part of the collective worker, as productive labour -, and representative of capital - as controllers and exploiters of the labour of others.

The orthodox perspective (Meiksins, Smith and Willmott) is consistent in its argument that, technical workers, such as engineers, may enjoy different work conditions and possess a degree of delegated authority within the capitalist labour process, in general, but that these conditions are artificially constructed in order to enable capitalist management to supervise these workers and to ensure that they exercise their critical functions in the benefits of capital.

The point raised by Meiksins, Smith and Willmott that, like other workers, professionals and managers are salaried workers, is also a reality. However, the general framework presented so far shows that the professionals' wage-labour condition alone is not enough to say that they are working class. As participants in the collective labour process, they really have one foot in the working class, but while agents of control and extraction of surplus value (or surplus labour) of others, they have the other foot in the dominant class. As Carchedi and Wright have argued, these double roles which they play place them in a very ambiguous position between labour and capital. As they perform a delegated function previously performed by the functioning capitalists, they are expected to defend the capitalists' interest in the first place. This seems to be one reason why even though professionals and managers are wage labour, and as such are also subject to exploitation in their function of collective labour, they have to avoid the working class behaviour (to be a union member, for example), if they want to keep their job. As Marx, referring to the work of functioning capitalist and their representatives (managers), stated:

> "Masters are labourers as well as their journeymen. In this character their interests is precisely the same as that of their men. But they are also either capitalists or agents of the capitalists, and in this respect their interests is decidedly opposed to the interests of the workmen (Quoted in Carter, 1985:63).

As Carter (1993) has argued, "under a socialist mode of production, there would be discussion about the methods, delegation, coordination and collective control. Everybody at the workplace would be part of socially necessary collective labour" (p.25). However, under a capitalist mode of production, "the lines between coordination as part of a collective labour process and control on behalf of capital, between labour and non-labour, are fluid" (Ibid, p.25). These issues are related not only with class struggle, but also with the forming and reforming of classes. This suggests that, if classes are to be defined according to exploitation relations, those who are exploiters (capitalists), and those whom the capitalist delegates its functions, cannot be placed in the same class place as those who are exploited.

The point raised by Carter also suggests that these occupational groups represent the seeds for the formation of new classes. Taken from this point of view, the work of Meiksins, Smith and Willmott, cannot be adopted if we are interested in understanding the processes of how new classes can be formed, reformed or merged, or rather how a new middle class can arise from these social processes.

To be consistent with the theoretical framework presented so far to the analysis of the work situation and class position of professional workers in capitalist societies, the theoretical models developed by Poulantzas, Carchedi and Wright, seem to be more flexible in understanding these processes. Their argument that the expanding category of professional workers who appeared with the development of the capitalist production process cannot be forced into being included within the two main classes - the capitalist and the working class -, but that they could be accommodated within a contradictory location, or more properly, within a new middle class, seems to present a wider perspective which can capture the social transformation which has been occurring in Brazil as a developing capitalist society.

are engineers produced, used and reproduced in developing capitalist society?; 2) How does the capitalist firm manage professionals?; 3) What are the consequences of these two forces for the work situation and class position of Brazilian engineers.

Although I will be basing most of my analysis of the class position of Brazilian engineers on the work of Poulantzas, Carchedi and Wright, I also intend to integrate my fieldwork in ways which accord with the different preoccupations of the diverse approaches to the class position of engineers in capitalist societies.

3. BRAZIL'S DEVELOPMENT AND TECHNICAL WORKERS

1. Introduction

In this chapter I take the view that capitalist development is not the same as industrial development, but industrial development is a precondition for successful economic growth. As Brazil is a developing capitalist society we can expect that industrialisation plays a fundamental role in its economic, political and social transformation. This is the main reason why the issue of industrialisation has to be investigated.

This chapter aims to provide both a background to the discussion of the work situation of engineers in Brazilian industry and also to examine some assertions that have been made about a "middle class" position for engineers in capitalist societies. It starts with an examination of the current approaches towards capitalist development in the Third World, and then focuses on an account of industrialisation in Brazil and the impact this has had upon employment. Special emphasis is given to the issue of the employment of engineers in Brazilian industry. This will also include an account of the interrelationship between class interests, alliances and industrial development. By showing that engineers form a very significant segment of technical workers in Brazilian industry, the chapter concludes by highlighting the importance of studying their case.

2. Theories of Third World Development

'Development' in the broadest sense, is assumed to improve the "quality of life". Better quality of life implies not only higher income but also better education, higher standards of health and nutrition, less poverty, a cleaner environment, more equality of opportunity, greater individual freedom, and richer cultural life [1].

When most developing countries achieved independence, their primary goals were the rapid structural transformation of backward agrarian economies into modern industrial economies, so that the quality of people's lives could be improved. The strategies to achieve this end were various. The dominant paradigm focused on four main aspects of development: capital formation, transference of resources from agriculture to industry, trade policies, and market intervention (World Bank, 1991:33).

It was initially thought that the lack of physical capital, especially infrastructure, was the critical constraint on development. Thus, domestic capital formation was the primary concern. The central problem of development was how to increase voluntary saving to an acceptable level of about 15 per cent of the national income, in order to invest it in industrial expansion (Lewis, 1954, 1955, Nursky, 1952).

However, promoting industry meant the neglect of the agricultural sector. Nonetheless, two aspects seemed to justify transferring resources, directly or indirectly, from the agricultural sector to industry. One was that the supply of unemployed or underemployed agricultural workers was abundant. The other was that the loss of agricultural output caused by taxing the sector, would be small. It was believed that if the surplus workers were withdrawn from agriculture and absorbed into industry, farm output would not suffer, and that industrial output would increase the community's income. Thus, according to Mandelboum (1945), the industrialization of densely populated backward countries rests upon this assumption.

It was also first believed, that trade had only a small and possibly detrimental effect on development. However, this assumption was later rejected because it was found that, in fact, the terms of trade, for primary commodities, between developed and developing countries had been working against the latter since about 1870 (Prebish, 1959; Singer 1949). This view was supported by others, who also stressed the difficulties of financing import needs by means of exports due to the gap in these relations (Chenery and Bruno 1962; Little 1982; Bacha 1984).

These findings led to the development of the "Dependency Theory", by ECLA's (United Nations Economic Commission for Latin America) economists, in which Raul Prebish was one of the most influential. ECLA's economists operated with a centre/periphery model of the relationship between the metropolis and the "Third World", and argued that there was a direct link between changes in the industrialized countries of the centre and the underdeveloped countries of the periphery. For them, Latin America had taken on the role of supplier of raw materials and foodstuffs for the industrial nations, and had, in return, imported manufactured products in the period from the late nineteenth century until the middle of the twentieth century. Moreover, the terms of trade had been moving against the Latin American nations since about 1870s (Roxborough, 1979;27-8).

ECLA observed that whenever this pattern of outward-oriented development was interrupted by war or world economic depression, there was a spurt of industrial development in Latin America. Thus, it argued that the only realistic policy for Latin American countries was to adopt a deliberate policy of fostering import-substitution industrialisation, and hence turn away from a policy of development towards the outside in favour of a policy of development towards the inside (Roxborough, 1979:29). The prescription for all Third World countries, was that certain structural obstacles to the expansion of the domestic market had to be removed.

These obstacles were identified, "at the political level", as the domination by a reactionary upper-class, and at the "economic level", as the perpetuation of an obsolete landholding system oriented to a pattern of development towards the outside, which was a brake on development oriented towards the expansion of the domestic market (Roxborough 1979:31).

ECLA's economists also predicted that state intervention in the economy would foster the creation of new industrial enterprises, and the industrial bourgeoisie and/or the urban middle classes would take over state power from the landed oligarchy. The industrial working class would benefit from increased employment, and the policy of maximizing consumer demand by redistributing income, would ensure that they would benefit in real terms from economic growth. In summary, the model proposed by ECLA called for a broad alliance of all social classes, but under the leadership of the progressive sector of the bourgeoisie (Roxborough, 1979:30).

Despite their influence, these approaches have led to different and contradictory results from country to country. Discriminatory taxes on agriculture have almost always turned out to be taxes on growth. Economic isolation, due to trade barriers, has proved to be costly, retarding competition and interfering with prices, and has very often proved counterproductive [3].

However, investment in people is seen as the firmest foundation for lasting development (Schultz 1961; Becker 1964). It is assumed that the growth of output, results from the growth of capital and labour, and changes in productivity of those inputs. Thus, the key to explaining the differences in the growth of output from country to country is the growth of productivity [4].

Productivity, in turn, is assumed to be driven by technological progress, which is in turn influenced by history, culture, education, institutions, and policies for openness in developing and industrial countries. Moreover, technology is diffused through investment in physical and human capital and through trade [5]. Research by the World Bank shows that "increasing the average amount of education of the labour force by one year raises GDP by 9 per cent" (World Bank, 1991:43). This holds for the first three years of education. Thus, three years of education as compared with none raises GDP by 27 per cent. The return to an additional year of schooling then diminishes to about 4 per cent a year. This therefore means a total of 12 per cent for the next three years of education (Ibid p.43). It is now recognized that the economic success of East Asian countries after the Second World War, and the Scandinavian countries, since 1870, is largely explained by their investment in human capital and their policies promoting outward orientation and competition (Ibid,pp.32-43).

Latin American countries have had a different experience. Among the various explanations for the development of the Third World, the ECLA's model was the most influential, from after the World War II until the mid-1960s. Brazil, in the period up to 1964, provided a typical example of the import-substitution industrialization (ISI) policies, but by the early 1960s its economy was experiencing a very serious crisis. Most attempts at industrialisation via the substitution of imports led to increasing balance of payments problems, increased foreign penetration of the economy, increasing unemployment, a widening rather than a narrowing of income differentials, greater vulnerability of the economy to cyclical movements, a continuing dependency on the export of a limited range of raw materials or agricultural products, and a limited and fluctuating industrial growth. Above all, it was noted that the mass of the population was not benefiting from economic growth. Thus, the conflict of interests involving the "mobilised masses", on the one hand, and the economic sectors, on the other, exacerbated the crisis and led to the military coup of March 1964 (Roxborough, 1979:35; Berstein, 1982; Ellis, 1969, Furtado, 1965).

Once in power the military government took the measures which projected Brazil on a very different road of development, which was later called the "Brazilian model". Before 1967, classic stabilization measures (tight budget controls) were applied to bring down inflation. In 1967 a new tariff law reduced protection to domestic manufacturing from 58.0 to 30.0 per cent. In 1968, it also established a fixed exchange rate system attached to the US dollar. These policies produced a surge in export volume of more than 10.0 per cent a year between 1964 and 1980, and an annual rate of growth of 9.4 per cent. Thus, for almost three decades (between 1960 and 1987) Brazil's average growth rate was 6.6 per cent a year, one of the most impressive for the period (World Bank, 1991:38). As a result of this development Brazil is now ranked as the eighth largest economy in the world.

3. Industrialization and the Growth of Technical Labour in the Post-War Period

Industrialization in Brazil started in the late 19th century, but until the period immediately after the 2nd World War, it was made without any conscious planning by the state at all. Industrial growth was an almost automatic response to external difficulties, caused by the Great Depression and the trade restrictions resulting from the Second World War. Only with the government of Juscelino Kubitscheck (1955-1961), and after 1964, was industrialization in Brazil subject to more careful planning (Humphrey, 1987).

The JK Government (1956-1961) focused on the development of the sectors of infra-structure and on the durable goods industry. Besides the construction of Brasilia, the automobile industry, steel, electrical energy, construction, roads, railways and air transport, were the sectors with the best performance. Between 1955 and 1961, industrial production grew 80.0 per cent, in fixed prices. The highest percentages were registered in the steel industry (100%), mechanical industry (125%), electrical industry and communication (380%), and transport equipment (600%). As a result, GNP grew 7.0 per cent a year on average, and "per-capita" income grew 3.8 per cent a year on average, while in previous years it had grown only 5.2 per cent and 2.5 per cent respectively (Brum, 1991:101).

Nonetheless the technical manpower working in industry was still limited in the early 1960s. TABLE 3.1 shows that, in 1960, the industrial sector employed only 11,000 engineers, 43,000 technicians and 546,000 qualified workers. These figures represented only 0.4%, 1.4% and 18.1% of the working population in the industrial sector respectively, although Brazil already had one of the largest industrial economies in the developing world. Un-skilled workers represented 80.1 per cent of the industrial working population.

TABLE 3.1 - STRUCTURE OF THE INDUSTRIAL LABOUR FORCE IN 1960

Occupational Group	Number of Workers	% of the Working pop.
Engineers	11,000	0,4
Technicians	43,000	1.4
Qualified workers	546,000	18,1
Non-qualified workers	2.400,000	80,1

Source: Gastaldi, J. Petrelli (1968:170), **A Economia Brasileira e os Problemas do Desenvolvimento**, Sao Paulo: Saraiva.

The pattern of economic development of the 1950s, based on the expansion of the consumer durable sectors, was not reversed during the Military Government from 1964. Apart from changes in such areas as wage policies, banking and taxation, the pattern of sectorial growth is considered very similar. Changes happened only after 1974, when the oil crisis, balance of payment problems, and the availability of low-interest foreign loans led to a considerable expansion of heavy industry and infrastructural investment on a large scale (Humphrey, 1987:17).

Thus, the economic sectors which led the post-1964 industrial growth were composed of state-owned industrial corporations operating in the sectors of energy, steel, telecommunications, and transportation; the locally owned private firms operating in the sectors of basic and intermediate goods; the foreign owned corporations operating in the durable goods sectors; and the financial system, with both the government's Development Bank and the large privately owned financial conglomerates (Frieden, 1987:102).

As a result, the governments' policies produced a surge in export volume of more than 10 per cent a year between 1964 and 1980 and led Brazil to experience high rates of economic growth from 1964 to 1987. As TABLE 3.2 shows, from 1964 to 1967, GNP grew at an annual average rate of 3.5 per cent; from 1968 to 1973, it grew at an annual average rate of 11.1 per cent, one of the highest in the industrialized world to date. These economic results led many observers to compare the Brazilian economic success to the "economic miracle" experienced by Germany and Japan, during the 1950s and 1960s, respectively. Yet from 1974 to 1980, the rate of GNP declined to 7.1 per cent a year on average, still very impressive, but 4.0 percent less than the previous years. It suggested the exhaustion of the economic model pursued from 1964. In fact, in the period 1981-1983, the economy went into recession, and GNP growth rates dropped to -1.7 per cent. Despite economic recovery from 1984, the annual average GNP growth rate for the period 1981-1989 was below 1.0 per cent.

TABLE 3.2 - AVERAGE ANNUAL GROWTH OF GNP, BY PERIOD, FROM 1964 TO 1989 (Per cent).

Period	% GNP	Type of Government
1964-1967	3.5	Military: two first years
1968-1973	11.1	Military: miracle years
1974-1980	7.1	Military: decline of the model
1981-1983	(-1.7)	Military: exhaustion of the model
1984-1986	7.4	Transition and Sarney Government
1987-1989	2.0	Civil: two last years of Sarney
1981-1989	0.85	The lost decade

Source: Brazil Central Bank in: Brum, Argemiro G.(1991). O Desenvolvimento Economico Brasileiro. 11th ed., Petropolis, Vozes, p.168.

The process of employment creation was remarkable in the 1960s and 1970s. The annual rate of growth of employment in manufacturing reached 6.3 per cent per annum, creating jobs on a large scale. The number of people registered as working in industrial activities, rose from 2.1 million to 10.8 million between 1950 and 1980. The proportion of the economically active population in industrial activities, rose from 14 per cent to 25 per cent in the same period (Humphrey, 1987:20).

Thanks to the educational reforms of the 1960s and 1970s, which allowed the foundation of many private engineering schools, the number of engineers tripled between 1968 and 1990. As Table 3.3 shows, in 1968 Brazil had 4.87 engineers per 10,000 people in the population, while by 1990 this proportion had increased to 30 engineers for the same group.

TABLE 3.3 EVOLUTION OF THE ENGINEERS POPULATION IN RELATION TO E NATIONAL POPULATION IN THE PERIOD 1968\1990

Year	National population (in million)	Number of Engineers	Rate per 10,000 people
1968	88,222	43,000	4.87
1979	119,000	130,000	10.92
1990	150,000	450,000	30.00

Source: Data for 1968 and 1979, adapted from ABENGE (1980), "Aspectos do desemprego dos Engenheiros", **Revista Ensino Engenharia,** p. 12; Data for 1990, from interview with Eng. Onofre Resende, President of CREA\MG, in May\1991

Technical manpower, as a whole, also grew significantly. As TABLE 3.4 shows, the number of scientists, engineers and technicians increased by 258.00 per cent between 1970 and 1980, with technicians representing nearly 70.00 per cent of this population.

TABLE 3.4 STOCK OF TECHNICAL LABOUR IN BRAZIL: 1970-1980 (Absolute and per cent)

Categories		Years		
		1970	1980	% Growth
Scientists and engineers		541,328 (31.50)	1.362,206 (30.70)	251.00
Technicians		1.177,494 (68.50)	3.074,358 (69.30)	261.00
Total	N=	1.718,822 (100.00)	4.436,564 (100.00)	258.00

Sources: UNESCO, Statistical Yearbook, Years (1982:v-24; 1984:v-30; 1985:v-20).

In 1979 Brazil had 130,000 engineers and 80.00 per cent of them worked in the engineering profession. Among these, 3.27 per cent worked in public administration; 59.11 per cent worked in industrial activities, including state-owned enterprises; 21.21 per cent worked in the sectors of agriculture, commerce, services, transport, communication, and the remaining 5.80 per cent of them worked for themselves (ABENGE, 1980:4). Nonetheless, only 5.80 per cent of engineers were self-employed while the majority (94.20%) were salaried professionals. This confirms Meiksins' (1982) assumption that engineering is an essentially organizational profession.

The technical manpower working in Research and Development also grew substantially. As TABLE 3.5 reveals, in 1970 Brazil had only 7,725 professionals working in Research and Development, but by 1985 this number had increased to 52,863. This represents a growth of 684.00 per cent in this period. TABLE 3.5 also shows that the number of professionals working in Research and Development increased to 58,574 in 1978, but dropped to 32,508 in 1982, as a result of the recession of

1982\1983. The number increased again to 52,863 in 1985, but remained smaller than that of 1978.

TABLE 3.5 TECHNICAL LABOUR ENGAGED IN RESEARCH AND DEVELOPMENT BY AREA OF KNOWLEDGE IN BRAZIL: 1970-1985 (Absolute and per cent)

Areas of Research and Development	Years			
	1970	1978	1982	1985
Natural Science	3,660 (47.37)	**	**	11,863 (22.44)
Engineering and Technology	1,088 (14.08)	**	**	7,765 (14.69)
Medical Science	818 (10.59)	**	**	6,107 (11.55)
Agriculture	785 (10.16)	**	**	7,607 (14,39)
Social Sciences	1,374 (17.78)	**	**	11,007 (20.82)
Others	----	**	**	8,609 (16.28)
Total	N= 7,725 (100.00)	58,574 (100.00)	32,508 (100.00)	52,863 (100.00)

Sources: UNESCO, Statistical Yearbook. Years (1975, 1982:v-30, 1985:v-25, 1990:5-21, 1991).
Note: (**) Data not available by area of research.

Table 3.5 also shows that the number of professionals doing research in engineering and technology increased by 713.00 per cent in the period 1970\1985, but their proportion in relation to the growth of the population working in Research and Development did not change, and remains at 14.69 per cent. Therefore, in 1990, Brazil had 450,000 engineers (see TABLE 3.4) but in 1985 only 7,765 worked in R & D (see TABLE 3.5).

It suggests that the majority of those working in the profession were engaged in production related activities. This is partially explained by the low investment in R & D in Brazil and by the massive import of foreign technology by Brazilian industries in the 1960s and 1970s. This led Brazilian engineers to be pushed into operative functions only, while the most "creative" engineering jobs were undertaken abroad. This affected not only the development of a national technology and a highly qualified labour force in general, but also a more substantial labour market for engineers (ABENGE, 1980).

Therefore, from 1981 to 1990, job opportunities in industry decreased by 12.89 per cent in relation to the situation in 1980, reducing vacancies for all qualified labour (BUSINESS JAPAN, 1990). After averaging 7 per cent annual growth between 1968 and 1980, manufacturing production dropped 10 per cent in 1981, stagnated in 1982, and fell another 20 per cent in 1983, leaving 1984 production levels at less than half of those for 1980. As a consequence of this, the country's major industrial centres experienced a massive dismissal of factory workers. Nonetheless, recovery began again in 1984, as a rapid expansion in the United States began to absorb exports from Brazil (Hirschman, 1987:20; Frieden 1987:121). Alongside this, growth was fuelled by the maturing of numerous industrial projects which had been set up during the Geisel administration (1973-1979), and which started producing in large-scale without new investments (Frieden,1987). Hence, in 1984 and 1985, GDP grew by an average of over 5 per cent a year. Industry began to rebuild, although it still had to make up for several lost years, and industrial unemployment remained at high levels (Hirschman, 1987:20; Frieden 1987:121).

During the first two years of the Civil Government of Sarney (1985-1990), industrial production grew substantially in all sectors, job opportunities increased together with a substantial improvement in the population's buying power, income distribution improved and consumption was raised. Inflation dropped from its previous rates of 500 per cent to 62.4 per cent in 1986 (Brum, 1991:245).

However, with the short term effects of its economic policies, interest rates transformed in speculation, relative values of salaries dropped and inflation rates increased from 366.0 per cent in 1987, to 933.6 per cent in 1988 and, to 1,764.86 per cent in December 1989 (Brum, 1991:255-260).

The following government, of Fernando Collor (1990-1992), has achieved limited results. Apart from its relative success in the privatization project, inflation continues to be over 20.0 per cent a month and the economy has not grown. Therefore, after only two years of mandate, President Collor was accused of mismanagement and corruption, and was replaced by his Vice-President Itamar Franco, following impeachment by the National Congress, in late September 1992. With Mr. Collor's resignation just before the final decision of his impeachment, in December 1992, Itamar Franco assumed formally the Presidency of Republic. In contrast to the period from the mid-1950s to the 1970s, the 1980s was a period of economic up and downs, marked by recession, unemployment and disillusion, to the point of where it has been considered a lost decade for the country.

4. Human Capital Development in Brazil after 1964

While the economic policies of the last three decades favoured the concentration of income in the hands of big business and the higher income social groups, little was done to sensitive areas such as health, education and technological development which are said to drive development.

4.1 Income Concentration

Income concentration in Brazil can be represented in three basic dimensions: a) the regional concentration in the south east region makes this richer than the rest of the country; b) concentration in economic sectors led to the formation of large industries, banks, supermarkets and shopping centres strong enough to control the market and dictate prices and; c) Personal concentration of income, created a social pyramid with a small proportion of people with high income but with the great majority with very little (Brum, 1991:187).

As TABLE 3.6 shows, from 1970 to 1983, the poorest 20% of the population had their proportion of the national income increased from 2.0 to 2.4 per cent. The middle lower group increased their share from 5.0 to 5.7 per cent in the same period. The middle and upper middle level income groups improved their share only marginally. Finally the richest 20.0 per cent of the population did experience some reduction in their share of wealth, but still held more than 60.0 per cent of the national income in 1983.

TABLE 3.6 - INCOME DISTRIBUTION BY GROUP OF HOUSEHOLD INCOME IN THE PERIOD 1970-1983 (Per cent)

Percentile Group of Household income	1970	1980	1983
The Lowest 20%	2.0	2.0	2.4
The middle lower 20%	5.0	5.0	5.7
The Middle 20%	9.4	9.4	10.7
The Upper-middle 20%	17.0	17.0	18.6
The Upper 20%	66.6	66.6	62.6
The Highest 10%	50.6	50.6	46.2

Source: World Bank, **World Development Report** 1979 p.173; 1986 p. 227; 1991 p. 263.

Income distribution did not improve in the 1980s and remains one of the worst in the world. TABLE 3.7 shows that while in 1988 the richest 20.0 per cent of the Brazilian population retained 67.0 per cent of the national income, the poorest 40.0 per cent had only 7.0 per cent. Compared to others developed and developing countries, Brazil is the worst in these terms.

TABLE 3.7 -INCOME DISTRIBUTION BETWEEN THE RICHEST 20% AND THE POOREST 40% OF BRAZILIAN POPULATION IN COMPARISON TO SELECTED GROUP OF DEVELOPED AND DEVELOPING COUNTRIES IN 1988 (Per Cent of income)

Economically Active Population	Brazil	Vene-zuela	Argen-tina	India	South Korea	USA	Spain
The richest 20%	67.0	54.0	50.0	49.0	45.0	40.0	40.0
The poorest 40%	7.0	10.0	14.0	16.0	17.0	17.0	19.0

Source: World Bank, **World Development Report 1989.**

Most of the problems of income distribution are said to be related to the salary policies adopted in Brazil since 1964. Brum (1991:194) argues that while the totality of salaries paied, in relation to the internal income of developed countries is situated around 70.0 per cent, as in the UK, USA, Germany and Japan etc., and above 60.0 per cent in Spain, Italy and Portugal, in Brazil, the participation of labour in internal income has dropped from 60.0 per cent, in 1960, to 35.0 per cent in 1989. Conversely, the participation of capital has increased from 40.0 to 65.0 per cent, in the same period, suggesting that labour was highly exploited in the last three decades in favour of capital (TABLE 3.8).

TABLE 3.8 PARTICIPATION OF LABOUR AND CAPITAL IN THE NATIONAL INCOME - 1960\1989 - (Per cent)

Year	Participation of Salary	Participation of Capital
1960	60.0	40.0
1970	40.8	59.2
1975	38.4	61.6
1980	37.9	62.1
1988	38.0	62.0
1989	35.0	65.0

Source: Brum, Argemiro G. (1991). **O Desenvolvimento Economico Brasileiro**. 11th ed., Petropolis, Vozes, p.194.

In fact, the relative value of minimum wages in 1976, declined to 31.00 per cent of its value in 1959 (Brum, 1991:160). Despite working class struggles for better wages, the buying power of minimum wages has improved little since 1976. In November 1992, the minimum wage was approximately US$ 66.17 per month, while in 1959 it was US$ 112.00, the highest value ever obtained. Obviously in a country where, in

1989, nearly 76.0 per cent of the overall economic population was either without any income at all, or had an income less than one-third of the minimum wage (BUSINESS JAPAN, 1990:61), the impoverishment of the mass of the population is undeniable.

Although professionals are said to have benefitted from the economic progress of this period, they were also exploited, as the "new middle class" theory implies, mainly during the "miracle years" (1968-1973), in favour of capital accumulation. TABLE 3.9 shows that, the rates of productivity were much higher than the rates of real pay increases. This meant that all salaried workers were exploited by the regime in favour of capital accumulation. Rates of pay increases were kept, on average, 50.00 per cent of the level of productivity rates increases.

TABLE 3.9 - DIFFERENCES BETWEEN RATES OF PRODUCTIVITY AND RATES OF REAL PAY RISE - 1968\1973 - (Per cent)

Year	Productivity rates	Rates used to calculate salary growth	Differences in favour of capital
1968	6.2	2.0	4.2
1969	5.9	3.0	2.9
1970	6.4	3.5	2.9
1971	8.1	3.5	4.6
1972	7.2	3.5	3.7
1973	8.4	4.0	4.4

Source: Brum, Argemiro G. (1991). O Desenvolvimento Economico Brasileiro. 11th ed., Petropolis, Vozes, p.161.

4.2 Development in Health and Education

Investments in social areas were progressively cut down during the last three decades. As TABLE 3.10 shows, the expenditure on health dropped from 6.7 to 6.1 per cent of national expenditures, between 1972 and 1989. More drastically, the expenditure on education was reduced from 8.3 per cent of national expenditure in 1972, to 3.8 per cent in 1980 and to 4.2 per cent in 1989. A contradiction when considering that the period 1970-1980 was marked by high rates of economic growth.

TABLE 3.10 - PERCENTAGE OF THE NATIONAL EXPENDITURE WITH HEALTH AND EDUCATION IN THE PERIOD 1972-1989

Year	Health	Education
1972	6.7	8.3
1980	7.4	3.8
1982	7.8	4.6
1983	7.3	3.7
1986	6.4	3.0
1989	6.1	4.2

Source: World Bank, **World Development Report** 1984 p.269; 1985 p.225; 1985 p.223; 1988 p. 267; and 1991 p.225.

In fact, education is an historical problem in Brazil. When compared to the rates of adult literacy in a selected group of countries, Brazil's poor standing is highlighted. TABLE 3.11 shows that in 1850, only 10.0 per cent of the adult population in Brazil and Japan were literate, while in Sweden this rate had already reached 90.0 per cent. In 1985 Brazil still had 22.0 per cent of its adult population illiterate, while Chile, France, Hungary, Japan and Sweden had already eradicated such a problem. Thus, in 1985, Brazil's rate of adult literacy was equal to that of Japan 65 years ago.

TABLE 3.11 - ADULT LITERACY IN BRAZIL COMPARED TO SELECTED GROUP OF COUNTRIES - 1850 to 1985 (per cent)

Country	Year							
	1850	1870	1890	1910	1930	1950	1970	1985
BRAZIL	10	18	18	35	39	49	64	78
Chile	18	29	32	51	75	80	89	94
France	62	69	78	88	95	97	100	100
Hungary	--	31	51	68	90	95	98	100
Japan	10	15	37	69	92	98	99	100
Sweden	90	93	95	98	98	99	100	100

Source: Adapted from World Bank, **World Development Report 1991**, pp.55-58.

Moreover, TABLE 3.12 reveals that the proportion of Brazilian people enroled in secondary and tertiary education (University) has improved very little since 1960. The percentage of the age group (14-17 years-old) enrolled in secondary education, rose from 11.0 per cent in 1960 to 38.0 per cent in 1988 , while the percentage of those expected to be enrolled in University education (18 to 22-years old), rose from 2.0 per cent in 1965 to 11.0 per cent in 1988. Despite this improvement, there is still a high waste of human capital development, as 89.0 per cent of the Brazilian population (18 to 22-years old) does not have access to University education. If education affects development (see section 3.2), in the sense that educated people allow a faster rate of technological diffusion and progress, which in turn, affects productivity and consequently economic growth, low investment in education affects Brazil's economic competitiveness.

TABLE 3.12 - PERCENTAGE OF AGE GROUP ENROLED IN EDUCATION

Age Group and characteristics	Years					
	1960	1965	1975	1980	1985	1988
Primary Education	95	108	90	93	104	104
Secondary Education: (15 to 17 years old)	11	16	18	32	35	38
University Education: (18 to 22 years old)	2	2	10	12	11	11

Source: World Bank, **world Development Report** (1978, 1983, 1988 and 1991).

Education greatly affects the structure of the country's labour force. As TABLE 3.13 shows, the proportion of professional workers in relation to the Brazilian economically active population, increased only from 4.8 per cent in 1970, to 7.3 per cent in 1988.

Brazil's economically active population increased to 61,047,954 workers in 1988, 4,464,573 of which were professional workers (Yearbook of Labour Statistics, 1991:24). Among professional workers 450,000 were engineers, representing 10.01 per cent of this population. As TABLE 3.13 shows, the proportion of Brazilian professional workers in relation to the economically active population, was 7.3 per cent in 1988, a little higher than Korea (6.7%), but lower than Japan (10.8%), Germany (15.0%), and the UK's and USA's (15.9).

TABLE 3.13 also shows that the proportion of agricultural workers in relation to the active population, reduced from 44.4 per cent in 1970 to 21.8 per cent in 1988, though this is still much higher than that of developed countries. Moreover, the proportion of production workers increased only 1.9 per cent in the same period, suggesting that Brazil's economy still relies largely on agricultural production. Nonetheless, the proportion of workers linked to the informal economy (those not classified in other occupations), which Marx called "lumpen proletariat", rose from 4.6 in 1970 to 11.8 per cent in 1988. By far the highest figure for the countries compared. If the human capital theory is right, Brazil's economic backwardness may be partially explained by this lack of investment in qualified manpower.

- TABLE 3.13 -

DISTRIBUTION OF THE BRAZILIAN ECONOMICALLY ACTIVE POPULATION BY MAIN OCCUPATIONAL GROUPS IN COMPARISON TO SELECTED GROUP OF

Source: UNESCO, **Yearbook of Labour Statistics** (1974, 1986, 1991). International Labour Office. Republic of Brazil

Notes: (*) Occupational Groups:

4.3 Labour Organization and Class Politics

The organization and politics of workers has also developed enormously in the last 15 years. The workers' organizations had been demobilized during the unsuccessful strikes of 1968 in Contagem (Minas Gerais State) and in Osasco (Industrial district of Sao Paulo). In the following ten-years the government permitted pay rises much lower than inflation rates, and unions were allowed to discuss only those things related to the work environment. It was during these 10 years of salary compression and repression of the working class that a new generation of union leaders were created to develop a "new unionism" in the country. This new unionism was able to dismantle the corporate union structure ruled by the state since the 1930s and, whose officials represented capitalist rather than working class interests (Cunha, 1975).

Among the new generation of union leaders, Luiz Inacio da Silva (LULA) was the most successful. After ten years of tight control over union activities by the government, the metalworkers of Sao Bernardo led a major strike in May 1978, in response to the long dissatisfaction with the labour policies and the political regime. To avoid repression by the police, which had protected capital interests for many years, some 2,500 workers of Saab-Scania, in Sao Bernardo, under the leadership of "Lula", went into work and occupied their machines, but refused to turn them on. This unusual tactic led 500,000 other manual workers, from 90 industries of the larger Sao Paulo district, to support the movement. As a result, the employers accepted to negotiate directly with the rank and file workers' commissions, instead of with the union representatives, inaugurating a new phase of Brazilian trade unionism. From that time on, the mobilization of workers then became stronger and spread over the country, attracting allies from all sections of the salaried working class. The majority of the "middle classes" had supported the military coup, but as soon as they perceived the regime had failed to satisfy their interests, they also started campaigning alongside the new unionism of the working class (Cunha, 1975:398-400). As TABLE 3.14 reveals, the number of strikes increased enormously at the end of the military government, and increased even further with the civil government from 1985.

The success of the labour movement improved working class political organization and created the Labour Party (PT), whose Chairman, Lula, stood in the general elections for President of Republic in 1989, and only by very few votes, was defeated by Fernando Collor in the second round.

TABLE 3.14 - STRIKES AND LOCKOUTS IN BRAZIL: 1980\1989

Year	Number of Strikes	Number of Worker involved (in 1000 workers)
1980	81	--
1981	79	--
1982	126	--
1983	312	--
1984	534	--
1985	843	--
1986	1,493	7,146
1987	2,369	9,146
1988	1,954	7,136
1989	4,189	14,093

Source: **YearBook of Labour Statistics** (1890-90, 1991), International Labour Office, Republic of Brazil.
Note: (--) = Data not available

4.3.1 Engineers and Trade Unionism

The Engineer's Unions have existed in Brazil since 1931 but until the late 1970s they could be said to have been non existent. This is because they had been founded by engineer entrepreneurs and were led by engineers who represented the interests of management, rather than those of the salaried engineers. However, the new generation of salaried engineers embraced the experience of the Metalworkers Unions of Sao Paulo and reorganized all the existing Engineers Unions in the country and also created new unions, to the point where that nearly 30.0 per cent of the 450,000 Brazilian engineers were unionized in 1992 [7]. I shall discuss this further in chapter 11.

5. Conclusion

This Chapter has shown that over the last 60 years, Brazil has managed to set up an industrial structure which is relatively modern, diversified and sophisticated. It is also capable of exporting an important variety of manufactured goods, which has allowed the country to achieve a positive trade balance. Overall, the national economy already possesses a solid base and can continue expanding. Thus, the import-substituting industrialization approach is no longer an adequate strategy to lead the industrial expansion and the national economy in the near future. Brazil's economic and political development was able to create a national bourgeoisie, a small "middle class" and a large urban working class. Brazilian people also enjoy a high level of political freedom today. The working class is becoming stronger and better organized in all of its branches. In these terms Brazil was successful. However the quality of life of the majority of the population did not improve in the same proportion. Economic development seems to have been interpreted as mere economic growth and the people have been forgotten in this process.

Despite being the 8th largest economy in the capitalist world, Brazil's infrastructure for health and education is far below the standard of developed nations, and income concentration, in Brazil, is one of the worst among developing and developed nations.

The education of Brazilian people has improved significantly at the primary level, but this is not the case at the second and third levels. Only 11.0 per cent of the age group which could be attending university, are doing so. This means there is a high waste of human capital, which could be developed. In this sense, Brazilian politicians do not seem to be aware of the importance of qualified labour for economic progress, as argued by the "human capital theory". Despite these contradictions, economic development in Brazil was able to create a large group of professional workers, with engineers representing 10.01 per cent of this population. The proportion of Brazilian professional workers to the economically active population (7.3%), is lower than that of many other industrialized nations, but it is very close to Japan's (10.8%), and higher than that of the Republic of Korea

(6.7%) which has been seen as the symbol of progress in the last decades.

The proportion of engineers working in Research and Development is around 2.50 per cent of the overall population engaged in this activity. This suggests that the majority of those working in the profession are engaged in production related activities, such as production, maintenance, process production, quality control, etc. Although many Brazilian engineers rise to higher hierarchical positions during their career in organizations, the fact that they have been denied more opportunity to engage themselves in more creative engineering activities, places most of them closer to lower level management and in more direct contact with technicians and qualified workers. Chapter 4 establishes the research design and highlights some of these issues.

4. RESEARCH DESIGN

1. Introduction

This research aims to analyze the work situation and class position of Brazilian engineers. Previous research has shown that the best procedure to fulfil these aims is a comparative study and in-depth interviews with engineers and observation of their daily work-place activities. Whalley (1986), Zussman (1985) and Crawford (1989), successfully used these procedures to analyze the work situation and class position of British, American, and French engineers, respectively. Smith (1987) has also used in-depth interviewing and observations to analyze the work situation, class position, and attitude to trade unionism of British engineers. I have thus decided to adopt the same procedures to approach the case of Brazilian engineers.

The comparative case study approach has also demonstrated its advantages over research at a single site, providing a bench-mark against which to compare different sorts of industries and phenomena in different realities (Whalley, 1986). Thus, I have decided to adopt this procedure to compare the work situation and class position of Brazilian engineers, in one national and in one multinational company.

The major disadvantage of the case-study method is the difficulty in generalising the findings to a wider population. However, by studying these two companies closely and by seeing how such things as the nature of work, technological constraints, and other issues, for example, attitudes to profits, the human resource policies, the profit searching methods shape the relationship between capitalists and the technical labour force, we can better understand how these forces operate in the society in general. Moreover, by combining these procedures to a well selected sample of engineers and careful data analysis, the limitations of such a research method can be reduced.

To achieve such objectives, it was necessary to obtain information at four levels: the company level, the engineers level, the State level and the professional institutional level. At the company level, information about the history of the companies was studied, including their products, technology, organizational structures, management style and their human resource management characteristics. At the department level, where engineers work, it was essential to examine the hierarchical structure, the division of labour, the nature of the engineers' work, their work environment, their status provision, the nature of supervision, and the engineers relationships with technicians and production workers. All of this was important to explain how the company manages professionals.

At the engineers level it was necessary to obtain detailed information about the following aspects: their education and occupational background, their career orientation, the nature of work, the degree of autonomy at work, satisfaction in the job, position within the labour process, performance evaluation, the relationship with management and workers, identification with company values, their experience with the human resource policies, their ideological, political and economic contexts, their class identity and class perceptions. It was also necessary to determine how their attitudes to the engineers professional associations are affected by their experience at work, and by the ideology they bring from the education and training systems.

At the State level, it was necessary to know how the society and the State itself have organized the engineering education and training systems, in order to produce and reproduce the engineers ideology, professional values and labour power.

Finally, at the professional institutional levels it was necessary to see how engineers are organized in terms of professional associations and trade unions. This involved interviews with representatives of the CREA - Conselho Regional de Engenharia e Arquitetura (Regional Council of Engineering, Architecture and Agronomy), in order to understand their aims and politics to establish and control the engineers labour market, status and professional legitimacy. I also undertook interviews in, and secondary source search of, the SENGE\MG (Sindicato dos Engenheiros to Estado de Minas Gerais or Engineers Trade Union of the State of Minas Gerais), to identify its organizational form, aims, actions and class politics. This provided an understanding of the extent to which the engineers involved in this research, were involved with the engineers' unions.

2. The Choice of a National and a Multinational Company

Previous researchers employing the comparative Case Study analysis approach (Whalley, 1986; Zussman, 1985; Crawford, 1989), have adopted the strategy of selecting a **"new industry",** with high knowledge-technology content and of recent origin, and an **"old industry"**, with relatively low knowledge-technology components and originating from the heyday of the first industrial revolution.

Thus, the above researchers chose electronics and metal-working industries, as representatives of these two divergent industrial settings. By comparing "old" and "new" industries in different countries, these researchers included in their research design the question of national context, and its implication for the shape and organization of technical labour. Their findings suggested that neither technology nor industry were fundamental to engineers, as similar features were found for engineers in both sorts of industries (Smith, 1990a). Crawford concluded that "the only generalisation that can be made about the rise of science based industries is that they require many more technical workers than other industries and that they employ a larger proportion of them in technical specialities outside the traditional, labour-intensive functions of production and maintenance" (p.235). Whalley also concluded, like Crawford, that the **national context,** and not technology, industrial structure or class relations, offered the best explanation for differences in the social organization of engineers in the countries studied. These conclusions raise the possibility of an infinite variety of ways in which technical workers appear in, and occupy, the division of labour. They also seem to challenge the structural dynamics of capitalism, such as the internationalisation of labour markets, capital and production, which seek to undermine and modify these "cultural" and historical structures (Smith, 1990a:7).

Taking these points into account, I thought it would be a good opportunity to extend the previous approaches by comparing one national and one multinational company in a developing country, like Brazil. This approach (highlighted by Smith) appeared relevant since it would allow us to analyze the implications of multinational capital and ideology in the national context. Thus, I decided to add the question of national and multinational companies to my research design. Since the question of high/low-tech enterprises did not prove very meaningful in previous comparative analysis, I decided not to consider this variable in this research, although the companies selected could be classified into these two categories.

2.1 Basic Aspects involving Multinationals

The study of multinational corporations (MNC) constitute a very important subject of analysis in itself, due to their impact on the world economy. However, their study is of special importance in the case of Brazil, because MNCs have played a central role since the beginning of the country's industrialization. The first MNCs to set up business in Brazil were those in the electrical sector, during the last decades of the nineteenth century (Newfarmer & Topik, 1982). During the 1950s, the MNCs of the automobile industry established their business in Brazil, and during the last three decades they have managed to consolidate their position in the most dynamic sectors of the country's economy. Of Brazil's five hundred largest and best companies, in terms of economic performance, the majority are foreign owned or are joint-ventures, and they are present in the most dynamic sectors of the national economy (Exame, 1991).

A complete examination of the role of multinationals in the developing world would require the elaboration of a specific thesis on the subject, and therefore goes beyond the scope of this Chapter. For the purpose of this research, I will concentrate only on some of the criticisms which have been made about the contribution of MNCs to Third World countries, and especially to Brazil. These criticisms are in terms of the direct investment of MNCs, technology transfer, their investment in Research & Development, job creation, their relationship with labour, and how these variables affects engineers labour market and work situation.

2.1.1 Economic Aspects

The contribution of MNCs to the development of Third World countries has been seen as both positive and negative, depending on the ideological tradition of writers on these issues. Writers associated with the "dependency school", consider the MNC to be one of the instruments by which advanced capitalist societies (the "centre") keep the developing countries (the "periphery") at a disadvantage in the international economy (Chaudhuri 1988:58). Firstly, the benefits of foreign direct investment are "unequally" or "unfairly" distributed between MNCs and host countries in favour of the former, and so, in effect, MNCs are able to siphon off investible surplus. Second, MNCs create distortions in the local economy by squeezing out local business, using inappropriate technology, acting to worsen the distribution of income, and finally, distorting consumer taste. Thirdly, foreign investors pervert or subvert the political processes of the host country(Newfarmer & Topik, 1982:33).

For those associated to the "bargaining school", MNCs and LDCs need each other, and whenever both parties have managed to reach agreements with respect to the sharing of benefits it has been mutually advantageous (Ibid.p.58).

The main advantages for the LDCs in associating with the foreign capital are said to be: the inflow of foreign capital; the possibility of immediate use of new technologies; the access to organizational and managerial capabilities; facilities to obtain access to credit through banks linked to the associated multinationals; facilities to export to markets controlled by such corporations; the generation of employment and tax; and the creation of small industries to supply parts and components (Brum, 1991:180).

The disadvantages are associated with the import of technology by MNCs, in the sense that, while developing countries need technology which employ more labour, foreign companies in turn, prefer to use capital intensive technology which save human labour and produces more profits. Thus, beside preventing the development of national technology, MNCs inhibit the creation of the labour market at all levels, but especially for the scientists and engineers of the host country (Ibid, p.180).

Nonetheless MNCs have to compete in the market of the host country, and so they must adapt to local environments. Within these circumstances, MNCs are forced to adapt their managerial practices, organizational structures and even their product lines, to respond to the economic, political, social and labour demands of the host country (Chaudhuri, 1988).

2.1.2 Labour Issues

Despite MNCs being seen by more orthodox writers as powerful institutions which can impose their will upon the local actors of the industrial relations were their operate (Bomer 1976:2), the debate tends to show that MNCs are, in fact, vulnerable institutions, in relation to time, place and internal condition, and are sensitive to labour demands and pressure (Ramsay & Haworth 1991:292).

The reasons for these are various. Firstly, it is assumed that the subsidiary's management are better acquainted with the country's customs, norms and regulations. Consequently, they are in a relatively favourable position to influence decision-making on local labour issues. This is the reason why industrial relations is one of the most decentralized functions within large corporations (Warner and Turner 1972).

Secondly, for Ramsay & Haworth (1991:289), management of human resources is a problem for any sort of firm, be it a MNC or not, because besides capital not being supremely coordinated in its actions, labour is itself an active and often resistant force. Therefore, the need for the MNC to attend to the demands of local markets and politics, puts them more or less in the same power position relative to labour as domestic enterprises. Although it has been found that headquarters management keep tight control over the Human Resources Management of their subsidiaries (Purcell et al. 1987), central management has been forced to decentralise this function in order to attend demands of the labour of the host country (Warner and Turner 1972).

Finally, Harvey (1982) has argued that the power of capital is enhanced in each locality by the maintenance of spatial divisions in the working class. Thus, decentralization has been an alternative way to insulate local bargaining and management of human resources from international developments in wages and working conditions, because international labour links can increase the power of labour at the negotiation table. In short, the literature suggests that although the management of Human Resources in MNCs tend to adopt the practices of the host country, in order to adapt to certain contextual variables, the headquarters management are able to keep control over the main human resource policies of their subsidiaries. Consequently, there would be significant differences in the human resources policies of national and multinational companies.

2.1.3 Multinationals in Brazil

Ever since the First Republic (1889-1930), MNCs have been welcomed in Brazil. However, during the period of National Populism (1930-1955), their operation in the country was subject to more scrutiny due to the nationalist ideas feeding the government (Newfarmer and Topik, 1988). During the JK government (1955-1961) and later the Military government (1964-1985), it was considered that the association with foreign capital would bring more advantages than disadvantages for national development. Thus, the relationship between the Brazilian government and multinationals became much easier. Instead of having to make concessions to enter the Brazilian market, MNCs from all around the world were invited to set up business in Brazil. These two governments also created various forms of subsidies, fiscal incentives, and labour legislation, to make the country even more attractive to foreign investors.

For some critics of MNCs' behaviour in the Third World, Brazilians have never perceived a natural conflict between themselves and foreigner investors. Consequently, this lack of criticism, the inability to negotiate well with MNCs, plus the complex interaction between the evolution of class relationships in the political economy of Brazil after the proclamation of the First Republic in 1889, as well as the exercise of MNCs' economic power in international markets, are seen as the main reasons for the present foreign control over Brazilian industry and its contemporary "dependent" position (Newfarmer & Topik, 1982:53).

This lack of criticism can be perceived in the scarcity of specialised literature on the subject in Brazil. However, Brum (1991), in a review of the available literature on the role of MNCs in Brazil has shown that when the military government opened the doors to the MNCs, it believed they could provide an important contribution to national development. Their main contribution was seen as giving access to captivation foreign savings, the transfer of managerial capabilities, the diversification of export goods, the transference of technology and the investment in R & D in the country. It was also believed that MNCs would favour the development of national suppliers and create jobs for non-qualified as well as for qualified labour (Brum, 1991:209).

Brum (1991) has also shown that in all aspects considered by the Brazilian governments on the issue of whether to open the country to MNCs, the contribution of MNCs has been relatively small to Brazil. Firstly, the inflow of capital through MNCs represented only 15.0 per cent of all the foreign investment in the country. Secondly, instead of transferring technical and administrative capabilities to Brazil, MNCs have made use of the existing scarce qualified labour force to their own benefit, absorbing it from national firms. Thirdly, MNCs have reserved the top positions, where critical decisions are taken, for executives from their home countries, and executives from the host country have been allowed to participate only in simple decisions (Brum, 1991:210). Thus, instead of creating job opportunities for technical professionals and national executives, MNCs prevent local managers from assuming top positions while expanding the labour market in Brazil for executives from their home country. However, this is not a problem related to Brazil only. Japanese firms in Ireland do the same. According to Wickham (1992), the Japanese firms in Ireland "have a small layer of senior management which is entirely Japanese, so that there is a clear limit on the internal promotion that their Irish engineers can expect" (p.178). Therefore, he argues that "although Irish employees visit Japan, permanent jobs in Japan remain completely closed to them" (Ibid. p.1978). This supports our view that, MNCs adopt different human resource policies from national company, as argued in the section 2.1.2.

Fourthly, the contribution of MNCs to Brazil's export position is impressive, but it is highly subsidized in order to make national products attractive in the foreign markets, bringing little contribution to the country's economy (Brum, 1991:210).

Fifthly, MNCs are neither interested in transferring technology, unless it is no longer "state-of-the-art", nor in investing in Research & Development in Brazil, because a new product has to be patented locally. Instead, MNCs concentrate financial, human and material resources in laboratories close to their headquarters, in their home countries, and attempt to acquire all scientific developments which interest them, wherever they are produced in the country (Brum, 1991:211). This suggests, that as MNCs import the technology they use in host countries, from their home countries, they are expanding in the host countries, the labour market for their home country's scientists and engineers. However, by importing technology MNCs are providing opportunities for host country engineers and scientists to work with and gain competence with these technologies. Therefore, as MNCs create job opportunities for only a minority group of host country scientists and R & D engineers to work in areas of Research and Development, they tend to become a local elite.

Finally, the utilization of capital intensive technology in the most dynamic industries, has prevented the creation of jobs for an expanding available work force. This expansion arose from population growth, and the migration from rural to the urban areas during the years of high economic growth of the late 1960s and 1970s. What is most revealing, is the fact that the use of foreign technology constitutes a barrier to national scientific and technological development, and for the creation of jobs for Brazilian scientists and engineers (Ibid, p. 211)

In short, the literature suggests that although multinationals are forced to adapt to the labour legislation and labour environment of the host country, they still manage to reserve the top hierarchical positions for the executives from their home country. By doing so, they do not transfer managerial capabilities, because the meaningful decisions are taken by the top hierarchy without the participation of executives from the host country. Moreover, this reduces the chances of careers progression for host country executives as they can only achieve middle level positions in these companies. Furthermore, as MNCs import their basic technology and do not invest in Research and Development in the countries where they have set up subsidiaries, they do not create jobs for host country scientists and engineers in that area of engineering. As a result, host country engineers are pushed into working in production related activities only. Obviously, this affects the nature of their work and work situation, their status, and the perspective of career in these companies. These will be the main points I shall be examining in this research concerning multinationals.

2.2 Sampling the Companies

In order to make possible the generalisation of the findings of this research to a wider context (of companies and of engineers), three main aspects were taken into consideration in the selection of the companies: 1) The importance of the business sector in which they operate within the Brazilian economy; 2) Their size and representativeness within their business sector and; 3) the number of engineers employed. their geographical location was also important, since it implied cost and time to carry out the field work.

Four business sectors were initially selected: the auto-industry, the steel industry, energy and telecommunications. However, some initial problems were detected, as the auto-industry is controlled by multinationals and the other three sectors are controlled by the Brazilian government. So, I was left with the alternative of examining two **sectors**, one with multinational dominance, the other with national capital. A complicating factor was geographical dispersal of the two industries. Most Brazilian steel companies are located in the state of Minas Gerais whilst most of the auto-industry is in the state of Sao Paulo. Hence, the fieldwork would be expensive because of the distances between these regions. However, there is one large German steel company and one big Italian auto-company in the State of Minas Gerais, both geographically located in the industrial city close to Belo Horizonte, the state capital of Minas Gerais. Furthermore, the most important state-owned companies of the energy, telecommunication and steel sectors have their headquarters in Belo Horizonte. Five of the above companies were thus contacted (one German steel company, one Italian car-manufacturer, one telecommunication company, one energy company and one Brazilian steel company) to seek permission to carry out the fieldwork. Fortunately, four of these companies gave permission to do the work, though the Italian car-industry refused access because my interviews with engineers would involve some questions concerning engineers and trade unionism. One more problem also arose. The Brazilian steel companies were on the government's target for privatisation. I thought the transition period could affect the organizational climate and consequently the quality of the data I would gather. Thus I was left with three companies: one German steel company, one Brazilian state-owned telecommunication company and one state-owned energy company. The energy and the telecommunication companies are very similar in all the criteria initially considered, but as the energy company had been the first to answer my request, I felt it was more willing to participate in this research. My final choice therefore, was a German steel company and a Brazilian energy company. Thus, this meant it was possible to compare a multinational and a national company, and at the same time, a private and a public sector enterprise.

Finally, one other important aspect to consider is the fact that my concern in this research is to examine the issue of national versus multinational company differences. The issue of **nationality** goes beyond of the scope of this research. Nonetheless, some aspects of the managerial culture of the german company will be addressed in specific topics of the following chapters.

3. Research Procedures

After choosing the two companies and having access confirmed, I then explained to them the procedures I would follow during the gathering of data. With their help I managed to select a sample of engineers for each company and to book all the interviews. Both companies provided all the resources I needed. They provided me with a room with telephone facilities, and also appointed one professional from the Training Department to help me to book the interviews. Both companies also made available the records of information about the human resource policies and practices such as salary scales, career patterns, benefits scheme, recruitment and selection procedures, training policies and so on, which I found necessary to examine. In the multinational company it was a little harder to obtain this information, because everything related to salary policies and practices are treated as confidential.

Two main procedures were followed to gain information at the organizational and the engineer level of the two companies. In both companies the organizational research was made through observation and interviewing with the persons responsible for the main departments, divisions and sections that compose the Directory Body of Human Resources Management for each company. Interviews were also conducted with people responsible for Industrial Relations, Organization & Methods Divisions, and Strategic Management Departments, in order to understand the company's norms and procedures, the logic of their organizational structures, the organization of the labour process and the status and power structures within the companies. Finally I also interviewed the person responsible for the departments of Social Communication, in order to understand the channels of communication between the company and its employees.

Most of the observations were made during the period the engineers were interviewed because, I had to interview most of them in their own work environment. This provided me with the opportunity to perceive the differences in terms of resources, facilities, working conditions, relations with managers and other workers, and the content and characteristics of their work between the two companies.

The research with the engineers was carried out within the company, during working hours. The engineers were randomly selected by myself and a representative of the Human Resources Department of each company, from the population of engineers of each department were engineers worked. All the interviews were carried out by myself, making it possible to keep control over the quality of the information gathered and over the time spent with every engineer interviewed. All the interviews were booked in advance by the training department assistant and a period of about two hours was reserved for each one. None of the engineers put off or postponed their booked interviews. All of the engineers interviewed demonstrated an interest in what I was doing, and this seems to have helped me in getting their cooperation and creating freedom for them to talk sincerely about the questions presented.

I spent two months in the Energy Company and one month and a half in the German Steel Company. I undertook three interviews a day, on average, from Monday to Friday. I spent three more weeks interviewing representatives of the Engineers Union (SENGE/MG), the Engineering Council (CREA/MG), and the Engineering Schools of Belo Horizonte. Thus, I spent four months, from February to June 1991, completing the fieldwork.

It was decided that I would not use the real names of the companies involved. Thus, from now on I will be referring to the multinational company as **"INTCO"** (international company) and to the Brazilian company as **"NATCO"** (national company).

4. The Sample of Engineers

As distinct from the USA, France, Germany and England, where a technical worker can achieve the status of engineer through training and experience in a company, in Brazil, engineers are only those who have obtained a university degree in engineering. Furthermore, to obtain the legal right to exercise as a professional graduate engineer, registration of the diploma with the **CREA** (Conselho Regional de Engenharia, Arquitetura e Agronomia or Regional Council of Engineering, Architecture and Agronomy), is necessary as this is the legal Institution responsible for controlling entry to, and the practice of, the profession.

In Brazil, each profession has its own **Conselho** (Council), to control its labour market and professional organization but, technologists and technicians are also registered with the CREA because the content of their activities are considered similar. However, technicians are educated in technical and practical terms to be an adjunct to the engineer, as subordinate staff. Thus, their place in the technical hierarchy, their prestige, status, power and the like, differ significantly from those of engineers. Technicians are considered middle level professionals. Therefore, it was necessary only to include in the sample professional graduate engineers. Furthermore, many Brazilian engineers rise to higher managerial positions, as directors or presidents, in the course of their career in companies. Thus, it was also necessary to include in the sample, engineers who had already reached the first and second levels of the managerial hierarchy, since their tasks still involve a certain level of application of engineering knowledge. These employees were probed, in part, to gain an understanding of their feelings towards their move from a technical to a managerial position. INTCO engineers are approximately 50\50 per cent engaged in technical and managerial functions, while at NATCO, 77.00 per cent of the engineers are engaged in technical functions and 23.00 per cent in managerial roles. Thus, the sample, by company, was composed following the same proportion of their distribution in these functions. However, the overall sample was composed of 66.00 per cent engineers in technical positions and 34.00 per cent in managerial roles.

Following the division of labour, the criteria of technical versus non-technical work was also used in the composition of the sample. Thus, it included engineers who work in the typical engineering areas of the two companies, such as research, projects, methods, production, maintenance, quality control, supply, training, workplace safety and data processing.

In order to focus on the significance of the differences between national and multinational firms and on the significance of differences of position between engineers and managers, the sample needed to be as homogeneous as possible to permit comparisons. Thus, the distribution of engineers by functions, is proportional for the two companies and the number of engineers they employed.

