UNIVERSITY OF SOUTHAMPTON

COMPUTER TECHNOLOGY AND THE REDEFINITION OF SUPERVISION

A STUDY OF THE EFFECTS OF COMPUTERISATION ON RAILWAY FREIGHT SUPERVISORS

by

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FOR MY MOTHER

University of Southampton

Abstract

Faculty of Social Science

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Doctor of Philosophy

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The relationship between computer technology and supervision is examined with reference to new empirical evidence drawn from a study of the computerisation of freight operations in British Rail. Attention is focused on the extent to which computerisation allows for a more integrated system of management control, and the possibility of devolving additional elements of control from middle management to the local supervisory level.

Contemporary research often claims that the first-line supervisor is becoming more peripheral to the direct control of operations, as computerised equipment takes over the execution of many supervisory tasks, and as operatives who are skilled in the use of new technology overtake the apparent skill superiority of first-line supervisors. This thesis contends that it is misleading to focus on the 'pure' role of the first-line supervisor when studying the effects of computer technology on supervision.

The main body of empirical data is drawn from an in-depth study of the effects of change in five traditional marshalling yards in three British Rail regions. The case study examines how the application of a comprehensive computer system to process and transmit information over diverse and spatially distant freight yards can transform the distribution of responsibilities for operational control within management. It is argued that the redistribution of management control functions over a network of organisational levels has resulted in a far more complex redefinition of supervision than is implied by the apparent erosion of the role of the first-line supervisor. A broader conception of supervision is presented in order to explain changes in the distribution of supervisory tasks across various supervisory levels, within the context of changes in work organisation and the system of management control. Finally, it is argued that whilst computerisation may erode the traditional basis of supervision, it may also result in the emergence of a new type of computer-oriented supervisor, whose role is to use the 'real-time' information provided by the computer to co-ordinate and control previously diverse areas of production or service operations.

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Glossary of Abbreviations

AFA	Area Freight Assistant
AFC	Area Freight Centre
ASLEF	Associated Society of Locomotive Engineers and Firemen
ATI	Advanced Traffic Information
BR	British Rail
BRB	British Rail Board
BRBHQ	British Rail Board Headquarters
CDC	Communication Data Control
CPU	Central Processing Unit
CWA	Central Wagon Authority
DDF	Dynamic Data Files
DDR	Daily Distribution Report
DU	Demand Unit
HQ	Headquarters
IBM	International Business Machines
ICL	International Computers Limited
MCJ	Message Control Job
MEJ	Message Edit Job
MI	Movement Instruction
MPJ	Message Processing Job
NEBSS	National Examinations Board for Supervisory Studies
NIIP	National Institute of Industrial Psychology
NTRG	New Technology Research Group
NUR	National Union of Railwaymen
SERC	Science and Engineering Research Council
SSRC	Social Science Research Council
SPR	Southern Pacific Railroad

TOC	TOPS On-Line Control
TOPS	Total Operations Processing System
TRA	TOPS Responsibility Area
TSSA	Transport Salaried Staffs' Association
TWI	Training Within Industry
VDU	Visual Display Unit
WRHQ	Western Regional Headquarters
WTT	Working Time Table

Acknowledgements

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In the course of working within the New Technology Research Group at Southampton University I recieved considerable support from other members of the group. I would like to thank: Robert Smith, Robin King, and Howard Rose, for their useful advice and encouragement; John Smith for his help in setting up the research programme and delineating the parameters of a worthwhile and yet manageable study; and Ian McLoughlin for acting as a continual source of help and providing many insights into the problems and practice of sociological research. I would especially like to thank my supervisor, Jon Clark, whose unending enthusiasm, energy, and criticism, provided the stimulation and motivation to complete such a large piece of work.

In presenting papers on this study, I have received many useful comments from a host of other interested academics. I would like to thank them all, and in particular, Steven Massey for his criticisms and suggestions. Finally, I would like to thank Sue Thomson, for her patience and support over the many weekends and evenings spent apart.

Chapter 1. Introduction

(i) Research Objectives

The purpose of this dissertation is to examine the effects of computerisation on the roles of supervisors and the function of supervision. This examination is conducted at two levels and deals with:

- the initial impact and longer term effects of computerisation on the roles of supervisors and the function of supervision
- the factors which shape the redefinition of supervision from the initial decision to invest in computer technology through to the routine operation of computer-aided operating (or production) systems

This research aims to complement the findings of contemporary studies on the 'impact' of new technology on the role of the first-line supervisor.[1] A major objective is to test empirically the general view of previous studies that the application of computer technology tends to erode the importance of supervision in the exercise of management control. In critically examining this view it is argued that the present debate is hampered by conceptual weaknesses deriving from the problem of defining supervisory roles and tasks. Through developing a broader concept of supervision it is suggested that computerisation is likely to involve a far more complex redefinition of supervisory functions than is implied by the apparent erosion of the role of the first-line supervisor. This hypothesis is evaluated in Part II in an empirical case study analysis of the effects of computerisation on the jobs of railway freight supervisors.

A major obstacle in any study which aims to examine computerisation and the redefinition of supervision is the length of the timescale involved. The computerisation of British Rail's system of freight information control took nearly six years from the initial decision to introduce computer technology through to the routine operation of the new computer system. Moreover, as the computer-aided operating system chosen for study had been implemented prior to the start of the research, it was not possible to monitor the whole process of change. Consequently, the nature of the operating system before and during the change had to be reconstructed from retrospective accounts and documentary material made available during the research. Chapter 4 examines those factors which shaped the process of computerisation from the initial decision to invest through to implementation and initial operation of the system. The remaining chapters then discuss in more detail the changes in supervision which resulted from the adoption of a computer-aided operating system.

The initial decision to investigate the effects of computer technology on supervision was taken by the New Technology Research Group. It was agreed that such a study would contribute to a wider programme of research being carried out at Southampton University, and further the Group's objective to critically examine the consequences of technological change for supervision, management and organisational structure.

(ii) The New Technology Research Group (NTRG)

The NTRG was established at Southampton University to combine the expertise of social scientists and engineers to investigate the introduction of new technologies in work organisations.

The Group was founded in 1979 by Dr. R.W. King and Professor R.C. Smith of the Department of Electronics, and Dr. J.W. Clark and Professor J.H. Smith of the Department of Sociology and Social Administration. Initial funding of approximately £100,000 was provided by the Joint SERC/SSRC Committee, which was the main source of support for the research into the introduction of a computerised freight information system in British Rail, and the modernisation of British Telecom telephone exchanges.

The principal objectives of the Group are to explore the process and outcomes of technological change, which includes an examination of:

- the consequences of technological change for management, supervision and organisational structure
- the problems of engineering and management choice, and design of new technologies in work organisations
- the nature of strategies developed to implement new technologies in the work place, including education and training in new skills
- the development of trade union strategies in response to the introduction of new technologies
- the consequences of technological change for the design of work and attitudes of work groups
- the effectiveness of industrial relations procedures in handling the issues arising from technological change.[2]

Since 1979, a number of empirical case studies on the introduction of new technologies in work organisations have been completed.[3]

(iii) Existing Research

The capacity of computer information technologies to capture, process and transmit large quantities of information at high speed has important implications for the ability of management to control production operations. This is especially the case where these operations are geographically dispersed, or in production units which are geographically remote from corporate management. Computer-based information systems have the potential to make operations more 'visible' to senior management and thus capable of being controlled more directly.[4]

Such an application of computer technology raises obvious questions about the role of the supervisory function in relation to management control systems, since supervisors have traditionally been at the interface of management and the control of production operations.

The literature of the late fifties and early sixties suggested that computerisation could either contribute to an erosion of the traditional supervisory role by enabling a centralisation of control in the hands of management away from the point of production, or alternatively, that computerisation could be used to decentralise production control and enhance the role of supervisors.[5] In either event, it was claimed that computer technologies would create new structures of control, particularly at lower levels of line management.[6]

The predominant findings of more recent literature suggest that computer technology is contributing to an erosion of the role of the first-line supervisor.[7] These studies illustrate how supervisors are becoming increasingly peripheral to the system of control as the shopfloor control function of supervision is incorporated into the machine, concentrated in higher management, or devolved to operatives. It has been found that although computer technology affords the possibility of combining an enhanced supervisory role with greater functional integration, in practice, the tendency has been to diminish the control function of supervision at the point of production and therefore, erode the role of the first-line supervisor.[8]

These conclusions contrast with those of the study into the effects of computer technology on marshalling yard supervision reported here. In this study it was found that some supervisory roles had persisted, some supervisory responsibilities had been eroded, and a new 'key' supervisory role had emerged. This suggests that computerisation can involve a far more complex redefinition of the supervisory function than is implied by simply pointing to the apparent erosion of the role of the first-line supervisor. This thesis therefore contends that a broader conception of supervision is required to account for changes in the distribution of supervisory tasks across various occupational levels within work organisations.

(iv) Reconceptualising Supervision

In order to take account of the way in which the traditional function of supervisory control is redefined with the introduction of computer technology, supervision is broadly conceptualised as the *direct control of workplace operations*. The supervisory control functions identified at the workplace comprise:

- planning and directing workplace operations
- monitoring and evaluating workplace operations
- correcting and adapting workplace operations

Individuals are designated as holding a supervisory relationship to an operating (or production) system in cases where: firstly, they are in direct control of some aspects of workplace operations; and secondly, authority is invested in their position by management and/or the workforce. These criteria are used to delimit a structure of supervision comprising a hierarchy of supervisory roles. The day-to-day liaison between, and interaction of, these individuals is taken into account by employing the concept of a 'supervisory system of control' developed by Thurley and Wirdenius.[9] The redefinition of supervision is also explained within the context of changes in work organisation and the system of management control (see Chapter 3).

(v) The British Rail Case Study

In 1971 British Rail decided to invest £13 million in a new computer information system to improve management's control over freight operations. The system, known as Total Operations Processing System

(TOPS), has been in operation since 1975 following a four year implementation programme. TOPS constituted one of the first large-scale ventures by British industry in the application of an on-line real-time computer information system. Moreover, whilst technological change on the railways is usually seen from outside the industry in terms of changes in traction, signalling, or 'permanent way', the application of computer technology to the problems of management control of railway freight operations is viewed within the industry as one of the most significant advances to have taken place within the last ten to fifteen years. The computer system is regarded by British Rail management as having accomplished a 'quiet revolution' in railway operating practice.

This dissertation documents the findings of research conducted between 1981 and 1983 on the effects of computer technology on railway freight supervisors. This involved a retrospective study of management strategy and industrial relations issues in the implementation of the TOPS system, and a more detailed study of the effects of change on local supervision in railway marshalling yards. The main body of empirical data is drawn from the latter research, which involved an in-depth study of the effects of change in five traditional marshalling yards in three British Rail regions.[10]

(vi) Research Methodology

The fieldwork for the retrospective study of the system implementation comprised the following methods and sources of data:

- a series of familiarisation visits and periods of observation at British Rail installations, for example, freight yard and customer terminals, British Rail Board and regional headquarters, regional control offices, and British Rail training schools
- a programme of interviews with 'key informants' involved in the implementation of the system including: the British Rail chief executive; the TOPS project manager; the implementation team manager; computing and telecommunications specialists; various members of the implementation team; and members of the freight operations department currently using the system at area and headquarters levels
- a search of documents and files held by the British Rail Board relating to the implementation and enhancement of the system (these included a detailed report prepared by the project manager on the implementation of the system)

- a search of files held by the rail unions and discussions with their research departments

This research was carried out by myself and by other members of the New Technology Research Group between October 1981 and the summer of 1982.[11]

The main body of research on the effects of computer technology on local supervision was conducted by myself between May 1982 and November 1983. During the study, interviews were conducted with 80 British Rail employees at:

- national and regional headquarters
- two British Rail training centres
- a number of British Rail marshalling yards

In the five marshalling yards which formed the basis of the study interviews were conducted with 10 local managers, 12 senior supervisors, 17 first-line supervisors, 12 deputy supervisors, and 10 working supervisors (for a more detailed breakdown see Tables II-V, pp.226-228). The interview schedules covered topics such as job content, working and personal relationships with other supervisors, management and yard staff, and the way these had been changed by computerisation (see Appendix III).

A questionnaire was designed solely for use with supervisory graded staff, who at the outset of the study claimed that they might not have enough time to be interviewed. The questionnaire was therefore intended either to provide data which could not otherwise be obtained, or to act as a supplement to interviews conducted with the supervisors. As it turned out, data elicited by questionnaire was largely used to supplement other methods of data collection. Questionnaires were completed by fourteen senior supervisors and ten first-line supervisors from a sample taken in five marshalling yards and two supervisory training centres (see Appendix IV).

A key research method used throughout the study was non-participant observation. In each of the five marshalling yards periods of between two to five weeks were spent observing the working practices of staff. Full ten hour day and night shifts were spent with individual supervisors and 'shunting gangs', observing and informally discussing the work of yard staff. Particular attention was paid to the use that was made of information from the computer system by supervisors in making operating decisions. In addition, the nature and number of contacts with other supervisors and yard staff were monitored. Such a detailed programme of observation made it possible to ascertain the nature of supervisory tasks and the roles of individual supervisors. Furthermore, from interviews and discussions, it was possible to construct a picture of working practices prior to computerisation.

Data elicited through these methods was supplemented by documentary material from the local marshalling yard (this included job descriptions of marshalling yard staff) and from national and regional headquarters.

Finally, further attempts were made to understand the operational use of the computer by briefly visiting and examining systems on Victoria Railways (Australia) and New Zealand Railways, and by attending courses held on the TOPS system for supervisors at British Rail's training schools (see also Appendix II).

(vii) Structure

Chapter 2 provides an historical outline of the emergence of the role of the formal first-line supervisor and characterises two general types of first-line supervisory positions. In an examination of the effects of technical change on the role of the supervisor, it is shown how debates within the literature have tended to focus on these two general types of supervisory roles and have equated changes in *supervision* with either changes in the *role*, or traditional *labour control function*, of *first-line supervisors*.

Following this general analysis of the effects of technical change on supervision, the next section critically examines the literature which discusses the effects of computer technology on the role of the supervisor. It is argued that the predominant view that the role and function of supervision is becoming increasingly peripheral to the control of production operations should be treated with some caution. The chapter concludes by suggesting the need for:

- a more differentiated conceptual framework for analysing the effects of computer technology on the roles of supervisors and the function of supervision
- an analytical framework for investigating the process of computerisation from the initial decision to invest in new technology, through to the routine operation of computer-based operating systems.

It is claimed that these are required in order to explain adequately the effects of computerisation on *supervision* in general, and hence to understand the implications of computer technology for the roles of supervisors and the function of supervision.

In Chapter 3, an analytical and conceptual framework for examining the effects of computerisation on supervision is developed. The first section identifies the 'stages of innovation' associated with the introduction of new technology, and at each 'stage', the main factors which have been identified within the literature as influencing the process of change. A number of analytically distinct 'stages' are then defined and a framework for the case study examination of the process and outcome of computerisation is provided. In the remainder of the chapter, a broader conception of *supervision* is formulated to take into account the variety of supervisory tasks, status levels, and job titles of individuals who are directly engaged in the continuous control of an operating (or production) system. This framework is employed in part II, in an empirical examination of the effects of computer technology on 'supervisory systems of control' and individual supervisory roles in British Rail marshalling yards.

Chapter 4 provides a retrospective study of management strategy and industrial relations issues in the implementation of TOPS. The analytical framework developed in Chapter 3 is used to examine the various stages associated with the introduction of TOPS including: the decision to invest; the choice and design of the technology; the initial planning and implementation strategies; and routine operation. The major factors which shaped the process of change are identified, and the chapter concludes with an assessment of the influence of these factors on the organisational outcome of computerisation.

In Chapter 5, the broader conception of supervision developed in Chapter 3 is utilised in an examination of the effects of computer technology on marshalling yard supervision. It is shown how computerisation involved a far more complex redefinition of supervisory functions than is implied by the apparent erosion of the role of the first-line supervisor.

Chapter 6 then examines the outcome of computerisation on first-line supervision. The degree to which computer technology is rendering first-line supervisory positions more peripheral or pivotal to the operating system is also discussed in the light of the recent debates outlined in Chapter 2.

Chapter 7 investigates the creation of a new supervisory position (the area freight assistant) and evaluates the extent to which computer technology may facilitate the emergence of a new type of computer-oriented supervisory position, the purpose of which is to control previously diverse areas of production operations.

In Chapter 8, the main substantive findings of the research are summarised and the implications of computer technology for supervision are reappraised.

Finally, it should be noted that unless otherwise stated, the diagrams presented in this study have been created by the author in order to clarify and illustrate the main body of the text.

Chapter 1. Notes and References

1. See for example, S.P. Black, 'Numerically Controlled Machine Tools in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company', and 'Computer Coordinate Measuring Machines in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company', in D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983; S. Rothwell, 'Supervisors and New Technology', *Employment Gazette*, January 1984, pp.21-25; and S. Rothwell, and D. Davidson, 'New Technology and Manpower Utilisation', *Employment Gazette*, June 1982, pp.252-254, and July 1982, pp.280-283.

2. See, New Technology Research Group, 'Annual Report: April 1982-September 1983', New Technology Research Group, University of Southampton.

3. For further information see the New Technology Research Group's Annual Reports, available from the New Technology Research Group, University of Southampton, SO9 5NH.

4. See for example, P.M. Blau, C.M. Falbe, W. McKinley, and P.K. Tracy, 'Technology and Organisation in Manufacturing', *Administrative Science Quarterly*, Vol. 21, No. 1, 1976, pp.20-40; M. Rose, *Computers, Management and Society*, Penguin, 1969; and M. Weir, 'Are Computer Systems and Humanised Work Compatible?' in R.N. Ottoway, (editor) *Humanising the Workplace*, Croom Helm, 1977.

5. For an overview of these early debates see, C.A. Myers (editor), *The Impact of Computers on Management*, Massachusetts Institute of Technology Press, 1967.

6. See for example, H.J. Leavitt, and T.L. Whisler, 'Management in the 80s', *Harvard Business Review*, Vol 36, November-December, 1958, pp.41-48.

7. See literature cited in Note 1.

8. See for example, D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983, p.257.

9. See, K.E. Thurley, and H. Wirdenius, *Supervision: A Reappraisal,* Heinemann, 1973, pp.27-29.

10. Four of the yards were principal marshalling facilities and the other was a smaller specialist traffic yard . Each of the principal marshalling yards comprised at least three distinct sub-yards and covered an area of one or more square miles.

11. See, I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson 'The Introduction of a Computerised Freight Information System in British Rail - TOPS', New Technology Research Group, University of Southampton, 1983.

Part I. Computer Technology and Supervision

The first part of this dissertation reviews the literature on technological change and supervision. Particular attention is paid to discussions of the emergence and changing role of the first-line supervisor. Two general types of supervisory roles are characterised and the implications of computer technology for these positions are appraised. It is suggested that in order to fully appreciate the effects of computer technology on supervision, it is important to examine changes in supervisory jobs within the context of changes in work organisation and the wider system of management control. With this aim in mind, supervision is reconceptualised and the criteria for identifying and defining supervisory positions are outlined. An analytical framework is also developed in order to identify and analyse the key factors which redefine supervision during the introduction of computer technology.

Chapter 2. The Role of The Supervisor: Historical Development and Key Issues

(i) Introduction

The two predominant themes within debates on the relationship between computer technology and supervision focus attention on: firstly, the extent to which there has been a shift in supervisory emphasis resulting in the emergence of a new 'breed' of supervisor; and secondly, the degree to which the role of the supervisor has become 'pivotal' or 'peripheral' to the operating (or production) system.

In the first section an account is given of the historical emergence and changing role of the supervisor. From this discussion two general types of first-line supervisory roles are characterised. The second section then examines two apparently contrasting views about the effects of technical change on the role of the supervisor. The third section discusses the particular implications and consequences of computer technology for the role of the supervisor. The chapter concludes by questioning whether changes in the *role of the first-line supervisor* can be equated with changes in *supervision*.

(ii) The Changing Role of the First-line Supervisor

Evidence from the literature suggests that the traditional supervisor concerned primarily with controlling the activities of labour (the 'overseer' of labour) has been replaced by a new type of supervisor who spends most of his time dealing with technical contingencies and monitoring the overall performance of a particular operating system. This section examines this hypothesis and outlines the main characteristics of two general types of first-line supervisory roles.

(a) The Historical Emergence of the First-line Supervisor

> From the master craftsman the supervisor....has largely inherited what is expected of him. From the lead man he has, however, largely inherited his actual position.[1]

The evolution of the supervisors' role has its origins both in the semi-independent contractor[2] and in the lead man or chargeman.[3] The internal contractor or piecemaster would undertake a certain project at a given price, receiving the difference between the stipulated rate and the costs in the form of a profit or loss.[4] The leading man or master craftsman would normally be responsible for the pace of work and the behaviour of the work group.[5]

Throughout the nineteenth century supervision usually involved some element of sub-contract.[6] The supervisors were regarded as 'undisputed masters' and had the authority to hire and fire, set wages, and plan the allocation of work.[7] The importance of supervision increased with the growth of large factories and the reliance on 'middle men' to oversee workplace operations under larger scales of production. In a study of the engineering industry, Melling suggests that employers used more intense and direct forms of supervision to reduce overall costs and improve output and efficiency.[8] The semi-autocratic supervisor was given free reign as employers attempted to instil discipline and improve the work performance of operatives:

> The agglomeration of workers into factories was a natural outgrowth of the putting out system whose success had little or nothing to do with the technological superiority of large-scale machinery. The key to the success of the factory, as well as its inspiration, was the substitution of capitalists' for workers' control of the production process; discipline and supervision could and did reduce costs without being technologically superior.[9]

Technology, therefore, was used by management to redefine labour's potential to produce output and supervision was used as a means of realising that potential.

By the 1870s the use of sub-contractors was in sharp decline, and by the turn of the century the traditional, directly-employed foreman had largely replaced the internal contractor before him.[10] In most workplaces with the possible exception of those employing large groups of craftsmen, such as in printing and ship building, the traditional supervisor held an 'undisputed' position of power and authority over shop floor workers. The major difference between the internal contractor and the traditional supervisor was that the latter did not employ their own labour, rather, their main source of income was in the form of wages. The role of the supervisor was carried out internally within the organisation rather than externally through sub-contractors. The change in the type of employment of the supervisor was complex. Essentially, the contractor either became integrated within the organisational structure as a directly employed foreman, or he became a semi-supervisor answerable to a foreman (for example, chargeman), or he became a 'submerged workgroup leader'.[11]

(b) The Traditional Labour-Oriented Supervisor

The traditional supervisor or foreman may be defined as: an individual who oversees the activities of a workgroup by close contact. Taken from the latin *supervidere* (to overlook), supervision was used to refer to the function of controlling labour. In this instance foremanship involves:

- regulating and directing the activities of labour
- monitoring and evaluating the performance of labour
- disciplining the non-compliance of labour[12]

In other words, the traditional supervisor is an 'overseer of labour' whose *raison d'être* is the close supervision and control of labour activities. The major characteristics of this type of supervisor are:

- predominantly of working class origin
- recruited from the shop floor
- knowledge based on years of practical experience
- little formal education and training
- position represents end of career progression
- tendency to be middle-aged

Through overseeing the activities of labour by close contact the traditional supervisor has been identified as a 'labour master',[13] a 'rank and file supervisor',[14] or a 'working-class foreman'.[15] In addition, he has been identified as holding an increasingly peripheral and ambiguous position to production control following shop floor unionisation, technical advance and the development of more impersonal forms of labour control.[16]

The modification of the traditional role of the supervisor as an 'hire-and-fire' figure is examined below, and the degree to which his 'labour master' role has become pivotal or peripheral to the operating system following technical change is discussed in greater detail in the next section.

(c) Challenge to the Traditional First-line Supervisor

At the turn of the century workplace conflict became an overt problem for employers. By the end of the First World War, the autocratic style of supervision was identified as a significant problem within British industry.[17] Supervisors were not only seen to be the cause of much work place conflict, but they were also found to be a major source of resistance to technical change and work re-organisation schemes.[18] As Child and Partridge note:

> After the war, the supervisor was singled out as the culprit for much of the industrial unrest and hostility of employers which then prevailed.[19]

During the inter-war period, scientific management became attractive as it appeared to offer a solution to this problem by challenging the span of control and degree of domination afforded the traditional supervisor[20] through the concept of 'functional foremanship'.[21]

F.W.Taylor (the founding father of scientific management) advocated the abandonment of an hierarchical militaristic type of organisation and suggested its substitution with 'functional management'.[22] The suggestion was to replace the traditional 'multi-purpose' foreman who was held responsible for the sucessful running of the entire shop, with a number of different bosses, all of whom would perform their own particular function (for example, gang-bosses, speed bosses, inspectors, repair bosses, and shop disciplinarian).[23] Although this form of functional management was never fully adopted in Britain, new forms of work organisation evolved during the inter-war period which reflected these Taylorite principles.[24]

Following the Second World War, many of the advocated solutions to the problem of autocratic supervision were based on formal supervisory training in 'human relations' techniques.[25] The emergence of early courses in job relations stem largely from the establishment of a Training Within Industry (TWI) agency, set up in America in 1940 to assist production and service executives in common human relations problems of industrial men and women. The TWI programmes were developed from an examination and identification of five essential requirements for effective supervision, namely: knowledge of work; knowledge of responsibility; leadership skills; instruction skills; and skill in improving methods of operation. The TWI system was based on the concept that, of the five essential qualities of a supervisor, the last three were common to all supervisory positions no matter what the nature of the industry.[26]

The three programmes in which these three common requirements were developed are:

- job instruction: for developing skill in the training of operators

- job relations: for developing skill in management
- job methods: for improving methods of work

In 1944, the TWI programme was adopted in Britain, and with the setting up of the Institute of Industrial Supervisors in 1947, the ground had been prepared for a period of 'training' and 'debate' on the issue of job relations and supervisory performance.[27]

After the Second World War, with the growth in the size of the industrial enterprise, economic prosperity and unionisation, an additional 'problem' of supervision was identified by academics who were concerned with the issue of supervisory re-adjustment and organisational change.[28] Essentially it was argued that with the advent of relatively full employment since the late 1940s, the mobility of labour had increased and consequently workers felt less compelled to submit to the authority of the foreman.[29] The supervisor had become the 'man in the middle' required to satisfy the needs of both management and the workforce.[30] In addition, it was argued that changes in the functional organisation of work, and the substantial growth in the collective organisation of employees and the power of the shop steward, had aggravated the supervisory 'problem' of conflicting demands and created the 'problem' of marginality.[31] In short, the traditional supervisor was not only caught between conflicting demands from management and the shopfloor, he was also becoming increasingly marginal to the actual running of the operating system.

The two 'problems' are defined in the literature as deriving from:

- the changing qualities required of individuals in supervisory positions
- organisational change and the 'middle' or 'marginal' position of the supervisor

As Thurley and Wirdenius have indicated:

> The great majority of studies have been dominated by two concepts, that of (a) leadership and (b) the link role (foreman between management and men)...The leadership studies provided the framework and justification for supervisory training in many countries...The link role studies on the other hand, have been utilized to explain supervisory behaviour in industrial disputes and the problem of role stress for supervisors.[32]

The leadership studies claim that the supervisor has an important role as a 'leader' and 'motivator' of men, rather than as a shop disciplinarian.[33] It would appear that effective supervision of labour demands a 'flexible-situational' but 'dispositionally-consistent' style of leadership.[34] This is in addition to the need for a 'differentiated role' and 'generalist approach',[35] which is both formally recognised and influential, and yet independent from management.[36] In short, through a programme of supervisory training the role of the supervisor needs to be redefined as a type of 'human relations leader' as opposed to a 'bowler-hatted boss'.

The basic argument of the 'marginal man' thesis is that since the war, the authority, status and role of the supervisor has been eroded because of increased worker unionisation and management specialisation (in, for example, the growth in personnel departments).[37] It is claimed that the position of the foreman has become increasingly peripheral to the system of control, and that there is no longer a need for traditional supervision within the modern organisation.

The literature therefore indicates that the role of the traditional supervisor has been either eroded, replaced or redefined. However, both the 'leadership' view and the 'marginal man' view are open to a number of criticisms. The leadership studies, for example, have not given adequate attention to the fact that the task of directing a work group may account for only a small proportion of the formal first-line supervisor's time.[38] In contrast, this may be a central element in the job of informal work group leaders, who are however not formally defined as holding a supervisory relationship to production.[39] This tendency in the literature to concentrate on formal first-line supervisory positions has major weaknesses which are discussed in more detail later. Furthermore, it is a fallacy to represent changes in supervision as a linear evolution followed by a subsequent decline in the position of the first-line supervisor. This is well documented in Melling's historical analysis of the changing role of the supervisor in engineering and building trades.[40] Melling demonstrates how the growth in scale and complexity of large enterprises, increasing managerial specialisation, the spread of formal union membership, and technological innovation, have not led to a coherent evolution in the role of the traditional supervisor. He concludes that by concentrating on the 'problem' of role conflict and role ambiguity, many writers fail to provide accurate accounts of the actual changes which have occurred to supervisory roles in specific trades and industries.[41] Studies carried out by Hill[42] and the National Institute of Industrial Psychology[43] have also illustrated the dangers of making general statements about the role of the supervisor.

They stress the need to examine the actual function of supervision in each particular industrial setting.[44] This will be one of the main aims of the case study discussed in Part II of the thesis.

Research carried out in the early fifties and sixties into the job of the supervisor demonstrated how the traditional responsibilities of labour leadership and control had been redefined. The supervisor was shown to be no longer primarily concerned with the supervision of labour activities, but involved in a much wider range of tasks.[45] As Thurley and Wirdenius note:

> The idea of the supervisor in charge of his group of men, which was a very accurate picture at earlier stages of industrialisation, has lingered on, and is highly misrepresentative of many situations in modern technology, where supervisors are extremely dependent on each other and working together with other supervisors and functional specialists.[46]

In a study of five production industries, Thurley and Hamblin found that the main supervisory functions carried out by first-line supervisors varied considerably both across industries and within different departments of the same industry.[47] Nevertheless, all of the supervisors were to some extent involved in doing four basic tasks, namely:

- planning work
- monitoring its progress
- dealing with contingencies
- reporting to management[48]

Studies concerned with the jobs of supervisors illustrate the diversity of supervisory tasks found in industry. In addition, they indicate a shift in supervisory emphasis away from the supervision of labour and towards 'machine' and 'process' supervision.[49] This is particularly evident in studies which have examined more technically advanced systems of production.[50]

In summary, this shift in supervisory emphasis identified in the literature suggests that there are two generally distinct 'types' of supervisor. One is primarily concerned with the supervision of people (the traditional labour-oriented supervisor), and the other is essentially involved in the supervision of equipment and technical processes (the machine-oriented supervisor). These two types (one concerned primarily with the 'human' aspects of work, and one concerned primarily with the 'technical' aspects of work) can be regarded as the two ends (polar opposites) of a continuum of supervisory roles found in practice.

(d) The Machine-Oriented Supervisor

The machine-oriented supervisor is the term used to characterise what has been identified as a new type of 'technical' supervisory role. Here supervision involves:

- planning and directing technical operations
- monitoring and evaluating technical operations
- correcting and adapting technical operations

The machine-oriented supervisor is concerned with the effective running and maintenance of an operating system in which technical contingencies are the prime cause of production failures. He has been identified as a 'managerial supervisor',[51] a 'technical supervisor',[52] and a 'middle-class foreman'.[53]

The major defining characteristics of this new type of supervisor are:

- predominantly of upper working and middle class origin
- recruited from the shop floor and/or as a graduate entrant
- knowledge technically based
- extensive training and formal education
- position represents one stage of career development
- tendency to be relatively young

In contrast to the traditional labour-oriented supervisor, this new type of machine-oriented supervisory position is based on technical skill rather than 'knowledge-through-experience' or an ability to supervise men. The extent to which this new supervisory role has become 'pivotal' or 'peripheral' under more technically advanced systems of production, is a question which will be examined in the following section.

(iii) Pivotal or Peripheral? Technical Change and the Role of the Supervisor

In this section two alternative views on the effects of technical change on supervision are examined:

- firstly, that the role of the supervisor is becoming increasingly *peripheral*
- secondly, that the role of the supervisor has become more *pivotal*

The first view suggest that advances in technology and work re-organisation schemes have contributed to an erosion of the traditional supervisory role, which is becoming increasingly peripheral to management as control is removed from the point of production.[54] An alternative, though not necessarily contradictory view is that, with advances in technology, the overall process of production has become more complex and the supervisor has been redefined as a 'technical expert' with a narrow span of control (the machine-oriented supervisor). He holds a pivotal position in relation to production control, by dealing with technical contingencies and ensuring the uninterrupted flow of the operating system.[55]

(a) The Peripheral View

The view that the supervisor is becoming increasingly peripheral has been forwarded by a number of writers covering a range of perspectives.[56] This section will concentrate on one particular perspective which links the erosion of traditional labour-oriented supervision with a decline in the need for the direct control of labour as more sophisticated mechanisms of control are introduced into the 'labour process'. In short, the labour control function of supervision is seen to be increasingly incorporated into bureaucratic or technical systems of control.[57]

Writers who adopt this perspective in their analysis of supervision and technical change generally claim that:

- the 'variability' of labour poses itself as a recurrent managerial problem, and increasing control over the 'predictability' of labour is a central managerial objective[58]
- new technologies tend to be introduced and used by management as systems of control which replace traditional modes of supervision. New technology is thereby seen to eliminate and/or erode the traditional function of supervision.[59]

Edwards, in his book *Contested Terrain*, identifies three elements essential to the control of labour, namely:

- directing the activities of labour
- monitoring the activities of labour
- disciplining the non-compliance of labour.[60]

According to his historical analysis, the systems of control used by management to co-ordinate these three elements have undergone fundamental changes. His argument is that it is possible to discern a typology of systems of control which have evolved as a result of conflict and contradiction in the capitalist enterprise, that is, from simple forms of personal control systems (entrepreneurial control and hierarchical control) to 'structural' systems of control (technical control and bureaucratic control).[61]

Edwards argues that under the personal control systems of the nineteenth century, the supervisor held a pivotal position as a managerial agent of labour control. The main function of supervision was to direct, evaluate and discipline labour with the objective of ensuring that workers worked. As Edwards noted:

> Power was unmistakably vested in the person of supervisor.[62]

With the growth in the size of businesses in the twentieth century and the increased need to co-ordinate spatially dispersed areas of operation, more formalised methods of control were developed. Management formulated and implemented sets of rules and disciplinary procedures. These impersonal 'bureaucratic' control methods had the advantage of being less visible to workers whilst resolving the 'problem' of autocratic supervision.[63] The other structural method which management has employed involved technical control through the introduction of modern technologies. For example, Edwards argues that the introduction of assembly-line technology enabled management to eliminate direct supervision which had highlighted the class division at the workplace:[64]

> The substitution of technical for human direction and pacing of work simultaneously revolutionised the relation between foreman and workers...In effect, the line eliminated 'obtrusive foremanship', that is close supervision in which the foreman simultaneously directed production, inspected and approved work, and disciplined workers.[65]

Whilst technical control incorporated the elements of direction, Edwards recognised that foremen on the assembly-line still held important positions as 'inspectors', with responsibility for maintaining product standards and detecting inadequate work.[66] He claims that the job of the foreman was transformed to a monitoring job and hence, was no longer concerned with the initiation and control of job tasks (the pace and pattern of work being set by the machinery).[67]

Edward's conclusion that traditional supervision is becoming increasingly peripheral to production rests on the claim that impersonal control mechanisms have replaced supervisors as the main instrument for controlling staff. It is argued that developments in systems of bureaucratic control have relieved the supervisor of the task of disciplining staff, and developments in technical control systems have incorporated the element of direction.

This approach examines and defines the position of foremen in terms of the labour control function of capital.[68] Essentially, the role of the supervisor is seen to centre on extracting 'surplus value' from the workforce and transforming 'labour power' into 'labour'.[69] These studies note changes in the methods employed by management to control labour and argue that there has been a 'peripheralisation' of the direct supervisor of labour. Advances in technology are thus seen to have reduced the pivotal position of the traditional supervisor as a managerial agent of labour control.

(b) The Pivotal View

The alternative view that the supervisor may hold a pivotal position under advanced technologies has also found support among a variety of writers.[70] This section will concentrate on one particular perspective which links technical developments in the system of production with the emergence of a 'technical expert' or 'trouble-shooting' supervisory role. According to this argument there has been a 'shift' in supervisory emphasis towards technical supervision. The supervisor is seen to hold an increasingly pivotal position in dealing with technical contingencies and ensuring that production systems operate effectively.

Writers who adopt this view generally claim that under technically advanced systems of production, first-line supervisors hold pivotal positions as technical advisers and trouble shooters. Their central position stems from their ability to deal with technical contingencies in the daily operations of the production process. The importance of 'fire-fighting' or dealing with technical contingencies increases as the total production process becomes more complex and the tolerance for disturbances within the system is reduced.[71]

Woodward, in her study of a hundred manufacturing firms in South-East Essex, concluded that technical variables played a key role in shaping organisational structure and supervision. Three general stages in the development of production technologies were distinguished:

- unit and small batch production
- large batch and mass production
- process production[72]

Woodward argued that it is possible to identify certain stages in the development of production systems which are associated with certain characteristic forms of organisational structure and supervision. Under unit production, the supervisor is shown to work with operators in small work groups, autocratic supervision is generally absent, and there is a relatively high ratio of first-line supervisors to operators.[73] Within large batch and mass production industries, the supervisor is concerned with containing conflict and absorbing industrial unrest, rather than controlling the work of operators. For example, under assembly-line production it is claimed that the traditional supervisory function of directing and monitoring the pace of work is incorporated into the machinery. In such cases, the supervisor becomes more concerned with quality control and the various problems associated with worker morale and absenteeism, rather than labour control.[74] Under process production, Woodward shows how the supervisor is no longer so much concerned with manning levels and product inspection, but rather, tends to act as a 'technical adviser' to 'responsible workers'.[75] The increased complexity of the production process creates an additional demand for managerial and supervisory skills:

> Not only were there relatively more managers and supervisors in process industry but they were also better qualified.[76]

Woodward proposes that with each movement from unit production towards process production there will be a growth in the command hierarchy and an increase in the proportion of supervisory personnel to non-supervisory personnel.[77] At the first-line supervisory level a 'curvilinear' relationship was shown to exist between types of technology and span of supervisory control.[78] The small spans of control associated with process and unit production firms indicated the way work was organised into small primary groups. In unit production firms, line supervisors tended to be older than their counterparts elsewhere, and their knowledge derived from years of practical experience. In contrast, first-line supervisors in process industries were younger, and their technical competence derived largely from formal training and the attainment of qualifications rather than being based on 'knowledge-through-experience'.[79] Finally, in mass production industries the supervisor's span of control was found on average to be far greater than with unit or continuous-flow production, this was explained as being due to a general reduction in the area of supervisory discretion and an overall increase in on-the-job conflict and stress.[80]

Woodward's study argues that there has been a transition in supervisory emphasis and a change in the supervisor's span of control under different production systems. The movement from unit to process production is seen to represent a shift from labour-oriented to machine-oriented supervision. The role of the supervisor under process technology is characterised as being pivotal to the operating system. Moreover, Woodward states that the degree of variation found among batch and mass production firms can largely be explained in terms of the predominant control system. Reeves and Woodward[81] claim that those firms in the middle category with predominantly personal controls will tend to have an organisational structure similar to those of unit production systems, whilst those with predominantly impersonal controls will tend to have organisational structures which resemble those of process industries.[82]

The relationship between the 'control system' (as developed by Reeves and Woodward) and the role of the supervisor is also discussed by Wedderburn and Crompton in their analysis of a large chemical complex plant in North East England.[83] This plant consisted of five main, physically separate works which were managed independently of the main company owning the site.[84] Their analysis showed how the supervisor in works 'A' (a continuous chemical process plant) co-operated closely with operatives and had a 'trouble-shooting' role, in contrast to the more traditional labour-oriented supervisory roles found in works 'B' and 'C'.[85] These differences are explained in terms of the technology and the system of control. In short, a unified mechanical control system was found to exist in works 'A', whereas, works 'B' and 'C' were identified as having fragmented and impersonal control systems. The tasks which required close supervision in works 'B' and 'C' were thus largely controlled by the unified impersonal control system in works 'A'.[86] Wedderburn and Crompton conclude that:

> Whilst some aspects of the role were dictated by the technology (the hardware of the plant and the recipes in use), others were dictated by the various systems devised for controlling aspects of the production tasks....From the viewpoint of the operator and supervisor, therefore, the important constraints in the work situation stem both from the production process itself and from the control system associated with it.[87]

Therefore, a number of supervisory roles were identified ranging from the co-operative trouble shooting and technical expert roles of the machine-oriented supervisor, to the more traditional 'policing' role of the labour-oriented supervisor. The latter were however, found to be more 'humane' and 'democratic' in their attitudes than their 'autocratic' predecessors. This illustrates how 'old' and 'new' types of supervisors may co-exist under different stages in the development of production industries. According to this view, the emergence of a 'new type' of supervisory role does not therefore necessitate the demise of the 'old'.

Woodward's approach advocates that with the advancement of technology there will be an increase in the technical complexity of production. Due to the critical nature of problems associated with emergencies, the supervisor will hold a key role as technical expert and problem solver. His pivotal position stems from his ability to deal with production contingencies and minimise disruptions to the operating system.

This prompts two questions: firstly, why have these two sets of studies come to such different conclusions? Secondly, what are the implications of modern computer technologies for the role of the supervisor? The first of these two questions is examined below.

(c) Pivotal or Peripheral? The Arguments Summarised

In examining the extent to which advances in technology enable management to incorporate the function of supervision into more impersonal methods of control, Edwards concentrates on managerial strategies of labour control. He concludes that the traditional supervisory function of directing and monitoring the activities of labour can be eliminated through the introduction of new technologies at the workplace. Moreover, he suggests that the ability of modern computer systems to monitor and evaluate work performance may bring about an erosion of the supervisory tasks of detection, inspection and evaluation.[88] It is claimed that this may bring in its wake the demise of the traditional function of supervision:

> As with real foremen, these mechanical foremen...are themselves directed, evaluated and corrected by higher level...minicomputers that control and direct many processes at once....Computer technology gives a giant boost to the earlier methods of technical control.[89]

This conclusion does not take adequate account of the possibility of a redefinition of supervision and a shift in supervisory emphasis following the introduction of new technology. In other words, Edwards tends to view changes in the role of the supervisor in terms of changes in its traditional labour control function. Consequently, he neglects the fact that supervision can be concerned with aspects of production control other than those associated with labour. Whilst his claim that the traditional function of supervision has been eroded may be correct, this does not necessarily indicate that there will not be an important role for the supervisor under more advanced systems of production.

In contrast, Woodward when examining the role of the supervisor in different production industries, detected a shift in supervisory emphasis from being mainly concerned with labour towards machine and process supervision. A number of supervisory roles were identified, ranging from the traditional 'policing' role through to the 'technical expert' and 'trouble shooting' role found in process industries. Although computer technology was in evidence in some of these advanced systems of production, Woodward was not able to examine the full implications of *computer technology* for the role of the first-line supervisor under less advanced systems of production.

Both sets of studies argue that the role of the supervisor has changed as a consequence of technical change. For Edwards, the introduction of new technologies signal the eventual abolition of traditional supervision. Whereas for Woodward, a variety of supervisory roles may co-exist under different stages in the development of production industries. Moreover, while the former concentrates on changes to the traditional *labour control function of supervision*, the latter focuses on changes to the *role of the formally defined first-line supervisor*. These conflicting emphases have thus led to the apparently contradictory conclusions that the role of the supervisor will either be 'peripheral' or 'pivotal' to the control of workplace operations with advanced technology. These conclusions will be tested empirically in Part II of this dissertation.

Within the context of this broader analysis of the general effects of technical change on the role of the supervisor, the next section examines the particular connection between computer technology and supervision. The capacity of this technology to affect organisational structures across different types of production and service industries suggests that it may prove more fruitful to treat this technology as a separate and distinct form of technical change.[90]

(iv) Computer Technology and The Role of the Supervisor

> At the core of all administrative and managerial activity are two crucial functions - communication and control - which themselves depend on the capture, dissemination, interpretation and utilization of significant pieces of information...In economic activities its transmission, collection and processing is hardly less important than the manufacture of goods...until recently there were no equivalents in information technology for the power tool, the automatic lathe or complex materials handling equipment.[91]

The importance of the availability of accurate information for effective production operations has been identified in a number of studies. For example, Roethlisberger and Dickson show in their classic study how:

> Only with the help of accurate information could the foreman act intelligently.[92]

With the growth in the size of industrial enterprises and changes in technology, more extensive formalised information control systems have been developed. These control systems, concerned with processing information (in order to co-ordinate diverse and spatially distant activities) have been further enhanced following developments in telecommunication networks, and the converging developments in microelectronic and computing technology.[93] Recent developments have served to reduce the cost and size of computer information systems whilst improving their performance and reliability. This has led to the widespread application of computer based systems which provide 'real-time' information on which 'intelligent' decisions can be based.[94] The significance of these more recent developments in microelectronics and computer technologies have been well documented elsewhere and need not be discussed in detail here.[95]

There are however, two essential points worth stressing:

- firstly, that information is a key resource in the control of diverse and spatially distant production operations
- secondly, that comprehensive computer information handling systems are currently available to organisations

The implications of these developments for the role of the supervisor and the function of supervision are examined in more detail below.

(a) Computer Technology: The Early Debate

> Over the last decade a new technology has begun to take hold in American business, one so new that its significance is still difficult to evaluate...The new technology does not yet have a single established name. We shall call it information technology. It is composed of several parts. One includes techniques for processing large amounts of information rapidly, and it is epitomized by the high-speed computer.[96]

The debate on the effects of computer technology on middle managerial and supervisory positions was initiated in the late 1950s. Much of the debate centred around the issue of whether computer technology would be used to centralise or decentralise production operations control,[97] and the question of whether the intermediate layer between top management and the work force would be eroded or enhanced as a consequence of computerisation.[98] Some commentators argued that middle management would be replaced by computer controlled information systems and that the role of the supervisor would be reduced to a basic routine monitoring function.[99] Others argued that although the effects of computerisation on middle management would be small, junior management and supervisory jobs would tend to become either fully or partially 'automated'.[100] Alternatively, it was also argued that certain aspects of the supervisor's job (for example, co-ordination and overall understanding of the working and problems of ground-level operations) would be heightened and his role as technical problem-solver strengthened.[101]

The early studies of Mumford and Banks,[102] and Whisler,[103] claimed that computer technology would lead to: the reduction in the number of clerical staff; the displacement of departments through increased integration; the centralisation of control (which would increase the 'visibility' of decisions made by middle and lower level managerial staff); an erosion of the supervisor's skill superiority with the emergence of new computer technologists; and a reduction in the span of control of first-line supervision.[104] As Mumford and Banks state:

> Department supervisors trained in traditional office routines are likely to find the new technology hard to understand; they may find their functions reduced in range and authority and they may have considerably fewer staff to control.[105]

In contrast, Zalewski suggested that the supervisor could hold a central position without necessarily being proficient over a range of complex tasks.[106] He claimed that the availability of accurate up-to-date information could widen the area of responsibility that individual supervisors had over production. Essentially, they could be concerned with the co-ordination of diverse efforts in the achievement of a common goal:[107]

> Supervision remains essential, but it is the final results rather than detailed operations that must be supervised in advanced stages of automation.[108]

According to Thurley,[109] and Zalewski,[110] the supervisor could hold a central position as either a 'technical adviser' (if he possessed sufficient technical skill and knowledge), or a 'work place co-ordinator' (if there was a widening of his area of responsibility) following the introduction of computer technology.

These early debates raised three points worth emphasising here. Firstly, that computer technology may enable an organisation to either centralise or decentralise decision making authority. In other words, computer technology does not determine organisational structure, rather this is determined by the way in which the technology is introduced and used. Secondly, strategies which promote centralisation are likely to erode supervisory positions as control is removed from the point of production. Thirdly, strategies which promote decentralisation may either erode or enhance supervisory positions. For example, it was claimed that if supervisors were trained in the use of computer technology then they would generally hold more important positions within the organisation, whereas, if supervisors were not retrained they would tend to find their functions reduced and the basis of their authority eroded. These studies therefore indicate the importance of examining the process by which computer technology is introduced into organisations in order to explain the outcome of computerisation on the role of the supervisor.

The need to examine the way new technology is introduced seems particularly pertinent in the case of computer technology where there would appear to be a choice between centralising or decentralising decision making authority and responsibility. Consequently, in the empirical case study presented in part II, the introduction of computer technology is examined in order to provide the necessary context within which a more detailed investigation of changes in supervision under the new computer-based operating system may be undertaken.

The following section examines the extent to which the general claims made during these early debates have been supported by more recent studies into the effects of computer technology on the role of the supervisor.

(b) The Impact of Computer Technology on the Role of the Supervisor

> The computer....can make efficient centralisation possible....or it can equally make for efficient decentralisation to take place making available to all locations the appropriate information required for decisions.[111]

The predominant findings from recent studies indicate that computer technology is contributing to an erosion of both the labour-oriented (traditional) and machine-oriented (technical) role of the supervisor.[112] For example, Rothwell,[113] and Rothwell and Davidson,[114] show that although computer technology affords the possibility of combining an enhanced supervisory role with greater functional integration, centralisation and 'flatter' hierarchies, the tendency has been to diminish supervisory responsibility. Rothwell thereby concludes by questioning the need for first-line supervisors.[115]

The view that computerisation tends to erode the apparent skill superiority of the supervisor, and reduce supervisory discretion and autonomy in controlling shopfloor operations, has found considerable support in the literature.[116] According to Buchanan and Boddy, computer technology erodes supervisory functions in three ways:

- through providing machine pacing of operations
- through enabling the automatic capture and analysis of production performance information
- through undermining the skill superiority of supervisors as operators gain experience with the new equipment.[117]

They illustrate how both the 'man-management' and 'technical' aspects of the supervisor's job are displaced under computer-based operating systems, and like Rothwell, conclude by calling into question the need for first-line supervision.[118]

Both sets of studies recognise that the capacity of computer technology to integrate previously diverse areas of operation could lead to the enhancement of some supervisory positions.[119] In general, however, their findings suggest that the role of the first-line supervisor is becoming peripheral to operating systems as the shopfloor control function of supervision is incorporated into the machine, devolved to operatives, or concentrated in management.

(c) Developments in the Role of the First-line Supervisor under Computer-based Operating Systems

Within the literature, it is possible to identify four broad choices for the development of the role of the first-line supervisor under computer-aided production systems. These are as follows:

> Reinforce the role of the supervisor as a 'specialist labour' role.
> The function of labour supervision becomes central in ensuring the integrity of information fed into the computer at the work place. For most commentators, this choice would be unlikely, given the capacity of this technology to direct and monitor production performance[120]
>
> Define the supervisor as a 'technical expert'.
> Under computerised production systems where breakdowns lead to more serious consequences for output, the supervisor could hold a key role in the maintenance of effective operations[121]
>
> Develop the role of the supervisor into a genuine first-line managerial role.
> Through enhancing decision-making activities following computerisation and delegating minor disturbance handling to work groups[122]
>
> Abolish the role of the supervisor.
> This is the predominant view in the literature, namely, that first-line supervision is becoming increasingly 'unnecessary' in

the control of operations with the introduction of new computer-based production systems[123]

These points illustrate that there is an element of choice in the development of first-line supervisory roles following the introduction of computer technology (the extent to which the role of the first-line railway freight supervisor corresponds to these options is examined in Chapter 6). However, as they concentrate primarily on the *role* of the formal *first-line supervisor*, they fail to take account of changes to the *control function* of *supervision*. In short, they do not address the question of whether changes in the role of the first-line supervisor can be equated with changes in supervision more broadly defined (see on this Chapters 3 and 5).

