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P.D. CARR

THE IMPLEMENTATION OF JUST IN TIME MANUFACTURING THROUGH TEAM LEADERS

SCHOOL OF INDUSTRIAL AND MANUFACTURING SCIENCE

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Ph.D. THESIS

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P.D. CARR

The implementation of Just In Time manufacturing through team leaders

Supervisors: G. Groves and J.M. Kay

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This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

Abstract

This thesis examines the implementation of Just In Time manufacturing through team leaders. Western industry has failed to achieve the performance benefits experienced in Japan with the introduction of Just In Time, a manufacturing system based on the relentless elimination of waste. Criticism is emerging of the experience of employees of Just In Time. It is argued that stress levels are high and motivation is low. However, Just In Time relies on a new, more active, role for employees. A contradiction is apparent between the needs of Just In Time, in terms of the role played by employees, and the reality of their experience of a Just In Time working environment. Resolving this contradiction, while improving industrial performance, is the subject of this research.

The research draws on knowledge from a wide range of fields. Work on Just In Time is combined with work on employee motivation, and the management of change. The role of the team leader emerges as a critical factor in the review of the literature.

The implementation of Just In Time, through a focus on team leaders, utilising knowledge gained from socio-technical systems is tested in a year long, action research project with Alcan Aluminium at their Banbury extrusions factory. Survey evidence is gathered to analyse its impact. The results suggest that companies will benefit from the utilisation of the approach developed; the implementation of Just In Time through team leaders. There is substantial scope for further work to develop this approach to the implementation of Just In Time and to explore its application in other forms of change.

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Chapter 1.

Introduction

1.1. Introduction

This chapter introduces the reader to the research reported in this thesis. It first looks at the background to the research, then outlines its main themes. The site that was used to test the hypotheses that emerged is described next and finally the potential value of the research is defined.

1.2. Background to the Study

In recent years evidence has been emerging of the failure of Western industry to perform to the same levels as that in Japan (Womack, Jones and Roos, 1990). Indeed, in spite of much activity to reduce it, the gap between Western and Japanese industry is being maintained at a constant level (Delbridge and Oliver, 1991). As the West improves, so too does Japan. Just In Time, in its broadest sense, (defined more fully in the literature review) is argued to be a solution to 'catching up'. Many companies have attempted elements of Just In Time and surveys show that they have been successful, to some extent (Keller, Kazazi and Carruthers, 1992, for example). However, Japanese levels of performance have still not been attained.

At the same time as failure to achieve the performance expectation of Just In Time has become more apparent, so too have criticisms of Just In Time from a human point of view. It is argued by many (including Parker and Slaughter, 1988, and Fucini and Fucini, 1990) that the working conditions of employees within Western applications of Just In Time are intolerable. The operation of Just In Time leads to unacceptable levels of stress as waste or slack is removed from the system. Similar criticisms of Just In Time have also emerged in Japan.

This creates a fundamental problem. Just in Time relies on an active role for employees. The need for their participation in problem solving and improvement activity is well documented. So too is the need for their flexibility and commitment to respond quickly to production demands. But, the operation of Just In Time so far is causing high levels of stress and dissatisfaction, which, it is suggested, are likely to hamper these employee actions. How can system performance be maximised, while achieving the desired behaviours of employees? That is the issue that this research seeks to address.

1.3. Themes of the Research

The themes that emerge in this research are those which surround this central problem. They are, due to the nature of the issue being studied, multi-disciplinary, covering a wide range of subject areas, and focusing on the elements of these subject areas that are relevant to this research.

The first subject area is the introduction and operation of Just In Time. As has already been outlined, this is a substantial problem in Western industry and its solution would be of benefit to many manufacturing companies. The theme, then, is how Just In Time may be improved.

The second theme is employee motivation. The employee dissatisfaction difficulties experienced by companies in implementing Just In Time are likely to be eased with an understanding of the research that has been undertaken on the motivation of employees. This might provide an indication as to the type of changes in current practice that are desirable. This has been less fashionable in recent years, but substantial research was undertaken before this and the incorporation of it in this research may be of value. The theme here, then, is how employee motivation might be improved in a Just In Time environment.

The role of first line managers is the next theme that has emerged in the conduct of this research. While efforts have been made to devolve responsibility, in a Just In Time environment, to shopfloor team leaders and supervisors, evidence indicates that this has been problematic (Lowe, 1993), resulting in a barrier in implementing the existing understanding of Just In Time and creating a potential barrier to any new approach developed in this research. As the research progressed, the role of first line managers was increasingly recognised to be one of critical importance. The development of the role of first line managers is an important theme of this research.

The fourth theme is the management of change. This research is about developing more effective means for implementing and operating Just in Time. As such, it is about changing from a conventional manufacturing environment (described here as Taylorist) to a Just In Time manufacturing environment. The management of change field is wide ranging, but is relevant to this research. The application of knowledge on the management of change to implementation of a human centred application to Just In Time, with a strong focus on the development of the role of first line managers is the fourth theme.

1.4. Alcan Aluminium

The research was sited within Alcan Aluminium's Extrusions and Tubes division. This division comprised four companies at the time the research was conducted,

producing extrusions for a wide range of markets, ranging from aerospace and defence, to more commercial applications like double glazing and caravans, to the high volume automotive sector. The division employed about 1000 people with sites at Banbury, Redditch, St. Helens and Warrington. The main testing activity took place at the company's Banbury site, which then employed about 500 people.

The aluminium market is a turbulent one. Aluminium prices fluctuate wildly and, as a consequence, so do the fortunes of the companies operating within this sector. This creates a difficult environment in which to conduct research and, indeed, the effects of this were apparent as the research progressed. Further details on the company are provided in Chapter 5.

1.5. Potential Value of the Research

The potential value of this research lies first in the benefits of improved application of Just In Time manufacturing. The achievement and indeed surpassing of Japanese performance levels would be of great value to individual companies, but also to manufacturing industry as a whole.

The lessons learned here are potentially relevant in the more general application of change in the manufacturing sector. Achieving change successfully towards the objective of Just In Time, may have benefits for the implementation of other types of manufacturing change.

The third potential benefit lies in the effects on the lives of employees, who now have to work in stressful conditions in a Just In Time environment.

1.6. Summary

This introductory chapter has first described the background to the research undertaken, outlining the main areas in which work had been undertaken. It next outlined the main themes of the research, describing the areas in which work would be done. The research site company, Alcan Extrusions and Tubes was briefly introduced and finally the potential value of this work was given. The next chapter is the literature study, which examines the literature which is relevant to this research.

Chapter 2.

Literature Review

2.1. Introduction

This literature review covers the main themes of this research, the improvement of manufacturing performance through the improvement of the application of Just In Time manufacturing. In order to do this it is first necessary to establish the context in which Just In Time is normally introduced in Western manufacturing companies. Having done this it is next necessary to look at the experience of companies implementing Just In Time to date, and to find the main areas in which problems occur. Next, literature relevant to the solution of these problems will be examined, to identify work previously undertaken and to find clues as to how implementation might be improved in the future.

2.2. Scientific Management

'Scientific management' (Taylor, 1911) is accepted as the basis for the traditional approach to manufacturing found in most Western manufacturing companies. This approach has four main elements. First there is the division between planning and execution of work, the notion that specialised preparation activities should be undertaken by specialists while the more routine tasks can be left to other employees. Second, is an emphasis on specialisation. Advanced production will require the combination of specialised knowledge. Workers will not be able to learn every skill required in complex production, nor would it be desirable that they should, due to the costs involved (Babbage, 1835), so production should be split into fragmented tasks. This fragmentation leads to the third element, an emphasis on management, to effectively integrate the complexity and ensure that production proceeds effectively. Fourth is the principle of measurement and norms, the establishment of timed standards of work to control employee performance, and assist the integration of complexity. The ultimate extension of this approach is the assembly line with individual workers completing simple repetitive tasks, in a carefully timed and managed system.

"The general expectation of the scientific management approach was that by simplifying jobs, work could be carried out more efficiently; less-skilled employees would be required; the control of management over production would be increased; and, ultimately, organisational profits would be increased." (Hackman and Lawler, 1971, p. 259.).

These elements have influenced the development of most Western companies, and can still be found in most companies today. It is credited with much industrial progress but implied a very negative view of worker nature:

"Under this system the operative is regarded as a person of a very low intellectual and educational level, a waster with an innate tendency towards low output, needing regular pacing to overcome habitual apathy, and requiring close supervision, but capable of positive motivation through payment by results." (International Labour Organisation, 1979, p. 2.).

2.3. The Human Relations School

The Human Relations school (Mayo, 1947) developed an alternative approach to people in industry. Instead of the narrow, negative view associated with Taylorism, they focused on designing jobs to improve employee motivation, satisfaction and performance. They argued that the Taylorist approach led to high levels of employee dissatisfaction which in turn led to lower levels of performance, reflected in increased absenteeism and turnover and substantial difficulties in effectively managing employees who work on simplified jobs. Through a better understanding and application of motivational factors, performance could be improved. Research centred on the factors which would influence motivation and which could be applied to improve performance in an industrial setting. McGregor (1957) described the difference in these approaches with his Theory X and Theory Y. Theory X was that humans were indolent, working as little as possible. They prefer to be led, lack ambition and dislike responsibility, resist change and are inherently selfish and gullible. This theory appeared to underlie much management activity. Theory Y, however, states that people are not passive by nature, but rather are conditioned to be so, by the way they are treated in organisations. They have the potential to develop and assume responsibility. Management should manage so that people can achieve their own goals while achieving those of the organisation.

The Human Relations research can be divided into two main areas; intrinsic factors and extrinsic factors. Intrinsic factors are those related to the content of the job itself, the actual work performed. This particularly looked at the relationship between repetitive work and monotony, monotony and satisfaction, task length or job size and satisfaction (Davies,1971). Argument ensued over the merits of job enlargement and job enrichment. Job enlargement is the addition of task variety to an employee's activity, hence reducing repetition, while job enrichment is the addition of tasks which allow more self-regulation and autonomy in work tasks, making a fuller contribution to individual whole products.

Extrinsic factors are those associated with job context (see for example Hulin, 1969), for example, working conditions, pay, supervisory relationships, community, industry type, leadership and managerial style. Herzberg (1966) argued that some

factors could be considered to be motivators while others would only appear as demotivators if they were not present. This theory was superseded by Hackman and Oldham's (1976), Job Characteristics Model, which identified five core job dimensions which were important for job attitudes and behaviour. They were:

- Task variety, the extent of the variety in tasks performed by individuals.
- Task identity, the extent to which the individual could identify their own tasks in the production of the final product.
- Task significance, the extent of the importance of an individual's tasks to the final product.
- Autonomy, the discretion possessed by an individual in the conduct of their work.
- Task feedback, the feedback received by the individual about their work.

Cross-sectional research has theoretical validity for this theory, but Wall and Martin (1994) argue that research is now required, based on change studies, so that a practical understanding of the operation of these relationships can be gained. The human relations approach considered an alternative approach to employee motivation, based on the difficulties which emerged in the application of scientific management. Substantial research has been undertaken which develops a better understanding of the factors which lead to improved motivation.

2.4. Socio-Technical Systems

The human relations approach has been criticised from a socio-technical systems perspective because it is argued to be too narrow. It argues that two critical factors are not taken into account. First, human relations theory assumes that technological development is a determining factor in job content. They assume that the tasks which must be performed, and the organisation of those tasks is determined by the technology itself, and unalterable. Instead, the socio-technical approach sees work as a combination of two separate systems, a social system and a technical system. The optimisation of one system could occur at the expense of another and lead to lower than achievable overall system performance. Instead, manufacturing design should take into account the requirements in both areas, and the inter-relations between these. In their famous study Trist and Bamforth (1951) noted how groups of miners responded to new technology in different ways. The introduction of new technology in the mines studied, led to new divisions of labour in terms of skill, status, extent of operation completed and physical separation. These changes led to severe production and industrial relations difficulties. Trist and Bamforth noted that many of these difficulties were overcome by allowing miners to redesign their own work, developing teamworking and developing a broader range of skills and controlling a larger part of the operation. A group working approach, with miners developing a broader range of skills and having greater discretion over tasks wanted and shifts worked led to easier management and better performance.

The socio-technical approach stresses the need to develop a social and technical whole. The exclusive focus on technical developments would have social costs, which would result in poor performance of the system as a whole. Similarly, a focus on social aspects of manufacturing would result in poor performance due to a failure to address technical issues. Rather, better performance would result from consideration of both of these factors and 'sub-optimisation' or a compromise to maximise performance between the two issues. Socio-technical systems theory does not simply suggest that a compromise is required. It also states that options exist in the organisation of work and that human choices can be made about the nature of work. These are not derived from the technology itself. The following chart summarises the organisation of work that the socio-technical systems approach advocates:

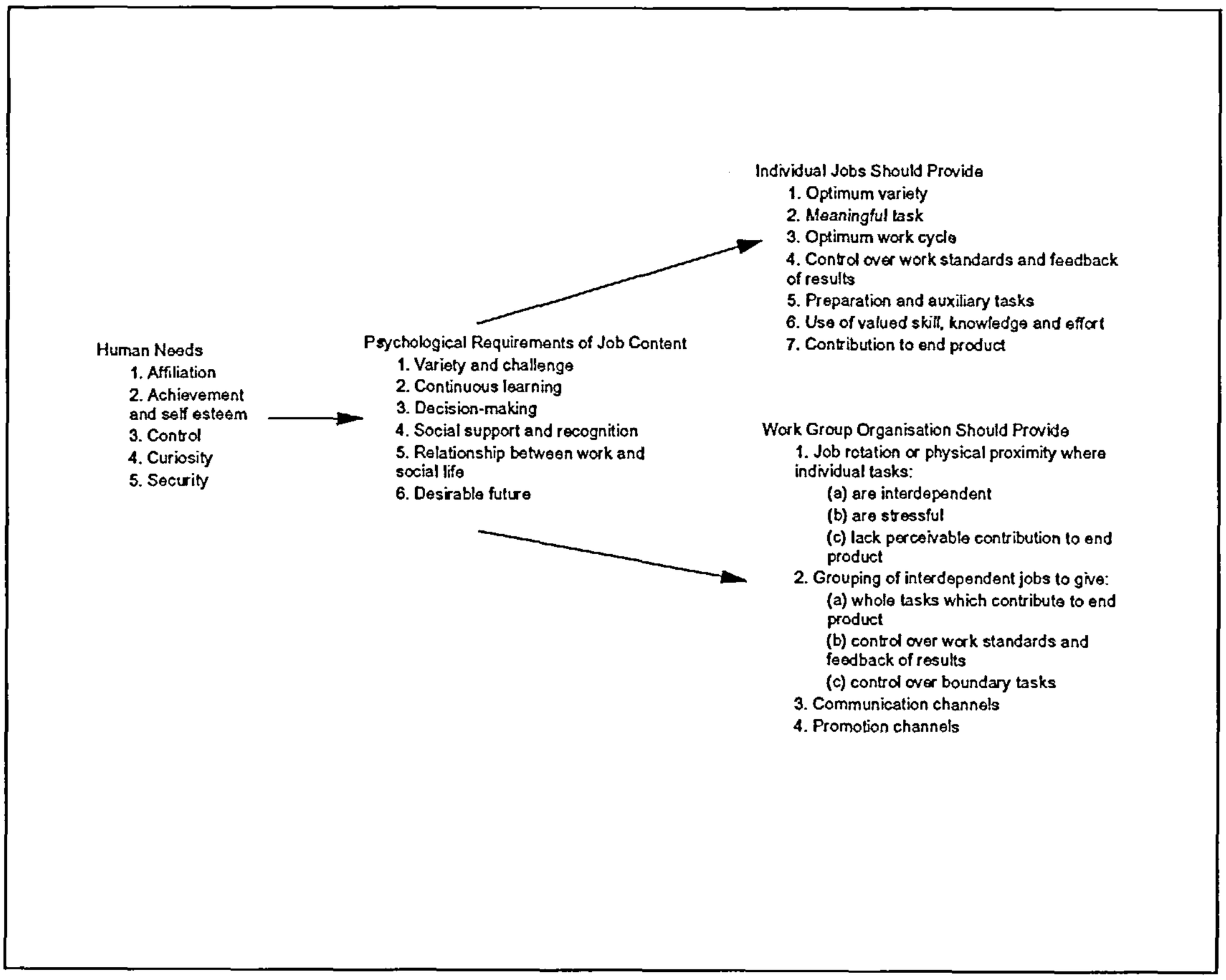

Figure 2.1, The Socio-technical systems approach to organising work, from: Buchanan, 1979, p.112.

The most famous example of the application of the socio-technical systems approach is that of the Volvo car plants at Kalmar and Uddevalla, where substantial effort was expended to create autonomous work groups, responsible for the completion of large parts of the final product and able to exercise much discretion over how this was done. In the U.S., General Motors have introduced their version of a socio-technical systems influenced plant, the Saturn production complex at Springhill, Tennessee (Rehder, 1994). The success of these plants has been less than clear. Volvo closed the

Kalmar and Uddevalla plants in 1994, while Saturn has yet to show a profit and continues to operate at lower productivity levels than U.S. Japanese transplants (typically, double the labour hours are required per car from Saturn). More debate exists over the performance of the Kalmar and Uddevalla plants, but it is not clear that in these examples, the application of socio-technical systems was superior in terms of manufacturing performance to that of other systems. Further, attempts to implement socio-technical systems in Europe generally have been examined critically by Kelly (1982), who found serious flaws in much of the research previously undertaken. He concludes that there is little evidence of socio-technical system success in application.

Labour problems raised by the pure implementation of the scientific management approach led to efforts to achieve a better understanding of people at work, and to activity to improve jobs from a human relations perspective. This approach focused on the design of individual jobs, while ignoring the wider context of job activity and assuming a large element of technological determinism. This approach was criticised for its narrowness by the socio-technical systems school who argued that wider issues of groupworking, the wider social environment and technological options, both in terms of the nature of the technology applied and the work organisation to support it, led to a requirement for reconciling and optimising the combination of social and technical systems.

2.5. Just In Time

The socio-technical systems approach was developed while there still remained general acceptance of the scientific management approach to manufacturing organisation, throughout Western manufacturing and throughout most Western academia. Indeed, discussion of alternatives to scientific management did not begin to appear until the 1970s (Sugimori et al, 1977) and much writing has followed. In recent years, the introduction of Just In Time manufacturing has been widely argued to be the solution to the gap between Western and Japanese manufacturing performance. Womack, Jones and Roos (1990) compile evidence of Japanese superiority in a wide area of manufacturing practice, displayed in Table 2.1:

Table 2.1. Summary of automobile assembly plant characteristics.

	Japanese in Japan	Japanese in North America	American in North America	All Europe
Performance				
Productivity (hours/veh.)	16.8	21.2	25.1	36.2
Quality (assembly defects/100 vehicles)	60	65	82.3	97
Layout				
Space (sq. ft./vehicle/year)	5.7	9.1	7.8	7.8
Size of Repair Area (as % of assembly space)	4.1	4.9	12.9	14.4
Inventories (days for 8 sample parts)	0.2	1.6	2.9	2
Work Force				
% Work Force in Teams	69.3	71.3	17.3	0.6
Job Rotation (0 = none, 4 = frequent)	3	2.7	0.9	1.9
Suggestions/Employee	61.6	1.4	0.4	0.4
Number of Job Classes	11.9	8.7	67.1	14.8
Training of New Production Workers (hours)	380.3	370	46.4	173.3
Absenteeism	5	4.8	11.7	12.1
Automation				
Welding (% of direct steps)	86.2	85	76.2	76.6
Painting (% of direct steps)	54.6	40.7	33.6	38.2
Assembly (% of direct steps)	1.7	1.1	1.2	3.1

The table shows higher levels of productivity, better quality, lower stock levels and a range of workforce characteristics in which performance in Japan is superior to that in North America and Europe. The Womack, Jones and Roos study asserts that 'Lean Production', or Just In Time is the cause of this superiority. It is perhaps helpful to begin with a clarification of what is meant by this term. As Safayeni et al (1991) state:

"The meanings of JIT range from an emphasis on inventory reduction and inventory turns, to a new vocabulary of 'pull' versus 'push' systems, to people working with different habits, attitudes and work organisation." (Safayeni, et al. 1991 p. 27).

For the purposes of this research, a broad definition of J.I.T. is assumed encompassing both manufacturing systems and people oriented changes. Voss (1987) provides a helpful definition:

"a disciplined approach to improving overall productivity and eliminating waste. It provides for the cost effective production and delivery of only the necessary quantity of parts at the right quality, at the right time and place, while using a minimum amount of facilities, equipment, materials and human resources."

It requires:

"total employee involvement and teamwork"

In manufacturing systems this is likely to mean changes in many areas. Surveys highlight the areas in which change has taken place in Western companies which have introduced JIT, see for example Moras and Dieck (1992), White (1993), while Ohno and Mito (1988) describe practices in Japan. It is possible to produce a list of areas in which change may contribute towards the ideal described by Voss. A comparative analysis of the literature on Just In Time found the following factors mentioned as important (Ramarapu, Mehra and Frolick, 1995):

Elimination of Waste

- Reduction in waste
- Reduce lot size
- Reduce lead time
- Automation

Production Strategy

- Reduced set up times
- Stable production
- Preventive maintenance
- Group technology

Quality Control and Improvement

- Continuous quality improvement
- Halt the production line
- Statistical process control
- Quality circles

Management Commitment and Employee Participation in Decision Making

- Cross-training/education
- Team decision making

- Management participation and commitment
- Employee suggestions

Vendor/supplier participation

- Quality parts
- Reliable and prompt deliveries
- Small lot size
- Communication with suppliers
- Long term contract
- Supplier training
- Single source supplier

The reduction of lot sizes assists the reduction of factory lead time, focuses attention on problems and enables stock levels to be reduced. This is assisted by reducing set up times and hence reducing the cost of time taken for set ups. Plant layout improvements are made possible by lower stock levels, but also emerge from an approach which focuses more closely on the operation of the manufacturing process. Kanban or 'Pull' systems are used to control the flow of work in the manufacturing operation. Work is only 'Pulled' to the next work station when it is required, rather than pushed when it is completed, causing stock accumulation and the production of unnecessary products.

To enable Just In Time operation, lower levels of process variability than those found in a traditional manufacturing environment are required. To achieve this, the standardisation of operating methods is undertaken to reduce variability in work practices, allowing standardisation of product and process quality and easier identification of areas for improvement. Maintenance of equipment must improve too, to assist the reduction of process variability and to minimise process disruption due to breakdowns, with Total Productive Maintenance being adopted, increasing preventative activity. Statistical Process Control methods are used to study and improve process activities.

As the process improves, stock levels can be reduced and the careful use of buffers supports this, with only necessary stocks being held. In some implementations, the reduction of stock is used to stress the work system and prompt improvement, in a repeating cycle.

While some texts, see for example Dear, (1988) imply that J.I.T. has a definite structure, in practice, as the surveys described above show, the application of the J.I.T. principles is likely to vary from business to business. The list above is of manufacturing tools which are used to achieve the objectives outlined by Voss. While Womack, Jones and Roos (1990) distinguish between J.I.T. and Lean Production, their term to incorporate a wider definition of manufacturing change, this widespread application of J.I.T. has led the researcher to use these terms interchangeably.

But, manufacturing changes are only part of the definition of J.I.T. provided by Voss. People changes are also necessary, and argued to be a critical element in Japanese applications. 'Family-style' management, as described by Ohno (1988) is argued to provide the framework in which J.I.T. must operate. In Japan, this would usually include lifetime employment, a strong emphasis on recruitment induction and training, pay and promotion based on seniority, enterprise unions, teamworking and involvement in improvement. Together, these factors are argued to provide the foundation on which the J.I.T. manufacturing principles might be applied.

2.5.1. Western Success

J.I.T., then, is a combination of manufacturing and people change within a company, with the objective of improving company performance. It is argued that this approach has resulted in substantial benefits to Japanese companies (Womack, Jones and Roos, 1990). However, in spite of attempts to implement J.I.T., the West has so far failed to achieve the levels of performance of its Japanese competitors.

Western interest in Just In Time has been apparent for many years. Literature surveys reveal that little empirical evidence of J.I.T. performance is available. Golhar and Stamm (1991) found 180 articles in refereed journals since 1970 which consider J.I.T. practices. From this 180, 23 are categorised as empirical while 106 are felt to be conceptual. It is thus accurate to state that in spite of a high degree of interest in Just In Time, empirical evidence on its success is somewhat lacking. Table 2.2. provides the results of the Golhar and Stamm study:

Table 2.2. J.I.T. Literature Review (Golhar and Stamm, 1991)

Category	*Conceptual*	*Empirical*	*Simulation*	*Math models*
Implementation in manufacturing (more than one tenet)	50	10	6	6
Elimination of waste				
Kanban	15	0	10	18
Cellular manufacturing	4	0	0	1
Accounting	6	0	0	0
Employee Involvement In Decision-making				
Human Resource Management	10	1	1	0
Supplier Participation				
Purchasing	18	11	2	5
Total Quality Control				
Quality	4	0	0	2

The dearth of research into the actual performance of Just In Time systems does not prevent the conclusion being drawn that substantial difficulties remain with implementation. Expectations of performance improvement to match or exceed Japanese levels have been widespread, evidenced by the volume of popular literature on the subject. It is argued that all companies can benefit from an application of Just In Time. A study by Billesbach (1991) allows him to assert that there are benefits applicable in all U.S. companies:

"The principles of Just In Time are applicable to some unknown extent in all companies", (Billesbach, 1991, p 4).

Similarly, a study of 66 European companies (Keller, Kazazi and Carruthers, 1992) finds benefits in a wide range of European industries. These are detailed in Table 2.3.

Table 2.3. European Benefits of Just In Time (% companies responding) from: Keller, Kazazi and Carruthers, 1992.

Aspect of Implementation	None	Some	Much	Not Known
Improved productivity	2.9	51.4	34.2	11.4
Improved plant efficiency	2.9	48.6	31.4	17.1
Improved production design	40	40	2.9	17.1
Improved competitiveness	45.7	37.1	8.6	8.6
Improved labour efficiency	14.3	54.3	14.3	17.1
Increased flexibility	5.7	34.3	48.6	11.4
Increased sales turnover	34.3	28.6	11.4	25.7
Reduction in inventory	2.9	11.4	74.3	11.4
Reduction in W.I.P.	5.7	20	60	14.3
Reduction in set up time	11.4	34.3	40	14.3
Reduction in lead time	5.7	25.7	48.6	20
Shorter production life cycles	45.4	28.6	11.4	14.3
Reduction in space requirement	14.3	28.6	41.8	14.3
Reduction in product cost	20	54.3	2.9	22.9
Reduction in labour cost	22.9	54.3	2.9	20
Reduction in direct manufacturing times	17.1	54.4	17.1	11.4
Reduction in transportation	28.6	45.7	11.4	14.3
Reduction in paperwork	14.3	51.4	22.8	11.4

The European and U.S. studies quoted may lead to the conclusion that J.I.T. is a 'quick fix' method of improving manufacturing performance. While the survey evidence indicates that most companies feel they have had benefits from J.I.T. analyses of the available statistical evidence suggests that there is some way to go, to achieve Japanese J.I.T. performance levels. Inman and Mehra (1993) study the financial performance of companies implementing J.I.T. and conclude that there are positive financial benefits for individual companies. However, although benefits have been gained by some companies these benefits have not been sufficient to keep pace with the Japanese. In addition to the 'Machine That Changed The World' study quoted earlier, Delbridge and Oliver (1991) look at stock turns in the Japanese and Western car industries and argue that a substantial gap remains between Japan and the West. Similarly, Schroeder et al (1992) compare Japanese and American owned plants in the U.S. and argue that a substantial performance gap still remains. While the West have improved their performance in recent years, whilst utilising Just In Time techniques, the Japanese have too, maintaining the performance gap.

2.5.2. Working in a Just In Time Factory

Research has identified that substantial changes will be required in the activities of people who work within a Just In Time system. Indeed, this is confirmed in studies of the changes which have taken place in companies which have implemented J.I.T. practices. The changes required are the subject of some debate, both on the actual changes required and in the effects that these changes have on the working lives of employees. Monden (1983) describes the Toyota production system and the role of employees within it. This follows from the requirements of the system itself.

The operation of this type of system can be contrasted with that of a traditional Western production system. In a traditional system employees normally have narrowly defined areas of responsibility, complete a limited series of tasks and are supported by a wide range of specialist departments. For example, maintenance is mainly undertaken by specialist maintenance craftsmen, quality is the responsibility of quality or technical departments, personnel is dealt with by the personnel department, improvements to process or product are undertaken by industrial engineers or designers. In this system, employees have little ability to influence the quality of the product, the quality of the process or to alter substantially the way that they work.

Monden (1983) describes his view of employee activity in a Just In Time system. This activity follows from the nature of the manufacturing system itself. This system requires greater flexibility and commitment from employees. This is due to the increased vulnerability of the system to failure due to lower stock levels and due to the principle of producing Just In Time the products which are demanded by the market. Employee activity should focus on producing the products that are needed, when they are needed. This leads to the following differences in employee activity in a J.I.T. system:

- Greater flexibility of activity
- Greater flexibility of employee numbers
- Greater responsibility for product quality
- Involvement in improving the product
- Involvement in improving the process
- Working together in teams
- Undertaking a wider range of maintenance duties
- More disciplined adherence to production demands, through kanbans or schedules

The demands of the new production system require employees to work where market requirements demand. While in a traditional system, employees would normally be responsible for a narrow range of jobs, in a Just In Time system, they would be expected to possess and exercise a wider range of skills to enable rapid response to changes in demands on the manufacturing system, or to problems which may occur. Similarly, changes in demand levels may require changes in the numbers of employees.

Shorter production runs, only producing for actual demand will require greater attention to product quality than in a traditional system where production for stock and / or surplus production to compensate for faults will allow errors to have a smaller impact. Production of scrap in a system without either of these cushioning factors will lead to substantial problems as delivery promises are not met and extra effort is required to produce the extra product required. Thus employees are expected to have more responsibility for the quality of product they produce. They should be involved in improvement of the product and of the process which produces it, through problem solving groups and suggestion schemes. Greater knowledge of the product and process and greater skill in making improvement will assist this.

While in a traditional system individual employees have responsibility for small individual parts of the process, the flexibility required in Just In Time systems is aided by the formation of groups of workers into teams, often as part of the implementation of group technology where machines are grouped which carry out all operations on a particular product. Teamworking also enables employees to undertake the continuous improvement that is required.

The maintenance of equipment in a Just In Time environment is more important than in a traditional environment. Poorly functioning equipment will lead to poorer quality and equipment failures will more rapidly result in stoppage of downstream processes. Responsibility for identifying and rectifying equipment faults is often devolved to employees who are directly connected with the process, rather than being left to specialists as in a traditional system.

While a broader role is described here for employees with higher levels of responsibility, it is important to stress that the Just In Time production system is also a highly disciplined working environment, requiring strict adherence to the demands of the system. Product stages are more closely interlinked, leading to less discretion as to which work may be undertaken and when. The reduced stock levels mean that a failure to produce when necessary to allow the next operation to receive the product when required will lead to reductions in product volume. Production must be of the product which is immediately required. Adherence to more stringent quality levels and output rates levels also requires that the variability of production activities be reduced. Production methods will possess greater standardisation and employees will be expected to adhere more strictly to these.

Japanese personnel practices which support this working activity have been well documented. Ohno (1988) describes the Japanese approach as 'family-style' management. Pang and Oliver (1988) list the common practices which are intended to assist the people aspects of Japanese production systems.

- Lifetime employment
- Seniority-based pay and promotion
- Training and education
- Company-based welfare facilities

- Single status
- Enterprise unionism
- Quality circles

Together, these factors have been identified as the main differences between people practices in Japan and those existing in the West. Lifetime employment, a commitment by the company to employ people for their entire working life, provides the security to allow employees to make improvements in the knowledge that they will not improve their job out of existence. It also allows and encourages the company to invest heavily in employee development, secure that most employees will not leave soon after.

Seniority-based pay and promotion increase the likelihood that employees will remain with a single firm. Movement to another would result in lower pay and reduced opportunities for advancement. Training and education, enabled by the secure working relationship, is required and provided at higher levels than in the West within a Just In Time system. The company also displays greater concern for the individual and links individual security to the company through a variety of company based welfare facilities. These often include sickness, accident or death benefits, educational support and subsidised housing, shopping or schools. Single status terms and conditions are intended to minimise the division between different levels of employees created by differences in uniform, canteens, parking arrangements and staff and hourly paid employees. Company based unionism is intended to assist the creation of the stable climate required for Just In Time while quality circles assist the continuous improvement process. Thus, a range of employee focused company practices are intended to support the operation of Just In Time in Japan.

It is argued, then, that Just In Time is an integrated manufacturing system which requires change to both people and systems aspects of conventional Western systems. These changes are complementary; J.I.T. manufacturing systems require new people practices. This point is stressed by Pang and Oliver (1988), who argue that the effective integration of people and systems aspects of J.I.T. lies at the heart of successful J.I.T. implementation. A failure to effectively integrate people and systems development will lead to at best sub-optimal implementation and at worst disaster.

"What is noteworthy about the successful Japanese companies in general is the goodness of fit between the strategies employed by their various constituent parts, particularly the fit between their manufacturing strategy and their human resource strategy." (Pang and Oliver, 1988, p 21).

2.6. Integration of People and Systems in Just In Time Manufacturing

It is generally acknowledged that J.I.T. requires changes in the activities of employees. Moras and Dieck (1992) survey companies which have implemented aspects of J.I.T. and note that employee involvement and team effort have been crucial components in the implementation process. More argument surrounds the success that companies have had in implementing the changes that J.I.T. requires and the effects that these changes have had or will have on employees. In spite of much conceptual debate in this area, there is little empirical evidence which can provide guidance to companies on implementation.

Conti (1992) outlines the areas which companies should need to focus on in changing the activities of employees with an analysis of the working practices barriers which are likely to impede the implementation of flexible manufacturing. He studied companies in both the U.K. and the U.S. and categorised restrictions as follows:

- Work assignments and duties, particularly demarcation of activities between employees and seniority based work rules which order work by time served with the company.
- Work scheduling and voluntary overtime, limiting the ability of companies to flex employees to meet unexpected surges or reductions in product demand (more important with lower stocks).
- Manning and technology restrictions, which limit the flexibility of staffing between machines and limit the technology which might be applied to continuously improve the process.
- Incentive pay, which motivates employees to continue production to meet pay targets expressed in volume and leads to inferior quality.
- Shutdown vacations, useful to offset difficulties caused by absenteeism as employees take non-shutdown holidays are likely to be limited by employees.
- Industrial disputes' effects on production in a J.I.T. environment are more severe.

Evidence of attention to flexibility is apparent in most studies of factors which have been important. A study by Voss and Robinson (1987) found that 80 % of companies implementing J.I.T. had introduced greater flexibility. In addition to flexibility, J.I.T. requires a more active role for employees in improving the production process. Evidence on the success of this in the West is scant but studies have emerged that give cause for concern. Mayes and Ogiwara (1992) studied the perceptions of managers in Japanese transplants in the U.K. of their workforces, compared to those they had previously managed. They separated the results between Japanese managers in the transplants, who compared their U.K. employees to Japanese employees in Japan, and British managers, who compared their U.K. employees to U.K. employees in other U.K. companies they had managed. The results (Table 2.4.) show that Japanese managers perceive U.K. employees to be inferior to Japanese workers, while British managers consider them to be superior to other U.K. employees they

had managed. This may indicate that while some success has been achieved in implementing Japanese techniques, there is some way to go to achieve Japanese levels of employee characteristics.

Table 2.4. Assessments of workforce characteristics, from Mayes and Ogiwara (1992), p. 100

Characteristic	Japanese Managers	British Managers
Speed and accuracy of work	2.2	3.7
Speed of learning and skill acquisition	2.9	3.5
Skills in operating machinery	2.7	3.6
Problem solving ability	2	3.3
Knowledge of products, processes and machinery	2.5	3.7
Willingness to improve the working environment	2.2	3.7
Co-operation and flexibility in teamwork	2.4	4.3
Competitive spirit	2.8	3.6
Willingness to improve skills and knowledge	2.8	3.7
Sense of belonging and participation in the company	1.7	3.9
Diligence and willingness to work	2.2	3.5
Sense of responsibility for job and product	2.2	3.8
Unweighted average	*2.4*	*3.7*
Scale: 5=much better; 4=better; 3=the same; 2=worse; 1=much worse		

Further evidence for the gap between Western and Japanese attention to people aspects of Just In Time emerges in a study by Oliver and Wilkinson (1989). Oliver and Wilkinson survey both U.K. companies emulating Japanese practices and Japanese transplants in the U.K. They find that the U.K. emulators fail to synchronise their people and manufacturing systems practices. The Japanese, on the other hand, do synchronise but have been slow to introduce Just In Time and Total Quality Management. This may indicate a greater understanding of the relationship between people and manufacturing systems and a recognition that Just In Time cannot work effectively without firmly established complementary people systems.

"Our evidence of 'emulating' companies suggests a surge in the planning, usage and implementation of Japanese-style manufacturing techniques in the mid 1980s. The sample sizes for specific sectors was small, but it appeared that all sectors were adopting the manufacturing techniques. However, the personnel and industrial relations practices which (theoretically) 'fit' these manufacturing practices frequently appear to be out of synchronisation with them. Japanese manufacturing companies,

on the other hand, are bringing with them to the U.K. many of the manufacturing and personnel practices which they use in Japan, although some lag in the adoption of J.I.T. and total quality control is apparent." (Oliver and Wilkinson, 1989, p. 87).

It is assumed that the objective of the people practices adopted by companies implementing Just In Time is the more effective operation of J.I.T. The changes required in employee practices have been detailed above and much of the literature assumes a harmonious relationship between Japanese people and manufacturing practices when adopted in the West. A new fulfilling and productive working environment will result from the new manufacturing paradigm. An early study by Johnson and Ouchi (1974) illustrates the optimistic view. They surveyed Japanese companies in the U.S. and identified a greater concern for the welfare of the employee. This concern and the practices which reflect it are said to produce the climate of higher levels of motivation, commitment and flexibility which J.I.T. requires. Johnson and Ouchi quote an American worker in a Japanese transplant electronics company, who they say reflects the views of employees in many of the companies they surveyed:

"The Japanese are concerned with the employee and the product. Americans just care about the product. The Japanese appear very much to want the employee to be comfortable. I never get the impression that the higher-up Japanese managers don't have time to talk. They usually seem concerned, whereas American bosses convey a 'you have to work, that's all there is to it' attitude." (Johnson and Ouchi, 1974, p.67).

This optimism is also displayed by Fazakerly (1976) who looks at the human aspects of group technology and cellular manufacture. She argues that the production organisation which results is likely to lead to both economic and social benefits. Similarly, many writers on Just In Time (for example, Schonberger (1982)) are confident that the working practices of J.I.T. will yield positive results. It is important to stress here that the operation of J.I.T. requires these higher levels of motivation, commitment and flexibility. There is a broad measure of agreement in the literature that J.I.T. will not operate successfully without this. Evidence is scant (again) on what actually happens. A study of Hewlett Packard by Groebner and Merz (1994) suggests that employee job attitudes changed for the better as Just In Time was introduced. However, other argument and evidence suggests that the West have failed to realise the people behaviours which are required for Just In Time.

Much of the literature in this area is conceptual, and little is based on hard research. This makes evaluation of the current position difficult, but there is sufficient debate to make this an area worthy of consideration. Delbridge, Turnbull and Wilkinson (1992) argue that J.I.T./T.Q.M. are little more than a management ploy to subjugate employees to the employer, creating a less desirable working environment:

"A J.I.T./T.Q.M. system does, as the advocates are keen to point out, entail a devolution of responsibilities traditionally held by management to the level of team leader or operator; however, this does not lead to autonomy, rather an increasing

(and increasingly taxing) set of tasks which are closely monitored and strictly controlled, such that the subordination of the worker to the capitalist is more complete. Total Quality Management in effect translates into Total Management Control." (Delbridge, Turnbull and Wilkinson, 1992, p.97).

This view is supported by Parker and Slaughter (1988), writing from a union point of view, who describe Japanese management techniques as 'Management by Stress'. The systems which are introduced are simply a means of exerting more control over employee activity. Inman and Brandon (1992) cite further evidence of increasing levels of stress in a J.I.T. environment. Fucini and Fucini (1990) examine workers' views at Mazda's U.S. auto plant and argue that the pace of work has been increased dramatically, causing workers to express strong complaints. Increasing survey evidence points to difficulties with Just In Time in Japan. Lincoln and Kalleberg (1985) survey 4567 U.S. employees from 52 plants in Indiana and 3735 employees from 46 Japanese plants in Kanagawa prefecture and find lower levels of job satisfaction in Japan on four separate job satisfaction items. The largest difference was on the question 'Does this job measure up to your expectations?'.