As the research also aimed to provide sufficient information for future comparative analysis between advanced and developing societies, the size of the sample needed to be compatible with previous research, for example: 110 (Whalley), 122 (Crawford), 80 (Zussman) and 57 (Smith). Thus, the overall sample totalled 114 engineers, including 44 from INTCO and 70 from NATCO.

In defining the sample size, I took into consideration the size of the engineer population for the two companies. NATCO employs 19,000 workers, and 1,400 of them are engineers. This technical workforce is spread throughout eight Directory Bodies, which in turn are organized into thirteen Superintendences of the same hierarchical level, which are themselves organized into Departments and which are then organized into Divisions (see FIG 4.1). Within this structure we find engineers in the most diverse positions, from trainee engineer to President. INTCO employs nearly 7,600 workers,224 of whom are engineers, also distributed within 6 Superintendences. At INTCO, as well, we find engineers occupying different positions, from those of trainee engineers through to the engineer President. Therefore, a brief comment on the organizational and hierarchical structure of the two companies is necessary, to understand the characteristics of the two samples. INTCO and NATCO adopt similar hierarchical structures but with different denominations (FIG.4.1).

FIGURE 4.1 - HIERARCHICAL STRUCTURES OF THE COMPANIES

	INTCO	NATCO
1st level	Presidency.............>	Presidency
2nd level	Directorship Level.....>	Directorship Level
3rd level	Chief of Area..........>	General Superintendency
4th level	Department ....>	Superintendency
5th level	.......................>	Department
6th level	Service ....>	Division
7th level	Assistant Engineers ...>	Engineer Tech Coordinator
8th level	Engineers ....>	Engineers

Source: Interview data

Although INTCO and NATCO have a similar hierarchical structure, INTCO has one hierarchical level less than NATCO. Department, at INTCO, (see 4th level FIG.4.1) is equivalent to Superintendency, at NATCO. It means that INTCO engineers are nearer the top of the structure than their NATCO counterparts.

As the engineer population for the two companies is very different in size, I had to base the sample size for each company by considering the minimum size necessary for scientific purposes and for statistical comparisons. I thus interviewed 70 engineers from NATCO, which represents 5.00 per cent of its engineer population, proportionally distributed by Directory Body and Superintendency (TABLE 4.1)

TABLE 4.1 - SAMPLE COMPOSITION BY AREA OF ACTIVITY - NATCO

Directory Body	Superintendency	Sample	Total
Production and Transmission	Operation and Control	6	22
	Production/Transmission	5	
	Coord. of Production	4	
	Maintenance	7	
Distribution of Energy	Distribution	8	15
	Distribution Centre	4	
	Distribution South	3	
Projects and Construction	Electrical Systems	5	23
	Power Generation	5	
	Construction	7	
	Planning and Coordination	6	
Research and Development	Studies on Energy	5	10
	Research and Studies on Gas	5	
		N=70	N=70

Source: Research data.

At INTCO I interviewed 44 engineers, representing 20,00 per cent of the population, and chosen according to the same strategy. Table 4.2 shows the sample composition by areas of activity.

TABLE 4.2 - SAMPLE COMPOSITION BY AREA OF ACTIVITIES - INTCO

Directory Body	Superintendency/Department	Sample	Total
Industrial	Production	17	30
	Maintenance	7	
	Research/Test/Quality Control	6	
Administrative	Data Processing	4	12
	Personnel Training	5	
	Safety on the Job	3	
Commercial	Commercial	2	2
		N=44	N=44

Source: Research data

After defining the number of engineers to be interviewed in each Superintendency of the two companies, I then had to select engineers occupying different positions within the hierarchy. As I have mentioned earlier in this Chapter, the sample had to be composed of engineers in both technical and managerial positions. As shown on TABLE 4.3, most of NATCO's sampled engineers were concentrated in the 7th and 8th levels of the hierarchy (see FIG.4.1) from the top to the bottom (as technical coordinators or engineers), while INTCO's representatives were evenly divided between the 6th and 8th levels (as Chiefs of Service and engineers).

TABLE 4.3 - SAMPLE COMPOSITION BY POSITIONS IN THE HIERARCHY

Hierarchical position	Hierarchical level from top\bottom	Companies		Total
		INTCO	NATCO	
Chiefs of Department	4th\5th	6	5	11
Chief of Division/Service	6th	17	11	28
Technical Coord./Assistant	7th	3	22	25
Engineer	8th	18	32	50
		N=44	N=70	N=114

Source: Research data

It is noticeable that the engineers' average age in the two companies, is 38 years for INTCO and 37 for NATCO. It is also interesting to observe that only 6 engineers of the sample were more than 46 years old and only one engineer was 25 years or younger. This suggests that these engineers were in the mature period of their career (TABLE 4.4).

TABLE 4.4 - CHARACTERISTICS OF THE SAMPLE BY AGE

	Companies		
Age group	INTCO	NATCO	Total
Up to 25 years old	1	0	1
26 to 35	13	27	40
36 to 45	26	41	67
46 to 55	4	2	6
Over 55	0	0	0
	N=44	N=70	N=114

Source: Research data

The characteristics of the sample by sex shows that there were no female engineers in INTCO and only 5 in NATCO. Thus, the sample could not have been more different in this respect, as NATCO employs about 200 females among its 1,400 engineers, while in INTCO, there were no female engineers in the technical staff (Table 4.5). This suggests that, in Brazil, engineering is still seen as a male profession.

TABLE 4.5 - SAMPLE CHARACTERISTICS BY SEX

	Companies		
Sex	INTCO	NATCO	Total
Male	44	65	109
Female	0	5	5
Total	44	70	114

Source: Research data

5. Questionnaire Design

The interview schedule (Appendix 1 to 6), used in the fieldwork was based on earlier research instruments adopted by researchers who had dealt with similar subjects of analysis

(Whalley, 1986; Crawford, 1989; Smith, 1987), and from other references taken from the current literature on technical labour.

The data concerning the engineers was collected using the **Interview Schedule 1** (Appendix 1). The questionnaire is composed of 71 semi-structured, pre-tested, open-ended and closed questions, covering the main variables related to the work situation and class position of Brazilian engineers. It measures the variables related to the educational background of the engineers, their perception of the general working conditions within the two companies, their attitude to trade unionism and professional associations, as well as their class relations and class politics. A clear specification of the variables and the questions used to measure them is presented in Appendix 8 (Identification of the Variables in the Questionnaire).

The closed questions were formulated according to a scale, in which the expected answers are graded from 1 to 5, according to the judgement of the respondents. Respondents were given a scale card with each of the closed questions so that they could formulate their answers. These grades are essential to generate quantitative data which can allow us to make statistical analysis involving the study of similarities and differences between the subjects studied, as well as to identify the degree of association between variables. The open-ended questions were adopted in order to improve the qualitative analysis of the data collected through closed-questions.

Social scientists have used the perception or judgement of subjects in social research for a considerable period of time. Lowler and Porter (1968), in their study of the impact of the structure of internal labour markets and of salary administration (salary equity, flexibility, rationality and diffusion of information about salary policies etc) on the engineers' behaviour, argue that if there is an impact from the characteristics of salary administration in the engineers' behaviour and attitudes, it is due to the way engineers perceive these characteristics rather than to the way they are actually applied. In order to analyze the consequences of the way the two companies manage technical labour for the work situation and class position of engineers, the perception of the engineers in relation to these issues had to be determined.

Although Whalley (1986) and Crawford (1989), two of the most representative works on the subject, do not give any explanation of how the quantitative data which they use in their work was generated, their analyses suggest that they also had to categorise the answers given by the engineers involved in their research, in order to establish relationships between variables analyzed through the chi-square test.

In order to collect the data about the companies, **Interview Schedule 2** was drawn up (Appendix 2). This was used for the interviews with the representatives of each company and to guide secondary search in the files of the companies. It covers eight main variables related to the companies, which are of interest of this research. These are: 1) the company history and position in the business sector; 2) the main products of the company; 3) the political, economic and labour environment in which the company operates; 4) the technology employed; 5) the market serviced; 6) the organizational structure; 7) managerial style and; 8) human resource policies.

The **Interview Schedule 3** (Appendix 3) was designed to guide the interviews with the heads of division where engineers work and the observations of the engineers work environment. It also covers eight variables of interest for this research. These are: 1) the nature of the engineer's work in each department; 2) the division of labour; 3) the nature of the work performed by engineers (if technical or administrative); 4) the characteristics of the physical work environment (for example, location, noise, dirtiness, comfort, size, facilities etc); 5) the status provision for engineers and managers; 6) the nature of supervision (if close or flexible); 7) the relationship of engineers with technicians and production workers; and 8) the hierarchical structure in the workplace.

In order to collect data concerning the education system, **Interview Schedule 4** was drawn up (Appendix 4) to guide the interviews with the Education System's representatives, and the secondary search in the engineering schools. It is composed of nine main topics, covering the evolution of the engineering schools in Brazil, the structure of the engineering courses, the content of the disciplines, changes in engineering education during the last three decades and the reasons for these changes, the relationship between engineering schools and enterprises, and the implications of the University reform of the 1960s and 1970s for the engineering profession.

In order to guide the data gathering in the Council of

Engineering **Interview Schedule 5** was drawn up (Appendix 5). The schedule was used for both secondary search and interviews with the President and Directors of the CREA/MG (Council of Engineering, Architecture and Agronomy of the State of Minas Gerais). The interview schedule covers six main aspects related to the engineering profession in Brazil, from the point of view of the Council of Engineering. These are: 1) the foundation and development of the functions of the Councils in Brazil; 2) explanations for the structuring of the engineering occupation and its transformation to a profession; 3) the evolution of the figures of Engineering Council's members; 4) the policies of labour market control for the engineering profession; 5) the engineers' Ethic Code and its ideology of professionalism; and 6) the trends in the profession's status, prestige, power, values and labour market.

Finally, **Interview Schedule 6** (Appendix 6) was prepared for the collection of data in the Engineers' Union. The schedule was used to guide interviews with Union Leaders and to undertake document search. It covers eleven main variables related to the engineers' union, which are of interest to this work. These are: 1) the time of foundation of the engineers' Trade Union and why; 2) its ideologies and class politics; 3) its recruitment strategies; 4) its membership; 5) its main conquest, if any; 6) trends in unionisation among engineers; 7) relationship of the Engineers' Union with the Engineers' Society and Council of Engineering; 8) its relationship with other unions; 9) its relationship with political parties.

6. Data collection

The data was collected following the questionnaire and interview schedules presented in the Appendices (1 to 6). All of the interviews (with engineers, managers, representatives of the companies, Council of Engineering, Engineers' Union and Education System) were carried out individually. Such a procedure allowed me to understand a little better the answers given by each interviewee. It also made it possible to increase the level of confidentiality and confidence between the interviewee and myself, such that, I believe, the quality and reliability of the data gathered was high.

7. Data Analysis

The data analysis is based on a combination of quantitative and qualitative analysis, in order to improve the explanations for every variable considered in the analysis. Descriptive statistics are used to analyze some grouped data, and the Chi-Square test is applied in order to make it possible to argue about the relationship between variables involving engineers in the two companies.

7.1. Procedure for Statistical Analysis

As argued in chapters 1 and 2, this thesis aims to answer three general questions: 1) How are engineers produced, used and reproduced in a developing capitalist society?; 2) How does the capitalist firm manage professionals?; 3) What are the consequences of these two forces on the work situation and class position of Brazilian engineers. This model of analysis implies that it is necessary to categorize the various characteristics of the sample of engineers and managers, in terms of their educational background, specialization, job history and their working situation in the two companies, as well as how they react to their employment reality in terms of politics, collective organization and militancy.

Therefore the work involved a comparative analysis of the work situation of engineers and managers in two different settings. Thus, to measure the degree of homogeneity and independence between the variables involving the engineers and their work situation and class position in two companies we adopted the Chi-Square test, which is often used in this sort of social research (Dowdy and Wearden, 1983; Ott, 1990; Hays, 1981). Statistical techniques were also used to obtain the frequency distribution. The statistical analysis (krosstab and calculations) were undertaken by using the statistical package MICROSTAT [1].

Finally, in order to reduce the concentration of information in the Contingence Tables throughout the thesis, it will be informed in the footnotes of each table only the chi-square value (x^2), the probability (P), and the statistical decision, i.e, if there is similarities or differences between the variables analyzed, or rather, if there is or not association between variables. All the results of chi-square statistics, including their critical values, are summarized in the Appendix 9.

5. THE EDUCATIONAL BACKGROUND OF BRAZILIAN ENGINEERS; and The Situation in INTCO and NATCO

1. Introduction

Engineering, like other professions, is produced and legitimated, in Brazil, by two basic systems: the educational and the professional (Vieira, 1985). The educational system is composed of the institutions responsible for the superior or university education, in the various fields of knowledge (Ibid. 1985). In Brazil, the superior education system is composed of Universities - public and private, faculties, education institutes, and institutions such as the Federal Council of Education and the Ministry of Education and Culture. The professional system, is comprised of those institutions which are responsible for controlling entry to, and the exercise of, the professions (which require an academic diploma), and for defending the interests of their members. In Brazil, CONFEA - Conselho Federal de Engenharia, Arquitetura e Agronomia (Federal Council of Engineering, Architecture and Agronomy), and its state branches, called CREAs - Conselhos Regionais de Engenharia, Arquitetura e Agronomy (or Regional Councils of Engineering, Architecture and Agronomy), are the institutions legally responsible for controlling entry to, and the exercise of, the engineering profession in the country.

I would like to add, that the **Political and Economic System**, which embraces the above systems, are the most powerful for the production, reproduction and the legitimation of any profession. This can be explained with reference to the professions which have appeared with the development of capitalism, like engineering, business administration, computer science etc, while others have almost disappeared or have been replaced by new ones. Thus, engineering, like other occupations, is legitimated by the economic system in which it is inserted. Its progress is related to the importance attributed to it by the economic system. The status of the professions, and its prestige, power and economic value, depends on its usefulness to the economic and social systems. Thus, to gain an overview of the engineering profession in Brazil, it is necessary to see how the political and economic systems have influenced the process of its production, reproduction and legitimation.

This Chapter examines the evolution of the Brazilian education system. Special references is made to the way engineering education has been transformed in Brazil, in order to shift the engineering profession away from its initial liberal condition to that of an organizational profession. In addition, this chapter examines the extent to which the educational and social background of INTCO and NATCO engineers, follows the patterns designed by this education and economic system.

2. Engineering Education in Brazil

During the first three hundred years of the Portuguese rule in Brazil, no attention was given to any sort of education. As a result, in 1850, 90.0 per cent of Brazil's population were illiterate (World Bank, 1991:55). The sons of rich families used to be sent to Portugal, France and England, to attend courses of Medicine, Law and Engineering. With the Royal Family's move to Brazil, in 1808, the situation improved a little. In 1810, the Academia Real Militar was founded (The Royal Military Academy), by D. Joao VI, the Portuguese King, to train military engineers and artillery officials. In 1839, civilians were also allowed to engage in study at the Military Academy. It was latter transformed to the Escola Politecnica do Rio de Janeiro (Polytechnic School of Rio de Janeiro). In 1875, the Escola de Minas de Ouro Preto was created (School of Mines of Ouro Preto), to train mining engineers, geologists, mineralogists and metallurgists, to attend the market demand related to the exploitation of the rich mines of the State of Minas Gerais (Castro, 1955). In 1894, the Politecnica de Sao Paulo was created (Sao Paulo Polytechnic), and 1896, saw the founding of the Engineering School of the Mackenzie College (Kawamura, 1979).

Engineering education was initially very generic, because engineers were expected to perform only bureaucratic functions in the State apparatus, in projects to build railways, ports and hydroelectric power stations. Most of these undertakings used imported technology and were controlled by foreign capital. Thus, their technical direction was undertaken by foreign engineers and by Brazilian engineers who had graduated abroad. Neither the foreign nor the State bourgeoisie held any interest in the development of local engineering schools

(Kawamura, 1979:63).

Later, foreign entrepreneurs attempted to make the Brazilian engineering education system more pragmatic and functional, so that they could contract Brazilian engineers already trained to work within a capitalist model similar to their home countries (Kawamura, 1979:66). However, the attempt to adopt the model of engineering education of industrialized countries in Brazil, soon revealed problems. The Brazilian agrarian bourgeoisie argued that the Brazilian agro-exporting economy did not require high-tech professionals, and that the industrial sector was still underdeveloped to absorb such manpower (Fernandes, 1971:120-121).

The possession of a University diploma used to give its possessors not only professional authority, but also reinforced the condition of membership of a new dominant social group in Brazilian society (Cruz, 1967:280-81). Lawyers and medical doctors were those who enjoyed the highest status, due to their natural involvement with the political and social systems. Engineers enjoyed only professional authority in their area of knowledge, but this also represented a new way to achieve social power (Nogueira, 1967:213). This authority was achieved in the few schools that existed, through a selection process which reserved the best opportunities for the members of the dominant class. Engineers used to originate from large-scale farmers, foreign entrepreneurs or the families of foreign professionals. Most of them worked in their family's businesses, whilst others worked as civil servants in the

State apparatuses(Kawamura, 1979).

Before 1930, the Brazilian education system was very elitist, and the majority of the schools which trained liberal professionals, such as medical doctors and lawyers, were public and free. For the "people" there were a number of places in the public primary schools, from where they could achieve, at most, a secondary technical education (Teixeira, 1964). The engineering education syllabus was very theoretical, so many students had to be sent for practical training in the USA and Europe, where technological development was taking place. Therefore, only rich students or those supported by the state apparatus, could afford this sort of education. Thus, the best places in the hierarchical structure of knowledge, were reserved for the descendants of the elite (Kawamura, 1979:71). As a result of these policies, Brazil entered the 20th century with 80.00 per cent of its population illiterate (World Bank,1991:55).

2.1 Engineering: Towards an Organizational Profession

Despite its effort to maintain control ideologically and economically of the state, the agrarian bourgeoisie could not prevent capitalist development forever. The international economic crisis of 1929, disarticulated the Brazilian agro-exporting economy as a whole. Hence the economic and political contradictions that arose led to the replacement of the land oligarchy in power in 1930. The new government intended to promote economic development through industrialization, and thus oriented the education system towards producing qualified manpower to attend to the industrial expansion which would take place (Lima, 1974:97-98).

Few engineering schools were founded during the 15-years of the Vargas government (1930 to 1945), but the existing ones underwent meaningful changes. Engineering education was oriented towards specialisation linked to industrial production, where it would play an important role in national industry. This tendency was also reinforced by Brazilian entrepreneurs, professors and engineers who were strongly interested in the new ideas of rational work organization, developed by Frederick Taylor and his followers (Kawamura, 1979:73).

Engineering education became more pragmatic, and the engineering schools were joined to other faculties and transformed into "Universities". Public and private engineering schools began to follow the same educational model as defined by the Ministry of Education, so that it could keep control over the quality of the labour force to be launched into the labour market. (Kawamura, 1979).

The place engineers should occupy in the division of labour, was also defined by the engineering schools' officials. Professors argued that the function of engineers, should follow Fayol's classic definition of provision, organization, supervision, coordination and control (Kawamura, 1979). By doing so, the education system stipulated that in capital/labour relations, engineers should represent capital. However, it was not mentioned that engineers constituted anything other than qualified labour. Contrary to the view of the professionalisation thesis the supervisory function was already embodied in engineering education in Brazilian society. The predicted conflict in performing technical and supervisory functions, at the same time, was not recognized.

Engineers were indirectly compensated for this double function through privileges created by the education system, which preserved the elitist view of the engineering profession observed before 1930. The rigid selection processes remained untouched, so that only highly prepared candidates could be approved. By doing so, the education system managed to reserve the opportunity to attend an engineering school, to students who came from the dominant classes. In addition, the labour market was still incipient, and was controlled by "engineer entrepreneurs", or by eminent politicians and rich families, which reserved the job opportunities for engineers, even in the public services, for members of their own classes.

The attempt to promote economic development after the 1930s, did not affect engineering education and the labour market for engineers in the same proportion. In 1964 there were only 4,534 engineers and 4,169 technicians, representing only 0.4 per cent of this working population, respectively (Junior, 1966:650). Only with the Military Government (1964-1985), did the proliferation of engineering schools occur and a more substantial engineering labour market develop.

2.2 Engineers as "New Middle Class"

When the military government assumed power in 1964, the traditional route for social mobility to the middle classes, through savings, investment in small business and capital reproduction, had already been narrowed, by the historical economic concentration taking place in the country. As a result, working and middle class people targeted education as a new way to improve social mobility and their standard of living. Although a University degree did not guarantee by itself a better social position, as in the past, it did allow degree holders to apply for better jobs and postulate social ascension in an emerging professional labour market (Cunha, 1975:47).

The middle classes had supported the military coup of 1964, and so the Military government attended their appeals for better education, since this would legitimate the new ruling class in power (Gomes, 1986). With the educational reform of 1968, whose model prevails to this day, the engineering and technical schools were structured to offer an imminently pragmatic education. The courses were subdivided, areas of specialization were created, and the content of disciplines was altered towards attending to industrial activities. Many technical schools and engineering faculties were created. In addition, courses for technologists, as an intermediate level profession between engineers and technicians were also created. The post-graduate system was strongly boosted too. A programme of "excellence centres" was initiated, through which Universities and Faculties, both public and private, were elected, if considered satisfactory, to receive financial support from central government (Cunha, 1975).

Engineering was divided into various areas of specialization, such as civil engineering, mechanical engineering, electrical engineering, metallurgical engineering, mining, naval and chemical engineering. These areas of specialisation were defined strictly according to the supposed market needs. For each course, a minimum curriculum requirement of 3,600 hours course-work was defined, to be given in 5 years time (MEC,1977:5).

The Military government did not open engineering schools with State expenses, but authorized the foundation of private engineering schools all around the country. These schools were set-up to balance, in the short term, the supposed market needs. For example, in 1959 there was only 84 engineering courses in the country, while in 1974 this had risen to 237 (MEC, 1977:18), and by 1988, to 332, including those in agronomic engineering (IBGE - Anuario Estatistico do Brasil, 1990). In the 1950s, most courses were in civil engineering, but by the 1970s, there were already specialised courses, including a course for technologists.

Moreover, the new education system established a new hierarchy within the engineering profession. Ranging from the top to the bottom of the professional hierarchy, we find Doctor engineers, Master engineers, specialist engineers, engineers, technologists and finally technicians. By the criteria of the school attended, we find professionals who have graduated in "Excellence Centres" (the best schools), through to those from "Non-excellence Centres". Here, the elitism still prevails.

As a result of these policies, the engineering population has increased substantially year on year since 1975. TABLE 5.1 shows that 12,425 engineers and technologists graduated in 1975; This annual figure almost doubled in 1985, to 19,945 graduates but decreased to 16,264 in 1987. This recent decline is a result of the recession and the decline of the labour market between 1982 and 1984, which has led some students to change their career orientation.

In 1991, Brazil had 450,000 engineers **[1]**. This translates to one engineer per 333 people in the country. This figure is low when we consider that in 1970, Germany already had on average one engineer per 15 people, and Argentina, one engineer per 62 people (ABENGE, 1980:12).

TABLE 5.1 - EVOLUTION OF THE NUMBER OF ENGINEERS AND TECHNOLOGISTS GRADUATED BETWEEN 1975 AND 1987.

Year	Number of Graduated
1975	12,425
1977	11,549
1978	12,653
1979	13,400
1980	14,147
1985	19,945
1986	18,511
1987	16,264

Source: MEC (1977), "Nova Concepcao do Ensino de Engenharia no Brasil", DAU\CFE, abril; IBGE (1990) "Anuario Estatistico do Brasil" pp.188-203.

However, with the stagnation of the Brazilian economy during the last decade, the labour market for engineers has been profoundly affected. The crisis of the early 1980s led many students to reorient their career. As TABLE 5.1 reveals, the number of graduates per year after 1985, has decreased. This is the result of a decrease in the enrolment on engineering courses, since the recession of 1982\1984.

Although the educational reforms of the late 1970s have created more opportunities for people to attend University, elitism and privileges have not disappeared from Brazilian society. The best courses and the best schools still offer very few opportunities, and do not offer evening classes necessary for working class candidates. Furthermore, they adopt a very hard selection process, require full time dedication, and their courses are of very long duration. A University course in Medicine, for example, lasts for 6 years plus a further 2 years specialisation in hospitals. Engineering courses last for 5 years full-time and 6 years part-time; Law requires 5-years dedication; as does Economics and many other courses. Thus, students who cannot afford to pay private schools fees or cannot afford to attend daytime classes in public schools, cannot become a full professional.

Within this system, students who are capable of entering the best engineering schools must also have had a very good secondary education, because the competition and the selection process to enter a public university is very tough. Part of this is explained by the fact that public Universities are responsible for only one-third of the vacancies available to superior education in the country. TABLE 5.2 shows the number of vacancies offered by public and private universities in 1988, and number of candidates who applied for selection to fill these places. We can see from this, that 66.4 per cent of all students who enroled for superior education in 1988, did so at private institutions. The proportion of total applicants was very close for each of the two types of institutions, although the number of vacancies in public institutions was much lower. This means that the competition for public universities was much higher.

TABLE 5.2 VACANCIES OFFERED BY PUBLIC AND PRIVATE UNIVERSITIES IN BRAZIL AND THE NUMBER OF CANDIDATES APPLIED FOR SELECTION - 1988 (absolute and per cent).

Type of University	Vacancies	Applicants	Enrolment
Public	149.593	931,136	144,312
	(32.2)	(48.0)	(33.4)
Private	314,146	990,742	287.952
	(67.8)	(51.5)	(66.4)
Total	463,790	1.921,878	432,264

Source: IBGE: "Anuario Estatistico do Brasil" (1990:188-203).

The competition to attend the most prestigious courses of private schools is also very high. For example, in the selection process of 1991, undertaken by the Catholic University of Minas Gerais, (a private institution), there was on average, 6 candidates per vacancy for their engineering courses (PUC\MG, 1991). Odontology, which is typical of the new wave of liberal professions in Brazil, received an incredible 40 candidates per vacancy, despite boasting the highest monthly fees in private schools. TABLE 5.3 shows some of the courses offered by the Catholic University of Minas

Gerais and the number of applicants per vacancy, in 1991.

TABLE 5.3 - RATIO APPLICANTS/VACANCY PER SELECTED COURSE OFFERED BY CATHOLIC UNIVERSITY OF MINAS GERAIS,1991

Course	Time/Classes M=morning A=afternoon E=evening	Number of Applicants per Vacancy
Computing Sciences	A	7.95
Civil Engineering	M	6.91
Electrical Engineering	M	4.26
	E	7.93
Mechanical Engineering	M	4.68
	E	6.51
Architecture	A	9.08
Business Administration	M	8.72
	E	10.50
Accounting	M	2.85
	E	5.49
Economics	M	3.64
	E	4.44
Biological Sciences	A	8.77
Nursery	M	11.96
Odontology/Dentistry	M	33.23
	A	39.16
Law	M	15.48
	E	22.45
Psychology	M	6.72
	E	6.16
Philosophy	E	0.74
History	M	1.46
Languages	M	1.05

Source: PUC\MG (1991), "Jornal da PUC\MG", Year 5, n.113, Belo Horizonte,20.05.91

Those lower status schools, which survive on the monthly fees of their students, offer bad facilities, and assume the responsibility for educating students who cannot pass the selective process in the "Excellence Centres". It has led some writers to argue that the most prestigious courses and institutions select candidates from the elite. By contrast, those less prestigious schools select candidates of lower socioeconomic positions. Therefore, the first group of institutions has been distanced even more from the second, and it is this that makes Brazilian educational system so elitist (Gomes, 1986:204). These assumptions suggest that once the two groups have attained different technical backgrounds they are likely to compete in different labour markets. However, I will be arguing in this thesis, that as there are so many engineers graduating from the low level schools, they have caused certain distortions in the labour market by accepting much lower salaries than in the past. Employers have used this reserve army to lower wages of engineers in general. Consequently, higher standard engineers have been obliged to compete in the general engineering labour market and to accept market salaries as other engineers have had to do.

As I have argued, the education system produces professionals which the current economic and social system needs. As we have seen, up until 1930, when the agrarian elite ruled the country, engineering schools aimed at perpetuating the privileges of the ruling class. Thus, engineers were first upper-class, before becoming engineers. From 1930 to 1945, a ruling class composed of both the agrarian and capitalist classes ruled the country. In addition, the engineering profession started to differentiate and to encompass a more middle class character, since the labour markets for engineers was no longer limited to running family businesses or to working as Civil Servants of the upper class. After 1945 capitalist development began to dominate the country, and the engineering schools were oriented towards supplying the market with a specialised labour force capable, as Marx said, to run all sort of industrial enterprises.

The result of those changes was that the number of engineers rose from 70,000 in 1975, to about 450,000 in 1991. Today, engineers can be found in all sorts of organizations in Brazil, and in the various positions of their hierarchical structures, from staff engineers to very senior positions. Nonetheless, most of them are no longer members of the upper-class, but part of a relatively large group of University educated people (7.1% of the economically active population) who, despite economic stagnation in the country, still enjoy better market and working conditions than the overall working population with a lower educational background. This gap makes it very easy for them to claim to be part of an expanding "new middle class". This is an important reason why research on the work situation and class position of engineers in a developing capitalist society such as Brazil is needed, in order to see to what extent their case is similar or different from that of engineers in advanced industrial societies.

Finally, the possession of a diploma does not give its possessor the right to exercise as a professional. Engineers are obliged to register their diplomas at the Regional Council of Engineering Architecture and Agronomy - CREA, in order to obtain the right to practice in the profession. In order to register, they have to present their diploma and curriculum of disciplines attended at University. This enables the Council of Engineering to define the area of activity in which they can practice in the profession. This is also a mechanism used to divide and control the labour market within the profession.

3. The Technical and Social Background of INTCO and NATCO Engineers

Based on these assumptions, this section discusses the social and educational background of the 114 INTCO and NATCO engineers. It also shows to what extent their case supports the positions discussed up to this point, that engineers are no longer descendants from upper-class families but come from the middle and lower income classes. The analysis is based on four main aspects involved in the educational history of engineers. Firstly, it the reasons why these engineers have chosen this profession will be looked at. As shown in the previous section, the educational reform of the 1960s and 1970s was one response to the claims of the middle classes for more opportunities for education at the university level, which were seen as a way of improving their social position and standard of living. Thus, by looking at the reasons why they have chosen the profession we can confirm to what extent these engineers and, probably their families, really saw engineering as a way to improve their social position.

Secondly, the type of secondary and superior education received by the engineers, in terms of attendance at a public or private school will be examined. As discussed previously, there is an assumption about education in Brazil, that middle class families send their sons/daughters to private secondary schools (which are considered better than public schools) in order to prepare them for the selection process to enter the

Federal Universities (which are considered centres of excellence). Conversely, working class families have to send their son/daughter to public secondary schools, which despite being of lower standard, are free. The consequence of this is that, as they are not well prepared in the public secondary schools they cannot pass the selection process for "excellence centres", and are thus obliged to go to private Universities if they want to became full professionals.

Thirdly, the conditions under which these engineers undertook their courses will be examined, or rather, whether they attended daytime classes or evening classes. This is because most working class students have to work during the day to pay for their evening classes.

Finally, the types of degree received by engineers in various technical specializations will also be examined, along with the importance of such a technical background to the companies they work for.

3.1 Reasons For Choosing an Engineering Profession

The reasons why the engineers interviewed chose the profession were various. TABLE 5.4 shows that 25.46 per cent of the engineers decided to do engineering because they were good in disciplines linked to exact sciences, such as mathematics and physics, so they expected to succeed in the profession; Some 24.56 per cent argued that they had family members who were already engineers and had succeeded in the profession, and had then recommended them to do engineering.

Another 21.93 per cent of them did engineering because there was good chance of employment. For 12.28 per cent of the engineers, being a technician initially had forced them to do engineering, because as technicians they could not progress in their career. Only a small group of 15.78 per cent of the engineers did not have a clear idea why to do engineering. Thus, 3.50 per cent of this group, said that their first choice was Medicine. They wanted to become a full liberal professional but did not succeed in the selection process, and subsequently succeeded for engineering as second option and the remaining 12.28 per cent, had to submit to vocational tests before making their choice.

TABLE 5.4 - REASONS FOR CHOOSING AN ENGINEERING PROFESSION

Main reason to do engineering	INTCO		NATCO		TOTAL	
	N	%	N	%	N	%
1) Family influence	14	32.00	14	20.00	28	24.56
2) Facility to deal with exact science	11	25.00	18	25.71	29	25.45
3) I was technician and needed to do engineering to progress in the career	4	9.00	10	14.30	14	12.28
4) I was not selected for Medicine, so I accepted the second option	3	6.80	1	1.40	4	3.50
5) Decided by vocational test	6	13.60	8	11.43	14	12.28
6) There was good chance of employment	6	13.60	19	27.14	25	21.93
Total	44	100.00	70	100.00	114	100.00

Note: N = Number of engineers who gave the same response

In short we can argue that 84.22 per cent of the engineers interviewed decided to do engineering in the expectation of professional success. Professional success meant fast upward mobility with good salaries and working conditions. Thus, the perception of perspective of employment and career is an important factor determining career choices.

3.2 Secondary and Superior Education: public or private?

The Brazilian education system has been described as elitist. Some writers like Kawamura (1985), believe that candidates who come from the lower social classes have little chance to attend superior (university) education in good schools in Brazil. However, we have seen that from the 1960s onwards, that the number of vacancies in private engineering schools has increased a great deal. As there are more vacancies, the number of candidates competing in the selection process is likely to be more distributed among the various schools, public and private, good or bad. Thus, more candidates of different levels of social class can gain access to engineering courses.

Furthermore, it is common knowledge in Brazil that the quality of public secondary schools is very poor, while most of private secondary schools are considered very good. Conversely, the public universities are said to offer better education than the private universities, because good courses require investment in laboratories and in professors of higher standard. As private schools survive with monthly fees paid by students, it is said that these schools cannot offer the quality offered by federal universities, which operate with federal funds. Therefore, it is argued that those students who come from public secondary schools can hardly succeed in the selection process for the federal universities. Only students who have attended good private secondary schools (which cost a lot of money) can succeed in such exams. Consequently, an inversion in the educational career of students who go to Universities is likely to happen. Those who have attended good private secondary schools are expected to enter federal universities, while those from public secondary schools are expected to go to private universities, where the selection process is a little easier. Within this context what needs to be said about the educational career of INTCO and NATCO engineers?. What kind of secondary and superior schools did they attend?. Does their educational experience confirm the above assumptions or not?.

As TABLE 5.5 shows, INTCO and NATCO engineers come from public and private secondary schools and from federal and private universities in a very close proportion. INTCO engineers are divided half and half between these two types of schools, while most of the NATCO engineers (35.09%) come from public secondary schools.

TABLE 5.5 - NATURE OF SECONDARY SCHOOLS ATTENDED BY THE INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample)

Nature of Schools	Companies					
	INTCO		NATCO		TOTAL	
	N=	%	N=	%	N=	%
Public secondary school	22	19.30	40	35.09	62	54.39
Private secondary school	22	19.30	30	26.32	52	45.61
Total	44	38.60	70	61.41	114	100.00

Notes: 1) Both differences not significant at the 0.05 level X^2 (X^2=0.305, P>0.05).

When we look at the type of University (public or private) attended by the engineers interviewed, we find almost the same spread between public and private (TABLE 5.6). There is no evidence to say that engineers of either company came from a special kind of university. They came from public and private universities in a very close proportion, although we note that, among the engineers interviewed, the majority of the INTCO engineers came from private universities while the majority of the NATCO engineers came from public universities. When we consider the total sample, we find that a slight majority of the engineers (51.75%) came from private schools, with the remaining 48.25 per cent from federal schools.

TABLE 5.6 - NATURE OF UNIVERSITY ATTENDED BY ENGINEERS

Nature of Universities	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Public	19	16.67	36	31.58	55	48.25
Private	25	21.93	34	29.82	59	51.75
Total	44	38.60	70	61.40	114	100.00

Note: Differences not significant at the 0.05 level X^2 (X^2=0.443, P>0.05).

Moreover, the data on TABLE 5.7 shows no evidence that students who attended secondary public schools tended to go to private universities, or that those who attended private secondary schools tended to go to federal universities. It shows that 54.39 per cent of the engineers interviewed attended public secondary schools, but had attended public and private universities in very close proportions. Similarly, the remaining 45.61 per cent of those who attended private secondary schools, are distributed in two groups of much closer proportions (23.68% and 21.93%), who attended public and private universities, respectively. In summary, the assumption concerning the inversion of educational career from public secondary schools to private universities or from private secondary schools to public universities, does not find support here. These findings also suggest that the nature of the school attended by engineers in the secondary and superior levels, does not matter for the employers as the assumptions about "excellence centres" suggest. The labour market for engineers at INTCO and NATCO is open to engineers from public or private Universities in a similar proportions.

TABLE 5.7 - RELATIONSHIP BETWEEN TYPES OF SECONDARY SCHOOL AND UNIVERSITY ATTENDED BY ENGINEERS AND MANAGERS (Total sample)

Secondary School	Type of University					
	Public		Private		Total	
	N=	%	N=	%	N=	%
Public	28	24.56	34	29.82	62	54.39
Private	27	23.68	25	21.93	52	45.61
Total	55	48.24	59	51.75	114	100.00

Note: Differences not significant at the 0.05 level X^2, (X^2=0.282, P>0.05).

3.3 Relationship between Social Origin and the Type of Secondary or Superior School Attended by Engineers

As argued in previous sections, the richest social groups in Brazil, are said to send their sons to private secondary schools which are considered the best schools, while the lower income groups tend to send their sons to public schools because they are free. However, TABLE 5.8 shows that the upper-middle class (group 1) tend to send their sons to study in public and private schools in close proportions. Yet, the group of salaried professionals (group 2) have a more definite tendency to send their sons to private schools, while the less privileged group (group 3) tends to send their sons to public schools. Thus, the assumptions of education choice is not confirmed for the upper class group, but is for the middle and lowest social groups.

TABLE 5.8 RELATIONSHIP BETWEEN THE ENGINEERS' SOCIAL ORIGIN AND THE TYPE OF SECONDARY SCHOOL ATTENDED

	Secondary School					
	Public		Private		Total	
Social origin	N=	%	N=	%	N=	%
1) Families work in their own business or are liberal professionals	20	17.54	21	18.42	41	35.96
2) Fathers are salaried professionals	8	7.02	14	12.28	22	19.30
3) Fathers are skilled workers, white collar or manual workers	34	29.82	17	14.91	51	44.74
Total	62	54.39	52	45.61	114	100.00

Note: Differences significant at the 0.05 level X^2, ($X^2=6.500$, $P<0.05$).

It was also found that engineers, independent of their social origin, have attended private and public universities in very close proportions (TABLE 5.9). In this sense, the idea that the engineering schools of public universities are reserved for the elite groups, does not find support in my findings. It is noticeable that only 4.39 per cent of the engineers interviewed came from upper-class families and that only one-third of this group did their courses in public universities. It suggests that the engineering profession does not seem to be the main choice for upper-class students. Engineering seems to be a career for the middle and lower classes. As we can see, 31.58 per cent of the engineers came from the traditional middle class; 19.30 per cent came from the so called "new middle class"; 35.09 per cent came from the skilled working class and only 9.65 per cent owe their origin to the unskilled working class. If we join the three lowest social groups (3,4 and 5), which is composed of salaried workers, we find that they are the fathers of 64.04 per cent of the engineers interviewed. Furthermore, 95.61 per cent of the engineers did not come from the upper-class. If we join the groups 2 and 3, we can argue that different from the period prior to fast industrialization (up to 1964), when according to Kawamura's view, Brazilian engineers had an upper-class origin, now 50.88 per cent of them have a typically middle class origin (groups 2 and 3), while 44.74 per cent of them come from lower income classes (groups 4 and 5). This confirms our view that Brazilian engineers now tend to have a more "middle class" background.

TABLE 5.9 - RELATIONSHIP BETWEEN THE ENGINEERS' SOCIAL ORIGIN AND THE TYPE OF UNIVERSITY ATTENDED

	Type of University					
	Public		Private		Total	
Economic and Social origin	N=	%	N=	%	N=	%
1) Family owns a big business	2	1.75	3	2.63	5	4.39
2) Family owns small business/ are liberal professionals	19	16.67	17	14.91	36	31.58
3) Fathers are salaried professionals	12	10.53	10	8.77	22	19.30
4) Fathers are skilled workers	21	18.42	19	16.67	40	35.09
5) Fathers are unskilled manual workers	1	0.88	10	8.77	11	9.65
	55	48.25	59	51.75	114	100.00

Note: Differences not significant at the 0.05 level X^2, (X^2=7.826, P>0.05).

When we look at the time of graduation of the engineers, we find the period when the social background of engineers changed within universities. Firstly, TABLE 5.10 shows that the proportion of engineers of the two companies located in each time range of graduation is similar. Secondly, we see that 40.35 per cent of the engineers graduated up to 10-years ago, 50.88 per cent graduated between 11 and 20 years ago, and that only 8.77 per cent of the total sample have been in the profession for more than 20 years. Thus, 91.23 per cent of the total sample have been in the profession for up to 20 years. This group has thus graduated from 1970 onwards. Since engineering courses take 5-years time to complete, we can argue that this group entered University from 1965 onwards, just one year after the military coup of 1964. Thus, all of them have been trained according to the new education system imposed by the Federal Government.

TABLE 5.10 - YEARS IN THE PROFESSION

Years in the Profession	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
01 to 10	15	13.16	31	27.19	46	40.35
11 to 20	24	21.05	34	29.82	58	50.88
21 to 30	5	4.39	5	4.39	10	8.77
Total	44	38.60	70	61.40	114	100.00

Note: Both differences not significant at the 0.05 level X^2, (X^2=1.434, P>0.05).

As previously shown in this Chapter, from the military coup in 1964, the main role of superior education in Brazil has been to produce a mass of qualified workers capable of supplying the market's needs. During these years, private engineering schools were allowed to establish and more students from all social groups were able to enter the profession. As engineering has become a mass profession, it is likely that the upper-classes have moved their interests to professions other than engineering. Engineering now seems to be a more middle class profession. However, I cannot prove here that the upper-classes have changed their ambitions, and it is not my intention to do so in this thesis, this insight must be left for future investigation. But, I can argue that almost one hundred per cent of the engineers interviewed are a product of an education system whose main role is to expand the specialised labour force.

In addition to the question of whether engineers come from public and private schools it is also necessary to know if they have graduated from **daytime** or **evening classes**. Brazilian students who study in evening classes are, in their great majority, workers who need to work to survive. In fact TABLE 5.11 shows that 50.00 per cent of the engineers interviewed graduated from evening classes and 50.00 per cent from daytime classes. It suggests that 50.00 per cent of the engineers, before becoming engineers, were in working class occupations, having to work during the day to pay for their private education at night. In the State of Minas Gerais, only the CEFET - Centro Federal de Educacao Tecnologica (or Federal Centre of Technological Education) maintain a course of operational engineering, with one evening class.

TABLE 5.11 - THE TIME OF ATTENDING CLASSES AT UNIVERSITY

Time of attending classes	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Morning or afternoon classes	20	45.45	37	52.86	57	50.00
Evening Classes	24	54.55	33	47.14	57	50.00
Total	44	100.00	70	100.00	114	100.00

Source: Interview data.

In fact, TABLE 5.12 confirms the above findings and shows that of the 48.25 per cent of the engineers who attended federal Universities, 83.62 per cent of this group attended daytime classes and only 16.38 per cent attended evening classes. This small group is composed of those who extended technician courses at CEFET, to become operational engineers. Conversely, among the 51.75 per cent of engineers who graduated from private schools, 83.00 per cent attended evening classes. This means that students who have to work, have to attend evening classes in private schools, while public engineering schools are reserved for those who do not have to work and can therefore attend daytime classes. Thus, we conclude that federal engineering schools favour those who have better economic conditions, because those who have to work can never attend daytime classes.

Despite the vacancies in federal schools being open to everybody who succeeds in the selection process, the fact that courses only run in the daytime imposes serious barriers for candidates from the working class. Thus, once this group is eliminated from the competition, due to the lack of economic resources to study, those vacancies are more freely fought between candidates who have a family capable of maintaining them in daytime classes. In this sense, the lack of democratization of public superior education is really confirmed. Thus, while the upper class students do not go to engineering schools, public or private, because they probably do not want to engage in the profession, those of working class origin cannot go to federal universities because the functioning of this system favours the middle income classes.

TABLE 5.12 - RELATIONSHIP BETWEEN TYPE OF UNIVERSITY ATTENDED AND TIME OF ATTENDING CLASSES OF INTCO AND NATCO ENGINEERS

Time of attending classes	Type of University					
	Public		Private		Total	
	N=	%	N=	%	N=	%
Day time classes	46	40.35	11	9.65	57	50.00
Evening classes	9	7.89	48	42.11	57	50.00
Total	55	48.24	59	51.76	114	100.00

Note: Both differences significant at the 0.001 level X^2, (X^2=45.530, P<0.001).

3.4 Specialization among Engineers

Another assumption about engineering education in Brazil, is its tendency towards specialization. TABLE 5.13 shows that 45.45 per cent of INTCO engineers and 41.43 per cent of their NATCO counterparts are graduate engineers without any complementary specialization; 47.73 per cent of INTCO engineers and 51.43 of NATCO engineers have complementary specialization in their area of activities. Another group of 7.14 per cent, composed of NATCO engineers, possess Masters degree. None of the interviewed engineers from INTCO held such a qualification. Conversely, 6.82 per cent of INTCO engineers possess a PhD Degree while nobody from NATCO held such a qualification.

TABLE 5.13 - SPECIALIZATION AMONG ENGINEERS

Highest level of specialization achieved	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Undergraduate only	20	45.45	29	41.43	49	43.00
Undergraduate plus specialization in 360-hours course	21	47.73	36	51.43	57	50.00
Undergraduate plus M.Phil	0	0.00	5	7.14	5	4.38
PhD	3	6.82	0	0.00	3	2.62
Total	44	100.00	70	100.00	114	100.00

Source: Interview data

When we consider the total sample, we find that only 43.00 per cent of the engineers hold a graduation degree only, against 57.00 per cent who possess further degrees. In short, there are more specialised than non-specialised engineers in both companies (TABLE 5.13). Thus, to a certain extent the assumption of the move towards specialization among engineers finds some support here. However, the qualifications of specialization are not so high. Only 2.62 per cent of the sample holds more than M.Phil degree. It also shows that the assumptions put forward by the Brazilian agrarian bourgeoisie of the early 1920s, that Brazilian companies needed only a group of graduate engineers with a minimum level of specialization in their area of activity, to allow them to run the business, is still alive in the country. This can be argued since Master and PhD degrees do not seem to matter too much for the companies studied, which are amongst the largest and most technologically advanced in their areas of activity in Brazil.

4. Conclusion

This Chapter has shown that the education system works as a powerful State apparatus, which can be used by the ruling class according to its political, social and economic interests. Before 1930, the education system worked to perpetuate social status and privileges. It worked according to ruling class interests, which was not interested in capitalist development, but in preserving the big feudal system ruled by landlords and Portuguese families. After 1930, when the new ruling class put forward a new project of economic development, the education system was reorganised to support its aims. From that time on, the education system took the responsibility to form a relatively large group of University educated people capable of making the economic system work as efficiently as possible. Although engineers are trained to sell their labour power in an unstable labour market, to have a professional credential in engineering still enables the owner to compete for the best job opportunities available in this market, as the majority of the working population without university education, do not have access. The gap created by this distinctive market situation, leads most of the professional workers in Brazil, including engineers, to claim that they are part of an expanding new middle class.

This Chapter has also shown that the educational history of the INTCO and NATCO engineers interviewed, confirms most of the assumptions that have been made about the Brazilian education system. It was found that the majority of the engineers interviewed based their decision to become an engineer on the expectation of finding a good job. Others, while students, did not know what sort of career to follow and only decided to engage in the engineering profession after submitting themselves to a vocational test. Some of them were technicians and later felt it necessary to do engineering as a way to improve their career opportunities. A very small proportion would have done medicine if they had succeeded in the selection process.

INTCO and NATCO engineers come from public and private secondary schools and from public and private universities in similar proportions. Thus, their case lends no support to the assumptions that students of private secondary schools go to public universities while students of public secondary schools go to private universities.

The engineers social origin did not really affect the choice of secondary school that they attended. Upper class engineers studied in public and private secondary schools in very similar proportions. Engineers from families of salaried professionals tended to go to private secondary schools rather than public schools, while those of lowest working class origin tended to go to public rather than private schools. At the University level, it was found that engineers from the different social groups attended public and private universities in very close proportions as well, although the engineers of upper and lower working class origins have studied mainly in private universities.

What is most revealing about the research, is that engineering is no longer an upper class profession. Some 50.88 per cent of the engineers interviewed come from middle class families; other 35.09 per cent come the skilled working class; and 9.65 per cent come from the traditional manual working class. Only a small proportion of them (4.39%) came from upper class families. Furthermore, 50.00 per cent of the engineers attended evening classes in private Universities and had to work, while students, to pay for their education. Nonetheless, the economic system seems to compensate them for this effort. All the engineers interviewed were engaged in professional jobs.

The lack of democratisation of public superior education in the country is also obvious. Students who have to work for a living cannot attend public engineering schools because they offer only daytime classes. Therefore, poorer students are penalised twice over: firstly they have to work to survive and to pay for the education they want to have. Secondly, they have to extend their daily activities to attend evening classes. Conversely, the richest ones are rewarded twice over: Besides not having to work for a living and being able to attend the daytime classes, they do not have to pay for the education they have chosen.

Finally, the engineers of both companies are well qualified for the positions they occupy in the companies. Some 50.00 per cent of them have specializations related to their daily activities and 7.00 per cent have Master or PhD degrees, while 43.00 per cent of them have only undergraduate degrees. Their level of specialization is according to what the companies require. Apart from the fact that the three engineers in the sample with PhD degree come from INTCO, no significant difference was found between the levels of specialization of the engineers of the two companies studied. We can then argue that, national and multinational companies, in Brazil, are similar in terms of the educational background of their technical staff. The following chapter approaches the characteristics of the two companies and shows other similarities and differences between them.

6. THE COMPANIES: INTCO and NATCO

1. Introduction

The objectives of this Chapter are twofold. Firstly, it is intended to examine some basic characteristics of the two companies and how they affect the engineers work and class position. These characteristics are the economic environment, technology, organizational structures and management style of the two companies. Secondly, it is intended to examine the human resource policies of the two companies, in order to establish a background to better understand the work situation and class position of the engineers in these two companies. It is assumed that to understand the work situation and class position of engineers we need to first examine the way employers see employees, because this will affect the way companies organize their human resource policies in order to manage and control their labour force, to achieve their objectives. Thus, I will start by examining the characteristics of these two companies separately, and later, conclude in relation to their similarities and differences on these issues.

2 The Multinational Company - INTCO

INTCO was originally established in Germany, in 1890. It expanded rapidly, due mainly to the revolutionary inventions of the INTCO brothers, that of the production of seamless steel pipes from steel bars. Today the company is to be found in over 100 countries, in which it has either production facilities or is represented through trading offices. INTCO initiated its activities in Brazil in 1954, in the state of Minas Gerais, aiming to supply the emerging Brazilian oil exploration industry with steel pipes. Today INTCO is among the largest Brazilian steel manufacturers. As the leader of a group of enterprises, it produces special steels and seamless steel pipes. The Group is also active in the areas of iron ore mining, reforestation, agriculture and cattle raising. It builds capital goods and undertakes plant assembly work. It also produces hydraulic components, cargo handling equipment, parts for the automobile industry, measuring instruments, electro-electronic panel controls and instrumentation. It was at the Barreiro Plant, the leader of the group in Brazil, where steels and seamless steel pipes are produced, that I focused my fieldwork.

TABLE 6.1 summarizes INTCO's basic economic, organizational and managerial characteristics, and shows that despite its relatively stable market, profitability has declined due to price controls by the government. This has led the company to cut costs, reduce investments, impoverish the working conditions and to reduce the workforce. To counterbalance these trends, trade union activity has increased. INTCO's response to this union activity has been to increase control over the workforce, which has worsened even further employee/employer relations.

TABLE 6.1 - CHARACTERISTICS OF THE COMPANY: INTCO

Characteristic	Summary
1. Market	- No strong competitors in Brazil - stable but, profitability is declining due to price control
2. Technology	- Developed its own technology for seamless steel pipes production - stable (long life) - Does not invest in basic Research and Development in Brazil - R & D engineers in Brazil deal only with adaptation of techniques for Quality Control. - Technical knowledge subordinate to the company's objectives
3. Organization of Production	- Plant organized by line of product and by phase of production. - Specialization by line of products and by phase of production - Most of the engineers are involved in production related activities
4. Hierarchical structure	- Organized in 5 hierarchical levels with managerial responsibly: 1st = President 2nd = Director (of production, commercial, finance, and administration 3rd = Chiefs of Area and Managers 4th = Chief of Department 5th = Chief of Service
5. Decision Making	- Centralized in the manager's hands and levels above - Chiefs of Department have little participation - Chiefs of Service and Engineers are quite absent from the process of decision making - Technical decisions strictly subordinated to the company's objectives
6. Information Flow	- Information and communication channels follow the hierarchy - Centralized in the managers and directors' hands - Chiefs of department and below levels receive only information related to their daily activities.

Source: interview data

The lack of investment in basic research in Brazil by INTCO has meant that the contribution of the company has been very poor in terms of job creation for Brazilian scientists and engineers in this area. As a result, INTCO engineers are essentially involved with production related activities. Although technical knowledge is very important in the company, technical decisions are strictly subordinated to INTCO's business objectives. This makes technical autonomy very limited in the company. Moreover, the organization of production by product-line and by phase of production, makes engineers very specialized, without gaining knowledge of the process of production as a whole. In addition, the autocratic style of INTCO's management and the centralization of the decision making process in the hands of managers and higher levels, makes the participation of the Chiefs of Department and lower levels, in the inner workings of the company, such as in finance, investment, budget and personnel policies, quite absent.

Finally, the control of information by top management leads the Chiefs of Department and lower levels to be involved only with routine information related to their daily activities, which is expressed in pre-designed objectives, cost and output controls and in personnel controls.

2.1 Personnel Administration

In this section I will examine the company's human resource policies and practices for recruitment, compensation, control of the labour force, benefits and social policies, work environment and trade union relations, and how these variables affect the engineers work and working conditions.

2.1.1 How the Company sees its Employees

I started my research in INTCO by interviewing the Chief of the Personnel Department, in order to understand the human resource policies of the company before going into other areas of personnel administration. I began by asking him how the company deals with and views employees, especially engineers, who constitute the technical staff of the company. He replied:

> "Your question applies most for Chiefs of Service and Engineers because they constitute the greatest contingent of technical professionals of the company. Furthermore, almost hundred percent of the Chiefs of Service are engineers. At INTCO, Chiefs of Service are more involved with technical than with administrative issues. They have to have a profound technical domain over what they do because they are close to the production workers. They are required to supervise many workers and to deal with things which demand a high degree of responsibility. Thus, INTCO expects them to be more involved with the company's life than with the employees. As such they need to know the details of unionism because they are the company's representatives in the front line where these issues are very conflictive. So, since engineers are seen as manager's technical staff they are expected not to be involved with the manual workers ideology of trade unionism. Engineers linked to trade unions have a poor image because they are the company's representatives. Finally, INTCO see all salaried workers as employees, even those in managerial positions."
>
> (A INTCO Chief of Personnel Management)

As the company needs engineers and other professionals as its representatives, INTCO developed the strategy of paying engineers by loyalty and by productivity. On this issue the interviewee said:

"Engineers as management's staff are grouped in four categories, in order to apply the payment policy. They are paid according to their professional maturity and to the degree of involvement with the company. Up to their fourth year in the company they are seen as more productive workers but still little engaged in the company's objectives. Their salary increases as long as they move from technical to a organizational maturity. From their eighth year onwards, they are expected to have an attitude very close to those who have already achieved the position of Chief of Service. As such their salaries are very close. After eight years they may be less productive but if they have survived in the company it is because they are trustworthy. From this position onwards loyalty is more important than productivity. So, they are paid for it. The company pays for loyalty. Thus, almost hundred per cent of our engineers refuse to involve themselves with trade union activities."

(Interview with INTCO Chief of Personnel Management)

This shows that an engineer's career track is neatly delineated, a seniority and managerial path is well articulated. Although the company pays engineers for loyalty, they are also required to be productive. The interviewee continued:

"The notion of productivity is clear. Everyone has to work. They are aware of this. The current philosophy is to have even less workers to do the same work being performed by the company. The company also expect to reduce people in a managerial position to the average of one boss per group of fifteen employees. Currently we have one boss per eight employees. It means that engineers will be required to work even more in their present positions because there will not be new vacancies for managerial positions in the short term, in the company".

(A INTCO Chief of Personnel Management)

Consequently, this policy of searching for profits by reducing labour and increasing productivity, has become the main reason to dismiss employees. He said:

"In normal the situation "low performance" is the main factor which leads to dismissal. This strategy increases pressure on everybody to work even more in order to guarantee their position. The company is very rigid on this issue. A worker can have 20 years in the company but if he is not giving the expected productivity he will surely be dismissed. Secondly, low performance employees are dismissed at any time the company faces the risk of having its profits reduced".

(Interview with INTCO Chief of Personnel Management)

As a result of this policy of reducing labour and increasing productivity, INTCO's workforce was reduced by 35.0 per cent from December/82 to April/91, when I finished the interviews in the company. This policy of "personnel reduction" follows a rigid determination from the heads of the company and affects all hierarchical levels without distinction. As a representative from the Personnel Control Service argued:

> "When the company is to cut jobs there is no distinction among occupational groups. It cuts from the top to the bottom in the same proportion. It cannot keep too many chiefs, professionals and few non-professional workers. The proportions are always maintained".

In short, INTCO engineers are placed in a very ambiguous position. At the same time that they expected to represent the interests of the company in the workplace - to perform the control function of capital, as argued by Carchedi (1977) and Wright (1985) -, they are also expected to be productive, i.e, to be productive labour, while participants in the collective labour process. As productive labour they know that they will live each working day, with the real risk of being dismissed at any time the company finds it necessary. Thus, while productive labour, their working conditions are similar to that of other INTCO employees, but while representative of capital their working conditions are different.

2.1.2 Recruitment and Selection Policies

INTCO adopts a selection process for everyone who applies for any position up to Chief of Service. For all higher positions, for example, Chief of Department, specialised engineers and higher levels, admissions are decided among the Personnel Manager and the person responsible for the area where the vacancy is open, without any participation of the recruitment and selection service.