(d) How Computers Affect Supervision

Within the literature, the primary focus has been on the 'impact' of computer technology and how it affects the role of the first-line supervisor, rather than on how supervisory functions are distributed and re-distributed across different levels within organisational structures. To this extent, the general view that computerisation is leading to an erosion of first-line supervisory roles and that supervision is therefore becoming peripheral to management control systems should be treated with some caution.[124]

To illustrate this point it is worth looking in more detail at the case studies presented by Buchanan and Boddy. They see computerisation as leading to an erosion of the responsibilities of first-line supervisors, especially where supervisory tasks are being incorporated into the machine or carried out by more 'autonomous' operatives. In one of their case studies Buchanan and Boddy researched two computerised process plants owned by the same company and situated on the same site. It was observed that computerisation eroded the role of the first-line supervisor and enabled operators to have more autonomy, and in one plant the role of supervisor was abolished altogether.[125]

However, the authors note (although do not attribute as much significance to) a number of other changes. For example, in the plant where the first-line supervisors' roles were abolished, supervisory tasks were still apparently being carried out by individuals not formally defined as supervisors, namely, the plant manager and shift chemist. These individuals were identified as standing in a 'supervisory relationship' to the operatives.[126] Moreover, in the other computerised plant the supervisor was identified as holding an important role in dealing with technical contingencies during frequent plant breakdowns (despite an increase in the responsibility and discretion exercised by operatives).

Thus, whilst Buchanan and Boddy's data may indicate that computer technology is posing fundamental questions about the need for first-line supervisors, such evidence should not be interpreted as indicating an erosion of the supervisory function itself. Rather it can be argued that the emergence of operative and management roles involving a supervisory element, indicate that computerisation involves a far more complex redefinition of the supervisory function than is implied by simply pointing to the apparent erosion of the role of the formally defined first-line supervisor.

In order to better understand the outcome of computerisation on the supervisory function, it is essential that supervision is not conceptualised exclusively in terms of either the role of the first-line supervisor or the traditional function of first-line supervision. A broader conception of supervision is required, which will take account of changes in the distribution of supervisory tasks across various levels within the organisational structure. In the next chapter a broader conception of supervision is formulated, and following Thurley,[127] and Thurley and Wirdenius,[128] the concept of 'supervisory system of control' is utilised and developed.

(v) Conclusion

Apart from indicating the need for a broader conception of supervision, this chapter has detailed the complex changes which have occurred to the role of the first-line supervisor. Through providing an historical outline of the emergence and evolution of the position of supervisor, two broad types of first-line supervisory roles were characterised, namely, the traditional labour-oriented and the new machine-oriented supervisory roles. These are intended to represent two general types at each end of a continuum of supervisory positions found within organisations (as such, they serve as a 'benchmark' in the case study presented in part II). Furthermore, this chapter has demonstrated how a variety of supervisory roles have emerged ranging from the traditional 'labour master' and 'man-management' role, to the 'technical expert' and 'fire-fighting' role found within more technically complex operating systems.

In examining the effects of technical change on the role of the supervisor, it was shown how debates within the literature have tended to focus on these two general types of supervisory roles. These studies conclude that the technical supervisor holds a pivotal position under advanced systems of production, whereas the traditional labour control function of supervision is becoming peripheral following its incorporation into more impersonal methods of control.

More recent studies into the effects of computer technology on the role of the supervisor were shown to call into question the need for first-line 'man-management' and 'technical' supervision. These studies support many of the claims made during the 'early debate' on the implications of computer technology for supervision. There are three main characteristics of computer technology which lend support to the predominant view that the role of the first-line supervisor is becoming peripheral to production control. Firstly, it enables the centralisation of management control and reduces the discretion and autonomy previously exercised by supervisors. Secondly, it encourages the formation of semi-autonomous work groups and erodes the skill superiority of supervisors. Thirdly, it incorporates into the machinery traditional supervisory control responsibilities of directing, monitoring and evaluating staff. In other words, as a result of computerisation the shop floor control function of first-line supervision can be concentrated in management, incorporated into the machine, or devolved to operatives.

These studies nevertheless indicated that computer technology did not determine the outcome of change for first-line supervision, rather, this was determined by the way in which the technology was introduced and used within an organisation. It was thus shown that although the capacity of computer technology to integrate previously diverse areas of operation could lead to the erosion of some supervisory positions, it could equally lead to the enhancement of others. This indicates the importance of examining not only the outcome of computerisation on supervision, but also the process by which computers are introduced into organisations. With this aim in mind, the next chapter develops a framework for analysing the process of computerisation. In Chapter 4, this framework is applied to an examination of the introduction of a computerised system of freight information control in British Rail.

In the final section of this chapter it was argued that in order to understand the outcome of computerisation on supervision, it is essential that supervision is not conceptualised in terms of the role of the formally defined first-line supervisor. In short, supervision needs to be reconceptualised to take account of the variety of supervisory tasks and their distribution within 'supervisory systems of control', if meaningful statements are to be made about the effects of computer technology on the function of supervision. In the second section of the next chapter, such a framework is developed and later utilised in an empirical examination of the effects of computer technology on marshalling yard supervison.

Chapter 2. Notes and References

1. P.F. Drucker, *The Practice of Management*, Pan Books, 1968, p.384.

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5. J. Melling, 'Non-Commissioned Officers: British Employers and their Supervisory Workers, 1880-1920', *Social History*, 1980, vol.5, p.91-92.

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7. J. Child, 'The Industrial Supervisor', in G. Esland, G. Salaman. and M. Speakman, (editors), *People and Work*, Holmes McDougall, 1975, p.72.

8. J. Melling, 'Men in the Middle or Men on the Margin? The Historical Development of Relations Between Employers and Supervisors in British Industry', in D. Dunkerley and G. Salaman, (editors), *The International Yearbook of Organisation Studies*, Routledge & Kegan Paul, 1981, p.74.

9. S. A. Marglin, 'What Do Bosses Do? The Origins and Function of Hierarchy in Capitalist Production', in A. Gorz (editor), *The Division of Labour: The Labour Process and Class Struggle in Modern Capitalism*, Harvester Press, 1976, p.29.

10. C.R. Littler, *The Development of the Labour Process in Capitalist Societies*, Heinemann, 1982, p.86.

11. C.R. Littler, op. cit., p.86-88.

12. See for example, R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century*, Heinemann, 1979.

13. J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society*, Cambridge University Press, 1982, p.209.

14. C.E. Davis, and J.P. West, 'Attitudinal Differences Among Supervisors in the Public Sector', *Industrial and Labour Relations Review*, July 1979, vol.34, no.4, pp.495-505.

15. D. Dunkerley, *The Foreman: Aspects of Task and Structure*, Routledge, 1975, p.170.

16. See for example, Edwards, op. cit., who argues that the traditional control function of supervision is becoming increasingly peripheral as more sophisticated methods of control are developed by management.

17. See for example, P.W. Betts, *Supervisory Studies*, 3rd edition, McDonald & Evans, 1980, pp.33-41; and W.H. Lozonick, 'Technological Change and the Control of Work: The Development of Capital-Labour Relations in US Mass Production Industries', in H.F. Gospel and C.R. Littler (editors), *Managerial Strategies and Industrial Relations: An Historical and Comparative Study*, Heinemann, 1983, pp.124-125.

18. C.R. Littler, op. cit., p.181 & 143.

19. J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society*, Cambridge University Press, 1982, p.7.

20. T. Kempner, K. MacMillan, and K.H. Hawkins, *Business and Society: Tradition and Change*, Allen Lane, 1974, p.65.

21. F. W. Taylor, *Scientific Management*, Harper & Brothers, 1947, pp.95-109.

22. For a useful summary and criticism see, H. Fayol, *General and Industrial Management*, Sir Isaac Pitman & Sons, 1949, pp.66-70.

23. F. W. Taylor, op. cit., pp.100-104.

24. C.R. Littler, op. cit., pp.105-116, shows that, during the inter-war period in Britain, Bedaux consultants consistently found supervisors a major source of resistance to these neo-Taylorite techniques of managerial centralisation and control (the Bedaux system was a development of Taylorism which attempted to take worker fatigue into account). In general, foremen were concerned with getting the work out, and for them this meant protecting their best workers from higher management and 'interfering change agents'. As a result of resisting the implementation of

these neo-Taylorite systems, foremen were often blamed for the problem of industrial unrest and were often dismissed if uncooperative:

> Despite supervisory scepticism and obstruction there were surprisingly few attempts to incorporate foremen into new-Taylorite systems in the 1920s and 1930s. Instead there was a propaganda campaign against the traditional foreman and foremen were often dismissed if uncooperative, or moved to other departments or demoted. (op. cit., p.143)

25. Studies carried out in the 1950s confirmed the importance of first-line supervision in influencing industrial performance. See for example, D.C. Pelz, 'Influence: A Key to Effective Leadership in the First-line Supervisor', *Personnel*, 1952, vol.29, pp.209-217; M. Argyle, G. Gardener, and F. Cioffi, 'The Measurement of Supervisory Methods', *Human Relations*, Vol. 10. 1957, pp.295-314; D. McGregor, The *Human Side of Enterprise*, McGraw-Hill, 1960; R.L. Kahn and D. Katz, 'Leadership Practices in Relation to Productivity and Morale', in D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, Tavistock, 1960; R. White, and R. Lippitt, "'Leader Behaviour and Member Reaction in Three 'Social Climates'," in D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, Tavistock, 1960; R. Likert, *New Patterns of Management*, McGraw Hill, 1961.

26. See for example, Training Within Industry, *Information About Training Within Industry*, undated; and Training Within Industry, *Supervisory Training*, April 1960.

27. See for example, O. K. McMahon, 'Morale is Built by the Supervisor', *Industrial Supervisor*, October 1956, pp.3-5; and December 1956, pp.12-13; Gallagher, 'Human Relations in Supervision,', *Industrial Supervisor*, June 1957; J. Munro Fraser, and J. M. Bridges, *The Industrial Supervisor*, Business Publications, 1964.

However, it was not until the late 1950s and early 1960s that supervisory training became heralded as the new panacea to the 'problem' of supervisory leadership style. During this period, courses were designed to help supervisors improve their 'human relations' techniques in 'motivating' employees:

> In broad terms....the so-called common skills phase and that associated with the systematic approach account for the broad span of activity of the past 25 years, all aimed at bettering the performance of supervisors through improved training.

> (D. Jenkins, 'The Supervisor Solution', *Management Today*, May 1978, p.75).

28. J. Child, 'The Industrial Supervisor', in G. Esland, G. Salaman. and M. Speakman, (editors), *People and Work*, Holmes McDougall, 1975, pp.73-74.

29. F.J. Roethlisberger, 'The Foreman: Master and Victim of Double Talk', *Harvard Business Review,* Vol. 23, 1945, pp.283-298.

30. The 'man in the middle' thesis emphasised the supervisor's peculiar middle position between management and operative, whose job is to promote the smooth working of formal and informal relationships. See, B. B. Gardener, and W. F. Whyte, 'The Man in the Middle: Positions and Problems of the Foreman', *Applied Anthropology*, Vol. 4, 1945, pp.1-28. Moreover, in trying to satisfy two sets of demands he may become the 'master and victim of double talk', and consequently experiences 'role conflict' from this stressful 'middle' position. See, F.J. Roethlisberger, op. cit.

31. D. E. Wray, 'Marginal Men of Industry: The Foremen', *American Journal of Sociology,* Vol. 54, No. 4, 1949, pp.298-301; formulated the original marginal men thesis. He criticised the marginal man thesis of Gardener and Whyte for assuming a 'unitary system of control and two-way communication', and taking no account of managerial specialisation and /or worker unionisation. He concluded that the 'man in the middle' phrase does not accurately describe the nature of the difficulties associated with the foreman's position:

> In short, the position of foreman has some of the characteristics of management positions but lacks other crucial ones...With respect to management the foreman's position is peripheral rather than in the middle. The poor fellow is in the middle of course, in the sense that...he gets it from both sides. (D. E. Wray, op. cit., p.301).

32. K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973, p.216. See also, D. Dunkerley, *The Foreman: Aspects of Task and Structure*, Routledge, 1975.

33. D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, 2nd edition, Tavistock, 1960.

34. P.M. Blau, and W.H. Scott, *Formal Organisations*, Routledge & Kegan Paul, 1963; G. Westerlund, and D. Stromberg, 'Measurement and

Appraisal of the Performance of Foremen', *British Journal of Industrial Relations*, Vol 3, 1965, pp.345-362; S.W. Gellerman, *Management By Motivation*, American Management Association, 1968.

35. R.L. Kahn and D. Katz, 'Leadership Practices in Relation to Productivity and Morale', in D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, Tavistock, 1960; M. Argyle, G. Gardener, and F. Cioffi, 'Supervisory Methods Related to Productivity, Absenteeism, and Labour Turnover', in E.H. Vroom, and E.L. Delci, (editors) *Management and Motivation*, Penguin, 1970.

36. D.C. Pelz, 'Influence: A Key to Effective Leadership in the First-line Supervisor', *Personnel*, 1952, vol.29, pp.209-217; A. Etzioni, *Modern Organisations*, Prentice-Hall, 1964.

37. D. E. Wray, 'Marginal Men of Industry: The Foremen', *American Journal of Sociology*, Vol. 54, No. 4, 1949, pp.298-301.

38. See for example, K.E. Thurley, and A. C. Hamblin, 'The Supervisor and His Job', *Problems of Progress in Industry*, No. 13, H.M.S.O., 1963; and C.R. Walker, R.H. Guest, and A.N. Turner, *The Foreman on the Assembly Line*, Harvard University Press, 1956.

39. A. Etzioni, *Modern Organisations*, Prentice-Hall, 1964, p.91.

40. J. Melling, 'Men in the Middle or Men on the Margin? The Historical Development of Relations Between Employers and Supervisors in British Industry', in D. Dunkerley and G. Salaman, (editors), *The International Yearbook of Organisation Studies*, Routledge & Kegan Paul, 1981.

41. J. Melling, op. cit., pp.263-266.

42. S. Hill, *The Dockers: Class and Tradition in London*, Heinemann, 1976.

43. National Institute of Industrial Psychology, *The Place of the Foreman in Management*, Staple Press, 1957.

44. See also, J.H. Goldthorpe, 'Technical Organisation as a Factor in Supervisor-Worker Conflict', *British Journal of Sociology*, Vol. 10, 1959, pp.213-230; and K.E. Thurley, 'Changing Technology and the Supervisor',

In J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective*, MacMillan, 1966.

45. See also for example, C.R. Walker, R.H. Guest, and A.N. Turner, *The Foreman on the Assembly Line*, Harvard University Press, 1956; and K.E. Thurley, and A. C. Hamblin, 'The Supervisor and His Job', *Problems of Progress in Industry*, No. 13, H.M.S.O., 1963.

46. K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal*, Heinemann, 1973, p.53.

47. K.E. Thurley, and A. C. Hamblin, op. cit., p.5.

48. K.E. Thurley, and A. C. Hamblin, op. cit., p.6.

49. T. H. Patten, 'The Authority and Responsibilities of Supervisors in a Multi-plant Firm', *Journal of Management Studies*, Vol. 5, 1968, p.139.

50. See for example, D. Gallie, *In Search of the New Working Class: Automation and Social Integration Within the Capitalist Enterprise*, Cambridge University Press, 1978.

51. C.E. Davis, and J.P. West, 'Attitudinal Differences Among Supervisors in the Public Sector', *Industrial and Labour Relations Review*, July 1979, vol.34, no.4, pp.495-505.

52. J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society*, Cambridge University Press, 1982, pp.213-214.

53. D. Dunkerley, *The Foreman: Aspects of Task and Structure*, Routledge, 1975, p.171.

54. See for example, H. Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*, Monthly Review Press, 1974; R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century*, Heinemann, 1979; S. Clegg, and D. Dunkerley, *Organization, Class and Control*, Routledge & Kegan Paul, 1980; and P. Armstrong, 'Class Relations at the Point of Production: A Case Study', *Sociology*, Vol. 17, No. 3, August 1983, pp.339-359.

55. See for example, F.E. Emery and J. Marek, 'Some Socio-technical Aspects of Automation', *Human Relations*, Vol. 15, No. 1, 1962, pp.17-22;

D. Wedderburn, and R. Crompton, *Workers' Attitudes and Technology*, Cambridge University Press, 1972; L.E. Davies, and J.C. Taylor, 'Technology, Organisation and Job Structure', in R. Dubin, (editor) *Handbook of Work, Organisation and Society*, Rand McNally, 1976), pp.379-419; and J. Woodward, *Industrial Organisation : Theory and Practice*, 2nd edition, Oxford University Press, 1980.

56. For example, R. Edwards, op. cit; D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983; and S. Rothwell, 'Supervisors and New Technology', *Employment Gazette*, January 1984, pp.21-25.

57. H. Braverman, op. cit., p.195; and R. Edwards, op. cit., p.119.

58. The two kinds of uncertainty associated with labour stem from: firstly, the need to translate labour power into a realised asset (to ensure that workers worked); and secondly, workers' collective resistance to subordination. See for example, R. Edwards, op. cit.; J. Storey, *The Challenge to Management Control*, Kogan Page, 1980; and P. Thompson, *The Nature of Work. An Introduction to Debates on the Labour Process*, MacMillan, 1983. That the development and introduction of modern technologies owe as much to the need to control labour as to attain more general 'efficiency' has gained fairly widespread support in the literature. For example, S. A. Marglin, 'What Do Bosses Do? The Origins and Function of Hierarchy in Capitalist Production', in A. Gorz (editor), *The Division of Labour: The Labour Process and Class Struggle in Modern Capitalism*, Harvester Press, 1976, pp.13-53; H. Shaiken, 'Numerical Control at Work', *Radical America*, Vol.13, No.6, 1979, pp.25-38; and M. Cooley, *Architect or Bee? The Human/Technology Relationship*, Langley Technical Services, 1980.

59. According to Edwards, op. cit., pp.124-125, new computer technologies are able to carry out the traditional supervisory functions of:

- directing and regulating the activities of labour
- monitoring and evaluating the performance of labour

Furthermore, Clegg and Dunkerley claim that a 'vicious circle of controls' can arise through the introduction of new forms of technology which serve to reduce worker discretion through tightening managment's control over the labour process This reduces the commitment of the workforce and highlights the need for tighter forms of control and discipline. See, S. Clegg, and D. Dunkerley, *Organization, Class and Control,* Routledge & Kegan Paul, 1980, p.364.

60. R. Edwards, op. cit., p.18.

61. The four systems of control which Edwards op. cit., develops in his book are:

(i) *Entrepreneurial control*: this refers to the simple forms of control which existed in the majority of small firms in the second half of the nineteenth century. It basically involves personal direct control by the employer (pp.25-30)
(ii) *Hierarchical control*: this refers to the military model of a giant pyramid of control with a chain of command, which emerged at the turn of the century with the growth in the size of organisations (according to Edwards the supervisor had 'despotic rule' at this time) (pp.30-36)
(iii) *Technical control*: this refers to the achievement of control through technical means which are built into the physical structure of the labour process, for example, the assembly line (pp.111-125)
(iv) *Bureaucratic control*: this is a form of structural control achieved through bureaucratic means in building in formalised rules and procedures into the social structure, for example, personnel policies, disciplinary procedures, formal job descriptions, and so forth (pp.130-162).

62. R. Edwards, op. cit., p.33.

63. R. Edwards, op. cit., p.145.

64. R. Edwards, op. cit., p.52-57.

65. R. Edwards, op. cit., p.119.

66. R. Edwards, op. cit., p.120-122.

67. See also, Braverman, who claimed that machinery is often used by management to increase their control over labour:

> Machinery offers to management the opportunity to do by wholly mechanical means that which it had previously attempted to do by organisational and disciplinary means.

H. Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*, Monthly Review Press, 1974, p.195.

68. P. Armstrong, 'Class Relations at the Point of Production: A Case Study', *Sociology*, Vol. 17, No. 3, August 1983, pp.354-355.

69. According to this perspective the production process is concerned with combining the labour process with the creation of value. The worker is employed as a form of variable capital and does not become a realised asset until his potential productive output (labour power) has been transformed into the creation of goods or services (labour). Moreover, the value created above the payment of the worker is identified as surplus value, and hence, where this process occurs (known by labour process theorists as 'valorisation') then the labour process is seen to be distinctly capitalist. See, P. Thompson, *The Nature of Work. An Introduction to Debates on the Labour Process*, MacMillan, 1983, pp.38-64.

70. For example, National Institute of Industrial Psychology, *The Place of the Foreman in Management*, Staple Press, 1957; F.E. Emery and J. Marek, 'Some Socio-technical Aspects of Automation', *Human Relations*, Vol. 15, No. 1, 1962, pp.17-22; R. Blauner, *Alienation and Freedom*, University of Chicago Press, 1964; D. Wedderburn, and R. Crompton, *Workers' Attitudes and Technology*, Cambridge University Press, 1972; and L.E. Davies, and J.C. Taylor, 'Technology, Organisation and Job Structure', in R. Dubin, (editor) *Handbook of Work, Organisation and Society*, Rand McNally, 1976), pp.379-419.

71. See for example, J. Woodward, *Industrial Organisation : Theory and Practice*, 2nd edition, Oxford University Press, 1980.

72. Woodward initially categorised firms according to various technical variables; for example, whether the production was standardized or one-off. One-off products were further subdivided according to whether production was non-continuous or continuous. In addition, what were termed as 'integral products' (that is, manufactured) were differentiated from what were referred to as 'dimensional products' (that is, processed). In the final

analysis, eleven categories were identified which can be listed under one of the three general stages outlined in the text. Woodward op. cit., pp.35-44.

73. Woodward op. cit., pp.51-67. See also for example, R. Blauner, *Alienation and Freedom*, University of Chicago Press, 1964, pp.43-44, who illustrates how printers have a high degree of self-discipline and personal control over the work process, and are generally free from close supervision. Similarly, T. Lupton, *On the Shop Floor: Two Studies of Workshop Organisation and Output*, Pergamon, 1963, p.85, demonstrate how supervisors can often become 'personal friends' of the workers under unit production industries.

74. Woodward ibid. See also for example, C.R. Walker, R.H. Guest, and A.N. Turner, *The Foreman on the Assembly Line*, Harvard University Press, 1956, p.31; R. Blauner, op. cit., p.107; J.H. Goldthorpe, D. Lockwood, F. Bechhofer, and J. Platt, *The Affluent Worker in the Class Structure*, Cambridge University Press, 1969, p.66; and H. Beynon, *Working for Ford*, Penguin, 1973, pp.129-150.

75. Woodward ibid. See also for example, R. Blauner, op. cit., pp.133 &137; L.E. Davies, and J.C. Taylor, 'Technology, Organisation and Job Structure', in R. Dubin, (editor) *Handbook of Work, Organisation and Society*, Rand McNally, 1976), p.399; and D. Gallie, *In Search of the New Working Class: Automation and Social Integration Within the Capitalist Enterprise*, Cambridge University Press, 1978, p.221.

76. Woodward op. cit., p.57.

77. Woodward op. cit., pp.56-57.

78. Woodward op. cit., pp.61-62.

79. Woodward op. cit., p.65. See also for example, D. Gallie, op. cit.

80. Woodward op. cit., pp. 64-67.

Within the literature, assembly-line production workers have generally been found to adopt an 'instrumental' and non-committed attitude to work. As a result, the supervisor may find himself spending a considerable time on problems associated with worker morale and absenteeism. See for example, J.H. Goldthorpe, D. Lockwood, F. Bechhofer, and J. Platt, *The Affluent Worker: Industrial Attitudes and Behaviour*, Cambridge

University Press, 1968. Under these circumstances the supervisor may find it important and useful to develop 'personal relationships' with operators in order to ease potential conflict. See for example, C.R. Walker, R.H. Guest, and A.N. Turner, *The Foreman on the Assembly Line*, Harvard University Press, 1956, p.31; and R. Blauner, *Alienation and Freedom*, University of Chicago Press, 1964, p.107. Alternatively, the supervisor may decide to adopt a 'laissez-faire' style of supervision. See for example, J.H. Goldthorpe, D. Lockwood, F. Bechhofer, and J. Platt, *The Affluent Worker in the Class Structure*, Cambridge University Press, 1969, p.66. Essentially, on-the-job conflict and stress derive from the need to ensure that the line is adequately manned, to contain conflict, and to maintain efficient operations,of what is boring, mundane, and repetitive work.

81. T. K. Reeves, and J. Woodward, 'The Study of Managerial Control', in J. Woodward, (editor) *Industrial Organisation: Behaviour and Control*, Oxford University Press, 1970.

82. Reeves and Woodward develop a fourfold categorisation of control systems based on the degree to which control systems were integrated or fragmented, and the degree to which control was exercised personally or indirectly. The relationship between the planning and execution of organisational tasks is seen to correspond to two central 'spheres' in the co-ordination and control of production tasks. As a firm moves towards more advanced systems of control the design system and execution system is seen to become increasingly separated. Reeves and Woodward provide the example of the design and planning of a continuous flow automated chemical plant, whereby, the erection of the plant is carried out by a separate organisation and is then handed over on completion. See, Reeves and Woodward, op. cit., pp.45-53.

83. D. Wedderburn, and R. Crompton, *Workers' Attitudes and Technology*, Cambridge University Press, 1972.

84. D. Wedderburn, and R. Crompton, op. cit., pp.27-33.

85. D. Wedderburn, and R. Crompton, op. cit., pp.121-132.

86. D. Wedderburn, and R. Crompton, op. cit., pp.128-132.

87. D. Wedderburn, and R. Crompton, op. cit., pp.138 &139.

88. R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century*, Heinemann, 1979, p.121.

89. R. Edwards, op. cit., pp.124 &125.

90. See,K.E. Thurley, 'Changing Technology and the Supervisor', in J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective*, MacMillan, 1966, p.336; K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973, pp.206-207; D. Dunkerley, *The Foreman: Aspects of Task and Structure*, Routledge, 1975, p.49; and D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age*: *Technological Imperatives and Strategic Choice*, Gower, 1983, pp.29 & 31.

91. M. Rose, *Computers, Management and Society*, Penguin, 1969, p.185.

92. F.J. Roethlisberger, and W.J. Dickson, *Management and the Worker*, John Wiley, 1939, p.448.

93. See for example, I. Barron, and R. Curnow, *The Future with Microelectronics*, Francis Pinter, 1979; T. Forrester, (editor) *The Microelectronics Revolution*, Basil Blackwell, 1980; and I. Benson, and J. Lloyd, *New Technology and Industrial Change. The Impact of the Scientific-Technical Revolution on Labour and Industry*, Kogan Page, 1983.

94. 'Real-time' information refers to information that is 'on-hand'. It is the information on 'what-is-happening' rather than on 'what-has-happened'. Peter Laurie has referred to real-time as the time before life catches up and makes the result out of date. See, P. Laurie, *The Micro Revolution*, Futura, 1980, p.17.

95. See for example, T. Crowe, and J. Jones, *The Computer and Society*, Fabian Society, 1978; Department of Industry, *Microelectronics: The New Technology*, H.M.S.O., 1978; Department of Industry, *Microelectronics: The Options*, H.M.S.O., 1979; J. Rada, *The Impact of Micro-electronics*, International Labour Office, 1980; R.D. Parslow, (editor), *Information Technology for the Eighties*, Heydon, 1981; and W.P. Dizard, *The Coming Information Age*, Longman, 1982.

96. H.J. Leavitt, and T.L. Whisler, 'Management in the 80s', *Harvard Business Review*, Vol 36, November-December, 1958, p.41.

97. Hoos for example, argued that computer technology would promote the centralisation of decision making activity. See, I. R. Hoos, 'When the Computer Takes Over the Office', *Harvard Business Review*, Vol. 38, July-August 1960, pp.102-112. In contrast, Burlingame claimed that information technology would actually strengthen the tendency towards decentralisation. See, J.F. Burlingame, 'Information Technology and Decentralisation', *Harvard Business Review*, Vol. 39, November-December 1961, pp.121-126. For an example of the discussions which surrounded the centralisation/decentralisation debate, see, C.A. Myers (editor), *The Impact of Computers on Management*, Massachusetts Institute of Technology Press, 1967.

98. See for example, T.L. Whisler, *The Impact of Computers on Organisations*, Praeger, 1970a; T.L. Whisler, *Information Technology and Organisational Change*, Wadsworth, 1970b; and R. Stewart, *How Computers Affect Management*, MacMillan, 1971.

99. See, Hoos, op. cit., p.107; T. Ward, and E. Mumford, 'How the Computer Changes Management', New Society, Vol. 6, No. 156, pp.6-9; and T.L. Whisler, 'The Impact of Information Technology on Organisational Control', in C.A. Myers (editor), *The Impact of Computers on Management*, Massachusetts Institute of Technology Press, 1967, pp.45-49.

100. See, R. Stewart, op. cit., pp.209-228.

101. See, M. Ashen, 'The Manager and the Black Box', *Harvard Business Review*, Vol. 38, 1960, p.92; and K.E. Thurley, 'Changing Technology and the Supervisor', In J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective*, MacMillan, 1966, pp.351-352.

102. E. Mumford, and O. Banks, *The Computer and the Clerk*, Routledge & Kegan Paul, 1967.

103. T.L. Whisler, 1967, & 1970a, op. cit.

104. E. Mumford, and O. Banks, op. cit., pp.173-183; T.L. Whisler, op. cit., 1967, pp.45-49, & 1970a, pp.30-45.

105. E. Mumford, and O. Banks, op. cit., p.14.

106. A. Zalewski, 'The Influence of Automation on Management', in J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective*, MacMillan, 1966.

107. See, K.E. Thurley, 'Changing Technology and the Supervisor', In J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective*, MacMillan, 1966. See also Thurley's later article 'Computers and Supervisors', in M. Warner (editor) *The Sociology of the Workplace*, George Allen & unwin, 1973.

108. A. Zalewski, op. cit., p.357.

109. K.E. Thurley, 1973, op. cit.

110. A. Zalewski, op. cit.

111. T. Crowe, and J. Jones, *The Computer and Society*, Fabian Society, 1978, p.7.

112. See for example, R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century*, Heinemann, 1979; J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society*, Cambridge University Press, 1982; and D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983.

113. S. Rothwell, 'Supervisors and New Technology', *Employment Gazette*, January 1984, pp.21-25.

114. S. Rothwell, and D. Davidson, 'New Technology and Manpower Utilisation', *Employment Gazette*, June 1982, pp.252-254, and July 1982, pp.280-283; and 'Training for New Technology' in G. Winch (editor) *Information Technology in Manufacturing Processes: Case Studies in Technological Change*, Rossendale, 1983.

115: S. Rothwell, op. cit., p.23.

116. See for example, A. Burkitt, 'Cold-Hearted Computers', *The Engineer*, May 18, 1978, pp.24-25; H. Shaiken, 'Numerical Control at Work', *Radical America*, Vol.13, No.6, 1979, p.36; and S.P. Black, 'Numerically Controlled

Machine Tools in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company', and 'Computer Coordinate Measuring Machines in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company', in D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983, pp, 58, 66 & 84.

117. D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983, p.7.

118. D. Buchanan, and D. Boddy, op. cit., p.257.

119. Within the literature, there are only a few examples where computerisation has resulted in the enhancement of the supervisor's role. See for example, C. Blaazer, 'A "key" Role', *Industrial Society*, Vol. 63, December 1981, pp.18 & 32; and C. Blaazer, and Molyneux, *Supervising the Electronic Office*, Gower, 1984. Blaazer provides an example where the supervisor holds a *key* position to effective operations under computer-aided office systems:

> Her (the supervisor) confidence, conviction and technical expertise will be crucial if she is to establish and maintain the word processing centre as a professional and efficient service, fully integrated into the organisation of which it is a part. (p.32)

120. See for example, R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century*, Heinemann, 1979.

121. See for example, C. Blaazer, 'A "key" Role', *Industrial Society*, Vol. 63, December 1981, pp.18 & 32.

122. See for example, S. Rothwell, 'Supervisors and New Technology', *Employment Gazette*, January 1984, pp.21-25.

123. See for example, D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983.

124. P.M.B. Dawson, 'The Implications of Computer Technology for Supervision', in H.J. Bullinger (editor), *Human Factors in Manufacturing*, IFS Publications, 1985.

125. D. Buchanan, and D. Boddy, op. cit., pp.203-231.

126. D. Buchanan, and D. Boddy, op. cit., p.223.

127. K.E. Thurley, 'Changing Technology and the Supervisor', In J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective,* MacMillan, 1966.

128. K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973.

Chapter 3. Computer Technology and Supervision: An Analytical and Conceptual Framework.

(i) Introduction

In Chapter 2, attention was focused on the role of the *formal first-line supervisor*. It was suggested that computerisation is likely to result in a far more complex redefinition of supervision than is implied by the apparent erosion of the role of the first-line supervisor. The corollary of this was that a more differentiated conceptual framework is required for the purpose of identifying and defining supervisory positions to enable an improved appreciation of the relationship between computer technology and supervision. The previous chapter also demonstrated how computer technology could be used to enhance the role of the first-line supervisor, and how managements' tendency to pursue strategies of centralisation was a key factor contributing to the erosion of first-line supervision. This indicated the importance of examining not only the *outcome* of computerisation on supervision, but also the *process* by which supervision is redefined. This chapter therefore sets out to provide an analytical framework for examining the process of computerisation, and a conceptual framework for examining the effects of computer technology on supervision.

The first section identifies and examines the various 'stages' of change associated with the introduction of computer technology. The combination of a number of analytically distinct 'stages' are used to represent the process of computerisation from the initial decision to invest in computer technology through to the routine operation of a stable system. At each 'stage', the main factors identified within the literature as influencing the process of computerisation are briefly discussed. This analytical framework is then employed in Chapter 4, which examines the extent to which various 'external' and 'internal' factors shaped the process of computerisation within British Rail.

The remaining sections focus far more exclusively on the definitional problems which surround the concept of supervision. A broader conception of *supervision* is formulated in order to take into account the variety of supervisory tasks, status levels, and job titles of individuals who are directly engaged in the continuous control of an operating (or production) system. This framework is then employed in part II in an empirical examination of changes to the 'supervisory system of control' and to individual supervisory roles in British Rail marshalling yards.

(ii) Analysing the Introduction of Computer Technology

A complex array of factors have been identified within the literature as influencing the process of innovation within organisations.[1] These range from external influences such as, changes in business market activity, and government policies, to various internal factors which may enable or constrain the process of change such as, the nature of the operating system, and managements' implementation strategies.[2] Furthermore, the degree to which these various factors combine to influence the process of computerisation has been shown to vary between organisations.[3] The main objective of this section is to provide an analytical framework within which it is possible to examine empirically the importance of these factors in shaping the various 'stages' associated with the process of computerisation. The extent to which these various factors influenced the process of computerisation in British Rail is examined in Chapter 4.

For analytical purposes, it is useful to distinguish between various discrete 'stages' of computerisation. By so doing, it is then possible to identify factors which influence the process of change from the initial decision to introduce computer technology through to the routine operation of a stabilised system.[4] With this aim in mind, four 'stages' associated with the introduction of computer technology have been identified, these comprise:

- the decision to introduce computer technology
- the choice and design of computer systems
- implementation and initial operation of the computer system
- routine operation of the computer system

It is important to stress that these stages are treated separately for analytical reasons and often overlap in practice. Futhermore, it should be noted that factors which shape each stage in the process of change are also factors which influence the eventual 'outcome' of computerisation. With these caveats in mind, the four stages outlined above provide a useful framework within which to analyse the introduction of computer technology.

(a) The Decision to Computerise

The decision to introduce computer technology is normally taken at a senior management level. These types of decision are referred to by Child as 'strategic decisions' and are often responses to the internal characteristics of the organisation and the external characteristics of the organisation's business market.[5] A number of strategic objectives have been identified within the literature as influencing managements' decision to introduce computer technology.[6] These include:

- business market objectives
- operating cost objectives
- product quality objectives
- operating control objectives

Each of these four strategic objectives are briefly discussed prior to an examination of the choice and design of computer systems.

Computer technology offers several possibilities for increasing an organisation's ability to adapt to changing market conditions. For example, the flexibility of computer programmed equipment may permit the modification and redesign of production without necessitating major structural alterations to the operating system. Alternatively, computer technology may enable a more effective utilisation of existing resources and increase operating efficiency while reducing overall operating costs, and thereby improve an organisation's business market position. Such an objective is achievable in cases where computer systems provide rapid access to accurate up-to-date information on the disposition of resources.[7]

Apart from reducing operating costs through the more efficient utilisation of material resources, savings may also be made by reducing the total number of jobs required in the production of a given good or service.[8] Furthermore, computer technology may be used to eliminate managements' dependence on 'in-house' labour by transferring the use of labour from an employment to a contracting-out basis.[9]

Improvement in the quality of products or services may also be an important strategic objective behind managements' decision to introduce computer technology, particularly in service industries where there may be little to differentiate between competing services.[10] Buchanan and Boddy provide four case study examples which illustrate how computer technology is often introduced for the purpose of improving product consistency and quality.[11] Finally, computer technology may be used to improve operational control through providing rapid access of information and integrating previously diverse areas of operation.[12]

(b) The Choice and Design of Computer Systems

The choice of which system is to be implemented is usually made at senior management level,[13] whereas the design of the system (the 'apparatus')[14] often reflects the values and assumptions of systems analysts.[15] In the introduction of computer technology, choices have to be made about 'hardware' configurations, and 'software' architecture.[16] The former refers to the various physical units which make up a computer system, which includes the central processing unit and its 'peripheral' artifacts, such as: keyboards; other processors; magnetic storage devices; line printers; facsimile machines; and Visual Display Units (VDUs), whereas the latter is the collective name used to describe a combination of computer programs. In addition, choices have to be made with regard to the operating system, that is, on the organisation of work in the day-to-day operation of the computer system.[17]

Wilkinson has described the decision on the type of operating system as being a 'social choice' between either enhancing the existing skills and experience of operatives, or using computer technology as a means of degrading jobs and increasing management's control over the labour process:

> The choice, it was clear, was essentially a social one between shopfloor control over production or office control, and it is worth repeating the quote from the production engineer who summed up the options: 'The firm has to go one of two ways. We can either retain skill on the shopfloor and have manual data input, or transfer skill into here with more tape control machines'.[18]

Thus, management's strategic decision on the choice and the design of the operating system reflect certain 'social choices', as well as 'technical choices' on the applicability of various computer systems to managements' strategic objectives. Moreover, these choices may also reflect certain external considerations, such as for example, governmental pressure to buy British computer systems.

(c) Implementation and Initial Operation

The implementation and initial operation of computer systems has been identified as an important 'negotiating' stage during the introduction of new computer-based technologies.[19] Buchanan has noted that while the pursuit of 'strategic' and 'operating' objectives tend to influence investment decisions, the pursuit of 'control' objectives 'influences the effect of technical change on the organisation of work, operation, skills, and performance.'[20] It is at this stage that occupational and employee concerns normally begin to influence the process of computerisation. For example, Edwards has suggested that resistance to the imposition of managements' implementation strategies can transform the workplace into a 'contested terrain' of political dissension and control.[21] However, these internal conflicts may not simply be a manifestation of workers' resistance to management, but rather, they may represent a complex political struggle between various occupational groups (managerial, supervisory, and operative) with differing vested interests. Moreover, the mobilisation of certain key occupational groups may be an essential prerequisite to the success of managements' implementation strategies. For example, Weir and Mills claim that supervisors often play an important role during the implementation and initial operation of computer systems:

> Although the firms differed widely in their products, staff employment and type of computer system, they all suffered considerable difficulties during the implementation process. One source of these difficulties, in our view, was that the potential of the supervisor to act as a 'change catalyst' was never adequately understood.[22]

Clearly, the effects of computer technology on work organisation is dependent not only on the objectives, assumptions and values of those who make decisions about its use in organisations, but also on processes of social choice and political negotiation between organisational factions during the implementation and initial operation of computer-based operating systems. Consequently, a critical stage in the introduction of computer technology is the design by management of implementation strategies.[23]

Several recent empirical studies carried out by the New Technology Research Group have highlighted the importance of managements' implementation strategies as being a major determinant of the successful introduction of new technology.[24] These studies illustrate how the applicability of particular strategies (ranging along a continuum from 'authoritarian' to 'consultative' and 'participative' approaches), vary beween organisations.[25] Furthermore, they also emphasise the importance of project management, the training and education of employees, and industrial relations considerations at this stage during the introduction of new technology (see on this point, Chapter 4).[26]

During the initial operation of computer-based operating systems a number of new developments or contingencies may arise which would compromise the 'success' of management's implementation strategy. For example, unanticipated technical problems may undermine the usefulness of the system in its replacement of traditional methods. As a result, this may cause conflict and confusion among staff and management, and threaten the establishment of new working relationships. Alternatively, if employees actively adapt and modify working practices around systems which have not been adequately 'debugged', then management may find it difficult to implement further changes. This point has been illustrated in Wilkinson's study of a plating company in which he notes that:

> ...in having to remedy the mistakes made by the new system until it was 'debugged' by frequent use of the manual override - workers have at the same time been establishing working practices. Now that the technical problems have been ironed out, management feel they are in a position to use the new system as originally intended. However, working practices are now to some extent 'institutionalised', and management are finding great difficulty changing them.[27]

Under the intitial operation of the system, employees may therefore adapt, modify, resist and redefine their positions under new operating procedures and working relationships set-up by management during system implementation.

<u>(d) Routine Operation</u>

The routine operation of a computer system is taken to refer to a relatively stabilised system in which the major social, political, and technical problems have been ironed out. At this stage during the process of computerisation, new forms of working practices have emerged and new patterns of established relationships are in operation. Therefore, the 'outcomes' of change can be examined and contrasted with the operating system prior to computerisation. Although in reality it is unrealistic to talk of any 'end-point' of change (as the process continues *ad infinitum)* it does make sense to talk of the 'effects' of a particular type of change. In the case of computer technology, it is possible to identify a period at some stage after final 'cut-over' when the day-to-day working of the computer system becomes a matter of routine. Under the routine operation of computer technology, it is possible to examine the *outcomes* of computerisation on organisational structures and traditional operating practices.

(e) The Process and Outcome of Computerisation

The *process* of computerisation is taken to refer to the complex sequence of events which occur from the initial decision to invest in computer technology through to the routine operation of a computer-aided operating system. The *outcome* of computerisation refers to changes in organisational structures and practices which can be identified from comparing the operating system prior to computerisation with the longer term effects of computerisation under routine operation. This emphasis contrasts with many recent studies which have tended to focus on the initial operation of computer technology, rather than on the effects of computer technology under routine operation.

The analytical framework developed above is employed in Chapter 4 in an examination of the introduction of a computerised freight information system in British Rail. In Chapters 5, 6 and 7 a more detailed examination of the effects of computer technology on marshalling yard supervision is undertaken. The remainder of this chapter sets out to conceptualise supervision in a way which enables its utilisation in the examination of the effects of computerisation.

(iii) Conceptualising Supervision

This section develops a conceptual framework for examining supervision which comprises: a working definition of supervision; an identification and definition of the range and types of various supervisory positions; an explanation of the concept of a 'supervisory system of control' and 'supervisory span of control'. Finally, it is argued that changes to supervision would be better understood in relation to changes in work organisation and management control. This point is supported by reference to the previous chapter and a consideration of the implications of computer technology for *supervision*.

(a) The Concept of Supervision

A major difficulty in trying to present a 'universal' concept of supervision stems from the variety of situations in which individuals can be identified as holding a 'supervisory relationship' within an operating system. In order to take into account the variety of supervisory tasks, status levels, and job titles which may exist within the supervisory genre, the term 'supervision' needs to be very broadly conceived. *Direct control of workplace operations* is a useful starting point as it locates supervision within the context of overall control of workplace operations.

The supervisory control functions which may be identified and differentiated at the workplace are:

- planning and directing workplace operations
- monitoring and evaluating workplace operations
- correcting and adapting workplace operations

However, these three functions of direction, appraisal, and regulation may be achieved through a number of differing 'personal' and 'impersonal' methods of control. In the previous chapter it was shown how both Reeves and Woodward,[28] and Edwards,[29] have developed a fourfold categorisation of control systems based on the degree to which systems of control were either integrated or fragmented, and the degree to which control was either exercised personally or impersonally. Put simply, the supervisory control elements outlined above may be distributed and incorporated into other methods of controlling shopfloor operations. Three examples previously discussed are: firstly, through incorporating elements of control into the actual machinery of production; secondly, through administrative or bureaucratic means by formulating a comprehensive series of operating rules and procedures; and thirdly, through the formation of 'self-supervising' autonomous work groups (in the sense of having control over their own job tasks).

If supervision is thus conceptualised, it is then possible to discuss the ways in which day-to-day control functions have been redistributed with the introduction of computer technology. It allows for the possibility of the redefinition of the control function of supervision under computer-aided production systems, for example, from being primarily concerned with the activities of labour, or machine and process supervision, to being concerned with a far wider area of production operations control. Alternatively, it is possible to envisage a situation where the role of the supervisor is abolished altogether through the development of fully automated production systems. In such a case, although the supervisory control elements would remain important, they would no longer be carried out by individuals who could be identified and defined as 'supervisors', for the control function of supervision would be wholly incorporated into the machinery of production.

(b) Supervision and Span of Control

The concept of 'supervisory span of control' has generally been used to refer to the ratio of subordinates to superordinate at each particular level of a 'supervisory hierarchy of control'.[30] The major limitation of examining changes in span of control in terms of the changing number of operatives responsible to a particular supervisory level, is that it tends to focus attention on the labour control function of supervision.[31] Therefore, while this concept may be adequate for examining changes in the role of the traditional supervisor, it is not a particularly useful method for analysing changes in the control function of supervision. It should be noted however, that the studies of Woodward, and Wedderburn and Crompton, used this conventional concept even though a range of supervisory roles were identified, and the importance of 'technical' (machine-oriented) supervision under advanced systems of production was stressed.[32]

Nevertheless, as the previous chapter demonstrated, it is clearly inadequate to gauge changes in supervision against an anachronistic perception of the function of supervisory control. Therefore it is argued here, that the term 'supervisory span of control' is used in a broader sense to refer not only to the control of labour, but also to the control of numerous other factors of production, such as, materials, machinery and information. Henceforth, this concept is used to refer to the discrete area of operations under the supervisor's direct control in the production of a good or service. Moreover, by using this wider conception of control, it is possible to envisage a situation where a reduction in the control of one element (for example, labour supervision) is more than offset by an extension in control of other aspects of production (for example, process or machine supervision), leading to an overall expansion of supervisory control. In other words, this concept allows for the possibility of a redefinition of supervision in which the role of the supervisor is eroded, enhanced, or simply redefined as involving another aspect of production control. Furthermore, while aspects of some individual roles may be eroded or replaced, others may be created or enhanced. Through using this concept it is now possible to examine both changes in the span of control of supervision and changes in the control function of individual supervisory roles (in part II it is shown how changes to individual roles do not always equate with changes in supervision).

Although this concept is useful in directing attention towards other elements of supervisory control, its primary use is in the analysis of overall changes in the control function of supervision. Consequently, while it accounts for changes in the supervisor's span of control, it does not provide a framework for detailing shifts in supervisory emphasis. In the next section, such a framework is developed.

(c) Supervisory Control Functions

It has already been noted that one common characteristic of supervisory positions across industries is that they are all to some extent responsible for the direct control of workplace operations. However, for the purpose of analysing shifts in supervisory emphasis a less general categorisation of the function of supervisory control is useful. With this aim in mind, it is argued here that the control function of supervision will normally consist of various combinations of the four broad elements of labour, product, material resources and machine control.[33] These four general types of supervisory control function are outlined below.

Labour control function: the main purpose of supervision is to direct, monitor and regulate the work of labour at the workplace. Traditional labour control functions would involve: directing the work of labour; monitoring and evaluating the performance of labour; and disciplining the non-compliance of labour. However, the labour control function described here is also taken to include dealing with human contingencies, such as, accidents to staff and staff absenteeism, in addition to other labour management tasks such as, the allocation of work and staff grievances.

Product control function: the main emphasis of supervision is on the 'product' of the operating system. Supervisors may concentrate on one or more of the following: the production methods employed by operatives; the use of materials and the costs of production; and the quality of the good or service produced. A key supervisory task in ensuring standardised methods, control of costs, and the maintenance of quality, is that of inspection.

Resource control function: the main purpose of supervision is to control and co-ordinate material resources in the production of a good or service. A key supervisory task is to ease bottlenecks and prevent material shortages. Supervisors are essentially concerned with ensuring the efficiency of operations through the direction, appraisal and regulation of material resources in the direct control of an operating system.

Machine control function: the main emphasis of supervision is on the maintenance of the technical system of production. Ensuring that plant and equipment are maintained, and dealing with technical contingencies as and when they arise are important supervisory tasks. Supervisors working under this machine-oriented operating system normally require extensive technical skill and knowledge. Thus, supervision is primarily concerned with monitoring the machine elements of production, rather than controlling the pace of work and levels of worker effort.

The conceptual framework developed above offers a broader conception of supervision from which the general effects of a change in technology on supervision can be analysed. Through using this categorisation, it is possible to demonstrate shifts in supervisory emphasis under differing technical and computer-based operating systems. For example, if this framework is incorporated into Woodward's analysis (see Chapter 2), then the general shift in supervisory emphasis (rather than changes to particular first-line supervisory roles) could be described as a movement from a labour control function under unit and small batch production, to a product control function under large batch and mass production, and finally, to a machine control function under process production.[34] However, it should be noted that the main emphasis of the control function of supervision need not necessarily equate with the main job tasks of individual supervisory positions. On the contrary, it is possible to envisage a situation where the main function of supervision is to control material resources and yet, the main job task of the supervisor is to deal with equipment failures or shortages of staff.

In common with other research, it is argued that the actual tasks which supervisors perform are neither 'universal' nor 'static', rather, they vary across organisations and over time. Therefore, an analysis of supervisory tasks can only be accomplished by a detailed examination of the job of the supervisor at his or her place of work (the job tasks of railway freight supervisors are analysed in Chapters 6 and 7). For this reason, no attempt is made to provide a list of common types of supervisory tasks (the problem of identifying the supervisor on the basis of job tasks is discussed in more detail in the next section).

A central argument of this chapter is that the supervisory function is in fact dispersed across several organisational levels, and therefore that it is misleading to focus on the pure role of the first-line supervisor. The following section sets out the criteria by which supervisors can be identified and their positions defined within organisations.

(iv) The Supervisor

(a) Identifying and Defining Supervisory Positions

Within the literature, a common method of identifying supervisors is on the basis of their formal job titles.[35] The most consistent title used to describe what is conventionally referred to as the first-line supervisor is that of 'foreman' and 'forewoman'.[36] However, the National Institute of Industrial Psychology (NIIP),[37] and Thurley and Wirdenius,[38] indicate that there are a number of problems associated with identifying supervisors according to their job title. The NIIP, for example, note a number of cases where individuals with the title of 'foreman' are not located at the formal first-line supervisory level.[39] The claim that foremen may not hold comparable positions within the organisation structure in different production environments has found considerable support within the literature.[40]

Another major problem with this method is that the control function of supervision may also be the concern of a number of individuals each holding one of a range of differing job titles. As Thurley and Wirdenius state:

> It is not very satisfactory to mark out a supervisor by his job title. Most industries have traditional titles which they use for particular jobs and these terms are not interchangeable between industries.[41]

Another possible method of identifying supervisory positions both across and within particular organisations is by job tasks. However, any attempt to identify supervisors according to common job tasks is fraught with difficulties. Thurley and Hamblin in their study of the job of the first-line supervisor found that the tasks and problems dealt with by supervisors varied considerably, even between different sections or departments of the same firm.[42] Supervisors were found to carry out any number of a hundred or more managerial and technical tasks. As Thurley and Wirdenius noted:

> A supervisor's job appears to be a type of empty box to be filled with activities and tasks according to the particular situation.[43]

In order to overcome this problem, it is argued that the broader conception of supervision outlined in the previous section can be used to define supervisory positions. Individuals may then be identified as holding a supervisory relationship according to the criterion that they participate in the direct control of workplace operations. This criterion also allows for the considerable variation in the job titles and tasks associated with such positions. Finally, it is claimed that in practice, the control function of supervision is likely be distributed across a network of interrelated roles, each with different supervisory elements and relationships. It is therefore suggested that the additional criterion of 'authoritativeness' should also be employed for the purpose of identifying and differentiating supervisory roles.