While evidence suggests that work in a Just In Time environment may not measure up to the enthusiasm displayed by Johnson and Ouchi (1974), there is now also evidence of concern about this by Japanese managers in Western companies. Oliver (1993) provides survey results that show a high degree of concern with the skills and diligence of British employees by managers in Japanese companies based in Britain. He surveyed 53 companies in 1991 (Table 2.5).

Table 2.5. Difficulties with British employees in Japanese companies in Britain

Difficulty	Number of citations			
	First Difficulty	Second Difficulty	Third Difficulty	Percentage of Total
Labour with the necessary skills / diligence	10	3	1	35
Different ways of thinking	8	1	0	22
Absenteeism / labour turnover	3	1	0	10
Management expertise / systems	2	2	0	10
Other	3	0	0	7
Incoming parts	1	1	0	5
Quality problems	1	1	0	5
Transfer of Japanese methods	1	0	0	2
Union issues	1	0	0	2
Recruitment	0	1	0	2
Total	30	10	1	100

Berggren (1993) details the areas in which difficulties are likely to arise in people practices in a J.I.T. environment:

- Relentless performance demands
- Unlimited working hours
- Working with pain
- A rigorous factory regime

Berggren argues that the J.I.T. system creates the pressure which results in these difficulties. Relentless performance demands are created by the focus on waste reduction in a J.I.T. environment. The constant quest to eliminate waste results in little free time for employees and stress. The J.I.T. requirement of flexibility causes companies to extend employee hours when problems arise in the production system. Rather than hold additional stock, people work additional hours. Debate exists about the safety of a J.I.T. environment. Berggren alleges that employees 'work with pain' both in the higher risks which J.I.T. pressures are said to create and in the ailments created by the completion of short cycle repetitive tasks which are used in J.I.T. to reduce process variability. Finally, the practices used to manage J.I.T. are said to be more rigorous, requiring higher levels of discipline, more constraint on holidays etc. Overall it is felt that J.I.T. constitutes a less pleasant working environment.

The evidence on this is aided by the work of Klein (1989) and Conti and Warner (1993) who modify the hitherto accepted theory that J.I.T. is either a 'paradise' of worker participation or is a more stressful, very undesirable working environment. They argue that the J.I.T. system requires increased levels of discipline but at the same time has opportunities for higher levels of involvement. Klein argues that companies which have implemented Western-style programmes of employee involvement will perceive the discipline of J.I.T. as greater stricture. The stress of J.I.T. should be compensated for by the holding of buffer stocks which provide some slack and scope for employee discretion. Conti and Warner argue that the quality levels required in J.I.T. cause pressure to standardise work practices and argue for offsetting employee participation in the establishment of these work practices and in other areas of work activity. They do not feel sufficiently confident to argue that this offsetting activity will be enough to prevent the deterioration in employee conditions.

Turnbull (1988) argues that this offsetting activity is unlikely due to the priorities of the culture that pervades Western companies. He argues that while in Japan the culture supported the emphasis on positive people activities:

"...J.I.T. could, if suitably modified, offer the opportunity to reskill work and enrich the jobs of working people. But management interest in J.I.T. is not derived from any predilection for the well-being of the worker. Their interest comes instead from the quest to realise levels of productivity comparable to those of the best Japanese companies. The reskilling of jobs becomes more of a theoretical fantasy than a concrete reality in a climate where unions are on the defensive and workers are the

recipients rather than the actors in the process of 'Japanisation'." (Turnbull, 1988, p.14).

The position may vary between Western nations as Baldry (1994) asserts. Different national conditions may influence the actual form that implementation takes. However a difficulty is emerging here with Just In Time manufacturing. If, and some evidence does exist to support the thesis that Western applications of Just In Time suffer from weak people practices, the people practices which are applied are creating a more stressful work environment, the activities of employees themselves are unlikely to facilitate the effective operation of Just In Time. While, in theory, the operation of work teams and employee participation are essential for productivity and help in the achievement of the required motivation and commitment of employees, the reality is one of demotivation, stress and fear. A focus on the integration of people and manufacturing systems development in the implementation of Just In Time may yield positive results. Milsome (1993) summarises the weakness of current research.

"Organisations are seeking a model which, if followed, will guarantee success. Unfortunately, no such model has yet been found." '(Milsome, 1993, p.5).

2.6.1. Socio-Technical Systems, Just In Time and Supervision

While Just In Time was trumpeted as the saviour of Western manufacturing, the increasing experience of application is that it has failed to deliver to the extent that initial expectations or Japanese experience would suggest. The difficulties experienced with Just In Time include a substantial weakness in the people aspects of Just In Time. For many, the experience is a negative one, an intensification of the alienation experienced under traditional Taylorist systems. This section considers the role that supervision may have to play in the solution of these problems.

Definitions abound of what supervision is. For the purposes of this research the definition adopted is that described by Jaques (1976), as an assistant to a full manager who performs certain delegated functions without severing the manager's direct authority over employees. They will be responsible for a group of employees and may or may not have chargehands assisting them in their duties. These 'first line managers' may be called supervisors, foremen or team leaders.

2.6.2. Supervision and Taylorist Work Systems

The development of supervision under Taylorist manufacturing management conditions is well researched. Prior to the adoption of Taylorism, supervisors had wide ranging responsibilities for managing production. The use of increasing levels of technology and the increasing scale of production combined with the separation of task conception from execution, led to a high degree of specialisation and division of labour. This in turn led to an increase in the number of specialist departments which

took responsibility away from the supervisor for both technical and labour activities. For example, technical departments would specify working practices to be followed, maintenance departments took on responsibility for maintaining equipment, toolmakers and setters took over machine setting, personnel took on increasing aspects of labour relations. Child and Partridge (1982) assert that this led to the role of the supervisor being undermined. Pay and status declined (Pollard, 1968). This situation was exacerbated as graduates were recruited into these specialist departments who became candidates for management promotion. A social and educational gap opened between supervisors, who were increasingly marginalised in the decision making process, and managers. Wray (1949) describes the resulting supervisor as 'the marginal man', who transmitted management decisions but no longer had a part in making them.

The role played by supervisors in Taylorist industry today continues to reflect this development. Studies have sought to identify the roles performed. The British Institute of Management (1976) found that they had some authority over safety, quality, materials handling, allocation of jobs, discipline and grievance handling, while they had little authority over production scheduling, the introduction of new working methods, maintenance of plant and equipment, cost control or the recruiting and promoting of employees. It is reasonable to conclude that supervisors have a limited control over production activity.

Instead of exercising extensive control over production activity, supervisors can be seen as reconciling the demands of managers and specialist departments and the needs of employees. While possessing a limited authority, they are responsible for deciding on which, often conflicting (Child and Partridge, 1982) demands to implement. Although 'marginalised', they must decide on what will actually happen:

"The uniqueness of the supervisors' position is that they are located at the interface of the management control system and the shopfloor: they are the ones who have to translate plans and policies into action." (Partridge, 1989, p.213).

The development of specialist department functions, involving the removal of responsibility from supervisors and the social and educational gap between supervisors and managers has led to the conclusion that there is very poor co-ordination and integration of management decisions in modern Taylorist workplaces. It is argued that management understand less and less of shopfloor activity (Partridge, 1989).

2.6.3. Socio- Technical Systems and Supervision

Against the background of difficulties with the operation of Taylorism, the human relations and socio-technical systems approaches have both addressed the problem of supervision. The human relations school has looked at the exercise of supervisor functions within Taylorism, while socio-technical systems has challenged the

operation of Taylorism itself and argued for a substantial change in workplace organisation. Within this change, the role of the supervisor is often thought to decline further.

The human relations concern with supervision has centred chiefly on the way in which supervisors perform their roles. Thus, different leadership styles are addressed, with concern focusing on the humanising of the exercise of managerial control. Rather than focusing on tasks, supervisors should focus on people and become more 'person-oriented'. By gaining better awareness of leadership and motivation they could help to overcome the difficulties associated with Taylorism. Control could be exercised in smarter ways, which motivated employees to change their negative behaviour and encouraged them to exercise discretion in a way which management preferred. Lewin (1948), is credited with initiating this approach. In recent years there has been substantial discussion on the role of leaders which appears to fit within the human relations approach. Research has looked at the relationship between leaders and their teams (Hollander, 1978, for example). Here it is argued that a social contract exists which allows leaders to exercise influence over their subordinates. The styles adopted by different leaders in different conditions and their success combined with leadership skill and competency are examined by Fiedler and Garcia, (1987). Different leader types will be better at different skills and hence perform differently within situations with differing conditions. Further interest is also displayed in leadership charisma (Howell, 1985). Different approaches to leadership training and selection are possible based on this research, however there is little empirical evidence of the success or otherwise of different methods used.

The socio-technical systems approach to supervision has been characterised in recent years by support for the development of autonomous work groups, responsible for as many of their own tasks as possible, including, for example, quality inspection and routine maintenance. They criticise the Taylorist approach for removing tasks to specialists and the human relations school for failing to question this basic form of organisation. They argue for a movement of many currently specialist tasks to shopfloor teams and for the development of what they call 'autonomous work groups'. This movement of tasks and responsibility and authority will, they argue, improve motivation and hence industrial performance.

"The success of autonomous work groups where other group techniques have failed highlights the failure of research workers and managers to make basic changes in organisational structure, and in the nature and organisation of work. This failure has its roots in unquestioned acceptance of the methods and assumptions of scientific management and the traditional management theorists." (Bucklow, 1966, p.209).

It is important to understand that the autonomous work group concept is fundamentally different from previous approaches to group working (Mayo, 1947, and Likert, 1961), in that it alters the existing Taylorist work organisation. The following quote from Bucklow illustrates the emphasis on a fundamental shift in power.

"Responsible autonomy is seen as crucial for the satisfactory design of production systems. It gives the work group a central role in the production system, not the peripheral supporting role envisaged by Mayo and Likert, and has successfully motivated rank and file workers to greater co-operative effort than other methods. It also makes more basic changes in the distribution of control and power, by transferring some of the traditional authority of management for the control and co-ordination of jobs, i.e. the part appropriate to the primary group's task, to the men who actually perform the task." (Bucklow, 1966, p.207).

The possibility of leaderless teams has been raised as one form of autonomous team development (see for example, Donovan, 1987, Semler, 1989). It is argued that the removal of an authority figure prompts the group to take responsibility itself for necessary decisions on what work is to be done, who will do it, how to do it, who to recruit, maintenance, training etc. Difficulties have been experienced with this type of work group, though, which are summarised by Bailey, (1983). He notes that research in Denmark (Larsen, 1979), on autonomous work groups, showed improved internal group cohesion led to improved group co-operation and group productivity, but inter-group problems emerged. Groups isolated themselves, became aggressive towards other groups, resisted change in group membership and became inflexible. Bailey also argues that autonomous group working is often introduced without regard for the impact on the organisation as a whole, leading to deteriorating overall performance and resistance to group working in other areas of the company.

Research in recent years has looked at the effective operation of group working systems, and evidence has continued to emerge of attitudinal and performance benefits (see for example Wall et al, 1986). The job characteristics model has been extended to cover group operation from individuals (Hackman, 1983). However, it is argued that empirical research remains weak. More fundamentally, there is a criticism that the social aspects of socio-technical systems have been concentrated on and the technical aspects have been neglected (Wall and Martin, 1994).

The effects of autonomous group working on supervision depend on the approach taken to this area of implementation. Some argue for a disappearance of the supervisory role as control systems are incorporated into technology and as routine supervisory tasks are passed to members of autonomous work groups (Edwards, 1979). However, evidence exists to the contrary. Citing a review of work restructuring programmes in the United States (Schlesinger and Walton, 1976), Partridge (1989) argues that supervision may even become more important:

"A review of work restructuring programmes in the USA also concludes that a particularly troublesome problem was the appropriate reformulation of the first line supervisory role. Moreover, the logic of the role, particularly highlighted by the new demands on production, suggests that whereas tiers of middle management might be made redundant, the supervisor cannot be as that is the role by definition which is at

the interface of the task and the control systems, and the role will therefore become more important." (Partridge, 1989, pp. 213-214).

The nature of this increased importance is explored by Thorsrud (1984), who lists the roles that supervisors and foremen would play in an autonomous group working environment. While teams would be expected to conduct their own internal co-ordination, under normal conditions, supervisors and foremen would increasingly concentrate on the co-ordination between departments. They would be involved with:

- Teamwork between departments that would have overall benefit to the organisation.
- Planning on a longer term basis and improving systems of maintenance, quality control, transport, storing and other service activities.
- Transfers between product types on a longer term basis.
- Working co-operatively with supervisors and foremen from other areas to manage day to day production.
- Working with middle management, because they would now be performing more middle management oriented tasks and hence would overcome some of the difficulties posed in current supervisory systems (see above).

The socio- technical approach to supervision is still being developed. Two positions are clear. First, that supervision will decline and disappear as autonomous group working is developed. The removal of hierarchical authority and the incorporation of previous service functions will liberate the team to organise itself, motivated by the additional responsibility to produce more effectively. The second approach is to suggest that far from being removed, the role of supervision will remain but change to support the operation of the autonomous work group through undertaking a wider range of planning, integration and development tasks. The evidence lies in favour of this second role at present as being the appropriate complement to socio-technical systems.

2.6.4. Supervision and Just In Time

Research from a socio-technical perspective has focused on the role of the supervisor and the introduction of autonomous group working in a Taylorist environment. Little work has been undertaken on the role played by supervisors in a Just In Time environment. One study has been conducted, however, (Lowe, 1993) which concludes that Supervision has a crucial role in the successful implementation of Just In Time;

"With production supervisors functionally responsible for discrete local areas on the shopfloor, it is perhaps not surprising that they become the central focus for integrating strategic goals, like total quality and continuous improvement, with operational concerns such as scheduling and manning levels." (Lowe, 1993, p.744).

This crucial role stems from the efforts within Just In Time implementation to devolve responsibility to production teams. Thus it is argued that production supervisors develop a new range of activities. These include the following found by Lowe at Nissan U.K.:

- Continuous improvement. The supervisor is given responsibility for initiating performance improvement activities within his own work area, gaining more control over the activities of engineering departments.
- Quality production. Responsibility for maintaining and improving quality levels within the team, in the absence of a large quality department.
- Training. Linked to quality is the training of production employees in quality requirements and in production skills.
- Elimination of waste. Responsibility for minimising stock and work in progress, through minimising disruption of the production process, including control of maintenance to prevent breakdowns and control of employees to minimise lateness and absenteeism. He thus requires greater control over personnel decisions.

It is thus argued that the supervisory role within Just in Time becomes more managerial due to the different range of tasks performed. The 'man in the middle' difficulties associated with supervision in a Taylorist environment are overcome. However, the studies of supervision in a Just In Time environment focus on greenfield sites (the other study is included in Fuccini and Fuccini (1990) at Mazda's Flat Rock plant in the U.S.). The company structure is established to minimise service operations and extensive selection and training of supervisors is undertaken. Most are graduates and have a greater pay differential than those in a Taylorist environment.

Lowe (1993) studies the development of supervision in the introduction of Just In Time in a Taylorist U.K. automotive manufacturer. He notes that there is a substantial gap between the tasks performed in Nissan and those in the plant studied. A substantial change in the tasks undertaken was envisaged by the company and supervisors were trained in what this would entail. However, Lowe found that in eighty percent of cases, job content was little changed. Ninety percent felt relationships with management had not changed and that they continued to lack management support. A lack of supervisor skill may have influenced this problem. Seventy-five percent felt inadequate or incapable of fulfilling the requirements of their new role.

The conclusions which Lowe (1993) draws are that there remain substantial issues for further action in developing how supervision is dealt with in a Just In Time environment. First, will supervisors regain power and authority? Clearly, to perform the tasks required by Just In Time this would be necessary. Second, will companies address the problem of supervisor pay and status? This has declined as Taylorism has been introduced; appropriate improvement in pay and status will be required to enable appropriately able people to be recruited to these positions and to enhance

power and authority. Third, there is the issue of selection and career development. Selection methods will need to be enhanced to ensure that selection of the higher calibre people is undertaken. These people are more likely to expect more emphasis on career development. Finally, and most critically, how is all this to be done? How is the transition from supervisor activity in a Taylorist environment to supervision in a Just In Time environment to be undertaken? There is no current research.

Lowe's (1993) work highlighted a critical problem. The role of supervision had failed to keep pace with the other changes made towards Just In Time in the company studied. There was thus the cost of failing to maximise the possible benefits of Just In Time and the danger that supervision will be a substantial barrier to implementation success:

"If senior management are intent on moving towards a lean production system they need to consider carefully the role of middle management in influencing the changes that take place at the supervisory and shopfloor level. Future research is needed to gain an understanding of the precise dynamics of the 'supervisory control system' under lean production and the constraints faced by mass producers in moving towards it." (Lowe, 1993, p.755).

This conclusion is also drawn in a recent study (Andersen Consulting, 1993). Basing their findings on a comparison of practices in auto component factories in Japan and the U.K. they argue that supervision is a key difference between normal and 'world class' plants, operating Just In Time. They observed the contribution made to a series of shopfloor activities: inspection, rectification, routine maintenance, quality improvement, hiring, firing and grievance handling. They found that production operators and skilled trades had less contribution in world class plants, while team leaders had more.

"The major difference between the world class plants and the rest was the contribution of the team leader, which was double that of team leaders in non-world class plants. In most activities the team leaders played a pivotal role in world class plants. The only exceptions were personnel decisions - hiring, firing and grievance handling - which for both world class and the other plants were largely the prerogative of staff specialists.

These findings suggest that the role of the empowered operator in world class manufacturing may have been overstated and that the crucial differences lie at team leader rather than operator level." (Andersen Consulting, 1993, pp. 13-14).

A critical role is thus identified for the supervisor in the operation of Just In Time. In those companies which are identified as being 'world class', a substantially different role is evident from that in other manufacturing environments. It is argued that the requirements of Just In Time, the transfer of previously specialist tasks to shopfloor areas and the imperatives of the Just In Time system itself (short lead time, low stock, right first time, etc.) lead to this situation. However, there is no research as to how the

transition to this new role might be brought about. Indeed, the evidence which does exist suggests substantial difficulty in this area which could lead to substantial problems in the operation of Just In Time.

2.6.5. Integrating JIT and Socio-Technical Systems

The problem which has been identified in the literature is a gap between expectations of Just In Time performance and its practice in Western companies. While expectations were high, and improvements have been experienced in many areas, these have not measured up to the improvements experienced by practitioners in Japan (see, for example, Womack, Jones and Roos (1990), Delbridge and Oliver (1991)). At the same time concern is emerging of the people aspects of Just In Time. Substantial change in the activity of employees is expected in a Just In Time environment which enable its benefits to be achieved (Monden, 1983). While hopes had been expressed of a motivating manufacturing environment, substantial evidence exists to suggest that this has not transpired in a significant number of implementations (see, for example, Parker and Slaughter (1988), Inman and Brandon (1992)) and further, that the people aspects of Just In Time were being perceived as a problem by those implementing them (Mayes and Ogiwara, 1992).

This problem appears very similar to that which was experienced in the early days of Taylorism and which spawned the work of the human relations and socio- technical schools. Perhaps a solution might be found here.

A human relations approach to Just In Time implementation and operation would focus on the people aspects of work, whilst assuming that the imperatives of the production systems would remain the same. Initial understanding of Just In Time systems in Japan appears to have reflected the human relations approach. It focused on employee conditions outside the immediate work environment and argued that it was practices (such as lifetime employment, company unions, etc.) which determined the different employee behaviour (discussed previously, see Pang and Oliver, 1988). Some examples of a human relations approach to Just In Time may be discerned in the literature, even if they are not explicitly expressed as such. Wood, (1993), in Table 2.6. compared the policies of 134 non-Japanese plants with 73 Japanese plants. His survey findings indicate a greater emphasis on human relations policies in Japanese plants.

Table 2.6. Adoption By Manufacturing Plants of H.R.M. policies.

Policy	Non-Japanese Plants %	Japanese Plants %
Permanent employment policy, for all employees, such that there is expectation on the part of senior managers that all new employees joining the firm will stay until retirement.	40	64
Policy of no compulsory redundancy.	15	58
Use of temporary staff, the primary purpose of which is to protect the security of the core workforce, and not to meet fluctuations in demand.	34	58
A policy of designing jobs to ensure the full use of workers skills and abilities.	38	56
Flexible job descriptions which are not linked to one task.	68	91
Production workers responsible for quality of their own output.	70	94
The predominant system of working is formally designated teamwork.	67	72
A system of regularly planned team or cascade briefing extends down to the shopfloor and involves stopping the production line.	52	86
Quality circles meet regularly.	16	39
Single status.	23	77
Production workers are assessed formally on an annual or biannual basis.	39	80
There is some element of merit pay in production workers pay.	50	76
There are profit sharing arrangements for production workers.	25	23

An example of individual company application of a human relations approach may be found at Nissan's Nashville, Tennessee plant. U (1989) summarises the approach to people here:

- The 1,000 employees have wholeheartedly embraced the participatory management style.
- Workers interviewed indicated that they felt management showed a genuine concern for the individual workers.
- Nissan sent over 40% of the workers on a visit to Japan to view the Japanese factory.

- The American workers chose which customs they wished to adopt at Nissan USA, which is a blend of both cultures.
- Company uniforms are provided at no cost.
- Callisthenics are encouraged but not mandatory.
- A short 'team meeting' is held before each shift.
- The executive dining has been eliminated and there is good food at cheap prices.
- There appears to be no use of the confrontation style typical of the UAW.
- Employees do not feel they need a union.
- The workers chosen are an elite with 1,000 chosen from over 120,000 people.
- Few of them have any previous auto experience (Detroit fosters bad habits) but they were hired as participative individuals.
- Although the American company dies not guarantee lifetime employment, the employees feel they can create their own security, simply by building a top notch product.
- Even after the short time operating, the people feel the company will not abandon them.

Measures similar to these appear to have been introduced in most prominent implementations of Just In Time (see for example Rover, I.R.S. Employment Trends, (1992), Nissan U.K. Wickens, (1987), etc.).

Klein, (1989), argues for an approach which eases the pressure that the Just In Time system places on individuals. Specifically, higher levels of stock could be held. This advice is echoed by Conti and Warner (1993), who argue for participation in the standardisation of work practices. Hiltrop, (1992), argues additionally for increased job rotation and the right to manage work methods and resources. The literature, predominantly reflecting a human relations approach, makes recommendations to offset the undesirable effects of Just In Time.

A socio-technical approach to Just in Time has not yet emerged in the literature. The only effort that has been made to date to integrate socio- technical systems with just in Time appears from Berggren (1993). He argues that the benefits of Just In Time can be combined with socio-technical systems, while the aspects of Just In Time which cause difficulty are not applied. Set up time reduction, integrated quality control and the application of statistical analysis are argued to constitute good practices which the West should adopt. However, he argues that other aspects, such as unconditional Just In Time control, create undesirable working conditions and should be rejected. He is arguing for an application of socio-technical systems and Just In Time in which the stress factors are removed and effort is expended to improve working conditions, specifically ergonomic conditions, machine pacing, work fragmentation and tight-coupling of the Just in Time system. To this should be added the positive socio-technical features of integration of work tasks, the development of the physical environment, less rigid coupling and a high degree of union involvement. He hopes that this will lead to improved manufacturing performance. Indeed, he feels that the JIT emphasis on standardisation and procedures would greatly benefit socio-technical systems applications:

"The Swedish long-cycle assembly systems would benefit from much more attention to details, order, and discipline (concerning tools and quality-control procedures, for example) and from much more systematic efforts to develop reliable standards for critical operations. Such efforts would help lagging teams, facilitate the training of new employees, and make it possible for qualified teams to concentrate on solving more complex problems and developing their methods." (Berggren, 1993, p. 254).

This version of integration would appear to address the human problems associated with Just In Time and discussed in the literature review. Research has established benefit in the development of working methods and the working environment. One aspect is likely to be particularly problematic, though: the decoupling, or weakening of the links between the stages of production, of the Just in Time system. Monden (1983) describes the main objective of the Toyota Production System as the elimination of waste. Decoupling the production system could only be achieved at the expense of waste creation, as buffer stock is created to ease the pressure of 'coupling'. While this may be desirable in terms of its human benefits there is an undeniable cost.

"The ultimate purpose of the Toyota production system is to increase profit by reducing costs. Cost reduction is achieved by eliminating waste; waste is exposed and eliminated by Just In Time production..."

"To practice smoothing the total production quantity without occurrence of waste between processes, the final assembly line and all processes must produce products according to the cycle time. This means balancing between processes (synchronisation) will be completely realised if every preceding process finishes at the same pace within the average cycle time for all specifications." (Monden, 1983, p.63-64).

Here lies the dilemma. Manufacturing performance will be determined by the integration of human and Just In Time activities. It is known that JIT can enable better and improving production performance. It is also known that socio-technical systems result in better employee motivation. The Just In Time system operates at its best when there is a relentless pursuit of the elimination of waste. This can result in unacceptable stress and a failure in the human aspects of production. A socio-technical compromise is required, which carefully integrates the pursuit of Just In Time with an enlightened approach to the motivation of employees. Further, this balance would need to be maintained on a daily basis as continuous improvement was undertaken and adjustments made to exist within a constantly changing market environment.

2.6.6. Achieving Just In Time With Autonomous Work Groups

An integrated socio-technical - Just In Time system is a far cry from the Taylorist production existing in many companies today and would require change in both

manufacturing activities and people activities. On the manufacturing side, change is necessary to move from a Taylorist method of operation to a Just In Time one, while on the socio-technical side, substantial change is also required. This literature review would indicate that change is likely in the following areas:

Just In Time (from: Ramarapu, Mehra and Frolick, 1995):

- Elimination of Waste
- Production Strategy
- Quality Control and Improvement
- Management Commitment and Employee Involvement in Decision Making
- Vendor / Supplier Participation

Socio Technical Systems (from: Buchanan, 1979):

- Development of Individual Job Content
- Development of Group Working

The autonomous work group lies at the heart of socio-technical systems implementation. It provides a framework for the application of socio-technical systems activities, with the group developing job content and the working environment. This would appear to complement ideally the JIT requirements of an expansion of employee responsibility for tasks such as maintenance and quality. A difficulty emerges, though. As previously noted, autonomous work groups have a tendency to work effectively internally, but to have difficulty integrating with external departments and functions (Larsen, 1979). At the same time, the integration of activities in a Just In Time environment to eliminate waste requires more effective integration than currently exists in Taylorist organisation (Monden 1983).

The debate on the role of supervision within an autonomous work group environment now appears relevant. It was argued that the role of supervision was to be:

- Teamwork between departments that would have overall benefit to the organisation.
- Planning on a longer term basis and improving systems of maintenance, quality control, transport, storing and other service activities.
- Transfers between product types on a longer term basis.
- Working co-operatively with supervisors and foremen from other areas to manage day to day production.
- Working with middle management, because they would now be performing more middle management oriented tasks and hence would overcome some of the difficulties posed in current supervisory systems.

Within a Just In Time environment these requirements would appear to become more important. The synchronisation of production activities requires a daily socio-technical compromise between the demands of the wider organisation and the

needs of the autonomous work group. This role would appear to be absolutely critical in integrating JIT and a more human centred approach. Further, the success of this integration can be measured in the success that is achieved in waste reduction, while maintaining human motivation. Literature was previously cited (Lowe, 1993) which argued that the development of supervision under a Taylorist regime was not remotely appropriate to this enhanced role. Instead of being the 'middle man' the supervisor would become a critical factor in Just In Time. Within human centred Just in Time, this is made even more critical. Evidence of an emerging recognition of this fact may be found in the Andersen Consulting (1993) report. A focus on this aspect of Just In Time implementation may yield valuable results, in improving on current practice. The next question is as to how this might be done?

2.7. Managing The Transition

A new role for supervision in Just in Time implementation and supervision is envisaged. How might this be brought about? The literature on the management of change covers a wide range of aspects, which should be considered. Wilson (1992), provides a framework in which the discussion can be placed. He divides the literature into four categories. There are two main divisions in the literature. First between planned and emergent change. Here the division is between approaches to change which look at how change planning can be done and those who study how change emerges, or occurs in organisations as a result of a wide range of factors. The second division is between a focus on change as a process, and a focus mainly on implementation of change.

The areas of greatest relevance to this literature review are those which focus on planned change, although some guidance may be obtained from the other writing. The literature on emergent theories first considers the process of change. The political factors, or distribution of power, within organisations is considered, looking at the effects of factions within organisations on actual change implemented, for example Hickson, et al., 1986. From an implementation standpoint, emergent theories focus on contextualism, the way in which the context of change influences the outcomes. While political factors may influence outcomes, contextualists see the implementation resulting from the context in which these factions developed (Pettigrew and Whipp, 1991). These emergent theories are important, because they provide advice as to the conditions in which change might be successfully undertaken. Indeed, socio-technical system theory includes an understanding of the open systems nature of organisations and the importance of understanding the context of the system adopted. Options exist as to the type of socio-technical system which might be adopted, but this is limited to those appropriate to a particular context.

Emergent theories consider how change results from the interplay of both contextual factors which have emerged over time and the balance of factors at a single point in

time. Planned change theories examine how change might be successfully undertaken. Process based approaches to planned change examine the processes through which a change may be managed over time. Implementation based planned change literature develops the means, or tools by which change might be brought about.

The implementation based approaches to planned change provide a range of tools which might be utilised. Lewin (1951) outlines force field analysis, the identification of factors for and against change in the organisation and the use of the concepts of freezing and unfreezing. He argues that within any organisation factors for and against change will exist. To achieve change, the current state must be unfrozen by altering the balance against change, the new state once achieved can be refrozen, by altering the balance in favour of the new status quo. Organisation development theorists look at the effect of interpersonal relationships on change, achieving change through the improvement of those relationships which inhibit change. Behaviour modification theorists (see for example, Wilson and Rosenfield, 1990) look at wider concepts of how the behaviour of individuals might be changed. This change in individual behaviour is to assist the achievement of the organisational culture which is desired through the use of theories of motivation, learning, and rewards. Management training and development is an important factor in the application of this approach.

The Organisation Development and Behaviour Modification theories are related to the literature on organisational fit, or the notion that specific types of organisations are likely to perform better in specific types of environments (see for example Lawrence and Lorsch, 1967). This is typified by the idea that a flexible, organic type of bureaucracy is likely to behave better, and has influenced much organisational activity in recent years. Miles and Snow (1984) argue that lean, decentralised action oriented structures are the most effective in today's environment, in common with much of the current literature. Quinn, (1993) argues for consensual incrementalism as the means of moving from a poor fit to a better one, overcoming the difficulties associated with alienation during rapid change.

The process and implementation of strategic change is dominated by literature described as structural functionalist by Wilson, (1992). He asserts that this literature focuses on studying organisational life as a myriad of variables within which there is a search for generalised laws of change, which it is assumed can be applied to any organisation. Literature on the achievement of change focuses on management skills and appropriate organisational structures and cultures to achieve particular desired states.

Alternative approaches to the process and implementation of change seek to understand wider factors and criticise the structural functionalist approach. They stress that this approach assumes organisational rationality, that it is assumed the actors within the organisation take decisions with complete knowledge and that are most appropriate in particular organisational conditions (see for example March and

Olsen, 1976). Incrementalism (Quinn, 1993) and the use of information technology (Martin and Clarke, 1990) are stressed as a means of overcoming the difficulties of achieving this complete knowledge. Instead, the alternative argument stresses that irrationality is more likely, that decisions are taken for a wider range of reasons, including particularly political power within the organisation. Thus the process of change is given greater emphasis. Rather than effective change being brought about by training managers in the skills necessary for appropriate behaviour and situating them within an appropriate organisational structure, it is argued that power relations must also be taken into account, as they will influence the actual decisions on change which are made (Braverman, 1974).

The literature on Just In Time accepts a broadly structural functionalist approach. This is dominated by a search for the key factors in implementation (Dear, 1988) in the hope that this will aid other organisations, whilst assuming the desirability of a decentralised, lean organisation (Monden,1983). The literature critical of Just In Time implementation to date can be argued to stem from a power perspective arguing that different forms of J.I.T. are possible theoretically, but that power has determined the form which Just In Time has taken (see Turnbull, 1988). Different perspectives are possible on the eventual form which will result. Optimists argue that market conditions tending towards flexible specialisation will produce favourable working conditions, pessimists argue that this flexible specialisation will result in poorer employee conditions, while a further group argue that flexible specialisation will not appear and that mass production in a Taylorist form, will remain (see Phillimore, 1989).

The socio-technical systems approach takes an alternative view still. It argues that an open systems approach should be taken, which involves an understanding of the external factors which will constrain the possibilities available for change within an open systems approach to organisations. They exist within and are influenced by the wider environment. However, the possibilities for change within an organisation are wider than is commonly assumed in the pessimistic literature. Options are available. The debate within the management of change literature is about two main aspects, the extent to which change is determined by uncontrollable forces, and hence the extent to which an organisation can implement specific changes within it in the face of these; and the nature of power within organisations, versus the structural functionalist approach that seeks to develop generalisable laws of change. Socio-technical systems, the development of theory on which predominately foreshadowed this approach, combines areas of each of these questions. External forces will influence change, but options will exist as to the nature of the organisations with these. Power will influence outcomes, but also, specific types of organisation are better than others. A more human centred approach is possible and can be profitable within a market environment.

An adoption of a socio-technical systems approach to Just In Time could address many of the difficulties associated with J.I.T. through incorporating an understanding of the operation of power within the organisation. Power within J.I.T. is a critical

factor, revealed by the people difficulties associated with its application (see for example Oliver, 1993). As discussed in respect of supervision, the implementation of a socio-technical systems approach to J.I.T. within an existing, Taylorist, manufacturing company implies a substantial transfer of power, from service departments to production areas and from managers to shopfloor teams. At the same time, there is an increased need for system integration to minimise waste. A very delicate balance of power must be maintained on a continuing basis. Not enough power on the shopfloor will result in a failure to achieve the responsiveness and flexibility that J.I.T. requires, while the benefits of socio-technical systems will not transpire. Too much, and integration will be poor and waste will result. This balance of power can be argued to be a determining factor in the success achieved with Just In Time.

This reveals a weakness in the current literature on Just In Time. While it is argued that J.I.T. requires the incorporation of a power oriented approach, the literature is structural functionalist, failing to adequately consider the power factor. An understanding of this, combined with the emphasis on socio-technical systems as a means of more effectively integrating human and system requirements in Just In Time would imply a radical approach to implementation. Whilst specific changes in the form of J.I.T. production and socio-technical organisation would be involved, it would also be necessary to incorporate the achievement and maintenance of the new, delicate, balance of power.

The discussion on supervision described the critical role that supervisors would play at the centre of this power balance, integrating socio-technical activities and this is further enhanced by this discussion on the effects of power in the management of change. The supervisors current role as 'man in the middle' must be dramatically altered. The implementation of a human centred approach to Just In Time would thus involve three aspects of change. First, the development of the Just In Time production system. Second, the creation of socio-technical work systems which overcome the human difficulties associated with current J.I.T. applications. Third, the achievement of the delicate balance of power within the organisation which will facilitate the implementation and operation of this new form of work organisation.

2.8. Summary

This literature review addresses the main theme of this thesis, the improvement of manufacturing production performance, through the application of Just In Time. As such it needs to be wide ranging, drawing on literature from a wide range of disciplines and focusing on those areas of these disciplines which are relevant.

The dominant theory of manufacturing organisation, since the industrial revolution, has been that of scientific management. The literature review first outlines the main tenets of this approach, with reference to the original writers in this field. Scientific

management was much criticised from a human standpoint, however, and attempts were made to humanise it. This requires an examination of those areas of human resources theory which consider human motivation. The human relations approach studied how this might be done and offered solutions through which it was argued that scientific management might be operated more effectively. This review outlines this approach but accepts the criticism levelled at scientific management from a socio-technical perspective. This criticism was that the human relations theorists assumed that scientific management itself was the most effective means of organising production. The socio-technical theorists argued that alternatives existed. While the socio-technical school levelled criticism against scientific management (or Taylorism), and proposed alternatives, little evidence is found of socio-technical systems' widespread successful adoption, and interest in its use has waned in recent years.

From a production standpoint, however, a new challenge to scientific management emerged. This was Just In Time, an approach which sought to remove waste from the production process and required dramatic change in the activities of employees. Substantial evidence exists of its successful adoption in a Japanese environment and of the resulting gap between those companies which have successfully adopted it and those that have not. Further, difficulties with the human resources elements of implementation were emerging in Western companies, which were contributing to a continuing failure to achieve 'world class' manufacturing performance.

Against this background, a socio-technical approach to Just In Time implementation is explored, with the conclusion being reached of a need to focus on the role of the supervisor or team leader. While some approaches to socio-technical systems suggest a decline in responsibilities here, evidence from a J.I.T. and socio-technical systems perspective suggests a critical role, one which is some distance from that found in most manufacturing companies. Achieving a change from the current predominantly Taylorist form of work organisation to the desired Just In Time requires an examination of the literature on the management of change. Here it is found that the conventional literature fails to deal adequately with the notion of power within organisations and therefore provides little guidance on how a transition might occur. Conventional methods, if used, are unlikely to result in the desired change.

The integration of Just In Time and socio-technical systems is therefore proposed with an emphasis on the role of the supervisor or team leader, implemented through a method of change which incorporates the understanding of the importance of the development of a new balance of power within the organisation.

Chapter 3.

Initial Theoretical Concepts and Key Hypotheses

3.1. Introduction

This chapter outlines the initial theoretical concepts and key hypotheses which emerge from the literature review. The theoretical concepts focus on the people aspects of the implementation of Just In Time. The literature reveals a growing concern with the practice of implementation, both in terms of the weaknesses in business performance resulting from inadequate attention to people factors, and from the concerns which have arisen about the experiences of employees in Just In Time manufacturing systems. A solution to these difficulties may be found by learning from the socio-technical systems approach, combining an understanding of technical and people aspects of production.

The hypotheses which are generated from the literature focus on the achievement of the integration of the socio-technical and Just In Time approaches. It is argued that supervisors have a key role in balancing the integration which will result in better implementation.

3.2. Initial Theoretical Concepts

1. *That Just In Time can be described as a combination of people and technical change.*

The definitions of Just In Time vary, but it is commonly accepted that it is a combination of people and technical change within a manufacturing company. Monden (1983) describes the Toyota production system which is often thought to have been the birthplace of Just In Time, and his description encompasses both of these aspects. Voss (1987) provides a people and technical systems definition of Just In Time, while numerous surveys find a combination of factors (for example, Ramarapu, Mehra and Frolick, 1995).

2. *That Just In Time has suffered from inadequate attention to people related issues.*

Oliver and Wilkinson (1989) and Pang and Oliver (1988) argue that there has been insufficient attention to the integration of people and technical aspects of Just In Time, in actual implementation. While companies have implemented change in both

of these areas, Mayes and Ogiwara (1992), provide evidence of increasing concern with the people related aspects of Just In Time from a managerial standpoint.

3. *That the criticisms of Just In Time people practices are similar to the criticisms of people practices in Taylorism.*

Taylorism was also criticised for inattention to people issues, see for example Boguslaw (1965). These criticisms are similar to those raised by Parker and Slaughter (1988), in their focus on increasing levels of stress and alienation amongst employees.

4. *That Just In Time requires a higher level of employee 'contribution'.*

The contribution required from employees in a Just In Time system can be argued to be higher than that in a Taylorist system. The range of activities is outlined by Monden (1983) and stems from the focus of the production system on the elimination of waste.

5. *That the socio-technical systems approach offers a way of improving employee motivation and commitment, but that it has suffered from a poor performance record.*

Studies stemming from the original work by Trist and Bamforth (1951) have demonstrated positive benefits from a socio-technical systems approach which has sought to integrate social and technical aspects of production. However, interest in this approach waned as interest in Just In Time grew. There is evidence of performance weakness (Womack, Jones and Roos, 1990) and little evidence of performance success (Kelly, 1982).

6. *That the pressure to eliminate waste in Just In Time often leads to unacceptable stress on individuals, but that waste reduction is the driving force behind performance improvement in a Just In Time system.*

The stress to employees resulting from Just In Time is documented by Fucini and Fucini (1990), Klein (1989) and others. It is argued that this stems from the relentless pursuit of waste elimination in a Just In Time system (Berggren, 1993). While it may be argued that the solution to this would be to ease the pressure (Berggren, 1993), Monden (1983) argues that this waste elimination is the key to performance improvement. It is therefore argued that any reduction in pressure to eliminate waste could, other things remaining equal, result in a reduction in manufacturing performance.