The main recruitment sources for engineers have been the Catholic and Federal Universities of Minas Gerais. However, the top positions in the technical areas are filled by engineers and executives from INTCO's home country. Therefore, INTCO prefers to recruit from its internal labour market firstly, and managers have total autonomy to appoint candidates for vacancies open in their area of responsibility. This strategy makes the employee highly dependent on their bosses for their career progression. Recruitment from the external market is used only for entry positions. This suggests that before being admitted, engineers have to demonstrate that they are in line with the company's ideology.

2.1.3 Salary Administration

INTCO's 6,000 direct employees, working at the Barreiro Plant, are distributed among 350 positions. INTCO also employs 2,000 workers of all levels (including engineers) as contract based workers, who lie outside its direct personnel administration policies. Thus, the total workforce is 8,000 employees. The company has adopted contract based workers in all seasonal work, to avoid dismissals and confrontation with the unions when the work is finished, and in critical areas such as maintenance, in order to reduce the bargaining power of these employees. Thus, INTCO's direct work force is distributed between three payment schemes, in which employees are grouped according to the nature of their work and their place in the hierarchy (TABLE 6.2).

TABLE 6.2 - DISTRIBUTION OF EMPLOYEES BY TYPE OF PAYMENT SCHEME: INTCO (Per cent)

Scheme	Type of Workers Included	% of the working population
A	Supervisors, manual workers, administrative workers	91.00
B	Chiefs of Service, engineers, other graduate professionals	7.00
C	Chiefs of Area, managers, Chiefs of Department	2.00
	Total	100.00

Source:interview data

SCHEME A is organized into 9 vertical levels and 6 horizontal bands. Thus, the internal labour market for this population is composed of 54 positions in the payment scheme.

In **SCHEME B** pay increases depend on professional maturity, which is defined by the duration of experience of the professional in the company and by their engagement in the company's ideology, i.e, by their abilities to perform the capital function. Professionals (engineers included) without managerial positions, are distributed between four groups (see

TABLE 6.3), with the salary of those in Group 4 being very close to that of the Chief of Service.

The policy has been to pay employees included in schemes "A" (see TABLE 6.2) less than the market average, and those in Scheme "B" and "C" according to their importance for the company. This indicates that there are different human resource policies to deal with those who are expected to perform only the labour function (productive labour), and those who are expected to play a double function - the functions of capital and labour at the same time. Engineers and managers are part of this group of workers who have to perform this double function.

Directors are not included in any of these Schemes, because they are not considered employees. As the Chief of Personnel Department said:

> "Here everybody who receives salary and are included in the payment schemes A,B, and C is considered an employee, including managers. Everybody is aware of it".

As argued in Chapter 2, despite all salaried workers being considered employees, they cannot all be regarded as working class, as they have different functions in the production process. Professionals and managers, despite being salaried workers, are paid to perform both the function previously performed by the functioning capitalist - the function of surveillance and control of the labour process -, while having to be productive workers as the general work force.

Finally, issues related to salary are treated as confidential in the company, and only the Chief of Department and his trusted assistants know all the payment schemes. It is believed that if the different groups do not know the salaries of each scheme, the conflict between occupational groups may be smaller. But of course, such secrecy also encourages individual competition and makes employees more dependent on management.

TABLE 6.3 - DISTRIBUTION OF PROFESSIONAL WORKERS BY GROUP OF PROFESSIONAL MATURITY: INTCO

Professional maturity	Characteristics by years of experience in the company
Group 1	2 years or less
Group 2	2 to 5 years
Group 3	6 to 8 years
Group 4	8 years and over

Source: interview data

2.1.4 Personnel Control

The adoption of different forms of personnel control is another indication that professionals are seen by the company a different category of workers. FIG 6.4 summarizes the basic control applied to each category of employee, classified according to their Payment Scheme.

According to a representative of the Personnel Department, INTCO uses different name-tags to ease the identification of members of each occupational group and also to increase status differentiation. Through this strategy managers and their representatives can approach and control each employee in a more suitable way.

It is worth noticing that although employees included in Group "B" are not subject to time cards, they are nevertheless subject to the general rules and regulations applied to group "A". They are also obliged to use electronic cards when they enter or leave through any of the company's gates. By the use of electronic cards, the company can instantly know which employees are within or outside of the company premises. Moreover, all of the additional control over professionals is made by their bosses. There is no "flexitime" for anybody in the company. Everybody has the right to delay for a total of 27 hours a year. Any additional lateness is deducted from the employee's payment. This indicates that, although the company distinguish them as special labour - as representative of capital -, they are also controlled in those aspects related to their functions as productive labour, as participants of the collective labour process.

TABLE 6.4 DISTRIBUTION OF EMPLOYEES BY TYPE OF CONTROL APPLIED BY THE COMPANY: INTCO

Payment Scheme	Type of control
Group A:	Everybody subject to time-card
	Identification:
Hourly paid workers	Yellow name-tag
Monthly paid workers	Green name-tag
Group B:	Not subject to time cards but is controlled by frequency list
Chiefs of Service, engineers, other professionals	Identification: Grey name-tag
Group C:	Neither subject to time card, nor to frequency list
Chiefs of area, managers, chief of department	Identification: Blue name-tag

Source: interview data

INTCO has also installed many Bank branches on site, to avoid workers wasting time going outside of the plant, and to prevent workers from meeting with militant trade unionists, who frequently campaign outside the company's gates.

INTCO keeps controls of all documentation referring to ex-employees for some 30 years after they have left the company. This is used for future consultation. Those who have taken legal action against the company, shown low performance, or have been in union activities, are not readmitted.

Information is also gathered for this control system through interviews carried out by social workers with employees who are either in trouble or wishing to leave the company. The main reasons provided by the Chief of Personnel for the dismissal of any sort of workers, was cost reduction and low performance. Professional workers are said to enjoy more job stability, but they are also subject to this policy.

In short, professionals, like other workers, are controlled by the company, but through different mechanisms. Manual workers are subject to a more direct "direct supervision", while professionals are controlled through mechanisms of "responsible autonomy". Direct supervision is defined by Crawford (1989) as the "control over how the job is done, though detailed instructions on how and when to do it and/or periodic inspection by the supervisor to make sure the job is being done properly" (p.101). Responsible autonomy is defined by Friedman (1977) in terms of "the maintenance of managerial authority by getting workers to identify with the competitive aims of the enterprise so that they will act "responsibly" with a minimum of supervision" (p.48). For Friedman, responsible autonomy is more applicable in dealing with more privileged skilled workers, who already have elements of job control and discretion. This seems to be the case at INTCO. In fact, privileges can be observed also in the benefits and social policies of the company.

2.1.5. Benefits and Social Policies

INTCO offers its employees free medical care, subsidised transport (by buses) and food (in the companys' restaurants). The most attractive of these benefits is the Medical Service. INTCO has built an Occupational Health Centre with 1,100 square meters of hospital space. It also has contracts with Doctors of 17 other hospitals located in the regions where the company operates. Medical care is free to every employee and their dependents, although in the case of very special treatment those in **Payment Scheme "A"** have to pay part of the costs, while those in **Payment Scheme "B"** and **"C"** do not. Nearly 91.0 per cent of the company's working population and their dependents make use of the company's health service because it is said to be better than the National Health Service. Benefit policies have been one of the most important strategies used by management in Brazil to recruit employees.

2.1.6 Work Environment

The physical work environment of a steel mill company is marked by its high level of air pollution, noise, dirtiness, gases and high temperatures. The case of INTCO is no exception. Therefore, the physical working conditions are very poor for the majority of workers. Only Directors, Chiefs of Area, Senior Managers and Chiefs of Department work in a comfortable private room with a secretary and air conditioning. Chiefs of Service work in a small private room with a telephone extension but do not have a secretary. Engineers work in a common room with very few facilities and one telephone extension for a very big group. Chiefs of Service of production have to divide their room with their assistant engineers or technicians. Everybody from chiefs of service and below, work in a non air-conditioned environmental and are supplied with only the indispensable resources necessary to do their work. Furthermore, there is no indication that INTCO will improve this work environment in the near future, due to its policies of cost reduction, and its search for profits.

2.1.7 INTCO and the Trade Unions

The relationship between the company and the unions which represent its employees is very strained. INTCO uses all the available resources to defend itself against union activities. To start with, nobody can get into the plant without an authorization card, electronically controlled by the security people who work in every entrance. This system is said to be very necessary because trade union representatives or activists can get into the plant during a "hot climate" period of strikes, confrontation or negotiation. In Brazil it is common for trade unions to operate outside plants and use factory gate recruitment to support campaigns against management who refuse union recognition. Security is therefore aimed at keeping out unionists.

INTCO also uses the restaurants to control union activities. In order to prevent trade union activities taking place during the lunch break, INTCO maintains two restaurants within the Barreiro Plant, located in the same building but divided by a wall. The restaurants serve the same quality food, but restaurant "2" is cheaper. Everybody, independent of hierarchical position, can use either restaurants. However, manual workers, qualified workers and operators etc, tend to have their lunch in restaurant 2, though a great number of them also use restaurant 1. Almost all of the professionals, managers, directors and administrative workers have their lunch in restaurant "1". Despite the cheaper price, few administrative or professional workers eat in restaurant "2". However, the strategy of control has worked very well, because chiefs, supervisors and professionals can be found in both restaurants, and therefore the workers have to be more careful since they may be under the visual surveillance of their bosses.

Despite such care, INTCO has not managed to undermine the union activities in the company. During all of my stay in the company and especially during the payment days, trade union activists settled down in front of the bank branch which pays hourly paid workers, to encourage their participation in the union struggle for better working conditions in the company. At the same time, inside the Plant, professionals from the Personnel Department and from other areas were working very hard to keep the Plant's internal climate fresh enough to guarantee, at least, the minimum output of production. It became clear that the Metalworkers Union (the only recognised union by INTCO to represent its employees) was struggling for real grievances.

3. The National Company - NATCO

NATCO was founded in 1951 by the State Government. It spent its first 10 years constructing hydro-electric power stations and electrical transmission systems, capable of supplying the State of Minas Gerais with its emerging industrialization. In the 1960s, NATCO incorporated the smallest companies still operating in the sector and involved itself in the distribution of energy to consumers. In 1973 NATCO incorporated the last big company in the sector (it was of North American origin), and assumed total control over this business in the State. In 1968 NATCO founded the Institute of Industrial Development, whose aim it was to identify and promote opportunities for the establishment of new industries in the State. In 1984 NATCO was transformed into an Energy

Company in order to expand its business into all areas of energy. As a result, it entered the area of Research and Development of new sources of energy, such as solar energy, natural gas and biomass.

After 38 years of existence, NATCO is seen as an example of a successful State-owned enterprise. Human Resources administration has been based on advanced techniques for personnel selection, training, compensation, evaluation and specialisation of the labour force, which has enjoyed a high level of job stability since the company's creation.

As NATCO employees have enjoyed high stability of employment due to the good economic performance of the company, it is said to have facilitated militancy among all sort of employees in the company. Hence since the late 1970s, strikes in the company have involved professional and non-professional workers in the same proportions.

Technical knowledge is very important for the company. A measure of this is the proportion of workers in technical jobs. NATCO employs 1,361 engineers, 1,414 technicians and 7,540 qualified workers. The area of Research & Development enjoys the status of Directory Body and employs 40 R & D engineers. Thus, 7.3 per cent of NATCO's workforce is composed of engineers. If you include the technicians, the proportion of the workforce in technical jobs increases to 15.00 per cent. These figures are much higher than the average for the engineering industries of developed countries, which employ only 3.1 per cent of the workforce in technical jobs (see Whalley, 1986:22).

As NATCO has a stable market and profits, it has invested its available resources in modernisation and in the development of new sources of energy. Direct employment has been raised from 12,754 employees in 1981, to 18,484 in 1990.

TABLE 6.5 summarises the above characteristics and also shows that NATCO's decision making process is centralised in the hands of managers, superintendents and directors. There is also high formalisation, clearly expressed in job descriptions, pre-design of objectives, cost information, output information, manuals of procedures, performance evaluation, recruitment and selection criteria and so on. All of this makes the degree of autonomy and authority of professionals and workers very limited in the company.

As it is a very big organization, each Directory Body resembles a separate company, specialised in its own business, with its own labour market and management style. But, in general, the overall management style is democratic and paternalistic, with supervisory relations based on responsible autonomy as described by Friedman (1977).

Information flow follows the degree of confidentiality. A specialised section is responsible for information in all areas of the company, and this controls what is considered suitable to be known by the different levels in the hierarchy. Strategic information related to finance, budgets, and investment, is kept at the top of the hierarchy only. Consequently, engineers are excluded from participating in the inner questions of the company.

TABLE 6.5 - CHARACTERISTICS OF THE COMPANY: NATCO

Characteristic	Summary
1. Market	- Retains a monopoly for energy in the State of Minas Gerais - Growing market with no competitors - Stable profitability, which tends to increase
2. Technology	- Uses national and imported technology - Stable (long life) - Invests in Research and Development in new sources of energy - Technical knowledge subordinated to the company's objectives
3. Organization	- Plant organized by product. Only one product (electrical energy) - Transmission and distribution organized in directory bodies, superintendence. - Technical job organized according to the three main areas of specialization of the company (production, transmition and distribution of electrical energy) - Technical staff highly concentrated in office-work
4. Hierarchical Structure	- Structured in 6 main levels with managerial responsibility: Levels Tittle of the Position 1st Presidency 2nd Director 3rd General Superintendent 4th Superintendent 5th Chief of Department 6th Chief of Division
5. Decision Making	- Centralized in the superintendents and above levels - Chiefs of Department have slight participation in critical decisions - Chiefs of Division and engineers have little participation in strategic decisions - Technical decisions are strictly subordinated to the company's objectives
6. Information Flow	- Information and communication channels follows the hierarchy - Centralized in the superintendents and above levels; Chiefs of department and below levels are well informed in those things related to their area of activities

Source: Interview data

3.1 Personnel Administration

In this section I will be examining NATCO's human resources policies and practices, in terms of recruitment, compensation, personnel training, benefits and social policies, work environment, and trade union relations, and to what extent these policies and practices affects the work situation and class position of the engineers.

3.1.1 How the Company sees its Employees

NATCO has developed a philosophy of personnel administration in which human resource is seen as the availability of human energy by the company in order to achieve its objectives. The Human Resources Management Superintendent argues that "such energy results from the dynamic interaction between people, task and work environment. The result of this integration is what the company understand by **performance.** So, to manage human resources is nothing more than to manage workers' performance". To achieve high performance from its employees, NATCO has developed a very powerful structure of job analysis, performance evaluation, salary administration, health and social service and environment studies, which I will be examining in the following sections.

Despite being a state-owned enterprise, the notion of profit is clear in the company. Hence employees are treated like any other resource the company uses (finance, technology, facilities), to achieve its objectives. As the Superintendent put it:

> "The Human Resources Area does exist in the company to help it to obtain the **best performance** of its employees. Here human resources are seen as the potential of human energy available to do the job the company has to do. The main aim of the company is profits, although it also accounts for the individuals' needs. Workers have never been dismissed for economical reasons or for low performance. In this sense the company seeks an equilibrium between capital and labour. Yet, we cannot forget that if it wants to survive it has to make profits".

In the Superintendent's view, the company respects employees because it needs them to run the business, but that the question of profit is the decisive factor. Employees have never been dismissed due to poor performance because the company enjoys a monopoly within its business, which is very profitable. Yet, the question of surplus value and productivity is serious. As the superintendent points out:

> "Salaries are paid according to the market average. The company follows the capitalist model of compensation for good performance and punishment for bad ones. The company has also tried to create "Cadre" in a French way to compensate its best talents. This group is composed of 807 employees today. This is the group who receives the special attention from the company".
>
> (A NATCO Superintendent of Human Resource Management)

This means that the vast majority of the company's employees and their jobs, the superintendent argues, are subject to the laws of the market. Despite trends towards proletarianization of working conditions, professionals still seem to have more privileges than the non-professionals. As the superintendent stated:

> "Professionals do not get paid for overtime. They receive a compensation for this by having a day off or equivalent

time they over-spent for the company. They are a little less controlled by management than non-professionals. Yet, privileges have been reduced. Professionals aren't an elite any more. The threat of proletarianisation is clear for them. NATCO has about 800 professionals in non-professional posts and the tendency is to increase this number even more"

(A INTCO Superintendent of Human Resource Management)

Thus we can conclude, up to this point, that professionals (including engineers), are seen by the company as employees who have a better educational background and enjoy certain privileges, but who are subject to the general policies applied to the whole workforce of the company. However, the company is keen on developing personnel policies to motivate and integrate professionals in the aims of capital. One indication of this is the attempt to create a "Cadre", like in the French enterprises, to accommodate and compensate those who are believed to be indispensable to run the company. According to Crawford (1989), to move into a cadre position, in France, is to move from labour to capital function. This view is also shared by the areas responsible for human resource management of the company (whose representatives I interviewed) and confirms our assumptions that the human resource policies and practices are shaped by the way the company see its employees.

3.1.2 Recruitment and Selection Policies

Recruitment and selection at NATCO is based on interviews, psychological tests, group experiments, technical tests, medical evaluation and so on. It is based on very detailed job descriptions for all posts up to the level of Chief of

Department. As NATCO is a state-owned enterprise, it has adopted public concourse (open recruitment) to avoid political appointments.

The recruitment strategies for technical professionals, such as engineers, have changed with the changes observed in the labour market. According to a Recruitment Division's representative, prior to 1970 it was very hard to find engineers to supply the company's needs and it became even harder between 1970 and 1978. The company used to recruit engineers from the Universities before they graduated because of the strong competition for engineering graduates. However, from 1978 to 1985 the situation changed in favour of the employers. As a result of the increasing number of engineering schools founded during the military government, the number of engineers increased, the labour market reduced, the levels of salary decreased and the exigencies increased enormously. Focusing on the NATCO labour market a recruitment division representative argued that:

> The internal labour market for engineers is very constrained in the company nowadays. There are about 1,000 employees with University degrees undertaking tasks to which is required only secondary level education. There is no chance to promote them to professional positions. Instead of their job being enriched the company has sub-divided it even more. Divisions and Sections have been created to satisfy the ambitions of power among professionals. Yet, instead of stepping up in the hierarchy professionals have been pushed down in the hierarchy, to function of very little power, such as supervisor".
>
> (A NATCO Recruitment Division Representative)

Thus, we can conclude here by saying that engineers, while salaried workers, are subject to the labour market laws, forcing them to rent their labour power at different prices and conditions, depending on their importance for the company which employs them. These trends become even clearer when we examine the compensation system adopted by the company.

3.1.3 Salary Administration

NATCO does not have a structure for technical careers. Its 18,484 employees are grouped into three main payment schemes, as summarized in TABLE 6.6.

TABLE 6.6 - DISTRIBUTION OF EMPLOYEES BY TYPE OF PAYMENT SCHEMES: NATCO

Scheme type	Category of Workers	% of the working population
Scheme 1	Chief of Division, Chief of District, Graduate professionals, engineers	12.00
Scheme 2	Technicians, administrative workers	43.00
Scheme 3	Qualified workers (electricians, mechanics, etc)	41.00
Special	Chiefs of department and above levels	4.00
	Total	100.00

Source: Interview data

Each payment scheme contains various horizontal and vertical levels, representing different salary values. **Scheme 1** is organized into 14 vertical levels and 7 horizontal bands. Thus, the company employs 98 different salary positions to compensate 12,0 per cent (2,200 employees) of its workforce. Each vertical level corresponds to a 10% pay rise and each horizontal band represents a 5% of pay increase; **Scheme 2** is organized into 15 vertical levels and 10 horizontal bands. Thus, the company has 150 different salary positions to compensate 43% of its working population. Finally, **Scheme 3** is organized into 11 vertical levels and 10 horizontal bands. Thus here, the company has 110 different salary positions to compensate 41% of the working population, that is 7,540 employees.

Chiefs of Department and Superintendents are grouped into a special payment scheme, which is treated as confidential by the company. Directors are treated in a different scheme, whose policies follow the decisions taken by the Company's Council of Administration.

Although NATCO does not have a career structure for professionals, it adopts a classification system in which everybody who is included in the hierarchical structure from the administration council to a professional position, is distributed between the 8 hierarchical levels (see TABLE 6.7).

From the "G" level and above, all positions are considered managerial. After 12 years experience in the company, an engineer can achieve a salary equivalent to the "G" level (Chief of Division), without holding a managerial function. However, Chiefs of Division are paid a commission for their position as Chiefs, whilst "G" level engineers are not. Therefore, engineers will never achieve the same level as their bosses. Thus, if engineers want to progress in the company they have to become Chiefs. This lack of career alternative has lead engineers to struggle together with the Engineers Union (SENGE\MG), to create a technical career in the company to accommodate its fourteen hundred engineers.

TABLE 6.7 - STRUCTURE OF CAREER FOR PROFESSIONALS AND ABOVE LEVELS: NATCO

Level	Position in the Hierarchy
A	Council of Administration
B	President
C	General Superintendent
D	Superintendent
E	Chiefs of Department
F	Chiefs of Department Assistants
G	Chiefs of Division
H	Chiefs of Section, other professionals and engineers. = ENGINEERS are classified in 7 levels from the top to the bottom of the hierarchy: 1. Coordinator engineer 2. Specialist engineer III 3. Specialist engineer II 4. Specialist engineer I 5. Senior engineer 6. Full engineer 7. Junior engineer

Source: Interview data

Moreover, engineers are losing ground in the company and in the market. Until 1982 there was special salary table for engineers, but since then their salaries have been graded according to the market average. Engineering is said to have lost its prestige in the market, while it has increased for other professionals such as economists, accountant and business administrators. As the representative of the Salary Administration Division said:

"The company needs labour power to make profits and the workers sell it at different prices. The company needs to buy it in the best conditions possible. The market laws have reflected in the salary levels of all companies. Today NATCO pays only 65% of what it used to pay for engineers 10 years ago"

In summary, we can conclude once more that, the question of surplus value is clear in the mind of the personnel administrators of the company. Like in INTCO, engineers face the problem of ambiguity of their function in the company. At the same time they are treated as a special group of workers in the system of compensation, and represent a pool for recruitment of managers, they also are expected to produce surplus labour as participants in the collective labour process.

3.1.4 Personnel Control

NATCO adopts various mechanisms to control its labour force. To control the levels of performance, it has developed a very sophisticated and formalised instrument of performance evaluation. It also uses bureaucratic controls to measure turnover, absenteeism, productivity and so on. All information concerning each individual worker, is recorded on a computerized system. However, the physical controls are a more differentiated according to the hierarchical positions of the employees (TABLE 6.8).

Although there are different control methods, all workers, independent of their hierarchical level, are obliged to use electronic cards to get in and out of the company. By this process the company can control everybody, without distinction. In those places where there is no electronic card system as yet, everybody is visually controlled by their bosses. Moreover, the system of performance evaluation and organization assessment is not only a powerful instrument of personnel administration, but is also an unquestionable instrument of social control within the company, through which the company can exert almost full control over the characteristics, performance, aspirations, ideologies and tendencies of its labour force.

TABLE 6.8 - DISTRIBUTION OF EMPLOYEES BY TYPE OF CONTROL APPLIED BY THE COMPANY: NATCO

Category of Workers	Types of Control
Managerial group	Free working time but have to use electronic cards
Graduate professionals in general	Use electronic cards Have flexible working time Are free from time-cards Identified by their brown-colour table
Technicians and administrative workers with secondary education only	Use electronic cards No flexible working time Are also free from time-cards

Source: Interview data

In short, professionals and non-professionals are controlled in the company through different control mechanisms. Like in the case of INTCO, non-professionals are subject to a more "direct supervision", whilst professionals are controlled though "responsible autonomy". However, NATCO seems to be more interested in adopting the mechanism of "responsible autonomy" to control its whole workforce. It has been done by making workers politically docile and submissive to the company's objectives through the training system.

3.1.5 Personnel Training

Professionals in managerial positions have been trained in techniques which aim to improve their abilities to deal with employees, or rather, to improve their abilities to control employees. Engineers are trained in technical subjects related to their areas of activities and in techniques which can enable them to deal more effectively with technicians who work under their technical supervision. A very powerful programme to train technicians and to qualify workers as technicians is maintained by the company in its own technical school. It also keeps hundreds of teenagers in its technical school, to be trained to work as auxiliary technicians and auxiliary electricians for the company. Thus workers are socialised early on in their career in the ideology of the company. Administrative training also receives great attention. Training has been seen as one of the most important variables in explaining the company's good performance.

3.1.6 Benefits and Social Policies

NATCO maintains a large Department of Health and Social Service, which provides its employees with much better social assistance than the National Health Service. It supports leisure activities, subsidises the worker's nutritional, transportation and habitational needs. Psychological assistance, rarely found in Brazilian companies, is also supported by NATCO. Finally, the company has also developed a programme to prepare workers for retirement. A specialised team of medical doctors, engineers and psychologists are responsible for workplace safety and the improvement of the physical work environment.

3.1.7 Work Environment

At NATCO, everything from the colour of the wall to the size of desks, is carefully studied in order to equate the environment to status levels, to facilitate the control of labour by management and to satisfy psychological needs. Superintendents work in big rooms with acoustic dividers up to the ceiling. There is a secretary for each of the Chiefs of Department and all levels above. Chiefs of Department are offered a room of 18 square meters, with 1.5 meter high acoustic dividers and a circular table for meetings. Chiefs of Division are offered a room of 13 square meters but with acoustic dividers only as high as for non-chiefs. Graduate professionals are guaranteed an average space of 9 square meters per person and clerical workers are given 6 square meters on average. However, Professional workers and non-professional clerical workers are offered tables of the same size but of different colours. Telephone facilities are very well provided, such that there is an extension for each group of 3 workers. Air conditioning is provided in almost all administrative areas of the company. A system of background music is also installed in the main building, where the headquarters are housed. In the Regional departments and Power Stations the work environment is different, but the company tries to apply the same policy.

The excessive care taken with the environment has generated positive and negative consequences for the employees. It is said that the open plan offices model reduces the workers privacy, but it has also improved the integration and socialisation of the workers within the firm. In my view, it is a very good strategy of social control at work because everybody knows what their colleagues are doing during working hours.

3.1.8 NATCO and the Trade Unions

Up until 1978, NATCO had managed to be immune to trade union action because it used to attend to the demands of the unions in a very paternalistic way. However, from this time onwards, trade union activities have increased substantially, most of which has been attributed to the new generation of professional workers who have learned how to question their employers through training in union activities in students associations. As the Chief of Trade Union Relations said:

> "Engineers graduated during the hardest period of the military government (1964-1970) and were educated to be the representative of capital. They enjoyed good times during the economic "miracle" and those who still wait for promotion after 15 years in the company do not join trade unions. This behaviour is so profound that the managerial group of the company still see trade unionism as absurd and those engineers who have some relationship

with their unions have less chances of promotion. The managerial group has not recognised yet that trade unions are very important elements of the enterprise. Trade unions work as a thermometer that helps to orientate the Personnel Administration Policies and the management of the company".

(A NATCO Chief of Trade Union Relations)

However, the engineers Union (SENGE/MG) is said to play a double game with its members. One is to use a political discourse to increase its political influence in the company, the other is to use a working class discourse when it is in negotiation. As my interviewee said:

> "The SENGE/MG acts rather as a political agent, as a branch of CUT and the Workers Party (PT) than as a real representative of engineers' interests. In the negotiation table it has assumed a working class discourse, and have accused management that Chiefs are workers too".
>
> (A NATCO Chief of Trade Union Relations)

This militancy is said to be associated with the stability on the jobs enjoyed by the electrical sector workers. As my interviewee argued:

> "As these workers enjoy a certain job stability and good working conditions they seem to have assumed the responsibility to struggle for new rights in the company. In this sense, electricity sector's workers are becoming a vanguard of Brazilian unionism. It is so incredible that the President of the Electrical Sector Workers' Union is an engineer. However, their demands continue the same: better salaries and preservation of benefits already conquered".
>
> (A NATCO Chief of Trade Union Relations)

It is also said that the political objective of the Electrical Sector Workers' Unions is to elect professionals for the presidency of their union, in order to improve the unions technical background and hence allow it to better deal with the company.

NATCO also recognises the development of a class consciousness among engineers and its direct consequences for union activities. The new generation of engineers is seen by the company as having a more professional attitude. They are not interested in being married to the company as it was in the past. As the Chief of Trade Union Relations said:

> "They have assumed the position of working for money and do not feel obliged to do everything the company want them to do as in the past. They have assumed a more working class position. If it is true professional unions will become so strong as the metal workers and electrical sector workers ones".
>
> (A NATCO Chief of Trade Union Relations)

In contrast to INTCO, which intends to eliminate any possibility of union activity in the company, NATCO is trying to incorporate labour relations as part of the activities of management. Hence, NATCO deals with professionals as it deals with all employees. Engineers and other professionals seems to have learnt these lessons and, like other workers, they have used their Unions as a legitimate institution to represent their interests in the company.

4. Conclusion

This Chapter has shown that both companies, INTCO and NATCO, were set up in the early 1950s, aiming to exploit a market being developed by the emerging industrialization of Brazil. Although INTCO is a multinational private company, it enjoys a monopoly for its products in Brazil as it has few competitors. NATCO, as a state-owned company, has had a monopoly for its products in the whole State of Minas Gerais since its foundation. However, the return on investment has been better for NATCO because INTCO has been subject to the laws of the free market whilst NATCO has not. As a consequence of this, INTCO's workforce has been reduced whilst NATCO's workforce has increased. Moreover, while the working conditions at INTCO have worsened, at NATCO they have improved.

It was found that both companies use a more stable (long life) technology for their sector of activities, which involves little change over the course of time. INTCO does not invest in Research and Development in Brazil, while NATCO has been active in the development of new sources of energy. Hence, most of INTCO's engineers are involved only with production related activities, while at NATCO they have a more diversified range of activities.

The companies' hierarchical and functional structures follow a similar model, but NATCO is much more formalised and bureaucratic than INTCO. In both companies the critical decisions are taken by employees from the middle to the top of the hierarchy. The operational functions are concentrated between the middle and bottom of the company. Consequently, the engineers' involvement in the inner questions of the company are absent. Moreover, information flow is very restricted in both companies. Engineers are concerned only with information related to their area of activities. The inner information is kept under the control of the top hierarchy in both companies.

INTCO's managers are more autocratic and control oriented while the managers at NATCO are more democratic.

However, in both companies professionals (engineers included) are controlled through mechanisms of "responsible autonomy". At INTCO everything concerning personnel management is decided by the managers who are given full autonomy to decide everything about their subordinate. At NATCO however, managers have to discuss everything with the Human Resources Superintendency before a decision about personnel is taken. Thus, while at INTCO the power rests of the hands of managers, at NATCO power rests on the organizational structure. Therefore, the management of both companies have been active in making professionals both, the representative of the company's objectives and productive workers. This supports the view of Carchedi (1977) and Wright (1985) that professionals play an ambiguous role in capitalist firms. One is to be representative of capital - to be controllers of the technical labour process and of the work of others - and the other, is to be submissive to the company's objective - as participants of the collective labour process, i.e, as productive labour. This ambiguity is what make their class position distinct from the capitalist and the working class.

These ambiguities are recognised and reinforced by the companies themselves, and are expressed in the different policies adopted to deal with professional employees. These policies also differ between national and multinational companies. INTCO pays a little less than the market average for non-professionals but accepts the demands of professionals if they are very important to the company. NATCO pays according to the market average for all professional and non-professional workers, even though they may be very important to the company. INTCO engineers are paid like other professionals, according to their importance for the company. At NATCO the relative value of their salaries has decreased by 35.00 per cent in the last ten years, but like other professionals, such as economists, business administrators etc, they still earn more than non-professional employees.

The benefit policies of both companies are quite similar, but NATCO is more paternalistic than INTCO. While INTCO tries to favour professionals rather than manual and administrative workers, NATCO tries to favour everybody without distinction.

Recruitment and Selection procedures at INTCO are highly influenced by managers interests and the company reserves its best top positions for executives and engineers from its home country. At NATCO such procedures are more independent, but it is the managers who make the final choice of any candidate. The training policies are similar and both companies have given more attention to technical training. Managers are trained in subjects related to their company's ideologies to make them more competent to deal with their subordinates.

The work environment is very different in the two companies. While NATCO has a policy of equating the work environment to the human needs, INTCO does not seem to be concerned with such an issue.

INTCO deals with Unions as if it was dealing with enemies. Professionals and those in managerial functions are forbidden to be involved with union activities. In contrast, NATCO is trying to incorporate trade union activities as part of the activities of management. Nonetheless, everybody who is involved with unions is less likely to be appointed for promotions.

The Personnel Control System have different characteristics in the two companies. INTCO controls its non-professional employees through "direct supervision", time-cards, and output production. At NATCO non-professional employees are controlled more psychologically through formal system of performance evaluation, organization of the work environment, training, orientation on the job, and psychological support for those considered inadequate. INTCO also adopts the threat of dismissal to make employees more productive, while NATCO adopts performance evaluation and the risk of a block on career mobility for those with low performance. However, in both companies professionals are controlled through mechanisms of responsible autonomy.

In short, national and multinational companies reveal significant differences in their human resource policies, but both deal with professional workers as a distinctive group within the company. It became clear that INTCO (as multinational) does not carry out Research in Brazil, reserves its best top positions for its home country executives and is not interested in transferring managerial capabilities to lower level managers such as Chiefs of Department or below. Although INTCO has been forced into adapt itself to the Brazilian economic, political and labour environment, its headquarters management still manage to control the general human resource policies adopted in Brazil. These findings are consistent with the theoretical approach on multinationals presented in chapter 4 namely that human resource management is one of the most decentralised areas within multinationals, but that the MNCs' headquarters management monitors the main policies of their subsidiaries in host countries. The findings are also consistent with the assumption presented in chapter 4 that, multinationals are not interested either in transferring managerial technology to host country executives, or in investing in research and development in their subsidiaries. Finally, Although engineers, like other professionals, can be equated to the whole work force in that they are salaried employees, their general working conditions differ from that of non-professionals workers. Their market situation and work situation distinguish them from the working class in general. These are important issues I will examine in detail in the next three chapters. The nature of the engineers' work and the physical working conditions under which they carry out their job are the subject of analysis of the following chapter.

7. THE ENGINEERS' WORK AND PHYSICAL WORKING CONDITIONS

1. Introduction

It was shown in Chapter 2, that the development of the capitalist labour process was marked by a gradual replacement of artisan control by the division of labour. In this, critical design, planning and supervisory functions became concentrated in the hands of the employers' representatives, while execution was left to manual workers whose jobs became increasingly routinized and supervised (Whalley,1986:66-67). Engineers, as highly specialised workers, are said to have become the employers' representatives within this labour process (Whalley,1986; Braverman, 1974; Poulantzas, 1975; Carchedi, 1977).

Ironically, Marxist theorists of proletarianization have made a strong case for the fact that engineers are now themselves the victims of effort to rationalize and simplify their own jobs. Chapter 2 discussed that debate in detail and pointed to the fact that in the view of proletarianization theorists, engineers are subject to increasing specialization of their work, to codification of their knowledge, under-utilization of their skills and to supervision of their work. This Chapter examined the case of INTCO and NATCO engineers in the light of this debate. This chapter starts with an historical overview of the place of Brazilian engineers in the division of labour and then focuses on the examination of the organization of technical labour and the nature of the work engineers undertake at INTCO and NATCO. There then follows an analysis of the physical working conditions (facilities provided) under which the engineers carry out their job and the supervisory relations involved. Therefore, a comparative analysis between the work and experiences of engineers in the two companies is also established. The chapter ends with an examination of the work and experience of Brazilian engineers in relation to those of developed nations.

2. Brazilian Engineers and the Division of Labour

During my analysis of the engineering education system in Brazil, in Chapter 5, I pointed to the fact that since the beginning of the engineering profession in Brazil, engineers have been educated to be the company's representatives and to assume technical and managerial functions in the state apparatuses and in private businesses.

It was also highlighted that until the mid-1930s, Brazilian engineering education had been highly influenced by the French model of "polyvalent" education. According to Crawford (1989:71), French engineers are educated to be "polyvalent" so that they can perform technical and managerial functions at the same time. Thus, Brazilian engineers used to be given only a generalist education, enough to run their family's businesses or to work in the state apparatus. However, the increasing American economic influence in Latin America after the 2nd World War, affected not only Brazilian industry and the economy but also engineering education. The American models of work organization and rationalization of tasks soon spread into Sao Paulo industry through IDORT (Institute of Rationalization and Organization of Labour), created by Brazilian and American engineers interested in the subject. As a result, engineering education was also progressively reoriented towards a more pragmatic approach, aiming to attend to the demands of industrial production. With the educational reforms of the 1960s and 1970s, the idea of "polyvalency" was firmly replaced by the idea of "specialization". Engineering courses were reorganized into various fields of specialization, such as civil engineering, mechanical engineering, electrical engineering etc, and within these courses, smaller areas of specialization were also defined. Thus, besides being responsible for the rationalization and organization of the work of others, Brazilian engineers themselves became the main victims of this process as their own specialization occurred simultaneously at university and in the workplace.

Considering this transformation in the engineering education system and in the technical labour process, and compared to the polyvalent engineers of the 1950s, Brazilian engineers are much more specialized today. Nonetheless, Brazilian engineers are likely to be undertaking much more **engineering** today than in the past. Moreover, like their American, French, German and Japanese counterparts (but in contrast to British engineers), Brazilian engineers have played an important role in Brazilian industry, both as managers and technical staff. The case of INTCO and NATCO engineers, provide good evidence of the variations in place, role and conditions in the technical labour process.

3. The Engineers' Work and Working Condition at INTCO

INTCO engineers are essentially concentrated in production and related activities, such as maintenance, quality control, process production, and project engineering. They are also found in the administrative areas of workplace safety, technical training and data processing. These different work environments create different demands, while the task contingencies create different pressures on the engineers. The hierarchical division of labour in technical and supervisory activities also affects the content of their work. Thus, this section examines the organization of the work of engineers in these various areas, the working conditions and the supervisory relations under which they perform their job in the company.

3.1 Engineers at INTCO: Work Organization and Activities

TABLE 7.1 summarizes the characteristics of the work done by INTCO engineers according to their place in the hierarchy and areas of activities. It shows that the Chiefs of Department are more involved with administrative tasks, that the Chiefs of Service are more involved with technical and administrative activities at the same time, and that the engineers are essentially involved with technical things.

TABLE 7.1 - CHARACTERISTICS OF ENGINEERS WORK BY THEIR PLACE IN THE HIERARCHY: INTCO

Position in the hierarchy	Area of Activity	Characteristics of the work done by engineers
Chiefs of Department	All areas	More administrative than technical
Chiefs of Service	Production	Technical and administrative/ managerial
	Maintenance, Projects and Quality control	More technical than administrative
	Workplace Safety	Essentially bureaucratic/ clerical
	Training	Technical and administrative
Engineers	Production	Routine technical work
	Process production, Maintenance, Projects, and Quality Control	Technical
	Workplace Safety	Technical and bureaucratic/ clerical
	Training	Technical and administrative/ managerial
	Data Processing	Technical and administrative/ managerial

Source: interview data

In terms of the technical division of labour, it was found that the job of production engineers is not so complex, and according to one production engineer a well trained technician could do the job. As he put it:

> "The function of a production engineer could be carried out by everyone who has any experience in the area or by a metallurgist technician without any problem. Experience rather than education seem to be the key skill for this job"
>
> (Engineer Chief of Service)

Conversely, process production engineers deal with all the production processes and the quality of products. Their job requires a high level of technical knowledge. Proof of this can be seen in the fact that most of them are specialised in one area of pig iron or steel production, besides holding a masters or a PhD degree. Despite enjoying a better position in the company, their place in the hierarchy has changed. In the recent past, they were part of a specialized team linked to the Superintendency of Production. In 1988, they were pushed down two levels in the hierarchy to the position of "process engineers", and are now subordinated to the Chief of Department where their technical knowledge is applied. Although their salary was not reduced, they are now more insulated in production than before. However, one of my interviewees said that he was now more of an engineer than a manager and that he felt much happier with his essentially technical activities.

Maintenance engineers are distributed among six areas of specialisation: electro-electronics, energy, production lines, mechanics, civil engineering and maintenance planning. The Chiefs of Department of these areas spend most of their time undertaking managerial activities, while the Chiefs of Service spend most of their time giving technical advice to supervisors, engineers, foremen and technicians. The engineers' work is complex and requires a great deal of involvement with production engineers. Engineers are also required to repair equipment themselves where higher technical knowledge is needed to do the job. Thus, their work is essentially technical.

Project engineers have a more diversified job and are a kind of strategic planner. They carry out projects related to factory expansion, technical investment and improvement of the company's infra-structure. Their job also involves a close relationship with production activities and requires knowledge of not only engineering but also of economics and business administration. It is also a creative job, in terms of engineering and business administration.

The area of Quality Control and Research is organized into three departments: laboratory, quality control and quality engineering (or research). Research engineers are involved with product and process engineering only, because the basic research is done in Germany. The Chief of Department spends a great deal of his time giving technical advice to the Chiefs of Service. The Chiefs of Service and engineers do a lot of laboratory tests following procedures described in the Quality Control manuals. They also operate sophisticated equipment and microscopes, depending on the complexity of the tests being done, but in general, their job is very repetitive. Technicians and laboratory auxiliaries do the simplest tests and gather samples from the production lines.

The poorest work, in terms of engineering, is performed by Workplace safety engineers. Their job is to introduce concepts aimed at reducing the risk of accidents in jobs and to supervise workplace safety. The Chief of Service has an essentially bureaucratic function, and the engineers and technicians spend half of their time with bureaucratic things and half in visiting different areas of the plant to analyze the degree of workplace safety. Engineers and technicians do almost the same thing. Besides being a very repetitive, bureaucratic and poor job, it is also seen as unnecessary by many of the chiefs in the company.

Training engineers, despite being subordinated to the administrative area, deal with technical aspects. These engineers do a kind of Taylorian industrial engineering, aimed at improving productivity. They make proposals for work organization, write technical manuals of technical operations for production areas and teach these operations to people who work in production and related activities.

Finally, the data processing area is organized into seven main activities: sales, production planning and control, purchasing, accounting and finance, personnel, cost accounting , expansion and maintenance. Thus, system analyst engineers are more involved with administrative concepts than with concepts of engineering.

In short, the technical content of the engineer's work at INTCO changes according to the hierarchical and technical division of labour. Engineers in managerial positions, are involved with both technical and administrative aspects at the same time. Those in technical positions in areas of engineering are essentially involved with technical things, while those who work in the administrative areas are more involved with concepts of administration than with those of engineering.

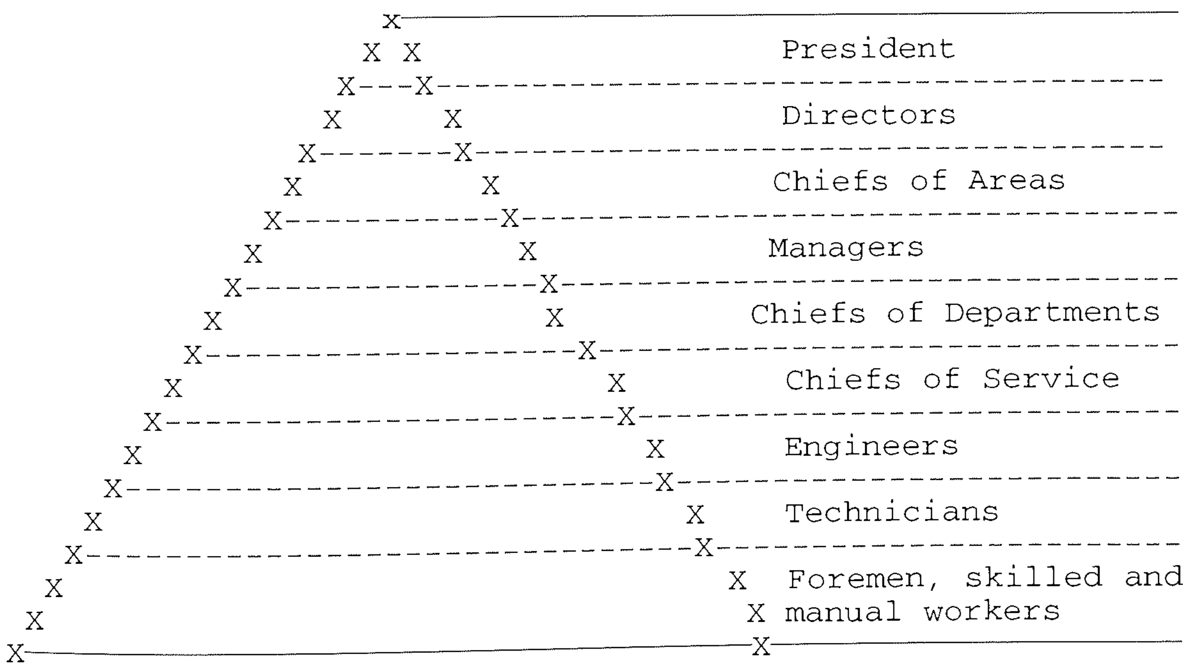
No indication was found of excessive rationalization of the engineers work as the proletarianization thesis implies, although the work of quality control engineers is, in fact, guided by manuals of procedures. Complaints about sub-utilization of technical knowledge was found among the engineers in pig iron production, workplace safety and data processing, while process production engineers commented on the high exigencies of technical knowledge involved in their activities. There is no doubt that the organization of the plant by areas of specialization of products, imposes certain limitations for the full use of knowledge brought by engineers from their engineering schools. Nonetheless, INTCO employs the strategy of job rotation between engineers of related areas of activities, in order to keep the team trained in the various areas of engineering. This strategy has been adopted to counterbalance the disadvantages of specialization in American firms (Crawford, 1989), and to build and diffuse an "*engineering* culture" in Japanese companies (McCormick, 1992:64).

3.2 Supervisory Relations of INTCO Engineers

FIGURE 7.1 summarizes INTCO's hierarchical structure, which in turn defines the basic supervisory relations in the company. For example, the Chiefs of Department are supervised by managers while supervising the chiefs of service. The Chiefs of Service are supervised by the Chiefs of Department and at the same time they supervise engineers. Engineers, in turn, are supervised by the Chiefs of Service, while they technically supervise technicians.

Nonetheless, this hierarchical structure and supervisory relations can vary according to the area of activity. In production, for example, the Chiefs of Service directly supervise technicians, foremen and manual workers, because they do not have engineers under their supervision. In all the other areas of the company, the Chiefs of Service have engineers under their supervision so they are less involved in directly supervising technicians or manual workers, as this task is left for engineers, technicians and foremen. Process production engineers are another example. They are subordinated to the Chiefs of Department and have almost no contact with technicians and manual workers.

FIGURE 7.1 - HIERARCHICAL STRUCTURE AT WORKPLACE: INTCO



Source: Interview data.

In general, the supervisory relations at INTCO tend to be more rigid, but it can vary depending on the area of activity and on the personal style of the manager. Process production engineers, for example, enjoy more autonomy and flexible supervision because they are in a very close position in relation to their Chiefs. Furthermore, they are more technical while their chiefs are more administrative. Thus, they have to combine their effort toward the same objectives. They do not directly supervise any worker but they do exercise technical supervision over the Chiefs of Service.

In the area of maintenance, everybody is subject to very close supervision. The Chiefs of Service directly supervise engineers and technicians, who in turn exercise only technical supervision over foremen and workers. In the area of Quality Control, engineers technically supervise technicians and laboratory auxiliary whilst the administrative supervision is undertaken by the chiefs of service.

Training engineers are subordinated to the area of human resources management, where supervisory relations are much more flexible. However, their sphere of relations is composed of production engineers and technicians. Finally, system analyst engineers are essentially involved with administrative workers of the areas where they are working and are subject to a more rigid supervision.

As argued at the beginning of this chapter, the area of activity also affects the degree of demands imposed by management on engineers. Engineers who work in production and related activities, such as in maintenance, process production and quality control, have to work at weekends or at night, if necessary. Therefore, they have to use a BIP (electronic pager), after going home, in order that they can be contacted by the company at any time, if necessary. This has been a matter for strong complaints. In their view, this affects profoundly their private life. As an engineer put it:

> "as I have to attend the company's needs first, at any time, my social and private life is highly controlled. Everything I go to do must be calculated. It is an arduous system, because the level of exigencies are very high. If I don't do this I don't serve for the company"
>
> (a Chief of Service).

Project engineers are also subject to time pressures and close technical supervision. Their work is followed by pre-design of objectives, time-sheet control and so on. The hierarchical structure is rigid. Like any other area of the company autonomy and participation is limited, and important decisions are taken at the department level and above.

The working time is rigidly controlled by the company. There is no flexible time for anybody in the company, and the Chiefs of Service and engineers are asked to avoid reading private newspapers or magazines during working hours, because this is associated with the idea of leisure.

In short, the technical and hierarchical division of labour affects the nature of work performed by engineers, their sphere of relationship at work and the sort of supervision they exercise upon others or are subject to.

3.3 Working Conditions and Status of INTCO Engineers

The status of engineers and their working conditions are highly affected by the hierarchical and technical division of labour, as well as by the engineering context in which they are involved. Engineers who work in areas of engineering have higher status than those in administrative departments, while those in managerial positions have higher status than those in technical roles.

The working conditions in production are among the poorest in the company. The Chiefs of Service work in an old building, very close to the production area. There is much noise, dirtiness, high temperature and a very high safety risk as well. The level of comfort is limited, with old furniture, small rooms, and a lack of facilities. Conversely, the Chief of Departments have bigger rooms with air conditioning and a big table, all according to their status in the hierarchy.

Process production engineers work in rooms with air conditioning, telephones and toilets, although the furniture is old and the tables are very small. INTCO also reinforces the status of those with a PhD degree, by calling them "Doctors" and by placing a plaque with their name and title (Dr.) on the door of their room. The size of the room and salary, are proportional to the level of qualification and to the contribution the individual is expected to give to the company.

Maintenance engineers have to work alongside those in production. Thus, their working conditions are very similar to that of production engineers. There are some differences in the working conditions of maintenance engineers who work alongside production engineers and those in the maintenance headquarters. The Chiefs of Department and the Chiefs of Service, who work in the maintenance headquarters, enjoy a private room much better than those of the production chiefs. Conversely, the room of a Chief of electro-electronic maintenance who I interviewed was only four square meters, and full of small equipment, and therefore almost impossible to use.

Like in production and maintenance, Quality control engineers work in a building strategically located alongside the production services, in a very old building, grey from smoke and pollution. Internally, it is a little less noisy and dirty compared to the production areas, since the laboratories have to be protected against environmental influences. Moreover, engineers who undertake quality control on the production lines are subject to that work environment too. Conversely, the Chief of Department is a "Doctor Engineer" with a PhD degree. As such he enjoys a very comfortable office, visibly better than those enjoyed by the other Chiefs of Department. The Chiefs of Service have a much smaller private room, very similar to those of others at the same level.

Engineers in projects, training and data processing activities are offered good working conditions. Project engineers, besides working in an office far better equipped than all the other offices for engineers in the company, also have to travel around the country to contact suppliers when equipment is being produced for the company. Training engineers work in a very comfortable building, specially built for training activities. There are plenty of rooms, telephone extensions, new furniture and all the necessary equipment for their activities. System analysts work in a very big common room with air conditioning, because the computers have to work under specific temperatures. However, as they are linked to the Administrative area their status is a little lower than those who have the title of engineer and work in specific areas of engineering.

Finally, the worst situation is found among the workplace safety engineers. The Chief of Service, engineers and technicians work in a very small, old and uncomfortable building. The working conditions enjoyed by the Chief of Service differs very little from that enjoyed by his subordinate engineers and technicians. Furthermore, these engineers enjoy a little worse status in the firm because this area exists in Brazilian companies because it is required by law. Thus,for most Chiefs it represents only a cost to the company, and frequently these engineers are seen as unnecessary.

In short, INTCO engineers in production and related activities are offered poor working conditions in terms of rooms, furniture and work environment. These conditions vary with the place they occupy in the technical and administrative hierarchy, and with the area of activity. The best working conditions were found among the Chiefs of Department in general, and in the areas of training, projects and headquarters maintenance. The worst conditions were found in the areas of pig iron production and workplace safety.

4. The Engineers' Work and Working Conditions at NATCO

NATCO engineers are concentrated in four main areas of engineering: production, transmission of energy, energy distribution, projects and research and development on energy. Similar to INTCO, the engineers work at NATCO is organized in superintendences, departments, and divisions. In the technical division of labour, engineers are grouped by areas of specialization. Thus, in this section I will examine the organization of work and what the engineers do in these different areas of activity, the physical work environment, the status enjoyed by engineers and the supervisory relations involved in their work.

4.1 Engineers at NATCO: Work Organization and Activities

As argued in section 3, the hierarchical division of labour affects the content of the engineers work, in the sense that as they move from a technical to a managerial career their function becomes more administrative. As TABLE 7.2 shows, like at INTCO, the Chiefs of Departments of all areas of engineering at NATCO are more involved with administrative rather than technical activities, although they do need to know the content of the technical work being carried out under their supervision. The Chiefs of Service perform a mixture of technical and administrative work, and depending on their area of activity, are more involved with either technical or administrative tasks. For example, in the commercial areas the chiefs of Service are more administrative, while in maintenance they are essentially technical. Engineers are in general involved with technical activities. Only in the area of market studies are engineers more involved with technical issues of economics and business administration, a characteristic also found among INTCO project engineers.

TABLE 7.2 - CHARACTERISTICS OF THE WORK PERFORMED BY NATCO ENGINEERS ACCORDING TO THEIR PLACE IN THE HIERARCHY

Position in the Hierarchy	Area of activity	Characteristic of the work
Chiefs of Department	All areas	More managerial than technical
Chiefs of Division	All areas	Half and half technical and administrative
Engineers	Production	Technical
	Transmission	Technical
	Maintenance	Technical
	Distribution	Technical
	Projects and construction	Technical
	Market studies	Technical studies, economic projects
	Research	Technical

Source: Interview data

Although the majority of engineers have an essentially technical job, the various technical environments create specific technical demands upon them. For example, engineers in production and energy distribution supervise the production process, operate substations of energy transmission, power stations and telecommunication systems. As there are different functions of engineering in these areas, the work is organized in such way that engineers are highly dependent on each other in completing the job.

In the area of maintenance of power stations and transmission lines, jobs are allocated according to the degree of technical specialisation of each division, and within each division there are "sections" specialised in specific issues. Engineers work very closely with technicians and auxiliary technicians, who work under their technical supervision. They do not do too much manual work, but the company tends to involve them in the maintenance of high-tech equipment. Yet, their work is complex but does not require a high degree of specialisation. As one engineer said:

> "we don't need to be highly qualified, because we use only a mid-level engineering in our daily life in the company".
>
> (A Maintenance Engineer)

In the Central maintenance workshop, engineers perform tasks such as studies, projects and evaluation of all work related to maintenance of power stations and civil engineering. Most of the jobs are allocated according to the hierarchical and technical division of labour within the Divisions. The Chiefs of Division are more involved with administrative issues and the engineers with technical aspects. Manual tasks are delegated to technicians and draughtsmen, though engineers also spend nearly twenty per cent of their time with operational activities.

The division of labour in the area of energy distribution, is highly affected by the geographical location of the engineers workplace. Engineers who work in the headquarters do the most complex jobs while those in the regional departments do the simplest tasks. Headquarters engineers deal with projects of construction and improvement of the distribution systems. These engineers are seen as technical consultants because they are required to give technical assistance to engineers in regional distribution systems. Their job requires a high level of engineering knowledge about distribution systems. Studies to adopt a CAD SYSTEM in this area have been done, but some engineers have resisted this idea. Nearly 80.0 percent of the workforce in this area is composed of engineers, the remaining 20.0 per cent being technicians. Technicians are fully involved with manual activities. Despite the work of engineers being very creative, it has also become repetitive because it follows a number of schemes previously drawn up for the company. Engineers in the Regional Departments (interior) undertake similar tasks to those performed by the previous group, but with a lower degree of sophistication, as I have mentioned.

The area of projects and construction is organized into five superintendences: energy generation, energy transmission, power station construction, project and installation of electrical systems and market studies. Despite being organized into different activities, the nature of the engineers' work requires similar levels of technical knowledge and knowledge of the firm. There is no doubt that this is one of the richest areas to apply engineering in the company. Engineers who work with construction projects have to exchange technical knowledge among themselves, because the projects are so big that nobody can do it alone. They work with sophisticated technology, such as CAD SYSTEMS, to draw the most complex electrical systems. Even the Chiefs of Division have to perform a mixture of technical and administrative activities. The technicians do the manual work for the engineers.

Market studies' engineers carry out studies about the forms of potential energy and their potential customers. The work is performed by an interdisciplinary group of engineers, economists and business administrators. Thus, the engineers are involved with administrative rather than with engineering concepts.

Research and development is organized into two main areas: research on gas and research and studies on energy. The engineers in research on gas deal with planning, calculations, market research, design of plants and distribution systems for gas production. They are also responsible for defining the economic viability of new research projects. Their work is creative because they have to deal with new procedures, new schemes, and new structures. The Chiefs of Department are essentially involved with administrative issues, while the Chiefs of Division are more involved with technical aspects. The engineers in applied research are searching for new sources of energy, such as gas, solar energy, methanol, coal energy etc. They have close contact with research institutes, and research departments of public and private companies, both at the national and international level. In contrast to other areas, the Chief of Department spends most of his time dealing with technical issues, since the department is not organized into Divisions and thus he has to deal directly with the engineers.

In short, as at INTCO, the engineers work at NATCO is organized by area of specialization in engineering, but no indication of deskilling was found in the company. To a certain extent the division of labour is necessary because the company deals with various fields of engineering. Thus, it would be impossible for any engineer to be involved with all these fields at the same time. In order to counterbalance the disadvantages of specialization and to prevent deskilling, NATCO adopts the strategy of job rotation, commonly found in American firms (Crawford,1989:74) as well as in Japanese firms (McCormick, 1992). Therefore, as in the case of French engineers (Crawford, 1989) the most routine and simple jobs are delegated to technicians who work under the engineers technical supervision.