Identifying supervisors on the basis of the authority and status afforded to them by management is a useful method of locating and defining 'formal supervisory positions'. However, this method does not take account of what can be termed as 'informal supervisory positions', which would be occupied by those individuals who are not recognised or formally defined by management as holding 'supervisory' jobs. As Etzioni has illustrated, whether one holds a position of power and authority over operatives is not solely determined by the location of that person within a formalised organisational command structure.[44] Etzioni makes a threefold distinction between:

- *officers*: referring to individuals who hold formal positions of power and depend on that power for maintaining a working relationship with their subordinates
- *informal leaders*: referring to individuals who are deprived of any formal organisational power and whose position is determined only by the consensus of their followers

- *formal leaders*: referring to individuals who combine organisational authority with personal influence[45]

This distinction suggests that it is possible to identify individuals who hold a position of authority over fellow operatives without being accredited authority by management. In other words, it may be that the influence which an individual has over a work group, partly derives from, or even depends upon them not holding a 'formal' supervisory position. Consequently, a major problem with identifying supervisors on the basis of their position within a hierarchical command structure is that it does not take into account the fact that the authority afforded to individuals by management may not coincide with the authority vested in an individual by his work group. It is therefore argued that supervisors can more usefully be identified and differentiated according to the extent of their authority (and hence status) accredited by management and/or operatives. Consequently, in Part II, railway freight supervisors are not identified by their job titles, but rather, according to the criteria that:

- they are in direct control of workplace operations
- authority is invested in their position by management and/or the workforce

(b) Levels and Types of Supervisory Positions

Individuals who can be identified as 'supervisors' may occupy one of a number of differing 'levels' and 'types' of supervisory positions both across and within particular organisations. These range along a continuum from 'mixed' managerial-supervisory roles (situated at the apex of the supervisory hierarchy of control) through to 'mixed' supervisory-operative roles (situated at the bottom of the supervisory hierarchy of control). These levels and types of supervisory positions are illustrated in Figure 1 (page 68).

The actual number of supervisory levels varies considerably between and within organisations.[46] For practical reasons, many commentators who identify a hierarchy of supervisory roles employ a four-level classification.[47] According to the National Institute of Industrial Psychology (NIIP), the four-level conception has proven to be 'the most convenient and workable'.[48] This claim is supported by the empirical case study presented in part II, which makes use of a modified version of the original classification developed by the NIIP.[49]

In the fourfold categorisation of levels of supervision outlined below, a distinction is made between the 'pure' and 'mixed' type of supervisory role. This should not be taken too literally, because in general, nearly all supervisory roles involve differing combinations of various clerical, supervisory, operative and managerial type tasks. The term 'pure' supervisory role is simply used to denote that one or more of the supervisory tasks associated with the direct control of workplace operations are the principal concern (rather than the only task) of a given position within the organisation.[50]

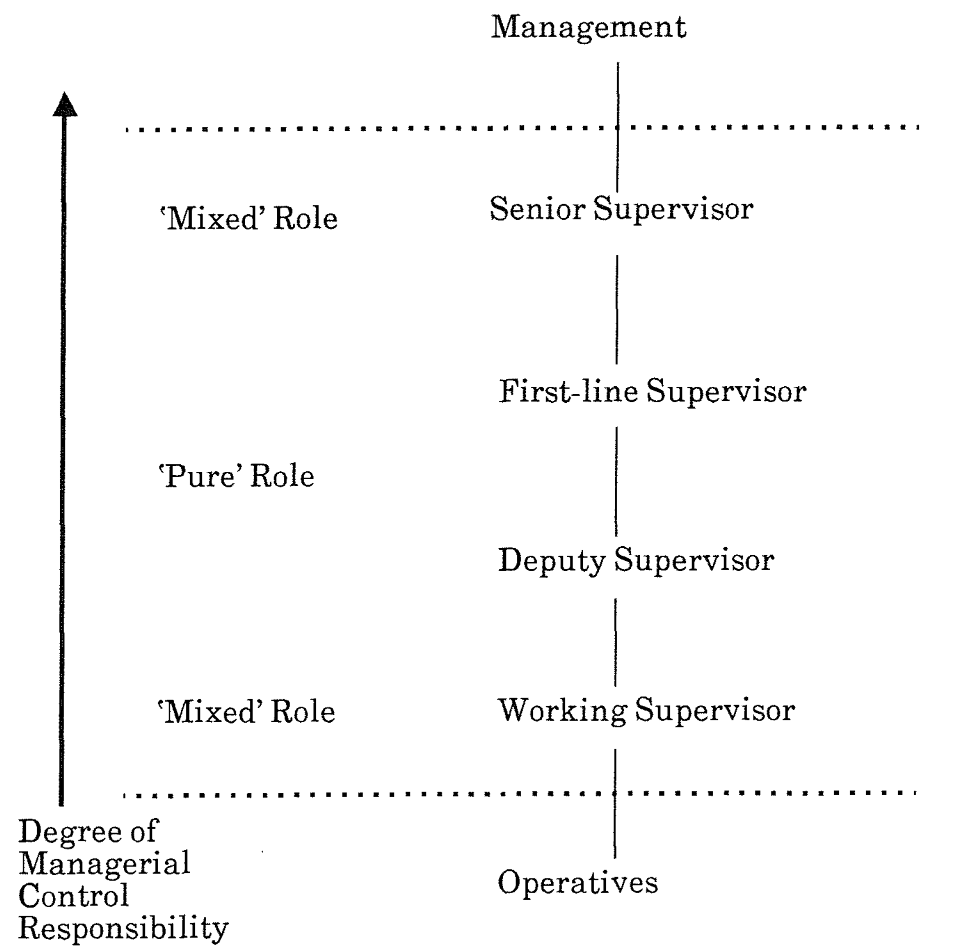
This formulation of types of supervisory roles derives from, and is a modification of the original distinction made by Thurley and Wirdenius.[51] They differentiate between: a 'pure' role concerned with the direct control of production and formally recognised as 'supervisory'; a 'mixed' supervisory/management role, such as where the status may formally be that of a 'supervisor' but the work involved is more specialised; and a 'mixed' supervisory/worker role, such as where an operative may be informally recognised as carrying out supervisory tasks.[52]

The framework of levels and types of supervisory roles employed throughout the remaining body of the text are outlined below (see also, Figure 1).

Level 1: The Working Supervisor: individuals who occupy this 'mixed' supervisory-operative position may be referred to as: 'head worker'; 'ganger'; 'leading hand', et cetera. Essentially, this category covers operatives with some specific responsibility and recognised authority over the activities of a work group of which he or she is a member.

Level 2: The Deputy Supervisor: this category consists of individuals with responsibility for controlling workplace operations over a small section of their own, and/or who act as a deputy/assistant to Level 3 supervisors (first-line supervisors). This may be a 'mixed' or 'pure' type of supervisory role depending on the size of the supervisory hierarchy and the degree to which the individual is engaged in one or more of the tasks associated with overseeing and controlling workplace operations. Possible job titles of individuals holding this position are: 'section supervisor', 'deputy supervisor'; 'assistant foreman'; 'junior foreman', and so forth.

Figure 1: Supervisory Hierarchy of Control



Level 3: The First-line Supervisor: this category includes traditional first-line supervisory positions with titles such as 'foreman' and 'forewoman'. It also incorporates the whole range of formally defined first-line supervisory positions, including machine-oriented first-line supervisory roles found in more technically complex operating systems. This level constitutes a 'pure' type of supervisory role in so far as the individuals who occupy this position are directly involved in the control of workplace operations. It is also worth noting that people located at this level tend to be regarded by management and the workforce as the immediate 'boss' of the work group, and are often described as such in grievance and disciplinary procedures.

Level 4: The Senior Supervisor: this category covers managers who are to varying degrees regularly and directly involved in planning, monitoring, evaluating, and regulating workplace operations. This type of supervisor can usually be identified in large organisations under a wide range of job titles, for example: manager; assistant manager; department head; superintendents; senior foreman, et cetera. They occupy a 'mixed' managerial supervisory role with direct responsibility for controlling operations over a whole shop or discrete operating area. Considerable authority and responsibility is usually accredited to senior supervisors and they would normally have level 3 supervisors subordinate to them. Senior supervisors are also likely to liaise directly with higher management.

This strata of supervisory roles is situated at the interface of management and the workforce. They consititute a 'structure of supervision' and form a distinct part of a management control structure in the direct control of workplace operations. It is argued here that this structure of supervision will take the form of a 'supervisory hierarchy of control'. It is composed of a number of different levels which can be distinguished according to their location within an authority and status structure, and according to the degree to which they participate in the function of supervision.

In practice, it is often difficult to identify and define the upper and lower edge of the supervisory hierarchy of control. The study of supervision undertaken by the NIIP noted this point in stating that:

> It is not easy to define either the upper or the lower limit of the supervisory strata in the pyramid of control. At the lower level there may be the Leading Hand or Working Chargeman, with some supervisory responsibility but remaining primarily an operative at the bench or machine. At the upper limit, there may be the Shop Superindendent, with responsibilities and powers closely approaching if they do not overlap, those of the manager.[53]

For practical purposes, individuals who occupy 'mixed' supervisory-operative positions can be identified and defined as 'working supervisors' according to the criteria that: firstly, they are afforded authority by the work group or management and hence, are of higher status than operatives; and secondly, that they regularly participate in the function of supervision.

Individuals who occupy 'mixed' managerial-supervisory roles may be identified and defined as 'senior supervisors' according to the same criteria.

They can be identified as a distinct part of the management control structure on the basis that they are *directly* involved in the *day-to-day* control problems of an operating system. In other words, senior supervisors are essentially members of a structure of control situated at the point of contact of the physical work of production. As Betts phrased it:

> Supervision implies operating at close range by actually overseeing or controlling on the shop floor, dealing with situations on the spot as they arise, whereas management implies controlling remotely by using other administrative means.[54]

Through using these criteria and the framework of levels and types of supervisory roles, a broader conception of supervision (which goes beyond the role of the formal first-line supervisor) can now be employed in analysing the internal characteristics of supervisory structures within organisations. Consequently, it is no longer necessary to be solely directed by common sense formulations of job titles and definitions of supervision. A good example of the problems of nomenclature and supervision is provided by Kelly when he describes the changes in the methods of organisation and supervision at the Glacier Metal Company.[55] He points out how Glacier, by abolishing the role of the foreman and creating the position of section manager, merely brought about 'a semantic transformation rather than an actual organisational change'.[56]

In order to prevent this occuring in the empirical case study in Part II, the framework developed in this section will be employed. This will make it possible to:

- identify and define the range of supervisory roles between management and the workforce
- locate these supervisory roles at a particular level within a structure of supervision

The various supervisory roles which constitute a structure of supervision do not work in isolation from each other as this 'static' model might suggest, rather, they form part of what Thurley and Hamblin define as a 'supervisory system of control'.[57]

(v) The Supervisory System

In examining the implications of computer technology for supervision it is important to consider the changing relationships between supervisors, as well as changes to individual supervisory roles. Furthermore, any analysis of changes in the distribution of control across supervisory levels also needs to be set in the context of changes to work organisation and to wider systems of management control. In this section, the concept of 'supervisory system of control' is explained, and the implications of computer technology for supervision, work organisation and management control are briefly summarised.

(a) The Supervisory System

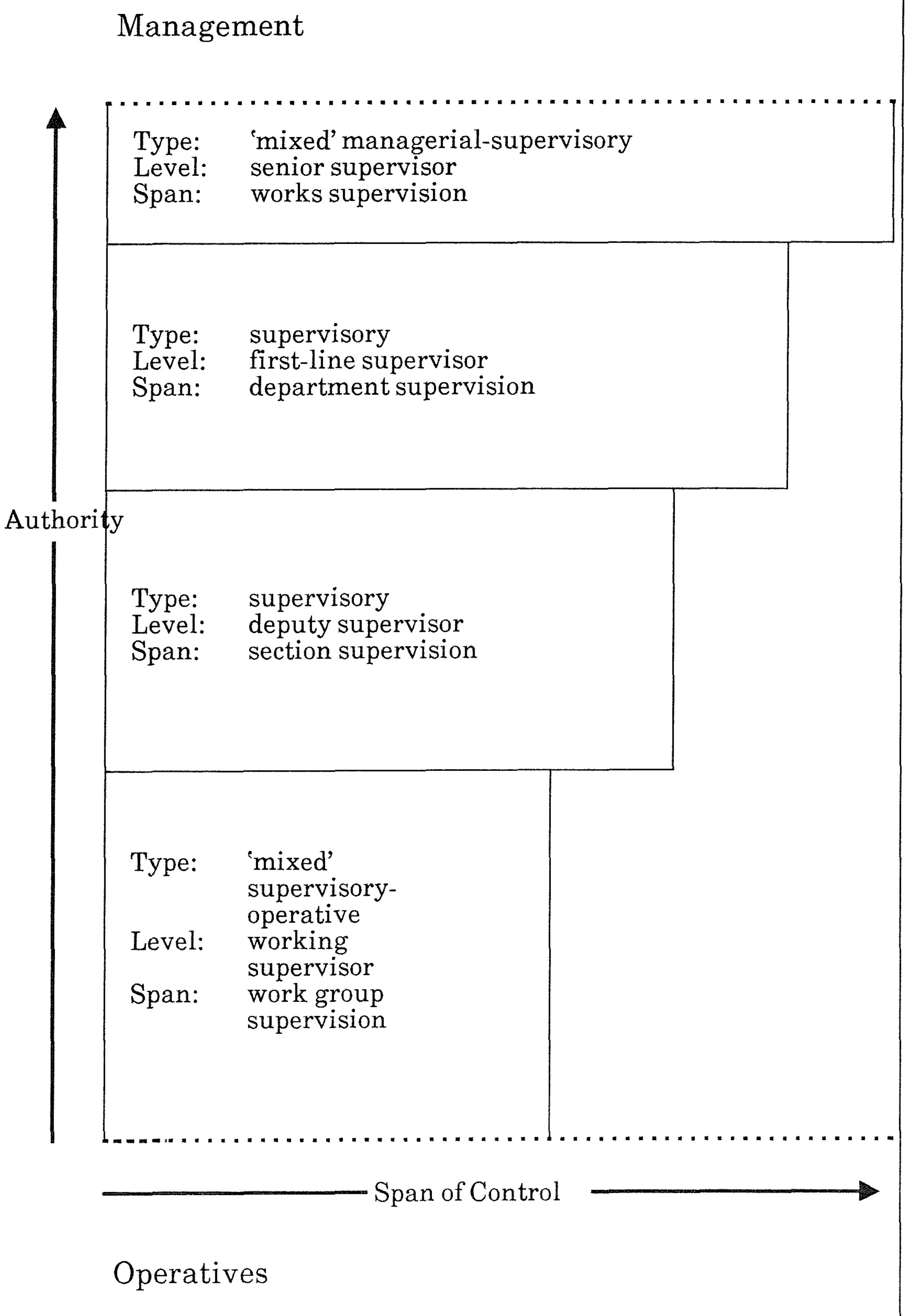
The term 'system of supervision' is used by Thurley and Wirdenius to refer to a set of interacting supervisory roles which are directly involved with the daily variations and problems of a production system.[58] This set of interacting roles are performed by various individuals who make up a structure of supervision, that is, the combination of levels from senior supervisor through to working supervisor.

Individuals may be identified as belonging to a supervisory system in cases where there is either worker or managerial recognition of authority; where the individual is in control of some aspects of the day-to-day operations of production; and where there is a certain degree of supervisory interdependence between the various levels which constitute a structure of supervision. In large organisations however, the boundaries of what actually might comprise the supervisory system may become difficult to discern. On this point Thurley and Wirdenius state:

> The only practical answer to this problem is to say that where the system of roles is formally and informally recognised as dealing with a discrete area of control responsibility and where the supervisors themselves are actually working together on common problems, then it is not misleading to refer to a distinct supervisory system.[59]

An illustrative example of a supervisory system is shown in Figure 2. The differing levels and types of supervisory positions identified and defined earlier in this chapter are combined with the supervisor's span of control. In the example given, the supervisory system is taken to represent a network of interrelated roles each with different supervisory elements and relationships. It should however be noted, that the 'dynamics' of supervisory systems (for example, the daily interaction of supervisors in dealing with common operating problems) cannot be realistically detailed in abstraction from the organisational settings in which they are located

Figure 2: An Illustrative Example of a Supervisory System of Control



(on this, see Chapter 5 which examines the effects of computerisation on supervisory systems in British Rail marshalling yards). Finally, it is worth emphasising that in the context of examining changes to supervision, it is important to consider both changes to the supervisory system as a whole, and changes to the individual roles which constitute that system.

(b) The Supervisory System, Work Organisation and Management Control

Supervisors are 'managers' concerned with the direct control of workplace operations. In many situations, supervisors who operate at different levels within the organisational structure work together in solving operating problems which affect them all. In such cases, supervisors may be said to form part of a supervisory system. Moreover, as the supervisory system is by definition located between management and the workforce(see Figure 2, page 72), strategies which promote either the devolution of operations control to operatives, or the centralisation of control at a higher level of management, are likely to result in significant changes both to the supervisory system and to individual supervisory positions. Consequently, in order to make sense of changes in the sphere of influence of individual supervisory roles, and of changes in the boundary or area of workplace control of supervisory systems, it is important to examine these changes within the wider context of changes in work organisation and management control.

This is particularly evident in the case of computer technology which, as a consequence of its implementation, may erode or enhance the span of control of supervisors and/or supervisory systems. As discussed in Chapter 2, this is apparently being caused by: centralising supervisory control functions at a higher level of management;[60] devolving traditional supervisory responsibilities to operatives;[61] and incorporating supervisory control functions into computerised systems of production.[62]

However, it is argued here that the outcome of computerisation on supervision should not solely be explained in terms of the capacity of the technology to carry out supervisory tasks and functions, or in terms of its 'impact' on the internal characteristics of supervisory structures. Changes in the organisation of work (for example, in the formation of autonomous work groups), and changes in management control (for example, in centralising elements of supervisory control at a higher level of management), need to be taken into account if an adequate explanation of the effects of computer technology on supervision is to be achieved. The claim that changes in supervision needs to be examined within the wider context of changes in work organisation and the system of management control, is tested empirically in Chapter 5.

(vi) Conclusion

Any detailed investigation of the effects of computer technology on individual supervisory roles and supervisory systems should be located within a broader analysis of the process of computerisation. As illustrated in Chapter 2, computer technology can be used to either centralise or decentralise control responsibilities. This indicates the importance of identifying factors which shape the introduction of computer technology, in order to provide a general explanation of the process by which supervision is redefined.

In the first section of this chapter it was suggested that a number of factors may influence the direction of change at different stages during the introduction of computer technology. For example, management's implementation strategy and occupational and employee response, were identified as significant variables influencing the implementation and initial operation of computer-aided operating systems. Therefore, for the purpose of aiding an empirical analysis of these and other factors which may shape the various stages associated with the introduction of computer technology, an analytical framework was developed. The four discrete analytical stages which were identified comprised:

- the decision to introduce computer technology
- the choice and design of computer systems
- implementation and initial operation of the computer system
- routine operation of the computer system

This framework is utilised in Chapter 4 which examines the various factors which shaped the process of introducing a computerised freight information system in British Rail. The remaining chapters then focus far more exclusively on the effects of computerisation on marshalling yard supervision.

The second part of this chapter argued that a more differentiated conceptual framework is required in order to fully appreciate the effects of computer technology on supervision. A broader conception of supervision was formulated which took into account the variety of supervisory tasks, status levels, and job titles of individuals who are directly engaged in the day-to-day control of an operating system. This section also provided the reader with: a working definition of supervision; an identification and definition of the range and types of supervisory positions; an explanation of the concepts of supervisory system, and span of control; and finally, an explanation of why the effects of computer technology on supervision can only be ultimately understood in relation to changes in work organisation and the system management control. In part II, this conceptual framework is used in an empirical examination of changes to supervisory systems and to individual supervisory roles in British Rail marshalling yards.

Chapter 3. Notes and References

1. See for example, A.K. Rice, *The Enterprise and its Environment*, Tavistock 1963; T. Burns, and G.M. Stalker, *The Management of Innovation*, 2nd edition, Tavistock, 1968; J. Bessant, 'Management and Manufacturing Innovation: The Case of Information Technology', in G. Winch, (editor) *Information Technology in Manufacturing Processes: Case studies in Technological Change*, Rossendale, 1983; D. Buchanan, 'Technological Imperative and Strategic Choice', in G. Winch, (editor) *Information Technology in Manufacturing Processes: Case studies in Technological Change*, Rossendale, 1983; J. Clark, A. Jacobs, R. King, and H. Rose, 'Industrial Relations, New Technology and Divisions within the Workforce', *Industrial Relations Journal*, Vol. 15, No. 3, 1984; and J. Child, 'Managerial Strategies, New Technology and the Labour Process', in D. Knights, D. Collinson, and H. Willmott, (editors), *Job Redesign. Critical Perspectives on the Labour Process*, Gower, 1985.

2. See for example, I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson 'The Introduction of a Computerised Freight Information System in British Rail - TOPS', New Technology Research Group, University of Southampton, 1983.

3. See, I. McLoughlin, H. Rose, and J. Clark, 'Managing the Introduction of New Technology', *OMEGA*, Vol.13, No.4,1985, pp.251-262.

4. B. Wilkinson, *The Shop Floor Politics of New Technology*, Heinemann 1983, pp.86-87, also distinguished 'stages of innovation'. The sequence of analytical categories he employed in his study consisted of: the design; the choice; and the implementation and debugging of new technology.

5. J. Child, 'Organisation Structure, Environment and Performance, the Role of Strategic Choice', *Sociology*, Vol. 6, No. 1, 1972, pp.1-22.

6. See for example, D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983, pp.242-244; and J. Child, Organisation: *A Guide to Problems and Practice*, 2nd edition, Harper & Row, 1984, pp..

7. See for example, I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit.

8. See for example, Confederation of British Industry, *The Challenge and Implications of Technology*, Confederation of British Industry, 1979; European Trade Union Institute, *The Impact of Microelectronics on Employment in Western Europe in the 1980's*, European Trade Union Institute, 1979; R. Rothwell, and W. Zegveld, *Technical Change and Employment*, Francis Pinter, 1979; C. Hines and G. Searle, *Automatic Unemployment*, Earth Resources Research, 1979.

9. See for example,R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century*, Heinemann, 1979, pp.163-199; and J. Storey, *Managerial Prerogative and the Question of Control*, Routledge & Kegan Paul, 1983, pp.152-156.

10. J. Child, *Organisation: A Guide to Problems and Practice*, 2nd edition, Harper & Row, 1984, p.251.

11. D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983.

12. I. McLoughlin, 'Problems of Management Control and the Introduction of New Technology', New Technology Research Group, University of Southampton, June 1983.

13. See for example, J. Child, 'Managerial Strategies, New Technology and the Labour Process', in D. Knights, D. Collinson, and H. Willmott, (editors), *Job Redesign. Critical Perspectives on the Labour Process*, Gower, 1985, pp.107-141.

14. The term 'apparatus' taken from Winner refers to the internal characteristics of computer technology, and does not include the design of operating systems which are required in operationalising these systems within organisations. See, L. Winner, *Autonomous Technology*, Massachusetts Institute of Technology Press, 1977, pp.11-12.

15. In cases where a whole new plant is erected (as illustrated by the development of computerised process production chemical plants) the design process is a critical stage at which decisions on the organisation of work are made. Davis and Taylor demonstrate this point and provide four case study examples where the 'psychosocial' effects or assumptions, were considered or ignored in the design and development of whole new plant organisations. See, L.E. Davies, and J.C. Taylor, 'Technology,

Organisation and Job Structure', in R.Dubin, (editor) *Handbook of Work, Organisation and Society,* Rand McNally, 1976), pp.381-385.

16. A point worth noting is that whilst an existing organisation may choose a ready-made system which comprises a hardware and software package, considerable modifications to the software can occur during the implementation and initial operation of the computer system. See for example, I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson 'The Introduction of a Computerised Freight Information System in British Rail - TOPS', New Technology Research Group, University of Southampton, 1983.

17. These three elements: hardware configuration; software architecture; and operating system; are taken to be the key constituents of computer technology. This broader definition of computer technology is utilised throughout the remaining body of the text.

18. B. Wilkinson, *The Shop Floor Politics of New Technology,* Heinemann 1983a, p.89.

19. See for example, B. Wilkinson, 'Technical Change and Work Organisation', *Industrial Relations Journal,* 1983b, pp.18-27.

20. D. Buchanan, 'Technological Imperatives and Strategic Choice', in G. Winch, (editor) *Information Technology in Manufacturing Processes: Case studies in Technological Change,* Rossendale, 1983, p.3.

21. R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century,* Heinemann, 1979.

22. M. Weir, and S. Mills, 'The Supervisor as a Change Catalyst', *Industrial Relations Journal,* Vol. 4, No. 4, 1973, p.69.

23. See also, for example, J. Child, 'Managerial Strategies, New Technology and the Labour Process', in D. Knights, D. Collinson, and H. Willmott, (editors), *Job Redesign. Critical Perspectives on the Labour Process,* Gower, 1985.

24. See for example, I. McLoughlin, H. Rose, and J. Clark, 'Managing the Introduction of New Technology', *OMEGA,* Vol.13, No.4, 1985, pp.251-262.

25. Ibid.

26. I.P. McLoughlin, and J.H. Smith, 'The Achievement of Change in British Rail: The Case of TOPS', New Technology Research Group, University of Southampton, May 1982, pp.11-16.

27. B. Wilkinson, *The Shop Floor Politics of New Technology,* Heinemann 1983a, p. 39.

28. T. K. Reeves, and J. Woodward, 'The Study of Managerial Control', in J. Woodward, (editor), *Industrial Organisation: Behaviour and Control,* Oxford University Press, 1970, pp.45-53.

29. R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century,* Heinemann, 1979, pp.111-162.

30. See for example, J. Child, *Organisation: A Guide to Problems and Practice,* Harper & Row, 1977, pp.50-65.

31. This is a criticism which can be levelled at Edward's examination of changes in the control function of supervision. R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century,* Heinemann, 1979.

32. According to Woodward, the average number of operatives controlled by first-line supervisors will increase from unit to mass production technologies, and then decrease from mass to process production industries. J. Woodward, op. cit., pp.51-67; see also, D. Wedderburn, and R. Crompton, *Workers' Attitudes and Technology,* Cambridge University Press, 1972, pp.121-132.

33. In the five year project carried out by Thurley et al on supervision in five companies, a number of differing supervisory functions were identified. Over forty functions were distinguished and the number observed within a single department ranged from eleven to thirty-one. By taking the main function or purpose of supervision, Thurley then developed a six-fold classification of the main types of 'supervisory systems of control' (this concept is explained later in Chapter 3), they were:

<u>Work Flow System</u>: where the main function of supervision is to get the work out on time

<u>Work Standard System</u>: where the main function is quality control

Machine Control System: where the main function is to control machine variations and breakdowns

Labour Control System: where the main function is the control of operatives

Cost Control System: where the main function is cost control

Work Methods Control System: where the main function is to control types of operative method

See for example, K.E. Thurley, 'Changing Technology and the Supervisor, in J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective*, MacMillan, 1966, pp.345-346.

34. See, J. Woodward, *Industrial Organisation : Theory and Practice*, 2nd edition, Oxford University Press, 1980, pp.35-44.

35. See for example, J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society*, Cambridge University Press, 1982, pp.17-31.

36. This is supported by numerous studies, see for example: F. J. Burns Morton, *The New Foremanship*, Chapman & Hall, 1946; C.R. Walker, R.H. Guest, and A.N. Turner, *The Foreman on the Assembly Line*, Harvard University Press, 1956; A. Etzioni, 'Human Relations and the Foreman', *Pacific Sociological Review*, Vol. 1, 1958, pp.33-38; T. H Patten, *The Foreman: Forgotten Man of Management*, American Management Association, 1968; and D. Dunkerley, *The Foreman: Aspects of Task and Structure*, Routledge, 1975.

37. National Institute of Industrial Psychology, *The Foreman: A Study of Supervision in British Industry*, Staple Press, 1951, p.155.

38. K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973, p.25.

39. National Institute of Industrial Psychology, op. cit., pp.113-114.

40. For example, compare: M. Dalton, *Men Who Manage*, Wiley, 1959, figure 1; with F.J. Roethlisberger, and W.J. Dickson, *Management and the Worker*, John Wiley, 1939, figure 20.

41. K.E. Thurley, and H. Wirdenius, ibid.

42. K.E. Thurley, and A. C. Hamblin, 'The Supervisor and His Job', *Problems of Progress in Industry*, No. 13, H.M.S.O., 1963, p.5.

43. K.E. Thurley, and H. Wirdenius, op. cit., p.26.

44. A. Etzioni, *Modern Organisations*, Prentice-Hall, 1964.

45. A. Etzioni, op. cit., p.91.

46. See for example, C. Fletcher, 'Men in the Middle: A Reformulation of the Thesis', *Sociological Review*, Vol. 17, 1969, p.350; and J. Kelly, *Is Scientific Management Possible?* Faber & Faber, 1968, p.168.

47. For example, National Institute of Industrial Psychology, *The Place of the Foreman in Management*, Staple Press, 1957, pp.16-17; H. Wirdenius, 'A Suggested Framework for the Development of Supervision', paper II, October 1979, p.7; P.W. Betts, *Supervisory Studies*, 3rd edition, McDonald & Evans, 1980, pp.10-11.

48. National Institute of Industrial Psychology, 1951, op. cit., p.17.

49. The National Institute of Industrial Psychology identify over three hundred different job titles which they categorise under four main supervisory levels, namely:

Level A: this includes most senior supervisors with titles such as, 'shop superintendent' and 'general foreman'
Level B: this category is composed of first-line supervisory positions and would usually have a number of junior supervisors to act as assistants or 'primary group' leaders
Level C: this consists of most assistant and junior foremen positions
Level D: this category covers such job titles as 'chargehand' and 'leading hand'

See, National Institute of Industrial Psychology, 1951, op. cit., pp.16-17.

50. For example, an individual who is principally involved in the supervisory task of controlling work place operations and yet on a given day spends 70% of his time carrying out operative duties (e.g. due to absenteeism) would still be identified as holding a 'pure' type of supervisory role.

51. K.E. Thurley, and H. Wirdenius, op. cit., pp.27-28.

52. Ibid.

53. National Institute of Industrial Psychology, 1951, op. cit., p.16.

54. P.W. Betts, *Supervisory Studies*, 3rd edition, McDonald & Evans, 1980, p.6.

55. J. Kelly, *Is Scientific Management Possible?* Faber & Faber, 1968; see also, W. Brown, *Exploration in Management*, Pelican, 1965.

56. J. Kelly, op. cit., p.172.

57. The concept of 'supervisory system of control' is used by K.E. Thurley, and A. C. Hamblin, 'The Supervisor's Role in Production Control', *International Journal of Production Research*, Vol. 1, No. 4, 1962, pp.2-3; and later by K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973, pp. 27-29.

58. K.E. Thurley, and H. Wirdenius, op. cit., pp. 27-29.

59. K.E. Thurley, and H. Wirdenius, op. cit., p.28.

60. H. Shaiken, 'Numerical Control at Work', *Radical America*, Vol.13, No.6, 1979, p.249.

61. D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983, p.249.

62. R. Edwards, op. cit., p.125.

Part II. The Introduction and Operation of a Computerised System of Freight Information Control in British Rail: A Case Study

The second part of this dissertation reports on a case study examination of the introduction and operation of a computerised system of freight information control in British Rail. The main body of research was conducted between 1981 and 1983. It involved a retrospective study of management strategy and industrial relations issues in the implementation of a computerised system of freight information control, and a more detailed study of the effects of change on local supervision based in railway marshalling yards.

Chapter 4 draws primarily on the retrospective study and analyses the main factors which influenced the introduction of computer technology. This examination of the process of computerisation has necessarily been retrospective and has sought to identify and investigate the various stages associated with the introduction of computer technology as outlined in Chapter 3. Interviews were conducted with key informants involved in various aspects of TOPS introduction and operation, and a search was made of various documentary materials held by British Rail and the railway unions (see Appendix II).

Chapters 5, 6, and 7, draw on data collected from an empirical investigation of marshalling yard supervision under the routine operation of a computerised system of freight information control. This involved an in-depth study of the effects of change in five traditional marshalling yards in three British Rail regions. In each of the five marshalling yards information was collected by: interviewing yard staff; carrying out a detailed programme of observation of local operations; and administering a questionnaire to supervisory staff. This information was supplemented by further interviews and documentary material from Regional and National headquarters (see Appendix II).

In Chapter 5, the concept of a supervisory system developed in Chapter 3 is utilised in an examination of the effects of computer technology on marshalling yard supervision. Furthermore, it is shown how a better appreciation of the relationship between computer technology and supervision can be achieved, by analysing changes in supervisory control functions within the broader context of changes in work organisation and the system of management control.

Chapter 6 details changes in the tasks and responsibilities of yard supervisors (an example of the 'pure' first-line supervisor) under the routine operation of the TOPS computer system. The degree to which computer technology is rendering first-line supervisory positions more peripheral or pivotal to the operating system is also examined in the light of the debates outlined in Chapter 2.

Chapter 7 then discusses how the introduction of computer technology enabled the creation of a new supervisory position, the area freight assistant (an example of a 'mixed' managerial-supervisory role). The common tasks and functions of this job are analysed, and the extent to which the occupants of such roles hold pivotal or peripheral positions in the day-to-day control of production operations is examined.

Chapter 8 provides a summary conclusion, outlining the central argument of the thesis and reappraising the main substantive findings of the research. In the penultimate section the main factors likely to influence the process of computerisation are identified and generalised to other organisational contexts. The final section then examines the policy implications of computer technology for supervision. It is suggested that computer technology could be introduced by management to create new computer-oriented supervisory positions and hence expand the span of control of local supervision, and integrate supervisors more closely into the wider system of management control.

Chapter 4. The Introduction of the TOPS Computer System

(i) Introduction

In 1971, British Rail decided to invest £13 million in a new computer information system to improve management control of freight operations. The system, known as Total Operations Processing System (TOPS), has been in operation since 1975 following a four year implementation programme. This investment was one the of the first large-scale ventures by British industry in the application of on-line real-time computer information technology. Since 1975, the system has been considerably enhanced.[1]

In Chapter 3, it was suggested that a number of 'external' and 'internal' variables are likely to influence the process of computerisation, such as competitive market pressures, management strategy and occupational and employee response. In this chapter, the extent to which these and other factors influenced the introduction of a computerised freight information system in British Rail are examined.[2] The analytical framework developed in the previous chapter is used to identify different stages during the introduction of the TOPS computer system. At each stage the major factors influencing the direction and outcome of change are examined. The chapter concludes by assessing the influence of these factors on computerisation and organisational change.

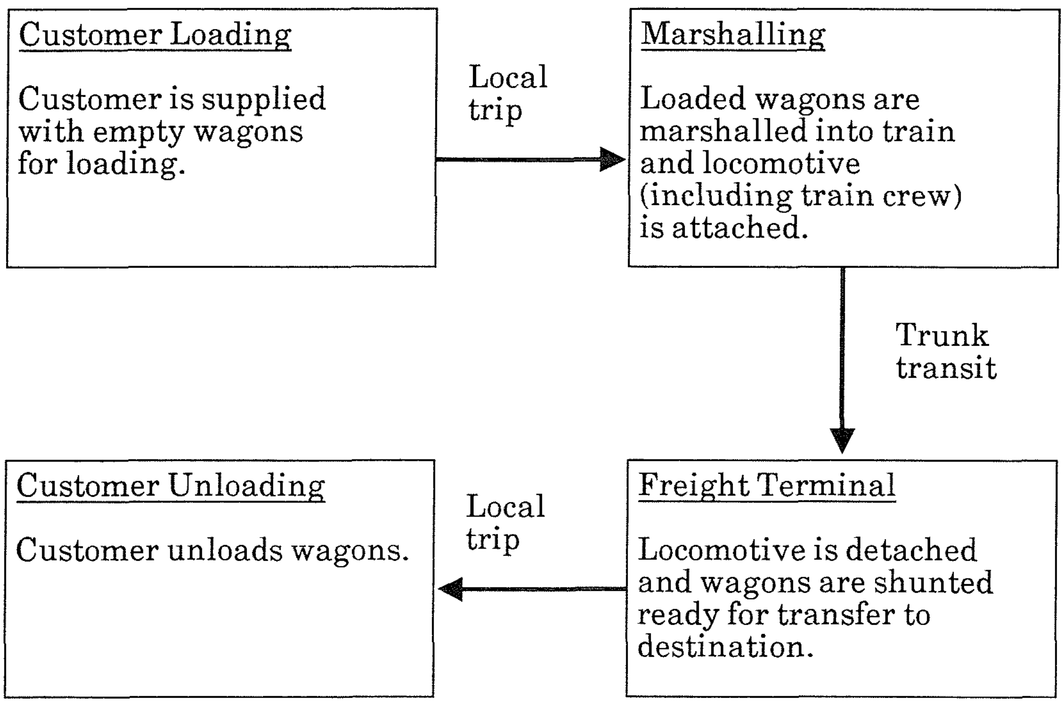
(ii) The Decision to Computerise

The decision to computerise was taken at the corporate level of the business organisation of British Rail. The strategic intentions behind the introduction of TOPS comprised various 'business market', 'operating', 'product', and 'cost' objectives. These in turn were influenced by the opportunities offered by computer-based technologies and the nature of railway freight operations. Each of these are discussed in more detail below.

(a) Railway Freight Operations and the Importance of Information

Railway freight transits consist of a complex and interdependent set of 'time sensitive' cycles of operations. The problem of management control centres on the task of providing an adequate supply of resources (wagons, locomotives, train crews) to meet changing customer demands, and then to integrate freight transits over a national rail network. Information has to be captured, transmitted, processed and disseminated on the location and disposition of resources over the entire network. This information then has to be utilised in the control and integration of a number of interdependent cycles of operations, for example, about the route to be taken, the provision of train crews (and relief), the type of locomotive required, the compatibility of wagons, and their integration into existing and planned passenger and freight train services.

Figure 3: Cycle of Operations in Freight Transits



The basic elements of this cycle of operations (as illustrated in Figure 3) is as follows:

- a customer is provided with empty wagons for loading
- the loaded wagons make a local trip to a marshalling yard
- the wagons are marshalled into a train and a locomotive (including train crew) is attached

- the train makes a trunk trip to another marshalling yard
- the wagons are shunted according to their individual destinations
- the wagons make a local trip to the customer unloading point

The control, co-ordination and efficiency rest to a large degree on the availability and accuracy of information about the location and disposition of resources (in particular empty wagons) and the movement and composition of freight trains. This is made even more imperative by the regular occurrence of contingencies in railway operations, including fluctuations in demand for freight resources, resource shortages, train delays, and locomotive failures, which require the daily re-scheduling of planned operations and services.

(b) The Business Market

During the 1960's, the economic problems of British Rail's freight operations had become acute.[3] Whilst the Beeching Report had made an attempt to arrest the decline in the passenger business, little had been done to reshape the ailing freight business which suffered from increased competition from other types of transport, in particular, road haulage of small consignments, and a decline in the industries which most used rail transport.[4] In 1956, 21% of freight tonnage was moved by rail compared with 75% by road.[5] By 1967, British Rail's share of the market had fallen to 11% and road haulage had increased to 84.6%.[6] In 1967, just over 6% of British Rail's receipts came from the haulage of freight, 48% of which came from the carriage of bulk commodities such as coal, coke, iron, and steel, which accounted for 75% of railway freight tonnes carried.[7]

By the late sixties the bulk of British Rail's freight business was concentrated in the carriage of bulk commodities in the face of a rapid decline in small consignments more suitable for road haulage.[8] There was growing concern that the freight business could not remain viable since the industries which provided the bulk of its freight traffic were either declining or growing only slowly. Coal and coke tonnage carried by rail fell by 27% between 1956 and 1967 as a result of the decline in the coal industry.[9] By 1967, British Rail had accumulated a working deficit plus interest charges of £153 million, largely as a result of the decline in freight business.[10]

In the preliminaries to the 1968 Transport Act, the then Labour government expressed concern over the position of the freight business.

British Rail repsonded by undertaking a series of planning exercises aimed at finding a way to improve productivity. In these, the unavailability of accurate up-to-date information was identified as the key factor contributing to the gross under-utilisation of resources, and consequently was singled out as an area where improvements needed to be made.[11] Thus, the opportunities afforded by new computer technologies to improve this situation influenced the British Railways Board in their strategic decision to computerise the freight information system. It was felt that computer technology could be used to arrest the decline in freight traffic by enabling the better utilisation and control of resources and hence improve the speed and efficiency of freight transits.

The principal problems associated with controlling the pre-TOPS freight system were seen to derive from the manual hierarchical system of freight information control, in particular, three inter-related characteristics of the pre-TOPS system. Firstly, management relied for its information about the disposition of resources on daily physical checks. At headquarters, day-to-day decisions about resource allocation (especially the supply of empty wagons to meet customers' loading requirements) were contingent upon the provision of information through hierarchical manual reporting procedures which listed the location and status of wagon and locomotive fleets. Secondly, the effectiveness of manual reporting procedures and information flows were undermined by a combination of the parochial attitudes of railway freight supervisors and the impossibility of validating the information provided by staff responsible for checking wagons. The need to satisfy local requirements and respond to fluctuations in customer demands meant that 'figure adjusting' in daily returns was widespread and that stores of unreported wagons and 'spare' locomotives were accumulated in individual local areas as a matter of course. Thirdly, customers had no knowledge of the whereabouts of their consignments. Once despatched, their wagons were 'lost' until such time as they arrived at their destination.[12] Despite the attention of a small army of wagon inspectors it was estimated that only 80% of the wagon fleet was accounted for in each daily distribution report.[13] Customers were also inclined to engage in wagon hoarding, and were able to use British Rail wagons within their own private rail networks with impunity.

All these factors combined to produce a grossly inefficient utilisation of material and human resources. These operating inefficiencies resulted in a wagon fleet which, despite substantial reductions post-Beeching, was still too large for the size of the network and volume of freight traffic. In addition, there was an over-provision of locomotives and train crews due to the variability of demands for freight services. Thus, the decision to computerise was not a response to problems of labour control, but rather, to internal operating problems associated with accurate information flows for the control of railway freight operations. Moreover, the availability of computer technology and external business market pressures, also played a part in influencing the strategic decision to computerise the freight information system. The strategic opportunities behind the introduction of the TOPS computer system are discussed in more detail below.

(c) The Strategic Opportunities

British Rail's 1971/75 Freight Plan unequivocally recommended computerisation, claiming that it would stem the loss making trend and make possible an expansion in British Rail's share of the freight market. It identified the need for a 'real-time' computerised freight information system which would enable the more effective utilisation of resources in the day-to-day control of railway freight operations. Moreover, it was also suggested that if a suitable computer system could be obtained from another railway then this would minimise delays, reduce the risks involved, and enable considerable savings in development costs.[14]

The 1971/75 Freight Plan set out the specifications from which a 'world tour' of railway computer systems could be judged. These specifications were as follows:

- more effective distribution and utilisation of freight rolling stock
- more effective pre-planning of yard and terminal operations
- the availability of accurate information to provide guaranteed transits from source to destination
- prompt response to customers' requests for information on the location of loaded and empty wagons
- provision of a data base for a comprehensive management information system
- more efficient control of locomotives and train crews
- prompt assessment of the practicality of meeting customers' needs for the running of special trains at short notice

- more effective re-planning of the total workload, particularly, short-term planning of the highly variable element of the freight business
- provision of an efficient system of traffic regulation and the means to decide on the priority of freight train movements[15]

(iii) The Choice and Design of the Computer System

(a) The Choice of TOPS

A team of British Rail executives appointed by British Railways Board travelled overseas to examine existing computer freight information systems. The team investigated systems in France, Germany, Japan and Canada. The TOPS computer system developed by the Southern Pacific Railroad in Canada was identified as the system that most closely met the requirements listed above. Unlike the experimental nature of computer systems used elsewhere, TOPS had been developed over 10 years, and represented a tried and tested system which had also proven to be a commercial success.[16]

The development of the original TOPS computer system began in the early sixties, when in the face of increasing competition, Southern Pacific Railroad (which deals almost entirely in freight traffic), was facing a financial loss for the first time this century. A cutback in the Space programme at around the same time had left International Business Machines (IBM) with a surplus of high level computer programmers, and at the initiation of Ted Strong (an entrepreneurial vice-president of IBM who had links with Southern Pacific Railroad) a collaboration was agreed on the development of a computer information control system for Southern Pacific Railroad's freight operations. In 1968, Southern Pacific Railroad had devoted 660 man years of effort to the development of TOPS software programs.[17] By the end of the sixties, TOPS was a 'comprehensive' and 'proven' computer system.

In June 1970, representatives from Southern Pacific Railroad carried out a feasibility study on the applicability of TOPS to the very different operating practices on British Rail. The Southern Pacific Railroad team made a number of visits to different British Rail regions, talked to management at all levels and concluded that TOPS could be used successfully in British Rail. A team from British Rail then re-visited Southern Pacific Railroad and began to probe the possibilities more deeply and to determine realistic timescales for inclusion in the submission for investment approval to put to British Railways Board and later the Government.[18]

The major benefits to be derived from the TOPS investment were judged to be: savings on wagon costs through better utilisation of rolling stock and a reduction in the size of the wagon fleet; reduced operating costs through improved utilisation of locomotives and train crews (with computerisation it was expected that 250 locomotives and 1200 train crews could be saved by 1980); and increased traffic retention through improving the quality of services by ensuring that 90% of train movements occurred as planned in the timetable. In the event, the savings from improved wagon utilisation alone were seen as sufficient justification for investment in the TOPS computer system.[19]

The draft submission for investment approval for the TOPS computer system was presented to the Investment Committee in March 1971, and from March until June, financial debates ensued over the investment, especially because of its speculative nature. In addition, the decision to purchase TOPS software and IBM hardware was met with considerable vacillation within British Railways Board and the Department of Transport, where considerable pressure was exerted to 'buy British'. However, the TOPS software was designed for use with IBM hardware, and an equivalent ICL product was yet to be developed. As it turned out, the Investment Committee agreed to implement TOPS on the casting vote of the chairman.[20]

In October 1971, the scheme was submitted to John Peyton, the Minister of Transport Industries, who in giving his approval for the TOPS investment stated that the personal views of the chairman and the chief executive that the project should go ahead weighed heavily with him in his decision. The major advantages of the TOPS computer system over a 'home-grown' system were seen to be in: the shorter lead times involved; savings in development costs; and the availability of specialist expertise from North America on a consultancy basis.[21]

<u>(b) The TOPS Computer System</u>

The TOPS computer system is an operations processing system and comprises: a hardware configuration; software architecture; and operating procedures (for a detailed discussion of the TOPS system, see Appendix I). The basic hardware consists of mainframe computer equipment and numerous peripheral devices. The mainframe computer equipment comprises two identical 370/168 IBM computers. One is always 'on-line' in the sense that it is connected to outlying terminals and is continually executing the TOPS Control and Application Programs (see software). The other computer is described as 'off-line', which means that it does not deal with everyday programs but is essentially a backup to the 'on-line' computer in case of breakdown. However, it should be noted that some TOPS programs always run off-line (see for example, Journal Files in Appendix 1).

The peripheral devices associated with the TOPS computer system, are essentially for the purpose of receiving data, producing printouts of processed data, and for storing data for future use. Two examples of the peripherals used on this computer system are disk drives and tape drives. The former refers to the devices which access data held on disk packs (approximately 25 disk packs are in use at once on the on-line computer, with each pack being able to hold up to 105,000,000 characters of data); the latter refers to the devices which access data held on tapes (they have the benefit of being cheaper, but access to the data takes longer), these are usually used when storage is for a longer-term period. The other hardware components include: printers, facsimile machines, Visual Display Units (VDUs), and input keyboards.

The software architecture consists of a number of computer programs which control the computer in the execution of its tasks. A program is basically a series of logical instructions which directs the computer in relation to the various functions it may be required to undertake. The five major program types in operation on the TOPS system are:

- IBM Operating System
- IBM Support and Utility Programs
- TOPS Control Programs
- TOPS Application Programs
- TOPS Support and Utility Programs

The IBM supplied Operating System is a suite of programs supplied by IBM which cover a range of generalised functions such as transferring data to and from peripherals. The IBM Support and Utility Programs are specific function programs for use off-line to undertake common computer activities, for example, copying the data from disks to tapes for security purposes. The TOPS Control Programs are general function programs used on the on-line computer for controlling the handling and processing of TOPS messages (originally supplied by TOPS Inc., but now maintained and developed internally). The TOPS Application Programs are specific function programs which are used on-line to process individual TOPS messages. The TOPS Support and Utility Programs are specific function programs for off-line activities associated with TOPS, which include the preparation of disk data to be referenced on-line, and the historical processing of data generated by the on-line system. In addition to the five program types outlined above, there are also a variety of other specific function application programs which have been developed by British Rail since the initial introduction of the TOPS computer system.