7. *That the link between management and shopfloor has been weak in a Taylorist environment, through a weak supervisory system.*

Child and Partridge (1982) describe the supervisory system in British industry. This is characterised by weak links between managers and supervisors, who are held in low esteem and have a limited range of power.

8. *That service departments have grown and acquired much responsibility for shopfloor activity under Taylorism.*

Child and Partridge (1982) argue that the decline of supervision power has taken place in the Taylorist work environment due to its predilection for specialist departments.

9. *That supervisors are increasingly recognised as an important factor in Just In Time and socio-technical systems success.*

Andersen Consulting (1993) argue that supervision is a key factor in Just In Time implementation. Lowe (1993) argues that inadequate attention is given to the changed role of supervisors in Just In Time, as functions pass from specialist departments to the shopfloor.

10. *That current approaches to change management fail to deal adequately with the concept of power inside and outside the organisation.*

Benson (1977) argues that an understanding of change must incorporate an understanding of power within and outside organisations. It is argued that much of the current literature on change (e.g. Kanter 1983) fails to take this into account.

3.3. Key Hypotheses

1. *That an improved approach to Just In Time would incorporate knowledge gained from socio-technical systems research.*

There is a similarity between the problems which are facing Just In Time and those which the socio-technical systems approach addressed with Taylorist systems. Many of the features of Just in Time can also be found in a socio-technical systems approach to manufacturing, specifically the movement of responsibility to shopfloor employees from specialists. It can be argued that the increased requirements of Just In Time from employees would be better achieved through the application of research knowledge gained from the socio-technical systems approach. Theoretically, some integration is possible (Berggren, 1993), but no work has yet been done on how this integration might be undertaken.

2. *That the approach should incorporate an understanding of the need to transfer power within the organisation.*

Benson (1977) highlights the need to consider power in the process of change, and this is reinforced in a Just in Time context by Turnbull (1988). Implementation of Just in Time in a Taylorist environment, taking power into account, would recognise the current power distribution. This is particularly highlighted in the literature as the power weakness of the supervisor and the power strength of specialist departments. It is therefore argued that the design adopted for the implementation of change should incorporate this understanding.

3. *That this approach should lead to success in technical performance.*

The implementation of this approach should lead to improved technical system performance. This is necessary to have a value in the business environment. The improved operation of Just In Time which is envisaged would lead to improved success through the combination of a reduction in stress levels, accompanied by a continuing emphasis on waste reduction, to exploit the conditions created by socio-technical systems.

4. *That this approach should lead to success in the human aspects of Just In Time.*

While technical success, in terms of company operating performance, is thought likely, it is also proposed that the human aspects of Just In Time are likely to be more successful in a socio-technical Just In Time implementation. This would mean that the criticisms of Just In Time, from a human perspective, would be addressed and that employees, far from experiencing a deterioration in working conditions, should experience an improvement.

5. *That this approach should develop a key role for supervisors.*

The literature has identified a key role for supervisors in Just In Time, a substantial change from the current position. It is argued that supervisor roles will develop through the application of this approach due to the need to balance social and technical aspects of Just In Time. It is argued that it is this balance which will determine the extent of the success achieved with both the people and performance aspects of Just In Time.

3.4. Summary

This short chapter has outlined the initial theoretical concepts involved in this study and the key hypotheses which emerge from the literature review. These can be summarised as the hypothesis that an improved implementation of Just In Time is possible through an approach which involves a key role for supervisors. The next chapter looks at how this hypothesis was to be tested.

Chapter 4.

The Research Design

4.1. Introduction

This chapter describes the research methodology which was adopted. The research context is described next, which enables an understanding of the limitations and opportunities which existed when the research was conducted. Alcan Aluminium provided case study facilities and extensive resources for the research.

The identification of the research hypothesis (in the previous chapter) and the availability of research resources, allowed the research methods to be selected. An action research approach, appropriate to both the applied nature of the research and the socio-technical systems orientation of the research was used.

4.2. Research Methods

The methods adopted for this research differ from those conventionally applied in scientific research. The conventional scientific framework is maintained but the method of following this is primarily from an action research perspective. Stock (1985) provides a framework, within which all research should be conducted. This begins with observation, to identify the area in which research will be conducted and the specific aspects on which the research should focus. The problem is defined and a hypothesis is generated, which can then be tested. This basic scientific framework is accepted by most researchers.

However, extensive deficiencies have been identified in the normal methods of conducting research within this general framework, in the social sciences especially. These are:

1. That it has a poor conceptual base (Hill, 1987). Current manufacturing research has been undertaken by academics with limited access to manufacturing companies, and by consultants under pressure to earn fees. These factors have prevented the creation of new knowledge with an adequate scientific base.

2. That empirical work and theory testing are inadequate. Ramarapu, Mehra and Frolick (1995), find that 105 articles have appeared on J.I.T. implementation since 1980 in refereed academic journals. Of these only 25 were of an empirical nature, while 65 were conceptual. It is argued that the balance of research is towards conceptual theorising, rather than empirical activity.

3. That research undertaken is of little relevance to the real world, and hence of little value to companies seeking solutions to everyday problems (Susman and Evered, 1978). This is created by the striving for internal scientific validity in research which prevents external validity being achieved.

The term action research is generally attributed to Kurt Lewin (1946), who applied the method in the social sciences, aiming to solve social problems. He was concerned with the difficulty of conducting laboratory based experiments to study complex social events. The method developed independently in the U.K. through the work of the Tavistock Institute of Human Relations, which used the method extensively in work with clients to implement and monitor change, particularly in a work environment (see for example the work of Jaques, 1951, on the Glacier Metal Co.[1]). The need for internal validity and the requirements which flow from it, is the main area of difference between normal research and action research. The internal validity requirement is defined by Argyris (1980).

"There exist rules that guide researchers in designing and executing their empirical work. One of the most fundamental rules is that scientists should strive to describe the universe as it exists; scientists should refrain from conducting research about universes that do not exist presently. A second fundamental rule is that scientists should minimise threats to the validity of their results. This rule can be approximated by striving for a priori precision, by unilaterally controlling the conditions and meanings of the research activity, and by distancing the researcher from the action context." (Argyris, 1980, p.179).

Thus, Argyris is arguing that in normal science, researchers are confined to the study of things as they are now. This is particularly affected by the requirements of distancing and unilateral control of events. These prevent active intervention or participation by researchers and limit the extent to which 'real' conditions can be the subject of research. If normal science conditions are adhered to, then, it is impossible to study new methods of implementing change within organisations. The activity undertaken would often require more active intervention by the researcher than would normally be permitted, to steer the change in the direction required. It also would prevent the change being tested in real conditions. The requirement of unilateral control of scientific conditions means that trials in volatile organisational conditions would be unacceptable. It is argued, by Argyris and others, that this has restricted the usefulness of social scientific research in the non-academic world, and will lead to marginalisation of the academic community.

An alternative approach has been developed in recent years. Action research combines making change in real conditions with addition to scientific knowledge. It is defined by Raimond (1993).

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[1] It may be of interest to the reader that the methods developed in this research were later applied by the researcher for the Glacier Metal Co. at their Ilminster, Somerset site.

"Action research is a collaboration between the researchers and the organisation studied, which is also the client. The researchers are working in the company for two purposes: to help solve the client problem and to add to the stock of human knowledge." (Raimond, 1993, pp. 103-104).

Action research involves an active role for the researcher, achieving a real change within a sponsoring organisation and making a contribution to scientific knowledge. Raimond again:

"In action research, the researcher does not simply stand on the touchline watching. The researcher joins in the play."

"By being a player in the action in the organisation he or she is better able to appreciate what is going on, is better able to understand what it means to the other players, and is better able to contribute to the action. Action research holds that it is possible for the researcher to take an active part in the organisation and, at the same time, observe the organisation." (Raimond, 1993, p. 105).

Action research permits this active role for the researcher so that a better understanding might be gained of the research subject. It is argued that this enables the researcher to gain access to real conditions which might otherwise be impossible. Assisting a company with a real change, which produces real benefits to the client is more likely to find willing clients than a proposal for access to conduct a strictly controlled, abstract scientific experiment which will have few, if any, direct benefits to the company concerned, and may incur substantial costs.

Access would not be sufficient reason, though, for abandoning scientific method. Rather, it is argued by Argyris, that scientific method, developed in the natural sciences, is flawed in its application in the social sciences. Unilateral control of conditions to enable scientific analysis is itself likely to influence results gained. Human participants in the experimental process are likely to act as they have been conditioned to act in experimental conditions. This may not produce realistic results. Further, experimental conditions themselves often require such 'unreal' control of circumstances that little useful, applicable knowledge is gained. The requirement of internal validity in research conduct thus prevents external validity being achieved.

In the conduct of action research it is not sufficient to abandon science. Indeed, Argyris, Putnam and Smith (1985) prefer the term 'action science' to imply a rigorous approach to action research which meets client needs but also meets scientific requirements. Substantial threats to scientific validity exist. These are primarily concerned with the role of the researcher and with the difficulties of ensuring objectivity. Satisfaction of the client, and hence justification of any payment by the client may lead to objectivity being reduced. The relationship between results achieved and the research activity is important too. Were results gained due to the actual research activity, or due to some other action by the client or the researcher?

Were results reported in surveys due to real change or the friendship of the subjects with the researcher? Threats exist in action research to the validity of results gained which must be taken into account when designing and conducting this type of research.

This approach to research is dependent on specific researcher skills, in conducting research in a scientific way, while engaging in managing change:

"It is argued that if the researcher is effective the hoped for outcome will come about because of the researcher's involvement, not from a detachment from the research process. Thus, a key criterion for the success of the action research approach may lie in such behaviours as empathetic understanding, taking the role of the other and in specific research methods which are more collaborative, such as participant observation and non-directive interviewing." (Gill and Johnson, 1991, p.73).

The background of the researcher will aid the exercise of these skills, as it may jeopardise the research process. It is important to distinguish between the extent to which results are due to the researchers previous experience and the extent to which they may be replicated by others. Research should therefore be designed to minimise the impact this experience might have.

The requirements of normal science lead to weaknesses in the conduct of social science research. Normal science has been criticised for a lack of relevance in the real world and this threatens both the non-academic support for research activity and the direction of real change if science is not applied. To overcome these difficulties the action research approach, allowing a more active role for the researcher, has been developed in recent years. Its application requires careful management.

4.3. Alcan Aluminium - The Research Site

The action research approach, with its emphasis on application, was chosen as the basis for the methodology which would be used in this research. The testing of the research hypothesis would benefit from application in a real industrial environment. The first stage in this research was the literature review which enabled the generation of the research hypothesis. This hypothesis, that Just In Time implementation and operation will be improved when a socio- technical systems approach is used, which focuses particularly on existing manufacturing team leaders, could only be effectively evaluated in a real industrial environment. It would involve substantial organisational change, to allow actual Just In Time implementation, and a substantial financial risk, if the approach failed. Action research, emphasising benefits for both client and science, was preferred.

An approach was made to Alcan Extrusions and Tubes, a division of British Alcan Aluminium. The author had undertaken work in this company before, which was

likely to increase the probability of a successful approach, but also the company was an ideal basis to use to test the hypothesis. Three companies existed in the division, each with different approaches to manufacturing. One would continue a broadly 'traditional' manufacturing approach throughout the conduct of the research, another was making extensive use of 'experts' in a more conventional approach to Just In Time implementation, while Alcan Extrusions Banbury, which had made some attempts to introduce Just In Time in the past could become the main trial site.

Alcan Aluminium is a Canadian company and one of the largest producers of aluminium in the world. World wide operations develop aluminium from bauxite, through a variety of production processes, for sale as finished products and at intermediate product stages. Since 1987, Alcan's performance had deteriorated relative to its competitors. Market prices had declined, particularly exacerbated by increasing exports from Eastern Europe, priced to generate hard currency. This had increased market supply, while demand had failed to keep pace.

Alcan owned 49% of Nippon Light Metal, a Japanese aluminium company. This had resulted in a stimulus towards new manufacturing systems based on two factors. First, Japanese companies locating in Western Europe that are customers of Nippon Light Metal are potential customers of Alcan. This led to collaborative arrangements that have influenced production methods and customer relationships in Britain. The second factor had been Nippon Light Metal's membership of the New Production Systems Research Association, an organisation led by Taiichi Ohno (father of Just In Time at Toyota), which was a source of assistance on the implementation of new manufacturing systems. Visits from New Production Systems Research Association and Nippon Light Metal 'experts' were a regular occurrence in British Alcan at the time of the research.

The research was intended to assist the improvement of Just In Time implementation in Alcan Extrusions and Tubes (A.E.T.). At the time of the research this division of British Alcan comprised four businesses - Alcan Extrusions Banbury, Alcan Tubes Redditch, Almetex and Alcan Speciality Extrusions Latchford. Each of these companies engaged in the production of aluminium extrusions for sale to a wide variety of markets. Aluminium extrusion is the process of pressing hot aluminium billet or log through a die to create a desired shape. This shape is cut to length and then proceeds through a variety of downstream operations, depending on customer requirements. This can include heat and or solution treatment to achieve particular metallurgical characteristics, rolling or drawing to achieve shape or particular diameters, further sawing to achieve tighter tolerances than can be achieved at the initial saw stage, packing and shipment. The normal range of support services that would be found in a western manufacturing environment exist (Maintenance, Sales, Purchasing, Finance etc.). Each site produces specific types of aluminium extrusion for particular markets, although some overlap exists.

Alcan Extrusions, in Banbury, Oxfordshire, employed approximately 500 people, operating six extrusion presses and a remelt casting facility, producing raw material

for the extrusion presses. Banbury produces a wide range of extrusion for a wide range of markets, from greenhouses to cars. Quality requirements between orders vary widely. The shopfloor organisation structure at the time of the implementation activity comprised shopfloor teams encompassing press and downstream activities related to each press. Team size varied greatly from 6 to 30, with chargehands existing in the larger teams. Each team was managed by a team leader on shifts who reported to a production manager.

Alcan Tubes, in Redditch, Warwickshire, employed approximately 300 people, operating three extrusion presses and a remelt casting facility, producing extruded tube for a wide range of markets. Downstream operations are more extensive than at Banbury, with a wider range of heat treatment facilities. Drawing of tube to achieve specified diameters and wall thickness is only undertaken at Redditch. The shopfloor organisation structure comprised smaller shopfloor teams than Banbury, with an average size of 6, each with a team leader reporting to a production manager.

Almetex is comprised of two sites (merged under one management structure during the research). The first site, Alcan Speciality Extrusions Latchford, in Warrington, Cheshire, employed approximately 150 people, operating 3 extrusion presses, producing a range of extrusions in a wider variety of alloys for a wide range of markets. Downstream operations were less extensive than Redditch. Small production teams (6 members on average) reported to shift production managers, who reported to a production manager.

Almetex, in St. Helens, Merseyside, employed approximately 120 people, operating 2 extrusion presses, producing more simple extrusion shapes. A large proportion of Almetex work is for the stockist market, leading to a greater concentration of standard extrusion shapes. Downstream operations are less extensive than those which exist elsewhere in Alcan Extrusions and Tubes.

An initial approach was made to the company in July 1992 and the research field and the likely research hypothesis were outlined to the Production Director. Agreement was reached that Alcan Extrusions and Tubes would support the research, by providing a research grant and allowing the Banbury site to be used as a trial.

4.4. An Ideal Way of Conducting the Research

The conduct of any research is likely to be limited by the conditions in which it can take place. It is useful, though, to look at the ideal way in which the research may have been conducted, to better understand the problems and benefits of the way in which it was actually done. A pure science approach to testing the hypotheses would have given the researcher more direct control over the research conditions.

This could be done in the following way. First, that trial company conditions would fulfil pure science conditions. That is, for example, a number of identical companies, in identical market conditions would be used to trial the approach to implementation presented in this thesis, while identical companies would implement using alternative methods. This would allow the effects of each type of implementation to be studied, with the confidence that the effects of each type of activity could be seen and compared. Second, that control of programme content would rest solely with the researcher. In this way, content of the programme could most accurately reflect the researcher's understanding of the research objectives. Third, that all evaluation methods could be controlled by the researcher, hence ensuring that the evaluation activity was designed to provide all of the information which the researcher desired to allow the hypotheses to be evaluated, following the research. Fourth, that the researcher should play a non-interventionist role, with research testing activity and data gathering carried out by 'independent' persons who were unlikely to have a vested interest in a positive interpretation of the results.

While these conditions may be the ideal way of conducting the research, the criticisms of them from an action research perspective, and the limitations of the conditions in which the researcher had to operate, led to the application of an action research approach which is described in the next section.

4.5. The Application of Action Research To Test The Hypotheses

This section describes the development of the action research approach in Alcan. Following agreement on the use of Alcan Extrusions and Tubes as the test site, the activities which would be undertaken to enable the hypotheses to be tested were developed. This involved the researcher combining the knowledge gained in the literature review with his own personal knowledge gained in industrial experience, with the objectives and interests of Alcan.

The literature review had allowed the researcher to understand the research which existed to date in the multidisciplinary areas which the research covers. This was combined with the experience of the researcher gained with a wide range of manufacturing companies. He was employed as Education and Training Manager with the Amalgamated Engineering Union for four years, prior to the conduct of the research and had visited and assisted the introduction of a wide range of change in industry. This led to practical knowledge which would influence the content of the research design.

The researcher's knowledge and interests were combined with the objectives of the company in allowing the research to be conducted. This was done through the researcher first gaining familiarity with the company through the conduct of prior research for his MSc. Thesis (Carr, 1992). To aid the design of the research for this thesis, interviews were held with the Production Director, all production managers

and team leaders. Group discussions with the team leaders featured too. A series of seminars involving employees throughout the company, reported in Carr (1992), had provided education in J.I.T. concepts and discussed its application at Banbury. Senior managers visited Japan to see J.I.T. application in Japanese aluminium extrusion factories.

The understanding gained from the literature review, previous researcher experience and the interviews and discussions within the company was combined in the production of an initial plan for the hypotheses testing. This was developed by the researcher and presented to the production management team at Banbury. Agreement was reached on the design of the programme which would be used. The use of a modular system, focusing on each of the implementation areas in turn was agreed with the production management team, to allow the implementation to be effectively managed. The widespread nature of the changes envisaged meant that everything could not be done at once, and the large number of people involved in the programme meant that a clear structure of implementation, understood by all would be necessary.

The application of each module would be developed as the programme progressed. The researcher would prepare detailed proposals after discussion with managers and team leaders. Applying the action research approach, the researcher would seek to ensure that an overall Just In Time direction was maintained, while working with managers with expertise and knowledge in each module subject area. For example, the maintenance module involved the researcher working with the maintenance manager, while the extrusion process module involved work with the technical manager and members of his department. Human elements of change were encompassed in both the content of the modules and the module process. Content was designed to include the development of skills and change of activities, for example, employee participation in working method development in the standard operating methods module.

A delivery system was developed which was intended to achieve the desired focus on manufacturing team leaders. Managers involved in the development of module content would also be involved in managing the implementation in that module area. A format was developed which would be used in each module. First, a seminar would be conducted to introduce the subject area concerned to the team leaders and their managers. All team leaders, covering production areas, were expected to attend the seminar at the start of each module which would last 1 - 2 days, depending on the subject matter. The seminar would provide any necessary skills and tools to assist in the planning of the change desired. Team leaders would then have one week to prepare a plan, jointly between shift based team leaders covering the same production areas. The plan would be presented to the researcher and the manager who the team leaders reported to. The plan would be discussed and agreed, detailing timescales and resources required. The plan would then be implemented by the team leaders, utilising internal or external services where appropriate. Once implementation was

completed, (on average 6 weeks later), the results would be presented to members of the production teams plus members of the Banbury production management team.

This delivery system was intended to ensure that the team leaders became the focus of the programme. They would be responsible for initiating change in their own production area and implementing the change desired. It was hoped that this would lead to higher levels of understanding and ownership of the changes implemented. The implementation would be supported by managers and the researcher, once the plans were agreed. Where team leaders experienced difficulties, efforts would be made to assist, especially where access to resources outside the control of the team was required.

A paper would be produced describing proposed module content and circulated to all managers and team leaders for comment, prior to the conduct of each module. The proposal would be amended where suggestions were made which were thought to enhance the objectives of the module concerned.

Thus, a programme to trial the implementation of the approach was established. While maintaining the emphasis on Just In Time the programme sought to maximise the involvement of manufacturing team leaders, through instituting a leading role in implementation design and management. The modules and their objectives are listed in the following table (Table 4.1.). The detailed content of each module is described in the next chapter.

Table 4.1. A summary of module content.

Module	Objectives
Continuous Improvement	To enable continual improvement skills to be learned and practised for application throughout the programme.
Housekeeping	To develop; implement and maintain a company standard for housekeeping.
Performance Measurement	To establish performance measurement which results in improvement with particular emphasis on On Time Delivery In Full.
Standard Operating Methods	The implementation of visible Standard Operating Methods.
Training	The establishment of training responsibilities and practices within the team using visible systems and trainers.
Safety	The improvement of current safety practices by increasing awareness of safety responsibilities through implementing the Safety Tag System.
The Extrusion Process	To provide a full understanding of the extrusion process in order that team leaders may maximise the contribution of the resources at their disposal.
Maintenance	To develop team equipment condition monitoring so that a fuller part may be played in maintenance.
Cost Management	To improve control of metal costs through improving measurement and introducing a pull system of work flow.
Introduction	To brief participants on the programme objectives, content and structure and to introduce visible systems and project planning.
Final Presentation	To allow team leaders to show other team leaders, team members, managers, and senior managers progress they have achieved through the programme.

4.6. Evaluation of the Trial Activity

This approach clearly falls within that of action research. The conditions of normal science are over-ridden by the active role of the researcher and the impossibility of unilateral control that the real industrial environment possessed. Evaluation would need to take this into account and be rigorous. The evaluation would not only need to satisfy scientific requirements, but would also need to satisfy company requirements

for real progress in the areas being studied. This section describes the evaluation activity which would be undertaken.

A series of activities were designed to evaluate the programme. Prior to the conduct of each module, clear objectives were identified which would be used to evaluate the success of that individual module. After module conduct, an understanding of the extent of the success achieved could be gained from comparison with actual results. At the end of each module seminar, a questionnaire was completed by all participants, gathering data on the perceptions of module seminar conduct and any suggestions for improvement. This provided valuable information for use in evaluating the seminars and also in identifying areas for attention in implementation. At the end of each module, team leaders presented the results achieved to their peers, managers and team members. The researcher also maintained a diary of module implementation events. It was thus possible to develop a descriptive account of the hypothesis test activity.

In addition to describing the practical activity which formed each module, survey activity was undertaken to enable a more objective picture to be established and to enable comparison to be made between the different Alcan Extrusions and Tubes sites. The characteristics of the different sites have previously been outlined. Surveying was required to understand the development of the non-Banbury sites during the test period and to enable comparisons to be made. Three surveys were developed. The first was an interview survey, which was conducted with all members of the production management above team or shift leader level at all Alcan Extrusions and Tubes sites. This would allow an outline of activity to be developed, to aid in the interpretation of the second survey. This was followed by a survey of all employees of Alcan Extrusions and Tubes, which was intended to identify differences in perception of the activities on each site, by employees at all levels of the company. This would aid the evaluation of the impact of the trial activity, and was conducted three months after the trial was completed. Finally, a survey was undertaken three years after the trial completion, of team leaders, to assist the assessment of the continuing impact of the trial. The surveys were intended to both provide scientific data for the researcher and to provide information to the company which would aid the development of future company activity.

The first survey, of Alcan Extrusions and Tubes production management was aimed at gaining a broad understanding of Just In Time activity at all A.E.T. sites. Questions would focus on both areas, but the survey was required to be wide ranging, drawing out all activities in these areas and the attitudes of those surveyed. A cross-sectional design was identified as being appropriate, surveying all production managers at a single point in time, providing a 'snapshot' of development immediately after the programme completion. A sample, consisting of all company production managers (twenty in total) was considered appropriate for this survey. They would be expected to possess the overview knowledge that the survey was intended to elicit. A depth interview survey method was adopted, to enable the survey to range as freely as possible. The survey content was developed in consultation with the company senior

management team. An initial draft prepared by the researcher was discussed with the company Production Director and agreement reached on the final content. The surveying was conducted by the researcher, due to the specialised skill required to conduct effective depth interviews (see Oppenheim, 1992).

The second survey was aimed at gaining a more detailed understanding of perceptions of change in recent years throughout the company. Views of success of J.I.T. implementation would give some indication of actual success areas and areas of weakness. Comparisons between and within sites could be related to the changes which were discovered to have taken place by use of the first survey and which had been undertaken as the test programme at Banbury. The success of the approach specifically focusing on team leaders could be evaluated using this survey. Perceptions of team leaders by their reports, managers and service departments would give some indication as to how successfully their role had developed. In addition, the views of team leaders themselves would identify their feelings about the change programme.

It was intended to assess attitudes to the changes which had taken place at all company levels, and was designed to focus on both Just In Time and socio technical systems changes, as well as any other changes the company might have made. The company were willing to allow a full survey of all employees throughout Alcan Extrusions and Tubes, because they perceived a value to the company of the information gained. This would also be of value to the researcher because it would allow detailed information to be gained on employee attitudes for use in the study. The survey thus aimed to satisfy company and research objectives.

The survey was designed through an initial draft being prepared by the researcher and this being considered and amended by the Banbury Production Director. Three Banbury team leaders were shown the design and their comments were taken into account too. The final draft was submitted to the Alcan Extrusions and Tubes management team for their comments. Piloting of the survey was undertaken at Banbury with a sample of ten employees completing the full survey and being consulted on its content. With some minor revisions for language, the survey wording was agreed.

The design adopted was intended to maximise data collected, while also maximising ease of completion. An interview survey would clearly not be practical with a sample size of 820. It had to be capable of being understood and completed by all employees from boardroom to shopfloor. A Likert scale method was chosen for the majority of questions due to its ease of use by both researcher and respondent, while being generally accepted as an effective method of surveying attitudes (Oppenheim, 1992). Likert scaling asks respondents to grade their own degree of feeling about a particular issue. Often feelings for a series of factors are aggregated to produce a total score. However, Likert scales are criticised when used in this way for their lack of reproducibility; total scores can be achieved in a variety of ways. It was therefore

decided that analysis would be confined to the scores given for individual questions and the pattern of responses.

The survey would be completed as a group administered questionnaire, in groups (averaging ten in size) by nominated representatives from each company site. These representatives were briefed and provided with written survey conduct instructions by the researcher. An average of 20 minutes was required to complete the survey.

The question order was intended to begin with easier questions about the future, position more difficult question areas towards the middle and end and conclude with a simple question on involvement The first section of the survey explained the survey conduct. Next respondents were classified by work area and level to allow detailed statistical analysis to be undertaken, splitting results by department and level. Section two asked the effect that respondents felt that specific changes would have on company performance if they were made in the next five years. A range of areas were covered which mixed the areas which were agreed with the company as possible areas of change, but which would also elicit information for the researcher's scientific purposes.

Effective evaluation of the research is discussed by Jick (1979). He argues that triangulation of research methods should allow researchers to be more confident about their results by combining different research methods to study the same subject. It should assist the discovery of additional knowledge through looking at the subject in a different way. While the results of the employee survey would give an indication of views immediately after the implementation of the test programme at Banbury and the observation of module conduct would allow an understanding to be gained of the programme affects, the action research approach adopted would still suffer from criticisms of its internal validity due to the role of the researcher and the action environment in which it was undertaken.

A survey was therefore designed to be conducted with Banbury team leaders, three years after the programme completion. This survey looked at the perceived continuing impact of the programme with an interview questionnaire, (see Appendix D). This was once again designed with the Banbury management team and covered the main aspects of Just In Time and people activities.

4.7. The Relationship Between The Research Activity and The Hypotheses

The key hypotheses to be studied in this thesis were detailed in the previous chapter. The research methods described above were intended to test these hypotheses as follows:

1. *That an improved approach to Just In Time would incorporate knowledge gained from socio-technical systems research.*

The design of the modular programme would need to incorporate the objective of Just In Time and the knowledge of socio-technical systems research. This was done through the researcher's role in initial module formulation and design of the content of each module. The testing of this hypothesis would be done through the observation of module activity and the surveying of attitudes to different possible changes which included these elements.

2. *That the approach should incorporate an understanding of the need to transfer power within the organisation.*

The transfer of power in the organisation was incorporated in the design of the programme through the central role of the team leader on the initiation of change, the approval role of the manager and the assistance role of service departments and managers. It was hoped that this would lead to a fundamental shift of power towards team leaders. This would be tested, again, through observation and the use of the survey data.

3. *That this approach should lead to success in technical performance.*

Technical performance would be assessed by examining the attitudes of survey respondents to company performance during the programme conduct. The surveys would be used, rather than actual performance statistics, which it was thought would be contaminated with other influences.

4. *That this approach should lead to success in the human aspects of Just In Time.*

The human aspects of Just In Time were identified in the literature review. The researcher would seek to influence the module content to ensure that the human aspects of Just In Time were addressed. These would be tested with the surveying of individual employees, about their attitudes in these areas.

5. *That this approach should develop a key role for supervisors.*

The programme structure, focusing on supervisors, was intended to support the development of this key role. Understanding of the actual results of this was to be tested using the observation of the module conduct, the survey immediately following the programme completion, and the survey conducted three years later.

4.8. Expected Research Contribution

The contribution that this research is expected to make falls in two areas. First there is the establishment of a new approach to the implementation of change within industry. The method which is tested in this thesis is the focus on manufacturing first line managers to design and implement change. It is expected that this will allow knowledge to be developed on the general use of this approach and about the detail of its application.

The second area of research contribution is expected to be on the implementation of Just In Time manufacturing. The method developed is to be applied to implementing Just In Time and thus knowledge is expected to be gained on the specific application of the method here.

The action research approach adopted in the research is intended to enable the research to contribute to both academic and industrial knowledge. While it should support the conduct of further research in this area, it should also assist industrial practitioners in the improvement of industrial operations.

4.9. Summary

This chapter has described the methods which were to be used in the conduct of the research. An action research approach was adopted which it was hoped would allow the research to be of value due to its application in real industrial conditions. However, this approach would suffer from potential criticism of its internal validity due to the absence of the ability to control research activity in an ideal scientific manner.

The research design incorporated a modular approach to the conduct of a trial programme in Alcan Extrusions and Tubes over a one year period and evaluation of this programme both during its conduct and afterwards. This evaluation would use a variety of methods, an approach known as triangulation, to offset the difficulties of action research and to allow a better understanding of the hypotheses testing to be gained. Thus, three surveys were used, first of company managers, second of all company employees and third of the Banbury team leaders.

This approach was intended to gain knowledge which would assist the more effective implementation of change in a manufacturing environment, in this case applied to the Just In Time approach. The next chapter describes the conduct of the research.

Chapter 5.

Research Conduct

5.1. Introduction

This chapter describes the activity which was undertaken to trial the adoption of the new approach to the implementation of Just In Time. An outline of the framework used for all modules is first provided. This involved a module design by company experts with the assistance of the researcher, followed by consultation with the company management team. The agreed module design was then followed in module conduct. First, a seminar for team leaders and managers was provided, team leaders prepared project plans, agreed these with the researcher, the experts and their manager and then a project was undertaken to implement the change desired. A period ranging from 2 to 8 weeks depending on the module subject was allowed for implementation. Each implementation was followed by a presentation to managers, team members and senior managers. Visibility of implementation activity was stressed throughout the programme.

Three surveys were used to gather information on the trial, which were described in the previous chapter. The conduct of these surveys is described here.

5.2. The Modular Programme

A modular approach was identified as being the appropriate method for the delivery of the programme which was intended to test the research hypotheses. This was led by the researcher and commenced in September 1991 and completed in September 1992. This section describes the activity which was undertaken in each module. It was gathered by the maintenance of a diary on the programme operation and assisted by the presentations made by the team leaders at the end of each module. Sample module materials appear in Appendix C.

5.2.1. Module 1. The Introduction

The Introduction was intended to establish a firm foundation for the programme and to communicate the direction that the programme would take. The first seminar would provide an overview of the programme as a whole, to allow participants to contribute towards programme content, to establish programme principles and to provide some basic foundation skills that would be used in each module. The objective of the first module was to brief participants on the programme objectives, content and structure and to introduce visible systems and project planning.

A two day seminar was presented and co-ordinated by the Works Director and the researcher. The seminar began with an introduction by a senior member of the management team and administrative arrangements, outlining the programme for the day, summarising the content of the programme as a whole and the objectives for this module. Time required for projects was to be agreed between participants and their manager and it was decided that in cases of dispute this would be resolved with the Works Director. Project resource allocation would be through normal managerial decision making channels.

An exercise was designed to develop discussion and consensus on the progress made on improvement to date. Participants were asked to score developments with people and production on a scale of 1 to 5 and discussion focused on the scores given, highlighting agreement and disagreement. This provided an opportunity for participants to express doubts and insecurities and for the researcher and managers present to comment. Actual company progress was then displayed (from company statistical sources) and contrasted with the perceptions of participants. Reasons for variance in perception were discussed (e.g.. poor communications or poor data collection). The surveys of managers, team leaders and shopfloor employees were considered next, with discussion on how these affected the current position and what opportunities and problems they may provide in future.

This examination of the company's current position culminated in an identification of the skills and qualities required in future by team leaders and team members. Identification of how this differed from the past was undertaken. A short psychometric test was then distributed which allowed individuals to consider how they compared with what they agreed was required. Individuals prepared their own results and these were not collected, demonstrating that the approach of the programme would be to help individuals change, not to identify fault and punish.

Participants were next given the opportunity to examine the content of each module. The approach to be taken was first outlined, i.e. seminar, project plan, plan approval by the researcher and manager, project implementation and project presentation. Each module description was discussed with modifications being taken into account where appropriate.

A framework of basic project management skills was thought to be essential for use throughout the programme. Every module involved a substantial project. A definition of project management was first provided stressing the uncertain nature of projects. A basic outline of project stages was given which emphasised the need for good planning. A comparison was made between the U.K. and Japan which illustrated how good planning could assist effective implementation. Details of report content were discussed and agreed. Reports were normally through presentations to managers, team members and the tutors. Suggestions for controlling implementation and, in particular, for managing meetings were discussed, illustrating the need for a practical approach to project management.

Costings of projects were considered next, with the assistance of the company management accountant. Past team leader experience of costing focused on the cost of peripheral items such as gloves, overalls etc. The main costs which they influence were in the production process e.g. stock, set up time, labour utilisation, customer service etc. This was explained and a format for displaying project costs and benefits was provided. These costings were important to establish proper cost justification of changes in future, to encourage decision making on a sound financial basis.

The importance of good communications was established. Team leaders considered their role in leading change identifying that leadership skills required good communications. A short exercise examined current communications practices. Feedback routes for team members were discussed, identifying the value of people receiving feedback from those whom they supply. The seminar next focused on the importance of visibility. Examples were provided from other companies. Participants were asked to develop a form of visibility for making their progress on this programme visible to team members. This was then rapidly implemented after the seminar.

Forms were distributed and individuals were asked for comments and suggestions on the conduct of the seminar. Project dates were agreed. The project for this module was to brief team members on programme content, in the presence of their production manager and the researcher. This was to be completed prior to the commencement of the next module (one week hence). Dates and times were agreed in the seminar.

The briefings were intended to ensure that team members were fully aware of why team leaders were not present in the team during seminar and project activity and to stress the participative approach being taken. The attendance of the production manager at the briefing was thought to be important because it emphasised that the team leader development was part of mainstream company activities. However, the organisation of the briefing by the team leader stressed that he was in control. Responsibility was established for the success of future projects.

5.2.2. Module 2. Continuous Improvement

Continuous improvement has been established as a feature in most Just In Time implementations. It is used to reduce waste in the production process and so fine tune the production system. It could also satisfy a number of the objectives of socio-technical systems. It could increase control over work standards and work activity through giving shopfloor teams greater ability to make improvements and improve communications through developing a regular framework of improvement meetings.

The module design process had decided that it would do this in a number of ways. First it would begin to establish the new relationships between the team leaders and

specialist departments through collaboration on the projects which emerged. Second, it was intended to provide a range of group working skills, which the team leaders would use during the rest of the programme, as well as in their new role. Third, the projects were intended to begin to establish an improved credibility for the team leaders with their managers, peers, specialist departments and the members of their teams, through successful completion of improvement projects. Finally, an emphasis on project results was intended to assist the establishment of a performance orientation to the programme.

The module seminar focused on the use of continuous improvement techniques. The seminar was presented and projects co-ordinated by the Production Services manager and the researcher. The approach taken here was that it was necessary to link involvement of people in the techniques with the use of the techniques themselves. The participants were involved through practising the use of the techniques in the seminar. The tutors would ensure that all participants led the use of at least one technique. Before introducing the techniques the tutors established why they were being used and that the company was determined to act on the results. It was known from the previous survey activity that individuals had put forward ideas for improvement in the past which were not acted upon. The first subject therefore focused on Deming arguments on Quality. The competitive situation (greater competition, greater quality) was explained and the options that the company had for responding to this detailed. Either costs would be cut in traditional ways, with undesirable results for people and the company, or the company would improve the quality of its process and product to become more competitive.

Deming's 14 points (Deming, 1986) were offered as a framework for the changes likely to be necessary to operate in a quality centred way. Participants were asked to comment on the progress made to date by the company in each of the 14 areas. This subject was intended to provide a direction for the rest of the seminar, establishing the commercial necessity of a quality centred approach. The proper involvement of people in the use of the techniques was thought to be essential. They were intended to be used in a group format.

Techniques for encouraging discussion were introduced (open and closed questions). Two exercises were used to establish the points made. Brainstorming was the next subject. This session stressed the importance of following brainstorming rules which ensured full participation. Examples were used to enable participants to practise the brainstorming techniques and to allow illustration of the consequences of not following the rules.

Data collection techniques were introduced next to support the development of a scientific approach to problem solving. This session looked at data types, data collection techniques (checklists, checksheets, drawings and tally sheets) and data analysis through Pareto Charts. The need to justify an improvement with data was strongly stressed. Participants were asked to design their own formats for data gathering and analysis for examples which were provided.

Fishbone diagrams allow problems to be broken down into their constituent parts. Participants were led through the seven stages used in the construction of Fishbone diagrams and examples were used to practice the use of the technique. Brainstorming was revised to emphasise the use of brainstorming in adding branches to the fishbone. While the previous techniques allowed individual problems to be looked at, Process Flow Diagrams allow a view to be taken of the process which should allow the inter-relationships of activities to be examined. This was important because the implications of activities undertaken in one area on another should be taken into account when changes are planned. Three flow diagram symbols were introduced which were though to be sufficient for basic use of this technique (start/end, process and decision). Process Cause and Effect Analysis, which combines fishbone diagrams and flow diagrams, was introduced which brought together the techniques learned during the seminar.

Project dates were agreed for presentation to managers and the tutors of the project plan and the presentation of project results to an invited audience. The project for this module was to identify a problem faced by the team and solve it through the use of one or more of the techniques. A presentation report would be prepared, detailing how the selected techniques had been used, and the progress made on solving the problem.

5.2.3. Module 3. Housekeeping

The focus of the third module, housekeeping, was intended to address predominately social aspects of production. Through attention to housekeeping activity, it was intended that the working environment be improved, thus improving perceptions of the value of employee skill, knowledge and effort. Further, it was intended that control over the nature of the working environment would be moved from management to the team leader, who, following module completion, would be responsible for maintaining the working environment at a high standard. Thus shopfloor teams would be acquiring responsibility for more auxiliary tasks. From a Just In Time perspective, housekeeping is intended to enable greater visibility of the production process, to assist the reduction of waste through its easier identification.

Housekeeping activities were intended to make the workplace safer, be easier for employees to work in, be more efficient when tools were more easily found and faults were more easily identified, less tiring and aggravating and generally a more pleasant place to work. The objective of this module was to develop, implement and maintain a company standard for housekeeping. The seminar was presented and the projects were co-ordinated by the Employee Relations manager and the researcher.

This seminar began with a discussion on company housekeeping standards. Photographic slides had been taken of the factory to illustrate unacceptable practices and these were shown. Discussion on the standard of housekeeping followed. When

this was concluded, three main areas of housekeeping activity were identified: Cleanliness, Painting and 'A Place For Everything'. In each of these areas, survey forms were developed. After an introduction to the principles in each area, team leaders toured the shopfloor and identified changes required, the materials required to make the changes, the time required to make the changes, and any assistance they required from outside their team. Once these forms were completed, a formal plan could be developed for presentation to their managers and the programme leader. The area is brought up to the required standard and visible systems implemented to maintain it. A presentation, including a tour of the team area followed.

5.2.4. Module 4. Performance Measures

The feedback of results of the work employees do is an important element in socio-technical systems and Just In Time. Through understanding their own performance better employees are encouraged to make improvement. This module was intended to change performance measurement from that undertaken to support the work of managers and specialists, to being used to support the work of team leaders and their teams.