4.2 Working Conditions and Status Provision for NATCO Engineers

The working conditions of NATCO engineers are no doubt far better than that of their INTCO counterparts. However, like at INTCO, their working conditions and status provision are affected by their area of activity and their place in the technical and hierarchical division of labour. Another important aspect that affects the quality of the work environment, is the main product of the company and the technology used. As NATCO produces electrical energy by water power stations, its production area is cleaner compared to other sources of energy production such as that from coal and uranium. Thus, NATCO production engineers enjoy a very privileged work environment, in which their offices are divided into small houses within a forest grown by the company around the hydroelectric power stations. The rooms, tables, telephones and air conditioning, all follow the high standard of the company. This work environment and the social relations at work, are all defined to promote status differentiation in the company. Secretaries refer to the Chief of Department as "Doctor" independent of whether he holds such a degree. Conversely, the Chiefs of Division and engineers are referred to as "engineer" only. The size of the room and the facilities are all proportional to their place in the hierarchy. Engineers enjoy a high status in the cities near the power stations they work in. Sometimes the very fact of working for NATCO can open doors to the high society of small cities.

In contrast, the working conditions of maintenance engineers are very different to those found in other areas of the company. The central maintenance workshop is located within the industrial area of Belo Horizonte, which is a very polluted, noisy and dirty place, with the smoke from the factories around it. The engineers' rooms are very small, they have old furniture, are very crowded and have few telephone facilities and no air conditioning. The equipment and facilities are limited to the minimum required to do the job.

Unlike the others, this Superintendency maintains a restaurant close to the workshop, since it is far from the city centre. Moreover, the status, prestige and power enjoyed by the Chiefs is much higher than that enjoyed by engineers, even though the engineers technical specialisation and salary are equivalent to their bosses. Thus, the great challenge is to became a "Chief".

The working conditions and status provision for energy distribution engineers, who work in the regional departments, follows the standards for the headquarters engineers. However, the maintenance engineers of regional departments have the worst conditions. Their rooms are small, the place is noisy and offers little comfort compared to that enjoyed by the headquarters engineers.

Status differentiation is clear in the regional departments. The Regional superintendent is always referred to as "Doctor" independent of whether he holds such a degree. The Chiefs of Division are called only "engineers". However, all of them use business cards printed by the company to improve their status in the city where they work, as they are highly involved with the community.

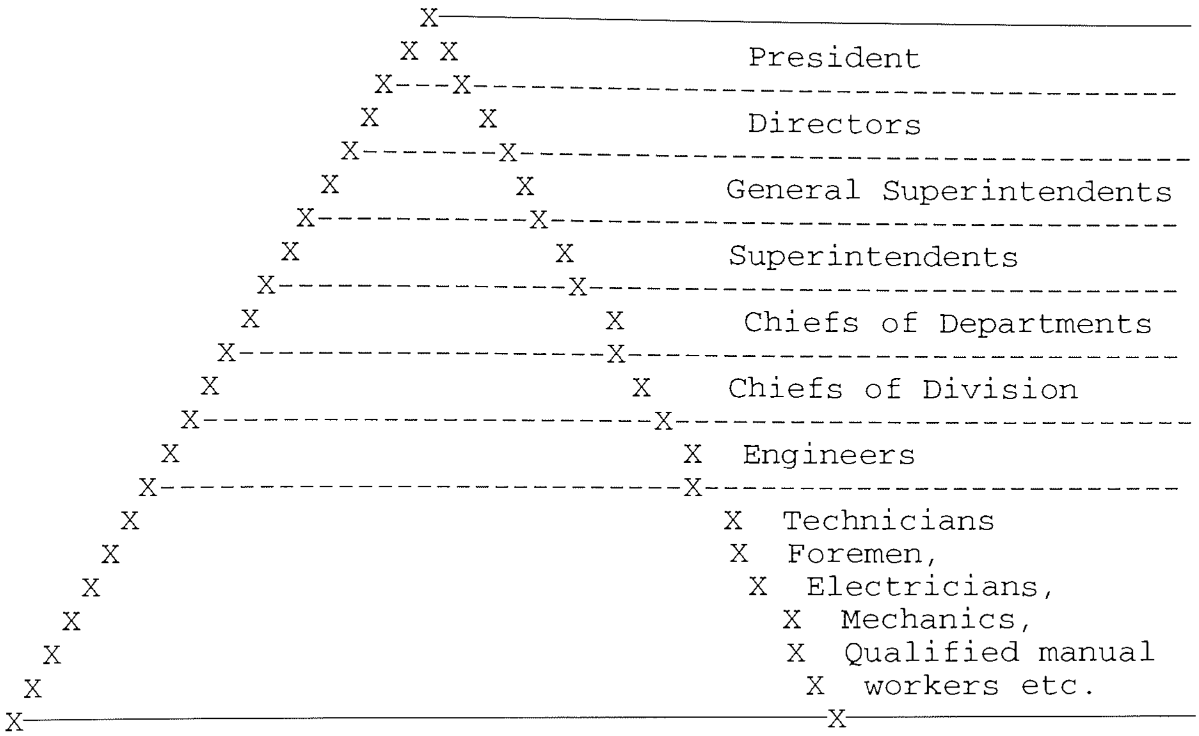
Research engineers also enjoy a high standard of working conditions. The Chiefs of Department used to wear ties and adopt a more arrogant and superior attitude. Their sphere of relationships is among the superintendents and directors. Most of them are called "Doctors", independent of holding such a degree. They also enjoy a much greater degree of information concerning the company. Their relationship with engineers is very close and flexible. Their private rooms are bigger than those of the Chief of Division but much smaller that those offered to the Superintendent engineers. The Superintendents have a very big private room divided by wood up to the ceiling, with a big circular table for meetings and some sofas for their visitors. The status differentiation is very clear between all levels.

In short, NATCO engineers, in general, are offered a high standard of working conditions. Part of this is explained by the company's preoccupations with this aspect of work, but part is also explained by the fact that most NATCO engineers are essentially engaged in office-work only. Moreover, manual and operational activities are performed by technicians and specialized manual workers. Only in the area of maintenance does the working conditions of the engineer resemble their INTCO counterparts, in the sense that it is very poor.

4.3 Supervisory Relations involving NATCO Engineers

FIGURE 7.2 summarizes NATCO's hierarchical structure, which defines its basic supervisory relations. The Chiefs of Department are supervised by Superintendents and they in turn supervise the Chiefs of Division and Assistant engineers. The Chiefs of Division are supervised by the Chiefs of Departments, who supervise engineers. Finally, engineers are supervised by the Chiefs of Division, who in turn supervise technicians and qualified workers on technical issues.

FIGURE 7.2 - HIERARCHICAL STRUCTURE: NATCO



Source: Interview data

The supervisory relations in the company are said to be flexible, but in practice they are rigid and vary according to the area of activity and to the personal style of the engineers in managerial positions. For example, in the areas of production and transmission of energy, decisions are highly centralised in the hands of the Chiefs of Department, the Superintendents and the Directors. Engineers have very little autonomy and participation in these decisions. As one engineer mentioned:

> "The decision making process is obscure and centred in the top level of the managerial hierarchy. Despite having some participation in the budget elaboration, we have no autonomy to decide about the money necessary to put into the projects is functioning. Some times the decisions are not taken and we continue without knowing what is happening with the company"
>
> (A Chief of Division)

Maintenance engineers are subject to pressure from their bosses to get the job done in the shortest time. Engineers also supervise technicians and auxiliary technicians on technical aspects. In short, maintenance engineers suffer the disadvantages of working under the worse working conditions, time pressures and toughest supervision.

In the area of energy distribution the work of the engineers is controlled by the "time sheet". In this managerial instrument of control, are specified the activities the engineer has to undertake and the expected time they are to be completed by. As a Chief of Division argued:

> "The adoption of "time sheets" was made necessary because we have too many tasks of different nature to do. If we don't do this we can get lost within the system. Yet, the adoption of this instrument of control have caused too much conflict among engineers because they feel as if they are under a kind of police control within the company".

As already noted, most of NATCO engineers supervise technicians and qualified workers. However, the Chiefs of Division also see engineers as participants on the collective labour process. As such, they are subject to the notion of productivity. As one of them said:

> "Engineers are specialised workers who receive a better salary than the majority of the working population. Yet, this salary difference is due to their degree of technical knowledge and activities, but it doesn't disqualify them as productive workers within the hierarchy".

Like at INTCO, here again the ambiguity of the function of professional workers in capitalist organization is clear. One of these functions is to be the representative of capital while supervising the work of others. The other is to be part of collective labour, i.e, as productive worker. This is what according to the "new middle class thesis", makes the class position of professional workers distinct from the working class.

In fact, when I asked my interviewee about the engineer's position in the class structure, their middle class character was mentioned. As he said:

> "If we consider the work situation (salary, status, stability on the job) enjoyed by NATCO engineers in comparison to the poverty of our working class, we can't say that NATCO engineers are working class. They could join the group of owners of small business (petty bourgeoisie)".
>
> (A Chief of Division).

In short, engineers who work in the superintendency of energy distribution are subject to very close supervision and their participation in the technical decision making process is very limited. Thus, in this respect their position in the labour process is similar to other workers. However, their place in supervisory functions, their status and rewards place them in a different position compared to other workers in the same superintendency and in the company as a whole.

Finally, in the area of research and development too, despite everything being highly technical, engineers have little participation in technical decisions. In general, the decision making process is long and sometimes decisions are not taken because political and economic variables affect the whole company. The result is a certain frustration among engineers because they perceive that the result of their efforts have been "binned".

5. The Engineers Work and Working Condition at INTCO and NATCO Compared

Although the two companies deal with different products and have different areas of specialization in engineering, they have many things in common in terms of the way technical work is organized, how the hierarchical and technical division of work is created and in how the supervisory relations work. Nonetheless they have little in common in terms of the working conditions offered to engineers.

5.1 Engineering: Organization and Activities

In the hierarchical and technical division of labour, TABLE 7.3 shows that the Chiefs of Department of both companies are more involved with managerial/administrative tasks. The Chief of Division of Workplace Safety at INTCO is highly involved with administrative (bureaucratic) things. The Chiefs of Service of production (at INTCO) and the Chiefs of Division of production (at NATCO) perform more administrative and routine technical tasks. However, in the areas of maintenance and projects of both companies Chiefs of Division/Service are more involved a little more with technical than with administrative tasks. In all of the other areas of both companies the activities of Chiefs of Division/Service are divided roughly equally between technical and administrative issues. Maintenance engineers of both companies are essentially involved with technical things and, sometimes, have to repair equipment themselves. Apart from the area of workplace safety, where engineers perform technical and administrative activities in similar proportion, in all the other area of both companies they are involved with technical activities only. Although they supervise technicians and qualified workers this is essentially linked to technical issues.

TABLE 7.3 - THE ORGANIZATION AND WORK OF INTCO AND NATCO ENGINEERS COMPARED

Position held by the engineers	Area of activity	Main characteristic of the Work done by Engineers and managers	
		INTCO	NATCO
Chiefs of Departments	All areas	More administrative	More administrative
Chiefs of Service or Division	Production	Administrative and routine technical activities	Administrative and routine technical activities
	Maintenance and Projects	More technical than administrative	More technical than Administrative
	Workplace safety	Highly adminis-trative/bureau-cratic	------
	Other areas	Half technical half administr.	Half technical half administr.
Engineers	Maintenance	Technical Repair equip-ments themselves	Technical Repair equip-equipments
	Workplace safety	Half technical half administr.	------
	Other areas	Technical	Technical

Source: Interview data

Moreover, neither of the companies exhibited a trend towards excessive specialization. Nonetheless, the organization of labour by areas of specialization, led production engineers at INTCO, and the engineers of maintenance of power stations and transmission lines at NATCO, to feel that their technical knowledge is under-utilized by the company. Yet, both companies adopt the strategy of job rotation to avoid deskilling, routinization and to increase the engineers technical skills in the various fields of engineering the company deals with.

5.2 Supervisory Relations

In both companies, engineers of all hierarchical levels are subject to supervision of their work, while at the same time they supervise the work of others. The Chiefs of Department at INTCO are supervised by managers, and in turn they supervise the Chiefs of Service and assistant engineers. Their counterparts at NATCO are supervised by superintendents while at the same time they supervise the Chiefs of Division and assistant engineers. The Chiefs of Service at INTCO and the Chiefs of Division at NATCO, are supervised by the Chiefs of Departments while supervising engineers and technicians. Finally, engineers of both companies are supervised by their Chiefs of Service (INTCO) or by their Chiefs of Division (NATCO), at the same time as they supervise technicians and qualified manual workers on technical matters.

Supervisory relations tend to be more rigid at INTCO than at NATCO, but in both companies engineers have their output and quality of production supervised by their bosses. In terms of social relations at work, production and maintenance engineers of both companies are closer to manual workers, while those in projects, research and in other essentially technical areas of engineering, are closer to managers.

Finally, in all of these areas, the hierarchical structure of supervision aims to maximise the productivity of labour. Engineers, even where they do not hold a managerial position, technically supervise other workers (technicians and qualified workers). This evidence supports the "new middle class" thesis, which shows that capitalists control the labour process to maximize the production of surplus-values. Within this process engineers play an ambiguous role. One is to be agents of control and surveillance of the process of extracting surplus labour from others. The other is to be subordinate to this production process, as they have to take part in the collective labour process, as productive labour. This is what make their class position different from the manual work force. Or rather, this is what make them a "new middle class" (see Poulantzas, 1975; Carchedi, 1977; Wright, 1985).

5.3 Working Conditions

The two companies provide different working conditions and status differentiation for engineers, according to their place in the hierarchy. The Chiefs of Department of both companies enjoy similar working conditions, independent of their areas of activity. They are offered big and comfortable working rooms with all necessary facilities to carry out their job. However, from the levels of the Chief of Division and below, the working conditions vary enormously between the two companies. While

NATCO provides a high standard of working conditions for all of its employees, INTCO provides very poor working conditions for those in production and related activities, from the level of the Chief of Service and below. NATCO Maintenance engineers are the only group which share similar working conditions to that of their INTCO counterparts. INTCO engineers in production and related activities, given the nature of the product they deal with (pig iron and steels), are subject to a very polluted environment, that is natural, but the working conditions of their offices do not depend on the product they deal with. Despite this, INTCO provides such engineers with only a small and crowded room, with few telephone facilities, no air conditioning, and old and even broken furniture. Their physical working conditions are worse than those offered to clerical workers in any other area in the company.

The two companies have similar policies of status provision for professional workers, but the status of the engineers compared to other professionals with a university degree differ between companies. At NATCO, engineers enjoy a status equivalent to other professionals with a university degree, and much higher than that of workers with lower educational background. At INTCO engineers enjoy a status slightly higher than other professionals with a university degree and much higher than the overall working population with lower educational background. Therefore, INTCO has a higher regard for those with a higher qualification, such as a masters or a doctorate. This seems to be explained by the fact that in German culture, engineers with a higher qualification, such as a PhD, are highly regarded by their employers (see Lawrence, 1992:77).

6. Conclusion

In both companies the work of engineers is organized in such a way that the individual progresses from a technical to a more administrative function, as he moves from the bottom to the top of the hierarchy. For example, the Chiefs of Department are more involved with administrative issues. The Chiefs of Service and the Chiefs of Division however, perform a mixture of administrative and technical tasks, while engineers are essentially involved with technical jobs and technicians undertake the less complex tasks for the engineers.

INTCO deals with Iron and Steel production, while NATCO produces and distributes energy. Thus, the content of the engineers' work in the two companies is different. However, the division and organization of labour follows a very similar pattern, which aims to facilitate the control of capital over labour to increase productivity, as argued by the proletarianization thesis. At INTCO, production is organized within the division which control each other since each supplies the other with its products so that a new product can be produced. Furthermore, engineers and the Chiefs of Service are highly insulated in their areas of activities, and have little time to involve themselves with the strategic issues of the company. No deskilling was found at INTCO, as the deskilling thesis implies, but the work has been divided in such way that it is very easy for a new engineer to assume any position within the company. Only the Chiefs of Department and those above them, have a full picture of the whole system.

NATCO too is organized into Departments, Divisions, Sections, and so on, and tasks have been divided so that no Division can completely produce a product by itself. Thus, this creates a high level of dependence on each other's work, and as such, the structure resembles an assembly line within an office-work organization. As engineers are very specialised in small fields of expertise, they become very insulated in their areas of activity, without knowing what is done in the next Division. Similar patterns of work organization involving engineers were also identified in relation to French engineering firms (Crawford, 1989), and in Britain (Whalley, 1986; Smith 1987). To reduce the impact of specialization, both companies have adopted a strategy of "job rotation", which aims: (1) to increase lateral cooperation with other managers and engineers in other functions; (2) to increase flexibility of technical labour and; (3) to develop the engineers' technical skills in the related areas of engineering in which they are involved. This strategy has been commonly adopted by American firms (Crawford, 1989:74) as well as by Japanese firms (McCormick, 1992), toward similar objectives. This form of work organization was intentionally adopted by the company, in order to keep full control over all technical operations necessary to its functioning.

Although no deskilling of engineers' work was found in the two companies, the majority of those interviewed affirmed that they use much less engineering knowledge than they could have. In this sense, the case of INTCO and NATCO engineers support the assumption about sub-utilization of technical knowledge by engineers, pointed out by proletarianization thesis theorists.

INTCO engineers, in general, are subject to a very poor and polluted work environment, similar to that of production and related workers. Conversely, NATCO's work environment, for all office-workers, is very pleasant. Engineers, like other professionals, have plenty of facilities, such as comfortable rooms, new furniture, telephones, air conditioning and the absence of pollution around them. Maintenance engineers are the only ones who are subject to the working conditions enjoyed by INTCO engineers.

INTCO engineers are also subject to a more authoritarian management style and closer supervision than their counterparts at NATCO. INTCO engineers are required subject to work weekends and to do overtime, while this rarely happens at NATCO. However, the productivity of engineers is rigorously controlled by both companies, through visual control (at INTCO) and through formal performance evaluation every year (at NATCO). Related to these aspects, engineers do not have any additional privileges compared to other employees.

The status of engineers is highly affected by their place in the hierarchy, by the geographical location of their workplace and by the type of company. The Chiefs of Department of both companies have a big private room with a secretarial service. NATCO Chiefs of Division have a smaller private room, while most of their INTCO counterparts have to share their room with engineers and technicians. NATCO engineers have a table of a specific size and colour, while INTCO engineers do not have this differentiation. NATCO Chiefs of Department are, some times, called "Doctor" while at INTCO only those with a PhD degree or medical doctors are referred to as such. Engineers of both companies have a status equivalent to that of other professionals with university education, but as INTCO has less engineers than NATCO, INTCO engineers are more respected by other workers than their NATCO counterparts. Finally, engineers of both companies have little participation in decision involving finance, budged, investment and personnel policy.

In general, the findings support the claims of the "new middle class" thesis, that engineers are part of a group of specialized workers who play an ambiguous role in the labour process (a new middle class). As already shown, engineers, even where they do not hold a managerial position, technically supervise technicians and qualified workers. In this sense they perform the capital and labour function at the same time. The capital function is performed when they are supervising and controlling the work of technicians and qualified workers. The labour functions is performed when they are subordinate to their managers and are obliged to be productive themselves. However, they are compensated for this double functions. They are paid better salaries and enjoy higher status and better working conditions compared to the overall work force of the company with lower educational background. Although they are salaried workers and as such they have to perform the labour function as well, their market and working conditions place them in a different position compared to the lower level work force.

The question of the engineers' market situation (internal and external labour markets, careers, salaries and job stability) will be discussed in detail in the next chapter.

8. ENGINEERS AND THE LABOUR MARKET: CAREER, SALARY AND JOB STABILITY

1. Introduction

It has been shown in chapters 1 and 2 that, the "professionalization" and "new middle class" theories argue that, due to the importance of their knowledge and role in production, as representatives of capital, technical workers enjoy high status, prestige, power, autonomy and authority on the job, besides better rewards, such as better salaries, prospects of advancement and stability of employment, compared to other workers. The proletarianization theory recognizes that technical workers enjoy better working conditions compared to lower ranking working population, but brings attention to the fact that, like for other workers, these conditions are vulnerable, as management directs technical labour to profitable results.

In light of this debate, chapter 7 examined the engineers work, and the physical working conditions and supervisory relations under which INTCO and NATCO engineers carry out their work. The question of autonomy, authority and participation of engineers will be examined in chapter nine. This chapter then, will examine three important aspects of the engineers working conditions at INTCO and NATCO. That is, their experience of career, salary and job stability. This chapter starts with an overview of the structure of the Brazilian labour market, with special reference to the labour market for professionals and engineers. It then focuses on the analysis of the characteristics of the internal labour markets of INTCO and NATCO, in terms of career prospects, salary and stability of employment. Finally, the chapter examines the extent to which the satisfaction of engineers with their career, is affected by their perception of the characteristics of the labour market of their companies. The chapter concludes by highlighting the similarities and differences between the two companies on these issues, and compares the case of Brazilian engineers to that of developed nations.

2. Theories of the Dual Labour Market

It has been shown in chapter one, that studies on technical labour are a recent occurrence, even in developed countries, and that in Brazil they are almost absent. Consequently, there is very little in the specialized literature on the labour market in Brazil which deals with technical labour as a separate issue. The few studies that are related to the labour market in Brazil have focused on the impact of industrialization on the creation of the primary labour market for qualified labour, while a secondary labour market remains around the traditional sectors of industry.

The work of the most representative writers on the subject in Latin America (Miller, 1971; Foxley and Munoz 1977) derives from, and follows closely, the work of Doeringer and Piore (1971) on the structure of the labour market in the USA (Humphrey, 1982). Thus, it is better to focus directly on the work of the American writers, in order to avoid redundancy.

The work of Doeringer and Piore distinguishes between two basic labour markets in the USA: **a primary labour market**, which consists of jobs with high wages, good working conditions, good chances of advancement, stability of employment, and equity in the administration of work rules (1971:165), and a **secondary labour market**, formed by clusters of jobs that lack these desirable characteristics. These two types of labour markets are defined according to distinct patterns of recruitment, training, and promotion within and between enterprises. What distinguishes these two patterns, is the concept of the **internal labour market**. Primary labour markets, they argue, are formed by a series of internal labour markets (1971:167).

An internal labour market is defined as "an administrative unit.. within which the pricing and allocation of labour is governed by a set of administrative rules and procedures" (Doeringer and Piore 1971:1-2). The internal labour market is defined in two basic forms: (1) a "closed" internal labour market, where entry to the firm is at the bottom of a job hierarchy and higher posts are filled through internal promotions, and (2) an "open" internal labour market, where jobs are filled from outside the enterprise by reference to non market criteria, such as the possession of a union card in the USA. The closed internal labour market predominates in the manufacturing industry of the USA (1971:2-3).

According to Humphrey (1982:60), modern manufacturing industry in Brazil constitutes a good example of the primary labour market, as defined by this theory. Wages are high, there is a demand for skilled workers in the major industrial centres and sophisticated systems of personnel management have been introduced. In fact, the case of INTCO and NATCO, discussed in chapter six, confirms these last two characteristics.

Rodrigues (1970), writing during the "miracle years", also supports the view that employees in a primary labour market form a privileged elite, with higher salaries and better working conditions. Referring to his study of auto-workers in Brazil he argued that:

> "Large firm, auto firm, more agreeable firm etc., rightly constitute for the workers synonyms for "higher wages" and "better employment opportunities". An it is in the big firms as well that workers believe they can find better chances of promotion. At the same time the firms makes possible better training, a specialization and the acquisition of skilled trades that often small firms cannot offer...For almost all of the respondents the company amply fulfils the expectation which accompanied the search for a job. (1970:45)

Despite these alleged good working conditions in modern firms in Brazil, Rodrigues predicted that "these chances, however, are likely to disappear when the Brazilian auto-industry reaches maturity" (Rodrigues 1970:101-102). This suggests that these working conditions change according to market forces and economic cycles.

In fact, Humphrey's (1982:104), study of metalworkers of Sao Paulo, ten years later, when the economy was in steady decline, found a clear degradation of working conditions in the Brazilian auto-industry. As he argued:

> "the characteristics of a primary labour market - stability of employment, equity in the administration of work rules, a healthy environment - were not found in the auto industry in Brazil at the time of the study. Instead, wage levels fluctuated in accordance with the influence of the State and external labour markets,

health and safety were far from ideal, productivity was increased without improved techniques, and the supervisory staff wielded considerable power, often in an arbitrary manner" (Humphrey 1982:104).

Besides market forces, the stability of labour was profoundly affected by legislation approved by the Federal Government, in order to favour the economic model put forward from 1964. In 1966, a new law was introduced concerning the stability of labour and compensation for dismissal. The Fundo de Garantia do Tempo de Servico - FGTS (the law relating to stability of employment and dismissal compensation) replaced the Lei de Estabilidade (law of stability of employment), that had been introduced during the Estado Novo (New State, period: 1937-1945), by Getulio Vargas, in order to structure urban labour markets and stabilize a new and growing labour force.

The FGTS differed from the Law of Stability in two major respects. Firstly, it removed the special protection afforded to workers with more than ten year's employment with the same firm (Cesarino, 1970:219-220; Cf. Humphrey, 1982:45). Secondly, the financing of dismissal compensation was changed and the financial burden on employers was reduced considerably by the new system (Magana, 1966). This has allowed employers to cut back on employment more easily in times of recession. This has also made deliberate hire-and-fire policies much cheaper to operate than under the old scheme (Humphrey, 1982:47).

A critic of the creation of FGTS, Cesarino (1970:276), one of the most traditional labour lawyers, argued that the FGTS: "means that employers are entirely free to dismiss whomsoever they see fit at their complete will and caprice... Dictatorship has been restored in companies" (cited in Humphrey, 1982:47).

The FGTS is applicable to all categories of workers, and to all categories of organizations, be they public or private. Although in the public sector dismissals are less applied than in the private sector, workers of both sectors are obliged to sign the employment agreement, accepting the conditions imposed by the FGTS law.

Besides the effect of market forces on the price of labour, the government has also legislated on wage policies, in order to favour capital accumulation. During the military government (1964-1985), salaries dropped nearly 30.00 per cent in real terms, in order to favour capital accumulation (Ministerio to Trabalho, 1987:80). The relative value of the minimum wage in 1976 declined to 31 per cent of its value in 1959, and has improved very little since then. Today it is nearly US$ 60.00 per month.

In short, these findings suggest that the Brazilian working class is subject to hard working conditions, both in the traditional and modern economic sectors. In both these sectors the chances of career, salary levels and the stability of employment depend exclusively on market forces and on the utility of labour to capital. These principles apply to both the technical and non-technical labour force without distinction.

2.1 Brazilian Engineers and the Labour Market

As I have shown in Chapter 3, the labour market for

Brazilian engineers was very narrow until 1964. Only with the economic growth through industrialization, from 1968 to 1979, was a more prominent labour market for engineers developed. However, this labour market declined sharply with the economic downturn after 1979, remained depressed until the recession of 1982/1983, and improved very little during the rest of decade. During the recession and in the following years, engineers, like other workers, faced unemployment, salary loss and high job instability, while many graduates of the 1980s did not find a job in the profession.

The specialized literature on the labour market does not mention the case of professional workers in Brazil, as a specific issue. However, in examining the growth of white-collar workers in Brazil in the postwar period (Chapter three), it has been shown that up until 1979, most Brazilian engineers were working in the profession, so the market for their labour could be said to have been very good. It was also indicated, that while in 1960 professional workers represented only 1.3 per cent of the economically active population, by 1987 they represented over 7.3 per cent. Despite the growth of high skilled manpower in the market, a report by Ministerio do Trabalho (1987) revealed that there was not an oversupply of technical manpower in Brazil, and that, unemployment among professionals in the country was minimal. Finally, the report argued that the possession of a university degree is still an important instrument in achieving a higher position and better salary in organizations. Therefore, the report argued that engineering remains one of the most prestigious professions in the country, alongside medicine and law (p.134-136). These findings suggest that, as there is no oversupply of technical professionals in Brazil, engineers still enjoy bargaining power in the market, as the theory of primary labour market implies.

However, studies on the internal labour market for Brazilian engineers have indicated a less promising reality. Albuquerque's (1982) study, involving one hundred and eighty R & D engineers from research departments of private and state-owned enterprises in Sao Paulo, indicated that career opportunities were limited, and to improve status and rewards engineers were obliged to move into managerial posts, even though they may not like this role. None of the companies studied had a technical career ladder. These companies only used separate pay schemes to compensate the various occupational groups (manual workers, technical workers, management etc,) that they employed.

The research of Marques (1989), involving R & D engineers from the five largest private electro-electronic industries of the State of Minas Gerais, also found that like in Albuquerque's case, career opportunities were limited, and if engineers wanted to improve their status and rewards they had to move into management, even though they may prefer their engineering role. None of these companies had a structure for a technical career, but it was in practice of little importance for the engineers. In the view of the engineers, promotion in private companies basically depended on their performance and utility to the company. A technical career ladder was seen by these engineers as a kind of "straight jacket", which prevents, rather than facilitates the promotion of those who are more dynamic in the area.

In short, firms which operate in the modern sector of the Brazilian economy pay market-average salaries, but they accept the demands of professionals if they are very important for the company. However, job stability depends on personal performance and on the utility of labour to the company. Finally, the question of a technical career ladder does not seem very attractive to Brazilian companies. The discussion of the characteristics of INTCO and NATCO in chapter five, also supports these trends.

The labour market for Brazilian engineers, has some points in common with that of engineers in developed nations. The seven case studies, covering engineers in Japan, Germany, Canada, the UK, Ireland and Hungary, presented in Lee and Smith (1992), reveal that, apart from Japan, where many categories of worker still enjoy lifetime employment (McCormick, 1992), in all these countries career prospects, salary levels and job stability depend on the engineers performance, technical capabilities and integration with the business values (loyalty), but above all, they depend on the growth or decline of the economic sector where their companies reside.

However, in contrast to the French, Canadian, German and Japanese engineers who, according to Lee and Smith (1992), enjoy very favourable working conditions (perspective of promotion, high salary and stability of employment), though similar to Irish, Hungarian and British engineers, Brazilian engineers cannot be said to enjoy so favourable working conditions. Little empirical work has approached the dynamics of the internal labour market of Brazilian engineers (Albuquerque, 1982; Marques, 1989), the following sections analyses the case of INTCO and NATCO engineers, and thus bring some more light to this debate.

3. The Labour Market for Engineers at INTCO and NATCO

Although there is not an oversupply of engineers in Brazil, their labour market seems to have stagnated. As shown in chapter six, recruitment of engineers at both INTCO and NATCO almost stopped in the last five years. INTCO has admitted only 23 engineers during this period, but these only for replacements. At NATCO only 18 out of the 70 engineers I interviewed, had been admitted in the same period. For a company which employs more than fourteen hundred engineers, this number is very small. This situation can be explained by the fact that both companies have achieved a stage of maturity. There is no prospect of new investment to increase their business in the country in the near future, which could have generated more jobs. Thus, their internal labour market can be said to have stabilized.

TABLE 8.1, shows that 30.0 per cent of the engineers at INTCO and NATCO were admitted in the 1980s, 40.0 per cent in the 1970s (in the period of highest economic growth), and the remaining 28.94 per cent were admitted before 1970. These findings confirm the view that job opportunities depend on economic cycles, or rather on economic growth or decline.

TABLE 8.1 - DISTRIBUTION OF ENGINEERS BY PERIOD OF ADMISSION IN THE COMPANIES (Absolute and per cent).

Period of admission in the company	Companies				Total	
	INTCO		NATCO			
	N=	%	N=	%	N=	%
After 1980	17	38.64	18	25.72	35	30.70
Between 1970-1980	12	27.27	34	48.57	46	40.36
Before 1970	15	34.09	18	25.71	33	28.94
Total	44	100.00	70	100.00	114	100.00

Source: Interview data

As the Brazilian economy has been declining since the end of the "miracle years" (1968-1973), INTCO and NATCO engineers have been cautious and experienced low professional mobility between companies. TABLE 8.2 shows that for 54.0 per cent of the total sample, their present employer was also their first employer; 25.44 per cent had only one job before; and only 20.17 per cent of the total sample had had more than two jobs.

Despite low mobility these findings suggest that the labour market for these engineers has been relatively stable, since the majority of them (92.99%) have had, at the maximum, three employers during their career as engineers. Therefore, 93.18 per cent of the INTCO engineers and 88.57 per cent of NATCO's representatives reported to have never been dismissed. Those who have changed from one company to another, did so for better career opportunities. Nonetheless, those who had already faced dismissal, attributed it to economic reasons. In short, in an unstable economy, such as that in Brazil, this level of stability can be said to be very good.

TABLE 8.2 - NUMBER OF JOBS HELD BY ENGINEERS BEFORE THE PRESENT ONE (Total sample by company)

Number of Jobs held as engineer	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
First job	24	54.54	38	54.28	62	54.39
One job before	10	22.73	19	27.14	29	25.44
Two jobs before	7	15.91	8	11.43	15	13.16
Three or more	3	6.88	5	7.15	8	7.01
Total	44	100.00	70	100.00	114	100.00

Source: Interview data.

These engineers have also had a relatively good chance of professional mobility in their companies. As TABLE 8.3 shows, 3.68 per cent of the engineers have never occupied a different position since they were admitted into the company; 25.44 per cent had had at least two promotions; and 50.88 per cent had had three or more promotions. Significant differences in the rate of mobility were found between the two companies, suggesting different practices in terms of human resource management between national and multinational companies.

TABLE 8.3 - NUMBER OF POSTS OCCUPIED IN THE COMPANY BY ENGINEERS AND MANAGERS (Total sample by company)

Number of posts held in the company	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
I have always been in this post	9	7.89	18	15.79	27	3.68
Two	11	9.65	18	15.79	29	25.44
Three	8	7.02	24	21.05	32	28.07
Four	5	4.39	5	4.39	10	8.77
Five or more	11	9.65	5	4.39	16	14.04
Total	44	38.60	70	61.40	114	100.00

Note: Differences between companies significant at the 0.05 level x^2 (X^2=9.504, P<0.05).

When comparing engineers and managers by company, some differences were found in their rates of professional mobility. TABLE 8.4 shows that, at INTCO, a similar proportion of engineers and managers had up to three years without promotion, more engineers than managers have been without promotion for between 4 to 6, yet far more managers than engineers have had more than 7 years in the same position. This shows that as engineers move up the hierarchy, their chances of career progression become more limited. This tendency can be explained by the fact that, in the organization, while the number of vacancies for higher positions tends to stabilize the number of candidates tends to increase. Moreover, INTCO reserves the top positions for its home country executives. This makes their chances of upward mobility more restrictive.

TABLE 8.4 - TIME WITHOUT PROMOTION BY POSITION OCCUPIED BY INTCO ENGINEERS AND MANAGERS (INTCO only)

Time in years in the same position	ENGINEERS		MANAGERS		Total	
	N=	%	N=	%	N=	%
1 to 3	5	11.36	7	15.91	12	27.27
4 to 6	12	27.27	5	11.36	17	38.64
7 or more	4	9.09	11	25.00	15	34.09
Total	21	47.73	23	52.27	44	100.00

Note: Differences between engineers and managers significant at the 0.05 level x^2 (X^2=6.405, $P<0.05$).

In contrast, NATCO engineers, in both technical and managerial positions, are evenly distributed among the time bands concerning the number of years without promotion. Although NATCO has a more balanced internal labour market, vertical promotion is more difficult. As argued in chapter seven, engineers only move in a process of "job rotation", through which they are assigned different activities and different salaries, but they improve very little their hierarchical position. Moreover, while INTCO fills the top positions with home country executives, NATCO fills its top positions with executives appointed by politicians, as the company is state-owned. This makes upward mobility to top positions more difficult for NATCO engineers too.

TABLE 8.5 - DISTRIBUTION OF NATCO ENGINEERS AND MANAGERS BY TIME WITHOUT PROMOTION (NATCO only)

Time without promotion	ENGINEERS		MANAGERS		Total	
	N=	%	N=	%	N=	%
1 to 3	23	32.86	6	8.57	29	41.43
4 to 6	17	24.29	6	8.57	23	31.86
7 or more	13	18.57	5	7.14	18	25.71
Total	53	75.71	17	24.29	70	100.00

Note: Differences between engineers and managers not significant at the 0.05 level X^2 (X^2=0.364, P>0.05).

In short, we can argue that although INTCO and NATCO engineers have had a relatively stable job and some professional mobility at the lower end of hierarchy, their chances to move up to higher hierarchical positions are limited. Their external labour market is also limited, as the economy is not growing. Thus, their labour market has been restricted to within their present employers. The following sections analyze the perception of the engineers in respect to the characteristics of the internal labour market of their companies, in terms of career opportunities, salary and job stability.

4. The Labour Market in INTCO and NATCO Compared: the view of the engineers

The previous section drew an organizational analysis of the dynamics of the internal labour market of the two companies, but without bringing the voice of the engineers to these issues. This section then, examines the five main aspects of the internal labour market in these two companies, involving engineers: career opportunity, requirement for promotion, salary, job stability, and career satisfaction, but from the point of view of the engineers themselves.

4.1 Career opportunity

The engineers at NATCO and INTCO have a different perception of career opportunity in their companies. TABLE 8.6 shows that, while the majority of INTCO engineers and managers perceive that their chances of a career in the company vary from **average** to **bad**, their NATCO counterparts perceive that their chances vary from **average** to **very good**.

TABLE 8.6 - PERCEPTION OF CAREER OPPORTUNITY BY INTCO AND NATCO ENGINEERS AND MANAGERS

Categories	Career opportunity						Total	
	Very Good		Average		Bad			
	N=	%	N=	%	N=	%	N=	%
INTCO	5	4.39	17	14.91	22	19.30	44	38.60
NATCO	28	24.56	31	27.19	11	9.65	70	61.40
Total	33	28.95	48	42.11	33	28.95	114	100.00

Note: Differences between companies significant at the 0.005 level x^2 (X^2=18.830, P<0.005).

INTCO engineers and managers share the view that the stagnation of the company's operations, the reduction of hierarchical levels and the reservation of the top positions for home country executives, are the main causes of this lack of career opportunity in the company. As one engineer said:

> "The company is old and does not increase its business in Brazil. In addition, it has reduced hierarchical levels such that there are only three levels within the managerial hierarchy (chief of service, chief of department and senior managers). Directory is composed of German executives only. Thus, to step over the position of Chief of Department is almost impossible in the company. Thus, the lowest professional levels cannot move up in the hierarchy, unless the company expands its business"
>
> (A Chief Service engineer)

This lack of space in the hierarchy, has led engineers to see their career blocked since the very beginning. It has led to lower motivation because they have limited prospects for the future. As an engineer commented:

> "The hierarchical structure was reduced and the best top positions are reserved to people appointed by the Directory and most of them are German. Although I feel that I am competent and could go further in my career if I had a chance. What keeps me working is my self-motivation, once I cannot wait much more from the company" (A Senior Engineer).

Although NATCO engineers, independent of their technical or managerial positions, have a more positive view of their chances of a career in the company, they also perceive some limitations of their company. As an engineer Chief of Department mentioned:

> "There are very few vacancies for posts superior to mine, and too many candidates disputing them. NATCO has more than fourteen hundred engineers in different stages of their career. The managerial hierarchy, from the lowest level of management (Chief of Division) to Directory offers only three hierarchical levels: Chief of Division, Chief of Department and Superintendent. The position of

Directory are fulfilled through appointment by political leaders, and NATCO does not have yet a technical career structure. Even the promotions to Superintendent and Chief of Departments have been influenced by politicians. So, the majority of the technical staff is compressed in the lowest levels of the hierarchy".

The above statement finds support with the majority of NATCO engineers in technical positions. The majority of them felt that they have received salary promotions, but have been kept in the same position. They recognise that there is no place for everybody in the managerial hierarchy and it is not in the interests of everybody to move into it. Thus, the only chance that they have is to struggle in order to create a technical career in the company.

In short, career opportunities in both companies are affected by four main organizational aspects. Firstly, both companies have achieved a stage of maturity, and there is no prospect of either increasing their business in the medium term, in order to improve the recruitment prospects in the external and internal labour markets. Secondly, both companies have a relatively flat hierarchical structure, with only three levels between the positions of the Chiefs of Division, at the bottom, and the Directors, at the top. Thirdly, both companies fill their top positions with executives recruited from the external labour market, and fourthly, neither of the two companies have a structure for a technical career. Thus, the only chance engineers have to improve their hierarchical position is to try for a promotion into management, which besides being difficult, may not be their first choice of career.

4.1.1 Requirement for Promotion at INTCO and NATCO

The engineers' answers to my question "what sort of things are needed to progress in this company" are summarised in TABLE 8.7. and TABLE 8.8. As TABLE 8.7 shows, 41.00 per cent of INTCO engineers and managers appointed the variables "involvement with the company", or rather, to put the company first in their professional life, as the main factors that influence promotion; technical abilities were considered decisive for only 20.45 per cent of the engineers, while "performance" was indicated, as a critical variable, by only 18.18 per cent. Time in the company, good relationships with influential people, political influence and submission to the company's values are inexpressive variables in influencing promotion at INTCO. It is interesting that "being German" does not figure in the view of the engineers as an important variable affecting promotion, because most of them are still at the bottom of the hierarchy. Nonetheless, it is likely that if we had more chiefs of department and senior managers in the sample, the question of being German would be more significant.

TABLE 8.7 - VARIABLES THAT AFFECT PROMOTION AT INTCO

Main Variables	Frequency	Per Cent
Time in the company	13	29.54
Technical abilities	26	59.09
Performance	19	43.18
Involvement with the company	27	61.36
Good relationship with influent people	14	31.82
Political influence	6	13.64
Be a German	2	4.55
Submission to the company's values	3	6.82
	N=44	

Note: Columns "per cent" adds to more than 100 per cent because of multiple responses.

NATCO engineers and managers are subject to different exigencies when they are to be promoted, but the most decisive variables are similar to those at INTCO. TABLE 8.8 shows that for the majority of the engineers their performance, technical abilities and involvement with the company variables, are the most decisive for promotion, respectively. Time in the company, good relationships and political influence, are also important but to a lesser extent. However, it is likely, that if we had more chiefs of department in the sample, the question of political influence would be more significant.

TABLE 8.8 - VARIABLES THAT AFFECT PROMOTION AT NATCO

Categories	Observations	Per Cent
Time in the company	28	40.00
Technical abilities	41	58.57
Performance	58	82.85
Involvement with the Company	37	52.85
Good relationship with influential people in the company	30	42.85
Political influence	17	24.28
	N=70	

Note: Columns "Per Cent" adds to more than 100 per cent due to multiple responses.

In fact, the importance of such variables in influencing promotion, depends on the engineer's areas of activity and on their hierarchical position. The majority of the engineers in managerial positions believe that political influence is a decisive variable in their career nowadays. Those in technical functions, tend to be appointed on technical ability and from having good relationship with people above their level in the company. As a Chief of Division argued:

"Technical capacity is only one variable to be considered for promotion from my level to above. I think that, above all, it is necessary to market oneself if you want to succeed in your career. It is not necessary to be so good technically. It is enough to have good relationship with the top men of the company".

Another engineer Chief of Department has also commented on the same issue. He stated:

"From my position to the top everything is associated with political issues. Despite knowing that I do my best for the company in technical terms, I know that without a political push I will not get upward mobility".

It was also found, that 85.71 per cent of NATCO engineers and managers find it **important** to **highly important** to be promoted (TABLE 8.9) and only 14.29 per cent of them find it of **little importance**.

TABLE 8.9 - IMPORTANCE OF PROMOTION FOR NATCO ENGINEERS AND MANAGERS

Categories	Observations	Per Cent	Total %
Highly Important	9	12.86	12.86
Very Important	25	35.71	48.57
Important	26	37.14	85.71
Of little importance	10	14.29	100.00
	N=70		

Source: interview data, question 32, Appendix 1.

The willingness of being promoted is also a critical issue at INTCO, as the chances are limited. The engineers answer to my question: "how important is it for you to be promoted" is striking. Nearly 90.0 per cent find promotion a very important thing for them, since they are still in the middle of their career.

These findings show that, like in the case of engineers in developed countries (see Lee and Smith, 1992; Crawford, 1989; Whalley, 1986), the most decisive variables for promotion at INTCO and NATCO are the degrees of technical competence and the absorbtion of the company's values (loyalty). As in the case of British engineers (Whalley, 1986), before being promoted engineers have to prove that they are trustworthy workers. Wickham (1992:179), referring to the case of Irish engineers, also argues that "firms in the electronics industry attempt to provide internal promotions as a reward for loyalty and commitment". In French firms too, only trusted engineers are promoted to **cadre**, which represents "a shift in allegiance away from the union and towards the company" (Crawford, 1989:154).

4.1.2 Locus of Career Ambition

Engineers and managers recognize the difficulties of getting promoted in their companies, nonetheless they plan their careers. When I asked them which would be the highest position they could achieve in the company (see question 36, Appendix 1), when considering only the real possibilities, it was found that, they focused their attention on the two hierarchical levels above their present positions. TABLE 8.10 shows that the majority of INTCO engineers and managers think they can only achieve the levels of Chief of Service or Chief of Department, while only 31.82 per cent of them believe they could achieve the position of Senior Manager. Those in managerial positions (most of them in the post of Chief of Service), think they can achieve the post of Chief of

Department or Senior Manager. Therefore, the absolute majority have in mind a managerial career. Since this is the focus of their attention, it is natural that those engineers who are still in a technical career, feel less satisfied with their career than those who have already risen to the first level of the managerial hierarchy, as Chief of Service.

TABLE 8.10 - LOCUS OF CAREER AMBITION: INTCO ENGINEERS AND MANAGERS

	Engineers		Managers		Total	
Locus of Ambition	N=	%	N=	%	N=	%
Chief of Service	9	42.84	3	13.04	12	27.27
Chief of Department	6	28.58	12	52.18	18	40.91
Senior Manager	6	28.58	8	34.78	14	31.82
Total	21	100.00	23	100.00	44	100.00

Source: Interview data, question 36, Appendix 1.

Similarly, TABLE 8.11 shows that NATCO engineers and managers have also tended to focus their attention on the second level above their present positions. The majority of those already engaged an the first level of a managerial career (Chiefs of Division), believe they can achieve the position of Chief of Department, Superintendent or even Director. Engineers in technical positions revealed a more diversified locus of ambition but, even here, the focus was on the second level above their present position - Chief of Department.

The majority of NATCO engineers believe they can achieve the post of Chief of Division, Chief of Department or even Superintendent or Director. However, a noticeable proportion of them (10 out of 53) did not yet have a clear view of what position they could reach in the hierarchy. Only 7.14 per cent of the engineers intended to pursue a technical career, to reach the position of senior engineer.

TABLE 8.11 - LOCUS OF CAREER AMBITIONS: NATCO ENGINEERS AND MANAGERS (Absolute and per cent)

Locus of Ambitions	Engineers N=	Engineers %	Managers N=	Managers %	Total N=	Total %
Senior Engineer	4	7.55	1	5.88	5	7.14
Chief of Division	13	24.53	1	5.88	14	20.00
Chief of Department	18	33.96	3	17.65	21	30.00
Superint/Director	8	15.09	10	58.82	18	25.71
Without definition	10	18.86	2	11.76	12	17.14
Total	53	100.00	17	100.00	70	100.00

Source: interview data

In short, for the engineers of both companies, it is not enough to only be promoted. Their ambition is to move into management, in order to improve salary and working conditions.

4.2 Salary at INTCO and NATCO

In contrast to Canadian firms, where salaries are not kept secret because they pay strictly market-average salaries (Lee, 1992), INTCO and NATCO treat all information related to salary as confidential. Despite the lack of information about real salary levels paid by their employers, the majority of INTCO and NATCO engineers and managers (77.19%) believe that they earn the same salary as their colleagues in the same position in their company. The information to support this view is likely to have been gathered between the engineers themselves. Only 22.81 per cent of the engineers find that they earn less than their colleagues of the same level. This seems to be one explanation for the fact that both companies keep salary issues confidential (Table 8.12).

TABLE 8.12 - PERCEPTION OF INTERNAL SALARY EQUITY BY INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample by Company)

Categories	Levels of Internal Salary Equity: My salary is the same as my colleagues		My salary is Lower		Total	
	N=	%	N=	%	N=	%
INTCO	33	28.95	11	9.65	44	38.60
NATCO	55	48.25	15	13.16	70	61.40
Total	88	77.19	26	22.81	114	100.00

Note: Both differences not significant at the 0.05 level x^2, (X^2=0.045, P>0.05).

However, the perception of **external salary equity** is very different for the two companies, and between engineers and managers (TABLE 8.13). While only 6.82 per cent of INTCO believed that they earned more than their counterparts from other companies, 34.29 per cent of their NATCO counterparts felt they did. The majority of INTCO engineers and managers believed that they earned less than their colleagues from other companies, while the majority of NATCO engineers and managers stated that they earned the same or more.

In short, NATCO's salaries are believed to be more competitive than those at INTCO, in the view of the engineers. However, only 23.68 per cent of the total sample believed to earn more than the market average for their salaries; Another 36.84 per cent believed that they earned only the market average salary, while 39.47 per cent stated to earn less.

TABLE 8.13 - PERCEPTION OF EXTERNAL SALARY EQUITY BY INTCO AND NATCO ENGINEERS AND MANAGERS (Total Sample)

	Categories							
	My salary is higher		Same		Lower		Total	
Companies	N=	%	N=	%	N=	%	N=	%
INTCO	3	2.63	15	13.16	26	22.81	44	38.60
NATCO	24	21.05	27	23.68	19	16.67	70	61.40
	27	23.68	42	36.84	45	39.47	114	100.00

Note: Differences between companies for the total sample significant at the 0.005 level X^2, (X^2=15.740; P<005).

The final issue on salary equity is the relation between the salary paid and the value of the job done for the company. The feeling of exploitation by capital, can be highlighted by the value engineers attribute to their work and the salary they receive for it. TABLE 8.14 shows that the feeling of exploitation among engineers varies between the two companies. The majority of INTCO engineers and managers (79.54%) felt that they were unfairly paid, while only 57.14 per cent of NATCO's representatives felt this way. However, when the total sample was taken, it was found that the feeling of exploitation was clear for 65.79 per cent of the engineers and managers of both companies. Only 34.21 per cent of them found that their salary was **fair** for what they were paid to do. These findings supports the new middle class position, presented in chapter 2, that despite engineers being representatives of capital in the process of surveillance and control of the labour process, they also are subject to become productive labour - as part of the collective labour -, and as such, to be exploited.

TABLE 8.14 - PERCEPTION OF PERSONAL SALARY EQUITY BY ENGINEERS AND MANAGERS (Total sample by company)

Categories	Levels of Personal Salary Equity					
	May salary is fair		My salary is unfair		Total	
	N=	%	N=	%	N=	%
INTCO	9	7.89	35	30.70	44	38.60
NATCO	30	26.32	40	35.09	70	61.40
Total	39	34.21	75	65.79	114	100.00

Note: Differences significant at the 0.025 level X^2, (x^2=5.070, P<0.025).

In short, these findings suggest that, in variance with the experience of French engineers who are said to be paid high salaries (Crawford, 1989), but similar to that of Canadian engineers (Lee 1992), the majority of Brazilian engineers (76.31%) believed that they are only paid up to the market-average (see TABLE 8.13), while pay increases are highly dependent on an individual's performance. These findings also support previous studies on Brazilian R & D engineers (Albuquerque 1982; Marques, 1989), in that Brazilian engineers are paid market-average salaries, and some times less, depending on the policies of the company. Finally, salary policies are more constrained in the multinational company (INTCO), than in the national company (NATCO).

4.3 Job Stability at NATCO and INTCO

Similar to developed capitalist countries, such as England (Whalley, 1986), Canada (Lee, 1992), France (Crawford, 1989), and the USA (Zusmann,1985), stability of employment in private companies in Brazil, is heavily dependent on the company's economic performance, or rather on the growth or decline of the economy, which always affects the company's performance. Only in Japan, some workers enjoy lifetime employment (McCormick, 1992). However, the lifetime employment system only operates in the large firms, representing only a minority of the working population and even this limited system has come under pressure recently (Kumazava and Yamada, 1989). Thus, it could be said more properly, that job stability depends on the utility of labour to capital. In fact, TABLE 8.15 shows that 47.72 per cent of INTCO engineers found that their job was insecure. This view is shared by engineers in both technical and managerial positions. Conversely, 95.71 per cent of NATCO's representatives find their job secure. The explanation for these feelings are various and vary according to the nature of the company, that is whether they are privately or state owned. Thus, these aspects need to be analyzed separately by company.

TABLE 8.15 - PERCEPTION OF JOB STABILITY BY INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample by company)

Categories	My job is secure		My job is insecure		Total	
	N=	%	N=	%	N=	%
INTCO	23	20.18	21	18.42	44	38.60
NATCO	67	58.77	3	2.63	70	61.40
Total	90	78.95	24	21.05	114	100.00

Note: 1) Differences between companies significant at the 0.005 level X^2 (x^2=28.119, P<0.005).
2) Fisher Exact Probability: Lower Tail = 4.182E-8, Upper Tail = 1.0000 (P<0.005).

4.3.1 Job Stability at INTCO

Job stability at INTCO seems to depend on five main variables: the economic situation of the company, the utility of technical knowledge, loyalty, salary levels and the usefulness of the workers to the company. For the INTCO engineers in general, job stability depends firstly on the economic performance of the company. Under these circumstances, anyone can lose his job if the company finds itself under the risk of reducing its profits. As one Chief of Service engineers stated:

> "I think I will be kept here while I am useful for the company. Security on the job is linked to utility".

Another has mentioned the question of age and submission as a threatening fact for him:

> "Those who are becoming older can foresee their professional end. In the company's view, the older we are the more the useless we become. After 15 years in the company the risks of dismissal increases. Qualification does not matter. They like more those who come from below with 'new blood' and less aspirations. They prefer those who marry the company, because they accept everything the company wants them to do".
>
> (Chief of Service engineers)

The question of submission was also mentioned by another engineer, as a variable which affects stability. He said:

> "What I do is important for the company, I am a good employee as well, but my behaviour of not accepting everything puts my professional life in risk. As soon as the company has a chance, I carry the risk of being put on the list for dismissal".
>
> (A Chief of Service engineer)

Another engineer has argued that no job is secure in private companies, and the idea of a "reserve army" as developed by Marx, also appears here:

> "There are too many engineers seeking a job, so all the engineers of the company can be replaced for the new generation looking for a professional position. In such circumstances, if you do not satisfy the company's standards you are dismissed.
>
> (An INTCO engineer)

The risk of dismissal due to economic reasons, which leads to cost reductions, was also mentioned:

> "I do my work very well, but I am subject to the company's decisions. For the survival of the company I can be dismissed. I've seen that all economic crises are good justification for dismissal in the company. Sometimes the company defines quotas of workers to be dismissed. Being an engineer does not prevent anybody from being included in the list of dismissal".
>
> (A INTCO Engineer)

The levels of salary paid can also be used to justify dismissals. As another engineer said:

> "To be promoted is very important but sometimes it creates more problems than solutions. In periods of economic downturn the company pay more attention to the salaries paid to its technical staff. As soon as it finds a way, it substitutes higher paid professionals by cheaper ones, who can do the same things. Being good or higher positioned in the company does not matter too much. We are paid to do some work. As soon as the company sees that such work can be done by a cheaper labour force, we will certainly be replaced".
>
> (A INTCO Senior Engineer)

In short, job stability at INTCO depends on the utility of the workforce to the company. Obviously, when the economy is growing, there are more job opportunities, so it temporarily increases stability. When the economy goes down, job stability disappears. However, engineers seem to enjoy a more stable job. As already shown in this chapter, the majority of the engineers interviewed in both companies have never faced the problem of dismissal.

4.3.2 Job Stability at NATCO

In contrast to their INTCO counterparts, 95.71 per cent of NATCO engineers stated that their job was secure, while 4.29 per cent of them found it insecure. Moreover, no engineer in a managerial position found his job insecure (TABLE 8.16).

TABLE 8.16 - PERCEPTION OF JOB STABILITY BY NATCO ENGINEERS AND MANAGERS

Categories	Degrees of stability in the job: My Job is Secure		My Job is Insecure		Total	
	N=	%	N=	%	N=	%
Engineers	51	72.86	2	2.86	53	75.71
Managers	16	22.86	1	1.43	17	24.29
Total	67	95.71	3	4.29	70	100.00

Note: 1) Differences not significant at the 0.05 level x^2, (x^2=0.140, P>0.05).
2) Fisher Exact Probability: Lower Tail = 0.8559, Upper Tail = 0.5720 (P>0.05).

Nearly a hundred per cent of those who felt their job was secure, based their perception on the fact that NATCO is a state-owned enterprise. Furthermore, NATCO retains a monopoly in its areas of activity and has never faced problems of economic hardship.

For those who perceived some instability in their job, the explanation lay in the risk of privatisation of all state-owned enterprises. If NATCO was to be privatized, they would follow the same policies as private enterprises when dealing with labour costs. As an engineer answered the question:

"In Brazil, the objectives of the State companies has changed a lot. Privatisation can happen here, as well. If the company goes to the hands of the "private sector", the rules of the game will be the same - employees will be treated as useful things only. As soon as they are seen as a cost they will be launched onto the labour market along with the hundreds of unemployed we can see in the streets".

(A NATCO Engineer)

Despite these differences between the two companies, when considering the total sample, the question of **stability of their job** looks good, as 78.95 per cent of the engineers interviewed felt that their job was secure (TABLE 8.15). In a country where everything is unstable, such as in Brazil, the labour market situation of these engineers is very privileged.

4.4 Satisfaction with the Career of INTCO and NATCO Engineers and Managers

The previous sections have examined several aspects of the labour market for INTCO and NATCO engineers. But how do these engineers feel about their careers?. This section will examine the relationship between the characteristics of the internal labour market of these companies (career prospects, salary equity and job stability) and the engineers' level of satisfaction with their careers.

4.4.1 Theoretical and Empirical Evidences

The basic reason why the study of career is important is that both past work experience and expectations for the future affects an individual's response to their present job (Crawford, 1989:135).

According to Burchel and Rubery (1987), job satisfaction is considerably higher when individuals view their current job as the best job they have ever had. Besides affecting job satisfaction, careers influence occupational identities and solidarities. For example, because military and medical careers lead all members of those professions through a similar and well ordered series of steps, they engender a sense of membership in a single professional community. In other cases, however, the career experience and prospect of experts in similar jobs may vary widely, breaking down solidarity among them and generating different interests and attitudes (Crawford, 1989:135).

One way in which career may produce different interests and sentiments, is by leading employees to different positions in the stratification systems. It has been recognized by sociologists that "rewards are attached to organizational positions" (Baron, 1984:37-38). According to Baron, organizations shape careers in two ways: "First, the division of labour among jobs and organizations generates a distribution of opportunities and rewards that often antedates....the hiring of people to fill those jobs. Second, organizational procedures for matching workers for those jobs affect the distribution of rewards and opportunities within and across firms, and thus influence the likelihood of career success".