The basic operating procedure of the TOPS computer system is as follows:

- clerical staff send and request information about train and wagon movements by entering 'messages' through computer terminals in local offices which are connected by land lines to the TOPS computer system at headquarters
- the 'message' is then passed through Communication Data Control (CDC), where facilities exist for re-routing 'messages' to and from individual terminals via different land lines as and when transmission problems occur
- finally, the 'message' is passed through the TOPS Computer Centre, where it is automatically fed into the computer system for other processing

(iv) Implementation and Initial Operation

A central feature of the TOPS investment strategy was the speed of implementation which was required if the various strategic objectives concerning saving on costs were to be achieved. If the investment was to bring the necessary improvement in freight service operations required to rescue the business, it had to be implemented within budget by 1975. Despite the advantages of 'buying-in' a proven system, a considerable implementation task had still be be faced and the trade unions convinced of its necessity. This involved:

- extensive modification of the TOPS software to suit British Rail's requirements

- the construction of a new computer centre and outlying local freight centres
- the enhancement of the British Rail telecommunications network to cope with TOPS data transmission requirements
- a programme of staff education and training (especially for the supervisors and staff responsible for exploiting the system)
- occupational and employee consultation and negotiation
- and the actual cut-over and operation of the TOPS computer system[22]

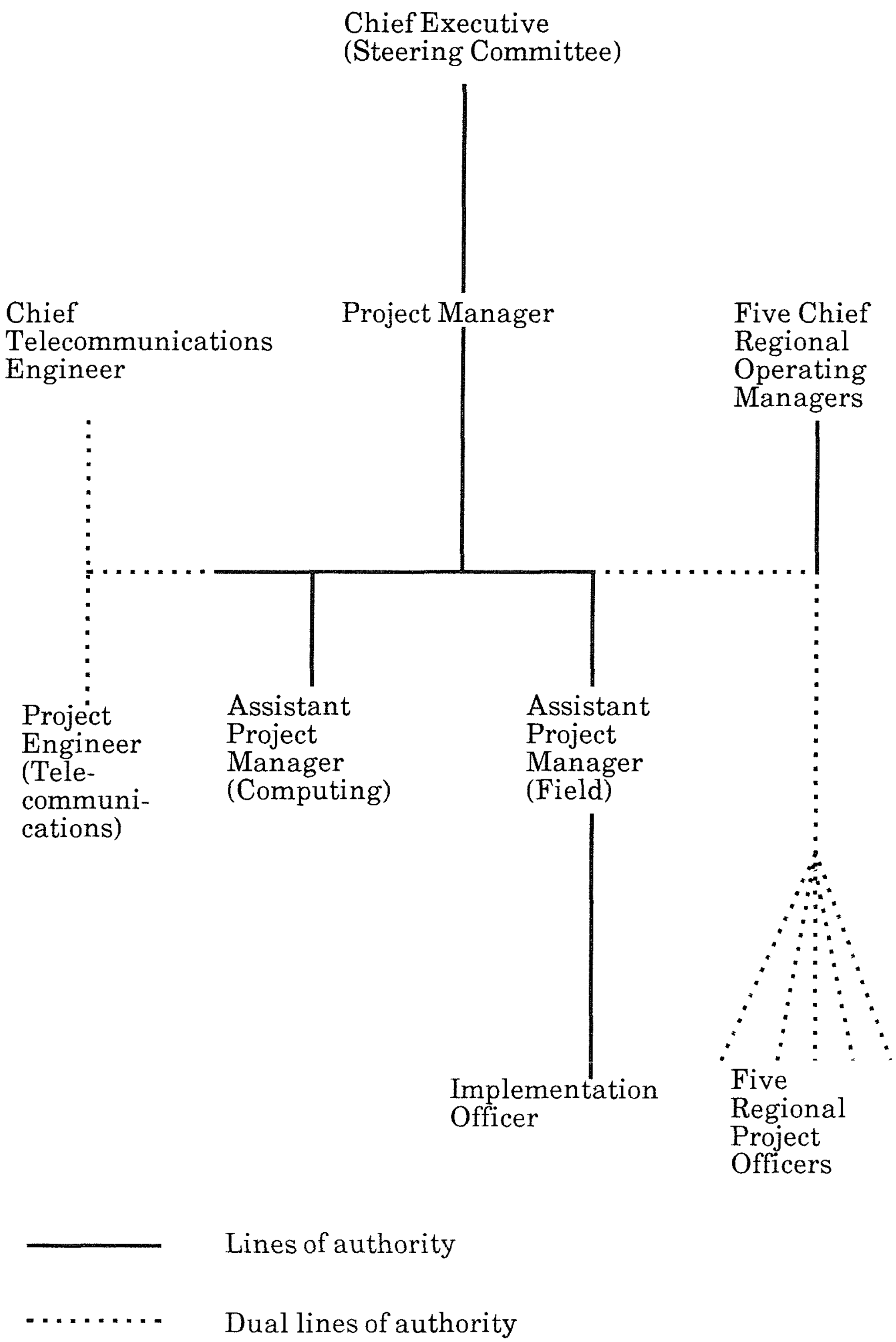
(a) The TOPS Project Organisation

Unlike previous and subsequent innovations within British Rail, the TOPS project organisation was deliberately constructed on cross-functional lines, incorporating under the overall control of one project manager, operating, computing and telecommunication specialists (see Figure 4). This particular organisational design was the product of the senior British Rail management who developed the TOPS implementation strategy. Two points worth emphasising are: firstly, that the project manager was invested with considerable authority and had a direct channel left open to the British Railways Board Chief Executive;[23] secondly, that the cross-functional project organisation was instrumental in avoiding inter-departmental rivalries and procedural delays.

The high level backing given to the TOPS project allowed for the necessary 'rule-bending' and 'by-passing' required of such a tight implementation schedule. The decision that the Project Manager should be a senior member of the operating department who knew nothing about computers had assured that TOPS implementation would take into account operating requirements of British Rail's railway freight network. Moreover, through assuring that the TOPS project would be represented on the top operating body within British Rail (the daily 'operating conference'),[24] it was possible to avoid the formal bureaucratic jungle and overcome individual managerial resistance. In the words of the TOPS Project Manager:

> I had the trust and backing from my colleagues to provide for them a workable system for operating staff. This obviated a lot time which would otherwise have been involved in meetings, explanations and arguments on how the system should be developed for use on British Rail.

Figure 4: TOPS Project Organisation[25]



In the Project Manager's view, the authority vested in him was a critical factor in achieving some of the major changes in management operating practice which the TOPS computer system made possible:

> I had heard that the intention was to draft Management Services resources to me on loan as necessary, and it did not appeal to me in the slightest. If I was going to run the project I wanted to run it my way, with a team completely identified with it and determined to share in its success. Knowing all too well the strength of the establishment I didn't dissipate time and effort making an issue of it, but went ahead building up the kind of joint organisation I considered essential....I can understand the annoyance when the *fait accompli* was realised, but without it TOPS would at best have been delayed, and at worst failed.

Within this framework a specialist implementation team was formed to carry out the task of implementing the system in each local area, The plan adopted was to introduce TOPS to the freight network in stages, over a period of approximately two years.

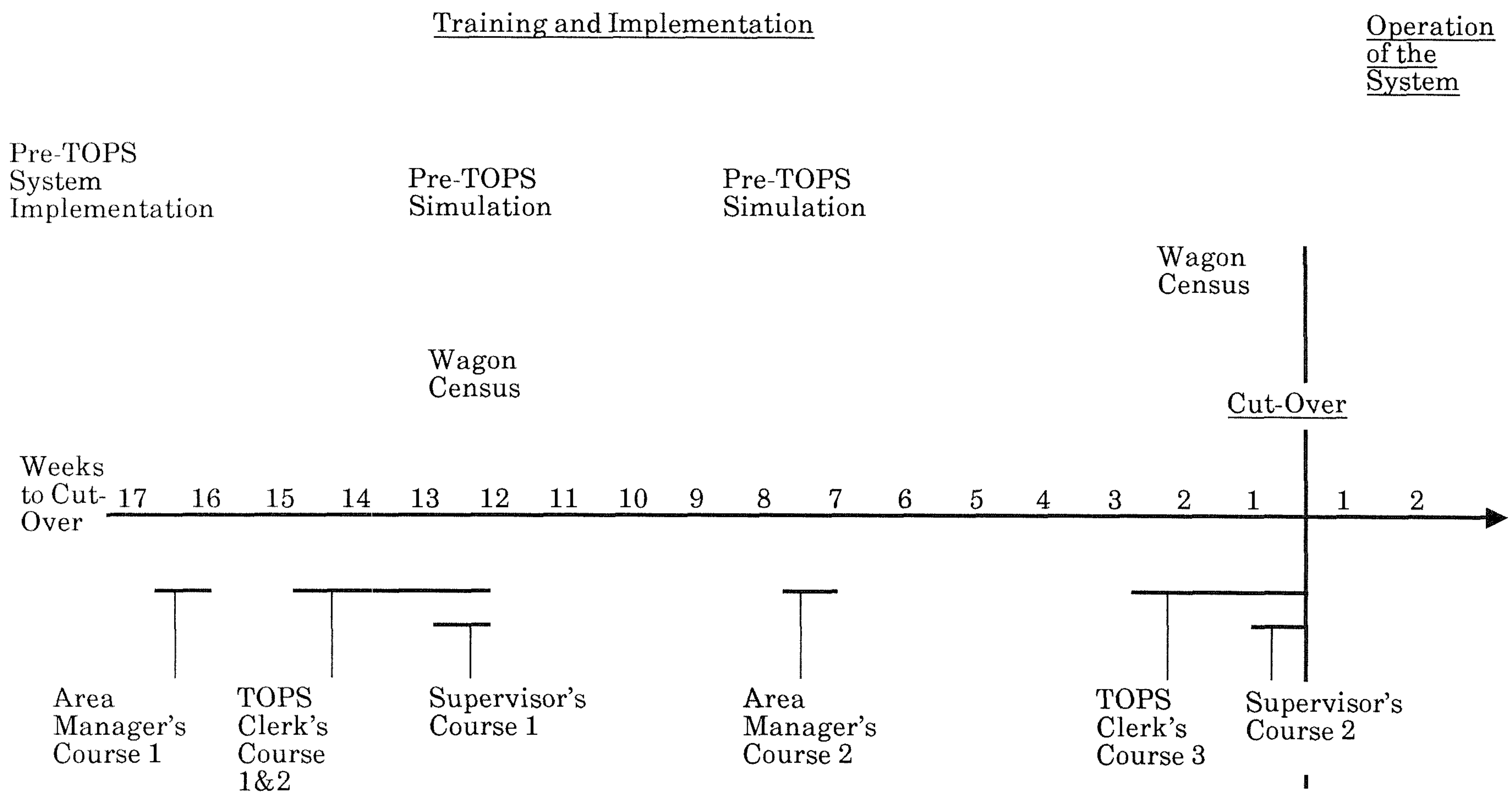
(b) Implementation

In setting up the implementation team, the strategic decision was made to combine the task of implementation with that of training. The decision was based on an immediate advantage of 'buying-in' an already developed and operational system, in that lessons could be learned from railways who had already implemented TOPS. One such lesson was the need to co-ordinate implementation with staff training as they can quickly become out of phase. Through bringing the two under the authority of the implementation team the organisation's established training facilities and procedures were by-passed.

As each local area was 'cut-over' to TOPS, the implementation team would move on to the next area and so on. At the peak of the implementation programmes several areas were being 'cut-over' simultaneously. During this period the team, which consisted of a combination of salaried staff seconded from operating jobs, management trainees, and other management staff, numbered over a hundred.

The mobility of the team was achieved by converting 'condemned' railway coaches into travelling classrooms. This enabled the team to act as 'trainers' and 'implementors', and to see the staff at each location through the entire conversion process. The basic programme of training and implementation is summarised in Figure 5. However, these timescales

Figure 5: Implementation and Staff Training for TOPS in Local Areas[26]



were often compressed, reflecting as the implementation officer stressed, that it was often 'ad hocery' rather than planning which was the key to the team's success.

The TOPS implementation team adopted a militaristic type 'task force' approach to computerisation.[27] During interviews, members of the team stressed the *esprit de corps* generated within the team fostered by an almost 'regimental' discipline. In the words of one of the team: 'if you weren't fired with enthusiasm for the project you were fired from the project'. This authoritarian task-force approach combined with a high level of management commitment generated what can best be described as a 'culture of change' within the organisation. The 'unity' of the project team was re-inforced through the design of a TOPS logo, the publication of a TOPS newsletter, and the manufacture of a TOPS tie. In addition, the commitment of the TOPS team was strengthened by senior management support:

> After every one of the TOPS offices was cut over I personally made a visit to the terminal. Not a red carpet or white-washed coal stacks affair, but to satisfy myself as to the quality of the equipment, working conditions and staff morale. To sit down and personally key enquiries into the terminal concerning current operations....Another feature was that I let it be known that promotion to Area manager was dependent on the chap satisfying us that he had TOPS 'under his skin'. (TOPS Project Manager)

These factors had a galvanising effect on the Project team which was passed on to the staff they were training. This bolstered the 'culture of change'[28] and generated the view that change could happen quickly. The Project team promoted confidence in the use of the TOPS computer system and bridged the transitional gap between implementation and initial operation. As implementors, they also became progressively more proficient and self-confident at each cut-over. This had a steam roller effect which made it all the harder for the remaining areas 'off-TOPS' to resist computerisation. This point has particular significance in understanding occupational and employee responses to change.

(c) Occupational and Employee Response

The implementation of TOPS was remarkably free from occupational and employee conflict and resistance. There appear to be a number of reasons for this.

Firstly, the initial effect of the TOPS computer system was to create jobs rather than reduce them. Moreover, all three rail unions agreed that the decline in the freight business had to be arrested and computerisation afforded this possiblity whilst also initiating the creation of new positions rather than displacing jobs. A large number of TOPS clerks were required to operate the computer system, this factor brought support from the Transport Salaried Staffs' Association (TSSA) who represent the majority of white-collar employees in the industry.

Secondly, operating with the TOPS computer system was seen to involve additional duties rather than fundamental changes in the skills or work roles of manual staff in marshalling yards. The concern of the union representing these staffs (the National Union of Railwaymen (NUR)) was to negotiate extra payments in recognition of the added responsibility involved in reporting information to the local freight centres. The union argued that the job of the shunter involved the additional task of checking and providing accurate information on freight movements and train formations (a task demanded by the characteristics of the technology). On this basis an extra grade related payment of £1.45 to £1.75 per week was agreed with management.[29]

Thirdly, national trade union support was also turned to good advantage by management in 'smoothing-over' local areas of resistance as TOPS 'cut-over' progressed. The leaderships of both the TSSA and NUR were instrumental in resolving local disputes which threatened to delay implementation. They provided what management regarded as 'constructive assistance' in the formalising of procedures for appointing new staff required to operate the TOPS computer system.

Fourthly, while the TOPS computer system could have been used for the recording and monitoring of the work of train crews and TOPS clerks, the exploitation of this 'labour control' capability was not considered a major priority by management. As already noted, the main motivation for introducing TOPS lay in the improvement in the control of material resources made possible by improving management information and performance through computerisation, rather than the application of the new technology to directly monitor the work and performance of manual and white collar staffs. This supports the claim made in Chapter 3 that supervision and management control is not solely concerned with regulating the activities of labour, but also, with a number of other elements of production, such as material resource control.[30] Furthermore, managment were able to allay the drivers' union (Associated Society of Locomotive Engineers and Firemen (ASLEF)) concern over the 'Big Brother' connotations that such a use of the computer would have for its members. Thus, management's strategic intentions behind the introduction of TOPS was supported by the railway unions which consequently influenced the eventual outcome of change under routine operation.

The response of the railway unions was one of co-operation rather than resistance to the introduction of TOPS. Convinced no doubt of the dire consequences of a failure to adopt the new technology as a means of improving operational efficiency. An editorial in the TSSA journal in 1975 emphasised the union's view of TOPS' significance:

> The project is now well and truly in operation and everything possible should be done to ensure that its potential is known amongst freight consigners, so that traffic which could best be conveyed by rail is switched to that mode of transport...British Rail has acquired what is regarded as the most advanced freight control system in the world. If it is going to help to bring better service to the customer and more freight to the railways, then there should be a 100% effort to ensure its success...The industry and its customers stand to gain by its success; that is the spur making it work.

Although the implementation and initial operation of TOPS was free from major industrial relations difficulties (through being given general trade union support), 'pockets' of resistance and conflict did occur in various local areas. For example, on the Western Region management's implementation strategy had to be modified (a number of sub-stategies were adopted) in order to deal with ground level resistance to change. These 'political' conflicts brought considerable delay to the implementation schedule, with the result that although the Western region was the first to start implementing TOPS in 1972, they were the last to finish. The size of the problem was indicated by one headquarters manager who recounted that 'the industrial problems in South Wales put the whole of the Cardiff division back about a year.'

The TOPS implementation teams were modified to deal with local resistance. This was achieved through developing locally-based implementation teams which in this case consisted of: a TOPS person from

Western Regional Headquarters (WRHQ), local management, local supervisors, and the involvement of shunting staff.

The major source of resistance in South Wales derived largely from management's implementation strategy which had not taken adequate account of the key role which the supervisor holds in absorbing local frustrations and industrial relations conflicts. The large marshalling yard in question acted as a 'semi-autonomous community' being located within a railway village where the 'top-down' authoritarian approach from a headquarters implementation team was not taken kindly to. As one supervisor put it: 'we weren't entirely satisfied with the chaps that came with the implementation team.' Another supervisor who formed part of the local implementation team recounted the difficulties and supported the claim by Weir and Mills, that the supervisor can often act as an important 'catalyst' in ensuring the relatively smooth transition of an organisation from one state to another:

> We had problems, you know, getting people to accept it, getting people to operate it accurately, because if it's not accurate it's worthless, because the rubbish into the computer is going to be the rubbish out. So you've got to have it accurate. And this is the thing with the human element, you've got to watch that the staff don't skimp it, it's got to be done properly or it's worthless. In the initial stages we kept our eye on everything. The TOPS people had been instructed if there was anything wrong, for them to ring back here and for us to put it right and to get it back in there. We had problems in the beginning...a month or five weeks and things began to follow a pattern. But even now, the problem is that you've got this human element that you've got to involve in the system, and it all depends on the individuals concerned. (local implementation team supervisor)

The findings from this part of the study illustrate how occupational and employee response can influence the process of computerisation, and in particular, management implementation strategies. In the South Wales Region, management strategy was composed of a series of sub-strategies which comprised both positive actions and reactions, as well as omissions and elements which could not be foreseen in planning the implementation stage of computerisation. For the most part however, the implementation and initial operation of the TOPS computer system was generally free of any major industrial relations difficulties. Active trade union support was given in the hope that computerisation would arrest the decline then apparent in British Rail's freight business. The major reasons why managements' implementation strategy was largely free of industrial relations difficulties can be summaried as follows:

- it was generally hoped that the computer system would improve the service and thereby win back freight orders lost to road hauliers
- the initial effect of the TOPS computer system was to create jobs rather than displace them
- additional payments were given for additional duties
- implementation strategies were modified and local implementation teams were created which incorporated supervisors and local shunting staff, this enabled the smoothing over of localised 'pockets' of resistance
- national trade union support also proved important in solving local conflicts and problems
- the labour control aspects of the TOPS computer system were never fully exploited by British Rail

The significance of computerisation needs to be seen not only in terms of implementation strategies and occupational and employee resistance and negotiation of change, but also in terms of the outcome of change on the day-to-day operations of the production system.

(v) Routine Operation

Routine operation of the computer system refers to the stage after initial operation when the day-to-day working of the system has settled down. New forms of work organisation and patterns of operating relationships have become established and defined. Moreover, broader management strategy and trade union response may become less pertinent factors in influencing day-to-day operating practices associated with computer technology as the problems relating to previous stages are sorted out. However, as changes in supervision, work organisation and management control under the routine operation of TOPS are the subject of Chapters 5, 6, and 7, they are not dealt with here.

(vi) Conclusion

This chapter has identified and examined the various stages of change associated with the introduction of the TOPS computer system. The combination of these discrete stages represent the process of computerisation from the initial decision to invest in computer technology through to the routine operation of a stable system. The four stages identified in the British Rail case study comprised:

- the decision to computerise
- the choice and design of the computer system
- implementation and initial operation
- routine operation

The decision to computerise was taken at the corporate level of the business organisation of British Rail. Strategic management's decision to introduce a computerised freight information system was largely a response to external business market competition and internal operating inefficiencies. Moreover, British Rail's 1971/75 Freight Plan unequivocally recommended computerisation, claiming that it would stem the loss making trend and make possible an expansion in British Rail's share of the freight market. It identified the need for a 'real-time' computerised freight information system which would enable the more effective utilisation of resources in the day-to-day control of railway freight operations. Furthermore, it was also suggested that if a suitable computer system could be obtained from another railway then this would minimise delays, reduce the risks involved, and enable considerable savings in development costs. Thus, the strategic intentions behind the introduction of a computerised freight information system consisted of various business market, operating, product, and cost objectives, which were in turn influenced by the nature of railway freight operations, and the availability and capacity of computer-based freight information handling systems.

In short, the decision to introduce the TOPS computer system was based upon:

- the specific recommendations of the 1971/75 Freight Plan
- the capacity of the TOPS computer system to provide 'real-time' information on the disposition and status of freight resources
- the availability of the TOPS computer system as a developed operational and commercially successful system
- the absence elsewhere of any similar system at the same stage of development or with the same capabilities

Moreover, the design of the system involved:

- the extensive modification of the original TOPS software to suit British Rail's requirements
- the enhancement of British Rail's telecommunications network to cope with the TOPS data transmission requirements
- the construction of a new computer centre at British Rail headquarters and the employment of specialist staff
- the deployment of TOPS clerks at outlying Area Freight Centres (AFC's), and the creation of a new senior supervisory position to exploit the information generated by TOPS

Thus, both the decision to introduce a computerised freight information system, and the choice and design of that system, depended primarily on management's strategic objectives, and the availability of computer information technology and its applicability to railway freight operations. At this stage during the process of computerisation there was no trade union or local operating staff involvement.

The implementation and initial operation of the TOPS computer system was from senior management's viewpoint a success. This was due to three main reasons. Firstly, the effectiveness of management's implementation strategy and 'task force' approach in circumventing organisational procedures and practices likely to delay final cutover, and in challenging traditional operating culture. Secondly, due to the absence of any intractable industrial relations problems during implementation and the support of trade union leaders for the project. Thirdly, the financial basis for introducing TOPS was based upon a short implementation programme with little margin for delay or overspending. Consequently, as the official opening of the TOPS computer system was held within schedule on Monday the 27th October, 1975 (just two weeks after final cut-over), this signified the achievement of an important managerial objective.

There are a number of factors which explain why the implementation and initial operation of the TOPS computer system was largely free from occupational and employee conflict and resistance. Firstly, the initial effect of the TOPS computer system was to create jobs rather than reduce them. Secondly, operating with the TOPS computer system was seen to involve additional duties rather than fundamental changes in the skills or work roles of manual staff in marshalling yards. Thirdly, while the TOPS computer system could have been used for the recording and monitoring of the work of train crews and TOPS clerks, the exploitation of this labour control capability was not a major managerial objective. Fourthly, national trade union support was turned to good advantage by management in smoothing over local areas of resistance as TOPS 'cut-over' progressed. Nevertheless, some local 'pockets' of resistance did occur, particularly in the South Wales region. This served to influence management's implementation strategies rather than the outcome of computerisation. This involved the setting up of local implementation teams which incorporated ground level supervisory and shunting staff participation. Thus, the modification of management's national implementation strategy illustrates how managerial sub-strategies can emerge as reactions to pressures and problems rather than as clear-sighted proactive decisions and choices.

This chapter has focused on the process of computerisation. A number of stages associated with computerisation have been identified and the key factors which have influenced this process at various stages have been examined. However, little has been said about the longer term effects of computerisation on supervision, work organisation, and management control. In the chapters which follow, the outcome of computerisation on supervisory systems, first-line supervisory positions, and the creation of new senior supervisory roles, are detailed in an examination of marshalling yard operations under the routine operation of TOPS.

Chapter 4. Notes and References.

1. When TOPS was implemented in 1975, IBM card reader/punchers were used in local offices to input and output information to the central computer. One advantage of this system was that each punched card represented one wagon and hence it was possible to compile packs of cards which represented marshalled trains. Furthermore, a physical representation of yard stocks and their movements could be kept by filing the punched cards into boxes which corresponded to sidings in the marshalling yard. However, by the early eighties this system had been replaced by mini-computer terminals each with its own visual display unit (this system was in operation during the main part of the study reported here). A further enhancement has been the use of the TOPS computer system for locomotive control in terms of planning the future allocation of locomotives for freight train services, and the planning of locomotive maintenance schedules. During the study, the TOPS computer system was also being used to process accounting data on freight consignments (Consigned Through TOPS - CTT). This enhancement enabled BR to improve its cashflow by reducing the time between the actual carriage of goods and billing the customer. More recently, the TOPS computer system has been used to plan cleaning schedules on passenger rolling stock. However, as these later enhancements occurred outside the timespan of this study, they are not detailed here.

2. This chapter draws mainly on I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, 'The Introduction of a Computerised Freight Information System in British Rail - TOPS', New Technology Research Group, University of Southampton, 1983.

3. See for example, C. Hirst, *The British Railway System*, Open University Press, 1974, pp.40-56.

4. Between 1963 and 1971 the total freight tonnage carried by British Rail fell by 41.7 million tonnes. C. Hirst, op. cit., p.52. See also, A. Ferner, 'Political Constraints and Management Strategies: The Case of Working Practices in British Rail', *British Journal of Industrial Relations*, Vol. 23, No. 1, 1985, pp.50-53.

5. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.6.

6. Ibid.

7. Ibid.

8. See for example, R. Pryke, *Public Enterprise in Practice*, McGibbon & Kee, 1971R; and R. Pryke, *The Nationalised Industries: Policies and Performance since 1968*, Martin Robertson, 1981.

9. E.I. Reid, and D. Allen, *The Nationalised Industries*, Penguin, 1970, pp.107-110.

10. C. Hirst, op. cit., p.64.

11. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.7.

12. In 1970, 33% of freight train services took three days or more to reach their destination. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.8.

13. Ibid.

14. British Railways Board, *The 1971/75 Freight Plan*, British Railways Board, 1970.

15. R. Arnott, *The Story of a British Railways Project*, British Railways Board, 1979, p.1.

16. I.P. McLoughlin, R. Carr, P.M.B. Dawson, and J.H. Smith, 'Origin, Operation and Utilisation of TOPS', New Technology Research Group, University of Southampton, February, 1982, p.4.

17. I.P. McLoughlin, R. Carr, P.M.B. Dawson, and J.H. Smith, op. cit, p.1-2.

18. I.P. McLoughlin, R. Carr, P.M.B. Dawson, and J.H. Smith, op. cit, p.4.

19. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.9.

20. I.P. McLoughlin, R. Carr, P.M.B. Dawson, and J.H. Smith, op. cit, pp.1-5; and I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., pp.9-13.

21. Ibid.

22. R. Arnott, *The Story of a British Railways Project,* British Railways Board, 1979.

23. The position of Chief Executive was established in August 1969 to provide overall managerial control of the British Railways system and future railway planning. See, M.R. Bonavia, *The Organisation of British Railways*, Ian Allen, 1971.

24. The daily 'operating conference' was chaired by the Chief Operating Manager of the British Rail Board, and comprised his senior officers and five regional operating managers.

25. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.16.

26. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.20.

27. See, I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., pp.15-21.

28. I.P. McLoughlin, J.H. Smith, and P.M.B. Dawson, op. cit., p.19.

29. P.S. Bagwell, *The Railwaymen Volume 2: The Beeching Era and After*, Allen & Unwin,1982, p.68.

30. See on this Chapter 3, pp.60-64.

Chapter 5. TOPS and The Supervisory System: The Redefinition of Marshalling Yard Supervision.

(i) Introduction

This chapter reports on an empirical examination of the effects of the TOPS computer system on marshalling yard supervision. The conceptual framework developed in Chapter 3 is used to analyse changes in supervision within the context of changes in work organisation and the system of management control. In particular, the concept of a supervisory system is employed in order to test the hypothesis that the large-scale introduction of computer technology is likely to involve a far more complex redefinition of supervision than is suggested by recent empirical findings presented in the literature.[1]

In the first section a brief history of traditional marshalling yards is provided, and the basic principles of marshalling yard operations are described. Against this backcloth, a summary is given of the research strategy and methods used in the study.[2]

The second part of this chapter analyses changes in the control function of marshalling yard supervision by comparing responsiblities for the control of railway freight operations prior to computerisation, with that under the routine operation of TOPS. Various levels and types of supervisory roles are identified and the ways in which the supervisors work together on common problems in the direct control of marshalling yard operations are examined.

(ii) High Capacity Marshalling Yards

Numerous studies exist on signalmen, permanent way staff, drivers, guards, engineers, station masters, and porters, in addition to the broader studies on British Rail management and industrial relations.[3] However, the literature on technical change and marshalling yard operations is generally only concerned with automatic marshalling techniques.[4] The industrial life of marshalling yard communities is one aspect of railway history which has not been well documented. Moreover, although TOPS has been described as 'the most sophisticated of all innovations which brought freight handling more completely into the age of electronics',[5] analysis of this change has largely been in the form of internal BR reports.[6]

In the following section, a brief historical outline of marshalling yards is provided, and the operation of marshalling yards is described to identify the key features of railway freight systems, and to provide a context for the subsequent comparison of freight operations control and marshalling yard supervision prior to computerisation, and after the introduction of the TOPS computer system.

(a) The History of the Great Marshalling Yards

The great marshalling yards of the nineteenth and twentieth centuries were located in central geographical positions on the railway freight network. Their function was to marshall unsorted freight so that it could be dropped off in sequence at various destinations and customer unloading points. In some cases the yards were situated close to the major cities, in other cases, they were situated at nodal points away from the industrial centres. The practice of marshalling freight services required considerable areas of land and equipment. Principal marshalling yards could cover several square miles and be the locus of employment for whole communities.

In the first half of the twentieth century there were over 6,000 smaller freight depots which acted as *outlets* and *inlets* to the rail freight system.[7] Following nationalisation in 1948 and the compilation of the 1950s Modernisation Plan, some of the smaller freight yards were closed in an attempt to remodel and speed up freight services.[8] However, it was not until Beeching in the 1960s that the biggest reduction in freight depots and marshalling yards occurred. Between 1960 and 1969, over 4,000 passenger and freight stations were closed, the number of freight wagons fell from 945,000 to 437,000 and the number of marshalling yards was reduced from 878 to 184.[9] Nevertheless, each region retained its own great marshalling yard or yards: for example, the Western Region had Severn Tunnel Junction (situated at the mouth of the Severn Tunnel which dealt with the marshalling of freight traffic into and out of Wales), and the Southern Region had Eastleigh (which until containerisation dealt with all principal rail freight traffic entering into and departing from Southampton docks).[10]

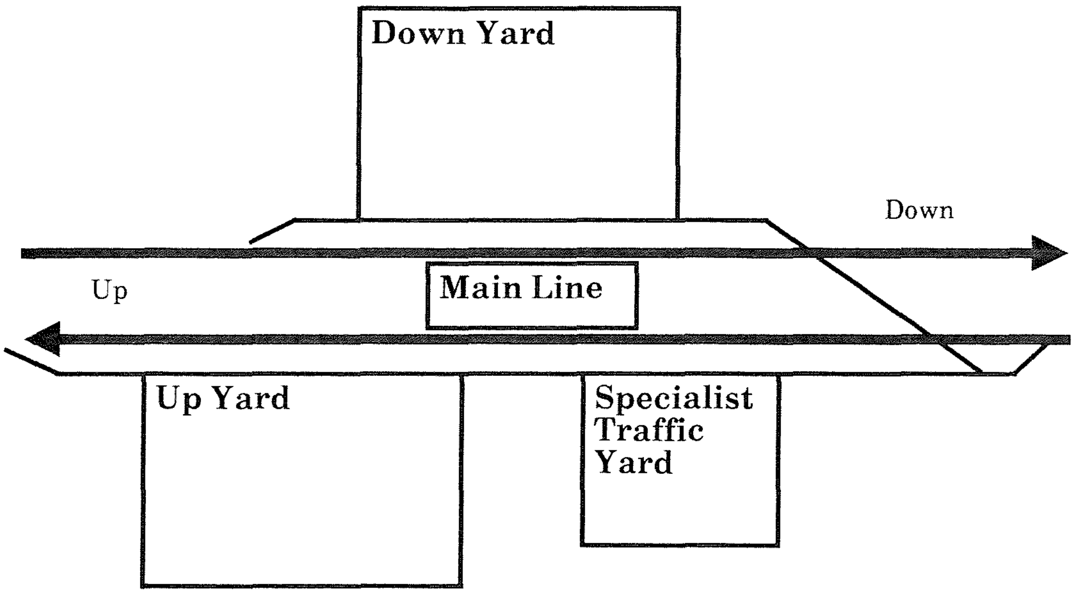
Today, most of these traditional marshalling yards have been replaced and/or transformed. In 1980 for example, there remained just over 400 freight yards, and only 34 marshalling yards.[11] Technical change in the form of wagon and locomotive developments, automated hump sorting and computerisation, have changed the management and operation of modern marshalling yards.[12] The use of computers for the *breaking* of wagons have in some cases largely replaced the traditional methods and techniques associated with marshalling yard operations. The modernisation of one of Australia's principal marshalling yards situated at Melbourne provides a good example of these developments.[13] By computerising hump shunting, wagons are automatically sorted into their designated track (that is, railway line or siding), without the need for any manual intervention.[14] In Britain however, both the manual hump shunting yards (for example, Severn Tunnel Junction) and the automatic hump shunting yards (for example, Bescot) developed in the sixties and seventies, are currently switching to flat shunting techniques.[15] Moreover, during the past twenty five years in response to a change in management strategy, there has been a decline in the number of single commodity trains and an increase in the number of sectionised and block freight train services.[16] Thus, changes in the market, management strategy, and technology have all served to influence the transformation of the great marshalling yards of the early twentieth century.[17] Nevertheless, the high capacity marshalling yards which remain are situated in nodal geographical railfreight positions and play a central role in the day-to-day operation of freight train services.

(b) The Operation of Marshalling Yards

Marshalling yards are important components in the overall operation of a railway freight network (see Chapter 4 (ii) (a) and Figure 3). Put simply, marshalling yard activities involve: supplying local customers with empty wagons for loading; running local trips to marshalling yards; marshalling wagons into train formation; and providing trunk transits to freight terminals where the wagons can then be shunted and placed onto a local service ready for transfer to their destination.

A high capacity marshalling yard can cover up to several square miles and will typically consist of a number of different sub-yards (see Figure 6). Each sub-yard will have a number of railway sidings (known as classification roads) for sorting incoming freight wagons. When the wagons have been sorted they will depart from the marshalling yard in one of two directions. The 'up yard' marshalls freight traffic destined to depart in one direction, whilst, the 'down yard' deals with all departures in the opposite direction. In addition, there may be a specialist traffic yard to deal with particular types of freight or specific types of wagons. Basically, *a*

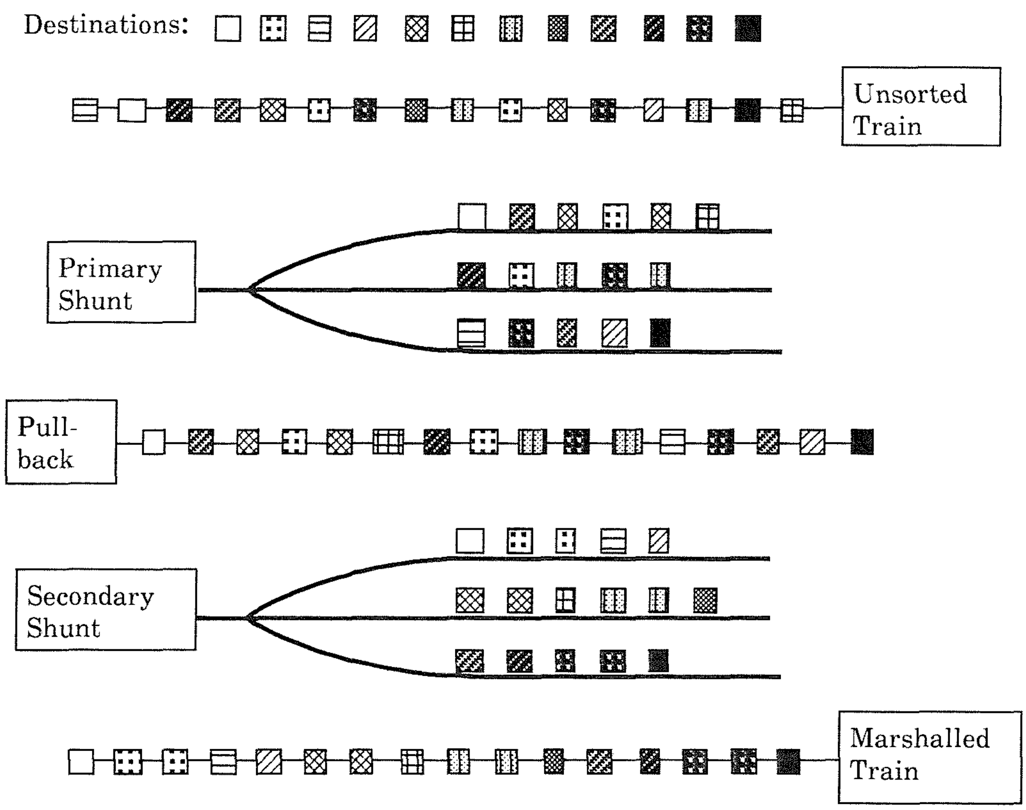
Figure 6: Diagram of Marshalling Yard Layout



railway yard which comprises a number of distinct sub-yards, and whose main purpose is to uncouple wagons on incoming freight trains for final assembly on outbound freight train services, can be defined as a marshalling yard.[18]

The basic operations of a modern marshalling yard are relatively straightforward (see Figure 7). Essentially, an unsorted train from some distant point is brought into one of the reception sidings. Individual wagons are then sorted and placed in one of about 30 to 60 classification roads, each of which collects traffic for one or a number of destinations. Once the train has been checked, the required wagons are uncoupled on part or all of the train by a *shunting gang* (a shunting gang is usually made up of 2-3 under shunters and a head shunter), and the train is slowly propelled by the use of a shunting locomotive. The points are set and before the train reaches the classification roads the head shunter will signal the driver of the shunting engine to stop. Propelled by their forward momentum, the wagons then continue into their allocated roads. The head shunter will signal to the driver of the shunting engine to repeat this operation and various points will be changed during the process of placing

Figure 7: The Principles of Marshalling Yard Operations[19]



wagons in the yard in preparation for final train formation (this is referred to in Figure 7 as the primary shunt). This sequence of shunting operations may be repeated (known as secondary shunt) prior to the marshalling of an outbound freight train service. The term *shunting* is used to refer to the placement of wagons in the yard, and the term *marshalling* is used to describe the placement of wagons into train formation prior to the departure of an outbound freight train service.

Receiving trains, marshalling wagons and running freight services involves a complex and interdependent set of *time-sensitive* cycles of operations. The co-ordination and control of these operations rests to a large degree on the availability and accuracy of information about the location and disposition of resources, in particular empty wagons, and the movement and composition of freight trains. The regular occurrence of operating contingencies, for example, fluctuations in the levels of freight, delays and 'acts of god', all serve to complicate the co-ordination and control of freight movements both within the marshalling yard, and over the national railfreight network. Information on changes to the railway environment is therefore a crucial resource in the day-to-day control of operations. However, before comparing marshalling yard supervision prior to computerisation with that under the routine operation of the TOPS computer system, the section which follows summarises the research strategy and methods used in the study.

(iii) Research Strategy and Methods

The adoption of a more differentiated conceptual framework for analysing supervision implies that a specific kind of research strategy was necessary. The need to explore in detail, the characteristics of individual roles, to get behind *formal* job labels and definitions, and the need to explore the specific relationships between management control, technology, production systems and supervisory functions means that an in-depth case study is most appropriate.[20] This was the strategy adopted in the research reported below and allowed for the detailed investigation of:

- the task and structure of organisational roles
- the distribution of supervisory tasks
- the characteristics of supervisory roles
- the nature of supervisory systems
- the relationships between the production system, technology, work organisation, management control, and supervision

The main body of research was conducted between 1981 and 1983.[21] It involved an in-depth study of the effects of change in five traditional marshalling yards in three British Rail regions. Four of the yards were principal marshalling facilities and the other was a smaller specialist traffic yard . Each of the principal marshalling yards comprised at least three distinct sub-yards and covered an area of one or more square miles (see Appendix 2).

During the study, 18 BR managerial staff, 15 senior supervisors, 25 first-line supervisors, 12 deputy supervisors, and 10 working supervisors were interviewed. Within the five marshalling yards which became the focus of the study, interviews were conducted with 10 local managers, 29 supervisory graded staff and 22 yard staff (see Tables 3 and 5, Appendix II). The interviews covered topics such as job content, working and personal relationships with other supervisors, management and yard staff, and the way these had been changed by computerisation (see Appendix III). The supervisors' interviews were supported by questionnaires which were personally administered to supervisory staff (see Appendix IV). A total of fourteen senior supervisors and ten first-line supervisors completed the questionnaire.[22]

In each of the five marshalling yards studied, a detailed programme of observation of local operations was conducted in order to ascertain the nature of supervisory tasks and the roles of individual supervisors. This involved spending periods from 2 to 5 weeks in each yard and attending full 10 hour day and night shifts with the supervisors. Periods of observation would typically involve the author noting and informally discussing the work of an individual supervisor throughout a shift. Particular attention was paid to the number and nature of contacts with other supervisors and their use of the computer system in making operating decisions. Actual freight and yard operations were also monitored, which involved observation and discussion of the work of various yard staff. Again attention was paid to the use made of information from the computer system and in particular, to the identification of the nature of any supervisory tasks carried out by the yard staff themselves.

In the course of interviews and informal discussions, a picture of supervision and freight operations prior to computerisation was constructed. This information was supplemented by further interviews and documentary material from Regional and National headquarters. Finally, an attempt was made to understand the operational use of the computer by briefly visiting and examining systems on Victoria Railways (Australia) and New Zealand Railways, and by attending courses held on the TOPS system for supervisors at British Rail's training schools.

(iv) Railway Freight Operations Control and Systems of Supervision

Since the early sixties there have been three main stages in the development of freight information control systems within high capacity marshalling yards. These are as follows:

- a manual system
- a telex based system
- a computerised system

Each of these stages will now be examined in terms of their effects on freight operations control and the supervisory system within marshalling yards. Attention is focused on the extent to which computerisation allows for a more integrated system of management control, and the possibility of devolving additional elements of control from middle management to local supervisory systems, (a more detailed examination of changes in the job of first-line and second-line supervisors is provided in Chapters 6 and 7). Furthermore, it should be noted that as the Advanced Traffic Information (ATI) system did not significantly change the control function of local supervisory systems, this stage is not examined in detail.

(a) The Manual System

Prior to computerisation, information on the disposition and location of freight traffic was disseminated by telephone through a hierarchical reporting and command structure which comprised: marshalling yard supervisors; divisional controllers; regional controllers; and headquarters staff. Marshalling yard supervisors were responsible for transmitting information on wagon stocks to one of 20 or so Divisional Control offices. The first hour of the supervisor's working day was often occupied ensuring that a physical check had been made on the stock of wagons in the yard and then telephoning the details to Divisional Control. These local reports were collated by divisional controllers who would attempt to produce an overview of the current state of freight operations under their jurisdiction. This information would then be transmitted to one of five regional control offices whose staff would control and co-ordinate the inter-regional movements of freight train services. At national level an attempt was made to monitor the movements of freight over the entire rail network. Whilst the Central Wagon Authority (CWA) held responsibility for the distribution of empty wagons (the freight railway's key resource), most day-to-day operating decisions involving the running and cancellation of freight train services were taken at divisional level.

The collection, collation and interpretation of this information at successive organisational levels was very time consuming. The process of disseminating this information from local to national level, and then the transmission of decisions affecting the movements of freight in the opposite direction could take up to ten hours. Moreover, there was no way of validating the reports received, and so the accuracy of this information was open to question. Despite the attention of a small army of wagon inspectors it was estimated that only 80% of a fleet of over half a million wagons were accounted for in each daily distribution report.[23] As a consequence, operating decisions were frequently taken on partial and retrospective information. Nevertheless, on the basis of practical experience local supervisors were able to do some pre-planning, for example, as one yard supervisor recounted:

> In regard to certain traffic we were fully conversant with the wagons to 'come off' and through telephone messages were able to visualise the formation of forward trains long before they arrived.

For the most part however, traffic was dealt with as and when it arrived and it was not uncommon for wagons to become delayed (especially those deemed 'low priority'), or even 'lost' on the network only to be found later on some marshalling yard 'rubbish' road.

From interviews and informal discussions with local supervisors, and from the analysis of documentary material, it became evident that under the manual system of freight information control, supervisory tasks were undertaken at four different status-levels in the occupational structure within high capacity marshalling yards (see Figure 8). These status-levels were:

- *senior supervisors* (movements supervisors) responsible for the control of all marshalling yard operations[24]
- *formally defined first-line supervisors* (yard supervisors) responsible for the day-to-day control of freight operations within the separate yards which make up a marshalling yard
- *deputy supervisors* (chargemen) responsible for the control of freight train movements into and out of the yard, and for overseeing yard operations in the absence of a yard supervisor
- *working supervisors* (head shunters) in charge of shunting gangs within sub-sections of the yard

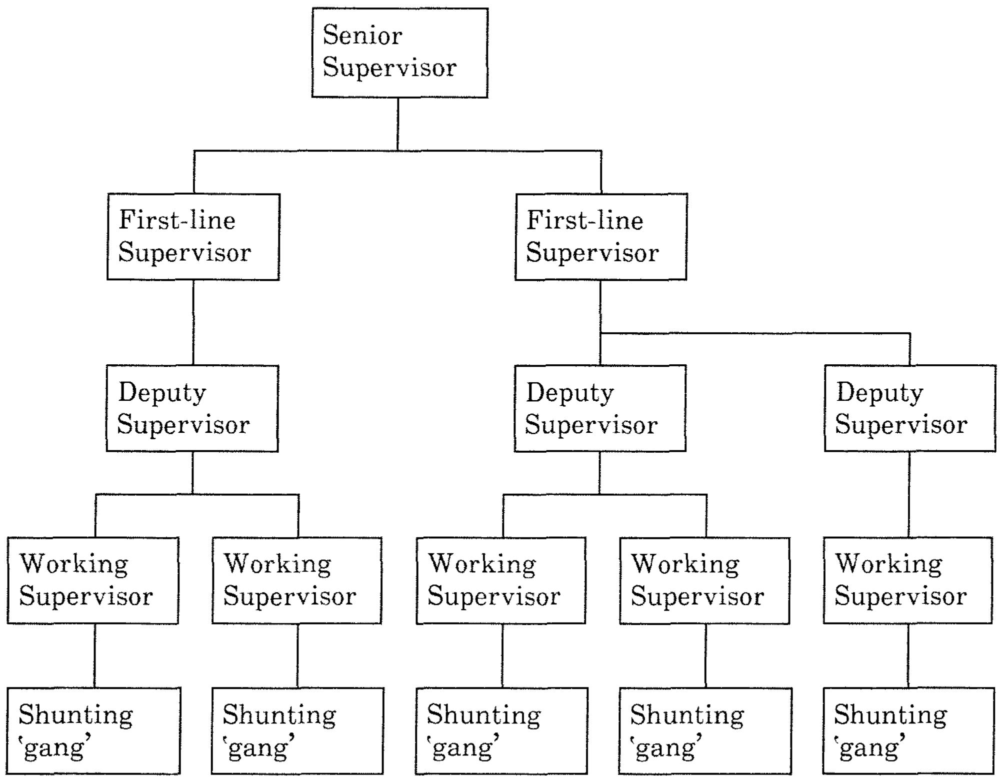
The individuals holding these positions would work together on common problems in the direct control of marshalling yard operations. A supervisory hierarchy appropriate to the marshalling yard layout shown in Figure 6 would comprise one senior supervisor, two first-line supervisors, three deputy supervisors, and five working supervisors (see Figure 9). This

Figure 8. Examples of Supervisory Systems within High Capacity Marshalling Yards in Circa 1960 and 1970.

	The Supervisory System c. 1960		The Supervisory System c. 1970
Supervisory Level ↓	Job Title ↓		Job Title ↓
Senior supervisor:	Movements supervisor		A.T.I. supervisor
First-line supervisor:	Yard Inspector		Yard supervisor
Deputy supervisor:	Foreman		Chargeman
Working supervisor:	Head shunter		Senior railman
Changes in span of control	Day-to-day control of marshalling yard operations	→	Marshalling yard operations and local movements of freight traffic
Changes in the control of freight train running	The running of freight services is the responsibility of the Divisional Control organisation	→	Where local freight traffic was sufficiently intense, control was devolved to local supervision

structure would vary according to local conditions, and in particular, to the nature of traffic flow and the layout of the marshalling yard.

Figure 9: An Example of a Supervisory Hierarchy in a High Capacity Marshalling Yard



This manual information system and hierarchical command structure had important consequences for the control of freight operations. The day-to-day control of resources in the provision of freight train services was exercised at a number of organisational levels. Supervisors who were concerned with the direct control of marshalling yard operations were not fully integrated into the wider management control system and tended to act out of local self-interest.[25] This fragmented control system caused a number of inefficiencies and inadequacies. In 1970 for example, 30% of scheduled wagon load services and 40% of scheduled block trains were cancelled each day.[26] To improve the efficiency of a largely labour based freight traffic control system, HQ management were forced to direct their efforts towards physical inspections of marshalling yard wagon stocks and 'post-mortems' of freight operations.

Within high capacity marshalling yards of the fifties and sixties, the movements supervisor held a 'mixed' managerial-supervisory role with a fairly wide span of control. His main task was to oversee marshalling yard operations as a whole (including for example, the supervision of staff in the locomotive shed), and to ensure that effective action was taken in the case of any of a number of marshalling yard contingencies. A retired movements supervisor summarised the job as follows:

> As a movements supervisor you were concerned with everything....you would see if there were any sort of problems, you know, that were going to happen within the next few hours. Then you would go out around the yard and check your wagons, and have a word with your supervisors, and check the cripples (wagons which are in need of repair), and see if things were on the move....As a movements supervisor you were in the yard continually walking from one yard to another, back and forth to the diesel depot and all that.

Under this manual system of freight information control, the yard supervisor held a 'pure' supervisory role in the direct control of operations within the yard. He would attempt to ensure that there was always a surplus of empty wagons to meet customer demands and he would initiate the cancellation or running of additional services through liaison with Divisional Control (the job of the yard supervisor is examined in more detail in Chapter 6).

An important supervisory task associated with the job of the chargeman was to direct the movement of trains into and out of the yard, and to check that the formation of outbound trains accorded with the rules and regulations laid down by British Rail. The chargeman held a 'pure' type of supervisory role, and would liaise closely with both his yard supervisor and head shunters in directing and monitoring the day-to-day movements of freight within the yard. Knowledge was based on years of practical experience and chargemen generally held few, if any, formal qualifications.

The term 'working supervisor' provides an accurate description of the job of head shunter. According to our previously defined supervisory types he held a 'mixed' supervisory-operative role in so far as he would often be directly involved in operative tasks (that is, the shunting and marshalling of wagons for outbound services), and yet he was also directly involved in the daily supervision of these operations.

Head shunters followed a similar career path to chargemen. Through years of 'hands-on' experience, they acquired considerable skills in the use of a shunting pole, an essential tool in the coupling, uncoupling and breaking of wagons. In addition, they had a practical understanding of the principles of marshalling and the routes of freight train services, for which they needed a detailed knowledge of railway geography. It was through this combination of knowledge and experience that decisions were made which affected the movements of wagons within the yard. The only information that was readily available to the head shunter was the destination of freight as indicated from a label on the wagon. The main supervisory tasks of the head shunter were to: direct the shunting activities of his shunting gang; decide on the yard placement of inbound freight wagons; and supervise the marshalling of wagons for outbound services.

(b) The Telex-Based System

Prior to the introduction of TOPS the position of movements supervisor had either disappeared as a result of local work re-organisation schemes, or they had been redefined as a consequence of the introduction of a telex-based system of freight information control called Advanced Traffic Information (ATI). In some of the smaller yards, the traditional tasks associated with the job of movements supervisor were incorporated into other supervisory and managerial positions. The task of dealing with contingencies for example, was in many instances incorporated into the job of the first-line supervisor (as a result yard supervisors were upgraded within the formal supervisory grading scheme). In the case of high capacity yards where fairly large supervisory structures existed and where the volume of local traffic was 'sufficiently intensive', the introduction of ATI brought about a re-location of the movements supervisor into the ATI office:

> The supervisor must be located next to the traffic clerk....He is responsible for organising the clerks working for him and integrating yard and office activities.[27]

Attempts to devolve responsibility for the control of local traffic can be traced back to this telex-based system of advanced traffic information introduced in 1970. However, the ATI system did not have any major effects on marshalling yard supervision.[28] It did not provide accurate and current information which meant that it was not possible to delegate control of the area movements of freight to the local level.[29] For these reasons, ATI is not examined in detail.