Much effort was put into the production of statistics at Banbury which were intended to improve production. A survey was conducted in early December 1991 to analyse the usage of currently available performance reports within extrusions departments in the company. Examples of reports were collected from statistic producing departments and circulated with a questionnaire to team leaders and managers in Production Departments. Reports produced by individual Departments and used by that department were not included. It was found that while much data gathering supported management activity, there was little data which was felt to be relevant to the activities of team leaders. The module would then seek to establish data gathering to aid team leader activity and hence give him more control of the work area. This would also contribute to the development of relationships between service departments and the team leaders, through the provision of data to team leaders by them.

A response rate of about 90% was achieved to the survey, so there can be reasonable confidence about the accuracy of the statistics gained. Forty-nine different reports were analysed. The findings can be summarised thus:

1. Very little data provided by the current performance measures systems was currently used on the shopfloor for performance improvement.

2. The data usage which did occur was inconsistent. Some people used it and some did not. Fewer than half the respondents used any one report for improvement. Reports which were used tended to focus on detail.

3. There was great variability in who saw reports in each department. This reflected a possible lack of focus and varying priorities. This may have been appropriate, reflecting differing departmental conditions but it was unlikely to be appropriate to the extent reflected in the statistics.

4. The overall clarity of the data provided was poor. An average score of 2.18 out of 5.00 on a scale ranging from 1.00 very unclear to 5.00 very clear was found for all reports.

5. Very few reports were thought by more than half the respondents to be either appropriate for Team Briefings (2 reports) or noticeboards (4 reports).

6. The most useful report for Team Briefing was the Team Brief Commentary, provided by the Works Director. This, was the only report which contained no statistics and simply gave opinion.

This module was intended to establish performance measurement which assisted team leaders in making improvement with particular emphasis on On Time Delivery In Full, which the company management team felt was their key performance target. The seminar was presented and the project was co-ordinated by the company Management Accountant, a Production Manager and the Programme Leader.

This seminar first looked at the current company performance measures systems, examining why performance measurement was used and how they were derived. Team leaders were then shown the survey results for the company and a discussion was held on their implications. The value of Lead Time reduction as a main performance aim, towards On Time Delivery In Full was outlined. An exercise followed on Lead Time reduction, identifying critical factors affecting Lead Time at each process stage. A planning form was used to identify appropriate measures of each critical factor to enable improvements to be made, with the involvement of team members. The project for this module involved the establishment of new measures for a fixed period (1 week) and a presentation on progress achieved.

5.2.5. Module 5. Standard Operating Methods

The standardisation of working methods is often noted as a critical component of Just In Time, see for example Monden, 1983. It is argued that standardisation allows J.I.T. to operate effectively but can restrict employee influence over working methods (Berggren, 1993). In the module, it was intended that working methods be standardised, but that content of the standardised methods would be influenced by the team and controlled by the team leader. Thus, while the benefits of standardisation could be gained, it was hoped that this would not be at the expense of the social benefits of employee participation in work method content. Rather, a design was adopted which was intended to give employees more control over working methods,

to vary the work cycle and undertake more preparatory tasks, as advocated in socio-technical systems theory.

A Standard Operating Method (the subject of Module 5) was defined by Alcan as the best way currently known to perform each operation in the production process which achieves requirements for safety, quality and productivity. It should detail the sequence of steps to follow when undertaking the operation and highlight safety, quality and productivity elements at each stage. By creating a common working method, activity is possible to study how work is carried out and identify where improvements might be made.

The Standard Operating Method is not a Training Syllabus but it should provide guidelines which will help operators who are already working at the operation to work more effectively. Over time the method will be developed to reflect new working methods which produce to new market requirements, are used for new equipment or are developed by operators' study of the process. S.O.M.s are based on the principle that most people want to do their job well. They have ideas about how their job could be done better, they want the opportunity to try these out and, if improvements result, to change the way the job is usually done. In factories where shift systems and/or flexibility exist, arguments about the best way to do the job could be frequent. The establishment of a Standard Operating Method system provides a structured, analytical method to continually improve the way work is done.

The objective of this module was the implementation of visible Standard Operating Methods. The seminar was presented and the project co-ordinated by the Production Services Manager and the Programme Leader. The seminar first established why Standard Operating Methods were required and what they were. This was a substantial change to current operating practices. Team members could be concerned that increased control of their work activity was likely. Team leaders would be aware of this and apprehensive until these fears were overcome. Once this had been achieved, attention could focus on the development of the Standard Operating Method. Charting methods, derived from the Alcan Kaizen programme were used, which allowed operating methods to be studied. Team leaders were divided into groups and asked to develop a Standard Operating Method for the same operation. This enabled comparisons to be made and areas for improvement to be identified.

The project focused on the implementation of standard operations in teams. A presentation was made to managers on changes made in the work area.

5.2.6. Module 6. Training

The control of training within the team was intended to give the team leader control of skills development within his team and the ability to develop flexibility and employee job content. By providing skills in training and an expectation of the

management of team skills, it was hoped that dependence on personnel department support could be reduced. While the previous module had established the need for standard operating methods, this module was intended to provide the skill, framework and power required to manage these effectively.

Within Just In Time, flexibility and the ability to undertake work competently are more important than in a conventional environment. This module was intended to improve this at Banbury. From a socio-technical systems viewpoint, this would further build on the work done on standard operating methods and increase the control of the team over its skill development. Maintenance of skill levels would feature an emphasis on job rotation.

At Banbury, the training system was in disarray. Trainers had been appointed within each shopfloor team but most had little or no involvement in training because much confusion existed about the role they were expected to perform. Meanwhile, task flexibility between shopfloor operators was thought to be limited by a lack of skill. There was a need to continually update skills as working methods are improved. The transfer of improvements between shifts and departments could be limited by the lack of an adequate training system. Current redundancies focused attention on the need for improvement.

Training was the subject of much change outside the company with the development of National Vocational Qualifications and Investors In People etc. in the U.K. It was felt to be important that the system developed was consistent with these developments. It was also thought to be important to consider the future role of the Personnel Department to support training. This would be mainly to service this system; providing new skills and training methods, gaining experience from other companies, and ensuring that the new system was continually improved.

The objective for this module, then, was the establishment of training responsibilities and practices within the team using visible systems and trainers. The seminar was presented and projects co-ordinated by the Personnel Operations Manager and the researcher. This seminar was attended by team leaders and the trainers who were members of their teams. The first seminar day began with an introduction to the module and was then devoted to Task Analysis. This is a technique derived from the International Safety Rating System which allows all operations to be analysed for potential losses due to safety, quality or productivity problems. A numerical scoring system is used to do this. This technique is thought to be useful both for analysing operations and eliminating loss potential but also as a framework for developing training syllabuses for each operation.

The second day began with a look at training syllabuses. A format for this had been developed with the Personnel Department which would be displayed at each work station. After an initial briefing, an exercise on syllabus construction was undertaken. Training Needs Analysis followed the syllabus construction and the framework for training provision was developed. Visibility of training plan development and

delivery was stressed. An exercise in needs analysis gave a rough outline of the training needs of individual teams.

For the module project, each team leader and Trainer were to prepare an analysis of the training needs of their team. A training plan was developed and presented to the manager and researcher. Once this had been agreed, visible systems were established and the plan implemented.

5.2.7. Module 7. Safety

Possible increases in stress levels in a Just In Time environment were likely to increase safety problems. It would therefore be important to include a module which would seek to improve the safety elements of manufacturing activity. The Safety module was also intended to further develop the socio-technical aspects of production through improving safety within the workplace, but also to transfer power to act on safety from managers and service departments, to the shopfloor team. This module was intended as a consolidation of existing safety activity within the company and the introduction of a new safety visibility practice which was intended to focus attention on activity to solve safety problems in each area. Safety Representatives attended the training seminar with the team leaders and the project for this module was carried out and presented jointly.

Surveying of team members revealed some doubt as to management commitment to a safe working environment, in the Quest seminars. Simply put, they felt that while a lot was said, little was done. The main theme of this module is to focus attention on action to improve safety. Prior to the module, a monthly safety meeting considered safety issues and decided on action which would be minuted and displayed on the noticeboards. This would be enhanced by greater visibility and greater involvement of team members. A visible action system was developed, based on a departmental Safety Board. The first task of this board was to record safety problems between safety meetings and to provide a focus for discussion at that meeting.

The second task was to stimulate activity to solve safety problems between safety meetings. Each departmental Safety Board has a limited number of large safety tags which are removed from the board and placed on items of equipment or areas of activity requiring attention for safety reasons. These fall in three categories: Maintenance, Accident or Incident. Maintenance tags are Red while Accident and Incident tags are Yellow. The tags contain blank spaces for recording the date and time of placement and a summary of the problem with a dry marker. Anyone has the authority to remove a tag from the board and place it on the shopfloor. A tag should only be replaced on the board when the team leader and the safety rep decide that it has been placed wrongly. If they do not agree, the manager decides.

Maintenance tags are replaced on the board when tasks are completed. Accident and Incident tags are replaced on the board by the next safety meeting. Part of that

meeting is a tour of the department and a removal of all tags where problems have been solved. If action has not yet been taken, the tags stay in place and the issue is discussed at the safety meeting. If this resolves the issue the tag can then be removed, if not it stays until the next safety meeting. It is important to stress that the tag is not replaced until the problem has been resolved. This warns others of the danger and focus attention on the action to resolve. Removal of all of the maintenance tags from the board signals that a serious situation exists and that urgent action is necessary. Within 24 hours an emergency safety meeting is held and action taken. Whichever shift removes the last tag organises this. The number of tags is decided by the safety meeting. Their objective should be to operate with as few tags as possible, indicating safe working practices and good preventative maintenance. Records of performance are kept which record the number of tags used in each category and the length of time before action is taken.

The improvement of current safety practices by increasing awareness of safety responsibilities through implementing the Safety Tag System was the objective of this module. The seminar was presented and projects co-ordinated by the Personnel Operations Manager, the Remelt Manager (a company safety auditor) and the researcher.

There were a myriad of safety practices at Banbury. The first stage of this module was a consolidation of these practices to ensure that they were being followed properly in all areas. This included a review of basic health and safety legislation, an outline of safety responsibilities, accident reporting and a discussion of the more pertinent results of a safety survey which had recently been undertaken. Particular attention focused on the company Safety Contact Scheme, incident reporting (providing an opportunity to brief people about new forms being used for this) and the development of standard operating methods which integrate with the programme of work currently under way in this area. Analysing safety training needs also featured here with a view to the provision of training to fill any gaps. The first half of the first day was used to provide this skill.

The Safety Tag System was outlined and team leaders surveyed each others' areas to identify sites for tags if the system was operational at present. This enabled discussion to take place on appropriate use of the system and provided a list of areas of action before the system commenced. The project for this module was to establish the new safety visibility system. Team leaders and Safety Reps would prepare a joint report on the introduction and operation of this system.

5.2.8. Module 8. Extrusion Process

Through greater levels of technical understanding of the production process, it was hoped that team leaders would be able to influence a range of factors which were normally controlled from outside the team. Technical expertise would normally reside with technical experts. This module would transfer some of that understanding

to team leaders giving them the ability to make decisions about processing methods and working methods which followed from these. It would allow him to make better judgements on the use of service functions. This, it was hoped, would allow more effective waste reduction, so improving the operation of the Just In Time system. It may also increase the perception of employees of the meaningfulness of the tasks performed, by creating a better understanding of extrusion activity and a better understanding of how they contributed to the end product produced.

This module focused attention on the understanding and improvement of the Extrusion Process, incorporating remelt, die making and die correction as well as press operations. The objective of this module was to provide knowledge about the process and on process improvement techniques and to allow experience to be gained in making improvements with the module project. While knowledge existed about the process, it was thought that this was 'patchy' and rarely comprehensive. An understanding of the current quality systems and in particular the standard BS 5750 and its relationship to improvement was thought to be important to team leaders in their projects, because a failure to adhere to these systems could have serious implications for the company if approval was lost, but also this would assist the release from dependency on external departments. Continuous Improvement covered group problem solving techniques and some data collection issues. Statistical Process Control utilised several techniques, some of which would be applicable at Banbury, even within a very variable process.

The seminar was presented and the projects co-ordinated by the Die Resources manager, the Remelt Technician, the Technical manager and the researcher. The training session provides understanding in the following areas: Casting and Homogenising, Extrusion Conditions, ((Ageing, Various Alloys (Anodising and Non - Anodising), Extrusion Speed Setting and Die Technology Development, which are all elements of the extrusion process. More advanced techniques for the utilisation of this knowledge follow, with Statistical Process Control being stressed.

To date, projects had been conducted within departments. The Extrusion Process created an opportunity to work across departments to gain greater understanding of the whole process. Three project groups were established - one per shift - incorporating team leaders from Remelt, Production and Die Resources. The project objective was to improve performance on a selection of dies across site (one per press) by studying the characteristics of their performance and making the necessary improvements. This project allowed experience to be gained on the whole process as well as the application of more advanced continuous improvement techniques.

5.2.9. Module 9. Maintenance

Control over maintenance activity was intended to give the team leader more ability to control the operation of equipment, and a better understanding of the relationship between the operation of the equipment and the quality and volume of product made.

This would further extend the ability to continuously improve the production process and to solve more quickly production problems which arose. It would also address socio-technical systems aspects. Adoption of maintenance duties and skills within the shopfloor team could increase the completion of preparation and auxiliary tasks and allow tasks to be grouped more effectively in the shopfloor team.

Prior to the conduct of this module, much activity had taken place to transfer routine maintenance activity to shopfloor personnel. This module was intended to reduce the 'fire-fighting' aspect of this and institute team equipment condition monitoring to enable potential equipment failure to be identified and rectifications made, either by shopfloor operators or maintenance craftsmen.

The seminar was presented and project co-ordinated by the Maintenance Manager, The Engineering manager and the researcher. The seminar first looked at the team leader's changing role. Now team leaders have responsibility for some maintenance activity within their team. It was thought that this could be improved through condition monitoring. An introduction was followed with a discussion on the performance of the Banbury Maintenance Department to date. This allowed the Maintenance Department to gain feedback from their 'customers' and also ensured that the seminar was not viewed as simply an attempt to shift blame. Reliability Centred Maintenance (R.C.M.) was described next, the main theme being pursued by the Maintenance Department. This allows the team leaders to understand condition monitoring in the context of wider maintenance activity. Total Productive Maintenance (T.P.M.) is the next stage beyond R.C.M. and was discussed more briefly to give team leaders an insight into future maintenance activity. Finally, the principles and practices of condition monitoring were outlined, with practical exercises focusing on its application. The theory here is that machinery will exhibit normal running characteristics which can be measured in terms of pressure, distance, time, temperature, sound etc., which will vary when machine performance deteriorates.

This module's project covered the acquisition of a series of measurements from extrusion presses which indicated normal performance. These were then made visible and used by the team to improve equipment performance.

5.2.10. Module 10. Cost Management

The cost management module was intended to strengthen the power of team leaders to control workflow, at the same time as the workflow method was to be developed to implement pull systems for Just In Time. It was hoped that this would shift power from schedulers and managers, and increase the ability of the team leader to control work effort and employee work duties.

The module focused first on metal cost control. This was for two reasons. First, the weaknesses in the current metal tracking procedures had been revealed by audits

immediately prior to the module. Second, good control of metal movement would assist the successful operation of the factory at lower stock levels. This involved the introduction of a 'Pull' system of metal flow. Achievement of successful change in these areas requires changes in current working procedures and so an approach which aimed to involve shopfloor team leaders and team members was adopted. The objective for this module was to improve control of metal costs through improving measurement and introduce a pull system of work flow. The seminar was presented and the project co-ordinated by the company Management Accountant and the researcher.

The seminar for this module focused on the compilation of a map of the area covered by each group of team leaders. As each section of the day was completed, the map was gradually built up which would be used in the project. The map covered:

1. Metal Flows. The movement of metal through the area of each group of team leaders was be examined first. The mapping of this included all possible movements, not just those that were normal. The visual depiction of this revealed opportunities for simplification.

2. Recording Accuracy. The accuracy of the recording of metal movements was studied next, with a focus on the variety of methods used to record metal weight and their effectiveness. Less effective methods were revised in favour of more effective methods. Standard Operating Methods were used and the practicality of shift and area metal reconciliation were examined.

3. Visual Stock Systems. The final examination was of metal stock visibility. Once appropriate areas for stocks were identified, visual systems, which provide easy estimation of stock levels were established.

The project for this module was to map current metal flows, stocks and measurement and to improve this. In improving the current metal control systems, team leaders should:

1. Simplify existing metal flow routes.

2. Improve recording accuracy of metal movement.

3. Implement visible systems for estimation of stock levels.

5.2.11. Module 11. Final Presentation

The final module was intended to enable the team leaders to demonstrate the progress made with the programme, to take ownership of the changes made and to gain recognition for effort expended; to allow team leaders to show other team leaders, team members, managers, and senior managers progress they have achieved through

the programme. A presentation training session brought team leaders together to provide information on the presentation format and to allow an initial planning meeting to be held. The researcher facilitated the consolidation of views on the programme. The project was for all participants together to prepare and deliver one presentation on the programme. It lasted about 1 hour followed by questions from the audience.

5.2.12. Summary of Module Content

The module content was developed jointly between the researcher and the company. It reflected the wishes of both in conducting the research for this thesis and in making a real improvement in company operation of Just In Time. Each module involved the implementation of change intended to move the company towards Just In Time and applied socio-technical systems theory.

5.3. The Conduct of the Survey Research

The previous chapter described the surveys that would be used to gather data on the affects of the modular programme. This section describes how these surveys were conducted.

5.3.1. The Manager Survey

The manager survey was intended to establish the managerial understanding of current company activity, to assist the analysis of the results of the survey of employees. The survey covered 20 senior managers across Alcan Extrusions and Tubes and was conducted in January and February 1992. All site general managers and managers with production or maintenance responsibility were interviewed by the researcher. A framework was adopted for the interview which is contained in Appendix A. This was piloted with two production managers in a full trial of the survey at the Banbury site. Wording was altered to enhance clarity. The framework begins by asking the interviewee their views on the most effective and most ineffective developments which have influenced company performance in recent years. This was intended to identify respondent feelings about changes which had taken place, as well as to provide the researcher with some initial practical data on significant events in recent years.

Next, the respondent is asked what the main factors are which influence customers to purchase from the company, how performance has changed in each of these areas in the past 5 years, and what plans exist to improve this area in the future. This question continued the theme of identification of significant features of company operation.

Section two focused on more detailed analysis of change and planned improvement in company performance in a series of specific areas. These would assist the detailed identification of the perceived focus of company improvement. It questioned the interviewee in the full range of manufacturing performance areas:

- On Time Delivery
- Scrap Reduction
- Man Hours Per Tonne
- Product Quality
- Stock Levels
- Manufacturing Lead Times
- Process / Machine Capability

Section three attempted to identify the nature of the company's focus on Just In Time, with an open ended request to describe activity in each of the following areas:

- Set Up Times
- Materials Handling
- Housekeeping
- Performance Measures
- Problem Solving
- Group Working / Cellular Manufacturing
- Standard Operating Methods
- Reduction of Product Diversity
- Customer / Supplier Relationships
- Kaizen
- Machine Reliability

Section four looked at the human aspects of company development. Respondents were asked to describe any company activity in each of the following areas:

- Employee Involvement
- Flexibility
- Training
- Responsibility
- Teamworking
- Communications
- Performance Appraisal
- Education
- Single Status
- Union Relationships

Section five looked at the management of improvement within the company, to identify the ways in which changes were managed. An open ended question as to how improvements were managed within the company was posed. Section six

examined the tools used to make changes in the past five years, requesting descriptions of their use where they had been applied:

- Training of Individuals
- Development of Work In Teams
- Development of The Organisation's Structure
- Integration of People and Their Work
- Development of Information Systems
- The Creation of Conflict

Finally, section seven provided respondents with the opportunity to comment on company improvement activity generally. Each interview lasted about one and a half hours. The data was processed by the researcher and a report was prepared (Appendix A.) and presented to the management team at each company site in a presentation lasting approximately forty-five minutes.

5.3.2. The Survey of Employees

The survey of employees, with 804 responses, which represents about 80 % of all A.E.T. employees, enabled a more detailed understanding of the effects of the team leader programme to be gained. The survey was completed between November 1992 and April 1993. Employees completed the survey in groups, of about 20 personnel. Completed questionnaires were placed in sealed envelopes and sent to the researcher for analysis.

The following areas were covered, with respondents being asked to categorise responses from Worse Performance to Better Performance.

- More Computers
- New Equipment
- Flexible Working Practices
- New Skills
- Team Working
- Performance Appraisal
- Just In Time
- Employee Involvement
- Use of Employee Ideas
- Equipment Modifications
- Quality Initiatives

Section three examined perceptions of company performance change in the past five years. This asked respondents the extent to which they felt company performance had improved or worsened in a range of areas covering usual manufacturing performance areas but including Job Satisfaction. This would assist the company's management

understanding of employee perceptions of performance to aid future management activity. The areas which were covered were:

- On Time Delivery
- Scrap Reduction
- Product Quality
- Stock Levels
- Throughput Times
- Total Output
- Job Satisfaction
- Productivity
- Customer Service

Question four examined the perceived contribution of different company levels and departments to improved performance in recent years. Any difference at Banbury may be attributable to the test programme there and hence would allow information to be gained for programme evaluation. Respondents were asked the extent that they felt that each group contributed to performance improvement:

- Shopfloor Employees
- Shopfloor Team Leaders or Supervisors or Foremen
- Maintenance
- Production Management
- Personnel or Human Resources
- Training
- Senior Management
- Contractors
- Sales Dept.
- Finance Dept.
- Consultants
- Customers
- Suppliers

Question five was about the influence that the factors listed in section two had on company performance in the past five years. Respondents were asked to grade each area on the a scale ranging from Made Worse to Improved. They were also asked to list any other factors which they felt made performance better or worse, the intention being to discover any outstanding areas not covered by the direct questions in the survey. Question six asked respondents their views on how much responsibility had changed in their job, how much they wanted it to change, and how much they thought it would change. This would assist an evaluation of the impact of Just In Time on employee perceptions of their job content. Were they being placed under intolerable pressure? Finally, question seven asked about involvement of employees in the changes that the company made. What effect would the programme have on employee's perceptions of their own involvement in changes the company made?

The employee survey was thus designed to gain extensive information on employee attitudes to changes made, immediately after the programme completion at Banbury and at the same time at the other A.E.T. sites. The Banbury results on their own would provide information on change at Banbury and could be compared with the results from other sites. The difficulty here was likely to be interpretation of results. This was the reason for carrying out the first interview survey, which would give the researcher a good understanding of actual events on the other sites which could give more meaning to responses in the more narrowly focused written survey.

5.3.3. The Team Leader Survey

The third survey, of team leaders at Banbury, three years after the completion of the programme was completed by five team leaders. This 25 % sample of the original team leader programme group was felt appropriate due to the time required to complete the survey. Interviews were conducted by the researcher, due to the expertise required not being otherwise available, and lasted approximately one and a half hours.

The survey began with asking what respondents thought were the main aims of the team leader programme and how successfully the programme had satisfied these objectives. Then, respondents were asked how the programme affected overall manufacturing performance in the area they worked in. Just In Time was covered next with respondents being asked about the effect of the programme on a range of Just In Time factors, during the programme conduct, and since it had been completed. These factors were:

- Stock levels
- Production lead times
- Set up times
- Product quality
- Product volume
- Factory housekeeping
- Production workflow
- Equipment maintenance
- Working methods

The next survey section looked at the effect of the programme on the people working in each production area, asking first about the contribution made to manufacturing performance and then about:

- Job satisfaction
- Employee involvement in improvement
- Employee responsibility
- Employee work discipline
- Employee motivation

- Employee problem solving
- Employee job security
- Employee skills

While recording of actual changes during the programme and surveys of attitudes would give some indication of the programme performance, useful information might also be gained from examination of company performance statistics before, during and after the Banbury programme. However, the operation of the A.E.T. businesses in different markets and with different operating activities led to the conclusion being reached that this would be of little value. Respondents were asked to grade each area on the a scale ranging from Made Worse to Improved. They were also asked to list any other factors which they felt made performance better or worse, the intention being to discover any outstanding areas not covered by the direct questions in the survey. Question six asked respondents their views on how much responsibility had changed in their job, how much they wanted it to change, and how much they thought it would change. This would assist an evaluation conducted by the researcher. An action research approach was adopted which allowed extensive practical testing of the research to be undertaken and it was hoped that this would provide knowledge of value to both academia and manufacturing practitioners.

The testing was aided by the conduct of three surveys which were designed to enable data to be gathered to assist the evaluation. The next chapter describes the results gained.

Chapter 6.

Results and Evaluation of the Programme

6.1. Introduction

This chapter describes the results of the research activity undertaken. First, the observations of the modular team leader programme are described, allowing the reader to understand the practical actions which occurred. Next, the survey activity is described, with results being presented as they apply to each of the five hypotheses.

A diary was maintained on the conduct of each module, as the programme progressed. This was aided by the presentation of module results by team leaders at the end of each module to an audience including managers and team members.

The survey of Alcan Extrusions and Tubes managers enabled the selection of Banbury and Redditch as the research sites. The survey of all employees provides evidence of the impact of the programme, conducted in the months following programme completion. The survey of Banbury team leaders enabled triangulation of research evidence and gathered evidence on programme impact, three years after the completion of the programme.

6.1.1. Module 1. Introduction

Evaluation of the seminar for the first module, conducted at the end of the seminar but before the project started, showed that concern existed about the costing aspect of module projects. Team leaders were not yet confident with the notion of providing financial arguments. Comments about the seminar were generally positive and all team leaders contributed at some point to the seminar. A lively atmosphere prevailed which was felt, by the managers and team leaders, to be important that this be maintained in future.

Team leaders were encouraged to develop materials for their briefings, the project for this module. They tended to share this task. A majority of team leaders appeared to be nervous but seemed to welcome the opportunity to perform. Team members were asked for their comments and on the whole were very positive. An atmosphere of expectation had been created and team leaders had committed themselves to the programme. Managerial involvement in this module included visits to the seminar and attendance at each team leader's briefing of team members. No problems with fear of authority being undermined were apparent. A visibility system designed by the team leaders incorporated photographs of teams and names of their team members. Most team members were happy to have their pictures taken.

Concerns about the response of the maintenance department to project requirements were often expressed by team leaders. This allowed a meeting to be arranged with the engineering manager to establish the high priority to be made for team leader projects and signalled to the researcher the need to be watchful for problems with this in future. The trade union convenor commented at the briefing he attended that he had been asking for this type of activity for a long time.

6.1.2. Module 2. Continuous Improvement

The emphasis of the materials for this module was on giving team leaders confidence with problem solving techniques. Brainstorming and fishbone diagrams mushroomed in usage on the shopfloor. Team leader evaluation questionnaire scores were positive. In one department the team leaders asserted that much of the change which occurred was due to team members understanding the project objectives. A detailed examination of the results of each module project, which were costed by the company cost accountant, is provided below.

6 Press Team Leaders

This project looked at reducing the amount of scratched and dented metal produced on 6 Press. A study of the effects of this was undertaken followed by the implementation of a novel idea which allows areas of the press table causing scratches and dents to be identified. This has been done by painting a black strip along the side of the table on which operators can indicate, with white chalk, the position of scratches and dents. A 50% reduction in scratched and dented metal was achieved, resulting in monthly savings of £2,500.

7,8 and 9 Bay Team Leaders

This project looked at reduction of production downtime due to full press tables and resulted in the introduction of new standard working practices which reduced production downtime due to full tables by 95%. Total savings: £8,500 per month.

5 Press Team Leaders

A study of unplanned recut (sawing metal to length as an additional process stage) resulted in modifications to improve saw cut quality on the press saw, which eliminated unplanned recut, saving £2,700 per month.

10 and 11 Bay Team Leaders

The build up of long length scrap results in increased stock holding costs. Prior to this project, all long length scrap had to be cut to a shorter length. This project developed a very simple tool which allows long length scrap to be banded with

aluminium wire for transport direct to Remelt for reprocessing, saving £950 per month.

Die Shop Team Leaders

Bridge dies are the most profitable for the die shop to make but capacity to make these is limited. Therefore, many bridge dies had to be sub-contracted. This project developed methods to double in house bridge die capacity resulting in savings of £4,000 per month.

Remelt Team Leaders

The remelt department studied methods to improve the cost effectiveness of the mix of materials used in the furnace to produce aluminium for customers. This identified potential savings of £25,000 per month.

Middle and senior management participation in the programme had not been a difficulty to date. There had been little difficulty in arranging time for meetings and project activity and support and encouragement had normally been given to team leaders. Attendance at the presentations had been very good. The managing director attended the group 2 presentations. Banbury accountants calculate that total benefits of projects undertaken during this module if sustained for one year would be about £550,000. Difficulties were experienced with obtaining assistance from the maintenance department to implement some of the planned changes. The remelt project required a reliable scrap supply to maximise the potential benefits. Unfortunately, this was outside of the control of the team leaders and was not achieved. Unreliability of the remelt forklift trucks also led to frustration during project implementation.

6.1.3. Module 3. Housekeeping

The material for the seminar for this module was brief in comparison with other modules. Most time was spent gathering data and planning projects. Evaluation forms for the seminars from the team leaders were positive. Slides showing current housekeeping practices were used to communicate a clear understanding of non-acceptable practices. Most activity was well scheduled and would not interfere with future modules. A works tour for office staff was organised in early March 1992, to provide a target for final project completion and to strengthen pressures to maintain standards. All departments established methods to maintain housekeeping standards. Shadow boards were established for cleaning materials but there was a need to stress their use for production tools.

The cost of materials and labour was initially raised by some managers, team leaders and team members although as the effects were seen this abated. The team leaders

provided an update in their presentations on previous module projects. A meeting was held to transfer ideas between departments.

The impact of housekeeping activity was visually dramatic. Whole departments were transformed over a weekend. Team members established the new standards themselves and were involved in planning the change. Since the module was completed the standard has, by and large, been maintained. Visible systems were established to monitor housekeeping standard maintenance duties. Shadow boards were established for tools to create greater visibility. Departments supported each other with provision of housekeeping supplies, labour etc.

Good housekeeping is not free. Paint and cleaning materials can be expensive, along with the time of those using them. This led to questions being asked as to why money was spent on housekeeping but not on new equipment? Full understanding that good housekeeping has financial benefits was not completely achieved. Some debate existed as to whether the schedule boards showing rotas for housekeeping duties are patronising.

6.1.4. Module 4. Performance Measures

The Performance Measures survey results provided direction for this module Prior to module commencement all team leaders and production managers were surveyed to establish the current usage of performance measures (as detailed earlier). It was now clear that current practices were inadequate. A review of the performance measurement activities of service departments was undertaken by the company management accountant and a production manager.

The survey was also useful in establishing to team leaders the role of performance measures. The objective for the module projects was the development of practical measures of performance which helped to identify areas for improvement. This was achieved, although some team leaders also implemented measures to assist scheduling and work organisation that were not directly related to team operation. The performance of service departments, in particular sales and production control was commented upon by the team leaders, who monitored scheduling accuracy to achieve delivery dates promised to customers.

Information on process activity was gathered which was previously unknown and which was used in future projects. It was felt, by the team leaders, that more time was needed to complete this project properly to allow for the initial data gathering before action could be undertaken. While this project was in progress short term company activity to reduce stock levels in remelt resulted in equipment stopping due to a lack of raw material. Managers remained supportive of the programme as a whole although visits to the seminars and attendance at the presentations was tailing off. Managers were more involved in module design for the Training Module, to further strengthen managerial ownership of new practices. This involved the preparation of

a consultative document on module content followed by a consultative meeting. 'Midnight meetings' were established to assist with the transference of projects between departments. These are held at midnight on each Wednesday evening for team leaders on that week's night shift.

6.1.5. Module 5. Standard Operating Methods

The Banbury Standard Operating Method - a format for the establishment of standard operating methods was developed by the team leaders in the seminar. Module projects which refined the new Banbury Standard Operating Method were conducted by all team leaders. They all involved members of their team in establishing S.O.M.s. The Banbury Standard Operating Method, is a participative approach to the introduction of S.O.M.s. It is a series of steps which focus on the involvement of shopfloor employees. Commencing on a Monday, the steps culminate in the display and implementation of the new standard operating method one week later (day 6). The development and implementation team is composed of the team leader (or supervisor or foreman) plus one representative per shift, of operators who perform the operation being studied. This team is responsible for drafting the standard operating method and consulting other team members about its content.

On days 1 and 2 (normally Monday and Tuesday), the team draft the sequence of operations, observe the operation and amend the sequence where necessary, sketch the operation layout, carry out timings and rotate the crew and repeat the process as necessary to establish the draft standard operating method. Once the draft is completed, it is circulated to all operators who perform this operation for comments and suggestions, which are gathered by team leaders and implementation team members on days 3 and 4 (Wednesday and Thursday). In order to do this, implementation team members return to their normal shift on these days. On day 5 (Friday) the implementation team review the draft and agree on the final version for display. On day 6 (Monday) the new standard operating method is implemented. It is the team leader's responsibility to ensure that operators work to the new method. This may require the organisation of training in the new method, by members of the implementation team.

All areas prepared plans for covering all operations with S.O.M.s in the future. The use of stopwatches to aid working method improvement was accepted. A standard format for S.O.M. documentation was slow to develop and this resulted in some team leader frustration. While progress was rapid in documenting S.O.M.s, there were still pockets of variance from these in actual methods used.

6.1.6. Module 6. Training

This module developed the role of the trainer, a team member who received a pay premium to support training within the team. The task analysis activity in this seminar gave team leaders and trainers further practical experience of the study of

work operations. Skill deficiencies between shopfloor teams were highlighted. The project for this module was to establish and present visibly a team training plan for the next year. This involved an analysis of team training needs and the scheduling of training to fill gaps in skill resources. A number of issues arose. First, current skill resources did not match training which had been undertaken previously. People had been 'signed up' for jobs which they either could not or would not perform. Trainers were asked to analyse skill resources in their team truthfully, in the knowledge that this would be made visible. A reasonably accurate picture should now exist of the skills breakdown.

Training plans were now visible everywhere and the objectives of the module project had been fulfilled. Project presentation attendance was low, partly due to other activities which were taking place at the same time and also due to their novelty value wearing off. A training needs analysis was carried out for every shopfloor job. Schedules were developed for meeting training needs. These schedules were displayed in each working area, with dates as to when training would be undertaken. Team leaders questioned the need for trainers within teams. They felt that they could perform this role themselves. Labour shortages hampered the release of employees from work for training.

6.1.7. Module 7. Safety

The Safety Tag System caused great initial apprehension amongst team leaders and some managers, which was expressed in the module seminar. They felt that the tags would disrupt production. The seminar spent considerable time in assuaging these fears and asserting the senior management determination to proceed with this. The module project was to introduce the Tag System which meant that it was more rigidly defined than in many previous modules. Team leaders and safety representatives worked together. Additions to the original system design to ensure an effective link with maintenance were made. Briefings of teams proceeded smoothly but were often characterised by a significant level of shopfloor cynicism. This was based on a feeling that the response of the maintenance department would not be forthcoming. These fears were eased when, in the week between the briefing and the date of commencement, the maintenance department were observed completing several minor repairs which had been outstanding for a long time, in some cases.

Few maintenance tags have not been replaced on the board prior to the target date for completion of the work required. Shopfloor reaction was very favourable. There was one hiccup when a team leader changed the classification of a tag without informing the person who had erected the tag but this was quickly resolved. An additional benefit of the system may be an improvement of the relationship between maintenance and production departments. A poem emerged from the maintenance department:

You don't have to nag,
to get work on a tag,
Just write it out clear,
and we will appear,
Nothing too large and nothing too small,
we will try to please you all,
Endeavour we will to do your task,
Good manners and politeness is all we ask.

6.1.8. Module 8. Extrusion Process

Team leaders were initially sceptical about the value of a module which was teaching them about a process they worked with every day. This scepticism soon disappeared as the content became apparent. Not surprisingly perhaps, greater interest was shown by 'other' departments. A suggestion was made that this seminar would benefit others in the company who deal with the production process, in particular, other people on the shopfloor and sales.

The projects for this module were intended to provide greater knowledge of the process and S.P.C. experience for team leaders. This happened with the shift projects which took place. The B Shift project raised fascinating questions about how the company currently managed the production process. On the die used for the project, it has been shown that greater attention to quality had enabled the speed of extrusion to be increased by 50%. It is thought by the die service department to be unlikely that this would be repeated to the same extent on every other die, but it raised fundamental issues about the approach that is taken by the company to die preparation. More initial attention may allow lower scrap levels and higher speeds to be achieved. The time taken to prepare some test dies for projects led to project delays. The A Shift project was delayed due to a lack of orders on the die to be tested. When original projects were scheduled, a high order volume was anticipated, but this did not materialise. Ideally, a wider range of billets would have been available for trial. Financial conditions led to restrictions on billet variety.

6.1.9. Module 9. Maintenance

This seminar was given consistently high marks by the team leaders who valued the opportunity to discuss maintenance service with the engineering manager and the maintenance manager. Projects for this module focused on the establishment of condition monitoring in extrusion and on mean time between failures in remelt. Applications varied between departments but all were successful in identifying appropriate conditions. These varying applications highlighted the continuing weakness of transference of improvements between departments. This module had also questioned the role of the maintenance department. There was a feeling that this module did not involve the maintenance department as much as it should have,

leading to complaints from team leaders that while production made efforts to improve, the complementary activities required from the maintenance department were not forthcoming. While conditions can be established on existing equipment for monitoring, it was felt that this would be easier if equipment was brought to a more reliable standard before these practices were introduced.

6.1.10. Module 10. Cost Management

This module was intended to integrate activities from previous modules with the introduction of pull systems to control manufacturing work flow, which would reduce stock costs and improve cost data recording. The charting of the manufacturing process, using shopfloor engineering plans, was successful. This provided a basis for team member involvement. In practice, little difficulty was experienced in the development of plans for pull systems. Following the seminar, team leaders developed rules for pulling work forward from one operation to the next and for minimising irregular work flow. This included a reorganisation of the flow of billets from remelt to production presses which is now described.

Over the years, each department had developed its own individual system for ordering billet - each of which had their own set of advantages and disadvantages. However, it was an all too frequent occurrence for presses to stop - not through lack of billet, but through the wrong billet size having been ordered. Large billet stocks began to accumulate, jobs were extruded on the wrong billet size - having a detrimental effect on site metal recovery.

In June 1992, a project team attempted to tackle the problem. They introduced a common system across the site - the 24 hour billet ordering system. With this system, the extrusion schedulers (who are office based) were responsible for hand-writing the billet requirements for a 24 hour period. This order was then taken to the remelt scheduler who loaded the information onto a computer. A schedule would then be prepared and taken to the remelt billet saws. However, this system did not give the desired results. Instead of inventory decreasing, it increased dramatically due to the extension of the order lead time, through extending the time period for those presses on 8 hour supply prior to the conduct of the project and through imposing a fixed 24 hour order point for those who were already on a 24 hour cycle. The longer the lead time is, the more variance there is likely to be between actual requirements and the order which is placed. A 24 hour billet requirement forecast is likely to be substantially at variance with actual requirements.

The work done on this module led to an increase in focus on remelt to develop a system which would let presses pull billets, as and when required. It was agreed that the idea of a common system across the site was important. To develop this, the team leaders on 'C' Shift met and developed a plan for the 8 Hour Billet Ordering System. Before the project team activity in 1992, number 5 and 6 Press had successfully operated an 8 hour system. There were problems, though. Problems arose because

there was no common system, that is, the other presses ordered on a 24 hour basis. Also, another major problem was that there was no set time at which the schedule would be submitted. Consequently, orders were placed at any time which led to confusion at the saw as to which orders to cut first. It was essential to develop a system to help both extrusions and remelt. Together, they developed a system in which the extrusions team leaders give remelt a definite saw schedule at the beginning of each shift and remelt have undertaken to deliver exact quantities to the presses, on time.

In this module, comprehensive, Just In Time, pull systems of process organisation were planned for all factory areas. These pull systems rely on accurate control of stock levels between processes. Simple cost saving measures were implemented which improved the company's cash flow. New methods were developed for the control of metal to improve the accuracy of metal accounting.

It was felt by some team leaders that this module should have been undertaken earlier in the programme because other modules would have supported the changes made. Demands on the computer services and information systems made by this module had long lead times. Full implementation of the plans developed would require substantial time and effort. It was intended that this should follow programme completion.