Taking these points into consideration, we can argue that the perception of success in a career affects the feeling of satisfaction or dissatisfaction with that career. Before focusing on the case of INTCO and NATCO engineers, it is necessary to grasp what "professional success" means for professional workers and engineers.

Crawford (1989:157) argues that the "professionalization theory" suggests an occupational culture with its own criteria of success - criteria which emphasizes peer recognition for technical expertise and achievement, while the "proletarianization theory" implies a greater concern with pay and security than with recognition by peers and management.

However, Crawford's (1989) analysis of French engineers suggests that, in contrast to the professionalization theory but closer to the proletarianization theory, professional success meant rapid upward mobility from the technical to the managerial hierarchy. He also found that the most satisfied with their career, were those who had achieved fast upward mobility (or who felt it would be possible in their companies). The improvement of salary levels was also a very important aspect of success. Disappointment with their career was associated with the perception of lack of career prospects, accompanied by low salaries (p. 158).

For Canadian engineers, professional success is also related to good salaries, benefits and working conditions (Lee, 1992:125). It has also been found that among British engineers, those who earned more had a more positive view of the profession (Ibid, 127). According to Lee, salary levels are an important factor in attracting people into the profession and keeping them there subsequently (p. 127).

The study of Irish engineers (Wickham, 1992), has also indicated that professional success is being defined as taking on managerial roles, accompanied by good salaries and prospect of progression to top positions. Finally, the cases of German and Japanese engineers, analyzed by Lawrence (1992) and McCormick (1992), respectively, provide two more examples that the prospect of promotion accompanied by good salaries are important variables which affect satisfaction with an employee's career.

4.4.2 Satisfaction with the Career among INTCO and NATCO Engineers

In examining the educational background of Brazilian engineers in chapter five, it was found that the main reason given by INTCO and NATCO engineers in their choice of an engineering career, was that they had relatives and close friends who had succeeded in the profession. For these engineers too, professional success meant finding a good job (with good salary, prospect of upward mobility and stability of employment), which would allow them to improve their status in society and their standard of living. Thus, we shall ask how the congruences and discrepancies between previous expectations and present experience of career, affect the engineers feeling of satisfaction in view of their career to date?.

It was found that the levels of satisfaction of staff engineers with their career varied between the two companies but no differences were found among managers. TABLE 8.17 shows that, among the INTCO and NATCO engineers in technical positions, the majority of INTCO's representatives felt only

reasonably satisfied or **unsatisfied** with their career, while the majority of their NATCO counterparts felt **reasonably satisfied** or **satisfied**. A more homogeneous level of satisfaction was found among managers. The majority of them felt either **reasonably satisfied** or **satisfied** with their career. When considering the total sample, it was found that the majority of the engineers and managers (87.72) felt **satisfied** or, at least, **reasonably satisfied** with their career, and no significant differences were found between companies.

TABLE 8.17 - SATISFACTION WITH THE CAREER

Categories	Satisfied		Reasonably satisfied		Unsatisfied		Total	
	N=	%	N=	%	N=	%	N=	%
Engineers:								
INTCO	5	6.76	9	12.16	7	9.46	21	28.38
NATCO	22	29.73	26	35.14	5	6.76	53	71.62
TOTAL	27	36.49	35	47.30	12	16.22	74	100.00
Managers:								
INTCO	14	35.00	8	20.00	1	2.50	23	57.50
NATCO	10	25.00	6	15.00	1	2.50	17	42.50
TOTAL	24	60.00	14	35.00	2	5.00	40	100.00
Total Sample								
INTCO	19	16.67	17	14.91	8	7.02	44	38.60
NATCO	32	28.07	32	28.07	6	5.26	70	61.40
Total	51	44.74	49	42.98	14	12.28	114	100.00

Notes: 1) Differences between INTCO AND NATCO, staff engineers significant at the 0.05 level x^2, (X^2=6.711; $P < 0.05$).

2) Differences between INTCO and NATCO (managers only) not significant at the 0.05 level x^2 (X^2=0.054, $P>0.05$).

3) Differences between the two companies not significant at the 0.05 level x^2 (X^2=2.386; $P>0.05$).

The results of tests of the associations between the characteristics of the internal labour market (salary equity, security on the job and prospects of mobility), with satisfaction with career, presented in TABLE 8.18, lend full support to the argument presented so far, that satisfaction with career is affected by the perception of the prospects for fast upward mobility, accompanied by the feeling of being paid a fair salary. However, no association was found between the perception of either internal or external salary equity, or job stability and career satisfaction.

As TABLE 8.18 shows, no association was found between the perception of internal or external salary equity and satisfaction with the career of INTCO and NATCO engineers and managers. The engineers and managers who perceived their salaries were the same as those of their colleagues, within or outside of the company, were proportionally divided between those who felt **satisfied** and **unsatisfied** with their career. Similarly, those who believed they earned less than their colleagues of the same position, within or outside of the company, are also proportionally divided between those who felt **satisfied** and **unsatisfied** with their career. This means that internal and external salary equity have nothing to do with career satisfaction.

Among the engineers who found their job secure, similar proportions were found between those who felt satisfied, reasonably satisfied and unsatisfied with their career. Similarly, it was also found that among those who felt their job was more or less secure or insecure, a proportional numbers felt satisfied, reasonably satisfied and unsatisfied with their career.

In contrast, the variable "career prospect", was strongly associated with the interviewees' feeling of satisfaction with their career. As Table 8.18 reveals, the majority of the engineers who perceived good chances of professional mobility, were also those who felt more satisfied with their career as engineers. The majority of those who felt only reasonably satisfied or unsatisfied with their career, were also those who perceived that they had bad prospects of upward mobility in the company.

TABLE 8.18 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND THE CHARACTERISTICS OF THE INTERNAL LABOUR MARKET FOR INTCO AND NATCO ENGINEERS AND MANAGERS

Variables	Results of the Test of Association				
	DF	CHI-SQUARE TEST	CRITICAL VALUE	SIGNIFICANCE LEVEL	ASSOCIATION
Internal salary equity	1	1.976,	3.841	0.1598	NO
External salary Equity	1	0.415,	3.841	0.5194	NO
Personal salary Equity	1	12.059,	7.879	0.0001553	Yes
Job Stability	2	1.408,	5.991	0,4945	NO
Perspective of Promotion	4	15.470,	13.277	0,00382	Yes

Notes: 1) DF= Degree of Freedom
2) Contingency tables for the above results (see Appendix 10)

Finally, the sense of personal salary equity, or rather, the feeling of being paid a fair salary, was strongly associated with the interviewee's degree of satisfaction with their career (Table 8.18). The proportion of engineers who felt that their salary was fair and who felt satisfied with their career, were much higher than the proportion of those who perceived that they were paid a fair salary but were not pleased with their career.

5. Conclusion

This chapter has shown that as the Brazilian economy has been in decline since the late 1970s, and that the two companies have achieved their stage of maturity, the engineering labour market within INTCO and NATCO has also stagnated in this period. This has also reduced the chances of professional mobility between companies. Consequently, for 50.00 per cent of the engineers interviewed, their present employer is also their first employer. Despite this labour market stagnation, these engineers have enjoyed a relatively stable job. The majority have never faced the problem of dismissal, and those who have changed from company to company, did so for better career opportunities. However, those who have already been dismissed, confirm that it happened because of the economic problems of their company. This finding thus supports the view that stability of employment in capitalist firms, depends on the company's economic performance and stage of maturity.

Although engineers have had a relatively stable job, both companies offer little opportunities for upward mobility to the top hierarchical positions. Their hierarchical structures are relatively flat, and from the first managerial positions engineers can achieve (Chief of Service at INTCO, or Chief of Division (NATCO), engineers have only two more positions to move up in the hierarchy (Chief of Department and Senior Manager). In contrast to American and Canadian firms, which invest in the development of technical careers (Lee, 1992), neither company studied had a technical career structure. Thus, engineers are promoted to different posts of the same level within technical area, but they do not improve their hierarchical position. However, in comparative terms, NATCO engineers have better career opportunities than their INTCO counterparts.

The internal labour market of the two companies is affected by the origin of the company (national or multinational) and by the nature of their shareholders (private or state-owned). INTCO, as a multinational company, besides not carrying out any basic research in Brazil, has reserved its top positions for its home country executives. This reduces the chances of upward mobility for Brazilian engineers who work in the company. Similar policies have been found among Japanese companies in Ireland. According to Wickham (1992), "the few Japanese firms in Ireland ... have a small layer of senior management which is entirely Japanese, so that there is a clear limit on the internal promotion that their Irish engineers can expect. Although Irish employees visit Japan, permanent jobs in Japan remain completely closed to them" (p.178).

Like the experience of engineers in developed countries, career prospects, salary and stability of employment of Brazilian engineers are highly dependent on market forces, on economic growth or decline, and on the utility and loyalty of technical labour to the company. As argued by the proletarianization thesis, the alleged privileged working conditions enjoyed by professionals in capitalist organizations, are vulnerable. This thus places technical workers, while salaried workers, close to the experience of the whole working class.

Also like the experience of engineers in developed countries (see Crawford, 1989; Lee, 1992; Wickham 1992; Lawrence 1992; McCormick 1992), satisfaction with career amongst Brazilian engineers, is highly dependent on the perception that they have of a chance of upward mobility. Therefore, professional success for them, means fast upward mobility, preferably into management, accompanied by good salaries and working conditions.

The findings also reveal that 66.00 per cent of the engineers felt that they are paid an unfair salary for what they do for their company. This confirms that, as argued by Carchedi (1977) and Marx before him, engineers play a double role in capitalist firms. One is to be representatives of capital in the process of extraction of surplus values from other as supervisor and control of the labour process, the other is to be submissive to the capitalist aims, as participants in the collective labour process, where they also have to give their surplus labour. Only 34.00 per cent of the engineers and managers felt that they were well paid, and as such they do not give their surplus labour. They can be said to be the typical representative of the functioning capitalist in the labour process.

The feelings of satisfaction with career may not be related with these variables only, but in terms of labour market conditions, they have the most affect. The nature of the engineers' work and the circumstances under which they do it, such as the degrees of technical autonomy and participation in the company's decision making process, and their integration into the business values, may also affect their feeling towards their career. These are important issues I will be dealing with in the next Chapter.

9. AUTONOMY, AUTHORITY AND PARTICIPATION

1. Introduction

Chapter 7 examined the nature of the engineers work, the physical working conditions under which engineers carry out their job and the supervisory relations involved at work. Chapter 8, examined the labour market conditions for engineers, such as career, salary and job stability. This chapter, focuses on the question of autonomy, authority and participation of Brazilian engineers in the companies under consideration.

As shown in chapter 2, the debate on the degree of autonomy, authority and participation of technical workers in the capitalist labour process, has focused on two basic positions: the "Professionalisation" thesis, which sees technical workers as "liberal" professionals, and the "Proletarianization" thesis, which sees professionals as only "specialised" workers. The "Professionalisation" theorists argue that professionals, due to their long and specific training in universities, code of ethics and value system, have a special orientation to profit making organizations. Professionals are more concerned with the rationality of science and with the freedom to use their knowledge, while capitalist organizations are concerned with using such knowledge for making profits. Thus, a value conflict may appear if professionals refuse to accept management authority and the pursuit of profit maximization. Hence, the integration of professionals in capitalist organizations is problematic

(Gouldner, 1978; Mallet 1975; Veblen 1965; Freidson, 1970; Gorz 1967; Galbraith 1967;). In contrast, sociologists linked to the "proletarianization" thesis, argue that technical professions were created with the development of industrial capitalism, and that as organizational professionals, engineers like other workers, are said to enjoy little autonomy and authority in the use of their knowledge because of their entrenchment in capitalist rationality (Larson 1977; Oppenheimer 1970, 1973; Aronowitz 1973; Derber, 1982; Smith 1990; Meiksins 1987). In fact, recent studies on American (Meiksins 1987; Zussman 1985), French (Crawford, 1989) and British engineers (Whalley, 1986) have confirmed such assumptions.

Thus, in the light of this debate, this chapter examines: the authority relations between managers and engineers; the legitimation of management by engineers; the degree of technical authority and professional autonomy enjoyed by engineers; the engineers' attitude to business values; and some managerial strategies adopted by INTCO and NATCO to mediate the predicted conflict between engineers and management. A comparative approach, between national and multinational companies and between engineers in technical and in managerial positions, is employed.

2. Legitimation of Management by engineers

The "Professionalisation thesis" and the "new working class" thesis, both assume that the value system of technical expertise and that of private business are different. Science is supposed to be conducted for the sake of increasing knowledge, while technology and those who develop and use it, are used by the capitalist firms for making profits (Gouldner, 1976; Mallet 1975; Galbraith, 1967; Freidson, 1970; Kornhauser, 1965; Kornhauser, 1963). This lack of symmetry between the two value systems, is likely to generate a crisis of legitimacy for management. For example, the commitment of engineers to the rational pursuit of knowledge may conflict with the employer's pursuit of profit maximisation. Bureaucratic authority may be undermined if engineers only accept orders related to technical exigences, rather than to managerial authority. Moreover, as engineers know the techniques of manufacturing well enough to manage without a managerial orientation, they perceive capitalist management as gratuitous and intolerable (Gorz, 1967:103-104; Veblen 1965:74). However, accommodative mechanisms have been developed by large-scale organizations to harmonize the requirements of professional autonomy with those of bureaucratic hierarchical authority, thus softening the potential in authority and protecting professionals from a full-scale assault on their autonomy (Freidson, 1970; Hall, 1968; Kornhauser, 1965). Other writers such as Stinchcombe (1959) have stressed the compatibilities in professional and bureaucratic authority, and Larson (1977) argues that contemporary professionalism has emerged, in part, as an adaptative mechanism for organizing power within large-scale organizations. Nonetheless, the theoretical question of the subordination of professional autonomy remains unresolved by many theorists of professions (Derber, 1982a).

The case of the INTCO and NATCO engineers suggest that engineers and managers accept managerial control and authority. In answering my question: "In a situation like yours, how necessary is it to have a boss"?, only 4.39 per cent of the engineers interviewed consider that they do not need a boss. The majority (67.54%) found it necessary to have a chief, while only 28.07% found little necessity. These responses are summarised below in TABLE 9.1.

TABLE 9.1 - LEGITIMATION OF MANAGEMENT BY INTCO AND NATCO ENGINEERS AND MANAGERS

Categories	Degrees of legitimation of management						TOTAL	
	My boss is Necessary		My boss is little Necessary		My boss Is not Necessary			
	N=	%	N=	%	N=	%	N=	%
Engineers	45	39.47	26	22.81	3	2.63	74	64.91
Managers	32	28.07	6	5.26	2	1.75	40	35.09
Total	77	67.54	32	28.07	5	4.39	114	100.00

Note: Differences between engineers and managers not significant at the 0.05 level x^2, (X^2=5.219; P>0.05)

But, why are bosses seen as necessary? For those who provided a justification to their answer, managers were seen as important in establishing organizational linkages and undertaking the control function of capital. As a INTCO engineer stated:

> "At INTCO, first level managers are necessary do keep control over the workforce, to conciliate some conflicts between areas, and to take claims of engineers to the top managers".

NATCO engineers provided quite a similar explanation for the utility of their bosses. For some, managers are important in the negotiation of their projects with the "administration". For others, they are important in taking decisions to improve the areas of activities of engineers. It is also notable that engineers of both companies, INTCO and NATCO, are very uncritical of the role of managers in the company. They accept the managers role as a given necessity. Even amongst those who found managers of little importance in their work, still nevertheless considered managers necessary.

However, when we look at the levels of control exercised by the company over the work of engineers, the managers' function as "controller" becomes clear.

3. Control by Management

As shown in chapter two, the management of physical and human resources is necessary under all systems of social production. But within capitalism, management is necessary due to the antagonistic nature of the capitalist labour process. Thompson (1989:234) shows that within capitalism, management has become a function specialized in two dimensions: Co-ordination and control. **Co-ordination** is necessary to avoid the wasteful use of the instruments of labour, and to meet the requirements of purchasing, finance, marketing and other factors. **Control**, in turn, is necessary to achieve profitable production. As Thompson (1989:234) puts it:

> "Capital and its agents are interested in control because they cannot achieve profitable production without among others things developing adequate mechanisms for directing, supervising, evaluating, disciplining and

rewarding the labour" (1989:234).

For the "new middle class theorists" (Poulantzas, 1975; Carchedi, 1977; Wright, 1985), engineers are part of this group of "agents of capital", which performs a mixture of the function of capital and labour. One of these functions is to control, and the other, to be submissive as productive labour. We can thus infer from this definition that it is likely that engineers legitimate management, because by doing so, they are legitimating their own controlling function in the capitalist labour process. However, as engineers also perform a labour function, they are also subject to management control and approval, as argued by the "proletarianization thesis".

In fact, the engineers answer to the question "how do you evaluate the degree of control exercised by the company (through management) over your work", supports the last point. Engineers of both companies, INTCO and NATCO, are subject to control by management. As TABLE 9.2 shows, 61.00 per cent of INTCO engineers said they work under a **little tight** to **very tight** control by their managers, while the remaining 39.00 per cent stated that they are subject to an **average** control by their bosses. At NATCO, 50.00 per cent of the engineers and managers work under a more **average** control system, while 29.00 per cent work under a **little tight** control, and the remaining 21.00 per cent work under **very tight** control. However, when considering the total sample we see that 54.39 per cent of the engineers in technical and managerial positions are subject to a **little tight** or to a **very tight** control by management, while 45.61 per cent are subject to **average** (soft) control. In summary, INTCO exercises more control over the work of their engineers, in relation to NATCO. However, only 31.58 per cent of the total sample are subject to a **very tight** control by management.

TABLE 9.2 - CONTROL BY MANAGEMENT OVER INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample by company)

	Characteristics of Control							
	Average		A Little Tight		Very Tight		Total	
Companies	N=	%	N=	%	N	%	N=	%
INTCO	17	14.91	6	5.26	21	18.42	44	38.60
NATCO	35	30.70	20	17.54	15	13.16	70	61.40
Total	52	45.61	26	22.81	36	31.58	114	100.00

Note: Differences between companies significant at the 0.01 level x^2 (X^2=9.324; P<0.01).

3.1 Control at INTCO and NATCO Compared

The control system was a little different between the two companies. At INTCO the direct supervision and control by managers is more visible. By direct supervision I share Crawford's (1989:101) definition, namely "the control over how a job is done, through detailed instructions on how and when to do it and/or periodic inspection by the supervisor to make sure the job is being done properly". Control at INTCO is based on this definition, that is, routine inspection to see how things are being done. At NATCO the direct supervision is not so noticeable, but the indirect control is very rigid. By indirect supervision I also share Crawford's (1989:101) definition, as "the control by means of job assignment, requirements for approval of decisions and evaluation of performance results". All of these strategies are clearly applied in the company.

These two control systems can also be interpreted according to what Friedman (1977) defines as **direct control** and **responsible autonomy**. Friedman (1990) defines direct control as a strategy through which "top managers try to reduce each individual's amount of responsibility by close supervision and by setting out in advance and in great detail the specific tasks individual workers are to do" (p.178). Responsible autonomy is defined as a strategy through which "managers try to accentuate the positive peculiar aspect of labour capacity, its malleability. Workers are given responsibility, status, light supervision, and their loyalty towards the firm is solicitated by encouraging venom against competitors, by fancy sports facilities, by co-opting trade union leaders, and so on" (Ibid. p. 178). According to Friedman (1977:48). Responsible autonomy is more applicable in dealing with relatively privileged skilled workers, who already have elements of job control and discretion. In contrast, direct control is most suited to large firms with stable product markets and a poorly organized workforce (Thompson: 1989:134). For Friedman (1977), responsible autonomy constitutes the major strategic alternative of management, in exercising overall control over the labour process.

The case of INTCO and NATCO engineers matches Friedman's system of control. Although the INTCO workforce is relatively well organized, INTCO engineers are poorly organized and few belong to any sort of union. NATCO, in turn, has a highly organized workforce at all hierarchical levels, and engineers play an important role in the labour movement, most of them being unionized.

Although NATCO engineers seem to be managed through "high discretion" (Fox, 1974) or "responsible autonomy" (Friedman, 1977), we cannot forget that the managerial function of the firm contains certain elements designed to monitor and maintain the quality of the work done (Goldthorpe, 1982:168-169). For example, a study by Causer and Jones (1990) involving scientists, engineers and technologists in the British electronics industry, demonstrated that despite the work of technical professionals entailing a significant degree of autonomy and discretion, it did not indicate the absence of managerial control. It did however indicate, a requirement to develop and utilise certain types of control mechanisms more appropriate to this sort of technical labour, such as (1) friendly relationships with management, which seeks to foster the involvement of engineers in the firm; (2) the monitoring and evaluation of performance; (3) specific career structure and the fusion of technical and managerial functions (pp.26-27), through which technical workers were involved in both the capital and labour functions at the same time. These findings are very similar to what has been found in INTCO and NATCO.

INTCO and NATCO have also used the labour market forces and the labour legislation to control their own work forces. Employment contracts are signed according to the FGTS law, which allows employers to hire and fire employees at their will. Thus, private companies, like INTCO, can use the threat of dismissal combined with the forces of the external labour market and direct supervision, to make people work harder. In public companies, like NATCO, the threat of dismissal is less applied. However the company uses the forces of the internal labour market, as argued by Causer and Jones (1990), to make workers more productive and integrated with the company's aims. In fact, NATCO uses performance evaluation linked to career mobility as a basic mechanism of control. The threat of having your career blocked due to bad performance, is very high in the company. Thus, if a professional wants to progress, he has to work under the rhythm established by the company. As Crawford (1989:108) has argued, with reference to the case of French engineers, "for salaried employees, the classic incentive for good performance is the possibility of promotion within the firm, assuming of course some supervisory discretion about granting them". Thus the possibility of promotion to higher management, often allows and justifies quite oppressive treatment of those who aspire to realize such career potential. Considering that both INTCO and NATCO do not have a structure for a technical career, the only option open to engineers is to move into management. As this is the only alternative, it is easier for these companies to pressurise engineers in order that they become trusted and productive workers before being promoted. Despite NATCO being a state-owned company, it follows the ideology of a private company. Thus, despite the differences in the nature of the control mechanisms adopted by INTCO and NATCO, workers of all levels are led to understand that they have to work hard and show that they are useful to the company if they want to progress.

The notion of "productive work" is very clear in both companies, and applies to all hierarchical levels, including the managerial positions. Managers of the two companies are less subject to direct supervision, but they are supervised through indirect mechanisms such as output production, cost information, and by managers of other areas of the company. Thus, despite managers enjoying more flexible supervision, they are still subject to the notion of "productivity" applied to everybody else in the two companies. Finally, if engineers and managers of both companies are subject to control by management, their autonomy at work is obviously affected.

4. Technical Autonomy

Studies on technical workers have shown that this occupational grouping still enjoys a certain level of autonomy at work (Crawford 1989; Whalley, 1986; Zussman, 1985; Meiksins and Watson, 1987). For Zussman this autonomy is guaranteed by the fact that this group possesses a degree of technical knowledge necessary for the company, which sometimes their superiors do not possess (Zussman, 1985:105-106). However, evidence from the study of engineers at INTCO and NATCO, discussed in chapters seven and eight leads us to agree more with Whalley (1986:75) who argues that, in practice technical managers possess a level of technical knowledge at least equal to that of their subordinates, but that the unpredictable nature of their work makes strict control by management a little difficult. As shown in chapters seven and eight, the most decisive variables which influence promotion at both INTCO and NATCO are the degree of loyalty to the aims of the company and technical knowledge. Before being promoted to a managerial position or even to a position of technical coordinator, engineers have to have proved that they have technical knowledge of all the engineering activities under their supervision. Therefore, the more technical the area of activity, the more technically qualified the engineers have to be. We have also shown that due to the excessive division of work at NATCO and the standardized production at INTCO, engineers do a relatively simple job, which could be performed by junior engineers after only a short period of training. Under these circumstances, it is very easy for the bosses to control the basic functions performed by the engineers under their supervision.

Finally, it seems reasonable to assume that technical autonomy in a company is different from that experienced by a scientist in a research laboratory. In this latter context, the results may or may not be useful, but this is part of the process of searching for things "new". Conversely, in a company, technical knowledge is used to serve the company's objectives (Meiksins, 1987), and not to satisfy the personal ambitions of its engineers. The work that engineers do has to be done according to what the company expects them to do.

Actually, the case of INTCO and NATCO engineers lends support to the view of Smith (1990) and Meiksins (1987), that the autonomy of engineers and managers is limited to their areas of responsibility, and to what is good for the company. The interview data presented in TABLE 9.3, reveals that 85.06 per cent of the engineers in technical and managerial positions have to consult their bosses when something goes beyond their routine activities, or beyond the limits of their position, and their decisions follow the chief's opinion. Only 14.91 per cent of those interviewed said that they used to discuss the problems with their bosses, but that they were allowed to decide what to do.

TABLE 9.3 - LEVELS OF TECHNICAL AUTONOMY ENJOYED BY ENGINEERS AND MANAGERS (Total sample by company)

	Categories of Technical Autonomy					
	Discuss the problem, but decides the best way to do the job		Discuss the problem, but gives priority to the chief's opinion		Total	
Companies	N=	%	N=	%	N=	%
INTCO	5	4.39	39	34.21	44	38.60
NATCO	12	10.53	58	50.88	70	61.40
Total	17	14.91	97	85.09	114	100.00

Note: Differences between companies not significant at the 0.05 level x^2, (x^2=0.329; P>0.05).

When considering the levels of technical autonomy of posts occupied by engineers, it was found that engineers in managerial positions have to work more on a basis of consultation than those in technical positions. Only 1 out of the 40 managers, and 16 out of the 74 engineers said that they were allowed to decide what to do, but only within the limits of the responsibilities of their positions. However, those who stated that they were allowed to decide what to do, only took decisions which did not meaningfully affect the content of their job. Therefore, engineers only undertake technical work which is considered useful to the company. Even in the R & D Department, engineers only undertake research which is related to what is approved by the company. As a INTCO Senior R & D engineer argued:

> "We have to do what the company want us to do. Technical autonomy is limited. Good ideas are accepted but we have to do what is scheduled by the company. I've been a researcher for 10-years, four of them in the company. Researchers have to do what is good for the company. Even in Universities there isn't freedom. We are obliged to carry out a project that the National Research Council finds good for the country. In the company, if I don't have freedom to do what I want, at least, I have resources to do what I am expected to do".

The above statement summarizes the view of the majority of INTCO engineers, and may also represent the voices of the majority of Brazilian engineers. As a NATCO Senior R & D engineer commented:

> "Research and development in companies deals with a selected number of items which the company is interested in. Here at NATCO we work with six main subjects previously selected by the top managers and Directory. Within these areas we can exercise our creativity. Everything that goes beyond this has to be approved by the company".

In short, both the INTCO and NATCO R & D engineers were talking about the same thing: that they have to do what is supposed to be good for the company.

Another issue related to technical autonomy and authority on the job, is the fact that engineers cannot choose what to do, and are sometimes, required to do things where the objectives are not clear. This is what Derber (1982) calls "ideological proletarianization".

The engineers' answers to the question "How well are you informed by your boss of why a particular job has to be done?, or why it has to be done in a particular way"?, are summarized in TABLE 9.4. This data highlights the above issues. It shows that 55.26 per cent of the engineers and managers are given sufficient explanation when they are required to do a certain job, while 44.74 per cent of them are not. It is noticeable that INTCO engineers are subject to a more authoritarian process of job imposition than their NATCO counterparts. The majority of INTCO engineers (27 out of 44) do not receive enough explanation from their bosses, while the majority of NATCO engineers (46 out of 70) are sufficiently informed about what they have to do. No significant difference was found between the way top management treats engineers in technical positions and those in managerial positions. Both engineers and managers, are proportionally distributed between those who are well informed about what to do and those who are not. In summary, Derber's position concerning ideological proletarianization finds support from only 45.00 per cent of the engineers interviewed.

TABLE 9.4 - "IDEOLOGICAL PROLETARIANIZATION" AMONG INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample by Company)

Companies	Categories of Ideological Proletartianization					
	Receive sufficient information		Receive insuffi cient information		TOTAL	
	N=	%	N=	%	N=	%
INTCO	17	14.91	27	23.68	44	38.60
NATCO	46	40.35	24	21.05	70	61.40
Total	63	55.26	51	44.74	114	100.00

Note: Differences between companies significant at the 0.01 level x^2, (X^2=6.955; P<0.01).

Autonomy and authority on the job are also affected by other organizational constraints, such as the equipment and technology adopted, material resources, finance, the nature of the company's business, time, bureaucratization, the hierarchical structure, political interferences, work organization and the characteristics of management. Table 9.5 shows that the five main constraints faced by engineers, are the control of expenditure, the pressure to work in a short time, the lack of adequate equipment to do the work, material supplies and managerial interference at work.

Control over expenditure is tougher at INTCO than at NATCO, while more NATCO engineers complained about material supplies. Managerial interference is also higher at INTCO than at NATCO. Political interference is a typical variable for NATCO since it is a state-owned company, but is not a relevant variable at INTCO. However, overwork and lack of career opportunities are critical variables for 11.36 per cent of the INTCO engineers (TABLE 9.5).

TABLE 9.5 - ORGANIZATIONAL CONSTRAINTS (Per Cent by company)

Variables	INTCO	NATCO	Total
Inadequate equipment	40.90	42.85	42.10
Cost/Finance control	63.64	37.72	62.28
Material supply	29.54	42.86	37.72
Pressures of time	68.18	58.57	62.28
Managerial interference	54.54	31.43	40.35
Nature of business	29.54	22.97	26.32
Political interference	---	15.71	9.65
Overwork	11.36	----	4.38
Lack of career	11.36	----	4.38
	N=44	N=70	N=114

Note: Columns add to more than 100 per cent due to multiple responses (see Question 9, Appendix 1).

In short, financial control, the pressure of time, and managerial interference are the three most critical constraints for INTCO engineers. These characteristics lend more support to the previous conclusion, that managerial control and the lack of autonomy is higher at INTCO than at NATCO.

Table 9.5 also highlights that "cost reduction" and the pressure on work by management, are the basic strategies adopted to increase technical labour productivity. The low level of technical autonomy is thus justified by the need to **reduce costs** and to increase **productivity**. As some INTCO engineers stated:

> "The company retains a certain monopoly in some lines of products. Thus, it is not very active in the market and it seems that it doesn't want to grow. However, it has focused on productivity and cost reduction to increase its profits.
>
> (A INTCO Chief of Service)

> "I have to work even harder. Many engineers were dismissed in the last three years but the amount of work has not reduced. The company has invested in automation to reduce human labour. So, there is no time to think in things technical".
>
> (A INTCO Senior engineer)

> "My boss is very rigid. He controls everything. I am interrupted very frequently in my work by him. I never know if what I started doing in the morning will make sense in the afternoon"
>
> (A INTCO Chief of Service)

> "The company's law is to produce as much as possible with the lowest cost. This means putting pressure on everybody at work. Consequently it creates conflicts. The control over time is very rigid. If I don't do everything I am required to do I loose my job.
>
> (A INTCO Senior Engineer)

> "There is a shortage of workers in all areas of the company and the pressures to produce are even higher. The technology is old and the workers have low qualifications. So, I'm obliged to produce things with a much lower standard than I would like to do because I have to achieve the pre-fixed output"

(A INTCO Senior Engineer)

"The company's policies doesn't motivate to do better work. We have to do what we are expected to do only. I think the company is not concerned with higher standards for its work force. If I do the average it is enough".

(A INTCO Data Processing engineer)

NATCO engineers have blamed organizational constraints for forcing them to undertake work far below their abilities. However, they focus more on the bureaucratic structure and on the excessive division of work, as the main barriers preventing them use their full abilities. As some of them have commented:

"The decision making process is very bureaucratic. There has been an excessive creation of simple tasks, through excessive division of work. NATCO has created too many managerial positions, so decisions take longer and sometimes they aren't even taken".

(A NATCO Chief of Department)

"The company has too many departments specialized in small things. Work that could be done in my department, I have to send to be finished in another one. It takes time and generates too much bureaucracy".

(A NATCO Chief of Department)

The pressure of time is also a major problem in the Department of energy distribution. As a Chief of Division stated:

"In my department everything is for "yesterday". Pressures made by customers and politicians alter profoundly our activities. It is very difficult to follow schedules. Human resources are few in the Department. The organizational structure is very rigid, so many times we can't do what we find necessary".

In the Directory of projects and construction, the problems are different. Engineers have to convince their bosses that the project has to be executed. Other times, they have to carry out a project for political purposes only. As some engineers argued:

> "The most serious problem we face here is that besides having to elaborate the projects, we also have to convince the company that they are viable. Political influence is also enormous. Sometimes political interests are given higher consideration than the technical aspects of the projects.
>
> (A NATCO Senior Engineer)

> "Politics is the greatest problem, because the technical staff is submissive to the company's political interests. The state government uses the company for political purposes".
>
> (A NATCO Chief of Division)

> "In addition, there is a lack of integration between the different areas of the company, such as planning and projects. Technical exigences are some times so high that the projects cannot go on".
>
> (A NATCO Senior Engineer)

In short, technical autonomy is limited for everybody in both companies. These findings lead us to conclude that although engineers still hold a margin of manoeuvre to apply their technical knowledge more appropriately to certain types of jobs, the proletarianization thesis is right when it argues that technical autonomy in organizations assumes only a symbolic meaning. This is so, because the final product of technical knowledge has to satisfy the objectives of the company, rather than the engineers own technical ambitions.

5. Participation in Decision Making

For the "new working class" theorists (Mallet, 1975; Gorz 1967), a technical job entails autonomy, involvement and participation, but as companies are bureaucratic and hierarchical, technical workers are not given the opportunity to participate in decision-making as they would like. This demand for participation, may represent a serious reservation about the legitimacy of bureaucratic authority. As technical workers become frustrated by their lack of participation in the organization, they are likely to try to ally with the manual workers. Such an alliance would have the intention of running the business themselves, without traditional management practices, through a process of **autogestion** (self-management).

The case of INTCO and NATCO engineers, shows that engineers have little participation in meaningful decisions in their companies, and that there is a great demand for more participation among the engineers interviewed. As TABLE 9.6 shows, the vast majority of the engineers (72.81%) desire more participation in the decision making process of their company. Only 27.19 per cent of them felt that they had enough participation. No difference was found in the level of perception and satisfaction of participation in decision making between the INTCO and NATCO engineers and managers.

TABLE 9.6 - PERCEPTION/SATISFACTION OF PARTICIPATION IN DECISION MAKING: INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample by company)

Degrees of perception of participation in decision making in the company	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
1) Wanting more participation	28	24.56	55	48.25	83	72.81
2) Satisfied with the participation	16	14.04	15	13.16	31	27.19
Total	44	38.60	70	61.40	114	100.00

Note: 1) Differences between companies not significant at the 0.05 level X^2, ($x^2=2.336$; $P>0.05$).
2) Source: see question 27, Appendix 1.

Table 9.7 shows that the majority of INTCO engineers and managers, are desirous of more participation in decisions related to "personnel policies" and in those tied to their own areas of activity. In contrast, NATCO engineers and managers are more concerned with issues related to their company's finances, investments, budgets and personnel policies, but less concerned with their areas of activity. They also have a little more say in the destiny of their company, compared to their INTCO counterparts.

TABLE 9.7 - AREAS OF INTEREST FOR PARTICIPATION IN DECISION MAKING: INTCO AND NATCO ENGINEERS AND MANAGERS

Areas of interest for participation	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
1) Finance, budget, investment	3	4.76	11	17.46	14	22.22
2) Personnel polices	8	12.70	16	25.40	21	38.10
3) Decision about own area of activities	17	26.98	8	12.70	25	39.68
Total	28	44.44	55	55.56	114	100.00

Note. Differences between companies significant at the 0.025 level x^2, (x^2=9.852; P<0.025).

INTCO engineers have made striking comments on their lack of participation in decisions, even in those directly related to their areas of responsibility. The Chiefs of Department are said to centralise all sorts of decisions. As a Chief of Service of the production area argued:

> "Everything is concentrated in the Seniors managers' hands. My responsibility is only to do the job previously defined by the senior manager and chief of department to be done by my Division".

Another INTCO engineer Chief of Service also commented:

> "The technical staff doesn't have any voice in the decision making process of the company. We pass our time working according to schedules defined in the Directory

and Senior Management. Even in technical decisions we have no participation. We only pass information to our chief but I don't know what kind of decision will be taken. What I know is that everything is centred in the senior manager's hands. We are paid only to do the job, not to decide or to think about it".

NATCO engineers and managers (Chiefs of Division) too, have complained about their lack of participation in those decisions which they believe to be their own responsibility to take. A Chief of Division commented:

"We have no voice in the decision making process related to investment, the nature of projects to be carried out and the inner decisions of the company. We don't have autonomy to decide even about small maintenance projects which we know are essential. Decisions about finance are highly concentrated in the directory and superintendency. From 1985 to now, almost everything is decided at the directory level".

Another Senior Project engineer also commented:

"It is hard to understand why we cannot decide or participate in decisions related to projects which we have elaborated. Most of the time we don't know who will decide about our own project and some times nothing is decided. I could say that, we engineers, are very far from the decision making process of the company".

In short, it has been demonstrated so far that, like other workers, engineers and first level managers are also subject to managerial control and approval, have limited autonomy on the job, and have little participation in core decision making. Despite this, they still legitimate management as a necessary function of capital control, over labour.

But what can we say about the engineers view of the participation of other workers? Would engineers reproduce the managerial ideology of control over lower level workers, as argued by Poulantzas and Carchedi, or would they wish for more participation for workers as they want for themselves?, as argued by the "new working class thesis"?

5.1 The Engineers View on Other Workers' Participation

The view of engineers on this issue differs significantly between the two companies, and between engineers in technical and managerial positions. Their answer to the question "what about the production workers, are there decisions that they should be involved in"? (see question 28, Appendix 1), shows that managers are much more restrictive than engineers in accepting that workers should have more voice in the company. TABLE 9.8 shows that the majority of the engineers (46 out of 74) are in favour of giving workers more participation, while the majority of managers (32 out of 40) are against this idea. This confirms that manager's function is to control the labour force. But it is not only managers who are resistant to this view. When the engineers and managers are taken together, we see that 52.63 per cent of them, independent of their position, believe that workers should not be given more participation in the company.

TABLE 9.8 - THE VIEW OF ENGINEERS AND MANAGERS, ON WORKERS PARTICIPATION IN THE COMPANY'S DECISIONS (Total sample)

Categories	Workers should participate more		Workers should not participate more		Total	
	N=	%	N=	%	N=	%
Engineers	46	40.35	28	24.56	74	64 91
Managers	8	7.02	32	28.07	40	35 09
Total	54	47.37	60	52.63	114	100 00

Note: Differences between engineers and managers significant at the 0.005 level x^2, (x^2=16.861; P<0.005).

When considering INTCO and NATCO separately, the degree of possible democracy at work, as argued by the "new working class" thesis, can be questioned. TABLE 9.9 shows that 72.73 per cent of INTCO engineers and managers are against the idea of giving workers more participation in the company. Engineers are divided almost half and half between those who are for and against this idea, whilst almost hundred per cent of managers are against this possibility. These findings give more support to what has been argued in previous sections, that the managerial control over workers is very rigid at INTCO. Managers are required to keep everything under control and labour is among the most important factors.

TABLE 9.9 - THE VIEW OF INTCO ENGINEERS AND MANAGERS ON WORKER PARTICIPATION IN THE COMPANY'S DECISIONS

Categories	Workers should have more participation		Workers should not participate more		Total	
	N=	%	N=	%	N=	%
Engineers	11	25.00	10	22.73	21	47.73
Managers	1	2.27	22	50.00	23	52.27
Total	12	27.27	32	72.73	44	100.00

Note:1) Differences between engineers and managers significant at the 0.005 level x^2, (x^2=10.462; P<0.005).
2) Fisher Exact Probability: Lower Tail = 1.000, Upper Tail = 0.0003986 (P<0.005)

The situation at NATCO is a little different. The majority of NATCO engineers and managers (60.00%) are for more participation of workers in the destiny of the company, while 40.00 per cent of them are against this idea (TABLE 9.10). The difference between engineers and managers is not so clear, although a slight majority of engineers in the sample (35 out of 53) are for more participation, while the slight majority of managers (10 out of 17) are against.

TABLE 9.10 - THE VIEW OF NATCO ENGINEERS AND MANAGERS ON WORKERS PARTICIPATION IN THE COMPANY'S DECISIONS

Categories	The Engineers and Managers' positions					
	Workers should have more participation		Workers should not participate more		Total	
	N=	%	N=	%	N=	%
Engineers	35	50.00	18	25.71	53	75.71
Managers	7	10.00	10	14.29	17	24.29
Total	42	60.00	28	40.00	70	100.00

Note: Differences between engineers and managers not significant at the 0.05 level x^2, (x^2=2.360; P>0.05).

When the engineers and managers at INTCO and NATCO were asked "can you give one example"? of what kinds of decision should workers be involved with (see question 28, Appendix 1), we see that a hundred per cent of the answers are focused on the strict limits of the workers' activities and professional life. Nobody commented on the possibility of workers being involved in decisions which can affect the company's life (TABLE 9.11).

When comparing the two companies (TABLE 9.11), it was found that for most INTCO engineers and managers (43.75%), workers should only have a voice in decisions related to definitions of their working time, while this was so for only a minority at NATCO (22.22%). The majority of NATCO representatives (53.70%) felt that workers should have more participation in the definition of their own work, which was so for only a minority of INTCO's representatives. This suggests that INTCO's management is more authoritarian in terms of imposing on the workforce what it finds necessary. A critical aspect is the fact that only a minority of representatives of both company's (31.25% from INTCO and 24.07% from NATCO), agree with the idea that workers should have more voice in the definition of personnel policies.

TABLE 9.11 - THE VIEW OF INTCO AND NATCO ENGINEERS AND MANAGERS ON WHAT KIND OF DECISION SHOULD WORKER HAVE MORE VOICE

Types of decisions in which workers should be involved	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Workers should participate only in decisions related to their own work	4	25.00	29	53.70	33	47.15
Should participate in decisions related to defi- tions of working time	7	43.75	12	22.22	19	27.15
Should participate in decisions of personnel policies which affect themselves	5	31.25	13	24.07	18	25.71
Total	16	100.00	54	100.00	70	100.00

Source: Interview data.

These findings suggests that both engineers and managers place themselves on the side of capital, for the basic things which affect the daily life of the general workforce, such as the definition of tasks, working time and personnel policies. Thus, these findings lend no support to the assumption of the "new working class" thesis that the characteristic demand of technical workers is either for democratic control and autogestion (self-management), or that they would ally with the manual workers in order to assume control of the capitalist firm. Contrary to this view, engineers reserve for themselves the opportunity of participating in the most important decisions of the company, such as those related to finance, budgets and investments, while workers would be given a voice only in decisions strictly linked to their narrow daily activities. While engineers are willing to participate with the group who control the business, who Cyert and March (1963) defined as "dominant coalition", and Child (1973) calls "decision-makers", workers are thought to deserve a level of participation restricted to their level as subordinate workers. However, these findings support the view of Poulantzas (1975) and Carchedi (1977), that engineers, even though they may not hold a supervisory position, they are ideologically and politically implicated in reproducing the capitalist ideology within the company. These findings also reveal that engineers can easily be integrated into the profit making ideology of the capitalist firm.

6. The Integration of Engineers into Business Values

The "new working class" theorists (Mallet, 1975; Gorz 1967; Veblen, 1965) assume that "by training, and perhaps also by native bent" (Veblen, 1975:74), engineers are anti-capitalist. Mallet goes further to argue that technical workers are likely to demand control over production at all levels together with manual workers, as reaction to the contradictions, conflicts and distortions perceived by them in the capitalist firm in its search for profits (1975:188). Post-industrial theorists (Bell, 1973) expect engineers, especially those in science-based industries, to reject the business ethos of the past century, in favour of the professional norms which reinforces their service orientation and social responsibility. All these arguments suggest that engineers are against the profit making ideology of the capitalist firm.

However, the case of INTCO and NATCO engineers has revealed a different picture against the above assumptions. It has been found that although engineers are given little autonomy and participation in decision making (see previous sections), engineers are very interested in getting involved with the core questions of the company's life, such as finance, budgets and investment issues. However, neither of the two companies wanted to increase the involvement of engineers in such issues. As I will be arguing in this section, INTCO and NATCO try to prevent, rather than to stimulate, the involvement of engineers in the core questions of the company.

But why does this happen? Organization theorists (Child, 1973, for example) have argued that, "in organizations the actions of all members are not usually of equal weight" (p.101). The power holding groups, with their different levels of power within the organization, have the option to define and implement control strategies according to their goals. This inequality of power is reflected in a differential access to strategic information and decision-making. One Labour process theorist (Armstrong 1987), argues that this is a consequence of division of managerial work, which leads to the formation of competing groups in the struggle for control within capital.

For Armstrong, the management functions on behalf of capital are carried out by specific occupational or professional groups. Each group competes to establish the necessary "trust" in order to carry out the control function, as against other managerial groups who may have carried them out in the past, or who may wish to in the future. Each group attempts to utilise a core of specialist knowledge and activities, which can form the basis of a "collective mobility project". This is said to be of special importance in the case of the engineering profession, in relation to the development of scientific management and its fall in terms of the difficulties of maintaining a monopoly control over certain functions that could be carried out by others (Cf. Thompson, 1989:240). In fact, it was shown in chapter six that NATCO engineers have been replaced by business administrators in certain areas of administration, such as in marketing and commercial areas. It seems very reasonable to argue in fact, that engineers have reasons to struggle, to recover the organizational space that they have lost. As Halles (1988:7-9) has observed, in the division of management labour there is a vertical fractioning of tasks and responsibilities, which distinguishes between those agents involved in managing **management** and higher level decision making, and those who tend to supply information and implement the decisions. As shown in chapter seven, INTCO and NATCO engineers can be truly classified in the latter group. Therefore, one basic aspect which differentiates these two groups is their access to strategic information. Sub-sections 6.1 and 6.2, bring more support to this position.

6.1 Access to Strategic Information

I started approaching the above issues by asking engineers "how much do you know about the overall financial situation of your company"? (see question 23, Appendix 1). The answers to this question gives us an indication of the degree to which the company involves them in the vital aspects of the business ideology. The findings in TABLE 9.12 are not surprising: 75.00 per cent of the engineers interviewed in both companies knew very little or nothing about the financial situation of their company, while only 25.44 per cent said they had great knowledge of it. More INTCO engineers than NATCO engineers were unaware of their company's finances.

TABLE 9.12 - FINANCIAL KNOWLEDGE OF THE COMPANY BY INTCO AND NATCO ENGINEERS AND MANAGERS (Total sample by company)

How much do you know about the overall financial situation of your company?	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Have great knowledge	6	5.26	23	20.18	29	25.44
Know very little	33	28.95	46	40.35	79	69.30
Have no knowledge	5	4.39	1	0.88	6	5.26
Total	44	38.60	70	61.40	114	100.00

Note: Differences between companies significant at the 0.01 level X^2, (X^2=9.327; P<0.01).

When each company is taken separately (TABLE 9.13), we see that only a small proportion of the engineers at INTCO (13.64%), most of them managers, said that they had great knowledge of the company's finances, while the majority (86.36%) had little knowledge of it. This supports the view that managers have more access to the company's information than non-managers.

TABLE 9.13 - FINANCIAL KNOWLEDGE OF THE COMPANY: INTCO ENGINEERS AND MANAGERS

Categories	INTCO					
	ENGINEERS		MANAGERS		Total	
	N=	%	N=	%	N=	%
Have great knowledge	1	2.27	5	11.36	6	13.64
Very little knowledge	20	45.45	18	40.91	38	86.36
Total	21	47.73	23	52.27	44	100.00

Note: 1) Differences between engineers and managers not significant at the 0.05 level X^2, (X^2=2.687; P>0.05).
2) Fisher Exact Probability: Lower Tail = 0.1144, Upper Tail = 0.9857 (P>0.05)

While 86.36 per cent of INTCO engineers and managers possess little knowledge of the company's finances (TABLE 9.13), this information is taken from outside the company through newspapers and magazines. As an engineer argued:

> "Information is selected to each area of the company. I receive only what the company finds useful for my work. Finance is a kind of "secret" in the company. I don't know even the price of the product I produce. The only thing I know about the company's finances is through newspapers, but that is selected information. When we receive some internal information it is to explain the hard side of the matter. I only know about "cost control", nothing more"(A INTCO Chief of Service).

INTCO engineers also complain that they do not receive any formal reports from the company, explaining whether it is performing badly or well. Everything they know comes through "boatos" (hearsay). As an engineer stated:

> "The information I receive is not reliable. I know only what people talk about. It is very informal. Some times the company publishes newsletters to show that it is

under financial distress but such news is used only to justify more sacrifices from all of us. Some times it comes before some dismissals are targeted".

(A INTCO Senior Engineer)

At NATCO too, the majority of managers have great knowledge or, at least, some knowledge of the company's finances, while the majority of the engineers in technical positions know little of it (TAB 9.14).

TABLE 9.14 - KNOWLEDGE OF THE COMPANY'S FINANCIAL SITUATION: NATCO ENGINEERS AND MANAGERS (NATCO ONLY)

Levels of knowledge	Engineers		Managers		Total	
	N=	%	N=	%	N=	%
Have great knowledge	13	18.57	10	14.29	23	32.86
Know very little	40	57.14	7	10.00	47	67.14
Total	53	75.71	17	24.29	70	100.00

Note: 1) Differences between engineers and managers significant at the 0.05 level X^2, (X^2=5.396; P<0.05).
2) Fisher Exact Probability: Lower Tail = 0.0113, Upper Tail = 0.9979 (P<0.05)

The way NATCO informs its engineers is very similar to INTCO. Information is selected and engineers receive only what is thought to be useful for their work. Financial data is considered "private" in the company. As an engineers stated:

"Although I need to have access to certain financial data of the company to carry out my work, I have very little access to it. Financial data is used to justify decisions which are not taken. If everybody has the real information the company can't make manipulations. Furthermore, I think the company prevents workers from knowing its real situation because if they knew it was doing well they would certainly revindicate more. Trade unionists are always searching for real data. If they knew everything, it is likely that their position would be strengthened. I believe that NATCO controls financial information exactly for these reasons".

(A NATCO chief of Division)

The restrictions on giving financial information to staff engineers and managers is generalised in both companies. It suggests that these companies do not expect engineers and middle level managers to be involved with their strategic information. Both companies expect these professionals to be only involved with information necessary to undertake their daily work.

Despite the barriers posed by top management in the division of strategic information, 91.23 per cent of the engineers and managers find it necessary to be informed about the company's finances (TABLE 9.15), because their work involves projects, planning, and cost information. Without a clear set of financial data, it is hard for them to carry out a good job. Only 8.77 per cent of them find it necessary to be only involved with technical things.

TABLE 9.15 - THE VIEW OF INTCO AND NATCO ENGINEERS AND MANAGERS, ABOUT THEIR INVOLVEMENT WITH THE COMPANY'S FINANCIALLIFE

Companies	The Engineers and Managers' View				Total	
	Should be more involved		Should not be involved			
	N=	%	N=	%	N=	%
INTCO	38	33.33	6	5.26	44	38.60
NATCO	66	57.89	4	3.51	70	61.40
Total	104	91.23	10	8.77	114	100.00

Note: 1) Differences between companies not significant at the 0.05 level X^2, ($X^2=1.245$; $P>0.05$).
2) Fisher Exact Probability: Lower Tail = 0.1330, Upper Tail = 0.9621 ($P>0.05$)
2) Source: question 24, Appendix 1.

The engineers were aware that their company does not involve them in such matters for strategic reasons. To divide information is to divide power. As a INTCO engineers argued:

> "INTCO knows that we need to know a little more but it has made a choice of keeping control over everybody. The company finds that if we know more it will become vulnerable. So, we are allowed to know only superficial data. Even chiefs of department receive only very well filtered and selected information. I think that if we had more information we could feel more involved with the company but, it seems that the company has made a choice of keeping us a little separate from its real life"
>
> (A INTCO Chief of Service)

The comments of NATCO engineers are quite similar. As a Senior Chief of Division argued:

> "NATCO doesn't seem to trust its technical staff. Although I occupy a managerial position, top managers do not divide their power. The levels of financial information I receive is the same as what I received ten years ago when I was an engineer. Our work requires some knowledge about finance but the company does not care about that. Financial information is reserved for the top economists, superintendents and higher levels".

In fact both companies are very careful about the sort of literature addressed to engineers and managers. TABLE 9.16 shows that, at INTCO, only 22.72 per cent of the engineers and managers had access to technical literature, compared to the majority of their NATCO counterparts. While only 27.27 per cent of INTCO engineers received some report or newsletter about the company's life, one hundred per cent of their NATCO counterparts received similar literature. Nobody at INTCO had access to the daily newspaper, while 8.57 per cent of NATCO engineers did. What is most striking is the fact that 50.00 per cent of INTCO engineers are not given access to any sort of literature within the company.

TABLE 9.16 - SORT OF LITERATURE ADDRESSED TO ENGINEERS AND MANAGERS BY THEIR COMPANIES

Sort of literature addressed to engineers and managers by their companies	Number and percentage of engineers and managers to whom the literature is addressed					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Technical magazines	10	22.72	66	94.28	76	66.67
Reports about the company	12	27.27	70	100.00	82	71.92
Daily newspaper	00	0.00	6	8.57	6	5.26
Nothing	22	50.00	0	.00	22	19.30
	N=44		N=70		N=114	

Note: Column, for NATCO, add to more than 100 per cent due to multiple responses (see question 25, Appendix 1).

Furthermore, INTCO engineers are asked not to bring their own newspapers or magazines into the company. As one engineer commented:

> "Reading is seen by the company as waste of time. We can't read even our own newspaper. We are kept in isolation from what is happening outside and inside the company. If I want to know anything I have to read or watch TV after my working time. Those who insist on reading, even in the lunch time, are seen badly as professionals. We have to be doing something all the time. If I want to read my newspaper or magazine, even in the lunch time, I go to the toilet".
>
> (A INTCO Chief of Service)

Such levels of surveillance did not occur at NATCO, although NATCO engineers are asked not to abuse work time by reading non-work material. NATCO engineers are satisfied with the nature of the information they receive at work, although the lack of financial information is their main complaint in this matter.

In short, engineers are allowed to be informed strictly on matters related to their technical activities, and at INTCO they are even prevented from being involved in such matters. The managerial control at INTCO through selected information, or rather through lack of information, is very high. INTCO's strategy is to use the engineers full work hours in productive activities, by reducing the loss of such time. NATCO's mechanisms are more psychologically oriented. Engineers are kept very involved with the current technical knowledge related to their activities. Both strategies ensure engineers are occupied with their daily activities, providing less time for them to search for better ways of involving themselves in the inner questions of the company. The interest in knowing more about the company arises from the engineers themselves, not from the company. On the contrary, both companies appear to prevent rather than facilitate such knowledge dissemination.

6.2 Integration in the Profit-Making Ideology

My final approach to the integration of engineers into the business values is based on the engineers view about the "profit making ideology" of the capitalist firm. Engineers were asked: "To what extent do you agree with the profit making ideology of the capitalist firm"?. The interview data on TABLE 9.17 shows that, contrary to the assumptions of the "professionalisation" thesis and "new working class" thesis, engineers are neither anti-capitalists nor against the profit making ideology of the capitalist firm. Only 5.26 per cent of them were against such values. The vast majority of engineers, and independent of their position in technical or managerial activities, supported the view that companies have to make profits. Some 60.53 per cent of them completely agreed with such ideals, while 34.21 per cent agreed to some extent.

TABLE 9.17 - AGREEMENT WITH THE PHILOSOPHY OF MAKING PROFITS (Total sample)

	Categories of Agreement							
	Completely agree		Agree a little		Completely disagree		Total	
Positions	N=	%	N=	%	N=	%	N=	%
Engineers	40	35.09	29	25.44	5	4.39	74	64.91
Managers	29	25.44	10	8.77	1	0.88	40	35.09
Total	69	60.53	39	34.21	6	5.26	114	100.00

Note: Differences between engineers and managers not significant at the 0.05 level X^2, (X^2=3.882; P>0.05).

The comments of engineers on such matter makes their position very clear:

"If the company does not make profits it can't survive. I'm for the idea that companies must make profits. If the country is to progress, enterprises have to make profits. In this company (INTCO) the idea of profits comes first. The only problem is that they forget the workers. Profits also have a limit. Workers should not be so exploited in this search for profits"

(A INTCO engineer Chief of Service)

Another INTCO engineer supported the same view and added some ideas on the possible socialisation of the profits made by the company:

"Profits are important for the survival of the company. However, part of these profits should be divided among employees. Since the company doesn't disrespect the workers, I'm for the idea of making profits."

(A INTCO Senior Engineer)

NATCO engineers are a little more cautious about such a an ideology, but even here the capitalist view of making profits is supported by the majority of them. As some of them commented:

> "Profits are basic for the survival of the company. State-owned companies should not be seen as social institutions. They also have to make profits. If the company goes down, the workers go together. I think all the companies, public and private, have to make profits".
> (A NATCO Chief of Division)

> All companies need to make profits, but I am against profits made through excessive exploitation of workers. Companies which don't search for profits easily disappear, unless they find a paternalist government to supply them with money at the cost of leaving important things without being done for the community in general".
>
> (A NATCO junior engineer)

In short, the engineers supported the capitalist system. They seem very rational in their view of profits. Although the companies prevent them from a deeper involvement with the most strategic information about their business, engineers are motivated to engage themselves in the capitalist ideology of making profits. But they are also concerned with fair share, equity and against profits at the expense of labour.

7. Conclusion

This Chapter has examined the degrees of autonomy, authority and participation that engineers have enjoyed in their companies, and the way they have been integrated into the capitalist values. Despite this, they still legitimate and consider management a necessary function for organizational linkage and as a control function of capital over labour.

Brazilian engineers enjoy limited autonomy and authority in the use of their knowledge and expect to work according to the standards defined by the company. Moreover, the companies are more interested in productive engineers than in high-tech ideas. Their participation in the core decision making process of the company, such as finance, budgets, investment and personnel policies, was also limited. Despite desiring more participation, their influence is very restricted in their companies. Despite being subordinate to the company's rules, they place themselves on the side of capital against workers since they intend to reserve for themselves only, the right to participate in core decision making. This attitude seems to be reminiscent of the ideology of the engineering schools and Council of Engineering, that engineers shall foremost represent the capitalist's interests. Despite the lack of participation and access to financial or strategic information, Brazilian engineers support the ideology of the capitalist firm.