(c) The Computerised System

Following Buchanan[30], the aims of British Rail management in computerising railway freight operations control can be divided into strategic (external, market and customer oriented), operating (internal, cost oriented) and control (internal performance oriented) objectives. These objectives can be applied to the British Rail case for computerisation in the following way:

- Strategic: to use computerisation to improve the market position of railway freight by offering a better quality service to customers, in particular, faster and more reliable freight transits.
- Operating: to use computerisation to reduce operating costs by improving the utilisation of wagons and locomotives.
- Control: to use computerisation to make operating conditions and performance more visible to management by providing real-time information at headquarters level

The achievement of these objectives depend on among others things: the capacity of the technology to be able to accomplish the tasks laid out in management's strategy; and the successful implementation of management's intentions developed with available technology and its capabilities in mind[31] As indicated in Chapter 4, it is therefore important to note the enabling characteristics of the TOPS computer system. These are as follows:

- accurate 'real-time' information is available to headquarters management at national and regional levels in order to monitor operating conditions and performance at remote locations
- reports made from local level via the remote terminals in the Area Freight Centres (AFCs) are automatically cross-checked and validated by the computer to prevent 'corruption' of its data base

- the daily distribution of empty wagon resources is accomplished by the computer which allocates each individual wagon a new destination immediately it is reported 'empty' (see also, Appendix 1)

The main element of management's strategy to exploit these enabling characteristics concerned the re-organisation of the existing rail freight operations control structure. The computer system obviated the need for a hierarchical reporting and command structure, since information could now be transmitted from remote locations direct to headquarters level. Furthermore, the computer data base could be used directly at local as well as headquarters levels, so that real-time information was available at the point of operations. As a result, there was no longer a need for divisional involvement in many of the operating decisions at local level. Computerisation therefore offered the possibility for management to transform the existing operational control organisation.

Management's plans to re-organise freight operations control had three strands:

- a centralisation of overall control of operations at regional and national headquarters
- a reduction in the role of Divisional Control involving the loss of 1000 controller-grade jobs at a saving of £7.5 million
- a delegation of day-to-day operating decision-making responsibility to remote locations, centred on the new Area Freight Centres (AFC)

The centralisation of control has enabled the remote monitoring and evaluation of area level operating performance by headquarters management at regional and national levels. Using the new information generated by TOPS, headquarters management are able for the first time to effectively co-ordinate freight resources. TOPS provides up-to-date information on the current operating situation; the disposition of resources; and the operating performance of every operating area on the entire network. This enables headquarters management to make rapid decisions on traffic priorities, and respond to changes in customer demands. Use of the TOPS system thereby ensures a more efficient utilisation of resources. In addition, a far more effective approach to long and medium term planning is possible, together with greater financial control and integration of marketing and operating objectives. The provision of a current picture of freight operations through the TOPS computer system has changed management from a retrospective oriented activity to one involving real-time control. As one senior freight operator commented: 'we now have a production line which we can control'.

However, management's plans to rationalise the Divisional Control organisation (whose function as a communication channel has in management's view been superseded by TOPS) has subsequently been an area of trade union concern. Senior British Rail management proposed that the existing operational control organisation should be centralised at regional level and that TOPS should be increasingly used as the source of information, especially for locomotive control. It was therefore intended that Divisional Control offices would be reduced to round-the-clock intelligence centres, and the number of controllers would be substantially reduced.

The rail unions have mounted strong opposition to these proposals, questioning both the ability of a TOPS based monitoring system to react to operating contingencies and emergencies, and the integrity of TOPS data for locomotive control. In the face of union objections, management agreed not to pursue a national rationalisation of the Divisional Control organisation but to allow each region to proceed at its own pace with those changes it deemed necessary. At the present time, only one region has successfully introduced a centralised system of locomotive control. Some managers see the failure to implement these post-TOPS changes in the operational control organisation as a major factor preventing the full realisation of the potential of the TOPS computer system to act as the basis for a production control system. However, as the TOPS project manager observed, the fact that these operating practices are 'so steeped in tradition' has meant that both the unions and managers concerned are unwilling to face up to the fact that the usefulness of the Divisional Control organisation is in question.

In 1975, the implementation of management's plan to delegate control to the local level involved the creation of 152 Area Freight Centres (AFCs) to act as 'data traps' for information from 5000 individual locations. However by 1985 this number had been reduced by around 35%. Each AFC is responsible for collating and reporting events at all locations within its specified TOPS Responsibility Area (TRA) to a central computer at national headquarters. These local centres are normally staffed by an Area Freight Assistant (AFA) and a number of clerical staff (referred to as 'TOPS clerks') who operate terminals linked to a mini-computer (see

Figure 10: The Operation and Organisation of a Typical Area Freight Centre

Area Freight Assistant
The AFA is essentially concerned with the control and co-ordination of freight operations within his TOPS responsibility area

Equipment
Computer Terminal, Facsimile Machine, Printer, Telephones, and Radio (for contact with Yard Supervisors).

Clerical Officer 1
The CO1 is involved in the monitoring of and recording of freight information on all traffic movements into and out of the 'up' yard, and to ensure that correct information is input to the TOPS computer system

Equipment
Computer Terminal, Facsimile Machine, Printer.

Clerical Staff Shift Leader
The shift leader is typically concerned with the recording and receiving of freight information on incoming trains (this information is then passed to the area freight assistant), he may also deal with specialist freight and mandated traffic

Equipment
Computer Terminal, Facsimile Machine, Printer.

Clerical Officer 2
The CO2 is involved in the monitoring of and recording of freight information on all traffic movements into and out of the 'down' yard, and to ensure that correct information is input to the TOPS computer system

Equipment
Computer Terminal, Facsimile Machine, Printer.

Figure 10). At each location, when any freight operations occur, the staff concerned (guards, shunters, supervisors) report details to the AFC via two-way radio, facsimile or telephone. This information is then transmitted to the central computer through the local terminals. In this way the central computer is able to keep on its files a continuously updated 'real-time' picture of the location and disposition of wagon and locomotive fleets over the entire rail network (see also, Appendix I).

Management's objective to centralise overall operations control at headquarters level whilst delegating local decision-making responsibility to the AFC, involved the creation of a new supervisory position in the form of the AFA (this position is examined in detail in Chapter 7). These new second-line supervisors are intended by management to be local freight 'supremos' making day-to-day operating decisions in each responsibility area from their base in the new operations nerve centres, the AFCs.

Under the computerised system of freight information control, supervisory control functions are distributed across four different status-levels (see Figure 11), namely:

- *senior supervisors* (area freight assistant) responsible for the control of area freight operations
- *formally defined first-line supervisors* (yard supervisors) responsible for the direct control of freight operations within the separate yards which make up a marshalling yard
- *deputy supervisors* (chargemen) responsible for the control of freight train movements into and out of the yard, and for overseeing yard operations in the absence of a yard supervisor
- *working supervisors* (head shunters) in charge of shunting gangs within sub-sections of the yard

These individuals work together on common problems in the day-to-day control of area freight operations, and as such they constitute a new supervisory system, with a span of control which extends beyond the traditional concern of freight yard operations within the boundary of the marshalling yard. However, although there has been an expansion in the span of control of local supervisory systems, a number of lower level supervisory roles have been eroded. This erosion of supervisory responsiblities is most evident in the positions of chargeman and head

Figure 11. An Example of a Supervisory System within High Capacity Marshalling Yards: Circa 1980

Supervisory Level ↓	Job Title ↓
Senior supervisor:	Area freight assistant
First-line supervisor:	Yard supervisor
Deputy supervisor:	Chargeman
Working supervisor:	Senior railman
Span of control	Day-to-day control of Area freight operations
Responsiblity for the control of freight train running	AFAs control the running of Area freight services and Divisional movements in liaison with other AFAs

shunter (for a more detailed examination of the role of the AFA and yard supervisor, see Chapters 6 and 7).

In the case of the chargeman, many of the traditional skills associated with this job are no longer necessary. Their knowledge of railway rules and regulations in authorising marshalled trains for departure is no longer required as the computer checks the composition of trains automatically. Although they still have a job to perform in supervising the movement of freight trains into and out of the yard and in monitoring and co-ordinating yard operations in liaison with yard supervisors and head shunters, the stock of knowledge they need has been substantially reduced. The additional skills required to operate with the computerised system do not offset the displacement of traditional skills associated with a detailed understanding of the principles and practices of railway freight operations.

A similar erosion of the need for traditional marshalling yard skills has occurred with the position of head shunter. Knowledge of the correct train routes for freight destinations is no longer used in the marshalling of trains since the computer now automatically provides a sorting code for each wagon according to its destination. A head shunter described the current operating situation as one where:

> You can't make a move on a train until you have got your TOPS list.

The main tasks of the head shunter today are: to direct the shunting gang with a view to minimising the movements of freight wagons needed to produce the correct formation of wagons for outbound services; to inform the AFC of any wagon movements within the yard; and to *marshall* wagons in accordance with a TOPS list. Nevertheless, the control of *shunting* activities has remained the responsibility of the head shunter (that is, the actual placement of wagons in the yard in preparation for the marshalling of outbound freight train services).[32]

(v) Conclusion

The TOPS system has enabled management to centralise the control of operations and devolve additional elements of day-to-day decision making responsibilities to the local level. As a result, computerisation has not merely led to an extension in technical control but also to a change in techniques and combinations of structures of control. Within this reconstruction, manual hierarchical structures of control no longer play such an important part in the operating system. Tasks previously carried out at divisional level have been incorporated into the machine, concentrated in higher management, and devolved to new supervisory systems of control. Nevertheless, management's attempt to rationalise the Divisional Control organisation has been frustrated by trade union and some middle management resistance. There has been strong opposition from controllers and all three rail unions to management's plans and a successful rearguard action has been fought in forcing management to negotiate a reduction in the role of Divisional Control on a region-by-region basis.

Prior to computerisation, the supervisory system within the marshalling yard was not fully integrated into the wider sytem of management control. The absence of accurate and up-to-date information meant that the attempts of management to control operations were retrospective and largely ineffective. Considerable knowledge and experience was required of staff to marshall unidentified inbound services, prevent yard congestion, and keep local customers satisfied. The various individuals who comprised the supervisory system (from senior supervisor to working supervisors) would work together on the common problem of keeping traffic moving. Congested yards caused delays and consequently drew the attention and criticism of management. Moreover, congestion created considerable extra work for yard staff and was therefore to be avoided. It is no wonder that traffic on the move was considered such a wonderful thing.

Operating with TOPS, the supervisory system is now more fully integrated into the wider system of management control. The availability of up-to-date accurate information about local operations enabled British Rail management to devolve responsibility for area operations control from middle management to locally based supervisors. This has resulted in an expansion in the span of control of local supervisory systems to extend beyond the traditional concern of controlling freight operations within the boundary of the marshalling yard. This extension in the control function of local supervisory systems has brought about a re-orientation of supervisory decision-making. Supervisors now require a broader and less parochial awareness of the consequences of their decisions for the operating system as a whole. In short, computerisation has brought about a redefinition of the supervisory system, which now occupies a pivotal position in management's system for controlling rail freight operations.

However, although there has been an expansion in the span of control of the supervisory system, there has also been an erosion of the traditional basis of marshalling yard supervision. For example, the knowledge previously required of chargemen to check train formations (especially the calculation of brake force) has largely been made redundant through the capacity of the computer to automatically check the reported formation of outbound freight train services. Similarly in the case of head shunters, their accumulated knowledge and experience of correct freight routes is no longer required, since the computer automatically allocates routes for each wagon according to its destination. Nevertheless, although computerisation has led to the displacement of many of the traditional skills associated with marshalling yard operations, it has also generated the need for new skills associated with the interpretation and utilisation of information made available by the computer. This in turn has produced a number of different effects on the various supervisory roles which constitute the new supervisory system of control.

This complex redefinition of local supervision highlights a major weakness of those studies which have attempted to explain changes in supervision in terms of changes in the role of the first-line supervisor. When evaluating the implications of computer technology for supervision there is a need to examine changes to both individual supervisory roles and to the supervisory system itself. It has been shown that although the capacity of computer technology to integrate previously fragmented and localised areas of operation may lead to the erosion of some supervisory positions, it can also lead to the enhancement of others. These findings substantiate the claim that a more differentiated conceptual framework is required for the purpose of identifying and defining supervisory positions and examining the relationships between computer technology and supervision. The case study reported here has also demonstrated the utility of the concepts developed in Chapter 3. These concepts provided a framework for examining changes in the roles and functions of individuals directly engaged in the direct control of workplace operations within a broader analysis of changes in work organisation and the system of management control. Consequently, it is argued that the conceptual framework for analysing supervision developed in this thesis could usefully be employed in future research which seeks to investigate the effects of computer technology on supervision.

The implication of computer technology for first-line supervision and the possible creation of new senior supervisory positions is discussed in the following two chapters, which examine in more detail the job of yard supervisors and area freight assistants. The degree to which computer technology is rendering these individual supervisory positions more peripheral or pivotal to the operating system is also discussed in the light of the recent debates outlined in Chapter 2.

Chapter 5. Notes and References.

1. See for example, Burkitt, A. 'Cold-Hearted Computers.' *The Engineer,* pp.24-25, May 1978; Shaiken, H. 'Numerical Control at Work.' *Radical America,* V.13, No.6, pp.25-38, 1979; and Black, S.P. 'Numerically Controlled Machine Tools in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company.' and 'Computer Coordinate Measuring Machines in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company.' pp.39-66 & 67-84, in Buchanan, D. and Boddy, D. (editors) *Organisations in the Computer Age.* Gower, 1983.

2. For a more detailed breakdown of research methodology see Appendix I.

3. See for example, J. Farrington, *Life on the Lines* Moorland, 1984; P.S. Bagwell, *The Railwaymen* Allen & Unwin, 1963; P.S. Bagwell, *The Railwaymen Volume 2: The Beeching Era and After* Allen & Unwin, 1982; M.R. Bonavia, *The Organisation of British Railways* Ian Allen, 1971; M.R. Bonavia, *British Rail: The First 25 Years* David & Charles, 1981; F. Cottrell, 'A Sociologist's View of Technological Change and the Railroads', *Railway Age*, vol.18, 1965, pp.16-21; International Transport Workers Federation ITF *We Don't Hate Technology But......* ITF, 1977; F. McKenna, 'Operating Requirements of an Automatic Railway', *Monthly Bulletin International Railway Conference Association*, vol.2, 1965, pp.199-205; F. McKenna, *The Railway Workers 1840-1970*, Faber, 1980.

4. See for example, D.M. Bowick, 'Computer Systems Impact on Railways.' *The Chartered Institute of Transport Journal,* vol.36, No.8, 1975, pp.179-185; O. Hein, 'A two-stage queue model for a marshalling yard', *Rail International,* No. 4, April 1972, pp.249-259; N. Miyakawa, 'Automation of Koriyama marshalling yard and the Herringbone track', *Rail International,* No. 5, May 1972, pp.300-320; and Rail Gazette, 'Barstow Rises From The Desert', *Rail Gazette*, Vol. 132, January 1976, pp.33-34.

5. P.S. Bagwell, *The Railwaymen Volume 2: The Beeching Era and After* Allen & Unwin, 1982, p.67.

6. During the late seventies an internal report on the introduction of TOPS was written by the TOPS Project Manager. R. Arnott, *The Story of a British Railway Project*, undated. This report is not available to the public.

7. P.S. Bagwell, *The Railwaymen Volume 2: The Beeching Era and After* Allen & Unwin, 1982, p.67.

8. E.I. Reid, and D. Allen, *The Nationalised Industries* Penguin, 1970 p.116.

9. M.R. Bonavia, *British Rail: The First 25 Years* David & Charles, 1981, p.135.

10. British Rail is divided into five Regions: Southern, Western, London Midland, Eastern and Scottish. In 1980 there were a total of 34 marshalling yards of various types and sizes on the network. See *British Rail Annual Report and Accounts*, BR, 1980. BR's policy is to increasingly concentrate operations within principal marshalling yards, hence the focus on larger units.

11. Ibid.

12. See for example,K.H. Spring, 'The Software Revolution and the Management of Railways', *Information and Management* vol.6, 1983, pp.1-9; F. Cotterell, 'A Sociologist's View of Technological Change and the Railroads' *Railway Age* vol.18, 1965, pp.16-21; H. Mallinson, 'Freight Planning and Control in the Computer Age', *Modern Railways*, January 1967.

13. The original Melbourne marshalling yard was built in 1903. It was designed for freight needs of the period; trains being shorter due to the size and power of steam engines, and there was a good deal less freight to handle. By the early 1960s the freight yard was becoming unworkable. At a cost of some $14 millions the yard was modernised. This entailed building what is known as a *hump* - essentially this is a man-made hill rising 4.6 metres above the sorting sidings - and implementing a computer controlled wagon retarder system. Whereas the old Melbourne yard could handle up to 2,500 wagons a day, the new yard can take 3,750 wagons daily.

14. The process involves pushing wagons to the crest of the hump and then letting them role down the hump into the appropriate siding. Their passage is controlled by a computer, that operates 30.5 metre wagon retarders. The retarders grip the wagon wheels as disc brakes do in a motor car and slow down the wagons to the correct speed that is, 3 kmph

which is known as *coupling speed.* The computer is programmed for wagon weight, rollability and track destination. Rollability speed is measured by radar equipment which feeds information into the computer.

15. With the growth in Speedlink traffic and the developments of modern air-braked traffics, it is no longer safe to hump shunt wagons. In the words of one yard supervisor: 'if you hump one of those you'll break it's back'. Flat shunting refers to the activity of shunting wagons on a relatively flat area of ground. Many of these changes in freight handling and operation derive from the implementation of BRB's freight plans and policies. See for example, H. Davies, 'BR's 39 steps to profit', *Sunday Times*, 2nd October 1983, p.2; P. Bassett, 'BR five year plan aims at profitable network by 1985', *Financial Times*, 19th August 1983, pp.1&23; P. Jenkins, 'Why Mrs Thatcher Needs a New Line on the Railways of the Future', *Guardian*, 30th June 1982, p.13.

16. Railfreight Speedlink provides a good example of 'sectionised' service. Wagons for these services are combined into small sub-sections which are then marshalled to form an outbound train. This service also provides overnight wagon load services and links into the Railfreight International network which is a roll-on roll-off cross-channel service to all parts of Europe. 'Block' services refer to trains which carry single types of commodities; for example, Railfreight Trainload which has developed in the last twenty years transports bulk materials and currently moves around 10 million tonnes annually. Coal, oil, steel, aggregates, chemicals, new motor cars and various other materials are moved in freight trains ranging from 500 to 3,000 tonnes. Traditional wagon load freight train services refers to single commodity trains which comprise a number of single wagons destined to different locations.

17. The Great Eastleigh marshalling yard on the Southern Region has been transformed following the introduction of containerised railway freight services. Most of the freight entering and leaving Southampton docks is now dealt with by Freightliners Ltd who deal with a wide variety of containerised freight, for example, steel, foodstuffs, bulk liquids and general merchandise.

18.What actually constitutes a marshalling yard is open to question. Since 1981 the figure for marshalling yards within BR's Annual Report included network yards and section sidings; for example, although in 1980 the figure was 34, in 1982 the number was 59. However, there are over twenty high capacity marshalling yards still in operation on BR. The focus of this study is on this type of large traditional marshalling yard, with which identification is no problem if only because of the sheer physical size of these yards.

19. Adapted from O.S. Nock, *World Atlas of Railways* Coloporteur, 1983, p.76.

20. This research strategy has been advocated by a number of authors in their studies of supervisors. See for example, K. Thurley, 'Changing Technology and the Supervisor', In J. Steiber (editor) *Employment Problems of Automation and Advanced Technology - An International Perspective* MacMillan, 1966, p.341; and J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society* Cambridge University Press, 1982, pp.79-82.

21. This study formed part of a programme of research which was conducted by the New Technology Research Group at Southampton University.

22. The questionnaire was produced in order to obtain data from senior supervisors (area freight assistants) who did not feel that they had enough time during the shift to be interviewed. Initially, this posed itself as a major problem. However, as the study progressed supervisory staff became more co-operative and would even give up some of their spare time in order to be interviewed. First-line supervisors were far more reluctant to fill-in the questionnaire and preferred to be interviewed. Some supervisors commented that the questionnaire was too long - it took some supervisors over an hour to complete. Nevertheless, it proved very useful to have a range of different methods which could be employed to elicit data. Occassionally the questionnaire actually facilitated interviews, for example, in cases where the supervisor initiated the interview by stating that he didn't mind talking about the job but he didn't want to fill-in 'one of those questionnaires' (a copy of the questionnaire is reproduced in Appendix IV).

23. I.P. McLoughlin, J.H. Smith and P.M.B. Dawson, op. cit., p.8.

24. Within high capacity marshalling yards of the fifties, there would usually be a senior supervisor in the form of a movements supervisor. He

would have overall control responsibility for all activities within the marshalling yard, including the supervision of locomotive operations. These operations now come under the control of traction and train crew supervisors, the traditional movements supervisor was thus the 'manager' of the yard.

25. This finding is not peculiar to British Rail. New Zealand Railways management also indicated that manual information systems and hierarchical command structures tend to promote parochial attitudes and encourage the hoarding of wagons at the local level.

26. I.P. McLoughlin, J.H. Smith and P.M.B. Dawson, op. cit., p.8.

27. British Railways, 'The ATI Investment Report', 14th-16th June 1971, para.3.3.

28. The most significant change brought about by ATI was the relocation of the movements supervisor into an ATI office within high capacity marshalling yards. These positions were later replaced by Area Freight Assistants, and the ATI office was replaced by TOPS offices.

29. In some yards this system did allow for a degree of devolution of control from the divisional to local level, namely, in cases where the local movements of freight were regarded as being 'sufficiently intensive'. British Railways, 'The ATI Investment Report', BR, 14th-16th June 1971 para.3.3.

30. D.A. Buchanan, 'Technological Imperatives and Strategic Choice', in G. Winch (editor) *Information Technology in Manufacturing Processes: Case studies in Technological Change* Rossendale, 1983.

31. Through introducing the TOPS computer system management achieved significant improvements in operating efficiency. Payload per freight train has increased by 12% and total operations cost per train mile has been reduced by 12%. Most strikingly, the total number of freight wagons on the network has been reduced by 61%. However, the decline in the volume of freight transits (reflected in only a 2% increase in freight receipts), has meant that the freight business has still struggled to 'break-even'. See, British Railways Board, *Productivity and Performance*, British Railways Board, 1982; D. Serpell, *Railway Finances*, HMSO, 1983.

32. It is worth noting that an attempt was made to control the exact placement of wagons in the yard by means of a TOPS allocation program. However in practice, the suggestions made by the computer are often unworkable due to their lack of flexibility an essential requirement of any road plan allocation of wagons.

Chapter 6. TOPS and The Yard Supervisor: The Redefinition of First-line Supervision

(i) Introduction

As discussed in Chapter 2, studies into the effects of technical change on supervision have tended to focus their attention on changes in the role of the formally defined first-line supervisor. The main debate has centred on the question of whether computer technology results in the erosion of the role of the first-line supervisor. The predominant finding is that computer technology does lead to an erosion of first-line supervision. This chapter critically evaluates this debate through examining the effects of computerisation on the role of the yard supervisor in British Rail marshalling yards.

The first section provides a brief reappraisal of recent studies concerned with the impact of computer technology on the role of the supervisor. This is followed by a critique of the four possible scenarios which are advocated in the literature for the development of the role of the first-line supervisor under computer-aided production systems.

The second section examines in detail the tasks and supervisory control functions of yard supervisors under the routine operation of TOPS. Retrospective accounts and documentary material is also used to compare the components of the yard supervisor's job with traditional first-line marshalling yard supervision.

(ii) Computer Technology and the Role of the First-line Supervisor

The two general types of first-line supervisory roles outlined in Chapter 2 provide useful benchmarks from which it is possible to identify and distinguish actual supervisory roles. To recap, one is concerned with the supervision of people (the labour-oriented supervisor),[1] and the other is involved in the supervision of machines (the machine-oriented supervisor).[2] For the moment, these two characterisations are best viewed as being two distinct and contrasting types at either end of a continuum of supervisory roles found in practice.

The predominant findings from recent studies indicate that computer technology is contributing to an erosion of both the labour-oriented (traditional) and machine-oriented (technical) role of the supervisor.[3] These studies claim that supervisors are becoming increasingly peripheral to the system of control as the shopfloor control function of supervision is incorporated into the machine, concentrated in management, or devolved to operatives. Rothwell,[4] and Rothwell and Davidson,[5] claim that although computer technology affords the possibility of combining an enhanced supervisory role with greater functional integration, the tendency has been to diminish supervisory responsibility. Rothwell concludes by questioning the need for first-line supervisors:

> The supervisors' skills in fixing and by-passing the formal system through a mixture of experience, cunning, personal contacts and trading of favours or indulgences, could appear to count for nought over-night. Even more straightforward expertise in planning and scheduling work, acquired through years of experience, could now be available to anyone who could operate the system.[6]

The view that computerisation tends to erode the 'skill superiority' of the supervisor and reduce supervisory discretion and autonomy in controlling shopfloor operations, has found considerable support.[7] Buchanan and Boddy, illustrate how both the 'man-management' and 'technical' aspects of the supervisor's job are displaced under computer-based operating systems, and conclude by calling into question the need for first-line supervision.[8]

These studies do often recognise the capacity of computer technology to integrate previously diverse areas of operation, which could potentially lead to the enhancement of supervisory positions. Generally however, they conclude that the role of the first-line supervisor is becoming increasingly peripheral to the system of control with the advent of new computer-based technologies.

There are two criticisms which can be levelled at these studies. Firstly, they tend to equate changes in the role of the *supervisor* with changes in *supervision*. The inadequacies of this reductionist approach to an analysis of supervision have been demonstrated in Chapters 2 and 5 and need not detain us here. Secondly, they tend to ignore the informal changes in organisational roles over time, in particular, the ability of individuals to adapt and accommodate to change through modifying and redefining their position. For example, Hill's study of dockers illustrates how supervisors can often play an important part in redefining their positions within new forms of work organisation.[9] A third point worth noting is the tendency within the literature to focus on changes in supervision either during the implementation stage of computerisation or during the initial operation of new computer-based operating systems. This has resulted in an emphasis being placed on the 'impact' of computer technology on supervision. Thus, the longer term effect of computerisation on supervision is an important area of study which has remained under-researched.

Four possible alternatives for developing the role of the first-line supervisor under computer-based operating systems which have been identified in the literature are:

- reinforce the role of the supervisor as a 'specialist labour' role
- define the supervisor as a 'technical expert'
- develop the role of the supervisor into a genuine first-line managerial role
- abolish the role of the supervisor altogether

The element of choice demonstrated in the fourfold model outlined above clearly limits the number of options open to managements in the development of first-line supervision.[10] The choice would appear to be either to develop first-line supervision into a traditional labour function, or to develop first-line supervision into a purely technical function. The problem with this model is that the supervisor's *raison d'être* is defined either in terms of their technical expertise or their ability to control the activities of labour. The implications of computer technology for supervision are therefore analysed by reference to changes in either the technical or labour control function of supervision. In other words, a major weakness of this model is that it reifies two abstracted polar types of first-line supervisory roles (one concerned with the purely human aspects of work, and one concerned with the purely technical aspects of work), for the purpose of formulating policy options for management. Consequently, this model should not be used to explain changes in supervision under the routine operation of computer technology, as it fails to take account of the possibility of a redefinition of composite supervisory tasks which may include: managerial, clerical, technical, traditional supervisory and operative type activities.

The aim of the study presented below is to counter these tendencies through a detailed investigation of the job of the supervisor[11] in an organisation which is routinely operating with the aid of computer technology, in order to discover what supervisors actually do, and how these activities and tasks have been affected by computer technology. The main findings drawn from the empirical case study are also used to inform the present debate and complement explanations of the effects of computer technology on the role of the first-line supervisor.

(iii) TOPS and The Redefinition of Yard Supervision

In the section which follows, changes in the job of the yard supervisor are examined in detail in order to understand the process of redefinition of the supervisor's role under the routine operation of computer-aided production systems. In analysing the empirical data an attempt was made to distill out the common aspects of the yard supervisor's job. Where possible typical responses have been abstracted from interview transcriptions in order to illustrate points made in the text.

(a) The Yard Supervisor

According to the data collected by this study the personal characteristics of the yard supervisor correspond to the labour-oriented type of supervisor outlined earlier. Yard supervisors:

- are predominantly of working class origin
- are recruited from the shop floor
- have knowledge based on years of practical experience
- have little formal education and training
- hold a position which represents the end of their career progression
- tend to be middle-aged

Yard supervisors typically joined British Rail between the ages of fourteen and sixteen. Then following two years on 'boys service' they would usually take a job either in the locomotive shed or in the yard. Through biding their time and gaining yard experience, opportunities for promotion would arise in the form of 'stepping into dead men's shoes.' On receiving promotion to a supervisory job an individual would normally have given over twenty years service to British Rail. A common career pattern described by a yard supervisor is given below to illustrate this point:

> I joined BR in September 1941, as an office messenger boy at the age of fifteen....I've gone through the grades of what is now a leading railman (used to be called an under shunter) and then progressed through to a head shunter and then onto a chargeman, and then in 1974 onto the job that I'm on now.

Thus, as the personal characteristics of yard supervisors correspond most closely to the labour-oriented type of supervisory role, it would seem fair to assume that the supervisory function would be primarily concerned with the control of labour activities. However, in the course of carrying out the research it was discovered that the labour control function of yard supervision had been redefined prior to the introduction of TOPS. This highlighted two important points worth stressing. Firstly, that in any retrospective analysis of changes in the functions and tasks of first-line supervisors it is important not to be misled by common assumptions about the nature of supervision prior to computerisation. Secondly, that shifts in supervisory emphasis can occur for a number of reasons other than those associated with a change in technology.

In the section which follows, the transformation in the labour control function of yard supervision is briefly discussed in order to clarify the nature of supervision prior to computerisation. Against this backcloth, the job of the yard supervisor is described. It will then be possible to compare changes in supervisory *tasks* under the TOPS system with those under the manual system of freight information control.

(b) The Labour Control Function of Yard Supervision

All the supervisors who were interviewed recounted their early days on the railway. The job of their predecessors was described as being primarily concerned with controlling the activities of yard staff. Considerable authority was vested in the role of the supervisor, and as the 'governor of the yard' he would continually monitor the work of his staff and oversee yard operations. 'Booking-on times' were strictly adhered to and staff who failed to comply with the supervisor's directions were immediately disciplined. This stern 'iron hand' approach to supervision was not readily accepted by all the yard staff. Numerous stories were provided to illustrate the informal methods employed by staff to 'get one back' on their supervisor. The example chosen below demonstrates how traffic which was deemed important (for example, perishables) provided shunters with such opportunities:

> Now years ago there were certain chaps here in those days that if they had the opportunity they would drop the inspector in it. They would leave it until the last minute and they would put it on the train behind six on the engine, and once it's gone out it's too late to do anything about it. Then they would gloat: 'that's

> worked one back on him he'll have a report to answer over that.
> (yard supervisor)

The emphasis on the labour control function of supervision was reflected in a style of supervision which was recalled as being markedly different from their own approach.[12] They claimed that the relationship between a supervisor and his staff was based on discipline. The following is a typical response:

> When I first started as a shunter, the shunters had their room and the Inspector had his room and he would look at his watch and say that it's time these blokes had their meal break. He'd come to the door and you was practically on your feet before he got one foot in the door, and out! But you didn't have the respect for them because you was like a slave to them all the time, you know, and when you had the opportunity to work one back - which they did do have no doubt - the blokes was doing it.
> (yard supervisor)

By the sixties this style of supervision was being replaced by what is commonly referred to as a 'human relations' approach.[13] Management's concern to improve industrial relations and reduce the conflict between supervisors and their staff, led to the introduction of a national supervisory training scheme (NEBSS) which aimed to improve supervisor-staff relationships. This training course was tailored to meet the needs of British Rail supervisory staff. The course still exists, and expounds the benefits of a 'democratic' as opposed to 'autocratic' style of supervision. The four broad elements of the supervisor's job currently defined by the course are:

- motivation - getting staff to support the supervisor in getting the job done
- planning - defining what needs to be done
- organising - getting together the resources to do the job
- controlling - ensuring that the right result is achieved[14]

The view that a different style of supervision is required today compared with the 'old steam days' found considerable support among all the supervisors who were interviewed. The need to 'know your men' and 'work together as a team' was frequently mentioned as the key to good supervisory practice. This assertion was generally followed by a statement on the need to maintain respect and to ensure that staff do not take advantage of this more democratic and 'tactful' approach. One of a number of similar repsonses made by yard supervisors is presented below to illustrate this point:

> If a chap runs late one morning on early turn you weigh him up you see, you say, well he was due on at six-o-clock and he didn't get here until twenty past six this morning, so if tomorrow he don't get here until twenty past six then as a supervisor you go and see to him. You don't walk in the cabin in front of three or four shunters and a couple of other men. You wait your opportunity and you say to him: 'you'll have to pull your socks up your time is six-o-clock the same as mine, now you make an effort tomorrow morning because you're not going to walk in here at twenty past six!' Now they accept that, but if I was to go in there in front of a cabin full of men and say you know: 'Oy! Twenty past six you're here this morning mate! Now you lose that twenty minutes!' You don't get nothing out of this because their heads go down. A little bit of tact goes a long way, that's what I find, and that's one of the things that this job's all about. Getting as much out of the men as you can with as little trouble as you can, and you only get that, I think, by talking to them on a man-to-man basis, not as: 'I'm the governor and you're the boy.'

Following this change from an autocratic to democratic style of supervision there has been a corresponding shift in supervisory emphasis. Yard supervisors are no longer primarily concerned with the labour control function of supervision. Rather, yard supervisors place far greater emphasis on the effective utilisation of machines and materials in the direct control of marshalling yard operations, and on the co-ordination and motivation of labour in the successful achievement of this aim. Consequently, supervisors no longer define themselves as 'overseers of labour', but rather, as controllers of an operating system in which team work and yard staff motivation became more important than the close supervision of labour. In other words, there has been a redefinition of the supervisory control function from being primarily concerned with monitoring the activities of labour and controlling the local movements of freight, to a concern with technical contingencies and local operating problems. Today, their main area of responsibility is concerned with the control of yard operations, of which labour and machine-oriented supervisory control functions are but a part.

(c) The Job of the Yard Supervisor Prior to Computerisation

Prior to computerisation the main objective of the yard supervisor was to ensure that the yard ran smoothly and that freight train services were not delayed on either entering or leaving the yard. With this objective in mind, the three broad elements of supervisory control comprised:

- planning and directing yard operations
- monitoring and evaluating yard operations
- correcting and adapting yard operations

Yard supervisors acted as 'gatekeepers' in the transmission of local operating information. Collecting, transmitting and assessing this information was both time consuming and labour intensive. Furthermore, in order to make realistic suggestions to Divisional Control the supervisor needed to be able to:

- assess how long various yard operations would take
- estimate wagon stock levels and the type of freight in the yard
- estimate the number and type of services due into and out of the yard

In liaison with Divisional Control, yard supervisors would make decisions on the need to alter planned services through continuously monitoring and analysing the performance of the operating system under their charge. Considerable knowledge and experience of local yard operations was required in dealing with the uncertainty inherent in this manual system of freight operations control. By rule of thumb, experienced supervisors were able to make quite reasonable predictions of potential loads on which the decisions to run additional services were based. Nevertheless, in dealing with information which was largely retrospective and not entirely accurate, Divisional Control was not able to provide empty wagons upon demand. The inadequacies of this system created a situation where local supervisors would often find it necessary to resort to 'tricks of the trade' through hoarding and over-ordering certain types of wagon stock in order to meet local fluctuations in the supply and demand of resources. The philosophy behind marshalling yard operations was 'get it out as quickly and as smoothly as possible'. One yard supervisor put it like this:

> I always believed that traffic on the move was a wonderful thing ..... You would never cancel a local train because you always had that little bit of surplus.

The local practice of hoarding empty wagons was particularly common and acted as an informal mechanism for dealing with fluctuations in the flow of local freight traffic. A chief operations manager described the situation as one where 'the supervisor was continually badgering control to get the traffic out'. As one yard supervisor recounted:

> Pre-TOPS days there were so many wagons on the freight side laying about in different yards and sidings, days and weeks on end, not earning a penny. This doesn't happen today because

> TOPS highlights it...In pre-TOPS days if the yard supervisor wanted a couple of box wagons to load something he didn't order a couple he ordered six to made sure he got two.

Under this manual system of freight information control, wagons were grossly under-utilised. It was not uncommon for a trainload of empty wagons to depart from a yard prior to the arrival of another batch of empty wagons. This informal practice of running additional services of empty wagons acted as a means of preventing yard congestion through reducing the total level of traffic within the yard. As one yard supervisor recalled:

> I can remember when I was shunting where there was so many wagons on the system just running around and doing nothing. Just travelling from place to place. To get rid of them you just put them on a train and got rid of them.

Due to the unavailability of accurate information on the current movements of freight, yard supervisors were afforded considerable autonomy in the control of marshalling yard operations. They were the only source of information about wagon stocks and requirements in each local area and hence were able to 'adjust figures' and conceal surplus resources to meet variable customer demands. Much of the yard supervisors' autonomy rested on their ability to *manipulate information* in this way, and on their accumulated knowledge and experience in using informal means to keep traffic flowing through the yard. The philosophy behind supervision was essentially parochial, concerned with moving traffic out of the yard as quickly and smoothly as possible, sometimes with scant regard for its destination and frequently with little knowledge or concern about the consequences that such decisions had for the operating system as a whole. Thus, whilst information was a key resource in planning yard operations prior to TOPS, the unavailability of accurate, up-to-date information on the disposition of freight resources created a situation where the yard supervisor would endeavour to keep a surplus of resources to meet variable customer demands. Considering the importance of information to the control of yard operations, it is not surprising that the introduction of a computerised system of freight information control brought about a redefinition of the supervisor's role and a re-orientation of supervisory decisions. The effects of this change on the job of the yard supervisor are detailed in the section which follows.

(d) The Job of the Yard Supervisor Under TOPS

The job of the yard supervisor involves the control and co-ordination of yard operations. His primary aim is to ensure the smooth and efficient movements of freight within the yard. Working within a local supervisory system concerned with the control of area freight operations, he will oversee yard operations, deal with operating contingencies, and plan the future yard movements of freight in close liaison with other supervisors and senior yard staff. He can be defined as: *a first-line supervisor who is officially recognised by management as being in direct control of freight operations within the yard.*

In controlling freight yard operations the *control function* of first-line supervision has generally remained unaltered. Yard supervisors are still principally concerned with directing, monitoring and correcting yard operations. As already noted, the traditional emphasis on the labour control function of supervision had largely disappeared prior to the introduction of TOPS. Nevertheless, the conclusions drawn in Chapter 5 suggest that there has been a re-orientation of supervisory decisions as a result of a change in the quality of information made available by TOPS. However, at this more general level of analysis it was not possible to uncover the ways in which this has changed the daily job tasks of yard supervisors. As argued in Chapter 3, an analysis of supervisory *tasks* can only be accomplished by a detailed examination of the job of the supervisor at his place of work. The remainder of this chapter therefore, sets out to detail general first-line supervisory tasks and the ways in which these have been changed under the routine operation of TOPS.

The main supervisory tasks which were found to be common to all the marshalling yards studied comprised:

- planning yard operations
- allocating labour
- performing job tasks of yard staff
- supervising yard staff
- supervising yard operations
- inspecting yard equipment
- inspecting train formation
- maintaining accurate reports and records
- acting as a communication link

- dealing with contingencies

It should be noted, that this list of supervisory tasks is not presented in order of importance or in terms of the proportion of the yard supervisor's time spent in carrying out these tasks.

Planning yard operations was in every case a major job task of first-line supervision. In theory, if there are no technical, human or operating contingencies and freight train services were to run according to the Working Time Table then there would be no need for yard supervisors to plan yard operations. In practice however, yard supervisors have to modify existing plans in liaison with their Area Freight Assistants (AFA) in order to accommodate the high degree of variation which is common to railway freight operating systems.

At the beginning of each shift yard supervisors get a number of computer 'printouts' which provide information on:

- what is in the yard
- what is coming towards the yard
- what is due out of the yard

Typically, yard supervisors claimed that the provision of this computer generated information had made their job easier through providing accurate information on the current operating situation within the yard:

> TOPS has made life so much easier for the shunters and the supervisors....As I said earlier on, you get a (TOPS printout), and you know more or less what's coming to you and what's in the yard....You can give the shunters a list - near enough correct - well in advance of the train arriving so that they can plan their movements.

As a result of computerisation, the first hour of the supervisor's day is no longer taken up in taking a 'tour' of the yard and noting the current stock of wagon resources, and then telephoning the details to control. This change in operating practice is well illustrated by the description of one yard supervisor who stated:

> With TOPS you have more information which makes the supervisors job a lot easier. It saves you the trouble of walking down the yard, and you don't have to physically check and calculate the brake force on a train. On the whole, it does make the job easier as you have all the information at your finger tips and you can sit in the office and control the yard.

At the start of each shift, yard supervisors assess the current operating position of the yard; check the number of staff who have turned up for work; identify priority traffic; and confer with their area freight assistant on what needs to be done. As one yard supervisor put it:

> We'll confer with one another with regards what we can run and what we can't run, or what he wants done.

The planning and replanning of yard operations continues throughout the yard supervisors turn of duty. With TOPS, he is no longer required to spend so much time in the yard, as he can now direct yard operations from his office in liaison with other yard supervisors and his AFA. Although some supervisors were observed to spend nearly a third of their time in the yard, this was largely for the purpose of dealing with some contingency which had arisen. For the most part, yard supervisors felt that they could effectively control yard operations from their office.

In cases where staffing was either below full complement levels or where there was a high level of staff absenteeism, allocating labour was viewed as both a key supervisory task and a central problem. Thus, differences in supervisory emphasis was found to reflect variations in the supply of labour rather than the personal characteristics of individual supervisors. A typical response of yard supervisors in marshalling yards operating with a less than full complement of staff is illustrated below:

> You really do have to spend most of your time in the yard when you experience shortages, you know, instead of five men you've only got two or you've only got three. It makes life a bit difficult for those blokes. You do go out and see that things are going as smoothly as possible, and you know, give what ever little assistance you can just to keep the job ticking over.

Staff shortages would often result in a greater proportion of the yard supervisors time being spent in the yard. He would attempt to distribute additional tasks among his staff in planning the allocation of labour. Moreover, yard supervisors would tend to make themselves more 'visible' to staff in order to 'lend a hand' and ensure that staff were coping. Nevertheless, although yard supervisors would assist their staff in periods of labour shortages they would rarely get involved in shunting activities. In fact, at no time during the study were yard supervisors observed assisting staff in the *shunting* of wagons. Only one of the yard supervisors of those interviewed claimed that he would get involved in such activities should the need arise:

> The shortages of staff is a real problem here and I try to assist by pulling the brakes. Sometimes I might even get involved with some shunting but that would be rare.

The task of planning the allocation of labour varied according to staffing levels. In two of the yards studied it was an on-going problem which would regularly occupy yard supervisors at the beginning of each turn of duty. At the other three yards, staffing levels did not pose itself as a major problem. Thus, staff shortages and absenteeism were human contingencies which would be dealt with by yard supervisors as and when the need arose, it was not a supervisory task peculiar to, or influenced by, the introduction of TOPS.

Performing job tasks of yard staff was not a task common to the job of the yard supervisor. Although they would help out their chargemen in 'pulling-brakes' and 'changing the points', supervisors were reluctant to perform any operative type task associated with the shunting and marshalling of wagons. The one yard supervisor who appeared to be more pragmatic about the need to help out shunting staff, still formulated his answer in terms of the supervisors' formal responsibilities:

> When you get these jobs you sign a document that states that you should have the interests of BR at all times, and that you must be prepared to carry out the duties of the staff that you supervise in an emergency. You don't just cancel all the bloody trains because you haven't got any staff, you cope as best you can even if it means doing some of the duties that they would normally do.

It was observed that yard supervisors rarely stood over and supervised the routine work of yard staff. Typically, yard supervisors described the situation as one where:

> As long as the job's going alright and things are making connections that are suppose to make connections, and things are running pretty well to time, why interfere with men because you get far more out of them by letting them get on with it.

Although yard supervisors were found to have the same personal defining characteristics as the labour-oriented type of first-line supervisor, the close supervision of shunting staff for the purpose of controlling routine yard operations was not identified as a significant task of first-line supervision. However, in supervising yard operations the yard supervisor would oversee the activities of individual shunters for the purpose of ensuring the safety of staff in the performance of difficult and dangerous job tasks. In such instances the yard supervisor would give 'personal attention to operations affecting the safety of the line'. As one yard supervisor put it:

> I'm responsible for the safe working of the yard and to see that nobody puts themselves into any dangerous situations. If I see that anything is going wrong, or they're doing something wrong, well I get and tell them.

The inspection of yard equipment is a routine task carried out by yard supervisors. Regular checks are made on various types of yard equipment, which include: fire appliances, point clips, and ground frames. However, this function has not been affected by the introduction of TOPS.

The inspection of train formation is a key task common to the job of all yard supervisors. Before the introduction of TOPS, considerable knowledge and experience was relied upon in checking that train formations complied with British Rail's rules and regulations. Today, large quantities of this information is stored within the computer. For example, if the formation of a train does not meet the safety standards laid down in British Rail's regulations then it will be rejected by TOPS, and a reason will also be provided on why the train has been rejected:

> REJECTED - 37 FT BARR REQ BETWEEN WAGON 01 & LOCO 47119. (TOPS printout)

In the example above, a dangerous goods train has been rejected because a barrier wagon has not been placed between the locomotive and the wagon load. The TOPS system will also check the loading of the train and ensure that sufficient brake force is available for the safe running of the service. This is illustrated by the comment of one yard supervisor who noted:

> As far as the yard working is concerned, the introduction of TOPS has made life much easier for the supervisor and chargemen. Chargemen before the introduction of TOPS had to calculate their trains and so on. But, since the introduction of TOPS you are greatly assisted....which makes things so much easier for you.

It is no longer necessary for yard supervisors and chargemen to manually check that train formations comply with the rules and regulations laid down by British Rail, nor do they need to calculate the brake force of their outbound freight train services. All these details (the number of the vehicle, its weight, brake force, brake type and destination) are listed on the computer printout (usually referred to as the 'TOPS train list'). Thus, TOPS has reduced the amount of knowledge required of yard supervisors and chargemen in ensuring correct train formations of outbound freight train services. Moreover, the availability of accurate information on train formation has facilitated quicker inspections of these outbound freight services.

During their turn of duty, yard supervisors carried out a number of clerical tasks which included:

- maintaining a supervisor's log
- compiling supervisory report sheets
- checking staff time sheets

Information recorded in the yard supervisor's log book tended to vary from yard to yard; for example, some log books provided an overview of the state of the yard, whilst others contained information on priority traffic and contingencies which would affect yard operations.

Supervisory report sheets were common to all supervisory posts in the yard. These report sheets would be forwarded to management and would contain information on any major accident or emergency which had occurred in the yard during the supervisor's turn of duty.

The certification of yard staff time records would usually be completed prior to the time sheets being sent to the finance clerk. As one yard supervisor put it:

> It is my job to scrutinise the sheets and advise the roster clerk of any discrepancies.

The dominant activity of yard supervisors was to act as a communications link in the day-to-day control of yard operations. Communication was a means of carrying out other tasks, and in common with findings of other researchers, it was not found to primarily involve the transmission of information between management and operatives.[15] The collection, processing and distribution of operating information was also a key supervisory task prior to computerisation. The major changes which have occurred with TOPS are that yard supervisors no longer act as a local communications link with Divisional Control, rather, they deal directly with their area freight centre located in the marshalling yard.

Communication by yard supervisors was observed to be for the purpose of giving and gathering operating information, and for making decisions on changes to planned operations. The local communication network comprised:

- yard staff
- other supervisors
- TOPS clerks

In being responsible for the control of yard operations, yard supervisors regularly came into contact with their chargemen, head shunters and other yard staff. From interviewing and observing yard supervisors, face-to-face communication with their chargemen was found to take up the most significant proportion of the yard supervisor's time. This is not surprising when one considers that the chargeman was viewed by nearly all the supervisors as their 'right hand man' in the day-to-day control of yard operations. A typical response of a yard supervisor is illustrated below:

> I leave my movements to the chargeman. I've got confidence in him to go out there and do the job because he's very good and I just don't interfere. I'm here for the safe working of the yard and to see that the yard is running smoothly.

In general, yard supervisors felt that overseeing the activities of labour would hinder rather than enhance the efficiency of yard operations, and relied on their chargemen to supervise the work of yard staff. As another yard supervisor indicated:

> They don't want anybody breathing down their necks because they know what is required. They've got a chargeman out there, and nobody resents more a bloke looking at them watching every move they make, because I've been through it, I know what it's like you know.

Yard supervisors tend to get involved with their head shunters when unforeseen events or emergency situations occur. As with chargemen, the communication between head shunters and yard supervisors is for the transferring of information in relation to yard operations. For example, a yard supervisor might inform his head shunter that certain wagons for connecting services need to be transferred to another yard within the marshalling yard, or he may enquire about the possibility of taking in some extra traffic from another part of the yard to prevent congestion. For the most part however, head shunters maintained a degree of independence in taking control responsibility for all shunting operations in their own particular section of the yard. As one yard supervisor commented:

> It's the head shunters responsibility how he shunts his yard.

While TOPS has not affected the relationship between head shunters and yard supervisors, it has reduced the degree of discretion and knowledge previously associated with the role of the head shunter. As indicated in Chapter 5, prior to the introduction of TOPS head shunters needed to be knowledgable about different types of traffic and the routes of various freight services. In the view of one yard supervisor:

> It's made the job of the head shunter much easier than it was in pre-TOPS days, because in pre-TOPS days the head shunter had to know the geography of the system. You had wagons coming into the yard for all the destinations on the Western Region and he had to know what trains they went on. But now under this TOPS system and the tag numbers everything's done for you, you know, all the thinking is done for you. It's taken a hell of a lot off the burden of training a shunter to work in the yard, you know, it took years and years to get to do the job properly.

Nevertheless, considerable experience is still required of head shunters in learning the principles of marshalling yard operations in order to minimise the number of shunting operations in the formation of freight trains.

In the course of planning yard operations, dealing with contingencies, making reports, and allocating staff, the yard supervisor will also come into contact with other members of his yard staff. However, apart from contacting particular individuals in cases where misdemeanours have occurred or where yard staff have continually turned up late for work, communication with other yard staff did not account for a significant portion of the supervisor's time.

In planning yard operations, yard supervisors will also liaise with both their AFA and other yard supervisors. In marshalling yards which only have one first-line supervisor per turn of duty, contact with other yard supervisors only occurred during the shift changeover. At this time the yard supervisor would provide the relieving yard supervisor with an oral account of the current state of yard operations and highlight the following: changes to booked services; immediate priorities; and any contingencies which may have occurred during his turn of duty. In common with evidence from other research, it was found that virtually all peer communication was devoted to work-oriented subjects.[16]

Contacts between yard supervisors were found to account for only a very small proportion of the yard supervisors time and it was not observed to be particularly crucial to yard operations. This was largely due to the keeping of a log book which provided a continual record of freight movements and contingencies which occurred during their turn of duty. Moreover, yard supervisors rated their peers as the least important people with whom it was necessary to have a good relationship. The major reason for this was that they did not feel that other yard supervisors had any significant influence over their daily work as they only came into contact at the beginning and end of each working day.