6.1.11. Module 11. Final Presentation

The project for this module was the organisation of the final presentation itself. It was attended by most managers and senior managers as well as team members. The presentation was well received and gave the team leaders the credit they deserved for the work they had done. The team leaders presented their perceptions of the strengths and weaknesses of each module and the programme as a whole.

The modules were completed in September 1992.

6.2. A New Organisation Structure

The completion of the team leader programme coincided with the beginning of the reorganisation of Alcan Extrusions Banbury into three extrusions operating streams - High Volume, Minalex and Added Cost (later to be titled Premier Extrusions). As part of this reorganisation the team size at Banbury was halved, and hence the number of team leaders was doubled. New team leaders were selected from shopfloor operators using interviews and psychometric testing. A series of modules for new team leaders, based on the original programme, were delivered over a two week period prior to the commencement of the new organisation structure.

At the end of the programme three month plans were developed for all team leaders in a day long planning session involving new and old team leaders in each operating stream. At the end of the day, presentations were made to operating stream and other senior managers. A discussion held one week later enabled operating stream managers and team leaders to agree on the plan content. It was in this context that the post-programme surveys were conducted.

6.3. The Survey of Alcan Extrusions and Tubes Managers

The survey of Alcan Extrusions and Tubes managers was described in the previous chapter. It was intended to establish the managerial understanding of current company improvement activity, which it was hoped would aid interpretation of the employee survey. Rather than providing strictly scientific data, the purpose of this type of survey is to aid the development of ideas, to understand the motives of the research subjects.

"The prime purpose of these interviews is heuristic: to generate further ideas about topics and variables that should be included in the research plan, links that should be explored, attitudes and motives that might determine some behaviours." Oppenheim, (1992), p. 76.

Analysis of the survey results allowed the following tentative observations to be made (a report prepared for the company is contained in Appendix A):

More Just In Time activity is apparent at Redditch and Banbury than at Almetex and Latchford. While programmes of Just In Time implementation existed at Redditch and Banbury, there was no evidence of effort to implement Just In Time at the other two sites.

Activity at Latchford is predominantly equipment oriented with improvements being gained from equipment changes (either modifications of existing equipment or the purchase of new equipment), reflecting a more traditional approach. Little significance was attached to communications or employee involvement. A new management team were keen to make progress with Just In Time but little work had been done so far.

Banbury had been engaged in a substantial range of Just In Time activity in recent years. This had involved a wide range of people and this was reflected in a wide understanding of Just In Time principles. The main activity towards Just In Time had been the team leader programme.

The Redditch Just In Time implementation was characterised by parallel Just In Time and traditional management systems. Substantial effort had been apparent but appeared dominated by centrally driven activity. A team of experts including a

secondment from Japan were driving the Just In Time activity, leading projects and designing change. There was a feeling that a new cell structure had been formally put in place but required development effort if it was to yield the expected benefits.

Almetex featured an equipment based approach to improvement which was similar to Latchford's. Solutions to problems were often felt to lie in externally controlled solutions i.e.. better quality of log / billet and better quality of dies. While many 'experts' had looked at improvement of Almetex, there seemed to be little improvement activity, leading to a lack of ownership of changes made and hence their rapid decline into disuse.

The manager survey found that while Redditch and Banbury had made efforts towards Just In Time implementation, Latchford and Almetex had not. The selected results of the next survey, of all employees, have therefore concentrated on Redditch and Banbury.

6.4. The New Production Systems Survey

The conduct of the N.P.S. survey was described in the previous chapter. This section describes the results which were received, at Banbury and Redditch, because these sites were those identified to have been attempting to implement Just In Time. These results are broken down in their relevance to the issues raised in the hypotheses. Each hypothesis is listed and the appropriate survey results are provided. The interpretation of these results is then considered. Full survey results are detailed in Appendix B.

1. *That an improved approach to Just In Time would incorporate a socio-technical systems approach.*

The extent to which the socio-technical systems approach adopted resulted in an improved approach to Just In Time may be gauged by comparing the survey responses at Redditch and Banbury. What were the perceptions of people within both companies, of the effect which Just In Time had had on company performance in recent years, and, further, how important did they regard it to improving company performance in the future. The survey results enable a judgement to be made about the extent to which the socio-technical approach used was an improved approach to Just In Time implementation. Table 6.1. details responses to the question: How do you feel Just in Time influenced performance of the company in the past five years?

Table 6.1. How do you feel that Just In Time influenced the performance of the company in the past five years? Scale: 1 = Made Worse, 3 = No Influence, 5 = Improved.

	Banbury	Redditch
Senior Managers	3.57	3.09
Middle Managers	3.60	3.21
Team Leaders	3.27	3.46
Office Employees	3.09	3.00
Shopfloor Employees	2.83	2.74
Site Average	2.97	2.95

The site averages vary little between Banbury and Redditch, the general feeling being of little influence of Just In Time on company performance. However, these averages are derived from a variety of views across the company. Senior managers, middle managers and team leaders at Banbury have moderately positive views of Just In Time implementation to date, while at Redditch, the senior manager view is that it has had little effect. There would appear to be greater consistency in the positive management view at Banbury. At both Redditch and Banbury, shopfloor and office employee non - managerial views are unenthusiastic, with shopfloor views being slightly negative.

Table 6.2. What effect do you think that Just In Time would have on overall company performance if it was made in the next five years? Scale: 1 = Worse Performance, 3 = No Effect, 5 = Better Performance.

	Banbury	Redditch
Senior Managers	4.71	3.83
Middle Managers	4.14	3.73
Team Leaders	3.79	3.58
Office Employees	3.43	3.29
Shopfloor Employees	3.09	2.93
Site Average	3.32	3.22

Perceptions of the future contribution to company performance at Banbury and Redditch are detailed in Table 6.2. These show substantially greater enthusiasm at Banbury at management levels, with slightly more positive figures for non - managerial employees. This enthusiasm is stronger for future implementation than it is for past performance of Just In Time. It would appear fair to suggest that while at Banbury the management perception is one of moderate contribution of Just In Time to date, there is substantial optimism remaining about its future application. Non -

managerial perceptions are positive in office areas at Banbury but flat on the shopfloor. At Redditch, there is less optimism about the future, and a more negative view of past success, while non - managerial views remain flat. It is reasonable to conclude that management views of Just In Time are more favourable at Banbury.

2. *That the approach should incorporate an understanding of the need to transfer power within the organisation.*

The extent to which power has been transferred within each organisation may be gauged by reference to the survey questions on how responsibility had changed and was desired to change at Redditch and Banbury. The survey question asked how much responsibility had changed in recent years, how much the respondent wished it to change, and how much they expected it to change in the future.

Table 6.3. In the past five years, how do you feel responsibility in your present job has changed? *Scale: 1 = Much Decreased, 3 = No Change, 5 = Much Increased.*

	Banbury	**Redditch**
Senior Managers	4.29	4.25
Middle Managers	4.00	4.38
Team Leaders	4.43	4.18
Office Employees	3.76	4.04
Shopfloor Employees	3.73	4.05

As Table 6.3. shows, all levels surveyed at both sites felt that responsibility in their jobs had increased in recent years, with office and shopfloor areas at Banbury feeling this least. While middle managers recorded the highest score in response to this question at Redditch, team leaders recorded the highest score at Banbury, with middle managers recording the lowest managerial score across the two sites. It may be concluded that while at Redditch the responsibilities of middle managers increased, at Banbury there was greater focus on team leaders.

Table 6.4. In the next five years, how much responsibility would you like to have in your job? *Scale: 1 = Much Less, 3 = No Change, 5 = Much More.*

	Banbury	**Redditch**
Senior Managers	4.71	4.25
Middle Managers	4.36	4.47
Team Leaders	4.20	4.12
Office Employees	4.00	4.44
Shopfloor Employees	3.67	3.75

Table 6.4. shows that little difference between the sites emerged in the responsibility desired in the future. Shopfloor areas desired least increase in responsibility, although the response remained positive. At Banbury the team leaders, who had perceived a strong increase in the past, continued to desire more in the future. So too did the middle managers at Redditch. Thus, increases in responsibility do not appear to be perceived negatively.

Table 6.5. In the next five years, how much responsibility do you expect to get in your job? Scale: 1 = Much Less, 3 = No Change, 5 = Much More.

	Banbury	Redditch
Senior Managers	4.57	3.75
Middle Managers	3.71	4.07
Team Leaders	4.17	4.12
Office Employees	3.57	3.81
Shopfloor Employees	3.59	3.67

Expectations of future responsibility at Redditch and Banbury vary quite strongly at senior management level (Table 6.5.). It is difficult to imagine a reason for this. At middle management levels it appears that Banbury middle managers may well anticipate a significant loss of power in future years, recording a low score. The Banbury team leaders on the other hand, anticipate that their responsibilities will continue to increase.

These survey results appear to indicate a shift in power from middle managers to team leaders at Banbury, but not at Redditch. This shift of power is expected to continue and is welcomed by the team leaders. Some concern is evident amongst the middle managers at Banbury who desire substantially more responsibility than they expect to get. It would therefore seem reasonable to conclude that a shift of power from middle managers to team leaders has occurred at Banbury and is expected to continue.

3. *That this approach should lead to success in technical performance.*

It may have been possible to compare operating statistics at Redditch and Banbury, to establish the effect that the contrasting approaches to Just In Time implementation had had on company performance, if the businesses were substantially the same in terms of markets served and operations undertaken. However, it was thought that market variation and other factors were likely to make this a misleading exercise. Instead, the survey asked respondents their views on company performance in a range of areas. It is still difficult to associate responses with Just In Time. The question was phrased in terms of how the respondents felt that company performance

had changed, which may have been caused by a range of factors. However, an indication of company performance during the period in which Just In Time was introduced could be gauged. The following Table 6.6. provides responses at Banbury and Redditch, to respondents perceptions of performance change in the past five years:

Table 6.6. Please indicate how you feel company performance has changed in the following areas in the last five years. Scale: 1 = Worsened, 3 = No Change, 5 = Improved.

Performance Area	**Shopfloor Employees**	**Office Employees**	**Team Leaders**	**Middle Managers**	**Senior Managers**
Banbury					
On Time Delivery	3.66	3.17	3.69	3.57	4.00
Scrap Reduction	3.03	3.10	3.06	3.36	3.43
Product Quality	3.28	3.06	3.37	3.00	3.14
Stock Levels	3.23	3.32	3.92	3.79	4.29
Throughput Times	3.47	3.42	3.63	3.50	3.71
Total Output	3.24	2.71	3.27	2.14	2.71
Productivity	3.29	2.98	3.41	3.14	3.57
Customer Service	3.40	2.89	3.51	2.79	3.67
Average	**3.33**	**3.08**	**3.48**	**3.16**	**3.57**
Redditch					
On Time Delivery	3.33	3.15	3.59	2.94	2.92
Scrap Reduction	3.12	3.00	3.53	3.35	3.33
Product Quality	3.43	2.50	3.81	3.76	3.75
Stock Levels	3.40	3.38	3.74	4.29	3.92
Throughput Times	3.39	3.04	3.97	3.50	3.25
Total Output	3.25	2.76	3.13	2.82	3.00
Productivity	3.25	2.85	3.61	3.35	3.50
Customer Service	3.08	3.15	3.31	3.56	3.00
Average	**3.28**	**2.98**	**3.59**	**3.45**	**3.33**

Examination of the average scores for each level and site indicates the trends in perceptions of company performance. Overall, there appear to be broadly positive scores recorded in managerial and shopfloor areas, with office employees perceiving little change. It is reasonable to assert that the implementation period is viewed generally positively on both sites. It would therefore seem that neither

implementation method is perceived to have resulted in negative performance change at either site.

The trend reflects that which emerged in the previous section, similarity in scores at office and shopfloor employee levels. Positive scores from team leaders at both sites, but relatively lower scores from Banbury middle managers and Redditch senior managers. This may be an indication of the lower level of ownership of the production process perceived by Banbury middle managers and the less positive senior management view of change at Redditch.

4. *That this approach should lead to success in the human aspects of Just In Time.*

The human aspects of Just In Time are discussed fully in the literature review. Difficulties experienced by companies and employees in Just In Time environments were described. Specifically, research was identified which argued that implementation increased stress levels and created an unpleasant work environment (Parker and Slaughter, 1988,). How did the Alcan sites do? This can be examined with reference to the survey question on job satisfaction. It was also argued that Western employees were poorer in terms of the skills of employees and their participation in teamworking (see the survey by Mayes and Ogiwara, 1992). An assessment of progress here may be gained by looking at survey questions on Flexible Working, New Skills and Team Working.

Table 6.7., Please indicate how you feel Job Satisfaction has changed in the last five years. Scale: 1 = Worsened, 3 = No Change, 5 = Improved.

	Banbury	**Redditch**
Senior Managers	3.43	2.92
Middle Managers	2.50	3.12
Team Leaders	2.96	2.91
Office Employees	2.46	2.65
Shopfloor Employees	2.59	2.77
Site Average	2.63	2.81

Job satisfaction (Table 6.7.) at Banbury appears to be perceived relatively more negatively than at Redditch, as the site average scores show. The trend varies again, though. Middle managers at Banbury appear to have a significantly lower perception of Job Satisfaction change at Banbury than at Redditch, while Redditch senior managers are more negative than those at Banbury. Banbury team leaders feel that there has been little change in Job Satisfaction, as do their counterparts at Redditch. Office and shopfloor employees at both sites feel that there has been a slight deterioration in Job Satisfaction, slightly more so at Banbury than at Redditch. It would therefore appear that the approach adopted on both sites has not led to the

substantial deterioration in Job Satisfaction that was observed by researchers in the literature review. There also does not appear to be the increase in Job Satisfaction at Banbury that may have been expected from the more people oriented approach, though.

Tables 6.8., 6.9. and 6.10, look at attitudes to the affects of Flexible Working, New Skills and Team Working.

Table 6.8. How do you feel that Flexible Working influenced performance of the company in the past five years? Scale: 1 = Made Worse, 3 = No Influence, 5 = Improved.

	Banbury	Redditch
Senior Managers	4.29	3.67
Middle Managers	3.79	4.20
Team Leaders	4.13	3.69
Office Employees	3.73	3.78
Shopfloor Employees	3.43	3.45
Site Average	3.59	3.62

Responses on Flexibility are broadly similar between the two sites, with average scores virtually identical for whole sites. However, senior managers and team leaders at Banbury have a more positive view of the affect of Flexibility than those at Redditch, while Redditch middle managers are more positive than other managers at Redditch. Banbury middle managers are, again, less positive.

Table 6.9. How do you feel that New Skills influenced performance of the company in the past five years? Scale: 1 = Made Worse, 3 = No Influence, 5 = Improved.

	Banbury	Redditch
Senior Managers	4.14	3.73
Middle Managers	4.00	4.00
Team Leaders	4.00	3.91
Office Employees	3.82	3.78
Shopfloor Employees	3.58	3.84
Site Average	3.69	3.87

Banbury shopfloor scores pull down their site average, having a less positive view of new skills than other company areas. However, on both sites a generally positive view of the contribution of New Skills to company performance in the past five years prevails.

Table 6.10. How do you feel that Team Working influenced performance of the company in the past five years? Scale: 1 = Made Worse, 3 = No Influence, 5 = Improved.

	Banbury	Redditch
Senior Managers	4.14	3.67
Middle Managers	4.14	3.82
Team Leaders	4.20	4.15
Office Employees	4.00	3.67
Shopfloor Employees	3.45	3.81
Site Average	3.66	3.85

Strongly positive views of Team Working are apparent at Banbury in all areas except shopfloor employees, who provide a less positive view. At Redditch, though, views of Team Working are mildly positive, except from team leaders, who are the only group that are strongly positive. The division at Banbury may indicate a perception of greater performance benefits by managerial and office areas, while shopfloor employees may be expressing some concern as to the operation of Team Working. Stress levels may be higher than those at Redditch

The trends in the human aspects of Just In Time at Banbury and Redditch reveal an interesting pattern. First, senior management and team leaders appear very positive about changes at Banbury, while there appears to be a less positive view at these levels at Redditch. Banbury middle managers appear to have a less positive view of Job Satisfaction and Flexible Working. Shopfloor employees at Banbury have generally more negative views of the human aspects of change.

5. *That this approach should develop a key role for supervisors.*

A key role for supervisors was intended from the human centred approach adopted at Banbury. Research evidence was cited which argued that the role of the supervisor had declined as Taylorism was adopted. Had it been possible to reverse this, and how did it compare to Redditch? The survey examined this in two main areas. First, respondents were asked the extent to which they thought various groups of people contributed to company performance in recent years. By examining their responses on team leaders, it may be possible to see the extent to which the whole company perceived this. It is also possible to examine the views of respondents as to how involved they felt they were in the changes the company made. Would team leaders at Banbury be any different from those at Redditch? Table 6.11. shows the responses on the contribution of team leaders, while Table 6.12. shows the responses on involvement in change.

Table 6.11. How do you feel Team Leaders influenced the performance of the company in the past five years? Scale: 1 = Made Worse, 3 = No Influence, 5 = Improved.

	Banbury	Redditch
Senior Managers	4.14	3.00
Middle Managers	3.57	3.44
Team Leaders	3.81	4.15
Office Employees	3.55	3.62
Shopfloor Employees	2.78	3.32
Site Average	3.08	3.48

The greatest difference between the two sites is the view of senior managers of the contribution of team leaders. At Banbury, the perception is of a strongly positive contribution, while at Redditch the view is that team leaders had had no affect on company performance. This would appear to indicate a substantial difference in perception. At shopfloor level, though, the difference is reversed. Shopfloor employees at Banbury feel that the contribution of team leaders has been mildly negative, while at Redditch the perception is mildly positive, affecting strongly the overall site averages.

Table 6.12. How much does the company involve you personally in the changes that it makes? Scale: 1 = Not At All, 5 = Always.

	Banbury	Redditch
Senior Managers	4.00	4.00
Middle Managers	3.14	3.06
Team Leaders	3.41	2.81
Office Employees	2.22	2.33
Shopfloor Employees	2.20	2.48
Site Average	2.41	2.63

Personal involvement in change also displays quite strong variation. Banbury team leaders feel more involved in change than those at Redditch. Shopfloor employees, though, appear to feel slightly less involved at Banbury, perhaps indicating the extent of concentration on team leaders here. It would appear reasonable to conclude that the survey results show higher levels of involvement by team leaders at Banbury, but also lower levels of involvement on the shopfloor.

6.5. The Banbury Team Leader Survey

The Banbury Team Leader Survey, conducted three years after the completion of the team leader programme, enabled triangulation of the results found in the employee survey and in the observation of module progress, and allowed an assessment to be made of the longer term impact of the programme. The survey combined Likert scaling with interview questions. Results analysis involved calculation of survey average scores, and the application of a coding frame system to the non-scale questions. It is important to note that the results gained here are likely to have been influenced by the changes made by the company and described earlier in this chapter.

The results are presented by research hypothesis, as in the previous section with the employee survey.

1. *That an improved approach to Just In Time would incorporate knowledge gained from socio-technical systems research.*

Table 6.13. details the survey responses which indicate the extent to which Just In Time improvements have been gained from the programme. They show that the team leaders felt that there had been improvement in all areas surveyed during the programme and that since programme completion, quality had declined and improvement in other areas was less dramatic. Responses to the survey question 'How did the programme affect this, as it exists now?' in each of these areas showed that lead times had been reduced through the implementation of Kanban systems and that scheduling by time, advocated by team leaders during the programme, was now being applied. On set ups, question responses indicated that team leaders felt that the focus on these had declined since the programme, but that improvements made during the programme had been maintained. They felt that product quality had declined since the programme completion due to a change in the company organisation structure which resulted in team leaders having a shorter span of control. Production workflow responses indicated that while some slippage had taken place from the systems which were introduced, Kanban systems had been maintained and there was a feeling that works orders were more often produced in schedule sequence and that there were fewer 'urgent' orders, requiring disruption of the production process. The Standard Operating Methods system introduced in Module 5 was still in operation and it was felt to have improved skill levels and encouraged job rotation.

Table 6.13. What effect did the programme have on the following specific areas: Scale: 1 = Deteriorated A Lot, 3 = No Change, 5 = Improved A Lot.

	During the programme	Since the programme finished
Production Lead Times	4.00	3.40
Set Up Times	3.80	2.80
Product Quality	4.20	1.80
Production Workflow	4.20	3.60
Working Methods	4.60	3.40

2. *That the approach should incorporate an understanding of the need to transfer power within the organisation.*

The transfer of power within the organisation was likely to have been affected by the organisation structure changes made by the company following the completion of the programme. Questions on the programme's effects on this were unlikely to be helpful.

3. *That this approach should lead to success in technical performance.*

The team leaders felt that the programme had improved overall manufacturing performance strongly (see Table 6.14.). Stock levels had improved strongly too, while there had been a moderate improvement in product volume. Since programme completion it was felt that overall performance had declined, although stock levels had continued to improve strongly. The stock level improvement was felt to be due to the introduction of new systems to control stock levels, greater awareness of the need to control stock levels and the focus which the programme had brought. Production volume improvements were thought to be due to projects which had enabled trials to take place on the production process which resulted in process improvements and the implementation of visible measurement systems which increased awareness of production performance within shopfloor teams.

Table 6.14. What effect did the programme have on the following specific areas: Scale: 1 = Deteriorated A Lot, 3 = No Change, 5 = Improved A Lot.

	During the programme	Since the programme finished
Overall Manufacturing Performance	4.20	2.20
Stock Levels	4.20	4.20
Product Volume	3.80	3.33

4. *That this approach should lead to success in the human aspects of Just In Time.*

Table 6.15. shows team leader perceptions of the human aspects of Just In Time. While they felt that perceptions of job security had only moderately improved, they felt that a range of indicators, stressed in both the Just In Time and socio-technical systems literature, had improved. Since the programme was completed, they feel that deterioration is evident, particularly in work discipline, employee motivation, and employee job security. This was felt to have been due to substantial redundancies in the period following the programme completion, which resulted in less job security. While they felt that motivation had improved during the programme, they also felt that events since had led to its decline. The decline in work discipline was felt to have been due to the increased use of temporary labour and a feeling that the programme had led to an increased focus on shopfloor activity in the company. Since the programme completion, it was felt that management attention on the shopfloor had declined. This was felt to have been affected by the reduced span of team leader responsibility.

Improvement, though, was felt to have taken place in employee involvement and problem solving, indicating a continuing effort to encourage participation. This was felt to be due to the problem solving skills gained by the team leaders during the programme, continuing in use after its completion, and the establishment during the programme of team meetings. Employee skills had also improved since the programme completion, due to the continuing use of the systems established to manage training.

Table 6.15. How did the programme affect the people in the area in which you work? Scale: 1 = Deteriorated A Lot, 3 = No Change, 5 = Improved A Lot.

	During the programme	Since the programme finished
Job Satisfaction	4.00	2.80
Employee Involvement	4.40	3.40
Employee Responsibility	4.20	2.60
Work Discipline	4.20	1.40
Employee Motivation	4.20	1.80
Employee Problem Solving	4.60	3.60
Employee Job Security	3.50	1.75
Employee Skills	4.60	3.60

5. *That this approach should develop a key role for supervisors.*

The key role of the team leaders was likely to have been affected by the organisation structure changes made by the company following the completion of the programme. Questions on the programme's effects on this were unlikely to be helpful.

6.6. Discussion

This chapter has thus far outlined the results obtained from the research and provided a brief interpretation of individual results. It is now appropriate to consider what can be learned from these in respect of each of the hypotheses being tested through the research. Each hypothesis is discussed in turn.

1. *That an improved approach to Just In Time would incorporate knowledge gained from socio-technical systems research.*

The first hypothesis postulated that the combination of Just in Time and knowledge gained from socio- technical systems would result in improved Just In Time implementation. It was argued that the requirements of employees in Just In Time were similar to the results that were expected from the application of socio-technical systems. The combination of these factors was through the application of an action research approach, implemented through a modular system focused on production team leaders. Was the implementation improved?

The New Production Systems Survey of all Alcan Extrusions and Tubes allowed comparison between Banbury, the site of the module implementation, and Redditch, where Just in Time had been applied using more conventional methods. The New Production Systems survey scores show that Banbury senior and middle managers have a more positive view of Just In Time implementation to date. In the rest of the company, differences are less apparent, with office and shopfloor employees recording virtually identical perceptions at each site. This trend continues in the scores recorded for views on future implementation of Just In Time. Banbury senior and middle managers record higher scores.

The team leader survey looked at the extent to which aspects of Just In Time were perceived to have improved at Banbury during the team leader programme and then how these aspects had changed after the programme was completed. The results show a perception that improvement had been strong during the programme, but that the rate of improvement had slowed in some areas and that decline had set in, in others. Responses to interview questions appeared to indicate that systems established during the programme were still being applied, but that the organisation change which the company had undertaken was thought to have undermined product quality.

There is, then, some evidence that the implementation of Just In Time using the method applied in this research successfully established key elements of Just in Time at Banbury, which remained in place three years afterwards. It can therefore be argued that the method applied here can be used to implement Just In Time. It is also necessary, in testing the hypothesis, to establish whether it was better than the conventional methods, applied with the assistance of Japanese experts at Redditch. Management at Banbury are more positive about the implementation, but other areas in the company are not. It is concluded that while there is some indication that implementation was better at Banbury, it is relatively weak.

The literature review had discovered that a debate existed between those who believed that socio-technical systems were based in 'craft production' (Womack, Jones and Roos, 1990) and those who argued that Just In Time placed intolerable burdens on the individual (Berggren, 1989). The combination of socio-technical systems knowledge and Just In Time was not thought possible by Womack, Jones and Roos, while Berggren argued that while it may be theoretically possible, it had not yet been attempted. The implementation at Banbury would appear to suggest that the case for an integrated approach has been strengthened.

2. *That the approach should incorporate an understanding of the need to transfer power within the organisation.*

The implementation attempted to shift power within the organisation towards team leaders, from managers and specialist departments. Evidence that this occurred is found in the responses of the team leaders to the New Production Systems survey. Here it is found that they feel that responsibility in their jobs has increased more than team leaders at Redditch feel. In addition, the Banbury middle managers give lower scores in response to this question than their counterparts at Redditch. Further evidence is found in the responses by Banbury middle managers which indicate that they expect to have less increase in responsibility in the future than do those at Redditch. It is therefore argued that the Banbury middle managers have perceived a relative decline in their power in the organisation, while the team leaders at Banbury perceive a relative increase in their power. There is no evidence of this increase in responsibility being viewed negatively.

The predominate trend in the management of change literature was identified as that of a desire to develop universal rules of change (see, for example, Kanter 1983). The proposition was developed which stated that management of change approaches failed to consider adequately the issue of power within organisations and that this should be incorporated into an improved approach to Just In Time.

Given the perception (albeit weak) that Banbury has implemented Just In Time more successfully than Redditch, and that the pattern of responses on responsibility would indicate that this has shifted towards team leaders at Banbury, it may be concluded

that the hypothesis that Just In Time requires a power shift within the organisation may be supported. It is difficult here to establish direct links to prove this, however.

3. *That this approach should lead to success in technical performance.*

The evidence would appear to show that the approach adopted did result in improved technical performance within the company. While examination of company performance measures was likely to be futile, due to the probable influence of market conditions here, the survey results showed a perceived improvement at both sites. There was little difference between the scores recorded at both sites and it is therefore argued that technical performance improvement over the time period covered was similar at each site. While the time period considered is relatively short in Just In Time implementation terms, it can be argued that the technical performance effects were moderately positive.

The reason for implementing Just in Time is normally a desire to improve the performance of the company. Evidence was cited in the literature review of substantial gaps between Japan and the West in industrial performance (Womack, Jones and Roos, 1990) and the continuance of that gap in industrial sectors which had attempted to introduce Just In Time in the West and their counterparts in Japan (see Delbridge and Oliver, 1991). It was therefore hoped that the research reported in this thesis would contribute to an understanding of how that gap might be narrowed. While the survey evidence indicates that the performance improvement at Banbury is at least as good as that at Redditch, and that it may have been better, this does not of itself prove that a solution has been found. However, it does indicate that a fruitful avenue of future research may have been found.

4. *That this approach should lead to success in the human aspects of Just In Time.*

The results of the programme on the human aspects of Just In Time display both positive and negative attributes. Job satisfaction results were slightly more negative at Banbury on the shopfloor, in spite of effort at Banbury to incorporate aspects of socio-technical systems in the module design. It is difficult to attribute reasons for this, but it may be due to the time at which the survey was undertaken. A new management team had been installed and much company reorganisation had taken place, which may have influenced this score.

There does appear to be a stronger perception of the contribution of employees at management levels at Banbury though, although once again the indications are mild. Banbury senior managers and team leaders perceive a stronger employee contribution through acquisition of new skills, flexibility and team working, than is perceived at Redditch.

The perceptions of Banbury team leaders suggest that there employee contribution improved strongly during the programme but deteriorated strongly afterwards, due to changes the company made. On a series of factors (Job Satisfaction, Employee Involvement, Employee Responsibility, Work Discipline, Employee Motivation, Employee Problem Solving, Employee Job Security, Employee Skills) there was a perception that employee activity improved markedly. However, there was a strong feeling that following programme completion, decline set in.

It may therefore be argued that the programme has influenced the contribution made by employees, but that the actions of the company after programme completion resulted in decline. This may partly explain the negative scores recorded by shopfloor employees in the New Production Systems survey. It is therefore argued that evidence exists to support the proposition that the contribution of employees increased during the programme. However, the effects of the programme on employee job satisfaction are unclear.

The human side of Just In Time has two key aspects. First, the effects of Just In Time on employee welfare (see Fuccini and Fucini, 1990, Parker and Slaughter, 1988) and second the weaknesses in Western workforce characteristics compared to those in Japanese companies (see, for example, Mayes and Ogiwara, 1992). It has been argued that Just In Time leads to deterioration in employee working conditions and that Western employees cannot achieve the characteristics of those in Japan. The evidence cited here would appear to show that the programme used at Banbury achieved better results than the programme at Redditch, in terms of the characteristics of the workforce. There appears to have been improved skill, flexibility and teamworking. Evidence on employee welfare is less clear. The team leaders feel that during the programme the working lives of employees improved. There is sufficient evidence here to suggest that the approach was successful, but further work is required to prove it.

5. *That this approach should develop a key role for supervisors.*

There was a clear perception at Banbury by senior managers that team leaders had contributed strongly to the performance of the company, substantially more so than was perceived by the senior managers at Redditch of their team leaders. Team leaders at Banbury felt more involved in company change than those at Redditch too. However, the positive perception at Banbury of team leaders by senior managers, was not shared on the shopfloor. Banbury team leaders received lower scores than Redditch team leaders from the people they managed. It is relevant here to note that the changes introduced by the Banbury management team following the completion of the programme doubled the number of team leaders, while maintaining team leader pay levels. While scientific evidence of the effects of this are not available, it is reasonable to believe that this may have affected survey scores.

The role of the team leader (or more generally, first line manager) in industry was reviewed in the literature survey. Evidence was cited of a powerless role in Taylorist manufacturing. It was argued that both socio-technical systems (Thorsrud, 1984) and Just In Time (Andersen Consulting, 1993, Lowe, 1993) required a more central role for team leaders. The method of changing from the existing weak position to that desired is not considered in the current research and no guidance is available on how it might be done. The evidence cited in this section would appear to show that a substantial difference exists in the role of the team leader at Banbury which was achieved with the programme described and their role at Redditch. The hypothesis that the new role would be established by the approach taken has been proven.

6.7. Summary

This chapter has described the research results, obtained from the hypotheses testing, describing the actions recorded in the diary of programme progress, and the three surveys which were undertaken. The results were displayed by hypothesis, allowing the reader to consider the evidence in respect of each in turn. The hypotheses were then considered in respect of the evidence. It was found that some evidence existed in support of the first hypothesis, that Just In Time would be improved with an incorporation of socio-technical systems research. The evidence is weak on hypothesis two , that the approach should incorporate an understanding of the need to transfer power within the organisation. While a shift in power is found to have occurred at Banbury, the link between this and better performance is difficult to establish. The third hypothesis, that this approach should lead to success in technical performance is indicated, though only to the extent that no worse performance was achieved at Banbury than at Redditch. There is slim evidence that a better performance may have been achieved, but further work is required here.

The fourth hypothesis, that this approach should lead to success in the human aspects of Just In Time has evidence in support of the employee characteristics human elements, but not in support of the employee welfare aspects, which require further consideration. A key role was developed for supervisors, substantially different from that which existed at Redditch (hypothesis 5).

Chapter 7.

Conclusions and Limitations of the Project

7.1. Introduction

This final chapter looks at what was done to identify the strengths and weaknesses of the approach adopted. It then summarises the contribution of the research undertaken. Recommendations for future work are given.

7.2. A Critique of What Was Done

Chapter 5 described the methodology which would be adopted in the research work described in this thesis. Action research, aiming to contribute to the practical concerns of the issue studied as well as to the development of social science was chosen, due to the emphasis on socio-technical systems and a desire to base the research in a real environment. This section discusses the extent to which action research principles could be adhered to in the research, to allow an accurate judgement to be made of the value of the results gained. Table 7.1., from Gill and Johnson (1991) page 61, is a useful comparison of the main aspects of action research, consultancy and pure research.

Table 7.1. Action research, consultancy and 'pure' research.

Stages	Action research	Consultancy	'Pure' research
Entry	Client or researcher presents problem. Mutually agreed goals.	Client presents problems and defines goals.	Researcher presents problem and defines goals.
Contracting	Business and psychological contracting. Mutual control.	Business contract. Consultant controls client.	Researcher controls as expert. Keeps client happy. Minimal contracting.
Diagnosis	Joint diagnosis. Client data/researcher's concepts.	Consultant diagnosis. Often minimal. Sells package.	Researcher carries out expert diagnosis. Client provides data.
Action	Feedback. Dissonance. Joint action plan. Client action with support. Published.	Consultant prescribes action. Not published.	Report often designed to impress client with how much researcher has learned and how competent he or she is. Published.
Evaluation	New problems emerge. Recycles. Generalisations emerge.	Rarely undertaken by neutrals.	Rarely undertaken.
Withdrawal	Client self-supporting.	Client dependent.	Client dependent.

In examining the application of the action research methodology in the research reported here, the above framework is helpful. In action research, in the entry phase of the research, the client or the researcher presents the problem and mutual goals are agreed. In this research, the researcher presented the problem (the implementation of Just In Time) to Alcan and goals for the activity were agreed. This is in contrast with pure science which is wholly controlled by the researcher, and consultancy in which the client presents the problems and defines the research goals. In this case, the researcher approached Alcan with the problem and activity was undertaken to achieve a mutual agreement on the research goals.

The contracting stage of the research is the establishment of the relationships which will determine the action carried out as the research proceeds. Here action research differs from pure science and consultancy once again in the joint nature of the control of decisions on activity to be undertaken. In action research, careful discussion and agreement is required to achieve the balance on which joint action depends. This

should not simply involve formal contracting, but will often involve a close collaborative relationship. The relationships which allowed this research to take place began to be formed in previous research undertaken by the author, which allowed confidence to be established within the company.

The diagnosis is the stage at which the client's problems are understood. In action research, a joint understanding is desirable due to the increased commitment that this will bring to the research. Activity to reach agreement on the approach to be taken at Banbury relied on discussion with the company management team, surveying and discussion with the Banbury team leaders and previous MSc. research surveying of all employees (Carr, 1992).

In the action stage of the research, action research is supposed to rely on action mainly being undertaken by the client, with some support from the researcher. This action is normally jointly planned and agreed. In this case, the activity undertaken was led by the researcher, but involved action by company management team members, specifically, the leadership of individual modules and agreement of project plans. In this research, the initial team leader programme design, the design and delivery of individual modules, and the agreement process on module projects, all involved arrangements for mutual agreement. Research in which the researcher prescribes the action would normally be within the realm of consultancy, but it would not be accurate to say that this research was. While the researcher had a higher than may be desired input into the action stage, there was still substantially more client participation in planning and carrying out the action than would be apparent in a consultancy project.

The nature of the work being undertaken, the introduction of new practices in Just In Time and socio-technical systems, was likely to require expertise other than that possessed within the company itself. In the absence of the availability of this expertise from any other source, it had to be provided by the researcher. A compromise of the research principles was required to allow the hypotheses to be tested.

The evaluation of the research in a consultancy project is not normally undertaken by neutrals, while in an action research approach it leads to the generation of new problems and activity to solve these, through a joint client - researcher analysis. The issue of neutrality in the conduct of evaluation is important to ensure that the research can be objectively analysed, rather than being undertaken in a way which will yield results which are favourable to the researcher. The evaluation work undertaken for this thesis did involve a prominent role for the researcher in the observation of module progress and in the conduct of the surveys which featured. However, module observation was influenced by regular review meetings with the company management team and regular presentations by the team leaders. The surveys were designed as a joint activity by the researcher and the client, and the major employee survey was conducted by nominated individuals on each site. In any case, as with the action stage, the researcher was the only person available to

undertake the evaluation activity. While it would have been desirable to have the evaluation activity undertaken by neutral observers, this was not possible within the constraints in which the research was done.

This critical approach to the implementation of the action research approach in this research focuses on the extent to which this research is action research and the extent to which it may be described as consultancy and hence not worthy of consideration as a research project. While in the entry, contracting and diagnosis stages of the research it is argued that an action research approach was clearly adopted, the action and evaluation stages did veer towards consultancy, and this is a weakness in the research. However, a more strictly action research approach would not have been possible in the conditions which were available in which to conduct the research.

7.3. Implementation of Just In Time

This section describes the contribution of this research and the limitations of it. This is outlined by hypothesis and then an overall summary is provided.

1. *That an improved approach to Just In Time would incorporate knowledge gained from socio-technical systems research.*

The research reported here has resulted in a successful application of Just In Time manufacturing at Alcan Extrusions Banbury. As such it indicates a value in the approach adopted. Incorporating socio-technical systems knowledge with Just In Time can be undertaken successfully. However, the continuation of this success requires a continuing management commitment to its operation, which did not occur in the research site. While success was achieved in the short term, further research is necessary to understand the longer term operation results.

2. *That the approach should incorporate an understanding of the need to transfer power within the organisation.*

The approach adopted at Alcan Extrusions Banbury did appear to result in a shift in power from middle managers to team leaders. Firmer evidence of this would have been available if a study before the programme commenced had been undertaken, but comparison with Redditch does seem to indicate a substantial difference. It is therefore felt that this research has developed a method for transferring power to team leaders in a manufacturing environment, overcoming the difficulties of the current supervisory position in a Just In Time environment. It is more difficult to establish the effect of that transfer of power on Just In Time performance.

3. *That this approach should lead to success in technical performance.*

Company performance was perceived to have improved during the period that the implementation was undertaken. This would appear to strengthen further the argument that the integration of human and technical aspects of Just In Time is of importance, as argued by Pang and Oliver (1988). The difficulty here is that this integration was only operated for one year at Banbury, and the longer term effects are not known.

4. *That this approach should lead to success in the human aspects of Just In Time.*

The management perceptions at Banbury were of better performance in the human aspects of Just In Time than was apparent at Redditch. However, the job satisfaction aspects are unclear, given the team leader survey responses indicating a feeling that motivation had improved and the New Production Systems employee post programme scores indicating a feeling that job satisfaction had declined. A number of improvements in the research are possible. Before and after results on job satisfaction scores, based on a proven survey method for analysing job satisfaction would give a more conclusive result here. Unfortunately this was not possible during the reported research. So, it would appear that in employee contribution, flexibility, skills and teamwork, an improved approach has been developed. The effect on the satisfaction of shopfloor employees is yet to be determined.

5. *That this approach should develop a key role for supervisors.*

The role of the supervisor at Banbury does now appear to be substantially different from that at Redditch, as evidenced by the New Production Systems survey scores. The approach allowed this role to be developed and it is reasonable to assume that this could be applied not just to the implementation of Just In Time, but also in a range of manufacturing changes. The importance of changing the role of supervisors is not just relevant in a Just In Time setting. However, two concerns emerged. First, the middle managers at Banbury do appear to be more pessimistic about their future role in the company. This may be an accurate perception, given the shift away from Taylorism they are likely to be less important and their jobs may be under threat. This issue was not considered in the research, but it would appear that it would have to be considered in future implementation. The second issue is the perception of team leaders by shopfloor employees. While it can be argued that the negative perceptions at Banbury were partly due to the changes made after the programme was completed, it may also be the case that the incorporation of team leaders into a stronger management position leads to a reduction in concern for the welfare of team employees. This was not considered in the research activity.

The major limitation of the derivation of general theory from this research is its situation in two companies and the difficulty of extrapolating from this restricted base. However, it can be argued that the opportunity which was provided by Alcan Aluminium to develop and trial the method is unlikely to be made available on a wider basis, and that it would have been impossible for the research to be implemented on a wider scale due to the expertise and resources required.