Despite engineers being wishful of more participation, they do not wish the same for other workers. Managers are more restrictive than engineers to the idea of giving other workers more voice in the decision making process of the company. Those who would give more participation suggest that workers should be given more voice only in decisions related to their own work. These findings lend no support for the "new working class" thesis assumption that technical workers are for "autogestion", neither for the view that they would ally with manual workers in defence of a common interest or to run the company. Poulantzas's view that engineers are aware of their role of management but they do nothing to change it, is supported here. Despite the engineers of both companies being aware that they are submissive to management and to the company's aims, they put themselves on the side of management against manual workers. The same behaviour was observed by Smith (1987) in relation to the British technical workers. Therefore, the "new working class" thesis' assumption that engineers are not given participation in decision making processes, finds clear support here but, the idea that engineers are anti-capitalist, as argued by Gorz and Veblen, does not. On the contrary, engineers have placed themselves on the side of capital against workers when they intended to reserve for themselves only, the right to participate in the central questions of the capitalist enterprise. However, the findings support the "new middle class" thesis advanced by Poulantzas (1975) and Carchedi (1977), that engineers, are politically and ideologically implicated in reproducing the capitalist ideology.

Moreover, the involvement of engineers with the making profits ideology is very well developed. They support the view that profits are indispensable for the survival of the companies and for the development of the capitalist system. Despite such absorption of the capitalist ideology, the entrepreneurs does not seem confident that engineers are really for the company. The majority of the engineers are not given access to financial information about the firm. If they want to know it they have to find out from abroad. Financial information is treated as "privileged" information in both companies. Only the top executives are given access to it. Furthermore, engineers have no access to strategic information of the company. They are informed only up to the level of their daily activities.

The lack of information is a powerful strategy used by both companies, INTCO and NATCO, to involve engineers in the activities the companies find useful. INTCO engineers are given access only to the bad side of the financial situation of the company. By doing so the company can justify that they have to work even more in order to bring the company out of financial difficulties. So, the involvement of INTCO engineers with production, is a very powerful control strategy adopted by the company. At NATCO, the strategy is to stimulate productivity in the task. So, engineers are highly "insulated" in their daily activities. In order not to make them alienated of it, the company supply them with technical information related to their activities. While engineers are involved with production issues, at INTCO, or with technical issues at NATCO, they do not have time to think about the inner questions of the company. While engineers work, top managers find enough time to decide about what is good for the company. Similar strategies have been identified in British companies (Smith at al. 1990; Smith, 1990; Whalley 1986).

Our conclusion is that the case of Brazilian engineers is very similar to those from other developed nations, in relation to the question of autonomy, authority and participation. National and multinational companies adopt different policies in these issues. It confirms some assumptions that although multinationals have to adapt to host country's economic, political and labour legislation (even labour environment), presented in Chapter 4, they manage to impose their basic personnel policies on subsidiaries in host countries. This suggests that the principles of multinational management can be generalised within developed and developing nations. The following chapter examines the place of engineers in the labour process, according to the way it is structured into supervisory and non-supervisory functions, and brings more support to this debate.

10. ENGINEERS, MANAGEMENT AND CLASS

1. Introduction

As we have seen in Chapter 2, the position technical workers occupy in the division of labour, has profoundly affected the way sociologists locate them in the class structure. The "new middle class" theorists (Poulantzas, 1975; Carchedi, 1977; Wright 1985), locate engineers, supervisors and managers in a "new middle class". For Poulantzas, technical workers, supervisors and managers are part of the "new petty bourgeoisie" because, although they lack ownership or control over capital, they are implicated by political and ideological relations in serving capital. For Carchedi, this group of workers are part of the "new middle class" because, at the same time that they are salaried professionals, and participate in the collective labour process, they also represent the capital function, as they perform the functions of control and surveillance of this labour process for exploitative purposes. Finally, Wright places professionals and managers in a "new middle class" position due to their educational credentials and access to organizational knowledge, which enables them to control the conditions for the coordination of labour.

The "new working class" theorists (Mallet, 1975; Gorz, 1967), consider engineers, technicians, supervisors and managers as part of a privileged "new working class" because of their different level of technical knowledge, role in production, and standard of living.

Finally, neo-orthodox Marxist theorists on technical labour (Smith, 1990; Meiksins, 1982, 1986) argue that, although engineers, managers and supervisors perform the function of control of capital, their condition as salaried workers place them in the working class. However, this thesis has been rejected because, within the neo-marxist tradition the condition of wage labour alone, is not enough to say that this group is part of the working class.

The involvement of technical workers in managerial and supervisory activities in organizations has also raised an inconclusive debate among sociologists of the professions, to whom the commitment of engineers with the rationality of science may conflict with managerial and supervisory activities, as these activities require technical workers to involve themselves with administrative aspects of the company, what does not seem to be their main objective as professionals (Freidson, 1973a; Kornhauser, 1965).

The points raised above are specially relevant for the case of Brazilian engineers. As I have argued within this thesis, Brazilian engineers have a tradition of being involved in supervisory activities from the beginning of their career in enterprises. Companies have structured the labour process in such a way that engineers are placed, at least, as technical coordinators, if there is no place for them in the managerial structure. The education system also reinforces the idea that engineers are paid to represent the interest of capital within enterprises. Even when they are not technical coordinators, they are used to having technicians and/or qualified workers to help them with manual tasks.

However, the role played by engineers in undertaking managerial functions, is not a privilege of Brazilian engineers alone. American and Continental European engineers are also highly involved with supervisory activities. British engineers are the only group typically involved in technical rather than in supervisory activities (Smith 1987; Whalley 1986).

In the light of this debate this Chapter examines the place engineers are located within the labour process, according to the way the labour process is structured for supervisory and non-supervisory functions; secondly, it analyses the engineers orientation towards technical and managerial careers, and the advantages and disadvantages they find in moving into each of these. Thirdly, it analyses to what extent engineers fell part of management as a result of the way this labour process is organized to make engineers the controllers of labour within the enterprise; finally, it concludes by approaching the relationship between the positioning in the labour process, working condition and class position of engineers and managers.

2. Engineers and Managers as Representatives of Capital

As shown in Chapter 2, within the Marxist tradition the "New Middle Class" theory has been advanced mainly by Paulantzas (1975), Carchedi (1977) and Wright (1985). For Carchedi (1977), the exercise of supervisory authority is a form of control and surveillance (the control function of capital), whose aims is to enforce the expropriation of surplus labour from nonsupervisory workers. The engagement of managers and supervisors in performing the control function of capital, is the basis to identify this occupational group as part of a "new middle class". However, for Poulantzas (1975) there are other forms of domination than supervisory functions, such as the monopolization of productive knowledge, which can also be used for the expropriation of surplus labour. All of those directly or indirectly engaged in this function can be regarded as part of what Poulantzas call a "new petty bourgeoisie". Thus, for Poulantzas and for those who have built in the work of Carchedi (Carter, 1985; Clegg, Boreham and Dow 1986), the notion of the function of capital encompasses a wider range of professional and technical occupations (Burris, 1989). This means that even those engineers who do not directly supervise other workers, can be regarded part of this "new petty bourgeoisie" (or "new middle class" according to Carchedi), as they also are implicated in the technical coordination of the labour process for exploitative purposes.

Although Wright (1985) agrees with the Marx's approach that class is basically a relationship of exploitation (the transfer of labour from one class to another), he rejects the usual Marxist view that exploitation depends mainly on the relations of production - i.e., the institution of wage labour and capitalist domination over workers at the point of production. For Wright, although the dominant form of exploitation in capitalist society is that based on the private ownership of the means of production, there are also subsidiary forms of exploitation that derives from the unequal distribution of productive assets. These assets are what he calls "organization assets" and "skill assets". Organization assets he means control over the conditions for the coordination of labour. For Wright, organization is itself a source of productivity. By controlling this asset (the "means of production") managers are able to exploit the labour of nonmanagers. The "skill assets" are technical knowledge, whose main supply is artificially restricted through credentials. By monopolizing this asset, Wright argues, credentialed workers (e.g. professionals) are able to exploit the labour of less skilled workers. Salaried managers and professionals are thus distinguished from the capitalist class by their lack of ownership of capital, and from the working class, by their ownership of skills (credentials) or organization assets (technical capacity and delegated authority do supervise others on behalf of capital). For Wright, the disproportionate share of these assets enables them to exploit the labour of other workers, even as they themselves are exploited by capitalists. Although Wright has brought new concepts for the analysis of the "new middle class", his work seems to be an extension of the work of Carchedi and Poulantzas. For Carchedi (1986) and Meiksins (1988), what Wright call "organization assets" can be interpreted as the same thing as supervisory authority in Carchedi's analysis.

The case of Brazilian engineers bring more support for the "new middle class" thesis' assumption that professionals and managers are involved in performing the capital function of the enterprise, although they also are engaged in the collective labour process. As argued in Chapters 1 and 2, and in the previous section, the majority of Brazilian engineers engage in supervisory functions during their career in organizations. The case of INTCO and NATCO engineers confirm this assumption. As shown in TABLE 10.1, 85.96 per cent of INTCO and NATCO engineers are engaged in supervisory functions, independent of holding a managerial position. Only a small proportion of them (14.04%) do not supervise other workers.

TABLE 10.1 - INTCO AND NATCO ENGINEERS IN SUPERVISORY FUNCTIONS (Total sample by company)

Categories	Supervise other Workers		Do not supervise other workers		Total	
	N=	%	N=	%	N=	%
INTCO	38	33.33	6	5.26	44	38.60
NATCO	60	52.63	10	8.77	70	61.40
Total	98	85.96	16	14.04	114	100.00

Note: Differences between companies not significant at the 0.05 level X^2, (x^2=0.032; P<0.05).

When taking only those engineers in technical positions, we find that 79.73 per cent of them are engaged in technically supervising other workers (TABLE 10.2). Among the 16 engineers who do not exercise supervision, one has the title of Chief of Service, at INTCO, but is engaged in purely technical activities. This is explained by the fact that some high-tech engineers are given promotion to managerial functions, only because there is no technical career ladder in the company and enables it to give a pay rise. The five INTCO staff engineers who do not perform supervisory functions, come from the areas of maintenance, data processing, training, sales and production. The 10 engineers from NATCO, are proportionally distributed among the areas of energy distribution, projects and planning.

TABLE 10.2 - INTCO AND NATCO STAFF ENGINEERS IN SUPERVISORY ACTIVITIES (Staff engineers only)

Companies	Supervise other workers		Do not supervise other workers		Total	
	N=	%	N=	%	N=	%
INTCO	16	21.62	5	6.76	21	28.38
NATCO	43	58.11	10	13.51	53	71.62
Total	59	79.73	15	20.27	74	100.00

Note: Differences between companies not significant at the 0.05 level X^2 (x^2=0.024; P>0.05).

The characteristics of the labour force supervised by engineers are very diversified. They supervise not only technicians, but also other engineers, manual workers and other professionals. TABLE 10.3 shows that 89.79 per cent of the staff engineers supervise technicians; 66.32 per cent supervise other engineers; 57.14 per cent supervise manual workers; 32.65 per cent supervise white-collar workers and only 21.43 per cent supervise other professionals. It is noticeable that more INTCO engineers than NATCO engineers have manual workers under their supervision. This phenomenon is associated with the fact that INTCO engineers are highly involved in production, while NATCO engineers are more involved with office based technical activities. In fact, more NATCO engineers have white-collar workers under their supervision.

This is because the level of bureaucratization at NATCO is greater - there are more white collar staff. INTCO engineers, on the contrary, are highly insulated in productive activities and little paperwork is seen on their tables, while at NATCO, bureaucracy and paper production is much greater.

TABLE 10.3 - CHARACTERISTICS OF THE LABOUR FORCE SUPERVISED BY STAFF ENGINEERS

Occupational groups	Companies					
	INTCO		NATCO		Total	
	N=	%	N=	%	N=	%
Engineers	22	57.89	43	71.66	65	66.32
Technicians	34	89.47	54	90.00	88	89.79
Other professionals	7	18.42	14	23.33	21	21.43
Manual workers	28	73.68	28	46.66	56	57.14
White-collar workers	5	13.15	27	45.00	32	32.65
	N=38		N=60		N=98	

Note: Columns "percentage" add to more than 100 per cent due to multiple responses

The above findings are consistent with the "new middle class" approach presented so far. Most of the engineers are engaged in supervisory functions, even though they do not hold a managerial position at all. In this sense they clearly perform the control function of capital as argued by Carchedi (1977). The few engineers who do not supervise other workers can be included in the group which Poulantzas (1975) consider to be indirectly engaged in supervising the work of others, as far as they work as manager's technical staff. Finally, supervisors and managers can be included in the group which according to Wright (1985), hold organization assets, while those who do not directly supervise other workers, still have skill assets, and like in Poulantzas's case, are indirectly involved in supervising the work of others. Thus, by the criteria of performing the capital function, these engineers and managers can be clearly separated from the traditional working class and regarded part of the "new middle class".

However, we still need to see to what extent we can separate INTCO and NATCO engineers and managers from the capitalist class. This will be done by looking at the extent to which they depend on organizational employment and on the salary as a way of living.

3. Engineers and Managers as Salaried Professionals

As shown in Chapter 2, one of the basic criteria for a Marxist class analysis is the ownership and non ownership of the means of production. This generates two basic classes: capitalist and workers. What distinguish the workers from the capitalist class, is the fact that they have to rent their labour power to the capitalist in a salary basis. This is a dimension of class analysis also recognised by all neo-Marxist theorists of the "new middle class". Thus, if the INTCO and NATCO engineers have to work in a salary basis for their employers, they cannot be regarded part of the capitalist class. Considering that they have already been separated from the working class, by their engagement in performing the capital function, if we can demonstrate that they are not part of the capitalist class, we can argue for their "new middle class" place, as the "new middle class" approach implies.

The dependence of engineers on organizational employment has already been highlighted, due to their historical relationship with the development of the capitalist enterprise (Smith and Meiksins (1992). As Carter (1985) has also shown, with the capitalist development, the functioning capitalist had to delegate his functions (of manager entrepreneur) to a new categories of specialized workers (managers, engineers and technologists), which would work for him in a salary basis. This indicates the differences between the manager entrepreneur (the owner of the enterprise), and the professional managers and their technical staff who, despite performing the functions of the functioning capitalist, they lack ownership of capital, and are subject to employment contract.

The case of INTCO and NATCO engineers reveals that, in fact, Brazilian engineers are highly dependent on organizational employment. As TABLE 10.4 highlights, the monthly salary is indispensable for the survival of 71.93 per cent of the engineers and managers and their families. For the remaining 28.07 per cent of them, their salary also has great importance. Thus, engineers are to sell their labour power, as a way of living, as all the working class does.

TABLE 10.4 - DEPENDENCE ON THE SALARY (Total Sample)

Categories	Importance of the Salary					
	Great Importance		Indispensable		Total	
	N=	%	N=	%	N=	%
Engineers	18	15.79	56	49.12	74	64.91
Managers	14	12.28	26	22.81	40	35.09
Total	32	28.07	82	71.93	114	100.00

Note: Differences between engineers and managers not significant at the 0.05 level X^2, (X^2=0.985; P>0.05).

Therefore, TABLE 10.5 shows that 79.82 per cent of them do not have an income source other than their monthly salary. Only 20.18 per cent of them have a complementary income source, but their salary is the most important one.

TABLE 10.5 - ADDITIONAL INCOME SOURCE TO SALARY (Total sample)

	Have other income source		Do not have other source		Total	
Categories:	N=	%	N=	%	N=	%
Engineers	17	14.91	57	50.00	74	64.91
Managers	6	5.26	34	29.82	40	35.09
Total	23	20.18	91	79.82	114	100.00

Note: Differences between engineers and managers not significant at the 0.05 level X^2, (x^2=0.590; P>0.05).

To have a complementary income source does not alter the engineers and managers standard of living that much. It only highlights the fact that engineers, as salaried employees, do not manage to fulfil their basic needs with their salary only. As Carchedi (1977) has argued, although they have to perform the capital function of the enterprise, as salaried employees, they also are subject to have their surplus labour exploited by their employers. As TABLE 10.6, shows, 96.49 per cent of them depend exclusively on their monthly salary and could not survive without it. Only 3.51 per cent of them have a parallel income source greater than their salary. These findings are also consistent with Wright's (1985) view that, although engineers and managers have some control of the capital function - in that they hold organization and skill assets -, and as such they can exploit the surplus labour of others, they also are subject to exploitation, as they lack ownership of capital and have to work as salaried professionals. This is what makes their class position very contradictory.

TABLE 10.6 - ENGINEERS' AND MANAGERS' MAIN INCOME SOURCE (Total Sample)

Categories	Main income source					
	Other sources		Salary		Total	
	N=	%	N=	%	N=	%
Engineers	1	0.88	73	64.04	74	64.91
Managers	3	2.63	37	32.46	40	35.09
Total	4	3.51	110	96.49	114	100.00

Note: 1) Differences between engineers and managers not significant at the 0.05 level X^2, (X^2=1.368; P>0.05).
2) Fisher Exact Probability: Lower Tail = 0.1233, Upper Tail = 0.9863 (P>0.05).

We can then conclude up to this point that, by the criteria of ownership and of dependence on salary, INTCO and NATCO engineers cannot be regarded part of the capitalist class. As argued in the previous section, they are salaried professionals who are implicated in performing the control function of capital, as well as in performing, to a certain extent, the function of collective labourer. These findings are consistent with the theoretical framework presented so far on the "new middle class". INTCO and NATCO engineers can be regarded in Carchedi's (1977) terms, a "new middle class", or in the view of Poulantzas (1975), a "new petty bourgeoisie", and in Wright's (1985) definition, a category of professionals engaged in a very "contradictory class location".

4. Engineers and Managers as a "New Middle Class"

These previous conclusions are also consistent with the view of the engineers themselves in relation to their place in the Brazilian class structure. As TABLE 10.7 shown, independent of their place in supervisory or technical functions, 8.77 per cent of the engineers ana managers consider themselves "upper-middle class"; some 53.51 per cent consider themselves "middle class"; another 35.09 per cent of them consider themselves part of a "lower-middle class"; and only 2.63 per cent of them regarded themselves "working class". In short, 97.37 per cent of the engineers and managers considered themselves "middle class".

TABLE 10.7 - THE ENGINEERS AND MANAGERS SELF-LOCATION IN THE CLASS STRUCTURE, ACCORDING TO THEIR PLACES IN TECHNICAL OR SUPERVISORY ACTIVITIES (Total Sample)

	Supervise other workers		Do not Supervise others		Total	
	N=	%	N=	%	N=	%
Upper-Middle-Class	7	6.14	3	2.63	10	8.77
Middle-Class	56	49.12	5	4.39	61	53.51
Lower-Middle-Class	32	28.07	8	7.02	40	35.09
Working Class	3	2.63	0	0.00	3	2.63
Total	98	85.96	16	14.04	114	100.00

Note: Differences not significant at the 0.05 level X^2, (X^2=5.505, P>0.05).

Although most of the engineers consider themselves a "new middle class", their contradictory position between labour and capital, as a "new middle class" based on organizational employment, seems to affect not only their level of commitment to their career in the company, but also their commitment to the organizational employment in general. For many of these engineers, management rather than a technical career, means a way of improving their salary, status, prestige, power and standard of living. However, they would prefer an independent career, as liberal professionals, outside the organization. This is a matter of analysis for the following section.

5. Engineers and the Managerial Career

The "professionalisation thesis" argues that, engineers, as experts, are expected to follow a technical rather than a managerial career. Engineers, as experts, are said to be committed to the rationality of science rather than to the administrative processes of the enterprise. Once they have autonomy and authority based on the nature of their knowledge, they are expected to defend their occupational basis as "experts" rather than their position in a particular organization. Having become experts, they do not depend on a specific setting to practice their knowledge (Whalley 1986:94-95).

The professionalisation thesis also defends the view that due to the complex character of their knowledge, the values of professionals differ from those of the enterprise, which are based on the profitability of capital. Under such circumstances we could expect that engineers would prefer a technical rather than a managerial career, because managers are, in general, highly involved with the profit making ideology of the capitalist firm.

However, such predictions do not find too much support in practice. Whalley (1986), for example, referring to the work of Zussman (1985), has shown that American engineers are more committed to management than to their professional peers, and professional ladders without managerial responsibility are seen by them as a "cooling out" process of organizational failure.

Other critics of the "professionalisation thesis" have also found that engineers are easily socialised by the enterprises and they easily embrace the organizational values and practices (Goldner and Ritti, 1967:491). Engineers have also embraced corporate positions as the mark of status and moving into management is seen as a symbol of professional success (Noble 1977:41). For others, it is very compatible with the engineering profession that engineers perform technical and administrative activities at the same time, because one function is said to enrich the other (Torstendalh 1982; Perucci and Gerstl 1969).

Finally, orthodox Marxist theorists of "proletarianization" have given no support for the assumptions about the autonomy and authority enjoyed by professionals, as the professionalisation thesis implies. On the contrary, they have assumed that the status, prestige, power and autonomy of professionals has only a **symbolic** meaning within enterprises (Smith, 1990; Meiksins, 1986). In practice, the technical division of labour has reduced the dimensions of the engineer's areas of activities (Braverman 1974). In addition, they can no longer define their own working projects (Derber 1982). Thus, managerial positions have become the locus of ambitions of engineers, because through this position they can take control over technical resources, and improve status, prestige and power (Galbraith, 1967). To assume control over technical resources, through management, is also a way technical workers have found to escape from the organizational alienation (Mallet 1975; Gorz 1967).

The case of INTCO and NATCO engineers shows that, in fact, the involvement of engineers in supervisory activities does not seem to have created major problems for them, as predicted by the "professionalisation thesis" and by some branches of the "new working class" thesis. On the contrary, the majority of those who supervise other workers feel satisfied or very satisfied in performing such a function (TABLE 10.8). Only 22 out of 98 staff engineers feel only reasonably pleased with their present function, while nobody stated to feel unpleased.

TABLE 10.8 - SATISFACTION IN PERFORMING TECHNICAL OR SUPERVISORY FUNCTIONS BY INTCO AND NATCO STAFF ENGINEERS

Degrees of satisfaction with the function of supervision	Supervise other workers		Do not supervise		Total	
	N=	%	N=	%	N=	%
Very satisfied	22	19.30	1	0.88	23	20.18
Satisfied	54	47.37	9	7.89	63	55.26
Reasonably satisfied	22	19.30	6	5.26	24	24.56
Total	98	85.96	16	14.04	114	100.00

Note: Differences between the two groups not significant at the 0.05 level X^2 (x^2=3.061; P>0.05).

Despite no statistical difference being found between the levels of satisfaction of the two groups (those who supervise and those who do not), we can see that only one non-supervisory staff engineers felt very much satisfied with the technical activities he undertook. The remaining 15 who do not supervise anybody, felt either from satisfied to reasonably satisfied with their functions. In short, we can say that being in a technical or managerial activity is a natural thing for the engineers and we can be sure that they are able to adapt to a function where a combination of technical and supervisory activities are required.

However, TABLE 10.9 shows that, independently of being in a technical or a supervisory activity, or in both at the same time, engineers are divided half and half between those who would choose a technical or a managerial career for the same salary. This means that the satisfaction with their present function, as presented above, is not explained by the nature of the function or the levels of salary only. Hence we have to search for other reasons which might explain their career choice.

TABLE 10.9 - CAREER PREFERENCE BY INTCO AND NATCO ENGINEERS ACCORDING TO THEIR PLACE IN SUPERVISORY AND NON-SUPERVISORY ACTIVITIES (Total sample)

Nature of the activities	Career preferred: Technical		Managerial		Total	
	N=	%	N=	%	N=	%
Supervise others	47	41.23	51	44.74	98	85.96
Do not supervise	10	8.77	6	5.26	16	14.04
Total	57	50.00	57	50.00	114	100.00

Note: Differences not significant at the 0.05 level X^2, (X^2=0.654; P>0.05).

Engineers seem to make a choice of career by taking their personal characteristics and personal needs as a starting point, and only later, focus on the content and values of the engineering profession, as argued by the "professionalisation thesis". The choice of a technical career is strongly based on the idea of personal vocation and abilities. TABLE 10.10 shows that the four main reasons to remain in a technical career are: (1) the facilities to deal with technical rather than with human things; (2) the pleasure in dealing with technical rather than with administrative things; (3) the lack of personal vocation to become a manager and; (4) The dislike of dealing with bureaucratic things. Yet, contrary to the Professionalisation and New Working Class thesis, bureaucracy and no vocation for management is a problem for only 35.09 per cent of those who would prefer to remain in a technical career. The nature of such answers suggests that the group of engineers who would choose a technical career, would do so because it is easier for them to remain accommodated in their present positions without having to face new challenges in their career.

TABLE 10.10 - REASONS FOR CHOOSING THE TECHNICAL CAREER

Main reasons	N=	Percentage
I find it easier to deal with technical than with human things	14	24.56
I like to deal with technical things	23	40.35
I dislike bureaucrat activities	8	14.03
Have no vocation for management	12	21.06
Total	57	100.00

Note: N = number of engineers who gave the same answer (see question 15, Appendix 1).

In fact, when looking at the reasons why the second group has chosen a managerial career, the psychological needs of status, prestige, power and progress clearly appear. TABLE 10.11 shows that, for 42.10 per cent of the engineers a managerial career is believed to provide more power, professional recognition, prestige and autonomy. Another 36.84 per cent of them believe that management gives more money, more challenge and progress in their career. In fact, for 33.33 per cent of them, management means enrichment of the profession. For the remaining 15.79 per cent, to become a manager is a natural process within organizations.

TABLE 10.11 - REASONS FOR CHOOSING THE MANAGERIAL CAREER

Main reasons	N=	%
Management is an enriching process for the engineering profession	19	33.33
Management gives more recognition, power, prestige and autonomy at work	24	42.10
Managerial career gives more money, more challenge, more progress	21	36.84
Managerial career is a natural process in organizations	9	15.79
Total	57	**

Note: ** Column "percentage" adds to more than 100 per cent due to multiple responses.

Moreover, TABLE 10.12 shows that the majority of managers would prefer to remain as managers rather than return to a technical position, while most of those who are in the training process to become managers, still prefer to stay where they are. It suggests that in the beginning of their careers, engineers seem a little resistant to abandon a technical career, but as long as they get engaged in the company's life they soon discover the advantages of this position, and the majority would then not like to remain in a technical position.

TABLE 10.12 - CAREER PREFERRED BY INTCO AND NATCO, ENGINEERS AND MANAGERS (Total sample by post)

	Career preferred					
	TECHNICAL		MANAGERIAL		Total	
Categories	N=	%	N=	%	N=	%
Engineers	44	38.60	30	26.32	74	64.91
Managers	13	11.40	27	23.68	40	35.09
Total	57	50.00	57	50.00	114	100.00

Note: Differences significant at the 0.025 level X^2, (X^2=6.509; P<0.025).

In fact, INTCO and NATCO engineers and managers are unanimous in affirming that the personal needs they think they can satisfy in a managerial position, are actually satisfied in the position. As some INTCO engineers commented:

> "As soon as I graduated I wanted to work with pure engineering. Slowly I started feeling that the companies want to expand quickly. In such an environment we can't practice engineering properly. Computers can do the basic things so I soon changed my view about engineering. Today I find management much more interesting and challenging for my career.
>
> (An INTCO Senior Engineer)

> "The managerial position gives more prospects to reach the top of the hierarchy. It also makes it easier to apply technical knowledge because it allows me to have a greater view of the company".
>
> (An INTCO Senior engineer)

> "A managerial function gives more chance to develop things. I have much more chances now than when I was only an engineer. The engineers who work under my supervision do not have the conditions to do anything meaningful in terms of engineering".
>
> (An INTCO Chief of Service)

> "Being a Chief gives more money, recognition and respect

as well. As an engineer only, it is very difficult to achieve such things. Management also enriches the technical activities. It brings us out of the daily routine of engineering and involves us with some more exciting things".

(An INTCO Chief of Service)

"Managerial activities enrich the work of engineering. As engineers it is difficult to survive in the company. We don't have any autonomy. We are kept down. As a manager I have more money, more prestige, more power and more professional respect".

(An INTCO Chief of Service)

The comments of NATCO engineers also lend similar support for the idea of the satisfaction of psychological needs through managerial functions. As some of them stated:

"After eleven years in technical activities I developed a tremendous fascination for a managerial career. As a manager you can do many other things that in technical positions would be impossible. I'm much happier now in my present position than before".

(A NATCO Chief of Division)

"In a managerial position I can combine technical and managerial things. I think management complements engineering. To be only an engineer is too limited".

(A NATCO Chief of Division)

"I like to deal with people and to be involved with many things at the same time. I find the condition of specialist very limited. I would like to become Chief very soon in my career.

(A NATCO Junior Engineer)

"I like both activities. In my area it is necessary to be a good specialist before becoming a manager. Many engineers are promoted into management because there is no other alternative. If there were a technical career ladder it would be a relief for many of them, because they fear the managerial responsibilities. But, nowadays management is the only alternative to progress in the company. Even though we had good chances in the technical career I would still prefer to move into the managerial one".

(A NATCO senior Engineer)

In short, the last comment seems to summarises the engineers' view of careers. Some engineers find a way of satisfying their psychological needs in a managerial career, while others, adopt a more preventive strategy of accommodating themselves in a technical career. But the absence of technical career ladder leads engineers to search for a managerial position as they do not have another choice. The previous findings also lend no support to the assumption that the values of professionals conflict with those of managerial positions. On the contrary, management works as an alternative to enrich the technical activities. It also supports the critics of the "Professionalisation thesis", like Goldner and Ritti, who argue that, technical professionals can be easily integrated in the managerial ideology of capitalist firms. It also supports Noble's (1977) findings, that engineers see management as a symbol of success in their career. Furthermore, it also supports the ideas of Torstendahl (1982), Perucci and Gerstl (1969), that there is no incompatibility in performing technical and managerial activities by engineers. Finally, it supports Galbraith's (1967) view, that management is a way through which engineers can have more control over technical resources within the firm.

5.1 Integration into Management

It was also found that as long as the engineers move up in the hierarchy and get closer to management they feel more engaged in the managerial philosophy. As TABLE 10.13 shows, the majority of the engineers who have only the title of "Engineer" (43 out of 50) did not feel part of management. When we step up in the hierarchy we see that among "Technical Coordinators", the number tends to be greater for those who felt part of management than those who did not; Among the Chiefs of Division or Chief of Service, more than two thirds felt part of management and hundred per cent of Chiefs of Department considered themselves part of management. It shows that as soon as engineers move from a technical to a more administrative or managerial activities, such a feeling changes according to the context of their activities.

TABLE 10.13 - RELATIONSHIP BETWEEN HIERARCHICAL POSITION AND FEELING OF BEING PART OF MANAGEMENT (Total sample)

Position in the hierarchy	Feel part of management		Do not feel part of management		TOTAL	
	N=	%	N=	%	N=	%
1) Engineers	7	6.14	43	37.72	50	43.86
2) Technical Coordinators	13	11.40	11	9.65	24	21.05
3) Chief Division\ Chief Service	23	20.18	10	8.77	33	28.95
4) Chief of Department	7	6.14	0	0.00	7	6.14
Total	50	43.86	64	56.14	114	100.00

Note: Differences significant at the 0.005 level x^2 (X^2=37.047; P<0.005).

The feeling of being part of management is also affected by the content of the engineers' work and by the level of autonomy, authority and participation engineers enjoy in the company. TABLE 10.13 also shows that 45.83 per cent of the technical coordinators (group 2), and 30.30 per cent of the

Chiefs of Division or Service (group 4), do not feel part of management. Why is this so? Those technical coordinators who do not feel part of management, were unanimous in affirming that they did not feel part of management because their work is essentially technical. Furthermore, besides supervising other workers, such supervision is essentially technical. They did not have any autonomy or authority to decide about anything related to the professional life of the workers under their technical supervision. Both themselves and their technical subordinates have to report to the Chief of Division or Chief of Service, as the first level position with managerial authority within the company. Lack of autonomy, no participation in meaningful decisions and the essentially technical content of the work performed by some Chiefs of Division and Chief of Service is what has led 30.30 per cent of them to feel separate from management. As a NATCO Chief of Division, include in this group, stated:

> "NATCO has created many new posts for new chiefs aiming at bringing engineers to the side of the company. It has also done everything to develop the feeling of being part of management in the lowest levels with supervisory activities as a strategy to increase control over labour but, the essential things for a managerial position, such as autonomy, authority and participation, has not being given by the company. Moreover, our work is still very technical and with very little managerial content. Under this condition I still feel more engineer than manager".
>
> (A NATCO Chief of Division)

Thus, in both companies some engineers are promoted to first level managerial positions (Chief of Service at INTCO, and Chief of Division at NATCO), but are called "managers" only in name, since the power, autonomy and authority to work as managers is not delegated to them.

However, TABLE 10.13 also shows that 43 engineers who perform supervisory activities (group 2 to 4) and 7 engineers in technical positions (group 1), firmly believed that they are part of management. We can ask what makes this group feel different from the other groups? The answers given by this group support the view that autonomy, authority, and participation, form the basis of the feeling of being part of management. This group has assumed that the levels of autonomy, participation and authority they have enjoyed is very compatible with their position within the managerial hierarchy. That is why they feel part of management. Within this group there are 7 engineers in technical positions who also feel part of management. In their view, despite not holding a formal managerial position they perform tasks that are helpful for their chiefs to carry out their managerial activities. This is the reason why they feel part of management.

In short, both groups (that which feels part of management, and that which does not) have located themselves in managerial or in technical functions according to the nature of their work, and to the degree of autonomy, authority and participation their positions are given in the company. They are aware that being supervisors does not mean to be participating in the destiny of the company. For them, management is a little more than to have workers under their supervision. Management means to have a voice in the inner issues of the company. While supervision is important to make workers carry out the work they are expected to do, management means to be involved in the running of the company.

5.2 Commitment to a Career in the Organization

Although most of INTCO and NATCO engineers are engaged in directly supervising other workers, which means a training process for upward mobility in a managerial career and consequently higher salaries, status, prestige and power (which could improve their "new middle class" position), most of them would prefer to develop a career outside the organization in an independent occupation.

This attitude seems to be associated with both the engineers' contradictory place in the capital/labour relations and the contradictory ideology of professionalism of the engineering profession in Brazil. As I will be demonstrating in the next chapter, the Council of Engineering, in Brazil, defend both the view that engineers are organizational professionals - in that they have to represent the capitalist interest in the capital labour/ relations - and that engineers, like medical doctors and lawyers, are liberal professionals, i.e., that they should see themselves as independent professionals. This last point is also associated with the ideology of professionalism in the United States, which has a great influence in Brazil. As some sociologists have argued, in American society, law and medicine have achieved so enormous power and prestige that they have become a model for other professions to follow (Hall 1975; Ritzer 1986; Caplow 1954).

The INTCO and NATCO engineers' answers to the question "have you ever thought of being self employed" reveals their lack of commitment to the organizational career, in favour of an independent occupation. TABLE 10.14 shows how striking this issue is for the engineers. Regardless of being in a managerial position or not, 81.58 per cent of them would prefer to work for themselves instead of working for a company as a salaried employee. Only 18.42 per cent of them would prefer to work as an employee. Their aspirations are petty bourgeois, or rather they want to be part of a middle class in a more conventional Marxian way, through self employment or personal business, which can allow them to be their own boss.

TABLE 10.14 - WILLINGNESS OF WORKING FOR ONESELF (Total Sample)

Categories	Not Willing		Willing		Total	
	N=	%	N=	%	N=	%
Engineers	15	13.16	59	51.75	74	64.91
Managers	6	5.26	34	29.82	40	35.09
Total	21	18.42	93	81.58	114	100.00

Note: Differences between engineers and managers not significant at the 0.05 level X^2, ($X^2=0.193$; $P>0.05$).

However, the choice of self employment was not motivated by a special commitment to the engineering profession, as the professionalization thesis could expect. Engineers would prefer to have a small firm, a consultancy practice, than to work as employees. The advantages for making such a choice are clear for them: to work for oneself gives more autonomy, more freedom, less pressure, less control and more self administration. They have not left the company yet, because the country's economy is very unstable, and they could not survive without their monthly salary. They seem determined to do this, but there are few real chances. Mechanical and electrician engineers have been trained to work as employees and there are few chances for them to set up a personal business. Civil engineers are the only ones who have had the option of working as salaried employees, or being self employed in small construction firms which operate in the housing market, or undertake construction projects as contract based workers for large engineering firms.

We can conclude that, to be an expert or a manager signifies, at first, for the engineers, only different stages of their career, which are attached to different levels of salary, benefits, autonomy and participation in the organization. Being an expert or a manager illustrates the way engineers have been able to accommodate themselves according to their personal abilities and needs of survival within these companies. The investment engineers place in a managerial career means a strategy for them to improve their working conditions and their standard of living. If engineers could make a choice, they would prefer to work for themselves rather than work for a company. If they managed to do this, they would be moving from their present "new middle class" condition, based on organizational employment, like in developed nations, to a more conventional middle-class or petty bourgeois place, according to the Marxist definition of class. However, as long as they remain highly dependent of organizational employment, the ambiguity of their class location and interests persist.

6. Conclusion

This chapter has shown that, in contrast to the British tradition, but in keeping with the American and continental European experience, the majority of Brazilian engineers, independently of holding managerial positions, are engaged in supervisory activities within organizations. They supervise not only technicians but also other engineers, other professionals, manual and white-collar workers.

The characteristic of the labour force supervised by engineers, is related to the nature of activities they have in the company. Those who work in production have more manual workers under their direct supervision, while those linked to technical activities have technicians and those who perform technical activities in offices supervise clerical workers too.

Our analysis of the work situation and class position of engineers shows that, although engineers perform the capital function (supervision and control of the labour process), they are also salaried professionals, who are highly dependent of organizational employment. Their place in the labour process (coordinators and controllers) and their economic condition (salaried professionals), are consistent with the definition of the "new middle class" thesis of what characterizes the "new middle class" of capitalist societies. Thus, we can argue that INTCO and NATCO engineers are part of a "new middle class", as described by new middle class theorists (Poulantzas, 1975; Carchedi, 1977; Wright, 1985). This conclusion is also consistent with the view of the engineers themselves in relation to their place in the Brazilian class structure. It was found that 97.37 per cent of the engineers consider themselves part of the "new middle class", while only 2.63 per cent of them regarded themselves part of the "working class.

The engineers involvement with supervisory or managerial activities does not create major problems of compatibility between professional values and business values, as argued by the "Professionalisation Thesis" and some branches of the "New Working Class Thesis". On the contrary, the majority of the engineers felt pleased with their business activities. A combination of technical and supervisory activities seems to be what the engineers want to do in their profession. Engineers who prefer technical careers are those who believe that their personal abilities are better suited to technical rather than to managerial activities. Those who would prefer a managerial career believe that the two activities are complementary and that management adds to a technical career. Thus, engineers consider their personal abilities and personal needs more important than the professional values embodied in the profession, as the starting point to their career choice.

A managerial career also gives more professional recognition, status, prestige and the possibility to increase power and participation in the organization, than remaining as an engineer does. The findings lend no support to the assumptions that professional values conflict with managerial activities. On the contrary, management works as an alternative to enrich the technical activities. Engineers are easily integrated into the company's schemes as stated by

Goldner and Ritti (1967). Engineers also see management as a symbol of success for their career, as argued by Noble (1971). Technical and managerial activities are also seen by engineers as very compatible with the engineering profession, as argued by Thorstendahl (1982) and Perucci and Gerst (1969). Management is also a way through which engineers can achieve more control over technical resources and improve their participation in the inner questions of the firm, as argued by Galbraith (1967)

Supervision and management have different meanings for the engineers - as it also has in the management theories. Supervision is seen as a task necessary to make workers do what the company wants them to do, while management means to supervise and to have a voice in the running of the company.

Supervisory activities do not lead engineers to feel part of management, because engineers exercise only technical supervision. The feeling of being part of management is based on the degree of participation, authority and autonomy engineers enjoy in the company. Management is also associated with the idea of having a voice in the inner questions of the company. It also involves the idea of autonomy and authority to decide about the professional life of other employees.

The feeling of being part of management is affected by the engineers' hierarchal position. Junior engineers hardly see themselves as part of management, while those in higher positions, like Chiefs of Department, strongly feel part of management.

The engineers' commitment to technical or managerial careers, is linked to the usefulness of such a career to improve personal resources. Engineers, independent of their position in the hierarchy, would prefer to work for themselves instead of investing their life in a career developed by the company. Their main commitment is with a better way of improving their standard of living. To be an expert or a manager does not matter too much. Engineers have invested their life in a company as a means for survival. They have oriented their career according to the opportunities the environment offers, and many, if they had a chance, would leave the company to set up a personal business.

The chances open to the engineers interviewed, up to now, have been to be salaried professionals of profit making organizations. The absolute majority of them depend exclusively on their salary to survive and do not have any meaningful complementary source. Thus, their condition as salaried professionals is confirmed. This is not a new phenomenon. As Meiksins and Smith (1992) have argued, engineering is a typical organizational profession. As such engineers, while professional, cannot survive without organizational employment.

My conclusions confirm various Western writers' view of the career orientation of engineers, their integration into the business values, and their middle class position. The case of the British, the French and the American engineers studied by Whalley (1986), Crawford (1989), and Zussman (1985), respectively, is a typical example of this model of class analysis. All these writers assume that engineers are part of a "new middle class" as they enjoy different employment and work conditions.

However, to the extent that they remain fully dependent on their salaries to survive, the ambiguity of their class position is highlighted. As Carter's (1985:66) interpretation of Carchedi's (1977) work demonstrates, even when professionals are on the side of capital, they are both exploiters (oppressors) and oppressed. Since the global function of capital is not necessarily dominant, their fundamental role is not necessarily that of exploiters or oppressors. This ambiguity is manifest in the class division within the engineering occupation in Brazil, which is expressed in the politics of the Council of Engineering and the Engineers' Trade Unions, in their alliance and political orientations, in their relationship with the working class and in the engineers' self location in the class structure. This ambiguity is also an important reason why some engineers have avoided union membership, while others, like other workers, have organized themselves into Unions in order to struggle for better salaries and working conditions, as I will discuss in the next Chapter.

11. COLLECTIVE ORGANIZATION

1. Introduction

Much of the literature on engineers and trade unionism "assume that engineers are part of management or the natural allies of management and therefore unlikely to be associated with labour unions" (see Meiksins and Smith 1992:137). Moreover, "professional ideology and professional forms of organization are seen as antiethical to unionism; those occupations which define themselves as "professional" eschew unionism as incompatible with their ethical principles, social status and employment conditions" (ibid, p. 137). However, I agree with Smith and Meiksins when they argue that, these assumptions are only partially true, because "engineers as salaried workers share with other employees many of the uncertainties of waged labour, and in many countries have sought economic protection through labour unions, rather than professional associations or individual deals with their employers". Thus, their experience as employees does place unionism on their agenda (p.137). In fact, this chapter reveals that, in Brazil, engineers are organized in professional associations for the purpose of labour market control and status issues, but that they also have had to unionise in order to protect their material interests in the workplace. It shows that professionalism is not incompatible with unionism, as argued by Meiksins and Smith, but rather this represents only different ways to approach the same profession.

This chapter starts with an examination of the evolution of the engineers professional associations and trade unions in Brazil. It then focuses on the involvement of INTCO and NATCO engineers with the Engineering Council - CREA\MG, and the Engineers Union - SENGE\MG, and on the extent to which they legitimate these institutions as representatives of their interests. Special emphasis is given to the factors that have facilitated or prevented engineers from being involved with their professional association and trade union.

2. Brazilian Engineers and Professional associations

The first engineering association, the **Clube de Engenharia** (Engineering Club), was created in 1880, in the Rio de Janeiro district. At the time the district was the capital of the country, and the region with the largest concentration of engineers. The club was created by engineer entrepreneurs and self-employed engineers, as a meeting point for engineers, industrialists and manufacturers. It also aimed to help business and, at the same time, become a venue for debating and clarifying technical questions. The late 19th century also saw the creation of the Instituto de Engenharia (Engineering Institute), in the Sao Paulo district. The Institute was also created by engineer entrepreneurs, with similar objectives. The "Clube de Engenharia" of Rio de Janeiro, and the "Instituto de

Engenharia" of Sao Paulo, were the only engineer associations until the early 1930s, when the Council of Engineering (CONFEA/CREAs), and the first Engineers' unions (SENGEs) were created (Simoes 1989:82-84).

2.1 The Council of Engineering

The **CREAs** (Conselhos Regionais de Engenharia, Arquitetura e Agronomia or Regional Councils of Engineering, Architecture and Agronomy) were created in 1933, during the Vargas Government, to control entry to, and the exercise of, the profession. The CREAs are organized at state level and their national level association is the **CONFEA** (Conselho Federal de Engenharia, Arquitetura e Agronomia or, Federal Council of Engineering, Architecture and Agronomy). Before the CONFEA/CREA system was created, the engineering profession was legitimated and controlled by Federal Decree. The Decree 3001 of 08/10/1880, the first related to the profession, established that, Brazilian engineers who had graduated abroad and foreign engineers had to register their diploma in Brazil, to obtain the right to practice in the profession. In 1924, the Law 4,793 was passed to licence engineers, only those Brazilian or foreign graduate engineers, who had had their diploma registered according to Brazilian law could practice (CREA\MG, 1990:2)

The Decree 25,569 of 11/12/1933, which created the CONFEA/CREA System, established that the exercise of the professions of engineering, architecture, and surveying, would be restricted to engineers who had graduated in courses recognized by the Ministry of Education, and to those engineers who already had their diploma recognised by Federal Law. Moreover, to obtain the right to exercise in their profession, these engineers had to register their diploma with the Ministry of Education and the CREA responsible for the region where they intended to practice (CREA\MG, 1990:24). The functions of the CREAs, as licensing institutions, have changed little since they were created, but their sphere of control has widened to include other professions related to engineering.

Thus, in contrast to the American and British engineering associations, which have not endorsed the "medical model" of professionalism, with its emphasis on self-employment and professional independence (Meiksins and Smith 1992:139), but closer to the Canadian case (Lee, 1992), in Brazil, the CONFEA/CREA system has tried to promote engineering as a liberal profession, similar to medicine and law. One explanation for this, is the fact that, until the 1930s, Brazilian engineers experienced independence and self-employment. Therefore, the elitist education system was oriented towards preserving social status and privileges for a minority group of engineers from middle and upper-class origins (chapter 5). As a result, the first engineering associations (the Clube de Engenharia and the Instituto de Engenharia) were created by these self-employed and engineer-entrepreneurs, of bourgeois origin. Their ideology was perpetuated by their followers, who passed to control the CONFEA/CREA system and the engineers' unions, which were created from the early 1930s until the late 1970s. Thus, it is natural that these ideological groups would try to promote engineering as a liberal profession, not only to preserve the status and privileges that they once enjoyed, but also to promote "professionalism" as apparently incompatible with unionism, to avoid the development of a union culture within the profession, as in the America case (see Meiksins and Smith, 1992:148-149). However, the CONFEA/CREA system has been relatively unsuccessful in its task of promoting engineering as a liberal profession, and preventing a union culture developing within the profession. With the capitalist development from the 1930s onwards, engineering consolidated its position as a typically organizational profession (chapter 5). This transition in the profession resembles the German case (see Gispen 1990). In Germany, engineering was initially based on a very elitist academic education, which served the interests of an elitist "professorate" rather than the interests of industrialists. However, the capitalist forces proved stronger, and this elitist "professorate" had to surrender and adapt the engineering education system to the interests of the business sector (p.10). This analysis leads us to conclude that, in fact, engineers are not liberal professionals (as the professionalization thesis argues) but organizational professionals (as argued by Meiksins and Smith, 1992), as they cannot survive (as professionals) without organizational employment.

Although the majority of Brazilian engineers are salaried employees, the CONFEA/CREAs remains dominated by conservative engineers who, besides being tied to the idea that engineering is a liberal profession, are strongly linked to the employers of engineers (Simoes, 1989). Thus, like the British and American engineering associations (Meiksins and Smith 1992:141), the CONFEA/CREA system has never exhibited much willingness to represent engineers in disputes over material issues. As a result, engineers have been frustrated in their search for protection by the CREAs, and consequently have needed to unionise in order to defend their interests. Thus, Meiksins and Smith (1992) are right when they argue that professionalism and unionism are not incompatible, and that the experience of engineers as salaried employees does place unionism on their agenda.

In fact, whilst Brazilian engineers still enjoyed favourable market conditions, they did not question the legitimacy of CREA to represent their interests, because they had never needed its protection. However, like their American and British counterparts, who during periods of economic hardship were unsuccessful in their search for protection by their engineer's associations (Meiskins and Smith 1992:150-151), Brazilian engineers too, were unsuccessful in their search for CREA protection during the recession of the late 1970s and early 1980s (Simoes, 1989). As CREA did not respond to their demands, the conflict of interests emerged within the profession. As a result, these engineers sought protection in the existing engineers unions. However the existing unions were also controlled by conservative engineers linked to the CREAs, and the employers. This then led to a long political battle within these institutions, until the more militant rank-and-file salaried engineers were able to assume control over these unions, and make them more legitimate institutions to represent their interests.

3. Brazilian Engineers and Trade Unionism

According to Meiksins and Smith (1992), "timing" and the presence of engineer-managers and engineer-entrepreneurs within the professional community, are very important variables in the history of engineering professionalism and engineers' unionism. In their study of engineers and trade unionism in the United States and Great Britain, these writers found that, where strong professional patterns of recruitment and organization emerged before engineers' unionism began to take root, like in the United States, the development of engineer's unionism was made more difficult, and did not succeed. By contrast, where engineering had not traditionally been highly valued, and where engineers have not been defined as prospective managers, like in Britain, the development of formal university training for engineers emerged relatively late. Consequently, they experienced union forms of organization before professional forms of associations. As a result, they developed a more positive view of trade unionism, and consider professional associations irrelevant for the profession (p.159-161). In relation to the second point, they argued that it has been the brand of professionalism defined by engineer-managers and engineer-entrepreneurs, which has been the official ideology of the organized engineering profession. And, their professionalism has often been particularly hostile to unions.

The history of the engineers' unions in Brazil matches the above theses. The first engineers union in the country - the **SENGE/RIO** (Engineers' Union of the State of Rio de Janeiro), was created in 1931, by self-employed engineers and state employees who also controlled the **Clube de Engenharia** (Engineering Club of Rio de Janeiro). In 1934, the SENGE\SP (The Engineers Union of Sao Paulo) was founded by an important native entrepreneur, who was then the president of the **Instituto de Engenharia** (Engineering Institute), and president of **FIESP**- Federation of Industries of the State of Sao Paulo (Simoes, 1989:90-93). Finally, In 1947 the Engineers' Union of the State of Minas Gerais (SENGE\MG) was also created by engineer entrepreneurs [**1**].

The membership of these unions was composed basically of self-employed professionals and state employees. Due to the nature of their membership, these SENGEs intended to give engineers the opportunity to form a "closed nucleus" with a corporatist character, rather than to be a militant kind of organization (Simoes, 1989:90). As a result, between 1930 and 1980, these engineer unions played a very conservative role, and represented the employers, rather than the salaried engineers interests [**2**].

Like the Councils of Engineering, SENGE/RIO and the SENGE/SP were created by the influence of labour policies of the Vargas government, rather than by the interest of the engineers themselves. It was period of rapid political, economic and social transformation in the country. The government of Getulio Vargas, which took office in 1930, aimed to promote economic development through industrialization. This implied the formation of a large urban working class, already in development since the late 19th-century. The working class which had emerged in the previous fifty years was relatively strong and had managed to make their trade unions more or less independent organizations, protecting the wages and working conditions of their members (Humphrey, 1982:13). In order to control the labour movement, the early Vargas government (1930-1936) reformulated the Labour Laws and the trade unions were recognized as legitimate institutions to represent the working class interests (Ibid.pp.13-14). Thus, conservative engineers who controlled the profession, preferred to facilitate the formation of engineers unions under their own leadership, as a preventive measure. As unionism was favoured by the government, it was likely that the new generation of engineers who would enter the labour market as salaried employees, would set up their own militant unions under influence of the "Left" which, according to Humphrey (1982:13), was strong in the country, at the time.

However, for nearly 50 years, these engineers' unions (SENGE/RIO, SENGE/SP, SENGE/MG) could be said to be non-existent, because they played a conservative role, besides representing the employers rather than the salaried engineers interests. Various factors contributed to their passivity. Firstly, between 1930 and 1964 there were few salaried engineers in the country, so those that existed enjoyed relatively favourable market conditions (see chapter 3). Secondly, after the creation of new labour system in the 1930s, by the Vargas government, which was later consolidated in the Consolidacao das Leis do Trabalho (CLT), trade unions remained under the control of the Ministry of Labour for nearly 50 years. To be recognized unions had to be subordinated to the government aims. Thus, they could not be either political or too militant because they could be closed by the government. Although this new labour system granted some protection to labour, it was made at the expense of any freedom of action (Humphrey, 1982:13-16). Finally, although the number of salaried engineers increased enormously during the 1960s and 1970s (Chapter 3), trade unions were kept under the direct and strict control of the military dictatorship (1964-1978). Union officials were appointed by the government, and salary and working conditions were established by Federal Decree or by the Ministry of Labour. As a result, labour unions lost their functions (Boito Jr, 1991:46-47).

The engineers' unions, like other unions in the country, were reorganized only from the late 1970s, under the influence of a new generation of militant trade unionists interested in breaking away from the old labour system (subordinated to the State) in favour of a new and more independent system of industrial relations (Humphrey, 1982). In reaction to the discontentment with the military regime and with the degradation of the social and economic conditions of the "middle classes", and the working class in general, these militant workers (Lula, for example) were able to mobilize the working class and force the government and their employers to make concessions (Boito Jr., 1991:47-59). As a result, the labour movement spread around the country. The successful struggle of metalworkers Unions of "ABC" (the largest industrial region of Sao Paulo), in the late 1970s, stimulated militancy in all sector of organized labour. Under the influence of this new unionism, salaried engineers, like other sectors of qualified labour (doctors, professors, and civil servants (Boito Jr., 1991:45), were able to transform their conservative unions and create new ones, all around the country, in order to defend their interests [3].

Although Brazilian engineers became salaried employees later than those in developed nations, and the political environment did not favour unionism in the country until the late 1970s, engineer unionism in Brazil progressed enormously in the 1980s, and was more successful than in Canada (Lee, 1992) and the USA (Meiksins and Smith, 1992). Rates of unionisation among Brazilian engineers are now closer to many developed nations, such as England and France, where labour unions have historically been strong. In 1991 Brazil had nearly 500,000 engineers, 30.00 per cent of which were union members, compared to 27.6 percent in England (McCormick, 1992:65), and 29.00 per cent in France (Crawford, 1989:18). Canadian engineers rejected unionism in favour of professionalism in order to increase power and social prestige, and as result, only isolated unionisation is found among their number (Lee, 1992:118-119), perhaps because these engineers have not yet faced economic hardship. In the USA, the failure of unionism among engineers was greater, and there is no indication in the more recent work in the subject (Meiksins and Smith, 1992) of engineers being unionised nowadays.

In 1992 there were 25 SENGEs (Sindicato de Engenheiros or Engineers Unions) organized by state, that is, there was one SENGE in each of the Brazilian states. At the national level, these 25 SENGES were organized into two federations - the **FNE** (Federacao Nacional de Engenheiros or National Federation of Engineers), and **CONSENGE** (Coordenacao Nacional de Sindicato de Engenheiros or National Coordination of Engineers Unions). The formation of the two national federations was a consequence of political and ideological divisions among engineers. The 13 left-wing SENGEs, which see engineers as workers, are affiliated to **CONSENGE,** and the 12 more conservative SENGEs, which see engineers as liberal professionals, are affiliated to the **FNE**. [4]

These political and ideological differences are also highlighted in the relationship between the engineers unions and the two Workers Confederations - the **CUT** (Central Unica dos Trabalhadores or Unique Central of Workers) and the **CGT** (Central Geral dos Trabalhadores or Central General of Workers). These two confederations have opposing political approaches to the form of organization of the working class. The **CGT** supports a centralised form of organization, whereas the **CUT** advocates "decentralisation" and actively supports the workers' organization at the workplace (Simoes, 1989:143; Boito Jr. et.all.1991). Therefore, the **CUT** is left-wing, while the **CGT** is more centre-left (Boito Jr. 1992).

As a result of these divisions, the 13 SENGEs who are affiliated to **CONSENGE,** support the politics of the CUT, which also supports the Workers Party (PT). The other 12 SENGEs, who are affiliated to the conservative **FNE,** supports the CGT, which has some affection for the PMDB (the largest centre-left political party in the country) **[5].**

However, it is argued by engineers' unions, that whether they are a CGT or CUT member or not, makes little difference. They think that the knowledge of engineers, can be used to the benefit of the trade-union movement as a whole. Their task should be to inform the benefits and consequences of all technological changes, for the whole society.

The Engineers' Union of the State of Minas Gerais (SENGE/MG), which represents INTCO and NATCO engineers, is one of the thirteen SENGEs which see engineers as workers, and is affiliated to CONSENGE. Thus, it also supports the CUT's politics and the Workers Party (PT).

In short, my analysis of the evolution of the engineers unions in Brazil, shows that the SENGEs are lead by engineers with different economical, political and ideological orientations. These oscillate between the "left" and the "centre-left". Consequently, these political orientations affect the way these unions approach both capitalism, the working class and the engineers themselves. As Meiksins and Smith (1992) have argued, the way the labour movement approaches engineers also affects the success of unionism within the profession. Consequently, the engineers themselves, based on their social origin, ideology, political beliefs, and market situation, may react to these two forms of union politics in different ways. Thus, it is likely that if unions and engineers have a similar orientation in these aspects, then unionisation among engineers is likely to be greater. By contrast, if union politics are contrary to the engineers political and ideological orientations, they are likely to see these unions as inadequate to represent their interests.

Thus, in the light of the debate over the evolution of the engineers' professional associations in Brazil, and on the theoretical framework underlining this analysis, the following sections examine the experience of INTCO and NATCO engineers with their professional association (CREA/MG) and the engineers union (SENGE/MG).

4. Engineers, Trade Unionism and Professional Association: the Case of INTCO and NATCO Engineers

This section is organized into two sub-sections. The first examines the relationship of INTCO and NATCO engineers with the CREA/MG, and the extent to which these engineers legitimate the CREA as their representative institution. The second focuses on the involvement of these engineers with the Engineers' Unions (SENGE/MG), and on the factors which have facilitated and prevented their participation in these unions.