In yards where there was a supervisor in both the 'up' and 'down' yard (see Figure 6, p.112), it was important for the supervisors to work together. In such case, communication was predominantly over the telephone, and the main reason for contact was to arrange the movement of freight traffic from one yard to another (this operation is referred to locally as transfers).

In the day-to-day control of yard operations the yard supervisor would also liaise with his AFA. As shown in Chapter 5, TOPS has facilitated the creation of a new supervisory system in which the AFA has overall responsibility for controlling all the movements of freight into and out of the yard, whilst the yard supervisor has overall responsibility for controlling all the movements of freight within the yard (see Figure 11, p.127). Consequently, it is important for AFAs and yard supervisors to work together in the control of area freight operations. This is illustrated in the following statement made by an AFA:

> Basically, if you've got a good relationship with your yard supervisors you're home and dry. They know what they've got to look for, you know what you're looking for, and if you were to happen to miss something they'd give you the wheeze that you've missed it.

While yard supervisors were directly responsible to their AFAs, it was observed that the working relationship was more of a partnership. AFAs would not make decisions that affected the working of the yard without first consulting the yard supervisor, and yard supervisors would inform the AFA of any problems in the yard. One yard supervisor described this working relationship in the following way:

> The AFA always notifies his yard supervisor. If for instance there were four or five trains being offered and the yard was congested he would ask my opinion, and then I'd be able to say to

> him 'well we can only accept three because of the situation. There's no way that we're going to shift these wagons.' You see you have to look at the yard in these situations and make decisions.

Yard supervisors would maintain contact with clerical staff in the Area Freight Centres (AFC) for the purpose of receiving information, either orally, or through requesting TOPS printouts. Yard supervisors who were located within the AFC tended to communicate directly with the TOPS clerks, whereas yard supervisors located in the yard tended to contact the AFC via the telephone. For the most part, yard supervisors would not make their own input to TOPS, rather, they would request TOPS enquiries from the clerks:

> They'll do the TOPS enquiry for you on the machine. So as for actually handling machines we don't, we just ask the TOPS clerk and he'll do the necessary for you. It's individual wagon enquiries and sort of general incoming train enquiries. (yard supervisor)

Yard supervisors rarely came into contact with their area managers. During the study not one instance was observed where the area manager visited the yard. This was illustrated by one yard supervisor who stated:

> We very seldom see the Area Manager, he might only come up here once every three months, then it might only be ten minutes or quarter of an hour, you know: 'Hello Tony, how are you?' And then he'll go in the TOPS office. That's of course if everything is running all right. I mean, if you had a major bloody crisis he'd soon be on you like a ton of bricks.

The communication patterns of yard supervisors show that whilst yard supervisors spend more time dealing with their senior railmen than any other *group*, the *individual* which they spend the greatest proportion of their time dealing with is their chargemen. Communication with local staff was shown to be for the purpose of giving and receiving information pertinent to yard operations, and for making decisions on changes to yard operations. Moreover, in the day-to-day control of yard operations, yard supervisors would liaise closely with their AFAs, and plan and arrange yard working in the light of changes to scheduled services and operating contingencies. Dealing with unforeseen events or 'emergencies' (a term used by yard staff to describe operating contingencies) was generally viewed by yard supervisors as the most important supervisory task of the job. As one yard supervisor put it:

> Emergency situations are what the supervisor is...ninety per cent of the supervisor's job is dealing with emergency situations.

The proportion of the supervisor's time spent dealing with contingencies would vary from day-to-day and therefore, it is not possible to indicate the significance of this task by simply referring to the time spent dealing with daily problems and difficulties. Moreover, in every case which was observed, dealing with operating contingencies always took priority over routine tasks. When yard supervisors were asked to describe their major job tasks they all stressed the importance of dealing with emergency situations. A typical reply was:

> Emergency situations with derailments and that sort of thing. It don't matter where you go on the railway, everybody says: 'supervisors, what do you want supervisors for?' You know: 'we're carrying them about, we're earning their money'. But as soon as something goes wrong, as soon as you get an emergency situation, whether it's a train failed, whether it's a derailment....anything like that. 'Well where's the supervisor?' Because everybody looks to him to do something about it.

Yard supervisors generally agreed that if everything went according to plan and there was a full complement of men, then you would not need supervisors because 'the men on the ground know their jobs'. However, yard operations rarely run according to plan and it is at these times that the yard supervisor must make decisions on the appropriate action to be taken. Typically, operating contingencies did not occur at evenly spaced intervals, rather, they tended to occur either in 'clusters' or during an 'on-going' problem, such as staff shortages. A passage from the observation notes made during the period of research is presented below to illustrate the type of contingencies that yard supervisors have to deal with:

> During the night shift the yard supervisor in the main up yard had to deal with four contingencies; namely, two machine failures, a wagon derailment, and a yard staff shunting contingency. One of the machine failures concerned the upper yard where half of the flood lights had failed. In this case, the yard supervisor informed his chargeman to shunt at a slower pace and to put safety before train schedules. The yard supervisor then informed his AFA of the problems they were having, and he asked for his decision to be written into the AFAs log book (a page of which is sent to the area manager every morning). Later that night the upper yard became congested and the relationship between the yard staff and the chargeman became strained, as well as between the chargeman and the supervisor located in the main down yard. By talking to the chargeman the up yard supervisor felt that he had managed to calm the situation down. However, at the end of the turn of duty

> the shunting staff in the upper yard refused to shunt a final Speedlink service which was running late. During his shift, the yard supervisor also had to deal with a wagon which had been 'bumped' (derailed) in the main up yard. The supervisor went into the yard and assessed the problem, he told me that he was concerned with what freight service the derailed freight wagon was due to go out on; how the wagon could be re-railed with the smallest inconvenience; and when would be the best time to allocate men to solve the problem. He decided that the wagon could be left until the rush was over. The final contingency which the yard supervisor had to deal with during the shift was an engine failure on the main line. In order to deal with this emergency the yard supervisor contacted the traction and train crew supervisor who organised a locomotive. I then accompanied the yard supervisor through the yard onto the locomotive to attend to the engine failure on the main line. The panel supervisor was contacted, the locomotive was attached and the train was pulled back to the marshalling yard. Dealing with this one contingency took nearly two hours. (observation notes)

The major types of contingencies which yard supervisors deal with are listed in Figure 12, this figure also records their frequency of occurrence as estimated by yard supervisors. As they are unexpected events it is only possible to estimate their frequency, therefore these figures should not be taken as indicating that a contingency will necessarily occur within the period stated. Marshalling contingencies tended to occur on a daily basis; problems arising from a shortage of resources tended to occur weekly; yard machine failures occurred monthly; and main line contingencies tended to occur quarterly; in addition, there was the annual problem of bad weather conditions. It should be noted that it is the category of contingencies which occur at these estimated intervals rather than the specific contingencies listed under these headings.

When yard supervisors were asked to list the main types of emergencies which they would expect to deal with, yard derailments and machine failures were the most frequently mentioned type of contingency (see Figure 13). Yard derailments were also viewed as being the most difficult to deal with (see Figure 14). However, following further discussions with yard supervisors it became apparent that derailments could prove to be anything from 'a minor problem to a major headache'. It depended on what was derailed, when the derailment occurred, and where the derailment happened. Similarly with the category of machine failures, where points failure, signal failure, and train failure, were all given as examples of possible machine failures. Thus, whilst some machine failures may be relatively straight forward, others could prove to be extremely difficult to deal with. Apart from yard derailments and machine failures, staff

Figure 12: Type and Frequency of Unforeseen Events Dealt with by Yard Supervisors

Types of Contingency	Estimated Frequency of Occurrence
Shunting Contingencies: • yard derailments • incorrest marshalling of trains • accidents to staff • overloading of trains • displacement of freight • late arrival of connecting services • incorrect TOPS information • TOPS list delays • alterations to diesel allocation • alterations to traffic destinations	Daily
Resource Shortages: • staff shortage • diesel shortage • wagon shortage	Weekly
Yard Machine Failures: • TOPS failure • train failure • points failure • lights failure • general equipment failures	Monthly
Main Line Contingencies: • signal failure • train failure • main line blockage • line defect • derailment	Quarterly
Bad Weather Conditions	Annually

Figure 13: Main Types of Contingencies Mentioned by Yard Supervisors

Types of contingency	Contingency mentioned by sample of 22 yard supervisors
Yard Derailments	81.8%
Machine Failures	54.5%
Staff Shortages/Absenteeism	45.5%
Main Line Contingencies	22.7%
Bad Weather Conditions	13.6%
Incorrect Information	13.6%
Accidents to Staff	13.6%
Staff Discipline	13.6%
Incorrect marshalling of Trains	9.1%
Late Arrival of Connecting Services	9.1%

Figure 14: Contingencies which Yard Supervisors Estimated to be the Most Difficult to Deal With

1. Derailments
2. Staff Shortages
3. Machine Failures
4. Incorrect TOPS Information
5. Accidents to Staff
6. Late Arrival of Connecting Services

shortages also scored highly, however, this reflected current concerns of yard supervisors at particular locations, for example, in two of the yards staff shortages were an on-going problem and hence were mentioned by all the supervisors, whereas, in other yards where the problem did not exist staff shortages were not identified as a major problem. Nevertheless, yard supervisors rated this human contingency as the second most difficult category of contingencies to deal with. Typically, they felt that is was unrealistic to expect them: 'to do the job without the men.'

Dealing with incorrect TOPS information and TOPS list delays was an additional type of contingency which had arisen following the introduction of TOPS. The generation of invalid freight data was generally associated with short-haul freight movements. In such cases, the service may either arrive prior to the output of a train consist, or with an inaccurate description of the make-up of the train. Yard supervisors would then have recourse to their own judgement on the yard placement of these 'unidentified' wagons. As noted in Chapter 5, head shunters feel that it is unfair to expect them to shunt incoming freight services without a TOPS list which details the next outbound destination of incoming traffic. Hence, yard supervisors would have to negotiate with their head shunters in allocating the train to a particular shunting gang. Alternatively, if the train is left on an arrival siding awaiting information about train formation then blockages can occur and a backlog of traffic is likely to result.

It was observed that this contingency sometimes caused considerable irritation among yard staff, especially when an incorrect decision was made on the yard placement of wagons which necessitated further action to correct. For the shunting staff, this may involve moving the wagons from their sidings in the yard and transferring them to another sub-yard within the marshalling yard. Yard supervisors would attempt to prevent the re-occurrence of such contingencies by placing pressure on their AFA to either deal directly with the problem, or to inform the area manager. Nevertheless, even though both AFAs and area managers had attempted to rectify this problem, TOPS list delays and incorrect TOPS information remained a fairly frequent type of contingency which had to be dealt with by yard supervisors (see Figures 12 and 14). These additional types of contingencies (which have arisen as a direct result of computerisation) have strengthened the yard supervisor's claim that the job involves dealing with unforeseen events and contingencies. Consequently, yard supervisors have been able to rationalise the effects of computerisation on their job through redefining their role as 'contingency men' and 'problem-solvers' under the routine operation of the TOPS computer system.

Dealing with unforeseen events was in all cases a central task of first-line supervision. Yard supervisors did not associate their job with routine tasks of marshalling yard supervision, but rather, with the variations, problems and difficulties inherent in the operating system of high capacity marshalling yards under the routine operation of TOPS. This general view is illustrated again in the words of one yard supervisor who said:

> People say you're wandering about and you're doing nothing because you haven't got a shunting pole in your hands and you're not pulling points. You can see people saying: 'he aint got a bad job like, he walks about and don't do bugger all.' But the first sign of anything going wrong and everybody shouts out: 'where's the yard supervisor!'

The above analysis of the job of the yard supervisor illustrates how although the control function of first-line supervision has largely remained unaltered, the way in which yard supervisors accomplish this end has significantly changed. Information has always been a key resource in the control of yard operations. However, with TOPS, yard supervisors are now able to more effectively control yard operations through exploiting the information generated by the computer. Moreover, yard supervisors have also been instrumental in redefining their roles as contingency men under the routine operation of computer technology. Thus, it has been the response of yard supervisors, the nature of the operating system and the enabling characteristics of TOPS combined with management's decision to create local freight centres and improve the provision of information at the local level, which have all played a significant part in redefining first-line supervision.

(iv) Conclusion: Computerisation and the Redefinition of Yard Supervision

Under the manual and telex-based system of freight information control, the unavailability of accurate up-to-date information meant that yard supervisors had to resort to informal methods in order to keep traffic moving and prevent yard congestion. On the basis of experience the yard supervisor was able to do a certain amount of pre-planning in regard to certain types of freight traffic. For the most part however, traffic was dealt with as and when it arrived. Computerisation has radically changed this situation. Yard supervisors are now able to preplan marshalling operations since detailed information about traffic approaching the yard, and traffic already in the yard is immediately available from the AFCs. From a few simple TOPS enquiries the yard supervisor is able to get detailed information on: what is in the yard; what is coming towards the yard; and what is due out of the yard. Using this information the yard supervisor is able to more effectively plan freight yard operations, and accommodate changes in scheduled services.

Conversely of course the actions of yard supervisors are now more 'visible' to higher levels of management who can monitor conditions within and the performance of individual marshalling yards. As a result, yard supervisors can no longer adopt a parochial attitude to railway operating decisions, rather, they are now required to be aware of the consequences of their decisions for the operating system as a whole. Thus it is not surprising that interviews and informal discussions with yard supervisors revealed an ambiguous attitude towards working with the TOPS computer. On the one hand yard supervisors were conscious of the fact that they could not 'go over the computer's head' in drecting yard operations. However, there was also a general view that computerisation had made the supervisors job easier by enabling them to exercise more effective control of yard operations.

The supervisory tasks of allocating labour, inspecting yard equipment, keeping records, overseeing the activities of yard staff and performing the job tasks of yard staff, were not significantly altered under the TOPS system. On the contrary, these tasks were mainly influenced by a number of situational factors; for example, the allocation of labour was mainly affected by staffing levels and/or staff absenteeism.

In contrast, the tasks of supervising yard operations and inspecting train formations have been redefined under TOPS. The TOPS computer system automatically checks the loading of a train and ensures that sufficient brake force is available for the safe running of the service. As a result, the knowledge and experience previously required of yard supervisors in calculating correct train formations has been substantially reduced. In addition, yard supervisors are no longer required to spend the first hour of their turn of duty taking stock of the wagons in the yard and telephoning the details to Divisional Control. With the TOPS computer system, they can pre-plan yard operations from their office on the basis of information generated by the computer. Nevertheless, although yard supervisors no longer dealt directly with Divisional Control they still acted as a key communication link in the day-to-day control of freight yard operations. Working within a new supervisory system, yard supervisors would liaise closely with their AFA and other local staff for the purpose of giving and receiving information on freight operations and making daily operating decisions.

Perhaps the most significant finding which has emerged in this study is the way in which yard supervisors have accommodated and adapted their position to change. They have played an important part in establishing new patterns of relationships and new working practices under the routine operation of TOPS. In particular, they have minimised the threat posed to them by computerisation through redefining their roles as contingency men in dealing with daily variations and problems associated with freight yard operations. They laid stress on the point that their role involved dealing with 'problems' associated with marshalling yard operations which would occur without a computer system, for example, derailments, staff shortages, machine failures, accidents to staff, and the late arrival of connecting services; in addition to those contingencies which have arisen as a direct result of computerisation, for example, incorrect TOPS information and TOPS list delays. In this sense yard supervisors seemed to regard the importance of their role as largely unaltered by computerisation, even though a number of traditional supervisory tasks have undergone a substantial transformation.

In examining the effects of computer technology on first-line supervision, this chapter has demonstrated how it is important to detail changes to the job of first-line supervisors under computer-aided production systems. In the case study presented here, it has been shown how the transformation of the job of the yard supervisor did not result in a simple 'peripheralisation' of either a 'labour-oriented' or 'machine-oriented' type of first-line supervisory function. While the two general types of supervisory roles outlined in Chapter 2 provide useful markers from which to examine first-line supervision, they should not be used as a twofold classification of the types of supervisory roles found in practice. Studies which reify these two broad characterisations in evaluating the future developments of first-line supervision are both inadequate and misleading. What is required are more detailed empirical investigations on the effects of computer technology on the tasks and functions of first-line supervisors. In the case of the yard supervisor, it has been shown how computerisation has led to a redefinition of composite first-line supervisory tasks, which currently comprise a mixture of traditional practices and new computer-oriented activities.

Chapter 6. Notes and References

1. See for example, J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society.* Cambridge University Press, 1982, p.209; C.E. Davis, and J.P. West, 'Attitudinal Differences Among Supervisors in the Public Sector', *Industrial and Labour Relations Review,* July 1979, vol.34, no.4, pp.495-505; D. Dunkerley, *The Foreman: Aspects of Task and Structure* Routledge, 1975, p.170.

2. Davis and West, op. cit., pp.496-505; J. Child, and B. Partridge, op. cit., pp.213-4; D. Dunkerley, op. cit., p.171.

3. See for example,J. Child, and B. Partridge, op. cit.; D. Buchanan, and D. Boddy, *Organisations in the Computer Age* Gower, 1983. R. Edwards argues that the control function of supervision is becoming increasingly peripheral as more sophisticated methods of control are developed by management. The three elements he identifies as being essential to the control of labour are: directing, monitoring and disciplining the non-compliance of labour. Furthermore, he claims that it is possible to discern a typology of systems of control which have evolved as a result of conflict and contradiction in the capitalist enterprise; namely, from simple forms of personal control sytems entrepreneurial and hierarchical control to structural systems of control in the form of technical and bureaucratic control structures. See R. Edwards, *Contested Terrain: The Transformation of the Workplace in the Twentieth Century.* Heinemann, 1979, pp.18-162.

4. S. Rothwell, 'Supervisors and New Technology', *Employment Gazette,* January 1984, pp.21-25.

5. S. Rothwell, and D. Davidson, 'New Technology and Manpower Utilisation', *Employment Gazette,* June 1982, pp.252-254, and July 1982, pp.280-283. See also, S. Rothwell and D. Davidson 'Training for New Technology' in G. Winch, (editor) *Information Technology in Manufacturing Processes: Case Studies in Technological Change,* Rossendale, 1983, p.119.

6. S. Rothwell, op. cit., p.23.

7. See for example, A. Burkitt, 'Cold-Hearted Computers', *The Engineer, 18th* May 1978, pp.24-25; S.P. Black, Numerically Controlled Machine

Tools in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company', and 'Computer Coordinate Measuring Machines in a Heavy Engineering Manufacturing and Assembly Plant: Caterpillar Tractor Company', pp.58, 66 & 84, in D. Buchanan, & D. Boddy, (editors) *Organisations in the Computer Age*. Gower 1983; H. Shaiken, 'Numerical Control at Work', *Radical America*, Vol.13, No.6, 1979, pp.25-38.

8. D. Buchanan, & D. Boddy, (editors) *Organisations in the Computer Age*. Gower 1983 p.2573, no.6, 1979, p36.

9. S. Hill, *The Dockers: Class and Tradition in London* Heinemann, 1976.

10. Caution should be given to studies which attempt to formulate general purpose models for the development of first-line supervision from particular cases. This criticism can be levelled at Child and Partridge who present their general types as a policy model for management. If the supervisor is not defined or seen as a 'labour master' or 'technical expert' - which is unlikely - then the suggestion is to abolish the role of the first-line supervisor. According to Child and Partridge this can be accomplished either by removing him from the shop floor and placing him in managment, or through simply discarding the role altogether. Thus, no place is left for the supervisor who may be carrying out a variety of tasks which include administrative, technical and labour oriented activities. This type of policy conclusion from academic study fundamentally challenges the role of the first-line supervisor. In attempting to explain the apparent erosion of first-line supervision it is important not to be misled by common assumptions and beliefs, and consequently support and contribute to an actual erosion of first-line supervision. J. Child, and B. Partridge, *Lost Managers: Supervisors in Industry and Society* Cambridge University Press, 1982 pp.206-218.

11. K.E. Thurley, and H. Wirdenius, have demonstrated the importance of treating the supervisor's job as: 'a type of black box, to be filled with activities and tasks according to the particular situation'. See, K.E. Thurley, and H. Wirdenius, *Supervision: A Reappraisal*. Heinemann, 1973, p.26.

12. Numerous studies exist on the style of supervision, see for example, D.C. Pelz, 'Influence: A Key to Effective Leadership in the First-line

Supervisor', *Personnel*, 1952, vol.29, pp.209-217; R.L. Kahn and D. Katz, 'Leadership Practices in Relation to Productivity and Morale', in D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, Tavistock, 1960; E.A. Fleishman and E.H. Harris, 'Patterns of Leadership Behaviour Related to Employee Grievance and Turnover', in E.H. Vroom, and E.L. Delci, deitors *Management and Motivation*, Penguin, 1970.

The early approaches tended to concentrate on the effect of democratic and autocratic styles of supervision on employee behaviour. See for example, L. Coch and J. French, 'Overcoming Resistence to Change', *Human Relations*, 1948, vol.1, pp.512-532; R. White, and R. Lippitt, "Leader Behaviour and Member Reaction in Three 'Social Climates'," in D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, Tavistock, 1960.

Later studies have tended to focus more on industrial context as a factor influencing the appropriateness or not of particular leadership styles. See for example, R. Likert, *New Patterns of Management*, McGraw-Hill, 1961; F.E. Fiedler, 'The leader's Psychological Distance and Group Effectiveness', in D. Cartwright, and A. Zander, (editors) *Group Dynamics: Research and Theory*, Tavistock, 1960.

For a good criticial summary of leadership style research, see, K.E. Thurley and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973, pp.44-51.

13. The 'human relations' approach associated with the Hawthorne Researchers: Mayo, Putnam, Pennock, Dickson and Roethlisberger, emphasised the importance of a more personalised and less direct style of supervision. See, F.J. Roethlisberger, and W.J. Dickson, *Management and the Worker*, John Wiley and Sons, 1939. The dissemination of this research led to the call for a more 'employee-centred' as opposed to 'production-centred' style of supervision particularly noticeable in the literature of the fifties and sixties. Essentially, the 'production-centred' style of supervision refers to autocratic and disciplinarian styles of leadership, which is often associated with traditional supervision; whereas, the 'employee-centred' or 'human relations' approach to supervision refers to employee-supportative and non-disciplinarian styles of leadership. See, S.W. Gellerman, *Management by Motivation*, American Management Association, 1968.

14. British Railways Board, *NEBSS, Supervisory Management Training: Stage 1*. British Railways Board, April 1981, p.14.

15. K. Thurley, 1963, op. cit.

16. See for example, R.H. Guest, *Organisation Change: The Effect of Successful Leadership*, Tavistock, 1959, pp.15-31.

Chapter 7. TOPS and The Area Freight Assistant: The Creation of a New Second-line Supervisory Job with Increased Responsibility

(i) Introduction

This chapter examines the creation of a new second-line supervisory job with increased responsibility, and details the supervisory control functions and job tasks of this new position under the routine operation of TOPS.

The first section examines the recruitment, training, and personal characteristics of Area Freight Assistants (AFAs). A brief overview of the creation of local freight centres and the emergence of the AFA is provided. The defining personal characteristics of the AFA are outlined and a typical career path to this position is described. A number of conflicting views on the abilities required of AFAs are compared, and the importance of training in supervisory and computer operating techniques is discussed. The section concludes by suggesting that the confusion which surrounds this position may be clarified from a detailed analysis of the job of the AFA at his place of work.

In the second section the job of the AFA is examined. The main emphasis of the supervisory control function associated with this position is identified, and the job of the AFA is analysed.

The chapter concludes by outlining the key attributes of this new type of senior supervisor, and assessing the degree to which computer technology may facilitate the emergence of such positions in other operating (or production) settings.

(ii) TOPS and The Position of Area Freight Assistant

(a) The Creation of Local Freight Centres and the Emergence of the Area Freight Assistant

Prior to computerisation, the position of second-line supervisor already existed in some high capacity marshalling yards. This position emerged as the result of managment's decision to introduce a telex-based information system for the control of local freight operations. The system known as Advanced Traffic Information (ATI), represented management's first attempt to devolve additional elements of control responsibility to the local level.[1]

Under ATI, the position of ATI supervisor was created and new local freight centres were erected within those marshalling yards where local freight traffic was 'sufficiently intensive'.[2] The clerical staff and ATI supervisors required to operate these new local freight centres were generally recruited from Divisional Control. Nevertheless, the ATI system did not provide accurate, comprehensive, up-to-date information on railway freight operations, and as a result, the characteristics of this technology acted as a constraint on management's attempts to devolve additional elements of operations control to the local level. In some cases, ATI supervisors were able to meet local customer demands and co-ordinate the *local* movements of freight. However, they were not able to pre-plan and arrange *trunk* freight train services.[3] It was not until the initial operation of the TOPS computer system that management's objective to devolve additional elements of freight transit control to the local level was fully realised. The TOPS computer system enabled pre-planning on a scale that was inconceivable under the traditional manual system, or the intermediary telex-based system of freight information control. The potential of the TOPS computer system for achieving one of mangement's long awaited objectives was recognised by the TOPS project manager. He advocated the need for a 'new supervisory concept' which demanded:

> A supervisor with organising ability....to act for the Area Manager round the clock over the whole area and not just over the yard in which the AFC was located. With TOPS he has the means to control the whole area, and this is how the grade of Area Freight Assistant came into being.[4]

However, this new supervisory concept has created a certain amount of confusion concerning the position of AFA. In the section which follows a number of conflicting perceptions on the nature of the AFA's role are discussed through examining the recruitment and training of AFAs.

(b) The Recruitment and Training of Area Freight Assistants: Managers, Supervisors or Clerks?

The AFA occupies a mixed managerial-supervisory position. He is concerned with planning, monitoring and correcting freight operations within a specified geographical area; namely, a TOPS Responsibility Area

(TRA). He can thus be defined as: *a second-line supervisor officially recognised by management as being in control of area freight operations.*

The defining personal characteristics of the AFA correspond to the labour-oriented type of supervisory role. According to the data AFAs:

- are predominantly of working class origin
- are recruited from the shop floor
- have knowledge based on years of practical experience
- have little formal education and training
- hold a position which represents the end of their career progression
- tend to be middle-aged

Typically, an AFA would have joined British Rail at an early age and worked his way up through the ranks. By far the most common route was via the control organisation, although interestingly, one AFA interviewed was an ex-management trainee. Unlike his colleagues he fitted more appropriately into the category of the machine-oriented type of supervisory role, this AFA:

- was of middle class origin
- was recruited as a graduate entrant
- had acquired his knowledge from formal education and 'in-house' training
- held a position which represented one stage in his career development
- was relatively young

Furthermore, when attending the TOPS computer training course another AFA graduate was interviewed who had followed a similar career path.

These two very different career paths to the position of AFA reflected strategic management's confusion over whether the job of the AFA was predominantly supervisory or managerial.[5] British Rail managers interviewed in the study were also uncertain about the nature of the job and the attributes required to make a 'good' AFA. This was particularly noticeable among area managers, who were uncertain as to whether it was the clerical aspect of the job, the operating element, or managerial decision making, that was most important. For the most part, this uncertainty stemmed from managements' confusion over what the job of the AFA actually involved. As one AFA put it:

> People don't understand now what it is, honestly, several managers have never quite grasped it and I'm not being unkind. It's just so intense a job.

Area Managers expressed a number of different views, some felt that it should remain a senior supervisor's job, others that it should be a junior management post, and one area manager felt that it should be open to senior TOPS clerks. From this diverse set of opinions, three distinct countervailing beliefs were identified: firstly, that ex-management trainees did not have enough operating experience; secondly, that yard supervisors did not have sufficient clerical experience; and thirdly, that senior TOPS clerks did not have enough experience of making decisions under pressure.

Nevertheless, there was general agreement among area managers and AFAs that the job involved elements of management decision making. This is illustrated in a typical reply made by one AFA who said:

> I've always believed that it should be a management grade and that it should have been from its earliest days. It's a very managerial job, you make endless managerial decisions....you do an awful lot of planning in the proper sense, things that actually involve a lot of people outside your own area of responsibility. I think it's much more managerial than a supervisory job and that's not trying to make more out of it than it is because I've got my feet on the ground don't worry....But the trouble is you just can't, it would unbalance the area managers organisation you see.

In addition, all the AFAs studied felt that it was important to have an understanding of the TOPS system. In fact, training in TOPS techniques was in every case evaluated as being more important to the job than general supervisory training. Typically, AFAs who had attended both the NEBSS course, and the TOPS course claimed that whilst the NEBSS course was enjoyable, the TOPS course was far more relevant to their actual job. AFAs would normally support this claim by pointing out that the job involved little, if any, elements associated with the close supervision of labour. As one AFA put it:

> The clerks that I deal with, they hardly need any supervision. They don't really, they've got their own job and they just get on with it. There is no supervision. I call it an area freight assistant, it's dealing with the freight all the time. The supervision of men comes from the yard supervision to my mind.

Interestingly, AFAs defined supervision in a fairly traditional way to refer to the face-to-face direction of staff activities, for them, the NEBSS course provided techniques for dealing with people on a face-to-face basis. Thus, as they did not view their job as involving this type of interaction, it is perhaps not suprising that only one AFA argued that the NEBSS course was 'very useful' to the job.

The TOPS training course which is available to AFAs is known as *Operating with TOPS*. The course aims to provide a detailed knowledge of the overall use of the TOPS system to senior supervisory staff. It is a one week residential course for newly appointed AFAs who have gained some appreciation of operating with the TOPS system. The working knowledge required before attending the course is documented as follows:

- an ability to operate Ventek or cardless machines
- a knowledge of train movement cycle procedures
- a knowledge of locomotive procedures
- an understanding of the basic enquiry procedures[6]

AFAs who do not have this background knowledge of TOPS are required to spend a number of weeks working within a TOPS office before attending the course.

Typically, a newly appointed AFA would spend between two to six weeks learning the job by working with an experienced colleague. Following this initial training the AFA would then be left on his own. For the most part, AFAs claimed that once a basic understanding of operating with TOPS has been acquired, the other elements of the job would normally be learnt from practical experience. As one AFA commented:

> It doesn't matter how much training you have because when you actually do the job, that's when it hits you. Because you can sit there all day with somebody and some of it's going in and some of it's going out again. When you sit there it happens, and all of a sudden you start doing it and that's when you really start to learn.

Nevertheless, AFAs who had undergone some formal TOPS training after taking up their post did generally feel that the course was useful. Results from the questionnaire administered to AFAs show that from a sample of twelve AFAs who had attended Brisith Rail TOPS courses, seven found the course 'very useful', four felt it was 'useful', and one that is was of 'minimal use'. The exceptional case who did not find the course very useful, qualified his answer by claiming that the TOPS manuals were more helpful as they enabled individuals to teach themselves at their own pace.

In summary, the interview and questionnaire data indicate that training in computer techniques is more important to the job of the AFA than general supervisory training. Consequently, although confusion over the essential attributes required of AFAs has remained unresolved, the findings from this study suggest that this may reflect local management's assumptions about the nature of supervision and the job of the AFA. The following section therefore analyses the job of the AFA under TOPS, and attempts to distill out the key requirements of this new type of computer-oriented supervisory position.

(c) The Job of the Area Freight Assistant Under TOPS

The job of the AFA involves the control and co-ordination of area freight operations. His primary aim is to ensure the efficient utilisation of resources in the provision of local and trunk freight train services. In order to achieve this objective, AFAs exploit the information generated from the TOPS computer system in assessing, planing, and co-ordinating freight train movements within their TOPS Responsibility Area (TRA). Working within a local supervisory system, he will monitor area freight operations, deal with operating contingencies, and plan the future movements of freight in close liaison with other supervisors and senior yard staff. According to the four broad types of supervisory control functions outlined in Chapter 3, the AFAs main area of concern is with the control and co-ordination of railway resources in the provision of freight train services. In short, the function of second-line supervision centres on the control of resources, within which the other three broad elements of product, labour, and machine control are but a part.

The main supervisory functions which were found to be common to all the marshalling yards studied in the control of area freight operations comprise:

- monitoring and evaluating area freight operations
- planning and directing area freight operations
- correcting and adapting area freight operations

At the beginning of the AFA's turn of duty, monitoring and evaluating area freight operations is particularly intense. Before it is possible to plan local freight movements and correct and adapt trunk freight train services, it is necessary to first evaluate the current state of area freight operations. As one AFA describing a typical day put it:

> Well you come in the office and take over from the previous AFA, who hands over to you what you can expect in the first couple of hours. You deal with incoming consists as they come in, and advise the Panel Box generally as to where to send the trains - that's the incoming trains. Then you study the print-outs from the machines and you generally get an impression of the traffic available for each of your services during the turn, and you arrange with the train crew supervisor and the control office the services which are and are not required.

Throughout his turn of duty the AFA maintains a record on:

- services which have been cancelled
- additional services which have been arranged
- local freight movements
- resource availability
- operating contingencies

This list serves as an aide-memoire during the AFA's turn of duty, and it is passed over to the relieving AFA at the end of each shift. An oral report is also given, and any problems which need immediate attention are brought to the relieving AFAs attention.

At the beginning of each shift, the AFA will make a number of computer enquiries from his terminal in the AFC. The two standard enquiries made by AFAs are known as the 'EY' and 'EJ' enquiry. These provide information on the current state of freight traffic both on hand and en route. The 'EY' enquiry provides a summary of all incoming trains and their destinations, and the 'EJ' enquiry provides a summary of all the wagons on hand and their next outbound destination. There are a number of additional computer enquiries which AFAs can make if they require information other than that provided by these standard enquiries; for example, if an AFA is worried about the supply of locomotives he could make a locomotive enquiry (known as the 'TV' enquiry). Essentially, the TOPS computer system provides the AFA with all the information he requires to make decisions on freight operations within his TRA. As one AFA typically put it:

> The first thing I do is get six or seven basic print-outs that you want, that will give you a complete picture of what you require for the TRA and the trip working. You also got notes left and

> wires saying this wants doing and that wants doing. Usually I like to have a clear idea in my mind before eight 'o' clock.

From the information generated by the TOPS computer system, the AFA will evaluate area freight operations. He will be particularly interested in finding out:

- what traffic is available for his various booked services
- what resources are available
- what traffic is coming towards him

Once the AFA has managed to gain an accurate overview of the current state of the operating system under his charge, he is then in a position to plan a programme of action and direct the future movements of freight. Monitoring and evaluating freight train services and planning a course of action, could take up to two to three hours of the AFA's turn of duty. During this time the AFA will also be directing the arrival and departure of freight train services, and dealing with any operating contingencies which may arise.

A key function of the job of the AFA is directing operations and planning the future movements of freight. The 'bible' from which the AFA operates is the Working Time Table (WTT). This lists all outbound scheduled services, all inbound scheduled services, and all those services which are scheduled to connect onto other booked freight train services. Formal alterations to the WTT are sent from regional headquarters to the AFCs in the form of weekly and daily freight train notices. This official plan of freight train services is the framework within which the AFA operates.

In the course of planning and directing area freight operations, AFAs also utilise a number of additional records, reports, and official notices. These are referred to locally as the AFA's 'boards'. It was observed that while the number of 'boards' varied between AFCs, there were a number of formal notices and daily records which were kept by all AFAs; namely:

- the freight train amendment board which listed the weekly and daily supplements to the WTT
- the engineering board which listed details of engineering work
- the freight train running board which was used by the AFA to record actual freight train running time against scheduled times
- the local trip working board which was used by the AFA to maintain a record of local freight train services

In the course of planning area freight operations, the AFA also takes into account correspondence and messages generated by the TOPS computer system.

These various records and reports provide the AFA with an overview of operations within his TRA from which he can plan the future movements of freight. By also using the information generated by the TOPS computer system the AFA is able to make 'sensible' operating decisions with regard to the cancellation and alteration of scheduled freight trains, and the running of local freight train services. In having all this information available, the AFA holds a key position in directing local freight operations, and planning and co-ordinating alterations to the WTT. This is illustrated by one AFA who described the situation as one where:

> You have to have something in mind from the outset. You have to have a feel for the fact that you will be able to run the additional service. You need to have a knowledge of the area, the people and the resources, as well as the booked services that additional trips may be arranged around, or at times replace. You need to have some general sense of what is possible and what is not possible from the outset. (AFA)

In the process of monitoring, evaluating, planning, and directing area freight operations, the AFA will therefore correct and adapt these operations to take account of any operating contingencies which may arise. The major types of unforeseen variations from the planned schedule which were identified during the research are listed in Figure 15. As discussed in Chapter 6, contingencies which occur in the yard are dealt with by the yard supervisor in liaison with the AFA; whereas, contingencies which affect the running of local and freight train services are dealt with by the AFA in liaison with other operating staff. For example, if a yard derailment affected the running of a scheduled freight train service, then the AFA would take responsibility for re-arranging services to accommodate this contingency while the yard supervisor would deal directly with the derailment in the yard.

Derailments, shortages of locomotive power and locomotive failures, were consistently cited by AFAs as the most regular type of operating contingency which they would have to deal with. Typically, AFAs would cancel services and make new arrangements for the movements of local freight traffic to accommodate these and other types of operating contingencies.

Figure 15: Railway Freight Operating Contingencies

Locomotive failure whilst in service
Shortage of locomotive power
Main line derailments
Yard derailments
Shortage of yard staff
Shortage of train crews
General shortage of wagons
Shortage of specific type of wagons
Late arrival of freight train services
Incorrect train consist
Incorrect marshalling of incoming train
Excess of mandated traffic
Signal failure
Track failure
Bad weather conditions

The breakdown of a locomotive on the main line was generally viewed as the most difficult and frustrating type of operating contingency which could arise. According to AFAs, this was because: firstly, it is necessary to use valuable resources to deal with the problem; and secondly, a main line failure makes it necessary for the AFA to re-route existing services, and alter, cancel and arrange future services. In dealing with this operating contingency the AFA will make a number of computer enquiries and plan the future movements of freight in close liaison with other operating staff. In addition, the AFA will deal with the immediate problem of clearing the main line and re-routing any services which were due to use that section of line. Thus, although there is a high degree of pre-planning in the form of the WTT, there is also a need to assess and re-plan freight train services due to the regular occurrence of operating contingencies, such as, machinery breakdowns, daily variations in the level of freight traffic, and daily fluctuations in the demand and supply of resources.

A key job task of the AFA is to exploit the information generated from the TOPS computer system, for the purpose of planning and directing these time-sensitive and interdependent cycles of freight operations in the course of dealing with any operating contingencies which may arise. As one AFA described the job when asked how much of his work he felt was routine:

> Well it's nearly all non-routine really. Alright we use those monitoring sheets but that's just to keep you fixed. You've got to have an overall plan because you could never start, you couldn't just kick-off off the top of your head.

The decision on whether to alter, cancel, or re-arrange freight train services is based on a number of operating considerations. The most important of these are: firstly, the priority of the service in question (for example, whether the traffic is mandated or not); and secondly, the consequence of change for the operating system as a whole (for example, whether, the freight traffic is due to connect with another service or whether the locomotive is allocated to run a mandated service elsewhere on the railway freight network). Such operating considerations are taken into account by AFAs in making alterations to the WTT in liaison with other operating staff. Moreover, as changes in the running of local services are less likely to affect the operating system than changes to national freight services, it is the local freight train services which are more frequently cancelled. In addition, these services are more likely to suffer from a high degree of variation due to the daily fluctuations in the demands of local customers. Consequently, local freight services are continually re-arranged to accommodate operating contingencies which serve to disrupt the running of trunk freight train services.

In dealing with unforeseen disturbances the AFA will re-plan scheduled services and plan the future movements of freight with the aim of minimising disruptions to the operating system as a whole. In this sense, the AFA attempts to steer area freight operations for the purpose of achieving optimum operating efficiency.

In making operating decisions, the AFA must be able to form a mental picture of the actual consequences of his decisions for the operating system, and estimate the time-span required for their implementation. The ability to conceptualise the practical outcome of decisions based on information provided by the TOPS computer naturally draws upon the individuals stock of knowledge and experience of railway operations. As one AFA described it:

> You need to be able to sit there and see in your minds eye what's going on everywhere at a given moment, even though you were talking about it an hour before, or even though you're talking about something now, you've got to be able to imagine how the things going to hang together in two hours time. And that involves how long it will take the engine to get from A to B, has it got to have relief, and all these multifarious little elements that are in it. I think that really to do the job well you 've got to get all those things, and that's what I call an *operating imagination*.

In the process of evaluating the information provided by the computer and translating this assessment into operating decisions, the AFA will liaise with other operating staff. He acts as a central communciations link in using the information provided by the TOPS computer system to plan and direct the efficient and safe movements of freight within his TRA. The activity of liaising and communicating with other operating staff takes up the greatest proportion of the AFA's time. This view is captured in the words of one AFA who claimed that:

> Ninety per cent of railway operations is communication and if communication falls down then the jobs not done, or done as it should be.

A considerable proportion of this time is taken up communicating with other operating staff over the telephone. Another AFA described the situation as one where:

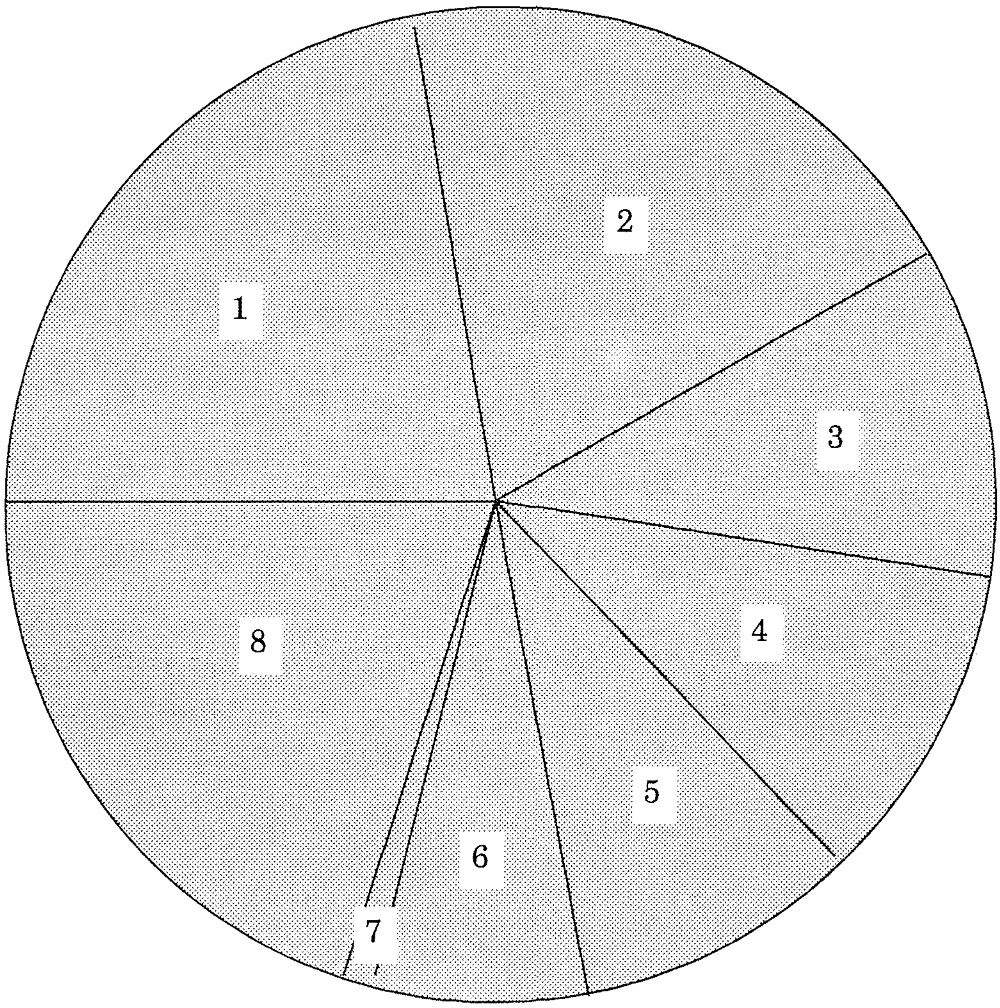
> Any of us can spend a day in the TOPS office and the phone will be incessant, it will be absolutely incessant. You can spend a twelve hour day in there like that and you'll come out and your head will be spinning.

From simply observing the work of AFAs it was not possible to discern patterns of communication. In an attempt to discover the proportion of the AFAs' time spent communicating with specific individuals a questionnaire was compiled and administered . The results are illustrated in Figure 16.

AFAs estimated that most of their time was spent communicating with their yard supervisors. However, none of the AFAs felt that it was possible to talk of a standard or regular pattern of communication. This was seen to be dependent on the number of operating contingencies and the level of freight traffic on the particular day in question. Furthermore, the high

Figure 16: Communication Patterns of Area Freight Assistants

This diagram illustrates the percentage of time taken up by AFAs communicating with other operating staff as estimated from a sample of fourteen area freight assistants.



1. yard supervisor	22%	5. other AFAs	9%
2. senior TOPS clerk	17%	6. assistant area manager	7%
3. other TOPS clerks	12%	7. area manager	1%
4. other yard staff	11%	8. others	21%

percentage recorded for 'others' indicated that certain key individuals had not been accounted for during the design of the questionnaire. From interviews and further discussions with AFAs it became apparent that they would also spend time communicating with: signal box supervisors, traction and train crew supervisors, regional and divisional controllers, and the central wagon authority. Moreover, it was discovered that the communication patterns of AFAs varied not only between differing turns, but also, between differing marshalling yards. This could be explained in terms of the location of the marshalling yard (for example, those situated near London tended to deal directly with the Central Wagon Authority), and the type of traffic being dealt with (for example, where local freight movements were fairly intense, AFAs tended to spend more of their time liaising with signal box supervisors in arranging the local movements of freight). Thus, any alterations to the WTT in the form of the cancellation of services, the re-arrangement of services, and the running of additional services, would involve liaison with other operating staff. These typically comprise some combination of the following: yard supervisors, other AFAs, signal box supervisors, traction and train crew supervisors, regional and divisional controllers, staff in outlying locations, local customers, and the Central Wagon Authority. For example, in order to arrange an additional service the AFA will need to liaise with the traction and train crew supervisor (to ensure that there are sufficient resources to run the train), signal box supervisors (so that they know when the train is going to run, from where, and where it is destined), and the receiving AFA (to ensure that he has room to accept the service). In arranging 'special' trunk services the AFA should also inform Divisional Control. However, while they are formally required to work closely with their divisional controllers they could and did discharge their responsibilities largely independently of them.

Non-participant observation of the work of AFAs proved interesting in this respect, for although they are still formally required to alter, cancel or arrange inter-area services in liaison with divisional controllers, it was observed that AFAs made these decisions without prior consultation. In consequence there was a certain amount of tension between the AFAs and the controllers. Furthermore, instances were observed where AFAs even arranged the short-haul inter-regional trips with others AFAs without liaising with either divisional or regional controls. Consequently, although Divisional Control still have official responsibility for controlling the inter-regional movements of freight, the jobs of many divisional controllers are becoming increasingly peripheral to the system of management control. As a result, AFAs are today carrying out many of the functions previously performed by divisional controllers. As one ex-controller put it:

> The only difference is that you are a controller and a supervisor at the same time, you actually see what you are doing going on, which a controller doesn't, he goes from one office to another (area freight assistant).

In short, AFAs liaise with other operating staff as required in altering scheduled booked services, and as such they act as a vital communication link in co-ordinating and controlling freight train movements.

The above analysis of the position of AFA shows how although the characteristics of AFAs generally correspond to the labour-oriented type of supervisory role, as far as the job is concerned they would be better located under a new type of supervisory position, which conforms to neither of the polar types presented in Chapter 2. Moreover, even though the AFA is more concerned with the technical (as opposed to purely labour) operations of production, his job can not be ascribed to a technical, or machine-oriented supervisory role. Consequently, he is not a 'technical expert' in the sense of having a detailed understanding of production machinery, but rather, he is an 'area operations controller' whose job is to deal with the myriad of non-routine events associated with the nature of railway freight operations. As such, he holds a pivotal position in the day-to-day control of railway freight operations.

(iii) Conclusion: Computerisation and the Emergence of a New Computer-Oriented Supervisory Role

The job of the AFA is almost entirely based on the exploitation of the real-time information made available by the TOPS computer system in the control of area freight operations. AFAs acquire information from the computer on: wagon stocks awaiting departure on scheduled outbound services from the marshalling yard; empty wagon resources on-hand; and the composition of approaching freight services. This information is used to plan the area movements of traffic in accordance with marshalling operations, which are themselves planned to meet the schedule of incoming and outbound services.

The job of the AFA can thus be described as a new computer (information) oriented type of supervisory position, involving the control and co-ordination of previously diverse areas of production operations. Moreover, in planning, monitoring and correcting area freight operations he acts as a crucial communications link within the railway freight operating system. The AFA liaises with other operating supervisors for the purpose of giving and receiving information on which day-to-day decisions can be taken on the running, cancellation, and alteration of freight train services. Any disruptions to the operating system are dealt with by the AFA as quickly and as effectively as possible. Consequently, he holds a pivotal position in the hour-by-hour management of freight operations within his TRA.

The main requirements of this new computer-oriented supervisory position are:

- an ability to acquire, understand, and utilise the information provided by computer systems
- an ability to make operating decisions on the basis of computer generated information
- an ability to conceptualise the practical consequences of decisions for the operating system as a whole
- an ability to deal with operating contingencies and minimise disturbances to the operating system as a whole
- an ability to work closely with other operating staff in the day-to-day control of production or service operations

In the British Rail case study presented here, management could have chosen to locate this new computer-oriented position within the existing control organisation, and/or accredit it with first-line managerial authority, however, they chose to create a new second-line supervisory position with increased responsibility. The possiblity for management to devolve additional elements of operations control had previously been constrained by the technical limitations of earlier information control systems (for example, ATI). However, the enabling characteristics of the TOPS computer system have provided management with the opportunity of achieving a long awaited strategic objective (namely, the centralisation and devolution of freight operations control). Moreover, the managerial decision to devolve additional elements of freight operations control to the local level was supported by individual supervisors and the two trade unions which represent supervisors and marshalling yard staff (see on this

Chapter 4). As a result, British Rail management have been able to redefine supervision in a manner which has both increased headquarter's control of freight operations and has enhanced the role played by local supervision. The role of the AFA has thus been designed explicitly to exploit the control potential of the information generated by the TOPS computer system.

Management strategy and the enabling characteristics of computer technology are crucial elements in shaping the outcome of computerisation. As this chapter has demonstrated, computer technology can be used in a manner which both increases management control and enhances local supervision through devolving additional elements of operations control to the workplace.[7] Thus, if managements choose to introduce computer technology as a means of integrating hitherto independent supervisory functions, then it is possible to envisage the creation of new computer-oriented supervisory positions, the roles of which are to control and co-ordinate previously diverse areas of production operations.

Chapter 7. Notes and References.

1. For example, initial operation of the Radyr ATI centre was achieved in October 1970, and involved the devolution of responsibility for the Cardiff valleys working from divisional control to the local marshalling yard. *Report of Documentation and Systems at Radyre ATI Centre,* BR, 1971 part II, para.7.

2. In some yards this system did allow for a degree of devolution of control from the divisional to local level, namely, in cases where the local movements of freight were regarded as being 'sufficiently intensive'. British Railways, *The ATI Investment Report*, BR, 14th-16th June 1971 para.3.3.