The research which was undertaken was also limited by the changes within the company after the completion of the programme. Longer term effects are impossible to gauge. We are left, then, with the evidence of the implementation period itself, and what can be seen in the company, in spite of events since the programme finished, at the time of completing the research (three years later). From this it is possible to assert with some confidence that the approach adopted here, of the implementation of Just In Time, with a socio-technical orientation, through manufacturing team leaders, is of value. Little research had attempted to do this before, although some literature suggested that it may be of value. Conducting this research has strengthened arguments in its favour and has opened a new avenue of practical research on how it might be done.

7.4. Recommendations For Further Work

This research has opened a new area of research, into the implementation of Just in Time, the application of socio-technical systems and the role of the team leader. The following issues emerge as areas of further research:

1. While this application aimed to apply socio-technical systems principles, further research could look at the application of particular elements in this new environment. A number of areas are possible, for example, the development of working methods in a Just In Time environment and the control of workflow by shopfloor teams in a waste reduction environment. While preliminary approaches to these issues were developed here, further work would identify better ways of doing this.

2. The link between the shift of power within the organisation to team leaders and the change in performance that this promotes is not clearly identified here. This is probably only possible when a large number of applications are in place. It would strengthen arguments in favour of this shift.

3. The technical performance success has not yet been clearly established. While the approach has resulted in similar performance improvement at Banbury as occurred at Redditch, it had been hoped that this approach would result in a way of closing the gap between the Japanese levels of manufacturing performance, from Just In Time, and those in the West. The timescale under which the application was undertaken, and the limited research base, were insufficient to allow definite conclusions on the

performance outcomes, although there was scope for optimism. Further study, with a wider research base and over a longer timescale may do this.

4. The inconclusive results on the effects of the implementation on employee welfare could be resolved on a wider research base and with the application of a proven survey of job satisfaction, compared to that achieved in a Taylorist environment.

5. The role of the first line manager was changed in the research and a method for doing this appears to have been found. While shopfloor employees, middle and senior managers were involved in the programme implementation, the main focus was on team leaders. It would appear valuable to consider the additional activity support which might be desirable at these levels to assist the change to the new operating environment. However, it is likely that caution would need to be exercised here. A strength of the existing approach is the power given to the team leader and the responsibility that they have for leading change. Activity in other areas should complement this.

Five areas for further research have thus been identified which would develop further knowledge in the field of this research. This would build on the initial exploratory work reported in this thesis and, it is hoped, further contribute to an improved application of Just In Time and manufacturing change generally.

7.5. Summary and Final Comments

This thesis has opened up a new area of research in manufacturing. This area is the improved application of Just In Time manufacturing through the incorporation of socio-technical systems knowledge, by a focus which develops the role of manufacturing team leaders. While this research has been undertaken in a limited research environment, over a limited time period, the results gained provide a basis on which further research can be undertaken. There is scope for optimism that a new approach to manufacturing change has been identified.

The literature review highlighted the value of this research approach. While Western industry continues to fall behind the performance of Japan and newly emerging industrial nations, the lives of employees in companies adopting the new manufacturing paradigm, Just In Time, are deteriorating, even though Just In Time requires higher levels of motivation, skill and commitment than has existed in Taylorist work systems. It seems reasonable to suggest that continuing in this manner is unlikely to yield success. Industry will decline and people's lives will become ever more unpleasant.

Finding a way out of this position is difficult. Conventional scientific method allows the study of existing industrial activity, not new ways of doing things, except in a laboratory environment which would be inappropriate for this field of study. As

Argyris (1980) has argued, academic research should address the most critical issues facing people and attempt to provide assistance on how they may be tackled, from a societal point of view, because this will contribute to the greater good, but also from self - interest. Tax payers are unlikely to pay for academics to undertake activity which they perceive is of little value to them.

Action research is advocated as a way of resolving this issue. The researcher works with the client, aiming to provide benefit to both the client and the wider scientific and societal community. The integration of these aims is difficult in today's turbulent industrial environment. Meaningful experimentation, while offering much in potential returns to wider society, is undertaken at a substantial risk to the client. In this case, for a brief one year period, Alcan were willing to be that client. Hopeful signs emerged of what might be possible, to be devastated by corporate decisions taken at a distance. Three years on, the participants in that experiment retain positive views of what was achieved; changes made continue to give the company benefits and that strengthens the evidence that positive results were gained and that this work should continue.

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Glossary of Terms

Billet	Short length of solid aluminium which is extruded in an extrusion press.
Extrusion	The forcing of heated aluminium through a die to produce a shape.
Human Resources Management (H.R.M.)	Company activities directed towards employees.
Just In Time (J.I.T.)	A Pull manufacturing system with short lead times and low stocks.
Kaizen	Literally 'continuous improvement', in Japanese. In Alcan, the term is used to refer to a fixed period of improvement project activity (usually a week) in which work measurement techniques are applied and changes made by a dedicated team.
Kanban	A card system used to support the use of Pull systems.
Log	Long lengths of solid aluminium which are extruded in an extrusion press.
Manufacturing Systems	The systems used to organise manufacturing. For example: Just In Time, Traditional, M.R.P.
Manufacturing Techniques	Techniques used to support the operation of manufacturing systems. For example, techniques to support Just In Time would include Kanban, Kaizen, Set Up Time Reduction, Standard Operating Methods, Statistical Process Control etc.
New Production Systems (N.P.S.)	An integrated combination of a Just In Time manufacturing system and complementary human resources activities.
Pull System	A system of manufacturing in which work in progress is 'pulled' forward to its next operation by that operation. For example, Just In Time.
Push System	A system of manufacturing in which work is 'pushed' by the completing operation to its next operation. For example, most traditional manufacturing systems are Push systems.

Quest	Quality Extrusions Supplied On Time - the campaign of New Production Systems implementation in Alcan Extrusions Banbury.
Remelt	The department which makes billet and log for extrusion by casting scrap and pure aluminium.
Standard Operating Methods (S.O.M.s)	Standard ways of performing work tasks.
Task Analysis	A method to identify the critical aspects (quality, productivity, safety) of standard operating methods.
Total Quality Management (T.Q.M.)	A programme to focus company attention on the improvement of product and process quality through the application of scientific technique and employee involvement.

Appendix A.

The Alcan Extrusions and Tubes Manager Survey

Alcan Extrusions and Tubes

New Production Systems Interview Survey

Introduction

This survey has analysed Alcan Extrusions and Tubes New Production Systems activity. An extensive interview questionnaire was completed by 20 senior production managers.The results show substantial areas of progress as well as areas where improvements can be made. The comments made are intended to assist the improvement of activity in the future.

New Production Systems are more than simple stock reduction or statistical process control but are a whole new approach to manufacturing. Studies of companies which have implemented N.P.S. show that it is the strategic integration of the various elements of N.P.S. which will determine the extent of the success achieved. This survey takes an overview of N.P.S. activity to allow the strategic direction to be considered as well as commenting on activity in individual areas.

I hope you will find it helpful.

Peter Carr

25th March 1993

Acknowledgements

My thanks go to all of the survey respondents for their patient endurance of the interview.

Survey Conduct

The survey was conducted on an interview basis with each interview lasting approximately one hour. The survey form is attached as Appendix 1.

Main Findings

1. Throughout Alcan Extrusions and Tubes there has been substantial activity which can be said to fall under an N.P.S. heading. This has had positive results.

2. More N.P.S activity is apparent at Redditch and Banbury than at Almetex and Latchford. Activity at Latchford is predominately equipment oriented with improvements being gained from equipment changes (either improvements or the purchase of new equipment), reflecting a more traditional approach.

3. Understanding of the strategic direction that N.P.S. activity is taking in A.E.T. is weak. The variety of feelings as to the importance of various changes in performance indicates this.

4. The establishment of systems to continue activity in areas where improvements have beemade does not feature as strongly as might be hoped. Too many improvements continue to rely on management tinkering for substantial periods of time.

5. The management of activity towards New Production Systems is not coherent. At Redditch this appears to exist through a separate and parallel management structure while a traditional management activity continues alongside. At Banbury there is a wide spread of activity but this does not have any co-ordinating focus.

6. While there is a recognition that Performance Measurement and Display is important there is little evidence that the substantial effort that is put into data collection is reflected in improvement effort. Further, it is questionable whether many of the measurements undertaken are appropriate for this purpose. This is an area which needs urgent review.

7. There is a strong feeling that we are now through the Information Technology revolution. Further, the experience of computers to date is causing an alarming reluctance to use computer based solutions in future. This indicates a need to improve our application of computer based tools which still can provide significant benefits to the business.

8. Throughout A.E.T. the people side of N.P.S. remains weak. There is no consistent method of employee communication or involvement, although this does appear spasmodically. Training and education have increased in volume in recent years but still require significant effort if they are to provide the support required by N.P.S. Union relationships are positive and not an area for concern.

9. While many improvements are recognised to have come from equipment developments in recent years, problems are seen to lie more with people.

Site Results

Latchford

There is an understanding at Latchford that the main threat in future years is imported extrusions from Europe. Having enjoyed a comfortable position ás the only U.K. supplier of large extrusions, effort is now required to ensure competitiveness. The responses to the survey at Latchford were characterisedby an equipment based approach to improvement. There is a strong feeling that equipment developments are the main source of improvement, reflecting a more traditional manufacturing approach. While equipment changes are important, N.P.S. encompasses a wide range of areas.

The previous management style here was particularly traditional and dominated by the personality of the General Manager. Little significance was attached to communications or employee involvement. Most people areas of N.P.S. remain weak.There is widespread hope and expectation that the new management (Tony Dickinson and Richard Duffell). Will adopt a more positive approach. However, there are pockets of scepticism about future new methods based on a 'we did alright before - why change now' attitude.

Banbury

Banbury has been engaged in a substantial range of N.P.S. activity in recent years. This has involved a wide range of people and this is reflected in a wide understanding of N.P.S. principles. Management involvement in N.P.S. has been weak though. While Team Leaders have been developed to support N.P.S. activities, management have retained a broadly traditional role. This has been exacerbated by a lack of understanding of the strategic direction that N.P.S. activity at Banbury should take and hence a plethora of activities which often appear to lack integration.

Redditch

The Redditch N.P.S style is characterised by parallel N.P.S. and traditional management systems. Substantial activity has been apparent but appears dominated by centrally driven team based activity. While success is apparent, more effort is perhaps required to establish improvement as part of normal day to day management activity. The links between Redditch and N.L.M. and Japanese customers seem to have been a valuable stimulus to N.P.S. activity.There is recognition that the new cell structure has been formally put in place but requires development effort if it is to yield the expected benefits.

Almetex

Almetex feature an equipment based approach to improvement which is similar to Latchford's. Solutions to problems are often felt to lie in externally controlled solutions i.e.. better quality of log / billet and better quality of dies. While many 'experts' have looked at improvement of Almetex, there seems to be little internally generated improvement activity leading to a lack of ownership of changes made and hence their rapid decline into disuse. More focus should be put on enabling Almetex to make changes itself and reducing the reliance on external 'experts'. Further, Almetex, whether by design or not, can only ever be run successfully on a Just In Time basis. It has the potential to provide a valuable test bed for N.P.S. techniques.

Results By Survey Section

This section details the responses to each section of the questionnaire, by section. The respondents were first asked:

What improvement in the past five years would you consider to have increased company performance most and why? (Internal to company only).

On each site, answers to this question varied but were predominately split into engineering changes and N.P.S. changes. There appeared to be little consensus on each site about the appropriate response to this question.

What change in the past five years would you consider to have decreased company performance most and why? (Internal to company only).

Decreases in company performance were felt to stem mainly from people (getting people to change their working practices) or effectiveness in managing i.e.. planning, consistency of approach.

Section One - Marketing

On all sites there is a recognition that Quality, Price and On Time Delivery are important, though the relative importance given to each area varies within sites and between them. There is a widespread feeling that the competition is getting tougher, either through threats to niche positions or general threats from Europe.

Section Two - Performance To Date

1. On Time Delivery

How would you describe company performance in this area?

Much Worse 0 Worse 1 No Change 6 Better 11 Much Better 1

What factors have influenced the performance in this area in the past five years?

Respondents are split on how company performance has changed in recent years as the numbers above show. the main factors which were thought to have influenced this were management focus and a variety of changes to scheduling. There was little mention of stock reduction or lead time reduction as having an effect here which may have been more indicative of an N.P.S. approach.

How important do you think it is that this area be improved in future?

Not Important Important 1 Very Important 18

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

A high proportion of respondents regarded On Time Delivery as very important. Plans for the future were more production than scheduling based than in the past and indicate a growing influence of Just In Time.

2. Scrap Reduction

How would you describe company performance in this area?

Much Worse 0 Worse 4 No Change 10 Better 5 Much Better 0

What factors have influenced the performance in this area in the past five years?

Respondents were particularly divided over their feelings about scrap reduction with 4 feeling that it had got worse and 5 that it had got better. Site seemed to have little influence over the responses made.

Changes here were influenced mainly by increasing product requirements and people attention to detail rather than any coherent approach to quality improvement.

How important do you think it is that this area be improved in future?

Not Important Important 2 Very Important 16

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

Quality improvements in future plans are mainly driven by improvement teams. There is some mention of encouraging people to 'Do It Right'.

3. Man Hours Per Tonne

How would you describe company performance in this area?

Much Worse 0 Worse 3 No Change 8 Better 6 Much Better 2

What factors have influenced the performance in this area in the past five years?

People reduction features as the main perceived influence on man hours per tonne (where it is felt that it has got better), combined with a reduction in order levels (where it is felt that it has got worse). There is occasional mention of machine improvements and / or people flexibility, but people reductions dominate.

How important do you think it is that this area be improved in future?

Not Important 1 Important 5 Very Important 13

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

There is much less reference to people reduction as a future determinant of man hours per tonne than in the past (except at Latchford) indicating a feeling that this is now past. Future emphasis is more on project driven activity (Redditch / Almetex) and devolution of responsibility (Banbury).

4. Product Quality

How would you describe company performance in this area?

Much Worse 0 Worse 0 No Change 5 Better 10 Much Better 5

What factors have influenced the performance in this area in the past five years?

Attention to detail and equipment changes seem to have been the main influences on quality in the past. This does not appear to be an area where a particularly systematic approach has been adopted.

How important do you think it is that this area be improved in future?

Not Important 0 Important 2 Very Important 17

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

Plans to improve quality include training, people giving more attention to detail and improved or new equipment. Perhaps surprisingly, there is little mention of the use of statistical techniques to improve quality. (e.g.. T.Q.M., S.P.C.)

5. Stock Levels

How would you describe company performance in this area?

Much Worse 0 Worse 0 No Change 2 Better 9 Much Better 8

What factors have influenced the performance in this area in the past five years?

Management directives and 'tighter control' are the main factors which are seen to have influenced stock levels. Occasionally mention is made of systems changes i.e.. raw material supplies and pull scheduling, but this is the exception rather than the rule.

How important do you think it is that this area be improved in future?

Not Important 1 Important 11 Very Important 8

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

There is a feeling that stock reduction is a less important activity than it may have been in the past. Substantial gains have been achieved and it will be a lower priority.

6. Manufacturing Lead Times

How would you describe company performance in this area?

Much Worse 0 Worse 1 No Change 5 Better 12 Much Better 1

What factors have influenced the performance in this area in the past five years?

Scheduling seems to have been the main area of activity on lead times, particular mention is made at Redditch of the new cell system. A variety of scheduling developments are mentioned.

How important do you think it is that this area be improved in future?

Not Important Important 6 Very Important 14

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

Scheduling continues to dominate efforts to reduce lead time. However, there is less emphasis on computer driven solutions and more on cell development and pull systems to reduce manufacturing lead time. Surprisingly, little mention is made of process variability.

7. Process / Machine Capability

How would you describe company performance in this area?

Much Worse 0 Worse 3 No Change 7 Better 7 Much Better 3

What factors have influenced the performance in this area in the past five years?

Opinion is very divided on this topic. Some feel it has improved while others feel it hasn't at the same sites. This probably reflects the survey base, i.e.. maintenance managers and production managers. The main influence on this is thought to be new equipment (either the acquisition of or the failure to acquire). There is little mention of any significant effort to improve the performance of existing equipment.

How important do you think it is that this area be improved in future?

Not Important 0 Important 2 Very Important 17

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

Again attention focuses here on equipment and dies and metal quality. There is slight mention of cause and effect analysis and S.P.C. which are techniques which would focus on the process as a whole rather than just the 'technical' side of it.

Section Three - New Production Systems

In each of the following areas please describe any activity in the past five years: (If none please leave blank).

1. Set Up Times

Alot of attention has been given to set up times where Kaizens have been undertaken. There doesn't seem to have been much overall strategic direction of set up time reduction efforts.

2. Materials Handling

The main area mentioned here is moves to use or not to use cranes or fork lift trucks. With lower stock levels and strict adherence to schedule order in production, opportunities are vast for improvements here.

3. Housekeeping

This has improved in most areas. Systems to manage it are variable though and should be standardised. One mention was made of housekeeping only being done for senior management visits. This sends very negative messages to the shopfloor and elsewhere.

4. Performance Measures

There is no consistent policy here beyond that 'there should be alot of them'. Vast quantities are produced but few seem to have a direct influence on improvement. Few are relevant to shopflodmprovements. Some conflict and send negative messages (i.e.. reporting based on total tonnes produced at the press without taking into account the volume scrapped).

5. Problem Solving

There is alot of small team centrally driven problem solving and some sporadic non-centrally driven problem solving at a local level. N.P.S. requires all employees to be involved in improvement. Substantial effort is required to get this into a self-sustaining position. The S.O.M.s at Banbury should provide a good basis for this.

6. Group Working / Cellular Manufacturing

There is wide recognition of the importance of team based activity. The main formal cellular manufacturing effort has been at Redditch. While the cell structure has been established effort is still required to make it work properly.

7. Standard Operating Methods

Except at Banbury, S.O.M.s have emerged mainly from BS5750 and Kaizen activity. Some have come from I.S.R.S. task analysis. The difficulty here is the need to ensure adherence and regular improvement. A method for this is being trialled at Banbury. The reduction in process variability that N.P.S. requires makes strict, continually improved standard operating methods essential.

8. Reduction of Product Diversity

Occasionally there has been a reduction in product diversity due to a declining market but this has had little influence. Operation streaming at Banbury and cells at Redditch are reducing product diversity in each production area.

9. Customer / Supplier Relationships

'One-off' close relationships with large suppliers and customers are a step towards achieving this with all customers and suppliers. This seems to be stronger with customers than suppliers.

10. Kaizen

Few Kaizens have been attempted at Almetex and Latchford, although some are planned in the near future. At Banbury and Redditch opinion on success is divided, with concerns being expressed about 'follow-up'. The role this should play in relation to other N.P.S. activity should be better defined and the principles and techniques more widely applied to other N.P.S. activity.

11. Machine Reliability

There is much dispute over actual changes to machine reliability. Certainly a dramatic improvement is normally required to enable N.P.S. to operate effectively which requires careful consideration of the availability of the necessary resources.

Section Four - People

In each of the following areas please describe any activity in the past five years: (If none please leave blank).

1. Employee Involvement

There does not appear to be a conscious strategy for employee involvement. Safety meetings are often mentioned as the main forum with teambriefings less frequent. There seems to be more employee involvement activity at Banbury.

2. Flexibility

There is a general feeling that this has substantially improved and is satisfactory. Craft areas are more reluctant than shopfloor areas to work flexibly on some sites.

3. Training

Training has increased in recent years. Respondents mentioned shopfloor training in particular, which had increased but was of very questionable quality. There is still too much training based on 'go stand next to...'. A stronger system of training which improves quality and stops it taking second place to immediate production requirements is needed. Some immediate skill needs are apparent where people reductions have resulted in skill shortages.

4. Responsibility

There is consciousness of the need to shift responsibility downwards but while some success has been achieved in doing this to team leader level, there seems to be difficulty in taking this lower, to the extent required for N.P.S.

5. Teamworking

There is consciousness of the value of teamworking and indeed some teambuilding training has helped here.

6. Communications

These are a major weakness. The publication of statistics should not be confused with communications. There are some teambriefings but many of the recent changes on many sites have suffered from a lack of workforce communications. Successful change depends on workforce commitment yet little effort is expended to get this.

7. Performance Appraisal

Performance appraisal is not popular with those who are currently appraised. It is a controversial subject in debates on N.P.S. with some arguing for a team based approach.

8. Education

The M.B.A. was mentioned by most respondents but enthusiasm for it is waning in some areas. There is a danger here that those for whom an M.B.A. is not immediately appropriate will feel that their progress in the company is unlikely, creating a dangerous 'them and us' division. This should receive attention.

This survey shows that more general education on N.P.S. topics would be valuable, possibly on a seminar basis. A thriving debate on N.P.S. issues should be encouraged.

9. Single Status

This has not really featured anywhere in A.E.T. to date.

10. Union Relationships

These are better with production unions than craft or staff unions, although few problems seem to exist.

Section Five - Management Methods

How are improvements managed within the company? (e.g.. management meetings, performance measures etc.)

There does not appear to be a coherent approach to the management of improvement anywhere in A.E.T. At Redditch a separate improvement structure has developed while at Banbury much activity has been stimulated but there is little strategic coordination.

This is important because N.P.S. is a 'system' which by definition is a series of elements which will be affected by how they are assembled together. Coherent leadership and management of change is essential.

Section Six - Change Tools

Which of the following tools have been used to make changes in the past five years? If these tools have been used please describe how, if they haven't, leave blank.

1. Training of Individuals

This has been covered in previous sections.

2. Development of Work In Teams

This has been covered in previous sections.

3. Development of The Organisation's Structure

There have been extensive moves towards flatness of structure throughout A.E.T., to which the organisation is still adjusting. There appears to be occasional confusion here between flatness and slimness, the former being a small number of levels and the latter being the number of people at each level.

4. Integration of People and Their Work

There has been no activity in this area.

5. Development of Information Systems

Responses to this question reflected a poor opinion of computer activity.

6. The Creation of Conflict

This has seldom appeared by design, although it is felt to have occasional value.

Section Seven - Other Comments

Do you have any other comments to make about company improvement activity?

Three areas were mentioned as additional areas of concernFirst, there was concern that improvement was easy during a recession when spare resources existed but was now going to be more difficult. More effort is now needed to ensure that this doesn't result in a decline in improvement activitySecond, mention was made of the positive influence of Japanese consultants (N.L.M.) and customersThird, Benchmarking was seen as valuable.

New Production Systems
Interview Questionnaire

Introduction

This survey is intended to gain information on improvement activities undertaken to date. While specific questions are asked, interviewers should probe more deeply where it appears this will be of value.

The first question is intended to gain awareness of the priorities of the interviewee.

Peter Carr January 1993.

What improvement in the past five years would you consider to have increased company performance most and why? (Internal to company only)

_____

_____

_____

What change in the past five years would you consider to have decreased company performance most and why? (Internal to company only)

_____

_____

_____

Section One - Marketing

What are the top three factors which influence customers to purchase from your company?

1._____

How do you feel company performance has changed in this area in the past five years?

_____

_____

What plans exist to improve performance in this area in future?

_____

_____

_____

2._____

How do you feel company performance has changed in this area in the past five years?

_____

_____

_____

What plans exist to improve performance in this area in future?

_____

_____

_____

3._____

How do you feel company performance has changed in this area in the past five years?

_____

_____

_____

What plans exist to improve performance in this area in future?

_____

_____

_____

Section Two - Performance To Date

1. On Time Delivery

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

2. Scrap Reduction

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

3. Man Hours Per Tonne

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

4. Product Quality

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

5. Stock Levels

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

6. Manufacturing Lead Times

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

7. Process / Machine Capability

How would you describe company performance in this area?

Much Worse Worse No Change Better Much Better

What factors have influenced the performance in this area in the past five years?

_____

_____

_____

How important do you think it is that this area be improved in future?

Not Important Important Very Important

If Important or Very Important, what plans exist to do this?

If no plans exist, what do you think should be done?

_____

_____

_____

Section Three - New Production Systems

In each of the following areas please describe any activity in the past five years: (If none please leave blank).

1. Set Up Times

2. Materials Handling

3. Housekeeping

4. Performance Measures

5. Problem Solving

6. Group Working / Cellular Manufacturing

7. Standard Operating Methods

Section Four - People

In each of the following areas please describe any activity in the past five years: (If none please leave blank).

1. Employee Involvement

2. Flexibility

3. Training

4. Responsibility

5. Teamworking

6. Communications

7. Performance Appraisal

8. Education

9. Single Status

10. Union Relationships

Section Five - Management Methods

How are improvements managed within the company? (eg. management meetings, performance measures etc.)

Section Six - Change Tools

Which of the following tools have been used to make changes in the past five years? If these tools have been used please describe how, if they haven't, leave blank.

1. Training of Individuals

2. Development of Work In Teams

3. Development of The Organisation's Structure

4. Integration of People and Their Work

5. Development of Information Systems

6. The Creation of Conflict

Section Seven - Other Comments

Do you have any other comments to make about company improvement activity?

Thank You.

Appendix B.

The New Production Systems Survey

Alcan New Production Systems Survey

Survey Completion Instructions

1. Assemble the group of employees to be surveyed in a room and ensure there will be no interruptions. Each employee should be given a pen and have a surface to lean the survey on.

2. Explain that you want them to complete the survey to help the company better understand its strengths and weaknesses. Point out that their full and honest responses are essential to find the truth. If we don't know the truth we won't improve.

3. Explain that the survey is being conducted by Cranfield Institute of Technology. Each group of questionnaires will be placed in a sealed envelope to be opened at Cranfield. The responses of individuals will not be revealed to the company.

4. Tell them that the survey will take about 20 minutes to complete. Tell them that they should try to answer every question. It is o.k. if they don't but we want as full a response as possible.

5. Tell them that once they have the survey it is best that they do not talk to each other until it is completed.

6. Hand out the survey and ask people to read the instructions - do not start the survey yet.

7. Ask if anyone is unclear about how to complete the survey and clarify any ambiguities.

8. Ask people to begin. Stay in the room while the survey is completed.

9. Do not collect any survey forms or allow anyone to leave the room until everyone has finished.

10. Collect the survey forms. It is important that this is done from

everyone at the same time.

11. Thank everyone for their cooperation. Tell them that they will be told what the results were in a few weeks. They may now leave.

12. Put the survey forms into the envelope and write on the outside of the envelope:

1. The name of the supervisor of the survey.

2. The date and time that the survey was completed.

3. The department surveyed.

If you have any difficulty with the survey please contact Peter Carr on 0295 264444 or 0280 848570, anytime.

Thank you.

Peter Carr

Alcan

New Production Systems Survey

Introduction

This survey is intended to analyse the reasons for company progress and problems over the past five years so that the company can operate more successfully in future. Your honest and full completion of this questionnaire is therefor very important. Details of individual's responses will not be made public.

Please try to complete every question.

Once the questionnaire results are compiled. they will be distributed to you.

Thank you for your cooperation.

Please complete this questionnaire as follows:

Boxes should be selected with a cross. For example:

Which team will win the next Football World Cup?

England	☐
Argentina	☐
Scotland	☐
Germany	☐
Brazil	☐

Where a grading of response is offered, please circle the appropriate answer. For example:

How likely is it that England will win the next World Cup

Not at all likely Certain

1 2 3 4 5

Now begin.

1. Please indicate where you work: (select one only)

Production ☐

Finance ☐

Sales ☐

Personnel or Human Resources ☐

Other (please describe) _____

Which of the following describe your job? (select any that apply)

Shopfloor ☐

Office ☐

Supervisor/Team Leader ☐

Middle Manager ☐

Senior Manager ☐

Other (please detail) _____

2. What effect do *you think* the following changes would have on overall company performance if they were made in the next five years?

	Worse Performance		No Effect		Better Performance
More computers	1	2	3	4	5
New Equipment	1	2	3	4	5
Flexible Working Practices	1	2	3	4	5
New Skills	1	2	3	4	5
Team Working	1	2	3	4	5
Performance Appraisal	1	2	3	4	5
Just In Time	1	2	3	4	5
Employee Involvement	1	2	3	4	5
Use of Employee Ideas	1	2	3	4	5
Equipment Modifications	1	2	3	4	5
Quality Initiatives	1	2	3	4	5

3. Please indicate how *you feel* company performance has changed in the following areas in the last 5 years (or since you joined the company, if less than 5 years):

	Worsened		No Change		Improved
On Time Delivery	1	2	3	4	5
Scrap Reduction	1	2	3	4	5
Product Quallty	1	2	3	4	5
Stock Levels	1	2	3	4	5
Throughput Times	1	2	3	4	5
Total Output	1	2	3	4	5
Job Satisfaction	1	2	3	4	5
Productivity	1	2	3	4	5
Customer Service	1	2	3	4	5

4. How do *you feel* the following contributed to performance of the company in the past 5 years (or since you joined the company)?

	Made Worse		No Influence		Improved
Shopfloor Employees	1	2	3	4	5
Shopfloor Team Leaders or Supervisors or Foremen	1	2	3	4	5
Maintenance	1	2	3	4	5
Production Management	1	2	3	4	5
Personnel or Human Resources	1	2	3	4	5
Training	1	2	3	4	5
Senior Management	1	2	3	4	5
Contractors	1	2	3	4	5
Sales Dept.	1	2	3	4	5
Finance Dept.	1	2	3	4	5
Consultants	1	2	3	4	5
Customers	1	2	3	4	5
Suppliers	1	2	3	4	5

5. How do *you feel* the following factors influenced performance of the company in the past 5 years (or since you joined the company)?

	Made Worse		No Influence		Improved	Don't know/ Not Used
Computers	1	2	3	4	5	☐
New Equipment	1	2	3	4	5	☐
Flexible Working Practices	1	2	3	4	5	☐
New Skills	1	2	3	4	5	☐
Team Working	1	2	3	4	5	☐
Payment Systems	1	2	3	4	5	☐
Performance Appraisal	1	2	3	4	5	☐
Scheduling	1	2	3	4	5	☐
Just In Time	1	2	3	4	5	☐
Employee Involvement	1	2	3	4	5	☐
Use of Employee Ideas	1	2	3	4	5	☐
Equipment Modifications	1	2	3	4	5	☐
Quality Initiatives	1	2	3	4	5	☐

Please list any other factors that *you feel* have made performance better.

_____

_____

Please list any other factors that *you think* have made performance worse.

_____

_____

6. (a) In the past 5 years, how do you feel responsibility in your present job has changed?

Much Decreased		No Change		Much Increased
1	2	3	4	5

(b) In the next 5 years, how much responsibility would you like to have in your job?

Much Less		No Change		Much More
1	2	3	4	5

(c) In the next 5 years, how much responsibility do you expect to get in your job?

Much Less		No Change		Much More
1	2	3	4	5

7. (a) How much does the company involve its people in the changes that it makes?

Not at all — Always

1 2 3 4 5

(b) Could performance be improved if the company involved its people more in the future?

Not at all — Very Much Improved

1 2 3 4 5

(c) How much does the company involve you personally in the changes that it makes?

Not at all — Always

1 2 3 4 5

Thank you for your time and cooperation

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Alcan New Production Systems Survey Results
Alcan Extrusions and Tubes: SUMMARY

Site:	A.E. Banbury	A.T. Redditch	A.E. Latchford	Almetex	A.E.T. Man. Team	Whole Company
No. Responding:	396	237	101	64	6	804
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?						
More Computers	3.32	3.45	3.89	3.43	3.80	3.44
New Equipment	4.44	4.10	4.43	4.24	4.17	4.32
Flexible Working	3.66	3.70	3.58	4.03	4.33	3.70
New Skills	4.01	4.26	4.09	4.48	4.50	4.13
Team Working	4.12	4.34	4.20	4.56	4.67	4.23
Performance Appraisal	3.48	3.52	3.72	4.17	4.17	3.58
Just In Time	3.32	3.22	2.86	3.15	4.17	3.23
Employee Involvement	4.09	3.42	4.31	4.52	4.50	3.95
Use of Employee Ideas	4.25	4.37	4.47	4.65	4.33	4.34
Equipment Modifications	4.17	3.99	4.39	4.53	4.17	4.17
Quality Initiatives	3.99	4.06	4.40	4.39	4.50	4.09
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:						
On Time Delivery	3.59	3.27	3.01	3.14	3.50	3.38
Scrap Reduction	3.06	3.18	2.61	2.57	3.00	3.00
Product Quality	3.24	3.42	3.38	3.22	2.83	3.30
Stock Levels	3.37	3.57	2.83	3.05	4.50	3.34
Throughput Times	3.49	3.44	3.52	3.61	4.00	3.49
Total Output	3.13	3.15	3.66	3.82	2.40	3.24
Job Satisfaction	2.63	2.81	2.69	2.54	2.60	2.68
Productivity	3.26	3.29	3.50	3.56	2.50	3.31
Customer Service	3.33	3.16	3.25	3.11	2.33	3.24
4. How do you feel the following contributed to performance of the company in the past 5 years:						
Shopfloor Employees	3.72	4.00	3.65	3.54	3.60	3.77
Shopfloor Team Leaders or	3.08	3.48	2.98	3.13	3.40	3.19
Maintenance	3.22	3.03	3.39	3.13	3.67	3.18
Production Management	2.86	3.12	2.92	2.90	3.00	2.94
Personnel or H.R.M.	2.81	3.16	2.87	2.79	2.83	2.91
Training	3.33	3.38	3.17	3.32	3.33	3.32
Senior Management	2.49	2.82	2.91	2.75	3.00	2.66
Contractors	2.62	2.49	2.76	2.52	3.00	2.59
Sales Dept.	3.19	3.07	3.09	2.90	3.40	3.12
Finance Dept.	2.97	2.97	3.00	2.87	3.17	2.96
Consultants	2.50	2.67	2.83	2.85	2.17	2.61
Customers	3.29	3.44	3.38	3.24	3.67	3.34
Suppliers	2.95	3.11	2.96	3.05	3.17	3.01
5. How do you feel the following factors influenced performance of the company in the past five years:						
Computers	3.79	3.81	3.92	3.34	3.67	3.77
New Equipment	3.66	4.14	3.98	3.71	3.33	3.84
Flexible Working	3.59	3.62	3.47	3.45	3.67	3.57
New Skills	3.69	3.87	3.56	3.71	3.67	3.72
Team Working	3.66	3.85	3.59	3.65	4.00	3.71
Payment Systems	2.71	2.75	3.03	2.86	3.17	2.77
Performance Appraisal	2.82	3.09	3.04	2.98	3.00	2.94
Scheduling	3.07	3.12	2.86	3.07	3.00	3.05
Just In Time	2.97	2.95	2.71	2.55	3.67	2.90
Employee Involvement	3.32	3.26	3.32	3.14	3.50	3.28
Use of Employee Ideas	3.00	3.46	3.14	2.93	3.33	3.14
Equipment Modifications	3.36	3.77	3.46	3.42	3.50	3.49
Quality Initiatives	3.13	3.38	3.24	3.30	3.50	3.23
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?						
	3.84	4.12	3.76	3.74	3.00	3.89
6.(b) In the next 5 years, how much responsibility would you like to have in your job?						
	3.83	3.99	4.01	4.16	3.67	3.92
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?						
	3.68	3.80	3.66	3.54	3.50	3.69
7.(a) How much does the company involve its people in the changes it makes?						
	2.51	2.82	2.51	2.13	3.00	2.57
7.(b) Could performance be improved if the company involved its people more in the future?						
	4.29	4.52	4.49	4.56	4.33	4.40
7.(c) How much does the company involve you personally in the changes that it makes?						
	2.41	2.63	2.40	2.11	4.00	2.46

Alcan New Production Systems Survey Results
Alcan Extrusions and Tubes: SHOPFLOOR EMPLOYEES

Site:	A.E. Banbury	A.T. Redditch	A.E. Latchford	Almetex
No. Responding:	270	142	62	41
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?				
More Computers	3.29	3.36	3.70	3.48
New Equipment	4.50	4.22	4.47	4.39
Flexible Working	3.46	3.43	3.34	4.12
New Skills	3.90	4.17	4.09	4.50
Team Working	3.95	4.20	4.18	4.61
Performance Appraisal	3.38	3.35	3.47	4.10
Just In Time	3.09	2.93	2.88	3.35
Employee Involvement	3.99	3.16	4.28	4.54
Use of Employee Ideas	4.21	4.34	4.51	4.68
Equipment Modifications	4.20	3.98	4.33	4.66
Quality Initiatives	3.90	3.87	4.28	4.32
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:				
On Time Delivery	3.66	3.33	3.06	3.10
Scrap Reduction	3.03	3.12	2.52	2.54
Product Quality	3.28	3.43	3.28	3.15
Stock Levels	3.23	3.40	2.92	3.00
Throughput Times	3.47	3.39	3.60	3.66
Total Output	3.24	3.25	3.66	3.78
Job Satisfaction	2.59	2.77	2.57	2.58
Productivity	3.29	3.25	3.50	3.61
Customer Service	3.40	3.08	3.25	3.02
4. How do you feel the following contributed to performance of the company in the past 5 years:				
Shopfloor Employees	3.70	4.10	3.63	3.61
Shopfloor Team Leaders o	2.78	3.32	2.71	3.10
Maintenance	3.18	2.94	3.20	3.20
Production Management	2.69	3.04	2.91	3.05
Personnel or H.R.M.	2.83	3.16	2.84	2.88
Training	3.21	3.25	3.03	3.05
Senior Management	2.43	2.55	2.85	2.61
Contractors	2.57	2.30	2.71	2.41
Sales Dept.	3.09	3.03	2.91	2.83
Finance Dept.	2.88	2.86	2.83	2.80
Consultants	2.52	2.66	2.68	2.88
Customers	3.25	3.39	3.23	3.38
Suppliers	2.90	3.06	2.93	3.05
5. How do you feel the following factors influenced performance of the company in the past five years:				
Computers	3.74	3.69	3.83	3.38
New Equipment	3.61	4.14	3.95	3.79
Flexible Working	3.43	3.45	3.38	3.43
New Skills	3.58	3.84	3.52	3.63
Team Working	3.45	3.81	3.53	3.58
Payment Systems	2.60	2.72	2.93	2.89
Performance Appraisal	2.74	3.05	2.98	3.03
Scheduling	2.92	3.04	2.78	3.03
Just In Time	2.83	2.74	2.76	2.87
Employee Involvement	3.21	3.04	3.08	3.19
Use of Employee Ideas	2.81	3.36	2.86	3.00
Equipment Modifications	3.28	3.72	3.47	3.44
Quality Initiatives	3.03	3.26	3.00	3.35
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?	3.73	4.05	3.64	3.54
6.(b) In the next 5 years, how much responsibility would you like to have in your job?	3.67	3.75	3.95	4.15
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?	3.59	3.67	3.56	3.61
7.(a) How much does the company involve its people in the changes it makes?	2.42	2.70	2.42	2.08
7.(b) Could performance be improved if the company involved its people more in the future?	4.26	4.57	4.54	4.60
7.(c) How much does the company involve you personally in the changes that it makes?	2.20	2.48	2.17	2.03

Alcan New Production Systems Survey Results
Alcan Extrusions and Tubes: OFFICE EMPLOYEES