4.1. The Legitimacy of the CREA by INTCO and NATCO Engineers

The professionalization thesis asserts that professionals are more likely to identify themselves with their counterparts of the same profession, due to their long period of training in similar technical issues. Such a long training period and technical background are likely to develop, in these professionals, a high level of occupational solidarity and association. As the professional associations assume the responsibility for controlling entry to, and the exercise of the profession, they can control the labour market for its members. By doing so, such professional associations are able to protect the privileges and interests of their members.

The case of INTCO and NATCO engineers, lend no support for this thesis. TABLE 11.1 shows that a hundred per cent of the engineers interviewed did not legitimate the function of the CREA/MG, and only pay the CREA's annual fees because they are obliged to by law. Therefore, 41.20 of the total sample considered the CREA/MG a useless institution. Some 14.00 per cent saw CREA as an institution concerned only with charging fees. Another 29.00 per cent recognised that the CREA only performs its function of controlling entry to, but not that of the exercise of, the profession. Only 15.00 per cent of the engineers saw that the CREA performed the functions for which it was created. Only 4.50 per cent also thought that CREA was useful in giving technical advice, while 4.40 per cent only found it useful in the inspection of civil engineering activities. Another group of 6.10 per cent reduced CREA's function to the emitting of Professional Cards. Finally, CREA's reputation was a little worse in the view of INTCO engineers, since 52.0 per cent of them saw CREA as a useless institution, against 34.20 per cent of NATCO engineers. In short, the majority of the engineers interviewed saw CREA as an irrelevant institution.

TABLE 11.1 -THE INTCO AND NATCO ENGINEERS's VIEW OF CREA's UTILITY (Per cent of the total sample by company)

Categories of utility	Companies		
	INTCO	NATCO	Total
It is useless to me	52.20	34.20	41.20
It is concerned only with charging fees	20.40	10.00	14.00
Useful as a licensing institution	11.30	2.80	6.10
Useful to inspect the exercise of the profession	9.00	18.60	15.00
Useful to regulate the profession	2.20	47.10	29.80
Useful only for civil engineering	6.80	2.80	4.40
Useful to give technical advice	4.50	----	4.50
Useful to protect the engineer's interests	11.40	17.10	15.00
	N=44	N=70	N=114

Note: Columns total to more than 100 per cent due to multiple responses (see question 38, Appendix 1).

The performance of the CREA and its relationship with its members has also been strongly criticised. TABLE 11.2 shows that for 13.10 per cent of the engineers, the CREA/MG does not perform its function at all, and has no interest in the demands of engineers. For another 8.80 per cent of engineers, the CREA/MG is a very elitist institution concerned only with charging professionals and engineering companies. A smaller percentage (3.50%) said they only pay the fees because they are obliged to by law, while 1.70 per cent of believed that only the Engineers Union should exist - SENGE/MG, because the CREA was a "failed institution".

TABLE 11.2 - THE INTCO AND NATCO ENGINEERS's CRITICISM OF CREA

Main critics	N=	Percentage (N1)	Percentage (N2)
It does not perform its function, does not have interest in its members' demand, but should do it	15	44.10	13.10
It is a very political and elitist institution seeking only profits	10	29.40	8.80
It is not necessary for the company	3	8.80	2.60
If I could I would not pay the fees	4	11.80	3.50
It is a failed institution. There Should be only the Engineers Union	2	5.90	1.70
	N=34	100.00	

Note: 1) Percentage (N1) refers to the number of respondents making that category one variable;
2) Percentage (N2) refers to the number of engineers who gave the same response in relation to the total sample
3) Source: see question 38, Appendix 1.

As the CREA is responsible for controlling entry to, and the exercise of all professions related to engineering, each of them with a different status and prestige within the technical hierarchy of knowledge, it was also necessary to examines how engineers deal with this issue. TABLE 11.3 shows that 21.90 per cent of the engineers were in favour of the idea that the CREA should only represent engineers, because technicians and technologists are only used by the CREA to increase the number of voters. Conversely, 42.10 per cent of them were against this idea because they thought the content of the work performed by technicians, technologists and engineers was almost the same. For 10.50 per cent of the engineers, it did not matter what happened to the CREA because they had no relationship with the institution, other than to pay its fees. Finally, 25.40 per cent of the engineers did not yet have a clear position on this matter. In short, this issue in debate did not matter for 36.80 per cent of the engineers. This illustrates the lack of involvement and interest in the CREA's activities. In fact, a NATCO engineer mentioned that "the relationship of ninety per cent of the engineers with the CREA is based on paying annual fees", only.

TABLE 11.3 - THE ENGINEERS OPINION IN RELATION TO RESTRICT THE RIGHT TO BE A CREA's MEMBER ONLY TO ENGINEERS (Per cent)

	Companies		
Opinions	INTCO	NATCO	Total
In favour of restriction	15.90	25.70	21.90
Against restrictions	45.50	40.00	42.10
Indifferent	9.00	11.40	10.50
Without position	29.60	22.90	25.40
	N=44	N=70	N=114

Source: Interview data

As the CREA has been seen by engineers as an useless institution to represent their interests, the Engineers Unions' leaders have tried to convince engineers that SENGE is their legitimate institution, the only one capable of defending their interests.

4.2 Unionisation and Politics of INTCO and NATCO Engineers

The case of Brazilian engineers discussed so far, confirms the thesis put forward by Meiksins and Smith (1992), that professionalization is not incompatible with unionisation, and that, as salaried workers, engineers like other workers, have sought economic protection through labour unions, rather than professional associations or individual deals with their employers. The case of INTCO and NATCO engineers provides further support for this thesis. As TABLE 11.4 shows, 50.88 per cent of the overall sample was either a member of the engineers Union (SENGE\MG) or belonged to other unions. The majority of the unionised engineers (84.48%) were composed of engineers in non-managerial positions. About 87.93 per cent of this group was composed of NATCO's representatives. INTCO engineers represent only 12.07 per cent of this group. Finally, 96.00 per cent of the unionised engineers were members of the Engineers' Union (SENGE\MG), with 4.00 per cent belonging to the major Union which represents NATCO's employees (TAB 11.4).

This low rate of unionisation among INTCO engineers and managers is related to the policies of the company. Union membership for engineers, at INTCO, was seen as a serious problem that can undermine career opportunities and end in dismissal. Union activities are controlled at NATCO too, but not like at INTCO. As a result 72.86 per cent of NATCO engineers were unionised (TAB 11.4)

Despite 35.09 per cent of the overall sample not being unionised, this group had a positive view of trade unions. This group I call "potential members". Thus, 85.97 per cent of the engineers were union members or potential members of one kind of union or another. The proportion of engineers and managers in this group of "potential members" is roughly the same (TABLE 11.4).

Finally, 14.04 per cent of the total sample had a negative view of trade unions and did not intend becoming union members in the future. Within this group, 62.50 per cent were managers and 37.75 per cent were engineers. Two-thirds of the INTCO representatives who would never become a union member were managers, while at NATCO, they were divided half and half, between engineers and managers. Moreover, two-thirds of this group were INTCO's representatives (TAB 11.4).

TABLE 11.4 - UNION MEMBERSHIP AMONG INTCO AND NATCO ENGINEERS AND MANAGERS

	Companies								
	INTCO			NATCO			TOTAL		
	Eng.	Manag.	Total	Eng.	Manag.	Total	Eng.	Manag.	Total
Members	15.91	0.00	15.91	60.00	12.86	72.86	42.98	7.89	50.88
N=	(7)	(0)	(7)	(42)	(9)	(51)	(49)	(9)	(58)
Potential members	22.73	34.09	56.82	12.86	8.57	21.43	16.67	18.42	35.09
N=	(10)	(15)	(25)	(9)	(6)	(15)	(19)	(21)	(40)
Hostile	9.09	18.18	27.27	2.86	2.86	5.71	5.26	8.77	14.04
N=	(4)	(8)	(12)	(2)	(2)	(4)	(6)	(10)	(16)
Total	47.73	52.27	100.00	75.71	24.29	100.00	64.91	35.09	10000
N=	(21)	(23)	(44)	(53)	(17)	(70)	(74)	(40)	(114)

Notes: 1) Differences between INTCO engineers and managers significant at the 0.01 level X^2, (x^2=9.262, P<0.01).
2) Differences between NATCO engineers and managers not significant at the 0.05 level X^2, (x^2=4.675, P>0.05).
3) Differences between engineers and managers for the overall sample significant at the 0.005 level X^2, (X^2=20.357, P<0.005).
4) Differences between companies significant at the 0.005 level X^2, (x^2=35.812, P<0.005).

It was also found that 82.15 per cent of those who were not unionised, had never been a union member in the past. When compared to the number of engineers and managers who have never been a Union member, no significant difference was found between the two groups.

TABLE 11.5 - EXPERIENCE WITH UNION MEMBERSHIP IN THE PAST AMONG INTCO AND NATCO ENGINEERS AND MANAGERS

	Non-members only					
	Membership in the past		Non-membership in the past		Total	
	N=	%	N=	%	N=	%
Engineers	6	10.71	19	33.93	25	44.64
Managers	4	7.14	27	48.22	31	55.36
Total	10	17.85	46	82.15	56	100.00

Notes: 1) Differences between engineers and managers not significant at the 0.05 level x^2, (x^2=0.528, P>0.05).
2) Fisher Exact Probability: Lower Tail = 0.9233, Upper Tail = 0.2332 (P>0.05)

The reasons why some engineers and managers have been less involved with union activities will be discussed in more detail in the next section, but an initial explanation is the fact that in order to be promoted they have to prove their loyalty to the company. As a Chief of Department commented:

> "I was a SENGE\MG member, but I left because in my position it is not accepted by the company. My role in the company is to represent capital. However, if I left the managerial position and became an engineer, I would join the union again".
>
> (A NATCO Chief of Department)

Therefore, this group seems not to be unionised because they are more controlled by their companies, not because they are hostile to membership. As Whalley (1986:161) has argued, attitude is more important than membership in analyzing union activity among professional workers. In fact the attitude of INTCO and NATCO engineers to trade unionism follows a different pattern. As TABLE 11.6 shows, a great proportion of engineers (43.11%), independent of their position or company, find Trade Unions useful for representing the interests of any type of employee. Some 37.72 per cent of the engineers and managers found that Trade Unions were not a good alternative for directors and senior managers. The remaining 20.18 per cent of them found that Trade Unions were good for everybody, except directors, managers and supervisors. Nobody said that engineers should be excluded from Union representation. The view that Trade Unions are a good alternative for only manual workers, did not find support among the engineers. In short, the majority of the engineers have a positive view of Trade Unionism.

TABLE 11.6 - THE UTILITY OF UNIONS IN THE VIEW OF INTCO AND NATCO, ENGINEERS AND MANAGERS (Total by company)

	Companies					
	INTCO		NATCO		TOTAL	
Categories	N=	%	N=	%	N=	%
Union important to all employees	21	18.42	27	23.68	48	42.11
Everybody, except Directors and Senior Managers	13	11.40	30	26.32	43	37.72
Everybody, except Director, managers and supervisors	10	8.77	13	11.40	23	20.18
Total	44	38.59	70	61.41	114	100.00

Note: 1) Differences between companies not significant at the 0.05 level X^2, (X^2=2.038, P>0.05). See question 48, Appendix 1.

4.2.1 Why Engineers are Unionised

It was found that 82.76 per cent of the unionised engineers had joined a union because they believed that through a collective representation they could achieve better results in the struggle for their interests. Only a small proportion of them (13.79%), were members because it was cheaper for them to pay the annual fees for their Unions, than to have a day's salary discounted annually by the Ministry of Labour (TAB 11.7). This is so because according to the CLT (Consolidated Labour Laws) professional workers who do not have their own unions, or who decide not to pay the fees either to their own unions or to the National Confederation of Liberal Professionals, nevertheless have to pay the equivalent to one day's salary a year to the Ministry of Labour, to fund the system of labour courts which will protect them in capital/labour relations. Boito Junior (1991) refers to this as 'State Syndicalism'. It remains a hangover from the labour capital laws of the Vargas Government.

In summary, unionised engineers have enough justification for their decision to be a union member. However, we are still left with a great number of engineers who are not yet unionised. How can we account for this?.

TABLE 11.7 - REASONS FOR JOINING A UNION

	Union' members by Company, only					
	INTCO		NATCO		Total	
Main reasons	N=	%	N=	%	N=	%
Collective representation is the best way to defend our interests	2	28.57	46	90.20	48	82.76
Influenced by colleagues	0	0,00	2	3.92	2	3.45
It is cheaper to pay the annual fees for our Union than to Ministry of Labour	5	71.43	3	5.88	8	13.79
Total	7	100.00	51	100.00	58	100.00

Source: interview data.

4.2.2 Why Engineers are not Unionised

The explanations for engineers not being unionised, lie in three basic variables: **management control**, **political involvement** and the **radical position assumed by the Unions**. As TABLE 11.8, shows, two-thirds of the non-unionised engineers are from INTCO. INTCO engineers have complained strongly about the inability of the SENGE\MG to deal with the company's top management. In their view, as both the SENGE\MG and the management at INTCO are too radical, they do not manage to achieve any agreement. Although they know that the SENGE\MG has been active in other sectors, at INTCO, it has not managed to penetrate in negotiations. Consequently, the SENGE/MG has proved useless for INTCO engineers. Furthermore, INTCO engineers are asked not to participate in union activities, and instances where they do participate, can undermine their career in the company or end in dismissal.

In short, managerial control, the incapacity of the SENGE to make itself useful for potential members, and the political radicalism of the SENGE/MG, are the three main variables which have prevented INTCO engineers, and some NATCO engineers, from being unionised.

Managerial control is the most influential of these variables. Where managerial control is lighter, engineers have the freedom to decide to join a Union of their preference or not, as at NATCO. Conversely, where it is extremely rigid, as at INTCO, even though engineers have a positive attitude to trade Unions, they can damage their career if they join them or become militant membership. Thus, Meiksins and Smith (1992) are right when they argue that, where there is a strongly anti-union culture and militantly anti-union managers, the labour movement will be placed on the defensive.

TABLE 11.8 -REASONS FOR NOT JOINING A UNION

	Non-members by Company, only					
	INTCO		NATCO		TOTAL	
Main reasons	N=	%	N=	%	N=	%
Union does not attend our interest in the company	1	2.70	5	26.32	6	10.71
Union too political and radical	8	21.62	13	68.42	21	37.50
Union too weak to deal with the company	15	40.54	3	15.79	18	32.14
Union is not good for managers	0	0.00	2	10.53	2	3.57
Don't believe in Union	6	16.21	0	0.00	6	10.71
Management forbid membership	37	100.00	0	0.00	37	66.07
	N= 37		N=19		N=56	

Note: Columns sum to more than 100 per cent due to multiple responses (see question 46.3, Appendix 1).

The incapacity of the Union to make itself useful for its potential members, is the second most important variable to prevent unionisation. As managerial control at INTCO is very rigid, the Union cannot represent the interests of engineers because it represents few engineers in the company. As a result, engineers do not find any reason to be unionised. Consequently, management control undermines both Union action and the engineers interest in becoming a union member, at the same time.

Finally, political radicalism is inadequate for an environment where management is more democratic, as at NATCO. As the company accepts Union activities in a more negotiable way, some engineers and managers see the radical union as inappropriate to negotiate with top management on their behalf. Thus, they have tried another way to protect their interests within the company, that is through a kind of "managers association". I will be talking about this later in the Chapter. These findings support our position that professionalism and unionism are not incompatible. The case of NATCO engineers has demonstrated that, in fact, the only way professionals have found to protect their interests in capitalist organizations, is to join any sort of association that they find most helpful. To struggle alone, or negotiate directly with the employer, is no longer viable in large organizations. This also indicates that those engineers who are presently linked to the "managers association", might also join the Engineers Union if it changed its tactics in dealing with top management.

Those **hostile to membership** stated that they would never join a Union, because Unions are in general too radical and are not interested in representing their specific interests (TABLE 11.9). However, it is likely that if Unions managed to negotiate in a more appropriate manner, this group might also change its attitude towards the role of Unions in dealing with large corporations.

In summary, the political radicalism of unions, management control and the weakness of the Unions to represent technical labour in a hostile managerial environment, are the main variables that have prevented roughly fifty per cent of the overall sample of engineers (56 out of 114, see TABLE 11.8) from becoming Union members. In the following sections I will be analyzing how such variables affect unionisation.

TABLE 11.9 - REASONS FOR NOT JOINING A UNION

Main Reasons	Hostile to Membership only, by Company					
	INTCO		NATCO		TOTAL	
	N=	%	N=	%	N=	%
Unions are too political and unprofessional	6	50.00	4	100.00	10	62.50
Don't believe in unions for professionals	6	50.0	0	0.00	6	37.50
I am against Unions for managers because managers represent capital	0	0.00	2	50.00	2	12.50
Unions are too weak to deal with personal interests	2	16.66	3	75.00	5	31. 5
	N=12		N=4		N=16	

Notes: Columns add to more than 100 per cent due to multiple responses

4.2.3 A Union for Managers

As mentioned earlier in this Chapter, the need for collective representation is not a privilege of the engineers only. NATCO's top management also find it very important to have a form of association to represent them in the company. As one of them stated:

> "Chiefs of Department and those above have a kind of "union" in the company that we call **AIC** (Interdepartmental Association of Chiefs) to represent our interests. The main objective is to strengthen our position to defend the Chiefs' work situation, to make the company respect our decisions and our reputation".
>
> (A NATCO Chief of Department)

My interviews with other "**AIC**" members, led me to conclude that this organization intends to defend managers against political interference, which has attempted to distort the company's objectives for political purposes. This situation arises because NATCO is state-owned. Despite **AIC** being different from the traditional Unions, it also aims to struggle for better working conditions, and improved status, prestige and power for the company's top managers. This also suggests that despite managers being the company's representatives, they are aware that they are under the control of share-holders, and carry the risk of having their career undermined by political and economic interests.

In short, the condition of any employee, be they managers, professionals or manual workers, is subordinated to the highest interests of the corporation. What is different for each sort of professional, is the characteristics of the problems they have to face and the working conditions they enjoy in the company. However, the condition of being an employee, is very similar for all workers, in any sort of enterprise. All workers are subjected to the possibility of being discharged by the company at any time it finds necessary, in defence of its interests of attaining the highest profits possible. Once all workers, independent of their hierarchical position, perceive such threats, they will seek a more consistent way of struggling for their interests. It does not matter what kind of "union" or "association" it is. What matters is whether such institutions can represent the interests of different groups.

The reasons why different groups of workers join Unions also depends on their work situation, their political and social ideology, and on the degree of control they are subject to in the corporation. I will be explaining these factors in the following sections.

4.2.4 Relationship between Managerial Control and Unionisation and Militancy among Engineers

I have argued throughout this Chapter that managerial control is the critical variable in preventing unionisation. In this section I shall prove this assertion. As TABLE 11.10 shows, where managerial control over union activity is particularly high, the proportion of unionised engineers is much lower than that of non-unionised engineers. Where managerial control is moderate or low, the proportion of unionised engineers is much higher than that of non-unionised engineers. Thus, unionisation is highly dependent on the level of management control.

TABLE 11.10 - RELATIONSHIP BETWEEN CONTROL OVER UNION ACTIVITY AND Unionisation AMONG ENGINEERS (Total sample)

Degrees of Control by management	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
High control	14	12.28	34	29.82	48	42.11
Moderate control	25	21.93	11	9.65	36	31.58
Low control	19	16.67	11	9.65	30	26.32
Total	58	50.88	56	49.12	114	100.00

Note: 1) Both differences significant at the 0.005 level X^2, (x^2=15.881, P< 0.005).
2) Source for degrees of control: see question 53.1, Appendix 1.

It is also noticeable that the level of managerial control has consequences for the individual and unionisation, and is absolutely associated with the consequences or risks it brings to the individual who decides to become a Union member. As TABLE 11.11 reveals, the proportion of engineers who perceive that their career can be profoundly undermined due to union membership and who are not unionised (69%) is much higher than the proportion of those who perceive high risks but are still unionised (31%). In fact, the proportion of unionised engineers increases as the consequences of membership diminishes. As we see, 70.00 per cent of those who perceive that their career can be undermined to a "certain extent", and 58.00 per cent of those to whom to be a union member could undermine their career "very little" are unionised. Thus, Meiksins and Smith (1992) are right when they say that an environment hostile to union activities does undermine unionisation.

TABLE 11.11 RELATIONSHIP BETWEEN THE PERCEPTION OF CONSEQUENCES FOR BEING UNION MEMBER AND RATES OF Unionisation AMONG ENGINEERS AND MANAGERS (Total sample)

Do you think that being a union member could undermine you career?.	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Profoundly	18	15.79	37	32.46	55	48.25
To some extent	33	28.05	14	12.28	47	41.23
Very little	7	6.14	5	4.39	12	10.53
	58	50.88	56	49.12	114	100.00

Note: Both differences significant at the 0.005 level x^2, ($x^2$14.547, P<0.005).

The most powerful of these consequences, are the risk of having one's career blocked and dismissal. Thus, the threat of dismissal undermines both unionisation and militancy among engineers and other employees. In fact, TABLE 11.12 shows that support to strike, was greater among those engineers who perceived that their job was secure, than among those engineers who felt their job was insecure.

TABLE 11.12 - RELATIONSHIP BETWEEN SECURITY ON THE JOB AND PROPENSITY TO STRIKE (Total sample)

Categories	Would support a strike		Would not support strike		Total	
	N=	%	N=	%	N=	%
My job is secure	57	50.00	34	29.82	91	79.82
My job is insecure	6	5.26	17	14.91	23	20.18
Total	63	55.26	51	44.74	114	100.00

Note: Both differences significant at the 0.005 level x^2, (X^2=8.498, P<0.005)

The propensity to support a strike, which has been the typical instrument used to express pressure by unions, was highly dependent on the risks engineers perceived in their work environment. TABLE 11.13 shows that 59.00 per cent of those engineers who perceived high consequences (dismissal or block on career mobility) for participating in strikes, would not support such action, against 41.00 per cent who would do so. Conversely, about 64.00 per cent of those who perceived moderate consequences (loss of confidence by the boss) to union activities, would support a strike, against only 36.00 per cent who would not. It is also noticeable, that 52.63 per cent of the overall sample would support a strike under any circumstance, against 47.37 per cent who would not.

TABLE 11.13 - RELATIONSHIP BETWEEN PERCEPTION OF CONSEQUENCES AND PROPENSITY TO STRIKE(Total Sample)

Degree of consequences	Would support a strike		Would not support		Total	
	N=	%	N=	%	N=	%
High consequences	23	20.18	33	28.95	56	49.12
Moderate consequences	37	32.46	21	18.42	58	50.88
Total	60	52.63	54	47.37	114	100.00

Note: 1) Association significant at the 0.025 level X^2, (x^2=5.900, P<0.025).
2) See question 50.1, Appendix 1, for degrees of consequences

4.2.5 Relationship between Proletarianisation and Unionisation

The "proletarianisation thesis" does not assume that proletarianisation makes engineers allies of the working class. However, Ross (1978) has assumed that deskilling and wage reductions makes professionals more disposed to ally with the working class, to defend traditional autonomy and the privileges that they once enjoyed. Gorz (1967) also argues that the powerlessness of working conditions, is likely to increase frustration among professionals, and this frustration is likely to increase militancy among professionals in the same way as that commonly found among traditional workers.

4.2.5.1 Relationship between Technical Proletarianization and Unionisation

The case of INTCO and NATCO engineers does not lend support to the above assumptions. Despite 52.63 per cent of the engineers perform work of a relatively simple nature, this group was split 50\50 between those who are and those who are not unionised. Conversely, the remaining 47.37 per cent who perceived no existence of technical proletarianisation, was also distributed roughly fifty-fifty, between those who are and those who are not unionised (TAB 11.14). No difference was found either between companies or between the perception of proletarianisation and the rates of unionisation of engineers and managers.

TABLE 11.14 RELATIONSHIP BETWEEN THE PERCEPTION OF TECHNICAL PROLETARIANISATION AND Unionisation AMONG INTCO AND NATCO, ENGINEERS AND MANAGERS (Total Sample)

Perception of Technical proletarianisation	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Do not perceive technical proletarianisation	28	24.56	26	22.81	54	47.37
Perceive technical proletarianisation	30	26.32	30	26.32	60	52.63
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences not significant at the 0.05 level X^2, (x^2=0.039, P>0.05).
2) See question 4, Appendix 1, for perception of technical proletarianization.

No association was found either, between the nature of the engineers' work, in terms of the technical or managerial content, and the rates of unionisation, or between the levels of technical autonomy and the rates of unionisation. TABLE 11.15 shows that 85.09 per cent of the engineers enjoyed low levels of technical autonomy, nonetheless, this group is divided roughly fifty-fifty, between those who are unionised and those who are not. Furthermore, two-thirds of those who enjoyed a certain level of technical autonomy are unionised, against one-third who are not. Thus, technical autonomy does not affect unionisation.

TABLE 11.15 RELATIONSHIP BETWEEN TECHNICAL AUTONOMY AND Unionisation (Total Sample)

Levels of technical autonomy enjoyed by engineers and managers	Unionised		Not unionised		Total	
	N=	%	N=	%	N=	%
I decide what I have to do	11	9.65	6	5.26	17	14.91
I decide after consultation to my boss	47	41.23	50	43.86	97	85.09
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences not significant at the 0.05 level x^2, (x^2=0.948, P>0.05)
2) See question 8, Appendix 1, for levels of technical autonomy.

4.2.5.2 Relationship between Objective Proletarianisation and Unionisation

In summary, the only variables related to the concept of "objective proletarianisation" which affect unionisation, are the **control by management** and **job stability**. TABLE 11.16 shows no association between the first eight variables (career opportunities, importance of promotion, satisfaction with the career, external salary equity, internal salary equity, personal salary equity, dependence on their salary and work environment) and unionisation among engineers. No differences were found between the two companies. Unionised and non-unionised engineers were proportionally distributed between those who perceived good, regular or bad career opportunities; between those for whom to be promoted was highly or of little importance; and between those who felt very pleased, pleased or disappointed with their career. They were also proportionally distributed between those who perceived that they earned a higher, the same or lower salary than their counterparts, in the same position both within and outside the company; and between those who felt that they earned a fair or unfair salary for what they do for the company. It was also found that unionised and non-unionised engineers were proportionally distributed between those who had a high or low dependence on their salary to survive, and between those who enjoyed a very pleasant, pleasant or unpleasant work environment. **Control by Management** and **job security**, on the contrary, showed a very significant association with the trends of unionisation among engineers.

TABLE 11.16 RELATIONSHIP BETWEEN OBJECTIVE PROLETARIANISATION AND UNIONISATION AMONG ENGINEERS AND MANAGERS

Variables of objective proletarianisation	Chi-Square	DF	Probability	Significance
1 e v	e		1	-
1) Career Opportunity	4.324	2	0.1151	----
2) Importance of promotion	0.728	2	0.6950	----
3) Satisfaction with career	2.212	2	0.3309	----
4) External salary equity	2.418	2	0.2985	----
5) Internal salary equity	1.581	2	0.4537	----
6) Personal salary equity	0.018	1	0.8925	----
7) Dependence on the salary	0.008	1	0.9271	----
8) Work environment	0.606	2	0.7385	----
9) Control by Management	6.957	2	0.0309	0.05
10) Security on the job	11.303	1	0.00070	0.005

Note: 1) DF = Degree of freedom
2) ------ = Association between variables not significant at the 0.05 level X^2
3) See contingence tables in Appendix 10.

As seen in previous sections, control by management profoundly undermines unionisation. Adding to that, the specific control by management over the daily activities of engineers undermines their chances of unionisation even more. As TABLE 11.17 shows, 6.14 per cent of the engineers were subjected to very flexible supervision, 62.28 per cent to some control by management, and 31.58 per cent to very close and rigid supervision. The consequences of such managerial practices, have been that about two-thirds of the engineers who were subjected to a more flexible supervision were unionised, against only one-third of those under rigid supervision. Thus, the higher the level of supervision by management, the lower the rate of unionisation among engineers. Conversely, the more flexible the supervision by management, the higher the rate of unionisation.

TABLE 11.17 RELATIONSHIP BETWEEN MANAGEMENT CONTROL OVER THE ENGINEERS WORK AND UNIONISATION (Total Sample)

Levels of control	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Very flexible	5	4.39	2	1.75	7	6.14
A little tight	41	35.96	30	26.32	71	62.28
Very tight	12	10.53	24	21.05	36	31.58
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences significative at the 0.05 level X^2, (x^2=6,597, $P<0.05$).
2) See question 21, Appendix 1, for levels of managerial control.

As already shown, the extent to which their job was secure, was another critical variable for the unionisation of engineers. Here I will provide some explanations as to the way such a relationship occurs. Contrary to the current view, that those in a more proletarian condition are more likely to join unions, it was found that those in "less proletarian" conditions were the most likely to be involved with union activities. This is, the more secure the engineers felt, the more likely they were to unionise. It was found that job security was a facilitator for unionisation, while insecurity was one inhibitor. TABLE 11.18 shows that 59.00 per cent of the engineers who perceived their job to be secure, were unionised, while 79.00 per cent of those who perceived their job to be insecure (a threat of dismissal), were not. As I have argued throughout this Chapter, the threat of dismissal is, on the one hand, the typical indication of the proletarian condition and, on the other, it is the most powerful strategy adopted by management to prevent unionisation and militancy among all sorts of employees, be they engineers or not.

TABLE 11.18 RELATIONSHIP BETWEEN SECURITY ON THE JOB AND UNIONISATION (Total Sample)

Categories	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
The job is secure	53	46.49	37	32.46	90	78.95
The job is insecure	5	4.39	19	16.67	24	21.05
Total	58	50.88	56	49.12	114	100.00

Note: 1) Both differences significant at the 0.005 level X^2, (x^2=9.510, P<0.005).
2) See question 33, Appendix 1., for levels of security on the job.

In summary, it was found that contrary to the current view that objective proletarianisation leads to unionisation, as the more proletariat the engineers, the less unionised they were found to be. That is, the more insecure they felt in their job, the more self protective they became. Conversely, the more secure they felt in their job, the greater the power and conditions they had to unionise and to be militant. Thus, rather paradoxically, excessive "proletarianisation" inhibits proletarian attitudes and behaviour.

4.2.6 Location in the Labour Process and Unionisation

Middle class theorists (Poulantzas 1975; Carchedi, 1977) have argued that engineers are responsible for the work of management and supervision. This suggests that technical workers are not likely to adopt a working class strategy of unionisation, as a resource to defend their interests. Instead, this occupational grouping is likely to defend the capitalist interest first. It also implies that, according to Smith (1990), the consciousness and the content of the engineers' work are irrelevant to the form their role as agents of capital takes. In fact, it was found that the content of the work performed by engineers (be it technical or managerial), did not interfere with their class politics. However, their ideological integration into the managerial ideology, was found to interfere with the class politics of the engineers

TABLE 11.19 shows that 85.96 per cent of the engineers, independent of whether they hold a managerial position or not, were engaged in supervisory activities in the companies studied. However, this group was divided fifty-fifty, between those who were unionised and those who are not. Of the remaining 14.04 per cent of engineers, who did not supervise other workers, 56.25 per cent were unionised and 43.75 per cent were non-unionised. Therefore, the nature of work and the structural position occupied by engineers in the labour process, were not good predictors of class politics for this group. Thus, the managerial strategy of involving professionals in supervisory activities, in order to make them less prone to involving themselves with working class politics, does not make much sense and needs to be revised.

TABLE 11.19 RELATIONSHIP BETWEEN ENGAGEMENT IN SUPERVISORY ACTIVITY and UNIONISATION (Total Sample)

Place in the labour process	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Supervise other workers	49	42.98	49	42.98	98	85.96
Do not supervise other workers	9	7.89	7	6.14	16	14.04
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences not significant at the 0.05 level x^2, (x^2=0.038, P>0.05).
2) See question 10, Appendix 1., for supervisory activity.

However, the degree of feeling of being part of management, had a reasonable influence on unionisation among engineers. Engineers who felt part of management tended to be less unionised than those who felt they were not part of management. TABLE 11.20 shows that two-thirds of the engineers who did not feel part of management were unionised, while 60.00 per cent of those who felt part of management were not unionised. This indicates that the likelihood of unionisation diminished, as the individual felt more engaged in the managerial ideology.

TABLE 11.20 RELATIONSHIP BETWEEN THE FEELING OF BEING PART OF MANAGEMENT AND UNIONISATION (Total Sample)

Engagement in the managerial ideology	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Feel part of management	20	17.54	30	26.32	50	43.86
Do not feel part of management	38	33.33	26	22.81	64	56.14
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences significant at the 0.05 level x^2, (x^2=4.216, P<0.05).
2) See question 29, Appendix 1., for feeling of being part of management.

Nonetheless, the absorption of the managerial ideology by engineers, depended on their formal position in the hierarchy of the company. Those who held higher positions, were more involved with the managerial ideology than those at the bottom of the hierarchy. TABLE 11.21 shows that the higher the engineer's position in the hierarchy, the lower their likelihood of being unionised. Conversely, the lower their hierarchical position, the higher their likelihood of being unionised. For example, 62.00 per cent of those who were only engineers were unionised, against 38.00 per cent who were not unionised; 75.00 per cent of those who held the post of "technical coordinator" (quite the same level as engineer) were unionised, against 25.00 per cent who were not unionised. Conversely, 75.75 per cent of those who held a position of "Chief of Division" or "Chief of Service" (which is the first formal level of the managerial hierarchy), and 85.0 per cent of those in the position of Chiefs of department, were not unionised.

TABLE 11.21 RELATIONSHIP BETWEEN HIERARCHICAL POSITION and UNIONISATION (Total Sample)

Position held	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Engineer	31	27.19	19	16.67	50	43.86
Technical coordinator	18	15.79	6	5.26	24	21.05
Chief of Division\Service	8	7.02	25	21.93	33	28.95
Chief of Department	1	0.88	6	5.26	7	6.14
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences significant at the 0.005 level x^2, (x^2=21.180, P<0.005).
2) See question 3, Appendix 1, Section A, for position held.

Unionisation was also associated with the degree to which engineers legitimated the managerial position. It was found that unionisation increased, where the engineers found management unnecessary. That is, unionisation increased where engineers, independent of their real place in hierarchy, believed in the possibility of industrial democracy or "co-gestion". TABLE 11.22 shows that 58.44 per cent of the engineers who found managers necessary, were not unionised, against 41.56 per cent who were unionised. Conversely, 70.27 per cent of those who perceived management as absolutely unnecessary, were unionised, against 29.73 per cent who were not unionised. Thus, the more engineers were engaged in the managerial ideology, the less prone they were to unionise.

TABLE 11.22 RELATIONSHIP BETWEEN LEGITIMATION OF MANAGEMENT AND UNIONISATION (Total Sample)

Legitimation of management	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Very Necessary	8	7.02	11	9.65	19	16.67
Necessary	24	21.05	34	29.82	58	50.88
Not necessary at all	26	22.81	11	9.65	37	32.46
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences significant at the 0.025 level X^2, (x^2=8.246, P<0.025).
2) See question 22, Appendix 1, for legitimation of management.

Finally, the personal identification with the profit making ideology of the capitalist firm, had a strong influence on unionisation. TABLE 11.23 shows that two-thirds of the engineers who completely agreed with the profit making ideology were not unionised, while only one-thirds of those who agreed little with such an ideology were unionised. Finally, 80.0 per cent of the engineers who completely disagreed with the profit making ideology of the capitalist were unionised. In short, high levels of agreement with the profit making ideology were associated with low rates of unionisation, while high levels of disagreement with such ideology were associated with high rates of unionisation among engineers.

TABLE 11.23 RELATIONSHIP BETWEEN AGREEMENT WITH THE PROFIT MAKING IDEOLOGY AND UNIONISATION (Total sample)

Agreement with the profit making ideology	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Completely agree	29	25.44	40	35.09	69	60.53
Agree little	24	21.05	15	13.16	39	34.21
Completely disagree	5	4.39	1	0.88	6	5.26
Total	58	50.88	56	49.12	114	100.00

Note: 1) Differences significant at the 0.05 level X^2, (x^2=6.464, P<0.05); 2) See question 26, Appendix 1.

Among the five variables related to the location of the engineers in the labour process, presented so far, and summarised in TABLE 11.24, location in supervisory or in technical functions, was the only one that did not affect unionisation. However, feeling of being part of management, hierarchical position, legitimation of management and agreement with the profit making ideology, were strongly associated with the unionisation of engineers.

TABLE 11.24 - LOCATION IN THE LABOUR PROCESS **X** UNIONISATION

Location in the labour process	Chi-Square	DF	Probability	Significance level (x^2)
1) Engagement in supervisory activity	0.038	1	0.8462	______
2) Feeling of been part of management	4.216	1	0.0400	$P<0.05$
3) Hierarchical position	21.180	3	0.00009	$P<0.005$
4) Legitimation of management	8.246	2	0.0162	$P<0.025$
5) Agreement with the profit making ideology	6.464	2	0.0395	$P<0.05$

Note: 1) DF= Degree of Freedom.
2) ____ = Association not significant, ($P>0.05$).
3) Source: see Tables 11.19; 11.20; 11.21; 11.22; 11.23

4.2.7 Political Ideology and Unionisation

Another important finding of this research, was the relationship between the political position assumed by engineers and their tendency towards unionisation. It was found that rates of unionisation increased as the political position of engineers moved from the right to the left wing. Conversely, rates of unionisation decreased as political position of engineers moved from a left to a right wing position (TABLE 11.25).

TABLE 11.25 shows that 31.58 per cent of the engineers had a "centre" or "centre right" political position, while 50.88 per cent were "centre left", with 17.54 per cent not defining their position. Little support is given to the traditional "right wing" party (PDS), the **PRN** (National Renovation Party), founded by ex-President Collor, and the **PFL** (Liberal Front Party), which is a small branch of PDS, whose politics were supported by only 17.54 per cent of the engineers. Within this group, 85.00 per cent of its members were not unionised.

TABLE 11.25 RELATIONSHIP BETWEEN POLITICAL POSITION AND UNIONISATION (Total Sample)

Political Position	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Centre-right	3	2.63	17	14.91	20	17.54
Centre	7	6.14	9	7.89	16	14.04
Centre-left	31	27.19	13	11.40	44	38.60
Left	9	7.89	5	4.39	14	12.28
Without position	8	7.02	12	10.53	20	17.54
Total	58	50.88	56	49.12	114	100.00

Note: Association significant at the 0.005 level x^2, (X^2=19.327, P<0.005).

TABLE 11.25 also shows that the group which supported the "centre wing", was always moving from the "centre-right" to the "centre left" and vice-versa, depending on the ideology and political projects of the candidates. Only 14.04 per cent of the engineers supported this position and, as such, they were divided roughly half and half, between those who were and those who were not unionised. Finally, 38.00 per cent of the engineers supported the "centre left" or "left", represented by the traditional the **PMDB** and the **PSDB**, which defend a more social democratic model of capitalist society. Within this group, 70.00 per cent of the members were unionised. The traditional "left wing", represented by the **PT** (Workers Party), found support among only 12.28 per cent of the engineers. Like the "centre leftists", 64.00 per cent of this group were unionised. Finally, those who did not have a clear position (17.54%), behaved in a more conservative way and 60.00 per cent of them were not unionised.

In summary, we can argue that the political position adopted by engineers affects their view and attitude towards unionisation. It is clear that those who supported the "right", were less prone to unionisation than those who supported the "left". Those engineers who were in the "middle" (Centre wing), were those still without a position. As this group did not have a clear position, they did not get very involved with trade union issues.

4.2.8 Class Position and Unionisation

Such findings lead us to ask what kind of relationship might there be between political position and class position, and also between class position and unionisation. If class position affects political position, then we could expect that class position would also affect unionisation? In practice such questions are nothing more than speculation. No relationship was found between political position and the perception of self location in the class structure. In addition, no association was found between self location in the class structure and the tendency towards unionisation.

INTCO and NATCO engineers located themselves in a "four level class structure", stratified from the upper middle class to the traditional working class (TAB. 11.26). The proportion of unionised and non-unionised engineers in each class category, was roughly the same. Thus, self-location in the class structure has nothing to do with tendency towards unionisation. As TABLE 11.26 shows, 62.28 per cent of the engineers and managers considered themselves fully "middle-class" (two first groups), but this group was split fifty-fifty between those who were unionised and those who were not unionised. Some 35.09 per cent of the sample considered themselves "lower middle-class", and were split almost half and half between those who were unionised and those who were not unionised. Two-thirds of those who considered themselves "working-class", were not unionised. This confirms, once more, my position that the more subject to proletarian condition the individual is, the less likely he is to unionise.

TABLE 11.26 RELATIONSHIP BETWEEN SELF-LOCATION IN THE CLASS STRUCTURE and UNIONISATION (Total Sample)

	Unionised		Not Unionised		Total	
Class location	N=	%	N=	%	N=	%
Upper-Middle-Class	5	4.39	5	4.39	10	8.77
Middle-class	31	27.19	30	26.32	61	53.51
Lower-Middle-class	21	18.42	19	16.67	40	35.09
Working class	1	0.88	2	1.75	3	2.63
Total	58	50.88	56	49.12	114	100.00

Note: Association not significant at the 0.05 level X^2, (X^2=0.415, P>0.05).

However, what if more revealing up to this point is that 97.37 per cent of the engineers consider themselves part of the "new middle class", while only 2.63 per cent of them consider themselves "working class". This then raises the question: if engineers are not working class, is it possible to expect a broad alliance between them and the traditional working class, as the "New Working Class", suggests?. This is a matter of analysis for the next section.

4.2.9 Alliance with Manual Workers

The "New Working Class" thesis predicts that technical workers are likely to assume a broad alliance with and leadership of manual workers. However, for the case of Brazilian engineers this remains an unanswered question. At the national level the 25 SENGEs (Engineers Unions) were organized in two federations - the FNE and the CONSENGE, which are affiliated to two confederations of workers - the CUT and the CGT. These two confederations have different political positions. The CUT is left-wing and supports the Workers Party (PT), while the CGT is only centre-left and supports the PMDB (the largest centre-left political party in the country). Therefore, the two confederations of engineers' unions do not seem interested in being in a vanguard position in the working class movement, preferring to follow predominantly manual union leadership.

INTCO and NATCO engineers were also divided in relation to the possibility of a broad alliance with manual workers. For

56.14 per cent of them, it was a good idea to support the main Union which represented the majority of the workers of a given company, since it could negotiate in favour of different groups within the enterprise. Additionally, it could strengthen the bargaining power for all workers. It is noticeable that 82.81 per cent of this group was represented by engineers in technical positions and only 17.18 per cent by managers (TABLE 11.27).

TABLE 11.27 - SUPPORT TO THE IDEA OF CLOSED SHOP

Position assumed	Companies								
	INTCO			NATCO			Total		
	Eng.	Manag.	Total	Eng	Manag.	Total	Eng.	Manag.	Total
For	34.09	11.36	45.45	54.29	8.57	62.86	46.49	9.65	56.14
N=	(15)	(5)	(20)	(38)	(6)	(44)	(53)	(11)	(64)
Against	11.36	18.18	29.55	20.00	14.29	34.29	16.67	15.79	32.46
N=	(5)	(8)	(13)	(14)	(10)	(24)	(19)	(18)	(37)
Ambiva-lent	2.27	22.73	25.00	1.43	1.43	2.86	1.75	9.65	11.40
N=	(1)	(10)	(11)	(1)	(1)	(2)	(2)	(11)	(13)
Total	47.73	52.27	100.00	75.71	24.29	10000	64.91	35.09	100.00
N=	(21)	(23)	(44)	(53)	(17)	(70)	(74)	(40)	(114)

Note: 1) Differences between engineers and managers, at INTCO, significant at the 0.005 level X^2, (X^2=12.292, P<0.005);
2) Differences between engineers and managers for the overall sample, significant at the 0.005 level X^2, (x^2=25.992, P<0.005);
3) Differences between engineers and managers, at NATCO, significant at the 0.05 level X^2, (X^2=7.376, P<0.05);
4. Differences between companies significant at the 0.005 level X^2, (X^2=13.261; P<0.005).

However, TABLE 11.27 also shows that 32.46 per cent of the engineers were absolutely against the idea of joining a workers' union or to allowing the main union negotiate on their behalf. This was because they believed that each occupational group has its own demands and that the Union which represents the majority of workers struggles for the interests of that majority, leaving aside the minority's interests. As a NATCO engineer argued:

> "In the past the majority Union used to negotiate for everybody, but our specific interests, as engineers, were left aside. Today things have changed. There is a collegiate composed of representatives of each Union which has members in the company, to negotiate with the company. Each one represents its groups' interests.
>
> (A NATCO Chief of Division)

One INTCO engineer justified his position due to the political militancy of the Metalworkers Union. In his words:

> "I am against being represented by the Metalworkers' Union. Working class unions, like this, are too influenced by politicians who only want to gather votes. The greatest problem is that the engineers' union (SENGE\MG) also does not represent our interests in the company. So, what is negotiated with the Metalworkers' Union is valid for us".
>
> (An INTCO Chief of Service)

The remaining 11.40 per cent of the sample did not have a clear idea about what would be better or worse for them, in terms of professional representation. The majority of this group (85.00%) was composed of INTCO managers (TABLE 11.27).

Finally, when comparing engineers and managers, for the total sample (TABLE 11.27), it was found that while 72.00 per cent of the engineers were for a integrated union action, 72.50 per cent of managers were against or ambivalent to such action. This suggests that managers are much more resistant to joining the working class movement than engineers. Managers, as the NATCO case has shown, have tried to organise their own association, outside the engineers' Union, because they believed that the unions cannot represent their interests in the company.

4.2.10 Collective Militancy

The possibility of collective action, including engineers and other workers, as argued by the "new working class thesis", is still another dubious question. Differences between the attitudes of engineers and managers to strike action was clear. TABLE 11.28 shows that 52.63 per cent of the engineers interviewed would not support a strike if it was not based on clear objectives, with 93.33 per cent of this group being composed of engineers in non-managerial positions. The absolute majority of the engineers who would strike (80.35%), were from NATCO, where control by management was lighter. The proportion of managers who would strike, was the same for the two companies. The remaining 47.37 per cent of the total sample would never strike and two-thirds of this group were managers.

These results confirm that NATCO's representatives were more militant or less controlled than their counterparts at INTCO, and suggests that the formal engagement in managerial activities also helps to prevent militancy among engineers and managers.

TABLE 11.28 - SUPPORT TO STRIKE BY INTCO AND NATCO ENGINEERS AND MANAGERS

Attitude to strike	Companies						Total		
	INTCO			NATCO					
	Eng.	Manag.	Total	Eng.	Manag.	Total	Eng.	Manag.	Total
Would strike	25.00	4.55	29.55	64.29	2.86	67.14	49.12	3.51	52.63
N=	(11)	(2)	(13)	(45)	(2)	(47)	(56)	(4)	(60)
Would not	22.73	47.73	70.45	11.43	21.43	32.86	15.79	31.58	47.37
N=	(10)	(21)	(31)	(8)	(15)	(23)	(18)	(36)	(54)
Total	47.73	52.27	100.0	75.71	24.29	100.0	64.91	35.09	100.0
N=	(21)	(23)	(44)	(53)	(17)	(70)	(74)	(40)	(114)

Note:1) Differences between engineers and managers at INTCO significant at the 0.005 level X^2, (X^2=8.075, P<0.005);
2) Differences between engineers and managers at NATCO significant at the 0.005 level X^2, (X^2=27.984, P<0.005);
3) Differences between engineers and managers for the overall sample significant at the 0.005 level X^2, (X^2=42.326, P<0.005);
4) Differences between INTCO and NATCO staff engineer only, significant at the 0.01 level x^2, (X^2=6.967, P<0.01);
5) Differences between INTCO and NATCO managers not significant at the 0.05 level x^2, (X^2=0.045, P>0.05).

5. Conclusion

This chapter has examined the organization of Brazilian engineers in terms of the evolution of the engineers professional associations and trade unions, and the degree of involvement of INTCO and NATCO engineers with these institutions. Special emphasis was given to the factors which facilitate, or prevent, the unionisation of engineers. The findings revealed that, as in developed nations, unionisation among Brazilian engineers was a fact of life. The findings also support the thesis which I share with Meiksins and Smith

(1992:137), that engineers as salaried professionals share with other employees many of the uncertainties of waged labour, and in many countries have sought economic protection through labour unions, rather than professional associations or individual deals with their employers. Actually, Brazilian engineers tend to see unionism as more relevant to their case as salaried professionals.

At the national level, nearly 30.0 per cent of engineers were unionised by the end of 1991, whereas 50.88 per cent of the engineers interviewed were unionised. The majority of NATCO engineers (83.00%) were unionised, while the majority of their INTCO counterparts (73.00%) were not.

Managerial control, accompanied by threats of dismissal and a block on career mobility, were the basic strategies used by INTCO to prevent unionisation among engineers and other workers. NATCO engineers did not carry the risk of dismissal, but they were threatened with a block on career mobility if they became militant member.

The non-unionised engineers in the sample, found the unions too political and radical, and very weak at representing their interests. For those hostile to membership, some felt that unions could not represent their personal interests and did not believe in unions for professionals, while others believed that as managers, representing the interests of capital, it was incompatible for them to join the working class interests.

Despite some engineers being resistant to unionisation, the majority of these engineers found it necessary to have a strong collective representation to face employers at the negotiating table. Although managers were less unionised, they did feel the need to form an association to defend their interests. NATCO's managers had created a Chiefs' Association, which they called the **AIC** (Interdepartmental Association of Chiefs), to protect themselves against political interference, since the company is state-owned, and also to negotiate on their behalf with top management. INTCO's managers did not belong to any professional association, but they too found it necessary to have some sort of representation against their bosses.

What is most revealing in these findings is the fact that, despite engineers being aware of their condition as subordinate actors in the social relations of production, this consciousness by itself was not enough to lead them to join a Union or Professional Association. Their attitudes towards such institutions were strongly affected by the degree of managerial control they were subjected to, the degree to which their job was secure, their hierarchical position, their ideological integration in the labour process, the degree of engagement in the profit making ideology, and by their political position. In contrast, no association was found either between those variables related to objective proletarianisation and the rates of unionisation, or between the self-location of the engineers in the class structure and unionisation. This seems to be explained by the fact that although many engineers worked under very poor working conditions (like at INTCO), control by management was able to undermine any attempt of unionisation among them. However, it is likely that if management was lighter, these variables would have affected unionisation.

Where managers did exercise high control or direct supervision over the engineers' work, the rates of unionisation were very low. By contrast, where engineers were subjected to more flexible supervision, the rates of unionisation were higher. I concluded from this, that contrary to the current view that "proletarianisation" of conditions leads to unionisation, it was found that, the more objectively "proletariat" the individuals were, the less likely they were to unionise. The more insecure they felt in their job, the more submissive and self-protective they became. Conversely, the freer they were from direct control by management, the more likely they were to unionise. The more secure they felt in their job, the more power and confidence they felt to unionise. Thus, despite being aware of their working condition, they could not react collectively or individually where the degree of control and threats were too high.

These finding raises some criticism of most of the literature on technical labour and class. To start with, the assumption of the "professionalisation thesis" that professionals are likely to join their professional association rather than unions, was not confirmed, as more engineers were unionised or potential members, and supported joint action together with the working class.

Braverman's (1974) version of proletarianisation through deskilling also has to be rejected, as the variables related to technical proletarianisation were unable to explain unionisation by themselves where managerial control was very tight, although trends towards technical proletarianisation were found: including the rationalisation of labour, the simplification of duties, automation and the division of labour, a downward drift in relative pay, low technical autonomy and unionisation. Nonetheless, Ross (1978) is right in assuming that, the loss of autonomy and privileges does not make professionals members of the proletariat, but makes them more disposed to struggle along with the working class to regain their losses.

The view of Poulantzas (1975), that despite engineers being aware of the ambiguities of their position in the labour process, they do not negate complicity as agent of capital was not confirmed. Their ideological position rather than their structural position, is more important in defining their support for labour or capital. As organizational professionals, engineers perform the functions of capital but at the same time they are workers. The ambiguity of their position in the labour process led them to vacillate between support for capital and labour issues. In fact, it was found that many engineers in supervisory positions did not feel as though they were representative of capital, and as such they were allies of the working class. By contrast, it was also found that those who were ideological supporters of the capitalist ideology, played a conservative role as agents of capital, even though they did not perform a supervisory or managerial function. As such they would hardly ally with the working class. This contradiction is not a new phenomenon. This is explained by the nature of their "new middle class" position. The new middle class theorists (Carchedi, 1977; Wright, 1985) have already raised this point.

Wright (1985) has also argued that, where degradation of working conditions occur, "it might be quite possible for the people in those contradictory class location which are ... exploited to see the balance of their interests as being more in line with the working class than with the capitalist class" (p.125). As argued in Chapter 10, it is exactly this ambiguity that affected the engineers's attitude toward their professional associations and trade unions, to political parties and to the labour movement in general.

The "new working class thesis" also finds meaningful support here. Those engineers who legitimated the managerial function the least, were the most unionised and disposed to joining the working class for collective militancy through strikes. They were also in favour of "syndicalism d'empresa", and for a greater democratisation of industrial relations. They also supported a social democratic ideology, as a way of changing the social system, and were in favour of collective militancy as a way of changing relations at work. Nonetheless, engineers were not against capitalism at all, and did not behave as a "vanguard", but they were disposed to struggling along side with the working class for common objectives.

Finally, the orthodox version of the "proletarianisation thesis" (advanced by Smith and Willmott, 1991, Smith and Meiksins 1991, Meiksins and Smith, 1992), which argues that professionalism is not incompatible with unionism, and that the professionals' condition of wage labour, does put unionism on their agenda, was the most consistent approach to analyze unionisation among Brazilian engineers.

12. CONCLUSION

This thesis has focused on Brazilian engineers, comparing their work situation and class position in two large corporations in Brazil, one national and one multinational. The analysis was based on a Marxist perspective on class. Weberian approaches were not adopted, because I was interested in approaching the question of class relation and conflicts between capital and labour from an analysis starting from inside the social relations of production.

It was found that although engineers and managers are salaried professionals, and as such they are subject to the general personnel policies of the capitalist who employ them, these conditions alone, were not enough to justify that they are members of the working class. The analysis of their role as representatives of capital (while supervisors of the technical labour process) and labour (as participants of the collective labour process), their possession of organizational and skill assets, indicated than they can be regarded part of the "new middle class", as argued by Marxist theorists (Poulantzas,1975; Carchedi, 1977; Wright, 1985). Therefore, their better employment conditions (chances to rise to higher managerial positions), their different levels of autonomy, authority, status, power and participation, and even higher salaries compared to non-professional workers in the companies studied, lead engineers (like other professionals) to enjoy a very noticeable social distinction in Brazil. In fact, the absolute majority of the engineers considered themselves part of this "new middle class", while only 2.63 per cent of them regarded themselves "working class".

My interest in investigating this subject, emerged whilst I was working in the area of human resources management for the two largest engineering corporations in Brazil. I observed that in periods of economic growth and large engineering contracts, engineers were highly valued, but in periods of economic hardship they were treated as any other employee. This instability of their employment conditions seemed not to correspond to the view that engineers, like other professionals, constituted a well established "new middle class" in Brazil, as in the rest of the developed world. Thus, it was a good opportunity to investigate to what extent this instability of their employment conditions could affect the organization and politics of this "new middle class". Secondly, Brazilian engineers represent 10.0 per cent of the Brazilian working population with a university education. Thus, by studying their case we could make generalizations about the work situation and class position of other professional workers in capitalist organizations. Thirdly, as engineers have played a central role in the industrial and technological development of advanced nations, the analysis of the case of engineers in Brazil, constituted a good option to understand their place in the national development and in the international division of labour.

Both a multinational and a national company were chosen, firstly, because Brazil's development was heavily based on multinational corporations, and secondly, to test some assumptions that the transnationalization of capital and management affects local labour relations and practices.

The two main reasons to choose Brazil for this research were: firstly, technical labour is a recent area of study, even in developed nations, and it is just beginning to be approached in Brazil. Secondly, Brazil is the eighth largest industrial economy in the world, with many problems of income, social and educational inequality. Only 7.3 per cent of the economically active population have a university education. Therefore, two-thirds of the overall working population earn up to the minimum wage per month, while university educated workers earn, on average, 10 times the minimum wage. Consequently, this economic, social and educational gap between university educated people and the rest of the population, makes it easier for professionals to claim that they constitute a "new middle class", characterized by these differences in educational background, employment and economic conditions.

In relation to the work situation of engineers, I examined the following aspects: the nature of work performed by the engineers, their place in the labour process, the working conditions under which they performed their work (the physical work environment, level of control by management over work, salary equity, stability of employment, career opportunities, status, power, autonomy and participation in decision making), and their relationship with management and manual workers.

In terms of class position, the thesis analyzed the place the capitalist located engineers in the capitalist social system through: (1) an analysis of the work situation of engineers within capitalist enterprises; (2) the way capitalist enterprises locate engineers in the capital/labour relations; (3) the way engineers are educated and legitimated in society; (4) how engineers locate themselves in the class structure and (5) the engineers' collective organization, politics and relationship with the working class.

The research was based on interviews and secondary research in the engineering schools, in the Council of Engineering, in the Engineer's Union, and in the departments responsible for personnel management of the two companies. Therefore, it also involved examination (through observation) of the organization of the technical labour process, the physical work environment where engineers carried out their job, and the strategies adopted by the two companies to coordinate and control their technical labour force. Most importantly, the research involved direct interviews with 114 engineers of different hierarchical positions, in order to understand how they felt, as salaried professionals, of profit making organizations.

Empirical research found that, although engineers shared with the working population the conditions of salaried employees, they earned a relatively higher salary compared to the majority of the working population, performed a relatively creative job, had a dominant position in the technical labour process, and the opportunity to rise to higher hierarchical positions. Therefore, engineers were recognised by the enterprises as salaried professional responsible for implementing the policies of the company at workplace and to defend the interests of the company in the capital/labour relations. The engineering schools also viewed engineers as specialized professionals responsible for the running of the capitalist firm, and to represent the interests of the enterprise in the workplace. Thus, we can argue that, although engineers are not part of the dominant class (because they are salaried professionals), they represent capital in the workplace and, according to the new middle class theory, they cannot be regarded as part of the working class, but of the "new middle class".

This general conclusion is what makes this work similar to previous works on the subject in developed nations, whose authors (Whalley, 1986; Crawford, 1989; Zussman, 1985) studied the case of the British, the French and the American engineers, respectively, and assumed that professional engineers were really members of a "new middle class", in the capitalist countries studied.