3. In one of the marshalling yards studied questions were asked about this telex based system of freight information control. There was general agreement among supervisors and yard staff that the system did not assist day-to-day marshalling operations due to the fact that much of the information was out-of-date. It did however, provide management with a retrospective record of local wagon movements within the yard. This point is illustrated by a chargeman in his description of ATI, this was as follows:

> A lot of the chaps never really benefited from ATI because it was not on the scale of TOPS. At that time the chargeman still had to go down and calculate the weight of the train and that sort of thing...As far as the supervisors and yard staff were concerned the ATI didn't contribute much in that respect, but it did as far as records and so were concerned. (chargeman)

For the most part, ATI was viewed by management and yard staff as one of BR's 'greatest white elephants'.

4. Arnott Report, BR, undated p.89.

5. Some writers have argued that management may attempt to redefine supervisors as first-line managers From a mangement point of view this may well be the ideal scenario in the case of the AFAs who were regarded as a 'new breed' of railway supervisor. However, up-grading to management status would have involved a loss of earning power for AFAs and would have had serious industrial relations implications.

6. British Railway Board, *TOPS Residential Courses: 1982.*, British Railway Board, 1982, Appendix.

7. A similar point is made by John Child, who suggests that centralisation and delegation should not be regarded as simple dichotomies in so far as there is a considerable choice of possibilities and variations in between. For example, delegation is not necessarily inconsistent with an increase in management control since: 'by establishing relatively independent sub-units within an organisation where middle managers and even supervisors are responsible for their own operations, delegation can result in more effective control and performance measurement. This is because separate spheres of responsibility can be identified and control systems applied to these units in order to provide more adequate feedback to higher management.' J. Child, *Organisation: A Guide to Problems and Practice.* Harper & Row, 1977, pp.119-123.

Chapter 8. Conclusion: Computer Technology and The Redefinition of Supervision

(i) Introduction

This thesis has investigated the implications of computer technology for supervision through a detailed case study of how the process of computerisation affected the roles of supervisors and the function of supervision. Previous discussions have tended to focus attention on changes in the role of the first-line supervisor and/or changes in the traditional labour control function of supervision. The general view that the application of computer technology tends to erode the importance of supervision in relation to management control needs to be treated with caution. It has been shown how present debates are hampered by conceptual weaknesses deriving from the problem of adequately defining supervisory roles and tasks. Thus, the objective of this study has been to present and analyse new empirical data on the computerisation of British Rail's system of freight information control, and in particular, on the longer term effects of computerisation on marshalling yard supervision. This was one of the first large scale applications of on-line real-time computer technology in British industry and therefore represented a pertinent case for study.

By way of conclusion this chapter will: review the debates presented in Chapter 2; examine the utility of the frameworks developed in Chapter 3; outline the main findings of the study into the process and outcome of computerisation on marshalling yard supervision; and draw some tentative conclusions on the more general policy implications of computer technology for supervision.

(ii) Pivotal or Peripheral? Computer Technology and the Role of the Supervisor

In Chapter 2, the predominant themes of the debates on the relationship between technology and supervision were outlined. The discussion focused on: firstly, the extent to which there has been a shift in supervisory emphasis and the emergence of a new 'breed' of supervisor under more technically advanced systems of production; and secondly, the degree to which the role of the supervisor has become 'pivotal' or 'peripheral' to the operation of computer-aided production systems.

Through providing an historical outline of the role of the first-line supervisor, two first-line supervisory positions were characterised. These were the traditional labour-oriented supervisor, whose primary function is to control the activities of labour by close contact, and a new machine-oriented supervisor who is concerned with the running and maintenance of 'advanced' operating systems in which technical contingencies are the prime cause of production failures. This new 'breed' of machine-oriented supervisor was shown to contrast with the traditional labour-oriented supervisor in so far as the key tasks are based on technical skill derived from extensive training rather than 'knowledge-through-experience' and an ability to oversee operatives.

When examining the alternative views on the effects of technical advance on the role of the supervisor it was shown how studies have tended to focus on either the traditional labour control function of supervision or changes in the role of the first-line supervisor. This has resulted in two apparently contradictory conclusions. Firstly, that the role of the supervisor is becoming increasingly *peripheral* to the control of production operations with advances in technology. The essential argument here is that, as more sophisticated methods of control are developed and introduced, so the pivotal position of the traditional supervisor as a managerial agent of labour control is reduced. For example, developments in systems of bureaucratic control are seen to have relieved the supervisor of the task of disciplining staff, and developments in technical control systems are seen to have incorporated the element of direction. Secondly, that there is a *pivotal* role for the supervisor under more technically complex operating systems. This pivotal position is seen to stem from the supervisor's ability to deal with technical contingencies in the daily operations of the production process, that is, the importance of 'fire-fighting' increases as the total production process becomes more complex and the tolerance for disturbances within the system is reduced.

Proponents of both views cite evidence to show how the role of the first-line supervisor and the traditional function of supervision have changed as a result of technical advance. However, by concentrating on a specific supervisory function, the former fails to account for changes in supervisory tasks; whereas by focusing on a particular organisational role, the latter fails to account for changes in supervisory roles other than at the formal first-line supervisory level. It was thus argued that, in order to fully understand the outcome of change on supervision, it is essential that supervision is not conceptualised exclusively in terms of either the role of the first-line supervisor or the traditional function of first-line supervision.

The tendency in much of the literature to sidestep the definitional problems involved in studying supervision can lead to partial and possibly misleading analyses. This tendency was shown to be particularly evident in recent studies which have examined the effects of computerisation on the organisation of work, and evaluated changes in supervision in terms of changes in the role of the first-line supervisor. For example, Buchanan and Boddy, in a recent study which described how the introduction of computer technology affected the organisational structure in six companies, claimed that supervisors are losing their skill superiority as operators gain experience with the equipment and begin to understand the interdependencies within the production system.[1] They point out that computing technologies introduce work disciplines and machine pacing independent of management objectives.[2] Finally, they suggest that as these computer systems enable management to automatically monitor production performance, it is questionable whether there is still a need for first-line supervision:

> Supervisory and lower line managment functions are eroded in three ways. First, computing technologies provide machine pacing of operations. Second, production performance information is captured and analysed automatically. Third, management lose their traditional skill superiority as operators become knowledgeable about the functioning and output of the technology.[3]

Nevertheless, the authors note that, in a plant where the first-line supervisors' roles were abolished, supervisory tasks were still being carried out by individuals not formally defined as 'supervisors'. Therefore, although recent empirical data may indicate that computer technology is posing fundamental questions about the need for first-line supervision, such evidence should not be taken as indicating an erosion of the supervisory function itself. Rather it was argued that the enhancement of some supervisory responsibilities, and the emergence of operative and management roles involving a supervisory element, indicates that computerisation involves a far more complex redefinition of the supervisory function than is implied by the apparent erosion of the role of the first-line supervisor. Consequently, it was advocated that a more differentiated conceptual framework is required to account for changes in the distribution of supervisory tasks across various levels within the organisational structure.

(iii) Reconceptualising Supervision

In order to take account of the way in which supervisory functions are redefined with the introduction of computer technology, supervision was broadly conceptualised as the *direct control of workplace operations*. The supervisory control functions which were identified are:

- planning and directing workplace operations
- monitoring and evaluating workplace operations
- correcting and adapting workplace operations

It is not sufficient to identify supervisors on the basis of their formal job titles, as a number of the supervisory job tasks outlined above are likely to be the concern of individuals holding a range of differing job titles. Therefore it was argued that supervisors should be identified according to the criteria that: firstly, individuals are in direct control of some aspects of day-to-day production operations; and secondly, that authority is invested in their position by management and/or the workforce. By using these criteria it was shown how a structure of supervision comprising a hierarchy of supervisory roles can be identified. The actual number of supervisory levels will vary both between and within organisations. However, for practical purposes a four-level classification of types of supervisory roles was employed. Operatives at the bottom of the hierarchy with supervisory responsibilities and recognised authority were identified as 'working supervisors' (level 1). At the second level, individuals with responsibility over a small section of their own, and/or acting as a deputy/assistant to level 3 supervisors were labelled 'deputy supervisors'. Level 3 comprised 'first-line supervisors'. Finally, individuals who may have formal managerial status and yet are to varying degrees regularly and directly participating in planning, monitoring, evaluating and regulating workplace operations were classified as 'senior supervisors' (level 4).

This stratum of supervisory roles is situated between management and the workforce. They constitute a 'structure of supervision' and form a distinct part of a management control structure in the direct control of workplace operations. At the apex of the hierarchy are individuals who hold 'mixed' managerial-supervisory roles. These individuals can be distinguished from management according to the criterion that they are *directly* involved in the day-to-day control problems of an operating system. At the bottom of the supervisory hierarchy are individuals who are afforded authority by their work group, and are performing supervisory tasks; they hold 'mixed' supervisory-operative roles. Between these two types is a 'pure' type of supervisory role occupied by individuals who are formally recognised as being involved in the control of production operations. In addition, it was shown how the concept of a 'supervisory system of control' developed by Thurley and Wirdenius can usefully be employed in analysing the day-to-day liaison and interaction of individuals concerned with various aspects associated with the control function of supervision.[4] Moreover, it was also illustrated how changes in supervision should be explained within the context of changes in work organisation and the system of management control.

This is particularly important in examining the relationships between *computer technology and supervision.* For example, studies which focus on the 'pure' role of the first-line supervisor do not take into account changes in the distribution of supervisory tasks across various organisational levels. This narrow approach to an examination of supervision has led many commentators to conclude that computerisation will erode supervisory tasks through enabling: the centralisation of the control function of supervision at a higher level of management; the devolution of the control function of supervision to a lower level of operative; and the abolition of the control function of supervision by its incorporation into computerised systems of production. However, computer technology can also be used to enhance supervisory positions and create new supervisory tasks. For example, an important element in the relationship between supervision and management is the degree to which the two activities are integrated. That is, the extent to which the control of production operations by management is linked to and co-ordinated with, the direct control exercised by supervisors. The significance of the application of computer technology rests on the fact that it offers a means of increasing management control by enabling the provision of faster and more precise knowledge about operating conditions, and thereby reducing the scope for indeterminacy in the behaviour of employees, and unifying previously segmented control systems. In the case of British Rail, computer technology allowed for a more integrated system of management control through enabling the devolution of operations control from middle management to the local supervisory level. This exemplifies the need for a more differentiated conceptual framework to explain changes in the distribution of supervisory tasks across various organisational levels within the context of changes in work organisation and the system of management control.

Finally, it was suggested that the term 'supervisory span of control' should be reconceptualised to extend beyond traditional concerns of direct supervision and leadership of subordinates to cover some or all aspects of the production or operating system. In this sense, it is better to regard supervisory tasks as those concerned with the direct control of production operations more broadly conceived. Defined in this way, supervision is not exclusively concerned with labour control tasks, rather, it involves responsibilities for controlling a range of elements of production, such as controlling material resources, monitoring operating conditions and product/service quality, and taking corrective action when operating contingencies occur. Consequently, this broader concept of supervisory control was utilised in an examination of both changes to individual supervisory roles and changes in the span of control of supervisory systems taken as a whole.

(iv) The Introduction of a Computerised Freight Information System in British Rail

The process of computerisation, from the intial decision to invest in computer technology through to the routine operation of a stable system, can often span several years. Therefore, in examining the process and outcome of computerisation, it makes considerable sense to use the variable of technology in order to identify differing stages prior to computerisation, and during the conception, execution, and conclusion of that process. By doing this, it is possible to identify the major factors influencing the process of computerisation at various discrete stages during the introduction of computer technology. The four stages which were identified for analysing the process of computerisation comprised:

- the decision to introduce
- the choice and design of the system
- implementation and initial operation
- routine operation

The decision to introduce a computerised system of freight information control was taken at senior management level. The strategic intentions behind computerisation comprised various 'business market', 'operating', 'product', and 'cost' objectives. These in turn were influenced by the opportunities offered by computer-based technologies and the nature of railway freight operations. Thus, the availability of computer information systems that were applicable to railway operations provided British Rail management with an opportunity to improve the operating efficiency and competitiveness of rail freight vis a vis road transport.

The decision to introduce the TOPS computer system was based upon: the specific recommendations of the 1971/75 Freight Plan; the capacity of the TOPS computer system to provide 'real-time' information on the disposition and status of freight resources; the availability of the TOPS computer system as a developed operational and commercially successful system; the absence elsewhere of any similar system at the same stage of development or with the same capabilities.

The design of the system involved: the extensive modification of the original TOPS software to suit British Rail's requirements; the enhancement of British Rail's telecommunications network to cope with the TOPS data transmission requirements; the construction of a new computer centre at British Rail headquarters and the employment of specialist staff; the deployment of TOPS clerks at outlying Area Freight Centres (AFC's), and the creation of a new senior supervisory position to exploit the information generated by TOPS.

Following the decision to computerise, and the choice and design of the computer system, British Rail management set about transforming the largely labour based system of freight information control. This was achieved by a TOPS implementation team which adopted a 'task force' approach during the implementation and initial operation of the TOPS computer system. The success of management's implementation strategy is demonstrated by the transformation in managerial and operating practices that was achieved. Despite the continued persistence of some elements of the traditional hierarchical mechanisms for management control, the parochial ethos of the local 'railway bailiwick' has been diminished. Local railway operating cultures are no longer rooted in the territorial rights which accompanied the manual system of management control, rather, computerisation has brought about a re-orientation of local operating decisions which now require a broader and less parochial awareness of the requirements of the railway freight operating system.

The significance of the 'task force' approach to implementation lies in the fact that it provided the means by which management could introduce radical changes in operating practices and control structures (that is, a new railway operating culture) which involved this transformation of traditional perspectives and practices based on the local area, to a wider concept of the operating system based on the information provided by the TOPS computer system.

The conclusions drawn from this study illustrate the importance of strategic choices made by senior management in shaping the organisational outcome of change. What is theoretically interesting about the strategic choices made in the case of the TOPS computer system, is the way in which management's implementation strategy was specifically designed to override resistance inherent in the traditional organisational culture and structure of the railway industry. The creation of a cross-functional autonomous project team was instrumental in creating a 'culture of change' which challenged traditional beliefs and practices and enabled the mobilisation of key organisational interests. This strategy proved particularly effective in gaining support from trade union leaders and senior management. This support was in turn influenced by the growing concern over the decline in railway freight traffic caused by changes in external business market activity. Computerisation was thus seen to offer a possible solution to an ailing freight business with the consequent benefits of improved market competitiveness for British Rail's freight train services.

(v) Computerisation and Marshalling Yard Supervision

In examining the relationship between computer technology and supervision, a number of factors were identifed which required empirical investigation in order to explain the manner in which computerisation resulted in a redefinition of marshalling yard supervision. As already noted, it is important to identify changes to individual supervisory roles, both formally and informally defined, and changes to the supervisory system itself and its relationship to management control and work organisation. In this respect the role of management choice in redefining supervision was significant and therefore management's strategy behind the introduction of a computerised freight information system was analysed. This raised the important question of the role of technology in the process of redefinition. The findings reported here, suggest that it is not determinate, but at the same time it does have enabling characteristics which shape the process of redefinition. In the case of the TOPS computer system these are as follows: accurate 'real-time' information is available to headquarters management at national and regional levels enabling them to monitor operating conditions and performance at remote locations; reports made from local level via the remote terminals in the Area Freight Centres (AFCs) are automatically cross-checked and validated by the computer to prevent 'corruption' of its data base by the storage of inaccurate or invalid information; and finally, the daily distribution of empty wagon resources is accomplished automatically by the computer which allocates each individual wagon a new destination immediately it is reported 'empty'.

Management's strategy in exploiting the enabling characteristics of the computer technology involved a re-organisation of its system for controlling freight operations. The new information flows and communication channels provided by the computer obviated the need for a hierarchical reporting and command structure. Information about operating conditions and performance at remote locations was now immediately available to headquarters management. Moreover, access to the real-time data base maintained by the computer was also available at local level. This meant that much of the decision-making responsibility exercised at divisional level for local freight operations could be delegated to the point at which the operations occurred. Management's objective was thus to centralise overall operations control at headquarters level whilst delegating local decision-making responsibility to the new AFCs.

Whilst the availability of real-time information has enhanced the role of local management and supervision in controlling ground level operations, it has also made their activities far more open to senior management control. The area manager of a principal marshalling yard in South Wales summed up the managerial implications of TOPS as follows:

> There's one very big 'disadvantage' of TOPS...and that is they can monitor the area manager...Sir Peter Parker if he wishes can press a few buttons and he can say: 'Christ! There's been twelve wagons at yard x now for fourteen days, what's the area manager doing about that.'...We've created a 'Big Brother' effect, now everyday's an 'open day', everybody knows what we're doing.

However another emphasised the interdependence between management levels that the system created as a means of improving freight operations control:

> It's become much more of a two-way feed because I can tell the divisional manager what my problems are and he can see that...In the past if some thing was going wrong you might think: 'well I don't tell those buggers at division or they'll be down on us like a ton of bricks'. Today, you know they know, and they know you know they know! You tend to get a better team approach to sorting something out.

The management control of freight operations can now be accomplished at local area and headquarters level without the need for any detailed involvement by Divisional Control. The movements of freight within local areas is now arranged by the AFCs and not by Divisional Control. The automatic distribution of empty wagons brought about by information from the computer has eliminated the need for Divisional Control to act as an intermediary between the Central Wagon Authority (CWA) and the local area in the co-ordination of wagon movements. Finally, the real-time information on the location and status of locomotives allows for a more centralised control of locomotive allocation and maintenance, further reducing the role of Divisional Control.

The delegation of control has resulted in a redefinition and expansion in the span of control of local supervisory systems. On the basis of TOPS generated information railway freight supervisors are now able to control and co-ordinate freight operations over a wider geographical area and arrange additional services in liaison with other operating staff. The availability of information on the future movements of freight has also made it possible to pre-plan marshalling yard operations to accommodate alterations to the Working Time Table. Finally, the TOPS computer system has enabled local supervisors to deal more effectively with daily operating contingencies through providing information on the disposition of resources over the entire rail network.

The individuals who comprise this new supervisory system are as follows:

- *senior supervisors* (area freight assistants) responsible for the control of area freight operations and the running of local freight train services
- *formally defined first-line supervisors* (yard supervisors) responsible for the day-to-day control of freight operations within the separate yards which make up a marshalling yard

- *deputy supervisors* (chargemen) responsible for the control of freight train movements into and out of the yard, and for overseeing yard operations in the absence of a yard supervisor
- *working supervisors* (head shunters) responsible for the control of marshalling activities within sub-sections of the yard

The individuals holding these positions work together on common problems in the direct control of area freight operations, and are now more fully integrated into the wider system of management control.

British Rails decision to create a new type of 'mixed' managerial-supervisory position - the Area Freight Assistant (AFA) - to exploit the information made available by the TOPS computer system has resulted in a substantial transformation in the function of local supervision. From making a few simple TOPS enquiries AFAs are able to acquire accurate real-time information on both the disposition of freight resources within their TOPS Responsibility Area (TRA) and on the composition of approaching freight traffic. This information is used to make daily operating decisions on the running and cancellation of freight services. With TOPS, it is thus AFAs (rather than divisional controllers) who occupy pivotal positions in the day-to-day control of area freight operations.

The characteristics of a typical AFA conforms to the labour-oriented type of supervisory role. For the most part, AFAs would have worked their way up through the ranks (from under shunter to senior supervisor), and would have acquired a detailed knowledge of railway freight operations. However, the job of the AFA is not comparable to either labour-oriented or machine-oriented supervision. Rather, they represent a new type of computer-oriented supervisor whose position has emerged as a result of British Rail's decision to computerise their system of freight information control and devolve additional elements of control to the local level.

In the case of the yard supervisor, the autonomy and control previously associated with this position has been reduced. Prior to computerisation yard supervisors would initiate the running and cancellation of freight trains in liaison with divisional controllers (paradoxically, although the Divisional Control organisation had overall decision making responsibility, effective decision-making depended upon the accuracy of yard supervisors' reports about current operating circumstances). Under the routine operation of TOPS, it is now the job of the AFA to initiate alterations to scheduled rail freight services. Furthermore, yard supervisors no longer need to spend the first hour of each turn of duty taking stock of the wagons in the yard and telephoning the details to Divisional Control. Any wagon movements into and out of the yard are immediately reported to the TOPS computer via terminals in the local AFCs. By recording every wagon movement, the TOPS computer system is able to maintain a continuously up-dated picture on what is in the yard, what is due to arrive in the yard, and what is due to depart from the yard. In automatically generating routing information for the distribution of empty wagons over the entire rail network, the TOPS computer system has also obviated the need for yard supervisors to hoard and over-order empty wagons to meet variable customer demands.

Nevertheless, these changes have not led to a simple erosion of the role of the first-line supervisor. Yard supervisors have redefined their roles as 'fire-fighters' in dealing with railway operating contingencies such as, yard derailments, shortages of staff, and late arrival of connecting services. Moreover, the introduction of the TOPS computer system is seen to have reinforced their role through creating additional contingencies such as, TOPS list delays and incorrect TOPS information. Consequently, although computerisation has eroded many of the traditional tasks of first-line supervision, yard supervisors did not feel threatened by this change, and have redefined their roles as contingency men in dealing with unforeseen events and operating contingencies common to the nature of marshalling yard operations.

Computerisation has reduced the accumulated knowledge and experience previously required of chargemen in making daily operating decisions on the formation of freight trains. They no longer need to check manually that the total brakeforce of outbound freight train services conforms to British Rail's rules and regulations, as the TOPS computer system automatically validates correct train formations. The main duties of the chargeman are to ensure the safe movements of all freight trains on their arrival and departure from the yard, and to deputise in the absense of the yard supervisor. Nevertheless, although the chargeman's traditional knowledge of railway operations has become redundant, they maintain an important role in motivating yard staff and overseeing yard operations.

A similar erosion of the need for traditional marshalling yard skills has occurred with the position of head shunter. A detailed knowledge of railway geography is no longer used in the marshalling of outbound freight train servies. The TOPS computer sytem automatically generates a sorting code which details the required formation of trains prior to their departure from the yard. However, although the *marshalling* of wagons is now determined by a TOPS computer printout, head shunters have maintained decision-making responsibility over the yard placement of inbound freight wagons (the *shunting* of wagons). Consequently, management's strategic objective to control shunting operations through the implementation of the TOPS Allocation Program has not been successful (this program cannot adequately deal with the continual adjustments required of a localised road plan allocation of wagons).

The introduction of a computerised system of freight information control has eroded many of the traditional tasks associated with marshalling yard supervision. Nevertheless, the displacement of traditional marshalling yard skills has not resulted in a simple erosion of supervisory roles and functions. While some supervisory tasks have been eroded and replaced, others have been created and enhanced. This has resulted in a complex redefinition of supervisory functions which currently comprise a mixture of traditional tasks and new computer based activities.

(vi) Computer Technology and The Redefinition of Supervision

This thesis has critically examined the redefinition of supervision both during the process of computerisation and under the routine operation of a computer-based operating system. The main 'internal' factors which were identified as shaping the process and outcome of change are as follows:

- management strategy
- the enabling characteristics of the technology
- the nature of the operating system
- occupational and employee response

All these internal factors were in turn shaped by various 'external' social, political and business-economic influences, in particular, pressure on the product market and the overall state of technological developments in the late 1960s.

The significance of these factors varied at different stages during the process of computerisation. For example, the decision to introduce computer technology was influenced by: British Rail's declining business market position; the obvious inefficiencies in the manual system of freight operations control; and senior management's observation that computerisation could improve the system of freight operations control and hence, stem the loss-making trend and make possible an expansion in British Rail's share of the freight market. Furthermore, the choice and design of the computer system was influenced by the availability of computer information systems, and their applicability to railway freight operations, in which the effective control of resources rests to a large extent on the availability and accuracy of information about empty wagons and the movement and composition of freight trains. However, in common with other research, it was found that during these stages there was no trade union or local operating staff involvement.[5]

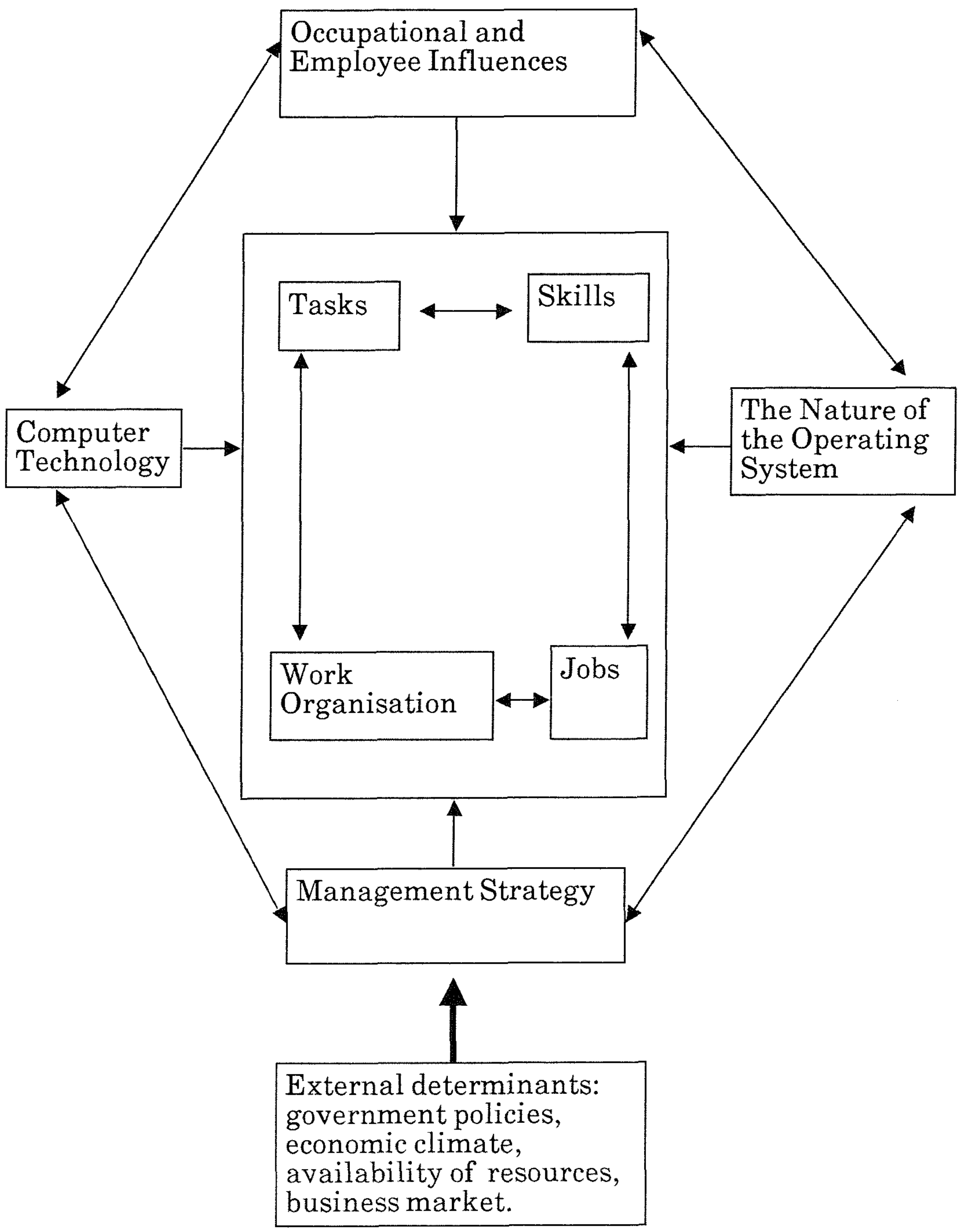
Once the decision to computerise had been made and the system chosen, external determinants no longer played such an important part in the process of computerisation. There were three variables of particular significance in shaping the process of change during the implementation and initial operation of the TOPS computer system. Firstly, the characteristics of the TOPS computer system, which provided management with the possibility of achieving a long awaited strategic objective, namely, the centralisation and devolution of freight operations control. Secondly, management strategy (British Rail's 'task force' approach proved instrumental in circumventing organisational procedures and practices likely to disrupt their implementation programme). Thirdly, national trade union support which facilitated the smoothing over of localised pockets of resistance, that is, the managerial decision to devolve additional elements of freight operations control to the local level was supported by individual supervisors and the two trade unions which represent supervisors and marshalling yard staff. These three factors were in turn influenced by the nature of the operating system and British Rail's freight market position vis-a-vis the road haulage industry. For example, the co-operative response of the railway unions to computerisation can in part be explained by their attitude towards the consequence of a failure to adopt the new technology as a means of improving operational efficiency.

Under the routine operation of the TOPS computer system, it was the responses of individuals working within new operating environments which served to influence the final process of change in redefining and establishing new working practices. This indicates the important influence which employees may have after the implementation and intitial operation of computer technology.

The empirical case study reported in this thesis demonstrates how management strategy, technology, occupational and employee response and the nature of the operating system, in addition to various external determinants of change, do not have equal explanatory significance at each stage during the process of computerisation. Consequently, these variables need to be examined empirically in order to evaluate their significance in redefining supervision in relation to work organisation and the system of management control in different production environments. Nevertheless, they do provide a useful guide to those factors which should be taken into account in any analysis of the process and outcome of computerisation within existing organisations. Moreover, it is possible to abstract at a very general level those factors which are likely to be most pertinent in shaping the process of computerisation in a range of differing organisations (see Figure 17).

In general, the decision to computerise and the choice and design of the technology will be influenced by managements' strategic objectives, the state of the business market, and the availability and applicability of computer information systems to particular operating systems. During the implementation and initial operation of computer technology, business market considerations are likely to decline in significance, whereas, occupational and employee concerns are likely to increase in importance and influence the outcome of managements' strategic objectives behind the introduction of computer technology. Finally, under the routine operation of computer-based operating systems, occupational and employee responses will further serve to shape the operational use made of the computer system. At this stage employees and occupational groups will finally adapt to change, and in the process, they are likely to redefine the consequence of change for their positions within the new organisation structures and operating practices imposed by management during the initial operation of the new computer-based operating system. In short, external factors will tend to decrease in importance at each successive stage in the process of change, whereas occupational and employee influences will tend to become more significant towards the final stages of change. Finally, it is worth restating that although it is possible to generalise about the relative importance of a range of variables in shaping the process of

Figure 17: Factors Influencing Computerisation within Organisations



computerisation within existing organisations, these variables need to be examined empirically in order to evaluate their true significance in different operating environments.

(vii) The Policy Implications of Computer Technology for Supervision

The converging developments in computing, telecommunications and microelectronics has produced a new technology which is likely to challenge hierarchical control structures and transform existing systems of management control. A number of choices are open to managements in the organisational design of new computer-based operating systems. In the case of British Rail, senior management developed a strategy for redefining supervision in a manner which both increased headquarter's control of freight operations and enhanced the role played by local supervisors. The availability of up-to-date accurate information about local operations enabled a centralisation of overall control at regional and national headquarters, and a devolution of responsibility for day-to-day decisions to local areas from divisional level. The findings from this study illustrate how management strategies for introducing computer information systems do not involve a simple choice between the centralisation or delegation of control. Rather, it has been shown how centralisation and delegation are not simple dichotomies and that in the context of computerisation the de-centralisation of decisions to supervisory roles is not inconsistent with an increase in management control. The implications of computer technology for supervision cannot therefore be adequately expressed in terms of a choice for management over the need or otherwise for first-line supervision.

The choice open to organisational practitioners are far broader than recent studies would tend to suggest. To understand this, supervision needs to be seen as a system of control comprised of a number of supervisory roles, formally and informally defined, and concerned not just with the direct control of labour but with the day-to-day control of production operations as a whole. There may be options open to management which involve the erosion of some or all aspects of supervisory tasks and roles but other choices will involve the opportunity to create new roles based on the exploitation of the control potential of the new technology. The result therefore may be a strategy which aims at an integration of local supervisory functions into management control systems.

The precise form of organisational arrangements that might arise from the pursuit of such strategies are of course likely to be shaped and mediated by a number of situational factors. In the case investigated here, management chose to create a new supervisory role, and expand the span of control of local supervisory systems. The role of the area freight assistant was designed explicitly to exploit the control potential of the new information that was made available by the computer. Thus, whilst the basis of the supervisor's autonomy within the marshalling yard prior to computerisation was eroded, the overall effect was to integrate supervision into the management control stystem by creating a new supervisory role responsible for area freight operations.

The emergence of a new type of computer-oriented supervisor indicates the possibility for management to integrate previously fragmented supervisory functions through the application of computer technology to the production process. Moreover, the strategy developed by management was based on the application of a large mainframe computer system. It is quite plausible that the enabling characteristics of more recent mini-computer and micro-computing systems would allow the distribution of processing capabilities to remote locations (either as sub-systems linked to a central mainframe or as modular alternatives to centralised computer systems) which might further enhance operations control by delegating more responsibility to local operating sites. If such strategies were adopted then it is possible to envisage the more widespread existence of this new type of supervisory role. Whilst it is only possible to speculate about the main characteristics of a variety of computer-oriented supervisory positions across organisations, this study has demonstrated how such individuals are likely to require a range of abilities centred around the task of exploiting computer generated information. Among others, this is likely to involve the following: an ability to acquire, understand, and utilise the information provided by computer systems; an ability to make operating decisions on the basis of computer generated information; an ability to conceptualise the practical consequences of decisions for the operating system as a whole; an ability to deal with operating contingencies and minimise disturbances; and an ability to work closely with other operating staff in the day-to-day control of production or service operations.

In the case of British Rail, this new type of supervisor has been placed within the traditional supervisory career structure, and hence, supervisors have tended to take-up these positions in order to gain promotion to a higher supervisory level. However, although their backgrounds resemble those of the labour-oriented type of supervisor, this should not be taken to indicate the general direction of future developments. It is equally plausible to envisage the emergence of computer-oriented supervisors where machine-oriented supervisors currently exist. Thus, only in the long-term would it be possible to outline the key characteristics of this type of supervisor were they to emerge across a number of different organisations. The very existence of this new type of supervisory position raises a number of interesting questions, for example: would the creation of computer-oriented positions in other industries differ from the type examined in British Rail, or does the emergence of this new supervisory position (whose job is to exploit computer generated data) signal the possible convergence in the general function of supervision across different industries?

For the moment these questions cannot be answered. Nevertheless, if management decide to introduce computer technology as a means of integrating hitherto independent supervisory functions, then it is possible to envisage the creation of new computer-oriented supervisory positions, whose role is to control and co-ordinate previously diverse areas of production or service operations. It is also plausible to suggest that these supervisors will exhibit characteristics which contrast with both labour-oriented and machine-oriented supervisors, and hence, represent a new 'breed' of supervisor.

Chapter 8. Notes and References

1. D. Buchanan, and D. Boddy, (editors), *Organisations in the Computer Age: Technological Imperatives and Strategic Choice*, Gower, 1983, p.237.

2. Op. cit., p.248.

3. Op. cit., p.249.

4. K.E. Thurley, and H. Wirdenius, *Supervision a Reappraisal,* Heinemann, 1973, pp.27-29.

5. See for example, B. Wilkinson, *The Shop Floor Politics of New Technology*, Heinemann 1983a.

Appendices

These appendices contain the following:

Appendix I: The TOPS Computer System. This appendix provides a description of the TOPS computer system. It has been created by the author from observation notes, interview data and documentary material obtained from British Rail.

Appendix II: Research Design and Methods. This appendix provides an outline of the research strategy and methods used in the empirical case study. It has been created from the records kept by the author during the study.

Appendix III: Interview Schedules. This appendix details the interview schedules designed and used by the author in collecting interview data.

Appendix IV: Supervisor's Questionnaire. A copy of the questionnaire designed and used by the author in the study of railway freight supervisors is provided in this appendix.

Appendix V: Marshalling Yard Staff Job Descriptions. This appendix consists of British Rail job descriptions of marshalling yard staff.

Appendix I: The TOPS Computer System

This appendix provides a detailed description of the operating procedures of the TOPS computer system.

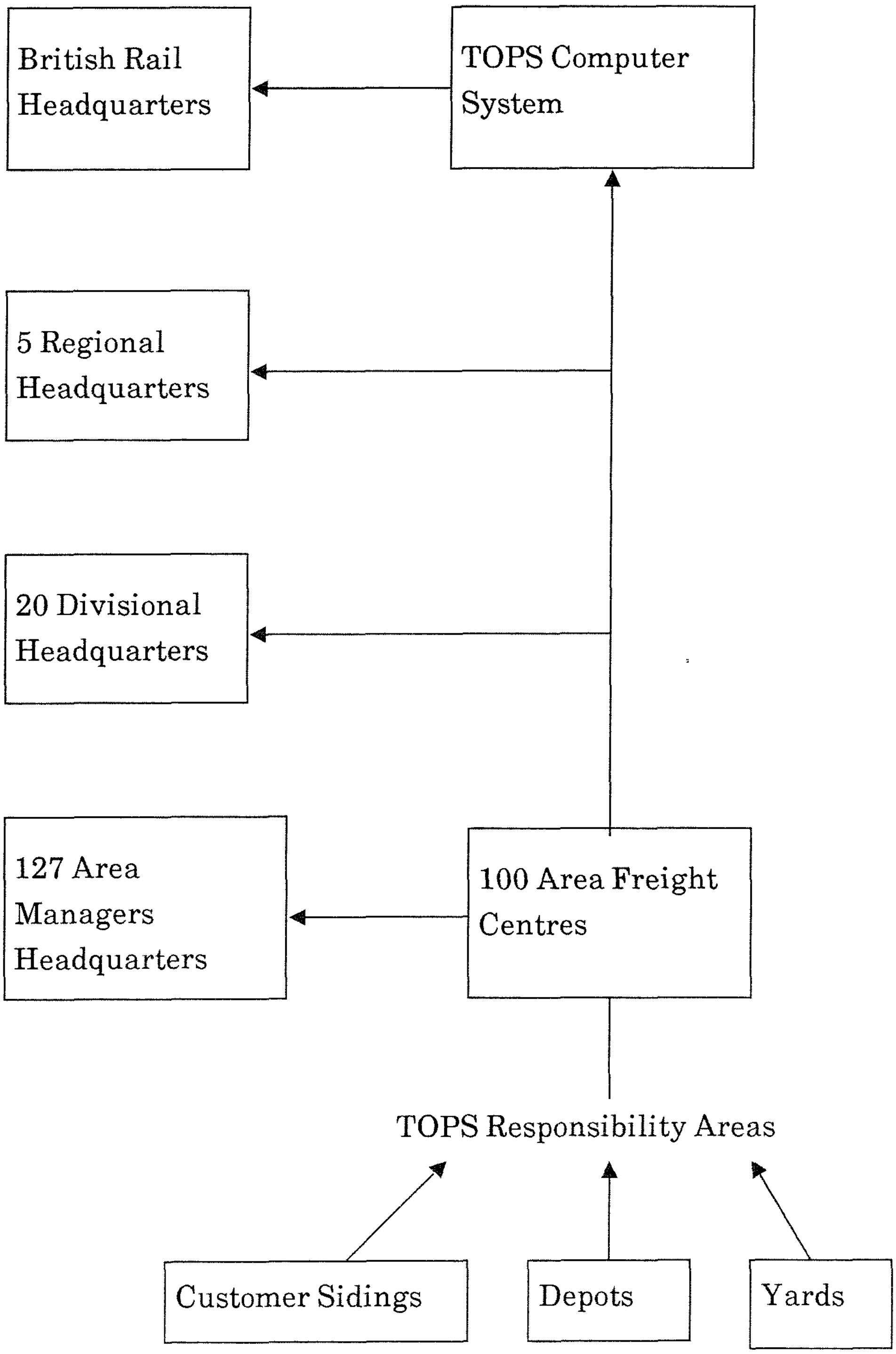
(i) Area Freight Centres (AFC's)

The main reporting points for all activities required to be known by TOPS are Area Freight Centres (AFC's), originally called TOPS offices (their title changed when it was realised that there was a need for an Area Freight Assistant (AFA) to be in proximity to local freight operations where the TOPS computer information was available).

In 1984, there were approximately 100 AFC's acting as 'data traps' for information from 5000 individual locations (in 1975 there were 152 AFC's, and by 1979 this figure had been reduced to 138). Each AFC is responsible for collating and reporting events at all locations within its specified TOPS Responsibility Area (TRA) to a central computer (see Figure 18). The original criterion for setting up a TRA was the number of services and the number of wagons that could be expected to pass through and be dealt with within certain geographical areas. For example, if a designated area was expected to deal with more than 6,000 wagons then a TRA/AFC would be set up. In other words, the dimensions of each TRA were judged by the level of freight activity and the number of reportable events to TOPS - initially the British Rail Board estimated the need for 180 TRA's, today this figure has dropped to around a 100.

Each AFC is normally staffed by an AFA and a number of TOPS clerks who are responsible for reporting TOPS information by entering data on mini-computer terminals which are linked to a central computer. In addition to the latter hardware, each AFC contains: telephones; two-way radios; facsimile transmitters/receivers; and at least one off-line terminal. At each location where an event occurs (knowledge of which is required by TOPS), the staff concerned (guards, shunters, supervisors) report details to the AFC for input to the central computer. In this way the central computer is able to keep on its files a continuously updated 'real-time' picture of the location and disposition of the wagon and locomotive fleets throughout the entire rail freight network.

Figure 18: TOPS Reporting Structure



Source: McLoughlin, Smith and Dawson, 1983, p.41.

(ii) The TOPS Computer System

The TOPS computer system consists of two IBM computers located at Blandford House, London. The on-line computer receives reports from the AFC's and the Central Processing Unit (CPU) then processes this information in order to maintain a picture of the disposition of the wagon and locomotive fleets (see Figure 19). The off-line computer acts as a backup to the on-line computer, and provides the processing power for TOPS off-line data bases generated from historical records of events reported to the on-line computer (that is, rather than providing a 'snapshot' of the freight railway at a particular moment in time, the off-line data show how this picture has changed over a given period).

The flow of data to and from the computer is always through the adjacent Communication Data Control (CDC) centre. The CDC office has an important role in ensuring that the data presented to the computer is in as reliable a form as possible. The principle objectives of the CDC are:

- to control, monitor and test transmission lines working between the remote data terminals and the central computer
- to act as an 'interface' for the assembly of the data lines into a configuration acceptable to the computer

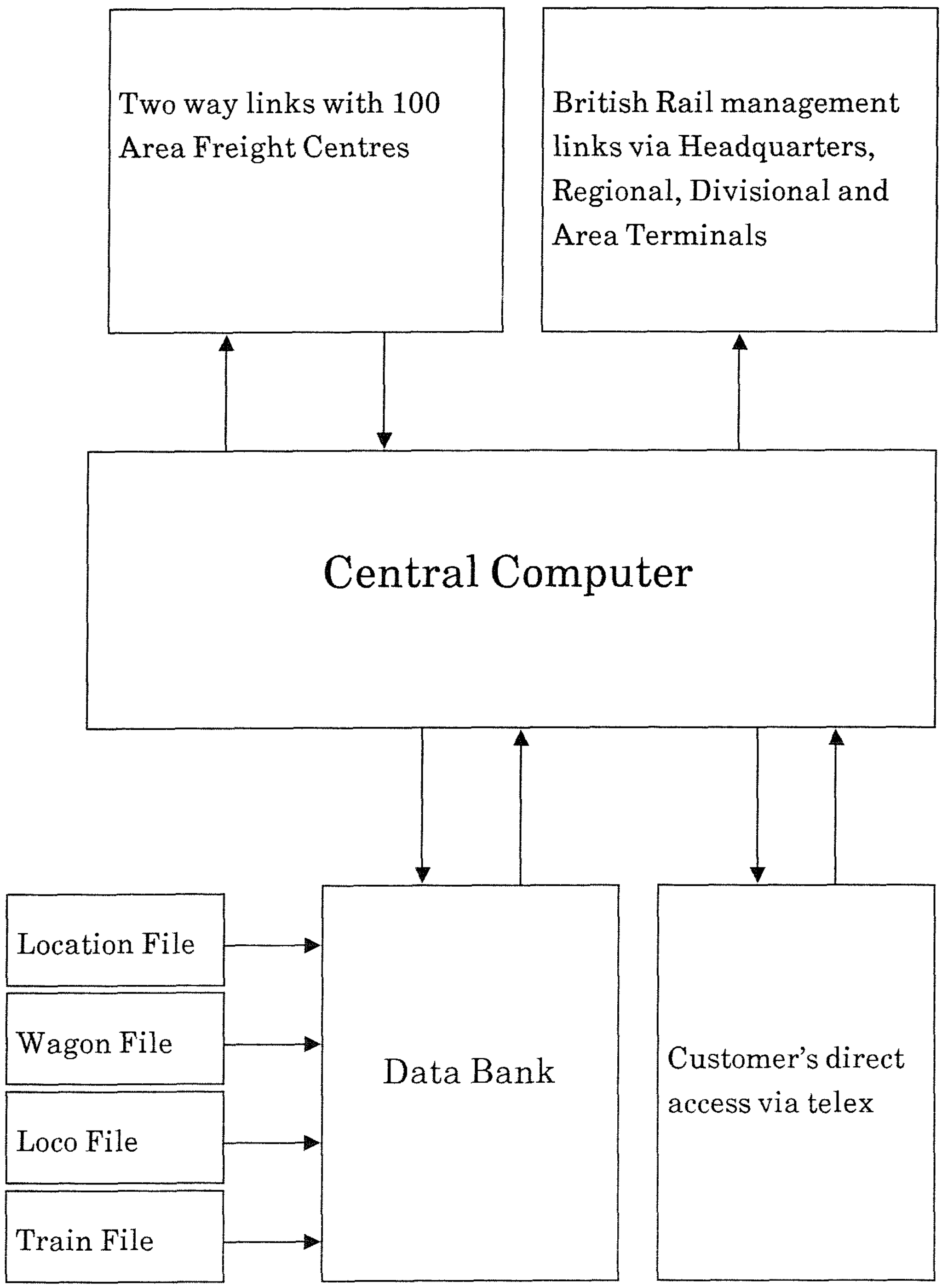
CDC has recently amalgamated with TOPS On-Line Control (TOC), which was originally set up as the first line of contact should there be problems for the TOPS clerks at the outlying locations (AFC's). This group had an important role to play in debugging during implementation and initial operation of the system.

The TOPS computer system is what has become known as a 'three partition system', consisting of a:

- Message Control Job (MCJ)
- Message Edit Job (MEJ)
- Message Processing Job (MPJ)

The MCJ consists of programs which handle the disciplines necessary to determine whether field terminals have a message to send. It also keeps account of which messages belong to which terminals. The MEJ provides the necessary format check to ensure that all messages are understandable (message validation) and acceptable to the computer. The MPJ is by far the largest and most complicated element within the TOPS computer system,

Figure 19: Central Computer Links



using more than half the capacity of the CPU. The MPJ: calculates addresses; moves information; ensures that no messages are missed or lost; processes every message to completion; and provides its own backup and recovery on TOPS computer information.

All the information reported to the on-line computer is stored on eight Dynamic Data Files and the information that is 'bled-off' to the off-line computer is stored on four Journal Files (see Figure 20).

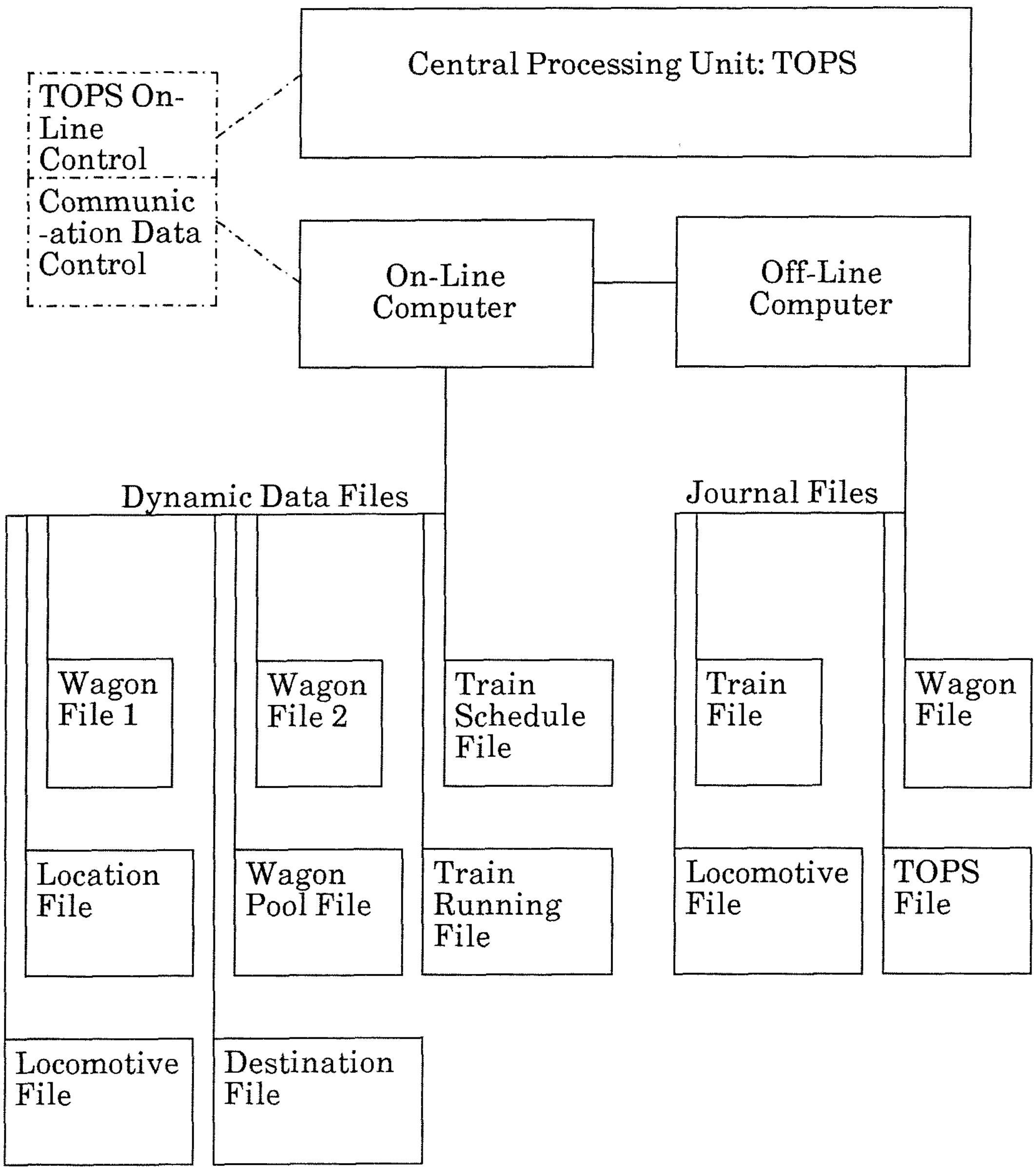
(a) Dynamic Data Files

The information stored on the Dynamic Data Files (DDF's) provide continuously updated information on the status and location of wagons and locomotives and the running of freight trains, as well as details on the characteristics of each individual wagon and locomotive, and the freight train working timetable. The individual files contain the following information:

Wagon File:- this file contains detailed information on every British Rail wagon (each wagon is provided with a unique five-digit number), which includes information on: the maximum speed at which the wagon can go, the type of wagon (including brake type); the 'present' and/or 'next' destination of the wagon; and the status of the wagon (that is: whether it is loaded or unloaded; whether it is in transit or not; and whether it is in need of repair). Furthermore, each wagon is identified by a unique six figure code and wagon initial (this indicates the designation of the wagon, for example, whether the wagon is privately owned, a British Rail freight wagon, or an engineers wagon). These wagon number are displayed on the side of each wagon to aid visual inspection (for example, designation B, wagon number 248572).

Locomotive File:- this file contains detailed information on the characteristics of each individual locomotive as well as its location. In addition, a record is kept of each locomotive's service hours, and the computer automatically calls locomotives for maintenance at required service intervals. Locomotives are identified by a unique five digit code, which is displayed on the side of all electric and diesel units (for example, 56458, indicating that it is a class 56 locomotive, sub-type 458).