Site:	A.E. Banbury	A.T. Redditch	A.E. Latchford	Almetex
No. Responding:	58	27	14	6
2. What effect do you think the following changes would have on overall company performance:				
More Computers	3.39	3.60	4.31	3.17
New Equipment	4.19	3.65	4.31	3.00
Flexible Working	4.00	4.00	3.85	3.50
New Skills	4.18	4.26	3.92	4.33
Team Working	4.29	4.41	3.92	4.67
Performance Appraisal	3.81	3.69	3.77	4.50
Just In Time	3.43	3.29	3.45	2.75
Employee Involvement	4.12	3.64	3.93	4.33
Use of Employee Ideas	4.28	4.22	4.14	4.50
Equipment Modifications	3.89	3.81	4.08	3.50
Quality Initiatives	4.18	4.30	4.17	4.00
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:				
On Time Delivery	3.17	3.15	3.15	3.33
Scrap Reduction	3.10	3.00	3.00	2.33
Product Quality	3.06	2.50	3.31	2.83
Stock Levels	3.32	3.38	3.42	3.40
Throughput Times	3.42	3.04	3.25	3.60
Total Output	2.71	2.76	3.83	3.60
Job Satisfaction	2.46	2.65	2.86	2.33
Productivity	2.98	2.85	3.58	3.40
Customer Service	2.89	3.15	3.23	3.33
4. How do you feel the following contributed to performance of the company in the past 5 years:				
Shopfloor Employees	3.64	3.69	3.77	3.50
Shopfloor Team Leaders o	3.55	3.62	3.31	2.83
Maintenance	3.45	3.23	3.50	3.17
Production Management	3.25	2.88	3.33	2.83
Personnel or H.R.M.	2.75	3.12	2.64	2.67
Training	3.44	3.50	3.38	4.00
Senior Management	2.56	2.96	3.00	3.00
Contractors	2.94	2.69	2.83	2.67
Sales Dept.	3.54	3.16	3.46	3.00
Finance Dept.	3.30	3.20	3.45	3.17
Consultants	2.54	2.84	2.75	2.83
Customers	3.29	3.39	3.75	3.00
Suppliers	3.14	3.13	3.50	3.00
5. How do you feel the following factors influenced performance of the company in the past five years:				
Computers	4.02	3.78	4.21	3.17
New Equipment	3.96	3.71	4.00	3.75
Flexible Working	3.73	3.78	3.67	2.80
New Skills	3.82	3.78	3.55	3.83
Team Working	4.00	3.67	3.55	3.67
Payment Systems	2.91	2.43	3.10	3.00
Performance Appraisal	3.00	2.88	2.67	3.00
Scheduling	3.48	3.24	2.80	3.20
Just In Time	3.09	3.00	2.67	2.50
Employee Involvement	3.39	3.23	3.64	3.25
Use of Employee Ideas	3.29	3.19	3.30	2.50
Equipment Modifications	3.59	3.75	3.60	3.00
Quality Initiatives	3.32	3.30	3.30	3.00
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?	3.76	4.04	3.57	4.17
6.(b) In the next 5 years, how much responsibility would you like to have in your job?	4.00	4.44	4.36	4.67
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?	3.57	3.81	3.14	3.17
7.(a) How much does the company involve its people in the changes it makes?	2.40	2.70	2.38	2.00
7.(b) Could performance be improved if the company involved its people more in the future?	4.24	4.44	4.21	4.50
7.(c) How much does the company involve you personally in the changes that it makes?	2.22	2.33	2.14	1.67

Alcan New Production Systems Survey Results
A.E.T. Sites: TEAM LEADERS

Site:	A.E. Banbury	A.T. Redditch	A.E. Latchford	Almetex
No. Responding:	49	33	13	11
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?				
More Computers	3.45	3.63	4.08	3.67
New Equipment	4.53	4.53	4.62	4.70
Flexible Working	4.15	3.94	4.00	4.10
New Skills	4.20	4.58	4.33	4.56
Team Working	4.59	4.79	4.18	4.60
Performance Appraisal	3.50	3.85	4.00	4.33
Just In Time	3.79	3.58	1.90	3.00
Employee Involvement	4.39	3.42	4.46	4.70
Use of Employee Ideas	4.39	4.69	4.64	4.80
Equipment Modifications	4.22	4.24	4.64	4.60
Quality Initiatives	4.12	4.31	4.77	4.90
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years (or since you joined the company, if less than 5 years):				
On Time Delivery	3.69	3.59	2.92	3.00
Scrap Reduction	3.06	3.53	2.67	2.55
Product Quality	3.37	3.81	3.50	3.64
Stock Levels	3.92	3.74	2.36	2.82
Throughput Times	3.63	3.97	3.58	3.64
Total Output	3.27	3.13	3.45	4.00
Job Satisfaction	2.96	2.91	2.67	2.55
Productivity	3.41	3.61	3.36	3.64
Customer Service	3.51	3.31	3.33	3.55
4. How do you feel the following contributed to performance of the company in the past 5 years (or since you joined the company)?				
Shopfloor Employees	3.94	4.19	3.54	3.82
Shopfloor Team Leaders or Supe	3.81	4.15	3.42	3.73
Maintenance	3.04	3.28	3.85	2.91
Production Management	3.13	2.94	2.46	2.60
Personnel or H.R.M.	2.89	3.07	3.00	2.50
Training	3.70	3.41	3.54	3.64
Senior Management	2.51	2.84	2.67	2.73
Contractors	2.48	2.53	2.90	2.55
Sales Dept.	3.24	3.00	2.90	2.91
Finance Dept.	2.98	2.96	3.11	2.73
Consultants	2.39	2.32	3.10	3.00
Customers	3.37	3.57	3.56	3.00
Suppliers	2.93	3.07	2.67	3.00
5. How do you feel the following factors influenced performance of the company in the past five years (or since you joined the company)?				
Computers	3.77	4.10	4.00	3.50
New Equipment	3.57	4.34	3.92	3.64
Flexible Working	4.13	3.69	3.91	3.90
New Skills	4.00	3.91	3.50	3.82
Team Working	4.20	4.15	3.62	4.09
Payment Systems	3.02	3.16	3.45	2.55
Performance Appraisal	3.05	3.30	3.50	2.67
Scheduling	3.23	3.31	3.00	3.09
Just In Time	3.27	3.46	2.30	1.90
Employee Involvement	3.56	3.42	3.82	2.91
Use of Employee Ideas	3.45	3.66	3.75	2.80
Equipment Modifications	3.40	3.85	3.44	3.64
Quality Initiatves	3.21	3.53	4.00	3.20
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?	4.43	4.18	4.54	4.36
6.(b) In the next 5 years, how much responsibility would you like to have in your job?	4.20	4.12	3.38	3.82
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?	4.17	4.12	3.62	3.45
7.(a) How much does the company involve its people in the changes it makes?	2.98	2.94	2.46	2.00
7.(b) Could performance be improved if the company involved its people more in the future?	4.46	4.71	4.38	4.64
7.(c) How much does the company involve you personally in the changes that it makes?	3.41	2.81	2.54	2.27

Alcan New Production Systems Survey Results
Alcan Extrusions and Tubes: MIDDLE MANAGEMENT

Site:	A.E. Banbury	A.T. Redditch	A.E. Latchford	Almetex
No. Responding:	14	17	9	3
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?				
More Computers	3.21	3.25	4.29	2.67
New Equipment	4.21	3.65	4.43	3.67
Flexible Working	4.00	4.29	3.57	4.00
New Skills	4.43	4.41	4.29	4.33
Team Working	4.57	4.71	4.71	4.33
Performance Appraisal	3.71	3.47	4.29	4.00
Just In Time	4.14	3.73	4.67	3.00
Employee Involvement	4.50	3.94	4.71	4.00
Use of Employee Ideas	4.43	4.41	4.57	4.00
Equipment Modifications	4.43	4.12	4.43	4.33
Quality Initiatives	4.43	4.53	4.43	4.33
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years				
On Time Delivery	3.57	2.94	3.14	4.33
Scrap Reduction	3.36	3.35	3.14	3.33
Product Quality	3.00	3.76	4.00	3.67
Stock Levels	3.79	4.29	2.43	4.33
Throughput Times	3.50	3.50	3.43	3.33
Total Output	2.14	2.82	4.14	4.33
Job Satisfaction	2.50	3.12	3.43	2.33
Productivity	3.14	3.35	3.86	3.67
Customer Service	2.79	3.56	3.29	2.67
4. How do you feel the following contributed to performance of the company in the past 5 years (or since you joined the company)?				
Shopfloor Employees	3.79	3.88	3.86	2.33
Shopfloor Team Leaders o	3.57	3.44	4.14	2.33
Maintenance	3.50	2.88	3.29	3.00
Production Management	3.21	3.65	3.57	2.00
Personnel or H.R.M.	2.29	3.31	2.86	3.00
Training	3.36	3.76	3.57	3.67
Senior Management	2.64	3.41	3.57	4.00
Contractors	2.85	2.82	2.83	3.33
Sales Dept.	3.43	2.94	3.29	3.33
Finance Dept.	3.14	3.13	3.14	3.67
Consultants	2.21	2.88	3.14	2.67
Customers	3.50	3.44	3.33	3.33
Suppliers	3.29	3.50	2.57	3.33
5. How do you feel the following factors influenced performance of the company in the past five years (or since you joined the company)?				
Computers	3.86	4.06	3.86	3.33
New Equipment	3.69	4.24	3.86	3.33
Flexible Working	3.79	4.20	3.50	3.67
New Skills	4.00	4.00	3.83	4.00
Team Working	4.14	3.82	4.00	3.00
Payment Systems	3.00	2.80	3.00	3.00
Performance Appraisal	2.92	3.31	3.50	3.00
Scheduling	3.46	3.36	3.43	2.67
Just In Time	3.60	3.21	3.20	2.67
Employee Involvement	3.92	3.75	3.71	3.00
Use of Employee Ideas	3.67	3.88	3.86	3.00
Equipment Modifications	3.77	3.75	3.86	3.33
Quality Initiatives	3.71	3.81	3.86	3.00
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?	4.00	4.38	4.00	4.00
6.(b) In the next 5 years, how much responsibility would you like to have in your job?	4.36	4.47	4.71	4.50
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?	3.71	4.07	5.00	4.00
7.(a) How much does the company involve its people in the changes it makes?	2.64	3.56	3.29	4.00
7.(b) Could performance be improved if the company involved its people more in the future?	4.36	4.38	4.71	3.50
7.(c) How much does the company involve you personally in the changes that it makes?	3.14	3.06	4.00	4.50

Alcan New Production Systems Survey Results
Alcan Extrusions and Tubes: SENIOR MANAGEMENT

Site:	A.E. Banbury	A.T. Redditch	A.E. Latchford	Almetex
No. Responding:	7	12	9	3
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?				
More Computers	3.33	3.36	4.29	2.67
New Equipment	4.29	3.42	4.43	3.67
Flexible Working	4.29	3.92	3.57	4.00
New Skills	4.43	4.25	4.29	4.33
Team Working	4.71	4.42	4.71	4.33
Performance Appraisal	4.00	3.58	4.29	4.00
Just In Time	4.71	3.83	4.67	3.00
Employee Involvement	4.43	4.50	4.71	4.00
Use of Employee Ideas	4.29	4.33	4.57	4.00
Equipment Modifications	4.14	3.92	4.43	4.33
Quality Initiatives	4.29	4.17	4.43	4.33
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:				
On Time Delivery	4.00	2.92	3.14	4.33
Scrap Reduction	3.43	3.33	3.14	3.33
Product Quality	3.14	3.75	4.00	3.67
Stock Levels	4.29	3.92	2.43	4.33
Throughput Times	3.71	3.25	3.43	3.33
Total Output	2.71	3.00	4.14	4.33
Job Satisfaction	3.43	2.92	3.43	2.33
Productivity	3.57	3.50	3.86	3.67
Customer Service	3.67	3.00	3.29	2.67
4. How do you feel the following contributed to performance of the company in the past 5 years:				
Shopfloor Employees	3.86	3.58	3.86	2.33
Shopfloor Team Leaders o	4.14	3.00	4.14	2.33
Maintenance	3.86	2.83	3.29	3.00
Production Management	4.00	3.58	3.57	2.00
Personnel or H.R.M.	3.29	3.17	2.86	3.00
Training	4.29	3.50	3.57	3.67
Senior Management	3.43	3.83	3.57	4.00
Contractors	2.86	3.08	2.83	3.33
Sales Dept.	3.57	3.33	3.29	3.33
Finance Dept.	3.43	3.42	3.14	3.67
Consultants	3.00	2.83	3.14	2.67
Customers	3.86	3.42	3.33	3.33
Suppliers	3.43	3.25	2.57	3.33
5. How do you feel the following factors influenced performance of the company in the past five years:				
Computers	3.83	3.42	3.86	3.33
New Equipment	3.71	4.17	3.86	3.33
Flexible Working	4.29	3.67	3.50	3.67
New Skills	4.14	3.73	3.83	4.00
Team Working	4.14	3.67	4.00	3.00
Payment Systems	3.00	2.64	3.00	3.00
Performance Appraisal	3.00	3.25	3.50	3.00
Scheduling	3.43	2.91	3.43	2.67
Just In Time	3.57	3.09	3.20	2.67
Employee Involvement	3.86	4.00	3.71	3.00
Use of Employee Ideas	3.57	3.75	3.86	3.00
Equipment Modifications	3.86	3.83	3.86	3.33
Quality Initiatives	3.57	3.50	3.86	3.00
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?				
	4.29	4.25	4.00	4.00
6.(b) In the next 5 years, how much responsibility would you like to have in your job?				
	4.71	4.25	4.71	4.50
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?				
	4.57	3.75	5.00	4.00
7.(a) How much does the company involve its people in the changes it makes?				
	3.43	3.33	3.29	4.00
7.(b) Could performance be improved if the company involved its people more in the future?				
	4.57	4.25	4.71	3.50
7.(c) How much does the company involve you personally in the changes that it makes?				
	4.00	4.00	4.00	4.50

Alcan New Production Systems Survey Results
Alcan Tubes Redditch: BY LEVEL

Level:	All	Shopfloor Employees	Office Employees	Team Leaders	Middle Managers	Senior Managers
No. Responding:	237	142	27	33	17	12
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?						
More Computers	3.45	3.36	3.60	3.63	3.25	3.36
New Equipment	4.10	4.22	3.65	4.53	3.65	3.42
Flexible Working	3.70	3.43	4.00	3.94	4.29	3.92
New Skills	4.26	4.17	4.26	4.58	4.41	4.25
Team Working	4.34	4.20	4.41	4.79	4.71	4.42
Performance Appraisal	3.52	3.35	3.69	3.85	3.47	3.58
Just In Time	3.22	2.93	3.29	3.58	3.73	3.83
Employee Involvement	3.42	3.16	3.64	3.42	3.94	4.50
Use of Employee Ideas	4.37	4.34	4.22	4.69	4.41	4.33
Equipment Modifications	3.99	3.98	3.81	4.24	4.12	3.92
Quality Initiatives	4.06	3.87	4.30	4.31	4.53	4.17
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:						
On Time Delivery	3.27	3.33	3.15	3.59	2.94	2.92
Scrap Reduction	3.18	3.12	3.00	3.53	3.35	3.33
Product Quality	3.42	3.43	2.50	3.81	3.76	3.75
Stock Levels	3.57	3.40	3.38	3.74	4.29	3.92
Throughput Times	3.44	3.39	3.04	3.97	3.50	3.25
Total Output	3.15	3.25	2.76	3.13	2.82	3.00
Job Satisfaction	2.81	2.77	2.65	2.91	3.12	2.92
Productivity	3.29	3.25	2.85	3.61	3.35	3.50
Customer Service	3.16	3.08	3.15	3.31	3.56	3.00
4. How do you feel the following contributed to performance of the company in the past 5 years:						
Shopfloor Employees	4.00	4.10	3.69	4.19	3.88	3.58
Shopfloor Team Leaders or	3.48	3.32	3.62	4.15	3.44	3.00
Maintenance	3.03	2.94	3.23	3.28	2.88	2.83
Production Management	3.12	3.04	2.88	2.94	3.65	3.58
Personnel or H.R.M.	3.16	3.16	3.12	3.07	3.31	3.17
Training	3.38	3.25	3.50	3.41	3.76	3.50
Senior Management	2.82	2.55	2.96	2.84	3.41	3.83
Contractors	2.49	2.30	2.69	2.53	2.82	3.08
Sales Dept.	3.07	3.03	3.16	3.00	2.94	3.33
Finance Dept.	2.97	2.86	3.20	2.96	3.13	3.42
Consultants	2.67	2.66	2.84	2.32	2.88	2.83
Customers	3.44	3.39	3.39	3.57	3.44	3.42
Suppliers	3.11	3.06	3.13	3.07	3.50	3.25
5. How do you feel the following factors influenced performance of the company in the past five years:						
Computers	3.81	3.69	3.78	4.10	4.06	3.42
New Equipment	4.14	4.14	3.71	4.34	4.24	4.17
Flexible Working	3.62	3.45	3.78	3.69	4.20	3.67
New Skills	3.87	3.84	3.78	3.91	4.00	3.73
Team Working	3.85	3.81	3.67	4.15	3.82	3.67
Payment Systems	2.75	2.72	2.43	3.16	2.80	2.64
Performance Appraisal	3.09	3.05	2.88	3.30	3.31	3.25
Scheduling	3.12	3.04	3.24	3.31	3.36	2.91
Just In Time	2.95	2.74	3.00	3.46	3.21	3.09
Employee Involvement	3.26	3.04	3.23	3.42	3.75	4.00
Use of Employee Ideas	3.46	3.36	3.19	3.66	3.88	3.75
Equipment Modifications	3.77	3.72	3.75	3.85	3.75	3.83
Quality Initiatives	3.38	3.26	3.30	3.53	3.81	3.50
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?						
	4.12	4.05	4.04	4.18	4.38	4.25
6.(b) In the next 5 years, how much responsibility would you like to have in your job?						
	3.89	3.75	4.44	4.12	4.47	4.25
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?						
	3.80	3.67	3.81	4.12	4.07	3.75
7.(a) How much does the company involve its people in the changes it makes?						
	2.82	2.70	2.70	2.94	3.56	3.33
7.(b) Could performance be improved if the company involved its people more in the future?						
	4.52	4.57	4.44	4.71	4.38	4.25
7.(c) How much does the company involve you personally in the changes that it makes?						
	2.63	2.48	2.33	2.81	3.06	4.00

Alcan New Production Systems Survey Results
Alcan Tubes Redditch: By Department

Department:	All	Personnel	Finance	Sales	Logistics	A Cell	B Cell	C Cell	D Cell	E.Prise/King	Remelt	Maintenance	Toolroom
No. Responding:	237	9	8	13	11	24	30	15	39	10	24	13	11
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?													
More Computers	3.45	3.67	3.30	3.83	3.82	3.52	3.31	4.13	3.13	3.58	2.83	3.38	3.55
New Equipment	4.10	3.43	3.40	3.92	3.45	4.29	4.26	4.53	4.00	4.10	4.32	4.54	4.55
Flexible Working	3.70	3.83	3.60	4.08	4.00	3.43	3.63	4.33	3.42	4.35	3.15	3.38	3.64
New Skills	4.26	4.57	3.70	4.31	4.27	4.52	4.19	4.67	3.91	4.50	4.00	4.38	4.00
Team Working	4.34	4.33	3.90	4.46	4.82	4.63	4.10	4.87	4.08	4.78	4.14	4.00	4.18
Performance Appraisal	3.52	4.33	3.60	3.92	2.91	3.48	3.16	4.13	3.46	3.94	3.11	2.92	3.73
Just In Time	3.22	3.25	3.22	3.83	3.55	3.55	2.58	3.73	3.16	3.21	2.59	2.92	3.27
Employee Involvement	3.42	4.00	3.11	3.67	3.00	2.91	3.23	4.00	2.84	4.44	2.74	3.38	4.18
Use of Employee Ideas	4.37	4.33	3.90	4.31	4.45	4.13	4.61	4.80	4.34	4.22	4.30	4.31	4.73
Equipment Modifications	3.99	3.50	3.30	3.67	4.09	4.13	4.04	4.53	3.90	4.31	3.90	3.92	3.82
Quality Initiatives	4.06	4.00	3.70	4.38	4.36	3.91	3.69	4.40	3.88	4.47	3.60	3.77	4.45
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:													
On Time Delivery	3.27	2.43	2.30	3.17	3.73	3.57	3.36	3.73	3.14	3.69	3.29	2.77	3.18
Scrap Reduction	3.18	2.86	2.50	3.36	3.09	3.17	3.18	3.53	3.27	3.82	2.91	2.69	3.18
Product Quality	3.42	2.43	2.50	3.33	3.00	3.38	3.31	3.93	3.44	4.24	3.25	2.92	4.09
Stock Levels	3.57	3.00	3.00	4.08	3.73	3.62	3.24	4.07	3.90	3.82	2.95	2.92	3.55
Throughput Times	3.44	3.00	2.63	3.67	2.64	3.86	3.11	4.13	3.67	3.81	2.89	3.42	3.64
Total Output	3.15	2.50	2.10	3.50	2.18	3.43	3.26	3.60	3.24	3.38	2.85	3.08	3.27
Job Satisfaction	2.81	2.71	2.40	2.42	2.27	2.43	2.76	3.87	3.13	3.10	1.81	2.38	3.82
Productivity	3.29	3.17	2.60	3.58	2.36	3.52	2.81	4.07	3.42	4.07	3.05	2.77	3.50
Customer Service	3.16	3.00	2.60	3.00	3.09	3.52	2.71	3.73	3.26	3.87	2.80	2.00	3.73
4. How do you feel the following contributed to performance of the company in the past 5 years:													
Shopfloor Employees	4.00	3.50	3.20	3.75	3.45	4.29	3.96	4.67	3.79	4.42	4.09	4.08	4.00
Shopfloor Team Leaders or	3.48	3.71	3.10	3.67	2.82	3.29	3.31	3.73	3.82	3.78	3.21	3.15	3.45
Maintenance	3.03	3.67	2.60	3.00	2.64	3.13	2.89	3.20	2.83	3.53	2.35	3.69	3.00
Production Management	3.12	3.43	2.90	2.75	2.45	2.87	2.64	3.40	3.16	3.76	2.68	3.15	3.73
Personnel or H.R.M.	3.16	3.60	3.00	2.92	3.00	3.17	2.88	3.77	3.31	3.80	2.55	2.83	3.40
Training	3.38	4.00	3.30	3.75	3.18	3.25	3.07	4.07	3.39	3.32	3.09	2.92	3.45
Senior Management	2.82	3.50	3.10	3.15	2.55	2.82	2.43	3.00	2.48	3.67	2.52	2.00	3.09
Contractors	2.49	3.00	2.30	2.92	2.45	2.95	2.12	2.79	2.45	2.31	2.05	1.54	2.82
Sales Dept.	3.07	3.17	3.00	3.75	2.64	3.35	2.54	3.20	2.94	3.33	2.95	2.92	3.18
Finance Dept.	2.87	3.25	3.20	3.17	3.09	3.04	2.65	3.36	3.07	3.09	2.37	2.69	3.27
Consultants	2.67	3.20	2.50	2.50	2.73	2.57	2.52	3.29	2.71	3.18	2.18	2.23	2.80
Customers	3.44	3.75	2.78	3.77	3.09	3.55	3.38	3.87	3.24	4.00	3.11	3.23	3.27
Suppliers	3.11	3.25	2.90	2.75	2.91	3.17	3.20	3.53	3.20	3.40	2.61	2.69	3.00
5. How do you feel the following factors influenced performance of the company in the past five years:													
Computers	3.81	3.83	3.33	4.00	3.55	3.71	3.71	4.23	3.39	4.07	3.81	4.00	4.00
New Equipment	4.14	4.00	3.70	4.36	3.18	4.14	3.96	4.86	3.81	4.72	4.33	4.23	4.30
Flexible Working	3.62	4.00	3.33	3.56	3.67	3.32	3.17	4.38	3.35	4.31	3.48	3.54	3.91
New Skills	3.87	4.00	3.50	4.10	3.73	3.71	3.46	4.57	3.55	4.59	3.78	3.54	4.00
Team Working	3.85	4.17	3.33	3.82	3.36	4.00	3.52	4.36	3.80	4.44	3.95	3.31	3.82
Payment Systems	2.75	3.17	2.30	2.89	1.70	2.73	2.37	3.00	3.53	3.20	1.80	2.33	3.82
Performance Appraisal	3.09	3.67	2.78	3.20	2.64	3.04	2.61	3.71	3.41	3.38	2.76	2.69	3.27
Scheduling	3.12	3.20	3.00	3.11	3.30	3.41	2.78	3.71	3.08	3.38	2.63	2.67	3.33
Just In Time	2.95	3.25	3.00	2.75	2.91	3.14	2.52	3.54	3.11	3.00	2.73	2.58	3.11
Employee Involvement	3.26	3.60	3.00	3.55	2.40	2.77	2.96	3.86	3.18	3.84	2.58	3.54	3.64
Use of Employee Ideas	3.46	3.60	2.89	3.33	2.91	3.45	3.14	4.38	3.55	4.29	3.25	3.00	3.18
Equipment Modifications	3.77	3.60	3.13	3.60	3.27	4.05	3.23	4.29	3.52	4.53	3.81	3.54	3.91
Quality Initiatives	3.38	3.75	2.88	3.44	3.10	3.65	2.48	4.00	3.25	3.93	3.25	3.08	3.73
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?													
	4.12	3.57	3.30	4.31	4.18	4.18	3.89	4.93	4.41	4.00	3.65	3.31	4.00
6.(b) In the next 5 years, how much responsibility would you like to have in your job?													
	3.99	4.71	3.90	4.54	4.55	3.55	4.14	4.27	3.91	4.00	3.50	3.31	3.64
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?													
	3.80	4.00	3.30	3.69	3.45	4.00	3.46	4.13	3.88	4.11	3.60	3.31	3.73
7.(a) How much does the company involve its people in the changes it makes?													
	2.82	3.71	2.56	2.38	2.18	2.67	2.47	3.47	2.92	3.61	2.36	2.25	3.27
7.(b) Could performance be improved if the company involved its people more in the future?													
	4.52	4.43	3.78	4.23	4.45	4.59	4.57	4.97	4.71	4.44	4.45	4.50	4.36
7.(c) How much does the company involve you personally in the changes that it makes?													
	2.63	2.57	2.44	2.31	2.55	2.68	2.10	3.27	2.89	3.39	2.41	1.75	2.73

Alcan New Production Systems Survey Results
Alcan Extrusions Banbury - BY LEVEL

Level:	All	Shopfloor Employees	Office Employees	Team Leaders	Middle Managers	Senior Managers
No. Responding:	396	270	58	49	14	7
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?						
More Computers	3.32	3.29	3.39	3.45	3.21	3.33
New Equipment	4.44	4.50	4.19	4.53	4.21	4.29
Flexible Working	3.66	3.46	4.00	4.15	4.00	4.29
New Skills	4.01	3.90	4.18	4.20	4.43	4.43
Team Working	4.12	3.95	4.29	4.59	4.57	4.71
Performance Appraisal	3.48	3.38	3.81	3.50	3.71	4.00
Just In Time	3.32	3.09	3.43	3.79	4.14	4.71
Employee Involvement	4.09	3.99	4.12	4.39	4.50	4.43
Use of Employee Ideas	4.25	4.21	4.28	4.39	4.43	4.29
Equipment Modifications	4.17	4.20	3.89	4.22	4.43	4.14
Quality Initiatives	3.99	3.90	4.18	4.12	4.43	4.29
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:						
On Time Delivery	3.59	3.66	3.17	3.69	3.57	4.00
Scrap Reduction	3.06	3.03	3.10	3.06	3.36	3.43
Product Quality	3.24	3.28	3.06	3.37	3.00	3.14
Stock Levels	3.37	3.23	3.32	3.92	3.79	4.29
Throughput Times	3.49	3.47	3.42	3.63	3.50	3.71
Total Output	3.13	3.24	2.71	3.27	2.14	2.71
Job Satisfaction	2.63	2.59	2.46	2.86	2.50	3.43
Productivity	3.26	3.29	2.98	3.41	3.14	3.57
Customer Service	3.33	3.40	2.89	3.51	2.79	3.67
4. How do you feel the following contributed to performance of the company in the past 5 years:						
Shopfloor Employees	3.72	3.70	3.64	3.94	3.79	3.86
Shopfloor Team Leaders or	3.08	2.78	3.55	3.81	3.57	4.14
Maintenance	3.22	3.18	3.45	3.04	3.50	3.86
Production Management	2.86	2.60	3.25	3.13	3.21	4.00
Personnel or H.R.M.	2.81	2.83	2.75	2.89	2.29	3.29
Training	3.33	3.21	3.44	3.70	3.36	4.29
Senior Management	2.49	2.43	2.56	2.51	2.64	3.43
Contractors	2.62	2.57	2.94	2.48	2.85	2.86
Sales Dept.	3.19	3.09	3.54	3.24	3.43	3.57
Finance Dept.	2.97	2.88	3.30	2.98	3.14	3.43
Consultants	2.50	2.52	2.54	2.39	2.21	3.00
Customers	3.29	3.25	3.29	3.37	3.50	3.86
Suppliers	2.95	2.90	3.14	2.93	3.29	3.43
5. How do you feel the following factors influenced performance of the company in the past five years:						
Computers	3.79	3.74	4.02	3.77	3.86	3.83
New Equipment	3.66	3.61	3.96	3.57	3.69	3.71
Flexible Working	3.59	3.43	3.73	4.13	3.79	4.29
New Skills	3.69	3.58	3.82	4.00	4.00	4.14
Team Working	3.66	3.45	4.00	4.20	4.14	4.14
Payment Systems	2.71	2.60	2.91	3.02	3.00	3.00
Performance Appraisal	2.82	2.74	3.00	3.05	2.92	3.00
Scheduling	3.07	2.92	3.48	3.23	3.46	3.43
Just In Time	2.97	2.83	3.09	3.27	3.60	3.57
Employee Involvement	3.32	3.21	3.39	3.56	3.92	3.86
Use of Employee Ideas	3.00	2.81	3.29	3.45	3.67	3.57
Equipment Modifications	3.36	3.28	3.59	3.40	3.77	3.86
Quality Initiatives	3.13	3.03	3.32	3.21	3.71	3.57
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?						
	3.84	3.73	3.76	4.43	4.00	4.29
6.(b) In the next 5 years, how much responsibility would you like to have in your job?						
	3.83	3.67	4.00	4.20	4.36	4.71
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?						
	3.68	3.59	3.57	4.17	3.71	4.57
7.(a) How much does the company involve its people in the changes it makes?						
	2.51	2.42	2.40	2.98	2.64	3.43
7.(b) Could performance be improved if the company involved its people more in the future?						
	4.29	4.26	4.24	4.46	4.36	4.57
7.(c) How much does the company involve you personally in the changes that it makes?						
	2.41	2.20	2.22	3.41	3.14	4.00

Alcan New Production Systems Survey Results
Alcan Extrusions Banbury - BY DEPARTMENT

Department:	All	Minalex	High Vol.	Premier	Maint.	Dies	Remelt	Sales	Finance	Purch+Cred	Develop.
No. Responding	396	52	98	86	28	37	48	25	10	9	6
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?											
More Computers	3.32	3.63	3.47	3.31	2.68	3.37	3.12	3.48	3.70	3.00	3.14
New Equipment	4.44	4.58	4.56	4.28	4.14	4.58	4.69	4.20	4.20	3.63	4.29
Flexible Working	3.66	3.85	3.72	3.40	3.00	3.72	3.84	4.33	4.20	3.67	4.29
New Skills	4.01	4.27	3.97	3.78	4.11	3.86	4.11	4.25	4.30	4.13	4.43
Team Working	4.12	4.55	4.29	3.91	3.57	3.61	4.26	4.48	4.50	4.22	4.86
Performance Appraisal	3.48	4.14	3.48	3.25	2.79	3.59	3.32	3.92	4.00	3.33	3.86
Just In Time	3.32	3.79	3.41	3.19	2.52	3.13	3.24	3.50	3.70	3.14	4.57
Employee Involvement	4.09	4.34	4.03	4.06	3.63	3.84	4.13	4.28	4.20	4.33	4.43
Use of Employee Ideas	4.25	4.47	4.24	4.17	3.89	4.17	4.41	4.44	4.40	4.56	4.29
Equipment Modifications	4.17	4.47	4.13	4.16	4.11	3.97	4.30	4.00	4.10	4.00	4.00
Quality Initiatives	3.99	4.48	4.00	3.85	3.61	4.03	3.67	4.28	4.10	4.00	4.86
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:											
On Time Delivery	3.59	3.86	3.71	3.77	3.08	3.62	3.48	3.12	3.00	2.67	3.14
Scrap Reduction	3.06	3.53	3.28	2.66	2.70	3.38	2.83	2.95	3.00	3.00	3.00
Product Quality	3.24	3.56	3.32	2.98	3.07	3.27	3.59	2.71	2.78	2.44	3.33
Stock Levels	3.37	3.90	3.48	3.59	2.36	3.09	2.62	3.39	3.78	3.63	3.71
Throughput Times	3.49	3.92	3.50	3.56	3.08	3.45	3.36	3.50	3.33	3.25	2.86
Total Output	3.13	3.51	3.18	3.31	2.69	2.84	3.09	2.76	2.33	2.86	2.29
Job Satisfaction	2.63	3.04	2.74	2.57	1.96	2.60	2.78	2.52	2.00	1.89	3.14
Productivity	3.26	3.65	3.37	3.43	2.72	3.18	3.02	2.78	3.11	3.13	3.14
Customer Service	3.33	3.64	3.38	3.54	2.88	3.21	3.45	2.72	2.78	2.00	3.00
4. How do you feel the following contributed to performance of the company in the past 5 years:											
Shopfloor Employees	3.72	3.98	3.62	3.77	3.41	3.75	3.83	3.67	3.67	3.11	3.57
Shopfloor Team Leaders or	3.08	3.20	3.18	2.78	2.96	3.00	3.09	3.84	3.78	3.00	3.43
Maintenance	3.22	3.28	2.84	3.43	4.52	3.08	2.74	3.63	4.11	3.13	3.14
Production Management	2.86	3.22	2.84	2.58	2.60	2.72	3.04	3.42	3.44	3.00	2.71
Personnel or H.R.M.	2.81	3.17	2.82	2.77	2.58	2.68	3.05	2.88	2.33	2.38	2.57
Training	3.33	3.46	3.15	3.43	3.33	3.00	3.53	3.48	4.00	2.56	3.71
Senior Management	2.49	2.73	2.67	2.29	2.27	2.19	2.55	2.75	2.56	1.78	3.00
Contractors	2.62	2.74	2.67	2.58	1.93	2.46	2.68	2.76	3.22	2.75	3.00
Sales Dept.	3.19	3.49	3.18	3.10	3.08	3.21	3.05	4.04	3.11	3.13	2.86
Finance Dept.	2.97	3.22	3.00	2.86	2.83	2.81	2.66	3.54	3.89	3.44	2.71
Consultants	2.50	2.94	2.70	2.52	2.00	1.91	2.29	2.35	2.67	1.88	2.86
Customers	3.29	3.56	3.28	3.30	3.25	3.00	3.24	3.57	3.56	3.25	3.29
Suppliers	2.85	3.24	3.00	3.06	2.88	2.61	2.44	3.22	3.56	3.25	2.86
5. How do you feel the following factors influenced performance of the company in the past five years:											
Computers	3.79	3.98	3.73	3.93	3.43	3.81	3.64	4.08	4.00	3.89	3.57
New Equipment	3.66	3.72	3.50	3.73	3.68	3.56	3.69	4.13	3.67	3.67	3.29
Flexible Working	3.59	3.68	3.43	3.63	3.54	3.55	3.76	3.70	3.88	3.43	3.86
New Skills	3.69	3.77	3.57	3.74	3.74	3.64	3.74	4.00	4.00	3.38	3.71
Team Working	3.66	3.90	3.71	3.49	3.54	3.32	3.73	4.21	4.00	4.00	3.86
Payment Systems	2.71	2.82	2.74	2.55	2.71	2.42	2.76	3.00	3.50	2.43	3.00
Performance Appraisal	2.82	3.10	2.87	2.72	2.50	2.62	2.86	3.13	3.25	2.71	2.80
Scheduling	3.07	3.43	3.12	3.08	2.74	2.78	2.67	3.65	3.00	3.60	3.43
Just In Time	2.97	3.34	3.11	3.11	2.09	2.50	2.76	3.13	3.50	2.50	3.43
Employee Involvement	3.32	3.55	3.32	3.36	2.75	3.32	3.18	3.50	3.67	2.75	3.57
Use of Employee Ideas	3.00	3.21	2.89	2.90	3.00	3.03	2.90	3.43	3.38	2.50	3.57
Equipment Modifications	3.36	3.41	3.07	3.65	3.69	3.03	3.21	3.70	3.50	3.50	3.67
Quality Initiatives	3.13	3.41	3.10	3.10	3.16	2.62	3.07	3.50	3.50	3.29	3.33
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?	3.84	3.96	3.96	3.71	3.79	3.84	3.89	3.76	3.70	3.56	4.00
6.(b) In the next 5 years, how much responsibility would you like to have in your job?	3.83	3.92	3.75	3.61	3.89	3.95	4.02	3.84	4.50	3.67	4.43
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?	3.68	3.76	3.86	3.55	3.50	3.50	3.65	3.76	3.60	3.00	4.29
7.(a) How much does the company involve its people in the changes it makes?	2.51	2.75	2.64	2.42	2.52	2.23	2.56	2.64	2.60	1.67	3.29
7.(b) Could performance be improved if the company involved its people more in the future?	4.29	4.48	4.24	4.36	4.11	4.08	4.31	4.48	4.40	4.22	4.00
7.(c) How much does the company involve you personally in the changes that it makes?	2.41	2.69	2.49	2.31	2.22	2.11	2.71	2.20	2.60	1.56	3.43

Alcan New Production Systems Survey Results
Alcan Extrusions Latchford - BY LEVEL

Level:	Whole Company	Shopfloor Employees	Office Employees	Team Leaders	Mid. and Sen. Management
No. Responding:	101	62	14	13	9
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?					
More Computers	3.89	3.70	4.31	4.08	4.29
New Equipment	4.43	4.47	4.31	4.62	4.43
Flexible Working	3.58	3.34	3.85	4.00	3.57
New Skills	4.09	4.09	3.92	4.33	4.29
Team Working	4.20	4.18	3.92	4.18	4.71
Performance Appraisal	3.72	3.47	3.77	4.00	4.29
Just In Time	2.96	2.88	3.45	1.90	4.67
Employee Involvement	4.31	4.28	3.93	4.46	4.71
Use of Employee Ideas	4.47	4.51	4.14	4.64	4.57
Equipment Modifications	4.39	4.33	4.08	4.64	4.43
Quality Initiatives	4.40	4.28	4.17	4.77	4.43
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:					
On Time Delivery	3.01	3.06	3.15	2.92	3.14
Scrap Reduction	2.61	2.52	3.00	2.67	3.14
Product Quality	3.38	3.28	3.31	3.50	4.00
Stock Levels	2.83	2.92	3.42	2.36	2.43
Throughput Times	3.52	3.60	3.25	3.58	3.43
Total Output	3.66	3.66	3.83	3.45	4.14
Job Satisfaction	2.69	2.57	2.86	2.67	3.43
Productivity	3.50	3.50	3.58	3.36	3.86
Customer Service	3.25	3.25	3.23	3.33	3.29
4. How do you feel the following contributed to performance of the company in the past 5 years:					
Shopfloor Employees	3.65	3.63	3.77	3.54	3.86
Shopfloor Team Leaders or Super	2.98	2.71	3.31	3.42	4.14
Maintenance	3.39	3.20	3.50	3.85	3.29
Production Management	2.92	2.91	3.33	2.46	3.57
Personnel or H.R.M.	2.87	2.84	2.64	3.00	2.86
Training	3.17	3.03	3.38	3.54	3.57
Senior Management	2.91	2.85	3.00	2.67	3.57
Contractors	2.76	2.71	2.83	2.90	2.83
Sales Dept.	3.09	2.91	3.46	2.90	3.29
Finance Dept.	3.00	2.83	3.45	3.11	3.14
Consultants	2.83	2.68	2.75	3.10	3.14
Customers	3.38	3.23	3.75	3.56	3.33
Suppliers	2.96	2.93	3.50	2.67	2.57
5. How do you feel the following factors influenced performance of the company in the past five years:					
Computers	3.92	3.83	4.21	4.00	3.86
New Equipment	3.98	3.95	4.00	3.92	3.86
Flexible Working	3.47	3.38	3.67	3.91	3.50
New Skills	3.56	3.52	3.55	3.50	3.83
Team Working	3.59	3.53	3.55	3.62	4.00
Payment Systems	3.03	2.93	3.10	3.45	3.00
Performance Appraisal	3.04	2.98	2.67	3.50	3.50
Scheduling	2.86	2.78	2.80	3.00	3.43
Just In Time	2.71	2.76	2.67	2.30	3.20
Employee Involvement	3.32	3.08	3.64	3.82	3.71
Use of Employee Ideas	3.14	2.86	3.30	3.75	3.86
Equipment Modifications	3.46	3.47	3.60	3.44	3.86
Quality Initiatives	3.24	3.00	3.30	4.00	3.86
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?					
	3.76	3.64	3.57	4.54	4.00
6.(b) In the next 5 years, how much responsibility would you like to have in your job?					
	4.01	3.95	4.36	3.38	4.71
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?					
	3.66	3.56	3.14	3.62	5.00
7.(a) How much does the company involve its people in the changes it makes?					
	2.51	2.42	2.38	2.46	3.29
7.(b) Could performance be improved if the company involved its people more in the future?					
	4.49	4.54	4.21	4.38	4.71
7.(c) How much does the company involve you personally in the changes that it makes?					
	2.40	2.17	2.14	2.54	4.00