My analysis of the education system revealed that, before 1930 engineers descended from families of large-scale farmers, entrepreneurs, politicians and professionals. Most worked in family businesses or in the state apparatus. Thus, engineers were educated within an ideology of liberal professionals, because few of them worked as salaried employees. Hence, engineers were members of the dominant social groups. After 1930, the education system was reorganized to support the new economic project, based on industrialization. Thus, engineering schools were transformed as qualifying agencies, creating a highly specialist labour force to attend to the needs of the market. Thus, engineering became a typically organizational profession, while engineers gained a more "new middle class" character.

In fact, the educational history of INTCO and NATCO engineers, revealed that the majority of the engineers interviewed chose the profession in the expectation of finding a good job. It meant a good salary with fast upward mobility in a large company. Some of them had already worked as technicians and needed to do engineering to progress in their career. They knew beforehand, that as organizational professionals they would be subject to market forces and to the policies of the companies they would work for. I then concluded from the analysis of the education and professional systems, that engineering is no longer an upper class profession, as it was in the period prior to 1930. Firstly, because the majority of engineers are now descendants of the middle classes; secondly, because since the 1930s, the objective of the engineering schools has been to produce engineers to attend to the needs of the market, and thirdly, because most engineers are now organizational professionals, and not either self-employed or engineer-entrepreneurs, as in the past. Engineering revealed to be a typically "new middle class" profession.

The analysis of the way INTCO and NATCO managed professionals, indicated that engineers cannot be said to be upper-class or working class because they are engineers. Both companies saw everybody who was salaried worker as employees, but the personnel policies applied to professional workers were different from those applied to the overall workforce of the company. Only the Directors and the President were seen as non-employees, because they were paid according to the profits of the company.

The analysis of the working conditions of engineers indicated that in both companies, INTCO and NATCO, engineers were subject to managerial control and supervision, and to similar physical working conditions offered to other professionals, but these deferred from those applied to the general workforce of the company. However, engineers and managers had little technical autonomy and participation in core decision making. Therefore, they had limited chances of promotion to top positions, but they enjoyed reasonable chances of career up to the level of Chief of Division.

The analysis of the content of the engineer's work indicated that in both companies, the Chiefs of Department were more involved with administrative things, the Chiefs of Service and Chiefs of Division with administrative and technical things, while engineers performed only technical activities. Technicians performed the manual and less complex tasks for these engineers. The engineers' work had been divided, for control purposes, in such a way that it was very easy for a new engineer to assume any position within the company. No indications were found of a proper deskilling process, but the engineers were unanimous in affirming that they used much less engineering knowledge in their work than they could. Only the Chiefs of Department and those above them, had a full notion of the general operations involved in their areas of responsibility.

It was also found that, in contrast to the British tradition, though similar to the case of American and continental European engineers, the majority of the INTCO and NATCO engineers, independent of whether they held a managerial position or not, were engaged in supervisory activities. Engagement in supervision was seen as a training process for a managerial career. A managerial career was believed to provide more professional recognition, prestige and power, than that of an engineer. These findings were similar to many previous works on engineers and management in developed nations (Lee and Smith 1992; Noble 1971; Thorstendahl 1982; Perucci and Gerst 1969; Galbraith 1967).

However, the undertaking of supervisory activities by itself did not lead engineers to feel part of management. For the engineers, being part of management meant having participation in core decision making, the autonomy and authority to decide about the professional life of employees, control over resources, as well as holding higher hierarchal position, which they did not have. Junior engineers hardly saw themselves as part of management, while Chiefs of Department felt absolutely part of management.

Location in the labour process, that is, in a managerial or a technical position, was useless in determining whether engineers were on the side of capital or labour, or rather, in defining their class position. The commitment of engineers to a technical or a managerial career, was linked to the usefulness of such a career to improve their personal resources. Engineers, independent of their hierarchical positions, preferred to work for themselves rather than to invest in a career in a company. The reason they had invested their life in the company, was because this had been the only way they had found to survive as professionals. They were unanimous in affirming that if they had a chance, they would leave the company for a personal business or to became self-employed.

However, the chances to become self-employed are very limited for engineers in Brazil, as around the world, because engineering is typically an organizational profession. Therefore, the vast majority of INTCO and NATCO engineers depended exclusively on their salary to survive. I concluded from this that, if they managed to free themselves from the condition of being salaried professionals, they would certainly be moving in the direction of a more traditional "middle-class" grouping. However, as they remain fully dependent on organizational employment, the instability of their "new middle class" position persists.

Therefore, most of the engineers chose an engineering career in the expectation of finding a good job, which meant fast upward mobility and a good salary. However, career opportunities to top hierarchical positions were limited, and neither of the two companies had a structure for a technical career. Career opportunity at INTCO was also affected by the fact that, besides not carrying out any basic research in Brazil, it reserved the top positions for its home country executives. This confirmed the assumptions that multinationals extend the labour market for their home country executives, in countries where they have set up subsidiaries. At NATCO, top executives were appointed by politicians, as the company is state-owned. Consequently, most of the engineers were frustrated, as they remained at the bottom of the hierarchy, and did not earn what they had expected. In fact, managers of both companies, were the most satisfied with their career. Dissatisfaction with one's career was associated with the feeling of being exploited through an unfair salary, and the perception of little chance of their promotion. Satisfaction with one's career was associated with no feeling of being exploited and with the perception of a good chances of their promotion.

Promotions in both companies were highly dependent on the involvement of engineers with the goals of the company, their performance and technical knowledge. At NATCO, political influence also had a meaningful weight in promotions to top managerial positions, as the company is state-owned.

Stability of employment was associated with whether the engineers were in the public or private sector. The feeling of instability of employment was higher at INTCO, while most of the NATCO engineers felt that their job was secure. INTCO is a private company, subjected to market forces, and highly concerned with profits. This has affected cost control, and ultimately the security of labour. In periods of economic hardship engineers carry the risk of dismissal. NATCO, besides being state-owned and paternalistic, retains a monopoly for its products, keeping the company under high economic stability.

Therefore, it is less concerned with high profits, and consequently, labour is less at risk. As a general rule Labour in the public sector is traditionally more stable, and this is born out in the case of Brazil. Thus rather than the question of multinational status of INTCO explaining differences in relation to job stability, the public status of NATCO is an equally important factor.

The physical working conditions under which engineers carried out their job, was the same as for other professionals, but different from non-professionals working in the same area, in the same company, although some engineers worked in worse working conditions. Therefore, the work environment of engineers was very different in the two companies. INTCO engineers, in general, worked in a poor and polluted work environment, with few facilities such as rooms, telephones, furniture, and air conditioning. At NATCO, engineers worked in a very pleasant work environment, with plenty of facilities. Engineers who worked in production and related activities at INTCO, and maintenance engineers at NATCO, for example, worked in a physical environment worse than that of all clerical workers of the company, and very similar to that of manual workers.

The level of status of NATCO engineers was generally higher than that of other employees, but similar to other professionals. However, the status of engineers at INTCO was higher than that of all other professionals and workers in the company. This is explained by the fact that, in the German managerial culture engineers are highly valued, compared to other organizational professionals (see Lawrence, 1992). Status differentiation at NATCO depended more on the hierarchical position of engineers than on their educational level, while at INTCO it was associated with both.

Despite their subordination to the managerial hierarchy, engineers, independent of their technical or managerial positions, legitimated the managerial function. They considered that managers were very necessary for organizational linkage and for the control function of capital over labour. Therefore, engineers supported the view that **profits** were indispensable for the survival of the company and for the development of the capitalist system. This attitude seems to be reminiscent of the ideology passed to engineers through their engineering education, which emphasizes that engineers shall represent the capitalist's interests in the capital/labour relationship, even though they are subordinate actors in this relationship. This attitude is also consistent with their role as representative of capital as argued by the neo-Marxist theorist on the "new middle class" (Poulantzas, 1975; Carchedi, 1977; Wright, 1985).

Despite the apparent integration of engineers with the values of the business, INTCO and NATCO top managers were not very confident that engineers would really defend the capitalist interests. This seems to be associated with their contradictory class location, between capital and labour. It was found that engineers were not given access to strategic information such as financial data, because, although top managers saw them as representatives of capital, they were also seen as part of the collective labour. As such, top managers feared that engineers would pass this information through to their unions, which would then use it on behalf of the engineers, at the negotiation table.

The case of Brazilian engineers confirm the view which I share with Meiksins and Smith (1992), that engineers as salaried professionals share with other employees many of the uncertainties of waged labour, and in many countries have sought economic protection through labour unions, rather than professional associations or individual deals with their employers. This is also a view advanced by Prandy (1965), in relation to the British engineers and technologists.

At the national level, nearly 30.0 per cent of Brazilian engineers were unionised by the end of 1991, whereas 50.88 per cent of the engineers interviewed were unionised. The majority of NATCO engineers (83.00%) were unionised, while the majority of their INTCO counterparts (73.00%) were not.

The reasons for the rise of unionization among engineers from the late 1970s onwards did not differ from those of the traditional working class. In the view of the engineers, the impoverishment of their market and working conditions, the improvement of the engineers political consciousness, better recruitment campaigns and the country's democratisation process were the most important variables to explain the rise of unionization among engineers.

Although 35.00 per cent of the engineers interviewed were not unionised, they had a positive view of trade unionism and might consider becoming a union member in the future. Only

14.00 per cent were **hostile** to union membership and said that they would never become a union member. More INTCO than NATCO engineers had a negative view of trade unions. This reflected the anti-union culture of INTCO managers.

These findings are consistent with Prandy's (1965) view that professionals and managers in large state-owned bureaucratic organizations, have a more positive view of trade unionism, as a possible alternative to defend their interests. Prandy also found that professionals in the public sector were much more unionised compared to the private sector.

Therefore, those "hostile" to membership seem to be more concerned with status issues, as argued by Prandy (1965), as professionals and managers, than with their condition as organizational professionals, which would lead them to have a more "class" attitude, i.e, to search for unionisation.

Although managers were less unionised, they did feel the need to form an association to defend their interests. NATCO's managers had created a Chiefs' Association , to protect themselves against political interference, since the company is state-owned, and to negotiate on their behalf with top management. INTCO's managers did not belong to any professional association, but they too found it necessary to have some sort of representation at the negotiation table.

Managerial control, accompanied by threats of dismissal and a block on career mobility, were the basic strategies used by INTCO to prevent unionization and militancy among engineers and other workers. NATCO used the threat of block on career mobility if engineers became militant union members.

Besides managerial control, non-unionised engineers found the unions too political and radical, and very weak at representing their interests. Those **hostile** to membership, (those who would never became a union member) did not believe in unions for professionals, and the managers in this group, believed that their position as representative of capital was incompatible with unionization.

The more unionised engineers were those who: (1) were subjected to more flexible supervision; (2) perceived high job stability; (3) did not feel part of management; (4) were at the bottom of the hierarchy; (5) felt that management was less necessary; (6) agreed little with the profit making ideology; and (7) had a more left-wing political position.

The less unionised engineers were those who: (1) were subjected to strict control and direct supervision by management; (2) perceived low job stability; (3) felt part of management; (4) were in higher hierarchical positions; (5) felt that management was necessary; (6) agreed more with the profit making ideology; and (7) had a more right-wing political position.

No association was found either between the self-location of the engineers in the class structure and unionization, or between those variables related to objective proletarianisation (technical autonomy, content of work, career opportunity, salary equity, dependency of the salary, physical work environment) and the rates of unionization.

What is most revealing in these findings is the fact that, contrary to the current view that proletarianisation leads to unionization, it was found that, the 'more proletariat' the individuals were, the less likely they were to unionise. The more insecure they felt in their job, the more submissive and self-protective they became. Conversely, the freer they were from direct control by management, the more likely they were to unionise. The more secure they felt in their job, the more power and confidence they felt to unionise. Thus, despite being aware of their working condition, they could not react collectively or individually where the degree of control and threats were too high.

Most of the engineers had a more centre-left political position, but few supported the radical left, represented by the Workers Party. These divisions led them to affiliate to different workers' federations, the CGT and the CUT, which also have different centre-left politics. Consequently,engineers were also divided on the issue of collective action together with the working class. Fifty-two per cent felt they would support a general strike, while forty-seven per cent would not. The managers of both companies felt they would not support a strike. In short, engineers were divided between the capitalist and the working class projects. This seems to be a consequence of their contradictory class position, which led them to vacillate between these two streams.

In general terms, the personnel policies of INTCO and NATCO were similar in content, in that both aimed to increase labour productivity, but they were different in the way they were applied. A basic point in their policies, was that both companies saw professional workers (engineers and managers included) as a distinct group of workers, and as such, they were subject to the different personnel policies from those applied to non-professionals. The similarities suggest that the basic principles of personnel management in capitalist organizations can be generalised, but INTCO did not adapt to the Brazilian labour environment, as theories on the subject argue. INTCO policies were generally more restrictive in terms of autonomy, authority and participation of workers in the company, as well as in terms of relationship with the trade unions, salary and benefits. The differences in the way these policies were applied reflected the influence of the German managerial culture (see Lawrence, 1992) within the Brazilian environment. This view is supported by the fact that INTCO Directors and top managers were all German, while the Personnel Manager was Brazilian. Thus, all the personnel policies of the company were influenced and monitored by German executives. Conversely, NATCO management had always been trained in the American managerial ideologies. Thus, the contrast was evident. INTCO management can be characterized by the concentration of decision making, strong personal responsibility, strong concern with the organization of production, cost control and productivity. These characteristics implied high pressure on the whole workforce, to achieve high productivity with low cost to increase profits. This also led to worse working conditions for the whole workforce at INTCO. At NATCO, management was also characterized by the concentration of decision making, great concern with cost control and productivity, but less concern with profitability. Therefore, NATCO management was more tied to the idea of responsible autonomy and indirect control over the workforce. This led to the more favourable working conditions at NATCO.

I also concluded that the work situation and place in the class structure of Brazilian engineers, were very similar to that of engineers in most developed nations. However, their position in the international division of labour and their relations with the working class are different. While engineers in developed nations have been more involved with creative jobs, involving the design and the development of new technology and products, Brazilian engineers have taken on the role of users of this technology for production purposes. Consequently, they were essentially involved with the less creative engineering jobs, in production and related activities. This international division of technical labour, places engineers in developed countries closer to strategic management of technology generation and commercialisation, while Brazilian engineers are closer to lower management. This seems to be one reason why Brazilian engineers believe that they can only secure a more stable middle class position through self-employment, while those in developed nations have tried to secure a middle class position through their career in organizations. This is also a reason why engineers in developed nations (Canada and USA, for example), have been more resistant to becoming involved with the working class movement than Brazilian engineers.

However, Brazilian engineers, due to their high level of education and salary, compared to non-professional workers, have enjoyed a very distinctive social position compared to non-professionals. In developed nations, this gap is much smaller and the social distinction between the various occupational groups is not so noticeable. This is one reason why it is very easy for Brazilian engineers to claim that they are part of the "new middle class".

However, since industrialization began, engineers have become subject to market forces. With the rise of the business schools in Brazil, in response to the development of specialized functions linked to finance, marketing, sales, and accounting within large organizations, engineers have been replaced in the management of these areas, by professionals specialized in these subjects. Therefore, the Council of Administration has been very active in the control of the labour market for business administrators. This seems to have helped to increase their competitiveness, while the Council of Engineering has done little to protect the engineers.

Finally, these conclusions lead us to make some recommendations for further research. Firstly, the engineering schools, through an analysis of the contradictions of the role engineers expect to play in organizations, and the place the capitalist locates them in the labour process, could revise the ideological content of their courses so that engineers could enter the labour market with a clearer view of their place in the social relations of production. Secondly, the Council of Engineering, by looking at the criticism raised by engineers, could improve its performance and relationship with the engineers, the engineering firms, the engineering schools and the community in general. Thirdly, the Engineer's Unions, with reference to the criticisms and demands of non-unionized engineers, and on the strategies used by employers to prevent unionization among engineers, could focus on the politics and tactics that would be more effective in dealing with these different situations. Fourthly, the managerial community could use most of the research findings to improve the working conditions of engineers and other professionals, mainly their career, the content of their work, their autonomy and participation in the life of the company, and the use of their knowledge for national development, as many developed and developing nations have done. Fifthly, the engineers, by looking at the reality of their contradictory "new middle class" place, based on organizational employment, could revise their ideological and political positions and become collectively stronger and better able to defend their interests as organizational professionals. Finally, the scientific and academic community should invest more in social research on Brazilian engineers, as we still know very little about them.

Future research should focus mainly on the role of engineers in Brazil's technological development, on their role in the Brazilian managerial culture, and on the educational background of Brazilian managers, in order to extract the proportion of engineers in managerial positions, compared to other professionals. Therefore, the structure of the engineers' labour market, the social origin of engineers, and the number of engineers who are self-employed, employers and employees needs to be investigated. Finally, a comparative study between

Brazilian engineers and those in other advanced developing nations, could suggest new departures for a careful application of the work of engineers in the development of Brazilian industry.

NOTES

Chapter 2

[1] See Wright (1985), for his interpretation of the work of Roemer

Chapter 3

[1] World Bank, **World Development Report 1991**, pp. 4-6
[2] Ibid, pp. 4-6
[3] Ibid, pp. 4-6
[4] Ibid, pp. 4-6
[4] Ibid, pp. 4-6
[5] Idid, pp. 4-6
[6] Ibid, pp. 4-6
[7] Interview with Engenheiro Jose Marcio, a SENGE\MG's (Engineers Union of the State of Minas Gerais) Director, in May 1991.

Chapter 4

[1] Although the MICROSTAT is not as versatile a "programme " as the SPSS and MINITAB, for example, it was very appropriate for the purpose of this research. It entailed working with 48 variables for krosstab, besides carrying out all the statistical testes that were needed (Chi-square test of homogeneity, chi-square test of independency, chi-square with continuous correction and Fisher's exact text). Therefore, it is was a very easy programme to use.

Chapter 5

[1] Interview with Eng. Onofre de Resende, the CREA\MG President, in May\1991.

Chapter 11

[1] Interview with Eng. Marcio Guerra, a SENGE\MG Director in May\1991.
[2] Ibid.
[3] Ibid.
[4] Interview with Enga. Maria Cristina, President of SENGE/MG, in March 1992.
[5] Interview with Eng. Jose Marcio, a SENGE\MG Director, in May\1991

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APPENDIX 1
INTERVIEW SCHEDULE 1 - ENGINEERS

SECTION A. SAMPLE CHARACTERIZATION

1. AGE______ 2. SEX: (1) MALE (2) FEMALE

3. POST: (1) ENGINEER (2) TECH.COORDINATOR (3) CHIEF OF DIVISION/SERVICE (4) CHIEF OF DEPARTMENT

4. TIME IN THE COMPANY______________________________

5. AREA:______________________________

SECTION B. EDUCATIONAL BACKGROUND

1. Could you please provide the name, location, type of school and whether they were day time classes or evening classes, for all schools attended from age 15.

Courses attended	Public School (1)	Private School (2)	Daytime classes (1)	Evening classes (2)	Year of graduat.
SECONDARY SCHOOL					
UNIVERSITY					
MASTER COURSE					
PhD COURSE					
POST-DOCTORATE					

2. Further training. Please give details of any apprenticeship scheme (craft, technical, others etc.) which you have participated in.

Type of course	length

SECTION C. JOB HISTORY

1. Please provide the following information for each job you have held. This should include information on different positions within the same company.

Job title\responsib.	Time in the post	department	companies

SECTION D. GENERAL QUESTIONS

1. At what age did you first decide to become an engineer?

2. What factors influenced your decision?

3. To what degree would you say that the technical abilities which you acquired at University are applied in your hob?
   (1) Fully applied
   (2) Applied in high level
   (3) Average
   (4) Applied bellow average
   (5) Not applied

4. Is there any part of your job that could be undertaken by a person with lower level of specialization than yours?
   (1) No
   (2) Yes

5. Do you get as many opportunities as you would like to try out new ideas or new ways of doing things?
   (1) Almost always
   (2) Regularly
   (3) Rarely
   (4) Never

6. Is there any job undertaken by engineers of this company which has become so specialized and routinised that there is not any interest or challenge left in them?
   (1) No
   (2) Yes

   If Yes: Do you have any idea why this is happening?

   If Not: Have you ever worked in any company where this phenomena has occurred or is occurring at present? If yes, in what area?

7. How well are you informed by your boss of why a particular job has to be done? or why it has to be done in a particular way?
   (1) Plenty
   (2) Sufficient
   (3) Partially sufficient
   (4) Insufficient
   (5) Uninformed

8. If you have an technical opinion different from your boss in relation to a work which is being undertaken by you, how do you manage it?
   1) Discuss the problem, but decide the best way to do it.
   (2) Discuss the problem, but give priority to the Chief's opinion
   (3) Follow the opinion of the person responsible for the team;

9. Are there any constraints on you doing the best technical job that you can?

10. Do you supervise other workers?
    (1) No
    (2) Yes
        If yes: what category of workers do you supervise?

11. How satisfied do you feel in undertaking supervisory activities?
    (1) Very satisfied
    (2) Satisfied
    (3) Reasonably satisfied
    (4) Dissatisfied
    (5) Very dissatisfied

12. Which aspects have contributed more for your promotion for the condition of supervising other workers

13. Among the areas which you have already supervised, which one do you prefer? Why?

14. Is there any area of the company in which you have a special interest for the future? which? why?

15. If you could receive an equal salary in a technical or in a managerial function, which would you prefer?
    (1) Technical
    (2) Managerial

    Why?:

16. If you make a mistake, do poor work, or do not do the job satisfactorily, who is likely to notice it first?

17. How will they notice this?

18. Of all the persons above you in the company, who has the most control over what you actually do on the job?

19. If your boss does not think you are doing such a good job, what kind of reactions are most likely? (consequences)

20. Do you think your boss really is in an effective position to evaluate you fairly? Why? Why not?

21. How do you evaluate the degree of control exercised by the company over your work?
    (1) Highly flexible
    (2) Very flexible
    (3) Average
    (4) A little tight
    (5) Very tight

22. In a situation like yours, how necessary is it to have a boss?
(1) Absolutely necessary
(2) Very necessary
(3) Necessary
(4) Necessary to a small degree
(5) Unnecessary

23. How much do you know about the overall financial situation of your company?
(1) Knows profoundly
(2) Have great knowledge
(3) Knows little
(4) Knows very little
(5) Have no knowledge

24. Do you think it is part of an engineer's job to be concerned about these things?
(1) Yes
(2) No
Why?:

25. What magazine, newspapers or newsletters are addressed to you by the company?

26. To what extent do you agree with the "profit-making" philosophy of the capitalist firm?

(1) Completely agree
(2) Agree a lot
(3) Non committal
(4) Agree little
(5) Completely disagree

27. Are there any decisions at this company that you think yourself and other engineers should have more say in?
(1) Yes
(2) No

If Yes: Can you give one example?

28. What about the production workers, are there decisions that they should be involved in?
(1) No
(2) Yes

If Yes: Could you give one example?

29. Considering your function in the company, do you feel part of management?
(1) Yes
(2) No
Why?:

30. How good would you say are your chances of career progression in the company?
    (1) Excellent
    (2) Very good
    (3) Average
    (4) Bad
    (5) Very Bad

31. What sort of things are needed to progress in this company?

32. How important is it for you to be promoted?
    (1) Highly important
    (2) Very important
    (3) Important
    (4) Not very important
    (5) Unimportant

33. How secure would you say your job is now? Why is that?
    (1) Very secure
    (2) Secure
    (3) Average
    (4) Insecure
    (5) Very Insecure

    33.1 Why?:

34. Have you ever thought of being self employed?
    (1) No
    (2) Yes

    If Yes: In what area?
    34.1 What would be the advantages? and the disadvantages?

35. How satisfied do you feel in relation to the way your career has turned out so far?
    (1) Very satisfied
    (2) Satisfied
    (3) Reasonably satisfied
    (4) Dissatisfied
    (5) Very dissatisfied

    If it is "very dissatisfied": Why?

36. What do you think will be the highest position you will ever hold in this company?
    (1) Senior Engineers
    (2) Chief of Division/Service
    (3) Chief of Department
    (4) Senior Manager
    (5) Superintendent
    (6) Director
    (7) President
    (8) Other ______________________________

37. Are you a member of CREA - Regional Council of Engineering Architecture and Agronomy?
(1) Yes
(2) No
37.1 If yes: Why did you join?
37.2 If no: Why you have not joined?

38. What do you think is the purpose of the professional associations like CREA? What do you think they should do for their members?

39. What do you think of the attempt to restrict professional membership to graduates?

40. Do you belong to a trade union?
(1) No
(2) Yes

If yes:
40.1 Which one?
40.2 How long have you been a member?
40.3 Do you hold (or have you ever held) any union office? If so, which? when?

If a union member:

41. Why did you join a union?

42. Why did you join that particular union?

43. Is there anything you dislike about your union?

44. Do you vote in union elections?
(1) No
(2) Yes
If not: Why not?

45. Have you ever stood, or thought of standing for union office?

If not a union member ask:

46. Have you ever belonged to a union in the past?
(1) Yes
(2) No
if yes:
46.1 Which one?
46.2 Why did you leave?
46.3 Why don't you belong to a union now?
46.4 Are there any circumstances under which you would consider joining a union again? What are they? What kind of union would you want to join?

all:

47. What do you think accounts for the recent increase in unionisation amongst engineers and other technical staff?

48. Belonging to a union is good practice for what sort of Workers?

49. What do you thing should be the of a union for engineers?

50. Would you support a strike? (Probe for conditions)
(1) No
(2) Yes

50.1 What are the consequences for you, if you support a strike?

51. What about a closed shop?

52. What is the relationship between management and the shop-floor unions here?
(1) Highly cooperative
(2) Cooperative
(3) Average
(4) Cooperative to a small degree
(5) Uncooperative

53. Do you think that being a union member could undermine your career in the company? Is there any risk of dismissal?
(1) Not at all.
(2) Very little
(3) A little
(4) To certain extent
(5) Profoundly

53.1 - How would you evaluate the degree of control by management over union activities among engineers in the company?
(1) High
(2) Moderate control
(3) Low

54. How would you evaluate your salary in comparison with other engineers in similar position to yours?

A) IN THE COMPANY

(1) Very High
(2) High
(3) The same
(4) Low
(5) Very low

B) IN OTHER COMPANIES

(1) Very high
(2) High
(3) The same
(4) Low
(5) Very low

54.1 What about your salary in comparison with professionals in the company?

a) In relation to managers

(1) Very high
(2) High
(3) The same
(4) Low
(5) Very low

b) In relation to other professionals

(1) Very high
(2) High
(3) The same
(4) Low
(5) Very low

c) In relation to technicians

(1) Very high
(2) High
(3) The same
(4) Low
(5) Very low

54.2 How do you evaluate your salary in relation to what you do in the company?

(1) Very high
(2) High
(3) Fair
(4) Low
(5) Very low

55. What is in the nature of the work of an engineer that should entail higher remuneration than that of a production worker.

56. What is in the nature of the work of an engineer and a manager that means a manager should earn more?

57. How would you feel if everyone received the same income whatever their jobs?

58. Some firms pay individuals strictly according to the particular job grade they occupy, while others pay on a more individualised system. Which way do you prefer? Why?

59. How do you evaluate the physical working conditions (equipments, rooms, furniture, work material, work environment etc) within which you carry out your job?
(1) Very satisfactory
(2) Satisfactory
(3) Reasonable
(4) Unsatisfactory
(5) Very unsatisfactory

60. How important is your salary for your survival?
    (1) Unimportant
    (2) Not very important
    (3) Average
    (4) Of great importance
    (5) Indispensable (essential)

= In addition to your salary, do you have other sources of income?
(1) YES
(2) NO

If yes: Which one is your main source of income?
(1) Other sources
(2) Salary

61. How satisfied do you feel with your present professional situation in relation to the expectance that you might have when you decided to become an engineer?
    (1) Very satisfied
    (2) Satisfied
    (3) Reasonably satisfied
    (4) Little satisfied
    (5) Dissatisfied

62. Have you ever been unemployed? If yes: Why did it happen?

63. Would you suggest "engineering" for a friend, son\daughter who are preparing to enter university?

64. What was your father's usual occupation while you were growing up?
    64.1 What was your father's final occupation?
    64.2 What was your mother's usual occupation?

65. What is or was the dominant political position of your parents?
    (1) Right
    (2) Centre-right
    (3) Centre
    (4) Centre-left
    (5) Left
    (5) Uncommitted

66. How would you characterise your own politics?

    (1) Right
    (2) Centre-right
    (3) Centre
    (4) Centre-left
    (5) Left
    (6) Uncommitted

64.1 To what, if any, party do you feel closest? Always that one? Are you active in or a member of any party or political movement?

67. Within Brazilian society, is a professional like yourself closer to manual workers, white-collars, managers, liberal professionals?

(1) Liberal professionals (self-employed professionals)
(2) Managers
(3) Employed professionals
(4) White collars
(5) Manual workers

68. How many social classes would you say there are in Brazil, and how would you describe them?

69. What category of people belong to each of these social classes?

70. In order to determine what class a person belongs to in Brazil, what is the most important factor to consider?

71. Which class would you say you belong to, and your family? Why?
(1) Upper-class
(2) Mid-upper class
(3) Middle class
(4) Mid-lower class
(5) Lower class (working class)

APPENDIX 2

INTERVIEW SCHEDULE 2 - ENTERPRISES
(Interview and secondary search
in the companies)

1. **Company history and position in the business sector**

2. **Products**

- types of products or services
- licensed products or developed by the company
- production to internationally agreed "standard"

3. **Environment**

- location
- political context
- economic conditions
- industrial relations context

4. **Technology**

- characteristics and development
- changes in technology
- expenditure in R & D
- number of engineers and technicians working in R & D
- modernity of the production line

5. **Market**

- main customers
- competition
- involvement with customers
- growth in sale and market participation
- return on capital (% of average of the market):
- consequences for the employees: expansion of employment and career opportunities
- consequences for the organisational structure and layout

6. **Organisational structure**

- Levels of formalisation in terms of written rules and procedures
- centralisation **x** decentralisation (participation in decision makings; centre of decisions making)
- bureaucratic/less bureaucratic
- vertical and horizontal channels of information and authority
- importance and autonomy of technical knowledge in relation to the bureaucratic control

7. **Management style**

- autocratic, democratic, paternalistic, professional
- nature of supervision: close/responsible autonomy
- centralisation **x** decentralisation of planning, control, decision-making
- formalisation (job description, pre-design of objectives, cost information, out-put information);

8. **Human resource policies**

- total workforce
- total employees per occupational category (engineers, technicians, other professionals, clerical, manual workers - during the last five years)
- policies and procedures for: admission, rewards, training, evaluation, promotion, transference, dismissals, with special focus on engineers.
- industrial relation (relationship between enterprise and trade union).

APPENDIX 3

SCHEDULE 3 - INTERVIEW AND OBSERVATION
(Interview with the head of division where engineers work and observation of the engineers work environment)

1. **Summary of the engineers work in each department**

2. **Division of labour**

   - how are jobs allocated?
   - are jobs performed by groups or by individuals?

3. **Nature of work**

   - what does the chief's work involve?
   - what do engineers do?
   - do engineers perform mental rather than manual work?
   - does the job involve technical knowledge rather than
     knowledge of the firm?
   - do the engineers undertake all the work or have they technicians to do the manual work for them?
   - Is it a repetitious or creative job? (at. in testing)
   - career prospects associated with areas of experience at work.

4. **Work environment**

   - location of the engineers offices
   - noise
   - dirtiness
   - comfort
   - furniture
   - Size (large/small)
   - bright/dark
   - open-plan office or acoustic dividers
   - facilities/equipments

5. **Status provision for engineers**

   - separate offices for manager or common room;
   - secretary, telephone, size of desk, special name tag, clothes/uniform, flexitime, restaurant and transport system offered by the company; magazines and newspapers addressed by the company.

6. **Nature of supervision**

   - close or flexible

7. **Relationship with technicians and production workers**

- Do engineers supervise or control other workers?
- What sort of workers?

8. **Hierarchical structure in the workplace**

- Does it follow: the bureaucratic structure, the degree of technical responsibility or the nature of work?
- Who decides the budgets?
- Is there any autonomy in budgetary decisions?
- Do engineers participate in technical decision making? Up to what level?

APPENDIX 4

INTERVIEW SCHEDULE 4 - EDUCATION SYSTEM (Interview with Education System's Representatives)

1. When were the first engineering courses created in Brazil?
2. Main aims of the courses of engineering
3. Structure of the courses of engineering
4. Content of disciplines (focus on technical disciplines or open to others such as social science and management)
5. Changes in the engineering education during the last three decades and why did it happen.
6. Who decides about the curriculum of engineering courses
7. Aims of the stratification/specialisation of the courses
8. Relationship between engineering schools and enterprises
9. What implications did the University reform of the 1960s and 1970s have for the engineering profession?

APPENDIX 5

INTERVIEW SCHEDULE 5 - COUNCIL OF ENGINEERING - CREA)
(Interview and secondary search in the Council of Engineering)

1. Foundation and development of the Engineering Council in Brazil?

2. Explanation for the structuring of the engineering occupation and its transformation to a profession in Brazil;

3. When did engineering become a profession in Brazil?;

4. Evolution of the figures of Engineering Council's members during the last three decades;

5. Policies of labour market control for the engineering profession;

6. The engineers Ethic Code and its ideology of professionalism;

7. Trends in the profession's status, prestige, power, values and labour market for engineers.

APPENDIX 6

INTERVIEW SCHEDULE 6 - ENGINEERS UNION - SENGE\MG)
(Interview with Union Leaders and Document Search)

1. Foundation of the engineers' Trade Union;
2. Why have an engineers' Trade Union;
3. Engineers Unions' Ideology and class politics;
4. Recruitment strategies;
5. Number of members;
6. What percentage of the technical labour force does this Union represent?;
7. Main conquests, if any;
8. Trends in unionisation;
9. Relationship with the Engineers Society and Council of Engineering;
10. Relationship with others Unions.
11. What Political party does this Union support?

APPENDIX 7

LIST OF ABBREVIATIONS

ABENGE	Associacao Brasileira de Ensino de Engenharia (or Brazilian Association of Engineering Education)
NATCO	The Energy and Electricity Company (the Brazilian Company)
CFE	Conselho Federal de Educacao (Federal Council of Education - an Organ of the Ministry of Education responsible for supervising the functioning of the Brazilian education system)
CLT	Consolidacao das Leis do Trabalho (Consolidated Labour Laws)
CGT	Central Geral dos Trabalhadores (Central General of Workers)
CONFEA	Conselho Federal de Engenharia, Arquitetura e Agronomia (Federal Council of Engineering, Architecture and Agronomy)
CONSENGE	Coordenacao Nacional de Sindicatos de Engenheiros (National Coordination of Engineers Unions)
CREA	Conselho Regional de Engenharia, Arquitetura e Agronomia (Regional Council of Engineering, Architecture and Agronomy)
CREA\MG	Conselho Regional de Engenharia, Arquitura e Agronomia do Estado de Minas Gerais (or Regional Council of Engineering, Architecture and Agronomy of the State of Minas Gerais)
CREA\RIO	Conselho Regional de Engenharia, Arquitetura e Agronomia do Estado do Rio de Janeiro (or Regional Council of Engineering, Architecture and Agronomy of the Estate of Rio de Janeiro)
CUT	Central Unica dos Trabalhadores (or Unique Central of Workers)
FGTS	Fundo de Garantia do Tempo de Servico (the law relating to stability of employment and dismissal compensation)
FNE	Federacao Nacional de Engenheiros (National Federation of Engineers)
INTCO	The Steel Mill Company (the German Company)
IBGE	Instituto Brasileiro de Geografia e Estatistica

(Brazilian Institute of Geography and Statistics)

MEC Ministerio da Educacao e Cultura (Ministry of Education and Culture)

PDS Partido Democratico Social (or Democratic and Social Party)

PFL Partido da Frente Liberal (or Liberal Front Party)

PMDB Partido do Movimento Democratico Brasileiro (or Brazilian Democratic Movement Party)

PRN Partido da Renovacao Nacional (or National Renovation Party)

PSDB Partido Social Democratico Brasileiro (or Brazilian Social Democratic Party)

PT Partido dos Trabalhadores (or Workers Party

SENGE/MG Sindicato dos Engenheiros do Estado de Minas Gerais (or Engineers Union of the State of Minas Gerais)

SENGE/RIO Sindicato dos Engenheiros do Estado do Rio de Janeiro (or Engineers Union of the State of Rio de Janeiro)

SENGE/SP Sindicato dos Engenheiros do Estado de Sao Paulo (or Engineers Union of the State of Sao Paulo)

APPENDIX 8

(IDENTIFICATION OF VARIABLES IN THE QUESTIONNAIRE - APPENDIX 1)

VARIABLE	QUESTION NUMBER IN APPENDIX 1
SECTION A: SAMPLE CHARACTERIZATION	
AGE	1
SEX	2
POST	3
TIME IN THE COMPANY	4
AREA (DEPT\DIVISION\SERVICE)	5
SECTION B: EDUCATIONAL BACKGROUND	
SECONDARY SCHOOL	1
UNIVERSITY	1
DAYTIME CLASSES	1
EVENING CLASSES	1
YEAR OF GRADUATION	1
SPECIALIZATION	2
SECTION C: JOB HISTORY	
PROFESSIONAL MOBILITY	1
TIME WITHOUT PROMOTION	1
TIME IN THE SAME POSITION	1
SECTION D: GENERAL QUESTIONS	
TECHNICAL PROLETARIANIZATION	3, 4, 5,
SPECIALIZATION	6
IDEOLOGICAL PROLETARIANIZATION	7
TECHNICAL AUTONOMY	8, 9
PLACE IN THE LABOUR PROCESS	10
SATISFACTION WITH THE FUNCTION	11
VARIABLES WHICH AFFECT PROMOTION IN THE COMPANY	12
IDENTIFICATION WITH AREA OF ACTIVITIES	13, 14
CAREER ORIENTATION	15
CONTROL BY MANAGEMENT	16, 17, 18, 19, 20, 21
LEGITIMATION OF MANAGEMENT	22
KNOWLEDGE OF THE FINANCIAL SITUATION OF THE COMPANY	23
INTEGRATION IN THE BUSINESS VALUES	24, 25
VIEW OF PROFITS	26
PARTICIPATION IN DECISIONS	27, 28
PERCEPTION OF BEING PART OF MANAGEMENT	29
CAREER PERSPECTIVE	30, 31

VARIABLE	QUESTION (continuation)
IMPORTANCE OF PROMOTION	32
STABILITY OF EMPLOYMENT	33
IDENTIFICATION WITH THE COMPANY	34
CAREER SATISFACTION	35
CAREER EXPECTANCE	36
INVOLVEMENT WITH PROFESSIONAL ASSOCIATION	37, 37.1, 37.2
THE ENGINEERS VIEW OF CREA'S UTILITY	38, 39
UNION MEMBERSHIP	40
REASONS TO JOIN A UNION	41
REASONS FOR NOT JOINING A UNION	42
CRITICISM OF THE ENGINEERS UNION	43
PARTICIPATION IN UNION ELECTION	44, 45
PAST EXPERIENCE WITH UNIONS	46
REASONS FOR THE GROWTH OF UNIONIZATION AMONGST ENGINEERS	47
UTILITY OF UNIONS ACCORDING TO CATEGORY OF WORKERS	48
THE ROLE OF THE ENGINEERS UNION	49
SUPPORT TO STRIKE	50
SUPPORT TO JOINT ACTION	51
CONTROL OF MANAGEMENT OVER UNION ACTIVITIES	52
CONSEQUENCES FOR UNION MEMBERSHIP AND MILITANCY	53
INTERNAL SALARY EQUITY	54A, 54.1 a, b and c
EXTERNAL SALARY EQUITY	54B
PERSONAL SALARY EQUITY	54.2
JUSTIFICATION OF SALARY	55, 56, 57
EQUITY BETWEEN SALARY POLICY AND ENGINEERS EXPECTANCE	58
PHYSICAL WORKING CONDITIONS	59
IMPORTANCE OF SALARY	60
COMPLEMENTARY SOURCE OF INCOME	60
MAIN SOURCE OF INCOME	60
SATISFACTION WITH THE CAREER	61
EXPERIENCE OF UNEMPLOYMENT	62, 63
ECONOMIC CLASS ORIGIN	64
POLITICAL POSITION OF ENGINEERS	65, 66
RELATIONSHIP WITH OTHER OCCUPATIONAL GROUPS	67
PERCEPTION OF SOCIAL CLASSES IN BRAZIL	68, 69, 70
SELF LOCATION IN THE CLASS STRUCTURE	71

APPENDIX 9

(RESULTS OF CHI-SQUARE TEST PRESENTED IN THE THESIS)

TABLE NUMBER	NOTE No.	CHI-SQUARE	DF	PROBABILITY	CRITICAL VALUE	SIGNIFICANCE AT α=
5.5		0.305	1	0.587	3,841	0.05
5.6		0.443	1	0.5088	3,841	0.05
5.7		0.282	1	0.5951	3,841	0.05
5.8		6.500	2	0.388	5.991	0.05
5.9		7.826	4	0.982	9.488	0.05
5.10		1.434	2	0.4882	3.841	0.05
5.12		45.530	1	9.019E-11	7.879	0.005
8.3		9.504	4	0.0497	9.488	0.05
8.4		6.405	2	0.0407	5.991	0.05
8.5		0.364	2	0.8336	5.991	0.05
8.6		18.830	2	8.150E-05	10.597	0.005
8.12		0.045	1	0.8312	3.841	0.05
8.13		15.740	2	3.821E-04	10.597	0.005
8.14		5.070	1	0.0243	5.024	0.025
8.15		28.119	1	1.142E-07	7.879	0.005
8.16		0.140	1	0.7087	3.841	0.05
8.17	1	6.711	2	0.0349	5.991	0.05
8.17	2	0.054	2	0.9732	5.991	0.05
8.17	2	2.386	2	0.3034	5.991	0.05
9.1		5.219	2	0.0736	5.991	0.05
9.2		9.324	2	9.446E-03	9.210	0.01
9.3		0.329	1	0.5665	3.841	0.05
9.4		6.955	1	8.359E-03	6.635	0.01
9.6		2.336	1	0.1264	3.841	0.05
9.7		9.852	2	7.367E-03	7.378	0.025
9.8		16.861	1	4.021E-05	10.597	0.005
9.9		10.462	1	1.219E-03	6.635	0.005
9.10		2.360	1	0.1245	3.841	0.05
9.12		9.327	2	9.435E-03	9.210	0.01
9.13		2.812	1	0.2304	3.841	0.05
9.14		5.396	1	0.0202	3.841	0.05
9.15		1.245	1	0.1436	3.841	0.05
9.17		3.882	2	0.1436	5.991	0.05
10.1		0.032	1	0.8573	3.841	0.05
10.2		0.024	1	0.8760	3.841	0.05
10.4		0.985	1	0.3211	3.841	0.05
10.5		0.590	1	0.4426	3.841	0.05
10.6		1.368	1	0.2422	3.841	0.05
10.7		0.505	3	0.1383	7.815	0.05
10.8		3.061	2	0.2164	5.991	0.05
10.9		0.654	1	0.4186	3.841	0.05
10.12		6.509	1	0.0107	5.024	0.025
10.13		37.047	3	4.037E-07	14.860	0.005
10.14		0.193	1	0.6602	3.841	0.05

Continuation

TABLE NUMBER	NOTE NO.	CHI-SQUARE	DF	PROBABILITY	CRITICAL VALUE	SIGNIFICANCE LEVEL At α=
11.4	1	9.262	2	9.747E-03	9.210	0.01
11.4	2	4.675	2	0.0966	5.991	0.05
11.4	3	20.357	2	3.799E-05	10.597	0.005
11.4	4	35.812	2	1.673E-08	10.597	0.005
11.5		0.528	1	0.4673	3.841	0.05
11.6		2.038	2	0.3609	5.991	0.05
11.10		15.881	2	3.560E-04	10.597	0.005
11.11		14.547	2	6.936E-04	10.597	0.005
11.12		8.498	1	0.003556	7.879	0.005
11.13		5.900	1	0.0151	5.024	0.025
11.14		0.039	2	0.8435	3.841	0.05
11.15		0.948	1	0.3303	3.841	0.05
11.17		6.957	2	0.0309	5.991	0.05
11.18		9.510	1	0.002044	7.879	0.005
11.19		0.038	1	0.8462	3.841	0.05
11.20		4.216	1	0.0400	3.841	0.05
11.21		21.180	3	9.612E-05	12.838	0.005
11.22		8.246	2	0.0162	7.378	0.025
11.23		6.464	2	0.0395	5.991	0.05
11.25		19.327	4	0.0006777	14.860	0.005
11.26		0.415	3	0.9372	7.815	0.05
11.27	1.1	12.292	2	1.510E-03	10.597	0.005
11.27	1.2	25.992	2	2.269E-03	10.597	0.005
11.27	2	7.376	2	0.0250	5.991	0.05
11.27	3	13.261	2	1.320E-03	10.597	0.005
11.28	1	8.075	1	4.489E-03	7.879	0.005
11.28	2	27.984	1	1.224E-07	7.879	0.005
11.28	3	42.326	1	9.539E-11	7.879	0.005
11.28	4	6.967	1	8.303E-03	6.635	0.01
11.28	5	0.045	1	0.8311	3.841	0.05

Note: 1) DF= Degree of Freedom
2) See note bellow for explanation of how the Chi-Square Test was used in the thesis.

NOTES ON THE USE OF THE CHI-SQUARE TEST IN THE THESIS

The Chi-square test is largely used when we need to answer questions about population. It can be used to decide whether or not a set of data fits a specific theoretical probability model. It can also be used to decide whether or not several samples come from the same population even when the model of the population is unspecified - this is called the **chi-square test of homogeneity** (Dowdy and Wearden, 1983:97). The chi-square test of homogeneity is used to determine whether two or more multinominal populations are the same (Ibid:115). Taking a case of this research, for example, we needed to know if the feeling of satisfaction with the career was the same for engineers and managers in the same company and between companies. To answer this question we formulated the following hypothesis for the test of homogeneity: The null and alternative hypothesis were:

Ho: The feeling of satisfaction with the career is the same between engineers and managers

H1: The feeling of satisfaction with the career is different between engineers and managers

Following the criteria defined to undertake the chi-square test and to analyze the results (see Ott, 1990:567-603; Hays, 1981:536-573; Dowdy and Wearden, 1983:97-124, for detail), if we have a 2 x 2 Contingency Table, which leads to a DF (degree of freedom) = 1, the critical Chi-square value for a level of significance of 0.05, (or $X^2_{0,05,1)}$ is = 3.841, the null hypothesis (Ho) is rejected if the Chi-Square statistic is greater than or equal to this value. In this case we would than argue that the level of satisfaction with the career among engineers and mangers is different. Or that, the differences of levels of satisfaction with the career between engineers and managers is significant at the 0.05 level X^2. Conversely, if the Chi-Square is smaller than the critical value (=3.841) we would have to accept the null hypothesis. We would then argue that the levels of satisfaction with the career among engineers and managers is the same, or in other words, that the differences between engineers and managers, in relation to satisfaction with the career, is not significant at the 0.05 level X^2.

It was also necessary to determine, for example, to what extent union membership among engineers was related to managerial control. In this case the test procedure was the **chi-square test of independence** (see Dowdy and Wearden, 1983:117-118; Ott, 1990:572-583; Hays, 1981:536-573). In this case the null (Ho) and alternative (H1) hypothesis were:

= Ho: Unionisation among engineers is independent of (or not affected by) management control

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= H1: Unionisation among engineers is dependent of (or affected by) management control

Following the same criteria presented above for a 2 X 2 Contingence Table, with 1 degree of freedom and significance of 0.05, and the critical value of 3.841, (or ($X^2_{0,05,1}$ = 3.841), the null hypothesis was rejected if the chi-square statistic was greater than or equal to this value. In this case we could argue that high or low rates of unionisation among engineers are associated to high or low control by management on the engineers. We could also argue that the association between variables (unionisation and control) are significant at the 0.05 level x^2. On the contrary, the null hypothesis (Ho) was accepted if the chi-square statistic wass smaller than 3.841. In this case we could argue that there was no relationship between rates of unionisation and management control, or in other words that, the association between the variables (unionisation and management control) was not significant at the 0.05 level X^2.

It was also important to define the basic criteria for the use of chi-square test, mainly for the tests involving 2 X 2 contingency tables. According to Ott (1990:574), "some researchers recommend that the sample size be large enough so that all expected cell counts are 5 or more". He criticises these exigences and argue that " this criteria is too stringent", and recommend that no expected cell count be less than 1 and that no more than 20% of them be less than 5 (ibid. p.574).

However, other statisticians accept even lower expected cells count. Hays (1981:552-555) accepts 2 x 2 contingency tables with all expected cell counts with less than 5. He even uses 2 x 2 contingence tables with one expected cell count equal to "0". Nonetheless, he argues that "in situations where the sample size is so small that the use of X^2 test is ruled out, it may be practicable to compute probabilities exactly" (p.552). A commonly known test to calculate exact probabilities is the **Fisher's exact test** for a 2 x 2 contingency table.

The interpretation of the results of **Fisher's exact test** is done in the following way:

1) If P > or = 0.05 for an α = 0.05 or less, we can argue that there is no association between the variables considered for analysis, in order words, we confirm that A an B have similar characteristics, or that, A and B are the same; 2) Conversely, if P < 0.05, for an α = 0.05, we can argue that,

A and B are different, or that there is an association between variables A and B (For detail about interpretation see Hays, 1981:552-558).

The quantitative analysis of the work situation and class position of Brazilian engineers throughout the thesis folowed the procedures presented so far for the use of chi-square test of homogeneity and the chi-square test of independence or association, as well as for the analysis of 2 x 2 contingency tables. The Fisher's exact test was used to define the "exact probability" in chi-square test for 2 x 2 contingency tables when the number of observations falling in more than 20% of the cells was less than 5. Therefore, the chi-square with continuous correction (X^2_{cc}) and the chi-square without continuous correction were both taken into account for the interpretation of 2 x 2 contingency tables.

APPENDIX 10

(CONTINGENCE TABLES FOR TABLE 8.18 AND 11.16)

1). CONTINGENCY TABLES FOR CHAPTER 8, TABLE 8.18)

TABLE 1 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND PERCEPTION OF INTERNAL SALARY EQUITY (Total Sample)

Satisfaction with the career	Perception of Internal Salary Equity					
	My salary is the same as my colleagues		My salary is lower		Total	
	N=	%	N=	%	N=	%
Satisfied	43	37.72	8	7.02	51	44.74
Unsatisfied	45	39.47	18	15.79	63	55.26
Total	88	77.19	26	22.81	114	100.00

Notes: 1) Chi-square= 1.976; DF=1; P> 0.01; Critical value = 3.841
2) Association not significant at the 0.05 level X^2

TABLE 2 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND PERCEPTION OF STABILITY OF EMPLOYMENT (Total Sample)

Satisfaction with the career	Perception of stability of employment					
	My job is secure		My job is insecure		Total	
	N=	%	N=	%	N=	%
Satisfied	43	37.72	8	7.02	51	44.74
Reasonably satisfied	38	33.33	11	9.65	49	42.98
Unsatisfied	10	8.77	4	3.51	14	12.28
Total	91	79.82	23	20.18	114	100.00

Notes: 1) Chi-square = 1.408; DF=2; P=0.4945; Critical value = 5.991
2) Association not significant at the 0.05 level X^2

TABLE 3 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND PERCEPTION OF EXTERNAL SALARY EQUITY (Total sample)

Degrees of satisfaction with the career	Perception of external salary equity: My salary is the or higher than my colleagues in other companies		My salary is lower		Total	
	N=	%	N=	%	N=	%
Satisfied	54	47.37	32	28.07	86	75.44
Unsatisfied	15	13.16	13	11.40	28	24.56
Total	69	60.53	45	39.47	114	100.00

Notes: 1) Chi-square = 0.415; DF=1; P> 0.05; Critical value = 3.841
2) Association not significant at the 0.05 level X^2

TABLE 4 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND PERCEPTION OF PERSONAL SALARY EQUITY (Total sample)

Degrees of satisfaction with the career	Perception of personal salary equity: My salary is fair for what I do		My salary is unfair		Total	
	N=	%	N=	%	N=	%
Satisfied	18	16.82	10	9.35	28	26.17
Unsatisfied	20	18.69	59	55.14	79	73.83
Total	38	35.51	69	64.49	107	100.00

Notes: 1) Chi-square = 12.059; DF=1; P = 0.005153; Critical value = 7.879
2) Association between variables significant at the 0.005 level X^2

TABLE 5 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND PERCEPTION OF PERSPECTIVE OF CAREER

	Perspective of career							
	GOOD		REGULAR		BAD		TOTAL	
	N=	%	N=	%	N=	%	N=	%
Satisfied	23	20.18	15	13.16	13	11.40	51	44.74
Reasonably satisfied	10	8.77	28	24.56	11	9.65	49	42.98
Unsatisfied	1	0.88	6	5.26	7	6.14	14	12.28
Total	34	29.82	49	42.98	31	27.19	114	100.00

Notes: 1) Chi-square = 15.470; DF=4; P=0.003820; critical value = 13.277

2) Association significant at the 0.01 level X^2

2). CONTINGENCE TABLES FOR CHAPTER 11 - COLLECTIVE ORGANIZATION

CONTINGENCE TABLE FOR TABLE 11.16

RELATIONSHIP BETWEEN OBJECTIVE PROLETARIANISATION AND UNIONISATION AMONG ENGINEERS AND MANAGERS

TABLE 1 - RELATIONSHIP BETWEEN PERCEPTION OF CAREER OPPORTUNITY AND UNIONISATION (Total sample)

Perception of career opportunity	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Good	21	18.42	12	10.53	33	28.95
Average	24	21.05	23	20.18	47	41.23
Bad	13	11.40	21	18.42	34	29.82
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 4.324, DF=2, P=0.1151, Critical value = 5.991

2) Association not significant at the 0.05 level X^2

TABLE 2 - RELATIONSHIP BETWEEN IMPORTANCE OF PROMOTION AND UNIONISATION (TOTAL SAMPLE)

Degree of importance of promotion	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Highly important	30	26.32	25	21.93	55	48.25
Of average importance	22	19.30	23	20.18	45	39.47
Of little importance	6	5.26	8	7.02	14	12.28
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square=0.728, DF=2, P= 0.6950
Critical value = 5.991
2) Association not significant at the 0.05 level X^2

TABLE 3 - RELATIONSHIP BETWEEN SATISFACTION WITH THE CAREER AND UNIONISATION (TOTAL SAMPLE)

Degree of satisfaction	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Satisfied	22	19.30	29	25.44	51	44.74
Reasonably satisfied	28	24.56	21	18.42	49	42.98
Little satisfied	8	7.02	6	5.26	14	12.28
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 2.212, DF=2, P= 0.3309
Critical value = 5.991
2) Association not significant at the 0.05 level X^2

TABLE 4 - RELATIONSHIP BETWEEN PERCEPTION OF EXTERNAL SALARY EQUITY AND UNIONISATION (TOTAL SAMPLE)

Perception of equity	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
1) My salary is higher than my colleagues in similar posts in other companies	15	13.16	10	8.77	25	21.93
2) My salary is the same	24	21.05	20	17.54	44	38.60
3) My salary is lower	19	16.67	26	22.81	45	39.47
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 2.418, DF = 2, P = 0.2985
Critical value = 5.991
2) Association not significant at the 0.05 level X^2

TABLE 5 - RELATIONSHIP BETWEEN PERCEPTION OF INTERNAL SALARY EQUITY AND UNIONISATION (TOTAL SAMPLE)

Perception of equity	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
1) My salary is higher than may colleagues in similar post in the company	1	0.88	3	2.63	4	3.51
2) My salary is the same	42	36.84	42	36.84	84	73.68
3) My salary is lower	15	13.16	11	9.65	26	22.81
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 1.581, DF=2, P = 0.4537
Critical value = 5.991
2) Association not significant at the 0.05 level X^2

TABLE 6 - RELATIONSHIP BETWEEN PERCEPTION OF PERSONAL SALARY EQUITY (FEELING OF BEEN EXPLOITED OR NOT) AND UNIONISATION (TOTAL SAMPLE)

Perception of equity	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
1) My salary is fair for what I do in the company	20	17.54	19	16.67	39	34.21
2) My salary is low for what I do	38	33.33	37	32.46	75	65.79
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 0.018, DF=1, P=0.8925
Critical value = 3.841
2) Association not significant at the 0.05 level X^2

TABLE 7 - RELATIONSHIP BETWEEN DEPENDENCE ON THE SALARY AND UNIONISATION (TOTAL SAMPLE)

Importance of the salary	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Of great importance	16	14.04	16	14.04	32	28.07
Indispensable/or essential	42	36.84	40	35.09	82	71.93
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 0.008, DF=1, P=0.9271
Critical value = 3.841
2) Association not significant at the 0.05 level X^2

TABLE 8 - RELATIONSHIP BETWEEN PERCEPTION OF THE QUALITY OF THE PHYSICAL WORKING CONDITIONS AND UNIONISATION (TOTAL SAMPLE)

Evaluation of working conditions	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Satisfactory	38	33.33	34	29.82	72	63.16
Reasonable	11	9.65	14	12.28	25	21.93
Unsatisfactory	9	7.89	8	7.02	17	14.91
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 0.606, DF=2, P=0.7385
Critical value = 5.991
2) Association not significant at the 0.05 level X^2

TABLE 9 - RELATIONSHIP BETWEEN CONTROL BY MANAGEMENT OVER THE ENGINEERS' WORK AND UNIONISATION (TOTAL SAMPLE)

Degree of control	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
Very flexible	5	4.39	2	1.75	7	6.14
Average	41	35.96	30	26.32	71	62.28
A little tight	12	10.53	24	21.05	36	31.58
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 6.957, DF=2, P=0.0309
Critical value = 5.991
2) Association significant at the 0.05 level X^2

TABLE 10 - RELATIONSHIP BETWEEN PERCEPTION OF SECURITY ON THE JOB AND UNIONISATION (TOTAL SAMPLE)

Perception of security on the job	Unionised		Not Unionised		Total	
	N=	%	N=	%	N=	%
The job is secure	54	47.37	37	32.46	91	79.82
The job is insecure	4	3.51	19	16.67	23	20.18
Total	58	50.88	56	49.12	114	100.00

Note: 1) Chi-square = 11.303, DF=1, P=0.0007737
Critical value = 7.879
2) Fisher Exact Probability: Lower Tail = 1.0000, Upper Tail = 0.0002841 ($P<0.005$)
3) Association significant at the 0.005 level X^2