Figure 20: Total Operations Processing System



Location File:- every TOPS location (sidings, depots, marshalling yards), is identified by a unique five digit location number, according to its location within a TOPS Responsibility Area (TRA). For example, the number 43212, where the first two digits indicate that the location is TRA number 43 (which happens to be the Stoke TRA), the third digit signifies the section of line within the TRA, and the last two digits indicate each particular individual location (in this case a siding within the Stoke TRA). Location numbers are arranged geographically, 01 identifying Perth TRA in Scotland, and 89 Dover TRA in Kent.

Train Schedule File:- this file contains the paths of all booked freight and parcels trains scheduled to run throughout British Rail on any particular day.

Train Running File:- this file contains details of the actual running of trains on the railway network on a particular day. The computer is able to check by referring to the train schedule file whether a train reported as running is a schedules service. It is also able to compare the actual running of freight trains with the static plan in the schedule file. Each train is identified by five alpha-numeric characters. For example, the code 6M26M represents the following: 6 signifies the classification of the train; M the regional destination of the train; 26 is the individual train number; and M is the expectancy of the train (that is, whether the train is mandatory or conditional). This example shows the identification code of the 1805 St. Blazey to Stoke indicating that this is a class 6 service (slow freight), whose destination, Stoke, is in the London Midland Region, the train reporting number is 26, and the train is a scheduled mandatory service.

Destination File:- this file contains information on the correct routes which wagons for particular destinations should follow. When a wagon is made available for movement it is automatically assigned a *tag number*. This is a three position alpha-numeric code which indicates the correct wagon routing through TRAs to eventual destination.

(b) Journal Files

The information stored on the Journal Files is 'bled-off' onto the off-line computer at the end of each 24 hour period from the 'on-line' DDFs. This data can then be processed to provide historical records of TOPS events. For example: the movements of a particular wagon over a given period; the running of a particular service; or the performance of a particular yard or loading point. The Journal Files are therefore management information data bases and comprise:

Wagon File:- this file provides information on wagon utilisation. For example, the number of wagons loaded/unloaded by location and by wagon group, and a wagon loading summary, (including the percentage of wagons loaded in comparison to the percentage ordered). In addition, the file provides detailed wagon histories on request; for example, on all the reported activities of specific wagons over a given period.

Locomotive File:- this file provides data on the utilisation and maintenance records of each locomotive.

Train File:- this file contains data on train performance, which includes: the punctuality of freight train services; and the cancellation of scheduled trains.

TOPS File:- this file contains data on the utilisation of the TOPS computer system and can monitor the workloads of a given TOPS unit or particular AFC (data on the performance of each input terminal is also available, and in theory, through identification by job names that of individual TOPS clerks, although this latter facility is not used on a systematic basis).

(iii) Automatic Empty Wagon Distribution

The processing capacity of the TOPS computer makes it possible to carry out most of the daily distribution of empty wagons automatically, The basic elements of the distribution system are 'Demand Units' (DUs) of which there are over 300, comprising large single customers, or groups of small customers. Each DU is supplied by the computer with a constant flow of empty wagons, based upon the DU's daily average requirement or Movement Instruction (MI). The supply of empty wagons (or 'pipeline'), is furnished from a predefined catchment area, whereby when a wagon of the required type is released in this area it is automatically allocated by the computer through the tag system to fill the DU's MI. When the MI is filled the computer automatically cuts off the supply of empty wagons to the DU and allocates released empty wagons to another DU or pools them as surplus.

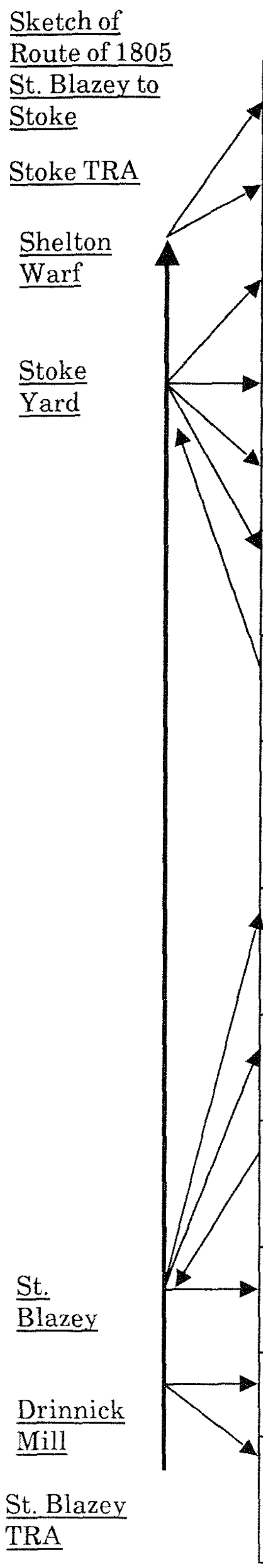
The Central Wagon Authority (CWA) at British Rail Board Headquarters monitors this process through the Daily Distribution Report (DDR), which is a TOPS printout giving the supply situation at each DU. When the flow of wagons indicate a shortage or surplus to a DU, CWA staff can make adjustments to the MI's on TOPS terminals. In this way manual intervention in the distribution and flow of wagons is confined to making adjustments to compensate for unusual fluctuations in the demand and supply of empty wagons.

(iv) Operating Procedures

The on-line files are constantly updated as events at ground level occur and are reported to AFCs. The most important series of events is the 'Train Movement Cycle', whereby a loaded wagon is despatched by a customer from a siding to a main marshalling yard, where it is attached to a trunk train bound for the main yard in the TRA for which the wagon is destined for unloading. To illustrate this cycle of events and the TOPS procedures that are followed in order to update the computer's files an actual example of the movement of China Clay traffic from Cornwall to the potteries is presented schematically in Figure 21. Wagon number B 49858 is loaded with China Clay at Drinnick Mill, location number 85220 in St. Blazey TRA, for unloading at Shelton Wharf, location number 43213, in Stoke TRA. The wagon makes the journey from St. Blazey to Stoke on the scheduled service (the 1805 train) between the TRAs (train number 6M26M).

The following procedures would be undertaken by the TOPS clerks to report changes to the computer in the wagon's status and location as it makes this journey. The *release* procedure notifies that wagon B498585 status has changed from *inposition* (that is, loading/unloading) to *normal* (that is, available to move). The *transfer origin/destination* procedures report the wagon's movement on a local trip from the siding at Drinnick Mill to the main marshalling yard at St. Blazey. On *release* the wagon is allocated a *tag* number which indicates its next marshalling yard beyond St. Blazey and its destination within that TRA (in this case the tag is 43T). The *train call* procedure is an 'unsolicited output' from the computer informing St. Blazey AFC, one hour before departure is due, that the 1805 to Stoke is scheduled to run. Yard staff report the marshalled order of the wagons for the train to the TOPS clerks who input the information to the

Figure 21: Train Movement Cycle (adapted from BRB documents)



TOPS Procedure	Report Input/Unsolicited Output
Status	Wagon No. B498585 status changed from *normal* to *inposition* (ie. ready to unload).
Transfer Destination	Wagon arrives at local siding, Shelton Warf 43213, and location changed from 43220.
Transfer Origin	Wagons marshalled according to *tag* No. in Stoke yard and despatched to unloading point.
Loco Work Performed	Arrival of booked loco confirmed (any change notified).
Work Performed	Arrival of booked wagons confirmed (any change notified).
Arrival	Train arrival at St. Blazey reported (if late coded reason given). Wagon location changed from 6M26 to Stoke yard 43220.
Consist Output	Consist of approaching train automatically triggered at Stoke AFC by input of departure and consist by St. Blazey AFC.
Departure	Departure reported by St. Blazey AFC of train No. 6M26 (coded reason given if late). Output of consist triggered at next calling point.
Loco Consist	Details of hauling loco, allocated by Power Control, input with details of where to be detached.
Consist Input	Marshalled order of all wagons on train input to computer. Location of wagons changed from 85220 to 6M26.
Train Call	Train No. 6M26 automatically called by CPU from data on train schedule file, one hour before booked departure time.
Transfer Destination	Wagon arrives at St. Blazey yard for marshalling on the trunk train. Location changed from 85412 to 85220.
Transfer Origin	Wagon despatched from local siding 85412 to marshalling yard at St. Blazey 85220.
Release	Loading of wagon No. B498585 completed and now ready to move. Status changed from *inposition* to *normal*.

← Computer Outputs → Reports to Computer ↑ Train Route computer as a wagon *consist* listing the numbers. weights and commodities of the wagons making up the train. Wagon B498585's location is changed from Stoke Yard, 43213, to train 6M26. In addition, details of the hauling locomotive are supplied by the control organisation and the *loco consist* for the 1805 input. The *departure* procedure reports the actual time the train leaves St. Blazey giving a coded reason if late. On receiving this information the computer automatically outputs the full *consist* of the train in the AFC at the next booked calling point, which in this case is Stoke yard, location number 43220.

In this way the yard supervisor at the receiving yard is able to plan yard operations according to the traffic which is approaching the yard. Arrival of the 1805 is reported by Stoke AFC together with confirmation of the wagon and locomotive consists (work performed and locomotive work performed) and details of any unbooked changes enroute. The *transfer origin/destination* procedures report the movement of wagon B498585 from Stoke yard to its unloading point at the customer siding at Shelton Wharf, location number 43213. On arrival at the siding the wagon's status is changed from *normal* to *inposition.*

(v) Marshalling Yard Operations

An important element in the train movement cycle is the actual marshalling of trains themselves. In the example above this occurred at two points, first at St. Blazey Yard where the wagons were prepared for the out-going trunk service to Stoke, and then at Stoke Yard where the incoming train was 'broken down' and its wagons allocated to their specific destinations. The cycle of events for the outgoing service would have been as follows:

1. the computer informs AFC at St. Blazey the the 1805 service to Stoke is due to run, one hour prior to scheduled departure time. This is known as the *train call.*

2. the yard supervisor consults the head shunter about the formation of the train ensuring the traffic for the train is marshalled. A provisional *trainlist* (detailing the wagon numbers, commodities, weights, and order on the train) is sent to the head shunter (usually by facsimile transmission), and the train is checked and any alterations reported to the AFC.

3. The revised *trainlist* is sent back to the yard and the yard supervisor checks that the train's formation conforms with British Rail Board's rules and regulations (the computer will automatically reject a train list which details an illegal train formation).

4. The locomotive is transferred from the locomotive shed or sidings and coupled to the wagons.

5. The train is now formed and the guard is given the trainlist to physically check that the train consist is as stated. The guard is also responsible for checking wagon couplings and brake-pipes and then completes a *driver's slip* which has information concerning total brake force, tonnage, train length and the maximum speed at which the train is allowed to travel.

6. Once the train is checked it is allowed to leave the siding and proceed to the departure roads.

7. The yard supervisor or chargeman will inform the local signalbox of the train's headcode, and then the signal box takes responsibility for the main line movement of the train.

8. Departure is reported to TOPS and the train consist output at the AFC at the next calling point, in this case the AFC in Stoke yard.

The cycle of events for the incoming service would have been as follows:

1. The consist of the incoming train is transmitted to Stoke AFC (*consist output*) on departure from St. Blazey. The consist is then passed to the AFA who decides where in the yard the train should be sent, and informs the local signalbox of his decision.

2. The consist is then passed to the TOPS clerk responsible for that section of the yard who forwards a *shunt list* to the yard staff by facsimile link.

3. On arrival of the train at the yard, the yard supervisor informs the AFC (to report to TOPS) and the traction and train crew supervisor (on destination of locomotive). The train is then checked by yard staff against the shuntlist and if any discrepancies are found the list is returned to the TOPS office and a new one forwarded. Finally, the train

is signalled into a siding, the engine uncoupled and the wagon brake pipes released.

4. The yard supervisor decides which 'pilot' (that is, shunting engine and staff) is to shunt the train, and the head shunter is advised that shunting can proceed.

5. The head shunter marks off the 'cuts' he intends to make on the shunt list according to the *tag* numbers of the wagons, and sends the list to the AFC by facsimile link. The TOPS clerk updates the information on wagon location in the yard (that is, as the wagons will be after shunting).

6. After shunting is completed the order and location of the wagons are checked by yard staff to ensure this tallies with information given to TOPS.

Appendix II: Research Design and Methods.

This appendix outlines the research design and methods of both the retrospective study of management strategy and industrial relations issues in the implementation of the TOPS computer system, and the more detailed study of the effects of computerisation on local supervision based in railway marshalling yards.

(i) The Study of the Implementation of the TOPS Computer System

The fieldwork for the retrospective study of the implementation of the TOPS computer system was conducted between October 1981 and the summer of 1982. The research comprised the following methods and sources of data:

- a series of familiarisation visits and periods of observations at British Rail installations (for example, freight yard and customer terminals, British Rail Board and regional headquarters, regional control offices, and British Rail training schools)

- a programme of interviews with 'key informants' involved in the implementation of the system including: the British Rail chief executive; the project manager; the implementation team manager; computing and telecommunications specialists; various members of the implementation team; and members of the freight operations department currently using the system at area and headquarters levels

- a search of documents and files held by British Rail Board relating to the implementation and enhancement of the system (these included a detailed report prepared by the project manager on the implementation of the system)

- a search of files held by the rail unions and discussions with their research departments

(ii) <u>The Study of Marshalling Yard Supervision Under the Routine Operation of the TOPS Computer System</u>

The study of the effects of computerisation on local supervision was initiated by Professor J.H. Smith of the New Technology Research Group. On the 8th March 1982, a letter was sent to A. Kentridge (Director of Strategic Studies, British Railways Board), outlining the terms of reference and requirements of a study on the impact of the TOPS computer system on local supervision. This letter is docummented below:

Dear Arnold,

When members of the group visited you at Rail House on the 26th February the question was raised of the possibility of one of our research students carrying out a study of supervision in a Marshalling Yard. There are two principal grounds for such a request. One is the general importance of issues of supervision and technical change in each of our present case studies: Patrick Dawson will be responsible for developing this comparative aspect in his work for his thesis. A second reason is the necessity, in appraising the implementation of the TOPS programme, for first hand information about the roles of supervisors at ground level: in particular in Marshalling yards. In asking for permission for Patrick to undertake this work we are looking for an opportunity to advance both our general interest in the study of technological change and your specific concern with the reasons for the success of the TOPS programme.

We suggest the following as Terms of Reference for Patrick Dawson's work:

"to make an overall appraisal of the effect of TOPS on roles of supervisors at ground level in particular in Marshalling Yards by:

(i) gaining an appreciation of the role of supervision at ground level and the impact of TOPS on this

(ii) examining the use of TOPS by Area Freight Assistants and Area Supervisors

(iii) following the effect of TOPS on supervisory decisions made at ground level."

We estimate that the study will require a period of 2-3 weeks in at least two Marshalling Yards: the methods to be used would be observation of Yard operators and interviews with Area Freight Assistants, Yard Supervisors, Chargeman, Area Managers and Operations Assistants.

If you are able to accept this proposal in principle it would be helpful to have some suggestions as to possible sites and also opportunities for initial briefing sessions. It would be convenient if this could be done directly between Ian McLoughlin and Neil Butters.

I think the point was made to you on the 26th February that it would be desirable for this study to be underway as soon as possible and I hope that we may be able to have a definite commitment from you in the very near future.

With best wishes, yours sincerely,

Professor J.H. Smith.

The study commenced in two traditional marshalling yards in one British Rail region. This research was intended to provide data for a comparative analysis of changes in supervision in British Rail Marshalling Yards and British Telecom telephone exchanges. However, the quality of the empirical data suggested that it would be more fruitful to focus on the British Rail case study and examine a number of other marshalling yards in different British Rail regions. This also made considerable sense in terms of resource commitments, as there were already two Research Fellows working full-time on the British Telecom study. In short, it was felt that a more detailed examination of marshalling yard supervision would provide a rich source of empirical data and further the New Technology Research Group's objective of providing case study analyses of the effects of new technology on the workplace.

By September 1983, the study had investigated five traditional marshalling yards in three British Rail regions. A summary of the locations visited and examined during the course of the research are listed in Table I.

During the study, interviews were conducted with a number of British Rail staff at: national and regional headquarters; training centres; and marshalling yards. These are listed in Tables II, III, and IV. Table V gives a more detailed breakdown of marshalling yard staff interviewed by grade and yard over the total number of staff in each of the five yards examined.

The interview schedules covered topics such as job content, working and personal relationships with other supervisors, management and yard staff, and the way these had been changed by computerisation. The main schedules used during the course of the research are documented in Appendix III.

The supervisors' interviews were supported by questionnaires which were personally administered to supervisory staff. Questionnaires were completed by fourteen senior supervisors and ten first-line supervisors from a sample taken from five marshalling yards and two supervisory training centers. A copy of the questionnaire has been reproduced in Appendix IV.

Table I: Summary of Fieldwork

November 1981	Training Centre A
December 1981	Marshalling Yard E
February 1982	British Railways Board Headquarters
February 1982	Marshalling Yard F
April 1982	Regional Headquarters A
May 1982	Marshalling Yard C
May 1982	Marshalling Yard G
May 1982	Marshalling Yard H
June 1982	Regional Headquarters A
June 1982	Freightliner Yard A
June 1982	Marshalling Yard A
October 1982	Marshalling Yard D
November 1982	Training Centre A
November 1982	Marshalling Yard B
November 1982	Marshalling Yard C
January 1983	Training Centre B
August 1983	Marshalling Yard E
September 1983	Marshalling Yard E
November 1983	Melbourne Marshalling Yard
November 1983	New Zealand Railways

Table II: Total Number of Interviews with British Rail Staff.

Headquarters Management	4
Training Centre Tutors	4
Local Managers	10
Senior Supervisors	15
First-line Supervisors	25
Deputy Supervisors	12
Working Supervisors	10

Table III: Number of Interviews with British Rail Staff in Five Traditional Marshalling Yards.

Local Managers	10
Senior Supervisors	12
First-line Supervisors	17
Deputy Supervisors	12
Working Supervisors	10

Table IV: Number of Interviews at Two Supervisory Training Centres.

Tutors	4
Senior Supervisors	3
First-line Supervisors	8

Table V: Number of Interviews with Freight Operations Staff over the Total Number of Staff by Supervisory Type and Yard

Marshalling Yard Staff	Marshalling Yards A	B	C	D	E
Local Managers Interviewed	2	2	2	2	2
Number of Local Managers	2	3	2	2	2
Senior Supervisors Interviewed	3	4	4	1	0
Number of Senior Supervisors	3	5	4	1	0
First-line Supervisors Interviewed	3	2	8	2	2
Number of First-line Supervisors	3	2	9	3	2
Deputy Supervisors Interviewed	2	2	6	1	2
Number of Deputy Supervisors	5	11	12	3	3
Working Supervisors Interviewed	1	1	6	1	1
Number of Working Supervisors	10	17	18	5	6

A detailed programme of observation was conducted in each of the five marshalling yards. This involved spending periods from 2 to 5 weeks in each yard and attending full 10 hour day and night shifts with supervisors and shunting 'gangs'. Periods of observation would typically involve the author observing and informally discussing the work of marshalling yard staff throughout a shift, this included: attending with yard supervisors any contingencies in yard operations; observing the use of the computer system in making operating decisions; and following the work of yard staff and the movements of freight between the different sub-yards which make up a marshalling yard. Local documentary material was also collected which included job descriptions of marshalling yard staff (see Appendix V); this information was supplemented by documentary material from national and regional headquarters.

The observation notes collected during the study were used to validate much of the data collected during the semi-structured interviews. The procedure adopted was to transcribe the interviews, develop from them a series of themes (e.g. job tasks, job satisfaction, management, the use of TOPS) and sub-themes (e.g. direct supervision of staff, contingencies, communication patterns), and then write them up as annotated 'summaries'. The evidence and findings contained in the summaries were subsequently cross-checked and validated with the material contained in the observation notes (amounting to around forty pages per yard) prior to being used in the body of the dissertation.

The data collected from the five marshalling yards has for the most part been amalgamated and treated as a whole. As has been stressed throughout, the main objective of the thesis has been to evaluate the effects of computerisation on the supervisory system of control in marshalling yards, rather than to explain the differences in the tasks and jobs of individual supervisors. In this respect, the findings showed a remarkable degree of standardisation across all five marshalling yards following the introduction of TOPS. However, as was pointed out on page 183 and shown by the observation notes cited on pages 157-158, the incidence and type of individual contingencies arising, for example, during an eight hour shift of an individual AFA, could vary significantly. The author has a large number of examples from observation notes similar to that printed on pages 157-158 which demonstrate this. It is hoped to make some of these examples available in published form in the future.

Appendix III: Interview Schedules

1. Supervisor's Interview Schedule

A. Career.

Why did you decide to join British Rail?

Were there any other jobs that you considered?

What made you seek promotion to your present position?

Do you intend going for promotion in the future?

Could you give a brief summary of your career in British Rail?

- position, location, dates

B.Job Tasks and Work Organisation.

As a supervisor do you feel that you have too much, about right, or too little:

- freedom of action
- responsibility
- authority

Could you describe your basic duties and responsibilities as a supervisor?

Could you briefly describe the work involved in a typical day/week?

What do you feel is the most important job task that you perform?

- how much time does this involve

Looking at your job overall, can you estimate what percentage of your time in an average week is spent:

- supervising staff
- dealing with contingencies
- other

What are the main reasons for having contact with yard staff?

Do you feel that the job of the supervisor has changed with the introduction of the TOPS computer system?

- what was it like before

- what changes have occurred
- has it made the supervisor's job easier/harder? In what way?

C. Training.

What type of training did you receive when you first took up your present position?

- length & type of training,
- whether: local, self-instruction, or formal course

Have you ever had any general supervisory training?

- when was that
- how useful was it
- evaluation: need more/less

Have you been trained in the use of the TOPS computer system?

- when
- type of course, length of training
- adequacy of training

5. Do you feel that you have received: too much, about right, or not enough training in the use of the computer system?

- why is that (e.g. training programme too short/long, course too complex/simple)

D. Job Satisfaction.

What do you like/dislike about your work?

- pay
- job security
- opportunity for exercising autonomy/management control
- variety of job tasks
- dealing with variations and unforseen events
- making decisions
- working with other supervisors, yard staff, managers

In your opinion, what are the key areas in which improvements could be made?

Could you briefly discuss any aspects about your job which you feel should be carried out by someone else?

- type of task(s)

- why, by whom

Do you feel that there is anything that the supervisor should be doing which at present he doesn't do?

Do you feel that the introduction of computer technology has made your job: more satisfying, less satisfying, or has it remained about the same?

E. Computerisation and Industrial Relations.

Are you in a union?

- (if no) why, nature of reason/objection
- date joined union
- reasons for joining

How do you feel about the way the national implementation of the computer system was handled by management?

- local level

How do you feel about the way the national implementation of the computer system was handled by the trade unions?

- local level

What are your own personal views on modernisation and the railways?

F. Personal Details.

- age
- position
- grade
- place of birth
- marital status
- occupation of father/mother/spouse
- previous employment

2. Yard Staff Interview Schedule

A. Career.

Why did you decide to join British Rail?

Were there any other jobs that you considered?

What made you seek promotion to your present position?

Do you intend going for promotion in the future?

Could you give a brief summary of your career in British Rail?

- position, location, dates

B.Job Tasks and Work Organisation.

As a chargeman/head shunter/shunter do you feel that you have too much, about right, or too little:

- freedom of action?
- responsibility?
- authority?

Could you describe your basic duties and responsibilities as a chargeman/head shunter/shunter?

Could you briefly describe the work involved in a typical day/week?

What do you feel is the most important job task that you perform?

- how much time does this involve

Looking at your job overall, can you estimate what percentage of your time in an average week is spent planning and supervising the work of others?

Do you feel that the job of the chargeman/head shunter/shunter has changed with the introduction of the TOPS computer system?

- what was it like before
- what changes have occurred
- has it made the job easier/harder, in what way

C. Supervision

How much contact do you have with your supervisor?

How much say does he have over your work?

Do you feel that supervisors have an important role to play in the running of the yard?

Do you feel that the job of the supervisor has changed with the introduction of the TOPS computer system?

What do you feel are the qualities needed to make a good supervisor?

What kind of relationship do you have with your supervisor?

- how important is it to have a good relationship
- are supervisor's generally a help or a hinderance

D. Training.

What type of training did you receive when you first took up your present position?

- length & type of training,
- whether: local, self-instruction, or formal course

E. Job Satisfaction.

What do you like/dislike about your work?

- pay
- job security
- variety of job tasks
- making decisions
- working with other yard staff, supervisors

In your opinion, what are the key areas in which improvements could be made?

Could you briefly discuss any aspects about your job which you feel should be carried out by someone else?

- type of task(s)
- why, by whom

Do you feel that there is anything that the chargeman/head shunter/shunter should be doing which at present he doesn't do?

Do you feel that the introduction of computer technology has made your job: more satisfying, less satisfying, or has it remained about the same?

F. Computerisation and Industrial Relations.

Are you in a union?

- (if no) why, nature of reason/objection
- when did you join the union?
- why did you join the union?

How do you feel about the way the national implementation of the computer system was handled by management?

- local level

How do you feel about the way the national implementation of the computer system was handled by the trade unions?

- local level

What are your own personal views on modernisation and the railways?

F. Personal Details.

- age
- position
- grade
- place of birth
- marital status
- occupation of father/mother/spouse
- previous employment

3. Training Tutor's Interview Schedule

A. History of the School

When was the school set up?

How many teaching staff are there employed at the school?

What is the annual intake of supervisors?

What percentage of these are:

- yard supervisors
- area freight assistants

What region(s) does the school deal with?

B. NEBSS Course

What are the main aims of the course?

- stage 1
- stage 2

- stage 3
- stage 4

How far do you feel that the BR course differs from other industrial NEBSS courses?

Do you feel that there are certain common aspects about the role of the supervisor common throughout different industries?

Do you feel that there are certain common aspects about the role of the supervisor within BR.

How far does the course attempt to deal with the particular problems associated with being a yard supervisor/area freight assistant?

C. Selection Process

Who decides which supervisor should attend the course?

- on what criteria does selection take place

How involved do management get in the progress of their supervisors?

- whilst on the course
- after completing the course

In general, do you feel that management take enough interest in the training of their supervisors?

D. Completion Rates and Feedback

What percentage of your initial intake of students usually complete all four stages?

What are the main reasons why some students decide to finish after stage two?

- disinterested in study
- feel that course is not relevant to actual job
- inability to continue (staff shortage/domestic reasons)

How much feed back to you receive from students after completion of the course?

E. Effectiveness of NEBBS Training

How difficult do you feel it is to assess the effectiveness of NEBSS training?

Is it possible to assess the effectiveness of NEBSS training in relation to the job of marshalling yard supervisors?

Which group of supervisors (if any in particular) do you feel are likely to gain the most from undergoing NEBSS training?

How adequate do you feel supervisory training is in BR?

F. Training

What are your views on training in BR in general?

What (if any) are you views on training for marshalling yard supervisors?

Do you feel that marshalling yard supervisors receive enough supervisory training?

Are there any other comments which you would like to make which have not already been mentioned?

3.Management Interviews

These were predominately unstructured interviews. Local managers were asked questions which included:

- purpose and success of creating AFA
- job of AFA
- promotion to AFA
- problems of getting yard supervisors to adapt to using TOPS computer system
- levels of responsibility for decision making
- levels of responsibility in relation to the interrogation of TOPS
- frequency and levels of training
- local management policy with respect to the organisation and operation of marshalling yards

Appendix IV: Supervisor's Questionnaire.

PATRICK DAWSON, a student of Southampton University, is currently carrying out a research project into *Computer Technology and Supervision*. Your assistance in completing the following questionnaire would be gratefully appreciated. All information received will be treated in the strictest confidence.

A. Personal Details.

1. Present job title:

2. Present grade:

3. Age:

B. Career.

1. Jobs held in BR (please give grades, location and approximate dates where possible).

2. Could you please indicate which of the following factors did or did not influence you in seeking promotion to your present post:

(a) Better basic pay
(b) Better earnings
(c) Increased reponsibility
(d) Greater freedom within the job
(e) A sense of achievement
(f) Better working hours
(g) The need for a change
(h) Other factors (please specify)

C. Training

1. Have you attended any of the NEBBS course? (if yes indicate the *date*, *stage*, and *location* of the various courses attended)

2. As a supervisor, do you feel that the NEBBS course(s) have been:

(a) Very useful
(b) Useful
(c) Of minimal use
(d) Of no use at all

3. Have you had any formal TOPS training? (if yes indicate the *date*, *title*, and *location* of the course)

4. As a supervisor, do you feel that TOPS training has been:

(a) Very useful
(b) Useful
(c) Of minimal use
(d) Of no use at all

Additional comments?

5. Have you received any other training in relation to TOPS? (if yes, explain and give dates)

6. Please list any other training courses attended during you employment with BR

7. Could you please list in the space provided any other formal qualifications (e.g. C.S.E.s, 'O' levels, City and Guilds, et cetera)?

D. Work Organisation and the Job of the Supervisor.

1. As a supervisor how many people are you responsible for?

2. What is the job title and grade of *your* direct superior?

3. What is the job title and grade of *your* immediate subordinate?

4. What are the average weekly hours that you work?

5.1. Who decides when you work?
5.2. Who decides the number of hours that you work?

6. *Area Freight Assistants answer this question*: looking at your job overall, can you estimate what percentage of your time in an average week is spent dealing with the following people?

6.1. You Area Manager
6.2. Your immediate superior (as in qestion 2)
6.3. Other AFAs
6.4. Yard Supervisors
6.5. Your immediate subordinate (as in question3)
6.6. Your shift leader
6.7. Other TOPS clerks

6.8. Other Yard Staff

7. *Yard Supervisors answer this question*: looking at your job overall, can you estimate what percentage of your time in an average week is spent dealing with the following people?

7.1. Your Area Manager
7.2. Your immediate superior (as in question 2)
7.3. Your AFA
7.4. Other Yard Supervisors
7.5. Your immediate subordinate (as in question3)
7.6. Head shunters
7.7. Other Yard Staff
7.8. TOPS clerks

8. Looking at your job overall, can you estimate what percentage of your time in an average week is taken up by the following:

8.1. Allocating work
8.2. Doing paper work
8.3. Communicating over the phone
8.4. Face-to-face communication
8.5. Directly supervising your staff
8.6. Appraising your staff
8.7. Arranging unscheduled services
8.8. Free time
8.9. Other

9.1. What would you say are the most common types of unforseen events/emergencies that you have to deal with in your present job? (Could you also please indicate approximately how often they occur, e.g. daily, weekly, et cetera).
9.2. Which of the above is the most difficult to deal with?

10. As a supervisor, do you see yourself as being part of: (a) management, (b) the operating workforce, (c) somewhere in between, or (d) not in any of these?

11. Do you feel that your immediate supervisor consults you: (a) too often, (b) about right, or (c) too little?

12. In general, do you think that managers in BR consult supervisors: (a) too often, (b) about right, or (c) too little?

13. Do you feel that you have (a) too much, (b) about right, or (c) too little of the following in repect to your job?

13.1. Freedom of action
13.2. Responsibility
13.3. Authority

14. Do you feel able to safely delegate responsibility to your immediate subordinate? (if answer *no* please go to question 16).

15. How useful is it for you to know that you have a subordinate to whom you can safely delegate reponsibility? Is it:

(a) Very useful
(b) Useful
(c) Of minimal use
(d) Of no use at all

Additional comments?

16.1. Could you please indicate the typical types of supervisory duties that would be carried out by your subordinate in an average week?

16.2. Could you please estimate what percentage of your immediate subordinates time in an average week is spent doing supervisory duties?

17. Which of the following groups of people is it most important for you to have a good relationship with:

(a) Your area manager
(b) You immediate superior
(c) Your/other AFA(s)
(d) Your/other yard supervisor(s)
(e) Your immediate subordinate
(f) Your other staff

18. Which of the above groups of people is it least important for you to have a good relationship with?

Additional comments?

E. Computer Technology and Marshalling Yard Supervision.

1. When TOPS was first introduced at which yard were you located and what was the approximate date of implementation?

2. What was your job title and grade at this time?

3. As a supervisor, how do you feel TOPS has affected the *freedom of action* within your job? Has it: (a) increased, (b) remained about the same, or (c) decreased?

4. As a supervisor, how do you feel TOPS has affected the *amount of responsibility* within your job? Has it: (a) increased, (b) remained about the same, or (c) decreased?

5. As a supervisor, how do you feel TOPS has affected the *degree of authority* within your job? Has it: (a) increased, (b) remained about the same, or (c) decreased?

6. Which of these improvements due to TOPS do you think is most important for your role as a supervisor:

(a) Increased control over wagons
(b) Increased control over locomotives
(c) Increased control over train crews
(d) Increased control over yard staff
(e) Increased control over freight operations in general

7. Could you please indicate by the appropriate letter: (a) strongly agree, (b) agree, (c) don't know, (d) disagree, or (e) strongly disagree - how far you agree with the following statements about the effect that TOPS has had on your job as a Supervisor?

7.1. With TOPS ground level experience is not of such importance in doing the job of the supervisor.
7.2. TOPS enables the supervisor to control freight operations far more effectively.
7.3. TOPS enables supervisors to control subordinate staff far more effectively.
7.4. TOPS has taken the skill out of being a supervisor.
7.5. Management now have far greater control of the supervisor.
7.6. The supervisor is now just a servant to the TOPS machine.

Additional comments.

8. In general, do you think TOPS has been either (a) a great success, (b) a limited success, or (c) something of a failure?

F. Unions, Modernisation and the Supervisor.

1. Please could you fill in the following details as appropriarte:

1.1. ASLEF (date joined/date left)
1.2. NUR (date joined/date left)
1.3. TSSA (date joined/date left)

2. Is the union of which you are currently a member, the union you would prefer to be in? (if *no* what would be you choice?)

3. Do you feel that supervisors in BR should (a) have a union of their own (b) be part of their subordinates unions, (c) be part of a management union, or (d) not be in a union at all?

4. Do you feel your union has handled the issue of modernisation:

(a) Very well
(b) Reasonably well
(c) Not very well
(d) Badly
(e) Don't know

G. Leisure Activities and the Supervisor.

1. Do you socialise with BR employees away from work? (if yes, please indicate how often this is, e.g. daily, weekly, monthly.)

2. What are your main leisure interests?

3. Were or are any members of your immediate family employed on the railway? (if so, please indicate their relationship to you and their occupation, e.g. Father, Guard)

4. Would you regard the job of a railway supervisor as a good career for a young person?

H. General Section.

1. As a supervisor, what has been the major change in job activity brought about by the introduction of TOPS?

2. Within the yard, which job do you feel has been most affected by TOPS and for what reasons?

3. In general, what are your views on technological change?

4. Have you any comments on the design of this questionnaire?

Appendix V: Marshalling Yard Staff Job Descriptions

Job Title

Area Freight Assistant

Marshalling Yard

B

Grade

Management Service 1

Responsibilities

Area Manager

Duties

Co-ordinate the activities of freight marshalling, freight terminal and train crew and locomotive supervisors to achieve maximum efficiency and economy in freight operations.

Assess priorities for freight movements in liaison with divisional control.

Monitor freight operations with the principal objective of improving turn round on trips and trains at terminals in the area, with special emphasis on merry-go-round services and conventional wagon movements, and company block trains.

Control all local trip services allocated to area manager's use and maintain current records.

Direct the activities of the Area Freight Centres, in conjunction with CO4 (TOPS) at B, S, W, ensuring the prompt and accurate processing of TOPS information and its full exploitation.

Liaise with specified customers on the movement of 'pipeline' traffic to private sidings.

Liaise with staff at local depots and supervisors at C and S in connection with traffic arrangements.

Liaise with train crew supervisors on availability of trip train crews and also engine arrangers on availability of power.

Advise train and trip programmes to train crew supervisor, W, B, S; engine arrangers, B; power boxes, W, W, B and manually operated boxes as necessary.

Allocate and distribute freight rolling stock within the area in accordance with specified priorities in conjunction with the CWA.

Maintain close liaison with divisional control and make reports as necessary.

Initiate schemes for improved train trip, marshalling yard and terminal performance.

Ensure in conjunction with divisional control that steps are taken to deal with mishaps in the area and traffic movement's adjusted as necessary to meet the emergency.

Take initial charge of mishaps in the local area pending arrival of 'on call' supervisor.

Undertake other duties related to freight activity, safety of line and staff administration as directed by area manager.

During the Sunday/Monday turn of duty, supervise all activities in marshalling yard B, including TOPS procedures, and deploy staff as necessary.

Job Title

Yard Manager

Marshalling Yard

B

Grade

Railway Supervisor: E

Responsibility

Responsible to the Area Operations Manager

Duties

Responsible to the area operations manager, for the supervision of marshalling yard B, and down tower. To plan and co-ordinate yard operations and liaise with service departments to ensure efficient yard workings.

Monitor marshalling yard performance: punctuality of services, maintenance of booked connections, currency of working, prompt release of locomotives, loading et cetera, and take corrective action where necessary.

Supervision of marshalling yard B, AFC in conjuction with area freight assistants and ensure fullest possible exploitation of TOPS, data integrity checks to be carried out bi-monthly.

Liaise with and provide information as necessary to the area administration officer at marshalling yard B.

Training and induction of staff in conjunction with administration section.

Welfare, and sick visits.

Liaison with roster clerk on the preparation of rosters (special weekend and overtime working and annual leave).

Review services and make recommendations on changes needed to meet current traffic requirements. Maintain check on standards as required by the Health And Safety At Work Act (HASAWA).

Deal with operating correspondence.

Liaise with coach and wagon department on efficient train examination cover and clearance of cripples, arrange and supervise train times as necessary.

Periodic examination of rules and regulations of supervisory and yard staff under his control.

Monitor freight train safety limits to conform to working manual standards.

Produce freight train simplifier.

Visit down tower PSB as laid down.

Attend and supervise yard mishaps when on duty.

Other matters as directed by area manager.

Assist in planning matters related to freight operations.

Job Title

Area Freight Assistant

Marshalling Yard

A

Grade

Railway Supervisor: D

Responsibilities

Responsible to Traffic Manager

Duties

To supervise current freight operations within the TRA during their turn of duty, to ensure efficient working and servicing of freight terminals.

To co-ordinate all freight movements within the Area including the provision of locomotives and trainmen in conjunction with Control, and in liaison with the train crew supervisors at S and O.O.C..

To give direction as necessary to freight operating and terminal staff in the Area.

To supervise the TOPS staff at marshalling yard A and to exploit the TOPS system of information and control, to achieve efficient utilisation of resources and optimum service for traffic.

Disposition of freight rolling stock with the Area as instructed by H.Q. Central Wagon Authority.

Job Title

Area Freight Assistant

Marshalling Yard

C

Grade

Railway Supervisor: D

Responsibilities

Responsible to Assistant Area Manager

Responsibilities

Co-ordination of movements function in operations area in conjunction with traffic control office, panel signalbox, et cetera. Maintenance of appropriate logs and records.

Provision of local trip services and freight rolling stock to freight terminals and private sidings in accordance with plan, but amended where necessary to ensure effective customer service.

Direction of TOPS staff to ensure the system is exploited to achieve efficient utilisation of resources and optimum service of traffic.

In emergency circumstances, make adjustments to train services in conjunction with traffic control office and liaise with customers.

Assistant to the area manager as directed in carrying out investigations into operating and terminal practices, and with engineering operations in the area.

Be conversant with the accident prevention measures applicable to area of responsibility and formulate own safety plan as necessary, and to ensure its implementation.

Assist as directed.

Job Title

Relief Yard Supervisor

Marshalling Yard

A

Grade

Railway Supervisor: D

Responsibilities

Responsible to Traffic Manager

Duties

Relieve yard supervisors for rest days as per roster.

Relieve yard supervisors and movements supervisors in locations as directed by traffic manager.

Work as required by traffic manager throughout the area.

Job Title

Movement Supervisor

Marshalling Yard

B

Grade

Railway Supervisor: C

Responsibilities

Responsible to Yard Manager

Duties

Shift supervision of marshalling yard B.

Day to day alterations to yard staff roster to meet current yard requirements.

Regulation of traffic in conjunction with area freight assistant to ensure prompt acceptance of inward services and punctual despatch of outward services.

Instruct hump chargeman in the priorities of the humping of trips and trains.

Maintain yard traffic position charts.

Keep in radio contact and instruct yard supervisor in the priorities of duties requiring attention.

Receive and issue special train and traffic notices.

Training arrangements for shunting staff and progress reports as specified by yard manager.

Supervision of TOPS procedures in areas affecting the operation of marshalling yard B and maximum exploitation of information.

Ensure yard mishaps are dealt with advising AFA for traffic regulations purposes and arrange restoration of normal working as quickly as possible.

Responsible for security of radio hand sets, check each shift.

Ensure high standard of observation of rules and regulations to maintain safety of line.

Ensure maintenance of yard position chart and train performance records.

Undertake other duties in relation to freight operations, safety of line and staff administration as directed by area manager.

Job Title

Yard Supervisor

Marshalling Yard

A

Grade

Railway Supervisor: C

Responsibilities

Responsible to the AFA (marshalling yard A) for the safe and efficient working of the yard during the turn of duty and for the supervision of all staff on duty in the yard.

Duties

Responsible for the maintenance of booked freight service connections throughout the yard, for the currency of the exchange between the sections of the yard and for the punctual despatch of trains.

Responsible for the disposition of staff as necessary to meet contingencies which may arise.

Responsible (in connection with Control) for the supervision of guards working from marshalling yard A, including other Region's guards, and for maintaining their proper adherence to booked or special working.

Responsible for supervising all aspects of work, including punctuality and regulation of traffic, and for making recommendations to the AFA at marshalling yard A for improvements as necessary.

Responsible for the preparation of reports to the divisional manager and area manager as necessary, on incidents arising during their turn of duty.

To be conversant with accident prevention measures applicable to area of responsibility. Formulate own safety plan as necessary and ensure its implementation.

Assist as required.

Job Title

Train Crew Supervisor

Marshalling Yard

C

Grade

Railway Supervisor: C

Responsibilities

Responsible to Assistant Area Manager

Duties

Responsible for the supervision of traincrew staff to include the certification of time records.

To exercise the necessary discipline over staff and promptly report to the area manager any cases of neglect of duty.

To ensure that the general working is carried out efficiently and in accordance with the rules and regulations and report any frequent departure from the scheduled working.

To give personal attention to the punctuality of trains, and operations affecting the safety of the line.

To take appropriate action in the event of an emergency arising, and in adverse weather conditions arrange for all concerned to be notified.

To make checks at prescribed intervals of first aid boxes, fire appliances, point clips, and cleanliness of premises.

To ensure that fuel and stores are used economically.

To maintain a supply of detonators in a suitable place and check all detonators in stock and in use at the prescribed time.

To ensure the security and protection of buildings and property.

To ensure that all accidents and untoward incidents are correctly reported and cases of personal injury to members of the staff are recorded in the depot register.

To maintain liaison with divisional traffic control office and ensure that all necessary train advices are forwarded. Maintain appropriate records.

To attend to special requirements, as directed.

To arrange for 6-monthly checks of trainmen's road knowledge cards to be carried out.

To arrange annual check of publications and items of equipment in possession of train crews.

To ensure that train crews notice boards and signature books are kept up to date.

To adjust the duties of traincrews and scheduled working of traction units to cater for contingencies.

To initiate casualty forms for traction failures.

To oversee, as far as practicable, the signing on and off of train crews and issue of notices during each turn of duty. Carry out spot checks of driver's tickets and guards journals and certify each day that this has been done.

To allocate locomotives to diagrams/turns/trains in conjunction with divisional locomotive control. Priority must be given to mandatory diagrams and only in extreme emergencies should the agreed allocations be set aside, and then the full facts must be reported to divisional locomotive control as soon as possible.

To liaise with the depot servicing foreman with regard to placing locomotives onto depot and subsequent release timetables. To advise depot servicing foreman of late running, and give revised estimated times of arrival.

To be responsible for stabling locomotives in such a way as to facilitate the use of the locomotive in the order required and that traction units stabled in the area are 'run-up' during frosty weather.

To advise divisional locomotive control of any problems arising as early as possible.

As requested by divisional control, to interview drivers of trains that lost time for no apparent reason. If the delay is applicable to the locomotive of the driver, to obtain report before he books off.

Be conversant with the accident prevention measures applicable to area of responsibility, formulate own safety plan as necessary and ensure its implementation.

Assist as directed.

Job Title

Yard Supervisor

Marshalling Yard

B

Grade

Railway Supervisor: B

Responsibilities

Responsible to Movement Supervisor

Duties

General outside supervision of marshalling yard B, including staff meal breaks and security of yard premises at close of work.

Pay special attention to the priorities of train and traffic movements and the correct marshalling of trips and trains.

Deal specially with explosives and traffics of an urgent nature.

See that CAB's are properly equipped.

Keep in close contact with movements supervisor by radio and telephone to power box and tower and AFC.

Attend and advise movements supervisor of all derailments, failures of trains and failures of yard equipment.

See that TOPS procedures are carried out correctly.

Booking on and off yard staff in time books.

Arrange with C & W staff, examinations to ensure punctual departures of trains and liaise with R & M and P & W staff.

Observe BR rules and regulations, safety of staff and report all failures to area manager.

Weekly health and safety inspections.

Late turn supervisor

Ensure that marshalling yard B attachments for ABW services are correctly positioned in down storage sidings to ensure minimum retention to speedlink services. Maintain close radio contact with movements supervisor, signalman down tower and C & W examiners to ensure rapid acceptance for marshalling and despatch of ABW services.

Night turn supervisor

Outside supervision of air brake network services to ensure punctual acceptance and despatch, connections are maintained, trains comply with the conditions of the book of rules and regulations regarding marshalling train loads, brake force et cetera, and that TOPS procedures are properly adhered to with regard to these services.

Other duties as directed.

Job Title

Yard Supervisor (Up Yard)

Marshalling Yard

C

Grade

Railway Supervisor: B

Responsibilities

Responsible to Traffic Assistant

Duties

Responsible for the supervision of all staff within the area of control to include certification of time records.

To exercise the necessary discipline over staff and promptly report to the area manager any cases of neglect of duty.

To ensure that the general working is carried out efficiently and in accordance with the rules and regulations and report any frequent departure from scheduled working.

To give personal attention to the punctuality of trains, and operations affecting the safety of the line.

To take appropriate action in the event of an emergency arising and in adverse weather conditions, arrange for all concerned to be notified. To take initiative in respect of all main line emergencies in the area.

To make checks at prescribed intervals at first aid boxes, fire appliances point clips and cleanliness of premises.

To ensure that fuel and stores are used economically.

To maintain a supply of detonators in a suitable place and check all detonators in stock and in use at the prescribed time.

To ensure the security and protection of buildings and property.

To ensure that rail vehicles, sheets and ropes are disposed of promptly after use.

To ensure that all accidents and untoward incidents are correctly reported and cases of personal injury to members of the staff are recorded in the depot register.

To maintain liaison with TOPS office and ensure that all necessary train advices are forwarded. Maintain appropriate records.

To attend to special requirements, as directed.

To maintain liaison with depot supervisor and down side supervisor.

Be conversant with the accident prevention measures applicable to area of responsibility, formulate own safety plan as necessary and ensure its implementation.

Assist as directed.

Job Title

Yard Supervisor (Down Yard)

Marshalling Yard

C

Grade

Railway Supervisor: B

Responsibilities

Responsible to Traffic Assistant

Duties

Responsible for the supervision of all staff within the area of control to include certification of time records.

To exercise the necessary discipline over staff and promptly report to the area manager any cases of neglect of duty.

To ensure that the general working is carried out efficiently and in accordance with the rules and regulations and report any frequent departure from scheduled working.

To give personal attention to the punctuality of trains, and operations affecting the safety of the line.

To take appropriate action in the event of an emergency arising and in adverse weather conditions, arrange for all concerned to be notified.

To make checks at prescribed intervals at first aid boxes, fire appliances point clips and cleanliness of premises.

To ensure that fuel and stores are used economically.

To maintain a supply of detonators in a suitable place and check all detonators in stock and in use at the prescribed time.

To ensure the security and protection of buildings and property.

To ensure that rail vehicles, sheets and ropes are disposed of promptly after use.

To ensure that all accidents and untoward incidents are correctly reported and cases of personal injury to members of the staff are recorded in the depot register.

To maintain liaison with TOPS office and ensure that all necessary train advices are forwarded. Maintain appropriate records.

To attend to special requirements, as directed.

To maintain liaison with depot supervisor and up yard supervisor.

Be conversant with the accident prevention measures applicable to area of responsibility, formulate own safety plan as necessary and ensure its implementation.

Assist as directed.

Job Title

Yard Supervisor

Marshalling Yard

D

Grade

Railway Supervisor: A

Responsibilities

Responsible to Traffic Assistant

Duties

In the absence of the traffic assistant, responsible for all shunting staff and shunting movements in upside and downside yards, also all local trip working during turn of duty.

Liaise as necessary with private firms.

Ensure that TOPS requirements are carried out efficiently.

Ensure release of train locomotives as soon as possible after arrival of terminating trains.

Responsible for the preparation of any documents required.

Maintain liaison with control, traincrew supervisors and signalmen as necessary.

Attend to all derailments in upside/downside yards and adjacent sidings taking initiative.

Comply with instructions contained in the rule book and general/sectional appendix, also any locally issued instructions.

Responsible for general cleanliness of shunting staff accommodation.

Responsible for the day-to-day H.A.S.A.W.A. for shunting staff.

Job Title

Chargeman

Marshalling Yard

C

Grade

Chargeman

Responsibilities

Responsible to Yard Supervisor (Up Yard)

Duties

Responsible to the yard supervisor for the efficient and safe working of the yard.

To release locomotives and air/vacuum on incoming trains, and TOPS check in accordance with laid down instructions.

To attach outgoing train locomotives, and ensure punctual departure.

The above duties to be carried out in conjunction with the senior railman/chargeman's assistant.

To deputise for the yard supervisor as necessary

To liaise with the leading railman safety man with all movements in the yard.

To assist as required.

Job Title

Chargeman (Under Yard)

Marshalling Yard

C

Grade

Chargeman

Responsibilities

Responsible to Yard Supervisor (Up Yard)

Duties

To be responsible for the safety of trains and pilot on Undy hump.

To assist, as necessary, with the disposal and preparation of traffic on Undy hump.

To instruct the leading railman at E.B. ground frame of the duties which he is required to perform.

To carry out rules and regulations, and local instructions, as far as they apply.

To ensure effective timekeeping of staff under your control.

To assist as required.

Job Title

TOPS Clerk Shift Leader

Marshalling Yard

C

Grade

Clerical Officer: 3

Responsibilities

Responsible to Assistant Area Manager

Duties

Responsible for co-ordinating work of the TOPS office clerks.

Maintain outstation location, yard and train user sets.

Receive all incoming train consists and disseminate information to appropriate locations.

Up-date wagon status as required from outstations and cripple sidings.

Receive and disseminate all messages and unsolicited outputs.

Process locomotive fueling and status changes received from the diesel depot.

Process all passenger and parcels trains inputs and outputs.

Receive and distribute freight rolling stock orders received from CWA and TOPS control office.

Collate and present traffic information to AFA and yard supervisors for forward train planning.

Receive and process all wagon enquries received from other TOPS offices.

Maintain monitoring reports of actual train performances and volume of traffic flows.

Monitor movements and connections of all explosive air brake traffic and other urgent traffic.

Liaise with divisional/territory and TOPS office control.

Receive information from customers in connection with release of wagons.

Assist as directed.

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