Alcan New Production Systems Survey Results
Almetex: BY LEVEL

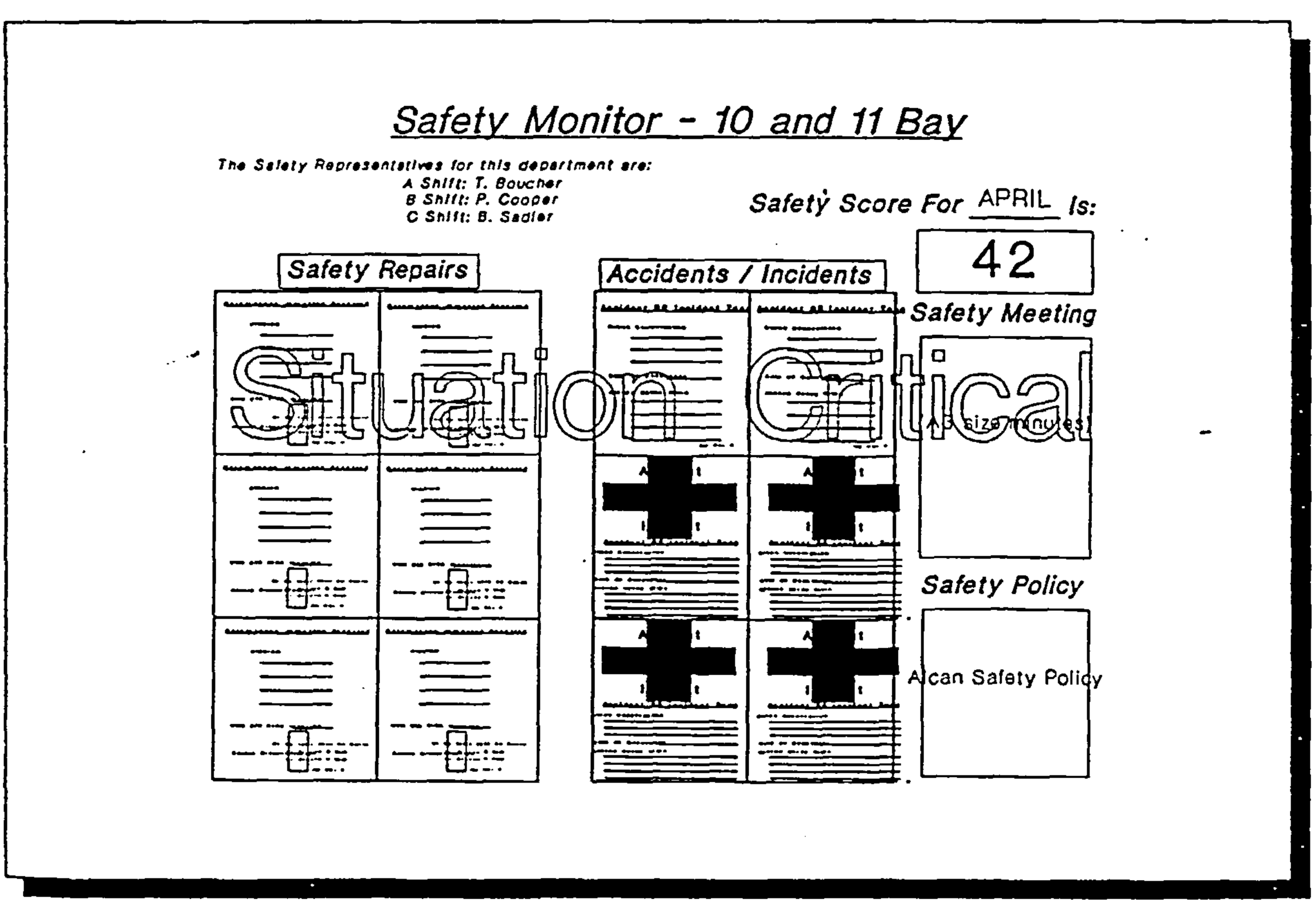
Level:	Whole Company	Shopfloor	Office	Team Leaders	Mid + Sen. Management
No. Responding:	64	41	6	11	3
2. What effect do you think the following changes would have on overall company performance if they were made in the next five years?					
More Computers	3.43	3.48	3.17	3.67	2.67
New Equipment	4.24	4.39	3.00	4.70	3.67
Flexible Working	4.03	4.12	3.50	4.10	4.00
New Skills	4.48	4.50	4.33	4.56	4.33
Team Working	4.56	4.61	4.67	4.60	4.33
Performance Appraisal	4.17	4.10	4.50	4.33	4.00
Just In Time	3.15	3.35	2.75	3.00	3.00
Employee Involvement	4.52	4.54	4.33	4.70	4.00
Use of Employee Ideas	4.65	4.68	4.50	4.80	4.00
Equipment Modifications	4.53	4.66	3.50	4.60	4.33
Quality Initiatives	4.39	4.32	4.00	4.90	4.33
3. Please indicate how you feel company performance has changed in the following areas in the last 5 years:					
On Time Delivery	3.14	3.10	3.33	3.00	4.33
Scrap Reduction	2.57	2.54	2.33	2.55	3.33
Product Quality	3.22	3.15	2.83	3.64	3.67
Stock Levels	3.05	3.00	3.40	2.82	4.33
Throughput Times	3.61	3.66	3.60	3.64	3.33
Total Output	3.82	3.78	3.60	4.00	4.33
Job Satisfaction	2.54	2.58	2.33	2.55	2.33
Productivity	3.56	3.61	3.40	3.64	3.67
Customer Service	3.11	3.02	3.33	3.55	2.67
4. How do you feel the following contributed to performance of the company in the past 5 years:					
Shopfloor Employees	3.54	3.61	3.50	3.82	2.33
Shopfloor Team Leaders or	3.13	3.10	2.83	3.73	2.33
Maintenance	3.13	3.20	3.17	2.91	3.00
Production Management	2.90	3.05	2.83	2.60	2.00
Personnel or H.R.M.	2.79	2.88	2.67	2.50	3.00
Training	3.32	3.05	4.00	3.64	3.67
Senior Management	2.75	2.61	3.00	2.73	4.00
Contractors	2.52	2.41	2.67	2.55	3.33
Sales Dept.	2.90	2.83	3.00	2.91	3.33
Finance Dept.	2.87	2.80	3.17	2.73	3.67
Consultants	2.85	2.88	2.83	3.00	2.67
Customers	3.24	3.38	3.00	3.00	3.33
Suppliers	3.05	3.05	3.00	3.00	3.33
5. How do you feel the following factors influenced performance of the company in the past five years:					
Computers	3.34	3.38	3.17	3.50	3.33
New Equipment	3.71	3.79	3.75	3.64	3.33
Flexible Working	3.45	3.43	2.80	3.90	3.67
New Skills	3.71	3.63	3.83	3.82	4.00
Team Working	3.65	3.58	3.67	4.09	3.00
Payment Systems	2.86	2.89	3.00	2.55	3.00
Performance Appraisal	2.98	3.03	3.00	2.67	3.00
Scheduling	3.07	3.03	3.20	3.09	2.67
Just In Time	2.55	2.87	2.50	1.90	2.67
Employee Involvement	3.14	3.19	3.25	2.91	3.00
Use of Employee Ideas	2.93	3.00	2.50	2.80	3.00
Equipment Modifications	3.42	3.44	3.00	3.64	3.33
Quality Initiatives	3.30	3.35	3.00	3.20	3.00
6.(a) In the past 5 years, how do you feel responsibility in your present job has changed?					
	3.74	3.54	4.17	4.36	4.00
6.(b) In the next 5 years, how much responsibility would you like to have in your job?					
	4.16	4.15	4.67	3.82	4.50
6.(c) In the next 5 years, how much responsibility do you expect to get in your job?					
	3.54	3.61	3.17	3.45	4.00
7.(a) How much does the company involve its people in the changes it makes?					
	2.13	2.08	2.00	2.00	4.00
7.(b) Could performance be improved if the company involved its people more in the future?					
	4.56	4.60	4.50	4.64	3.50
7.(c) How much does the company involve you personally in the changes that it makes?					
	2.11	2.03	1.67	2.27	4.50

Appendix C.

The Sample Module Materials

British Alcan
Team Leader Training

Module 7.
Safety



Quest: Leading Improvement

Module 7. Safety

The Safety Tag System

Introduction

This paper details the introduction and operation of a Safety Tag system which is intended to improve safety practices in a factory environment as part of the implementation of New Production Systems. The system detailed has now been introduced at British Alcan Extrusions, Banbury.

Module 7. Safety
Module Description

Objectives:

To improve current safety practices by increasing awareness of safety responsibilities. To establish a visible safety system

Training Session Content:

Consolidation of current practices
The new visible safety system

Module Project

'To establish the new safety visibility system Team Leaders and Safety Reps should prepare a joint report on the introduction and operation of this system'

The following stages should be followed

1. Hold a safety meeting to brief safety committee members.
2. Brief team members.
3. Establish new system
4. Report on progress made.

Quest: Leading Improvement

The system was introduced as part of the Quest: Leading Improvement programme of N.P.S. implementation.

Why Is Safety Important?

While it should be obvious that we don't want accidents to happen, and that in a climate of increasingly rapid change they can be more likely, it is perhaps less obvious that a real commitment to safety affects employee morale and productivity. By demonstrating a clear commitment to safety we are showing that we care about the people who work in the company. Conversely and seriously, the opposite is also true.

How Does The Tag System Work?

The Safety Tag system is intended to make safety ACTION visible. It should stimulate greater awareness of safety issues within the shopfloor team and, most importantly, it should lead to A C T I O N. Employees can stimulate ACTION on safety issues themselves. The system is managed by Team Leaders and Safety Representatives together so it should be seen as a cooperative initiative.

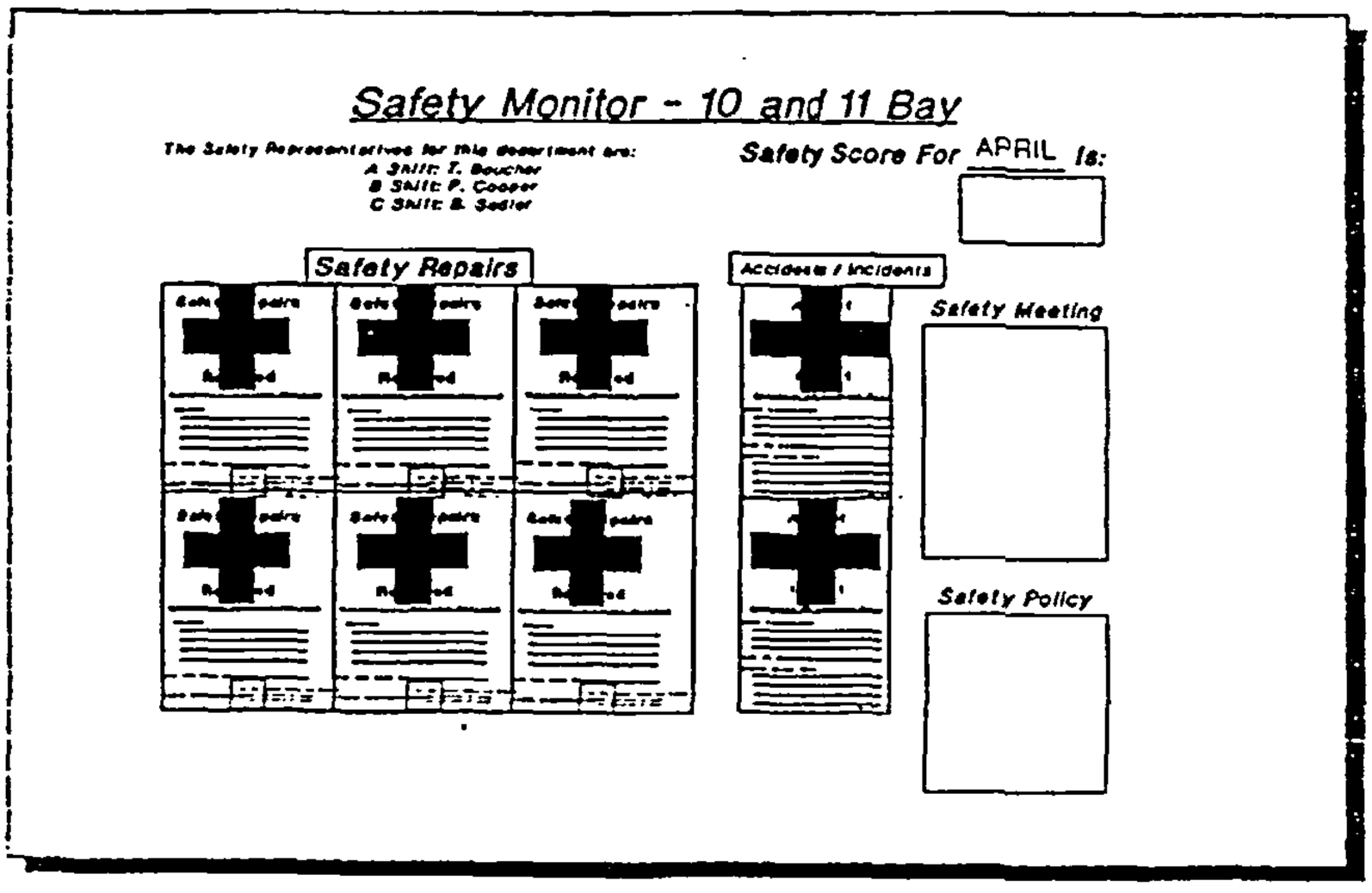
The Safety Tag System

- ✓ Visible
- ✓ Stimulates Awareness
- ✓ Stimulates Action
- ✓ Empowers Operators
- ✓ Managed by Team Leaders and Safety Representatives

Quest Leading Improvement

The Tag System is based on a central departmental Safety Monitor. This monitor records and assists the management of day to day safety activity and provides a focus for monthly departmental safety meetings.

Each Monitor has a limited number of large (A3) safety tags which can be removed from the board and placed on items of equipment or areas of activity requiring attention for safety reasons. Two categories are n e e d e d ; Maintenance and Accident or Incident, due to the



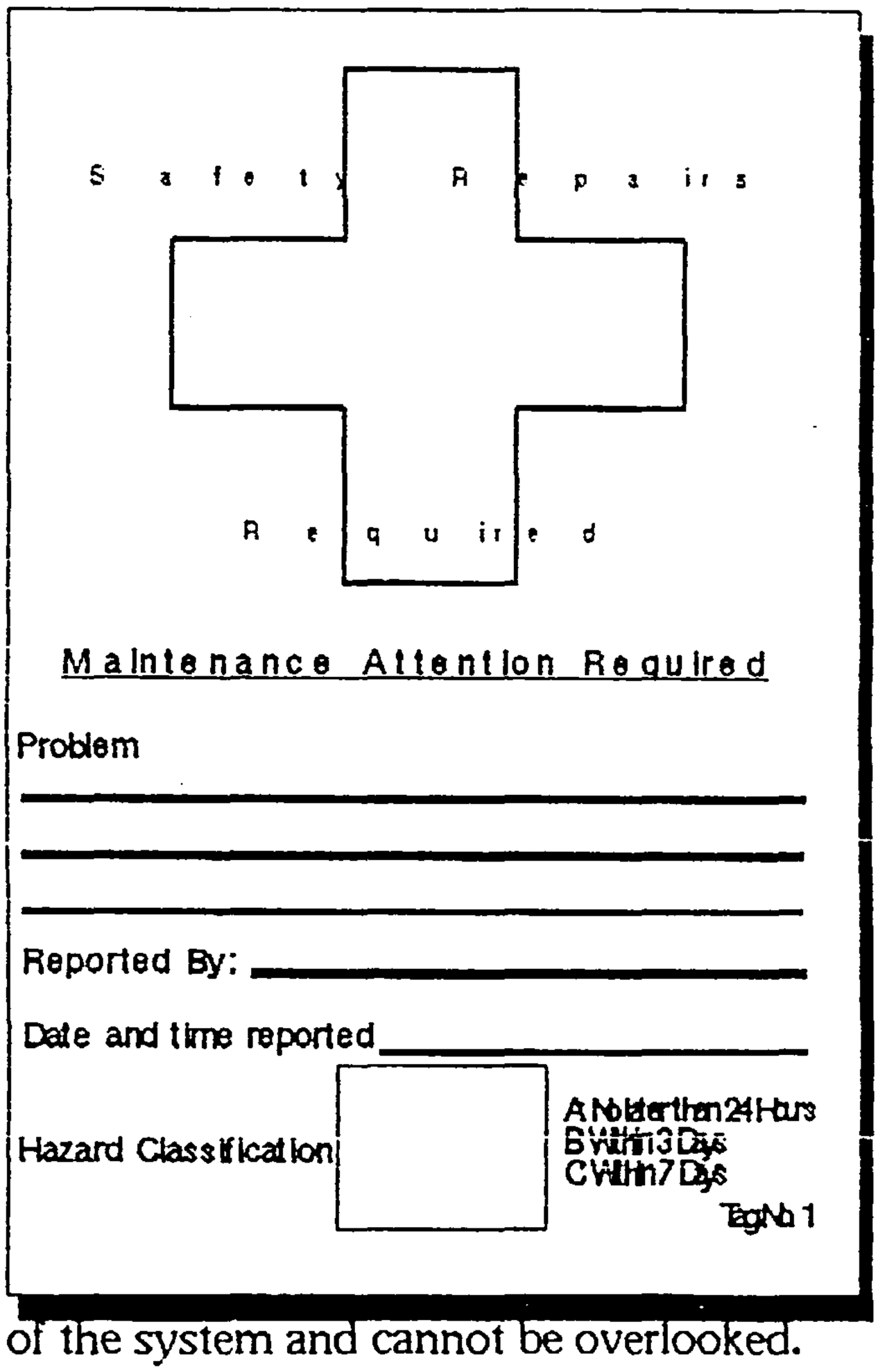
differing type of action required to make improvements. Maintenance tags are Red while Accident and Incident tags are Yellow.

The tags contain blank spaces for recording the date and time of placement, name of the person placing the tag and a summary of the problem, with a dry marker. Accident or Incident tags also contain space for details of action taken to prevent recurrence. All of this information is also recorded in the blank space revealed on the board.

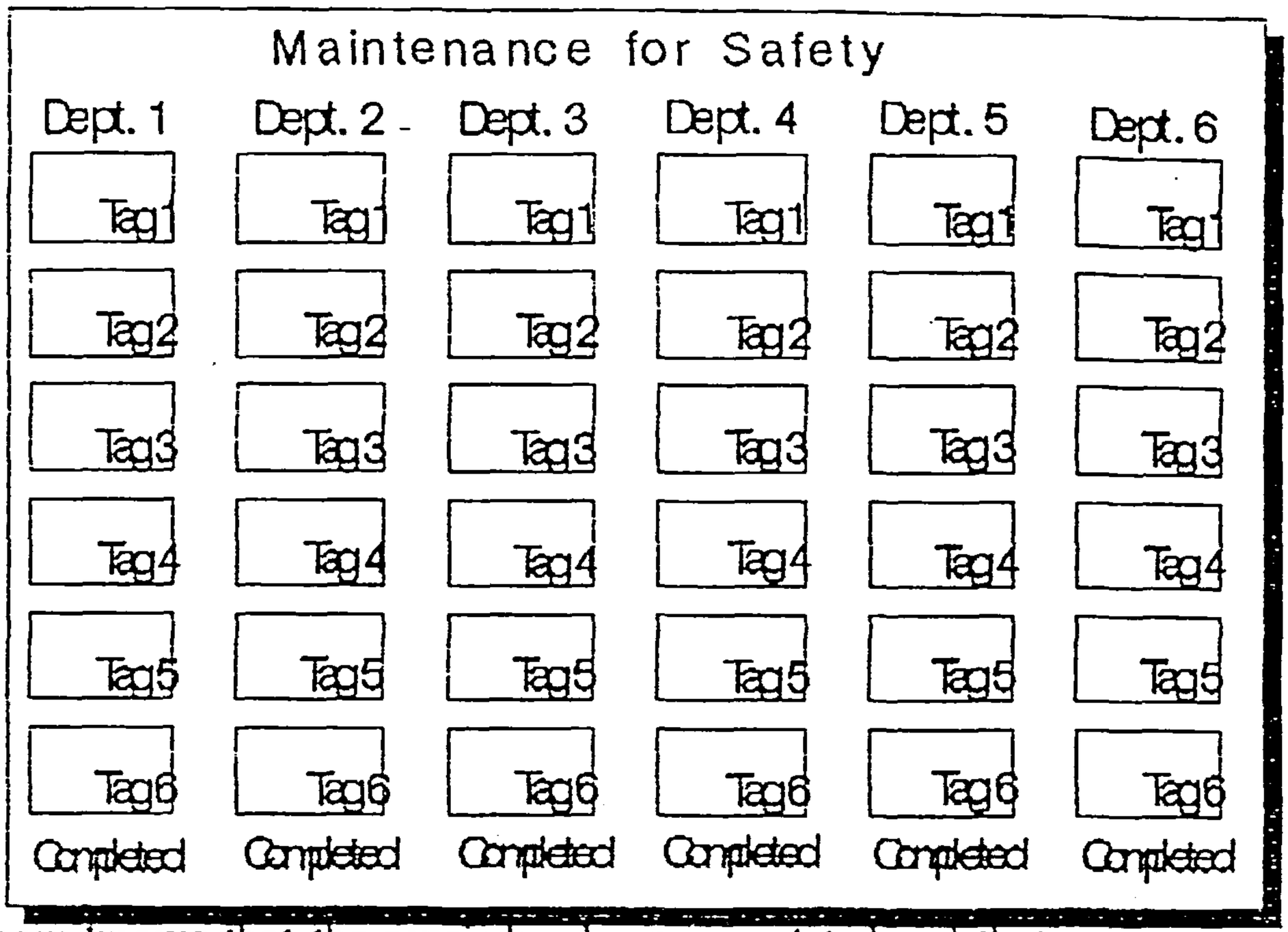
ANYONE has the authority to remove a tag from the board and place it on the shopfloor.

Maintenance tags are placed on or near any item of equipment or area of activity where maintenance action is required for safety reasons by the person who has identified the problem. As in normal circumstances, work should stop immediately on any piece of equipment or in any area in which there is an immediate danger.

In cases where immediate action is not required, a time classification (up to a maximum of seven days) is given to each tag, within which work must be completed. If work is not completed within the required time limit, affected equipment should be stopped. This is essential to maintain the credibility of the system and cannot be overlooked.



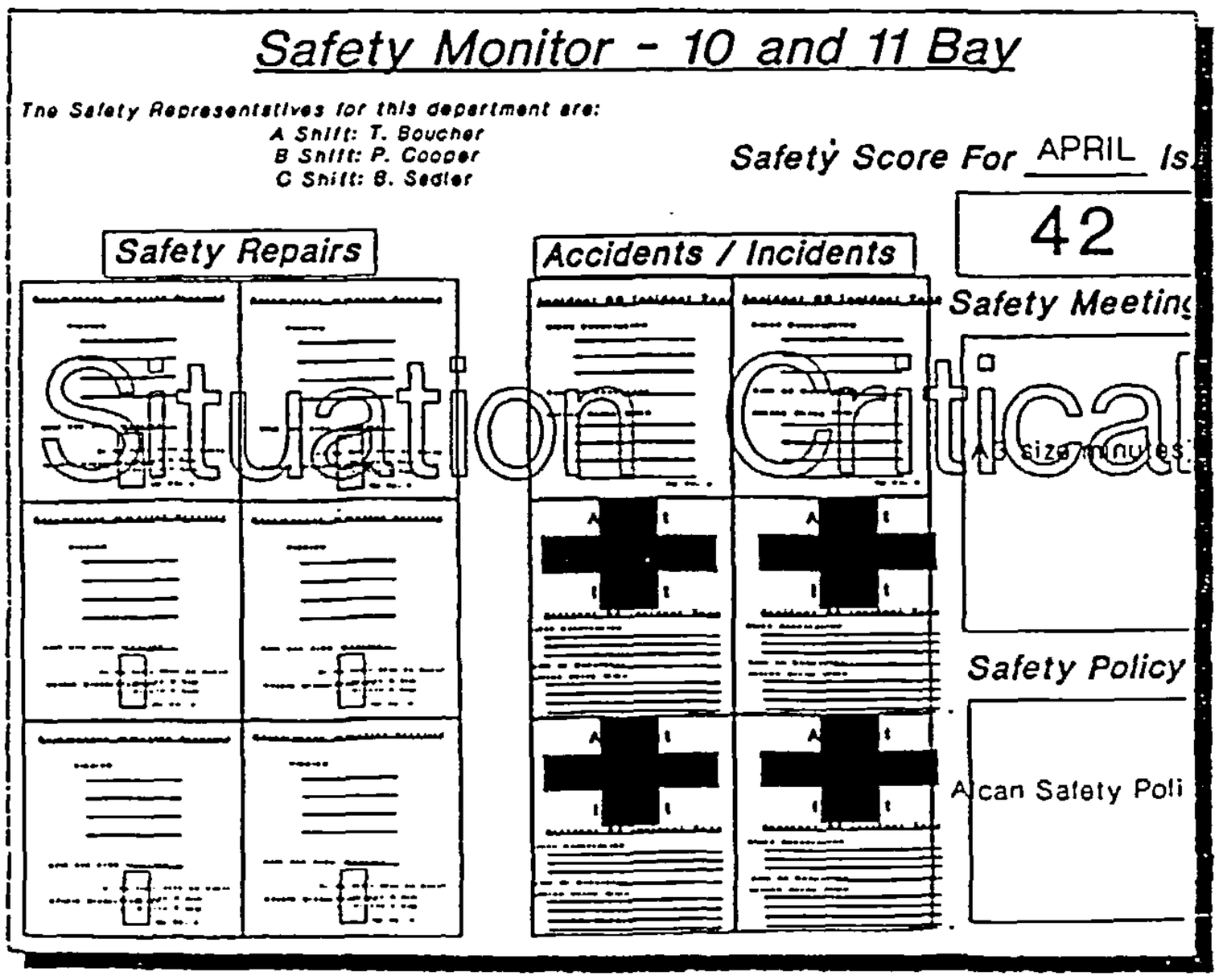
At the same time a smaller tag which hangs behind the large tag is completed and taken to a central Safety Maintenance monitor which is located outside the maintenance workshop. This tag has a pocket for a ticket which records action required which is taken from a duplicate book held by the Team Leader. A central record therefor should exist of all maintenance safety repairs which



are outstanding. Team Leaders retain a record of all action taken on all Maintenance tags issued in their area.

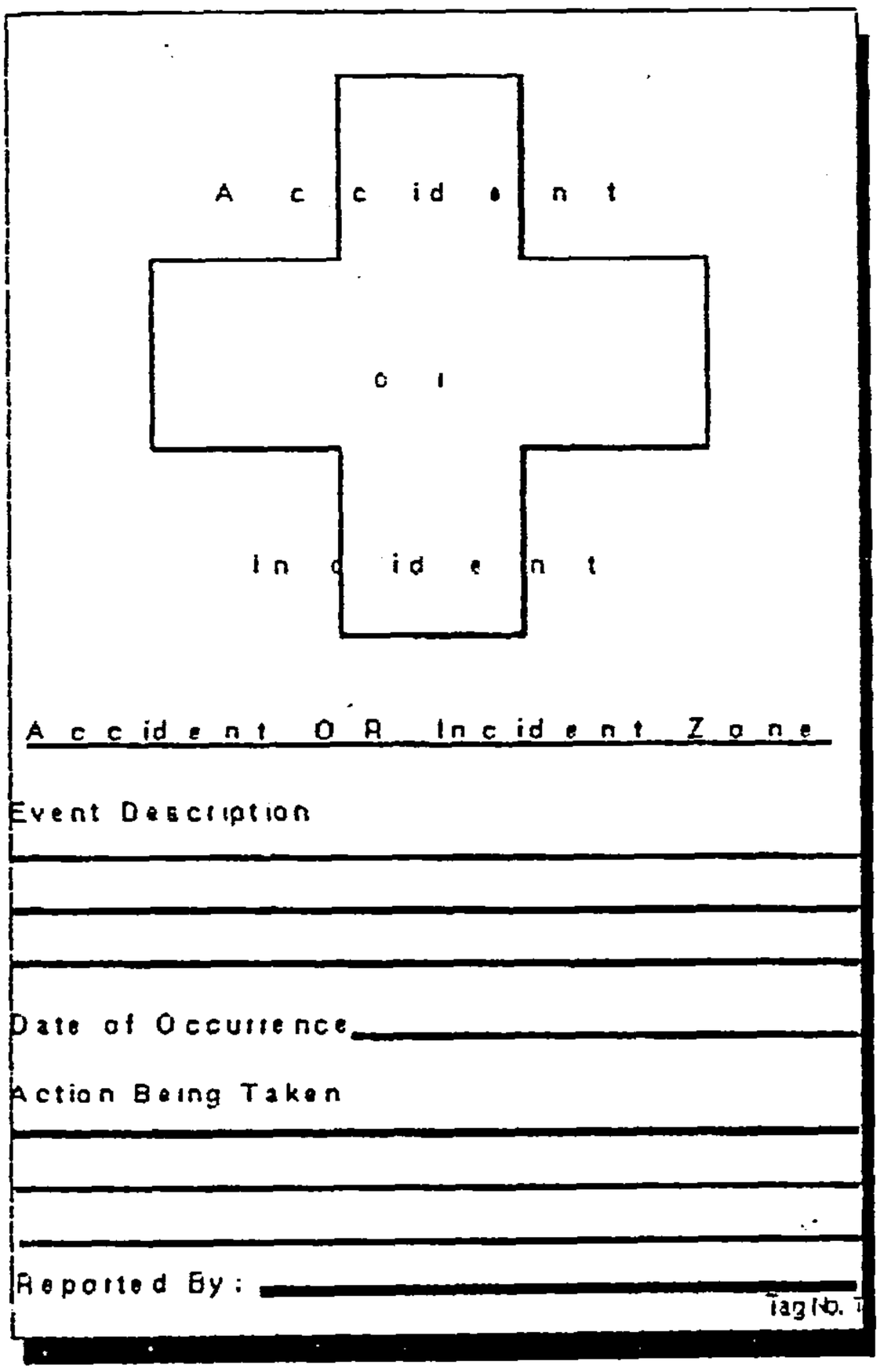
When a maintenance safety repair is completed, the small tag is returned by the maintenance department to the departmental Safety Monitor. The Team Leader now knows that the repair has been completed and that the large tag can be removed and replaced on the board. It is important to stress that the tag should not be replaced until the problem has been resolved. This would warn others of the danger and focus attention on the action to resolve.

Removal of all of the maintenance tags from the board should signal that a serious situation exists and that urgent action is necessary. Within a specified period of time, (no more than 24 hrs) an emergency safety meeting should be held and action taken. Whichever shift removes the last tag should organise this.



Accident or Incident tags are placed wherever an Accident or Incident has occurred. Again, the Safety Monitor provides a central

record of the current situation. This system should supplement current Accident and Incident reporting. Most companies have some form of recording of accidents which should normally continue.



The tag system makes Accidents and Incidents visible to everyone who works in or happens to be in the area concerned. As such it is a warning to others to act carefully in future. It also should encourage more reporting of incidents. This reporting can be seen to result in the incident being highlighted to work colleagues who will then be less likely to have an accident. Each department should have a monthly safety meeting. This meeting is the only body authorised to remove Accident or Incident tags. The meeting should tour the department and discuss the tags with those working in the proximity of tags. It may be decided that tags should remain in place due to the length of time since placement or the seriousness of the Accident or Incident.

The number of tags on each Monitor should be decided by the safety meeting. Their objective should be to operate with as few tags as possible, indicating safe working practices and good preventative maintenance.

This system works because most people take safety seriously. There may be concern in the company about irresponsible use of the system resulting in disruption of production. This will not happen.

Introducing The Tag System

The tag system should be introduced by Team Leaders and Safety representatives together. A seminar should be organised, attended by both at which current practices are consolidated and the new system is introduced. It is necessary to consolidate current practices to ensure that everyone is clear about how the tag system relates to other safety activity. Everyone should be aware of their legal responsibilities at this point. The seminar should conclude with Team Leaders and Safety Representatives from each department making a trial joint presentation on the operation of the tag system.

It is obviously important that the maintenance department are involved with the introduction of the system. Maintenance team Leaders should attend the seminar and will brief their own team on the operation of the system.

Monitor Boards and tags should be prepared before the seminar and made available when the seminar is completed. The boards should be erected and Team Leaders and Safety representatives should then brief their teams.

It is a good idea to provide a period of time between the seminar and the start date to allow maintenance repair jobs to be undertaken so that the system does not start with a flood of maintenance requests which cannot be fulfilled.

The Banbury Experience

The tag system was first introduced at British Alcan, Banbury in June 1992 as part of the Quest: Leading Improvement programme.

Module 7. Safety
Programme - Day 1.

8.00 am	Introduction
8.30 am	Task Analysis (for safety reps and maintenance team leaders only)
12.30pm	LUNCH
1. pm	Safety Background · Health and Safety Legislation · Responsibilities · The Safety Survey · Accident Reporting
4.30 pm	Close

Quest: Leading Improvement

Module 7. Safety
Programme - Day 2

8.00 am	Safety Contact Scheme
8.45 am	Incident Reporting
9.15 am	Developing Safe Working Practices
9.45 am	Analysing Safety Training Needs
10.30 am	The Tag System
11.30 am	Safety Meetings
12.00pm	Tag Exercise
1 0pm	Lunch
1.30pm	Tag Exercise Continued
3.00pm	Exercise Review
4.00pm	Summary and Evaluation

Quest: Leading Improvement

Team Leaders and Safety Representatives expressed initial apprehensions about the operation of the system. These were chiefly that there would be a forest of tags which would prevent production taking place and that their would be no change in the perceived slow response of the maintenance department.

Briefings of teams proceeded smoothly but were often characterised by a significant level of shopfloor cynicism. This was again based on a feeling that the response of the maintenance department would not be forthcoming.

These fears were eased when, in the week between the briefing and the date of commencement, the maintenance department were observed completing several minor repairs which had been outstanding for, in some cases, a long time.

The system has started well. So far, no maintenance tags have not been replaced on the board prior to the target date for completion of the work required. Shop floor reaction has been very favourable. There was one hiccup when a Team Leader changed the classification of a tag without informing the person who had erected the tag which caused some anguish but this was quickly resolved.

An additional benefit of the system may be an improvement of the relationship between maintenance and production departments. A poem has emerged from the maintenance department:

You don't have to nag,

to get work on a tag.

Just write it out clear.

and we will appear,

Nothing too large and nothing too small

we will try to please you all.

Endeavour we will to do your task.

Good manners and politeness is all we ask.

Future Development

In future the system will need to be managed to ensure that action continues to be taken on tags within the time limits given. As long as this continues, the system should be successful.

In other areas, an extension of the tag system might be considered for quality and productivity repairs or modifications with the central monitor acting as a prioritisation mechanism.

Peter Carr 24th June 1992.

British Alcan Team Leader Training

Module 10. Cost Management

Quest: Leading Improvement

Introduction

Module Description
Module 10. Cost Management

Objectives

To improve control of metal costs through improving measurement and introducing a Pull system of metal flow.

Seminar Content

Metal Movement
Metal Measurement and Recording
Process Flow

Module Project

To improve the accuracy of metal measurement and recording, and to introduce a Pull system of process flow.

Module Dates

	Group 1	Group 2
Seminar	17th Aug.	24th Aug.
Presentation To Manager	21st Aug.	28th Aug.
Team Member briefings	24th Aug.	1st Sept.
Project Presentation	11th Sept.	18th Sept.

Seminar Programme: (1 day)
Module 10. Cost Management

8.00 am	Introduction and Background
9.00 am	The Map System
9.30 am	Metal Flow
10.00 am	Tea
10.15 am	Metal Flow (cont'd)
11.00 am	Recording Accuracy
12.30 pm	LUNCH
1.30 pm	Visual Stock Systems
2.30 pm	Energy Costs
3.15 pm	Tea
3.30 pm	Project Planning
4.15 pm	Summary and Evaluation

Quest: Leading Improvement

METAL CONTROL

- BACKGROUND TO REQUIREMENT
  - WEAKNESS IN CURRENT METAL TRACKING PROCEDURES.
  - WILL HELP TOWARDS OPTIMUM METAL FLOOR LOAD.

METAL CONTROL

- HISTORY OF STOCKTAKE DIFFERENCES
  - 1989 TO SEPT 1990 = GAINS OF 140 TO 200 TONNES
  - TO JUNE 1991 SINGLE FIGURE GAINS
  - AUGUST 1991 40 TONNE LOSS
  - NOVEMBER 1991 8 TONNE GAIN
  - FEBRUARY 1992 29 TONNE LOSS
  - MAY 1992 54 TONNE LOSS

METAL CONTROL

- **IMPLICATIONS OF STOCKTAKE DIFFERENCES**

  - WE CANNOT CONTROL OUR MAIN MATERIAL RESOURCE !
  - LARGE DIFFERENCES IN TOTAL OR BETWEEN STOCK CATEGORIES UNDERMINES MANAGEMENT CONFIDENCE AND CREDIBILITY.
  - UNSATISFACTORY SITUATION TO ALCAN GROUP AND AUDITORS.
  - SATISFACTORY INVENTORY ACCOUNTING AND RECONCILIATION IS IMPOSSIBLE.
  - MANAGEMENT DECISION MAKING IS HAMPERED.

METAL CONTROL

- ADVANTAGES OF ACCURATE METAL RECORDING
  - WE CAN CONTROL OUR MAIN MATERIAL RESOURCE.
  - MANAGEMENT CONFIDENCE AND CREDIBILITY IS RESTORED.
  - SATISFACTORY SITUATION TO ALCAN GROUP AND AUDITORS.
  - SATISFACTORY INVENTORY ACCOUNTING AND RECONCILIATION IS POSSIBLE.
  - MANAGEMENT DECISION MAKING IS AIDED.
  - WASTED TIME AND EFFORT IS SAVED.

Metal Movement

Quest: Leading Improvement

METAL CONTROL

- **WHY MAPPING OF METAL FLOW IS IMPORTANT**
  - TO CONFIRM IN VISUAL MANNER WHAT IS ACTUALLY HAPPENING.
  - TO IDENTIFY FOCAL POINTS FOR WEIGHING.
  - TO IDENTIFY POTENTIAL BOTTLENECKS.
  - TO HELP DECIDE AREAS FOR FLOOR MARKING.
  - TO HELP ESTABLISH BEST LOCATION FOR SCALES.
  - TO CONFIRM AREAS OF OWNERSHIP AND ACCOUNTABILITY.

Metal Flow Map Key
Flow Now

Normal Metal Flow

(Green)

Normal Metal Stock

Exceptional Metal Flow

(Red)

Exceptional Metal Stock

Quest: Leading Improvement

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Metal Flow Map Key
Future Flow

Normal Metal Flow

(Green)

Normal Metal Stock

Exceptional Metal Flow *(Red)*

Quest: Leading Improvement

Metal Weighing and Recording

Quest: Leading Improvement

METAL CONTROL

- **WHY WEIGHING AND RECORDING ACCURACY IS ESSENTIAL.**
  - GARBAGE IN = GARBAGE OUT.
  - POTENTIALLY GIVING METAL AWAY.
  - INACCURATE RECOVERY AND THROUGHPUT MEASUREMENT.
  - WRONG MANAGEMENT DECISIONS TAKEN.
  - DEVELOP STANDARD OPERATING METHODS TO ENSURE COMPLIANCE.
  - RECONCILIATION REQUIRED BY SHIFT OF METAL MOVEMENTS TO GIVE OWNERSHIP AND ACCOUNTABILITY.

Planning Form
Metal Weighing and Recording

Scales:	*Map Reference*

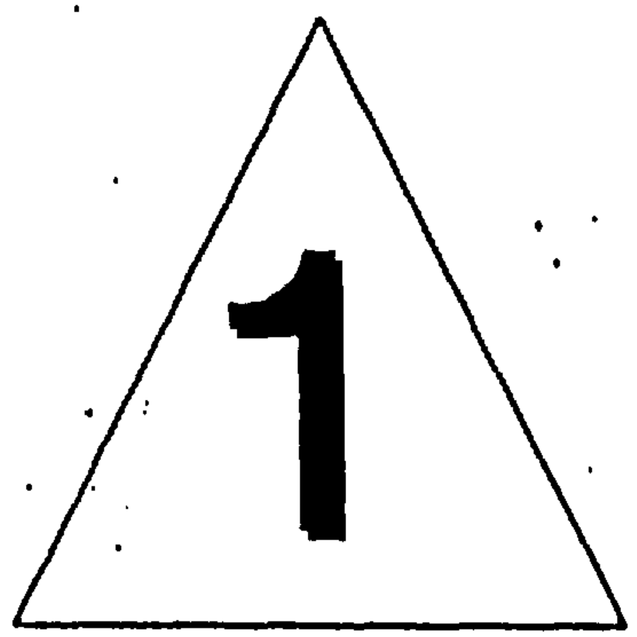
Current Weighing or Recording Procedure

Actual and Potential Sources of Inaccuracy

Action To Be Taken

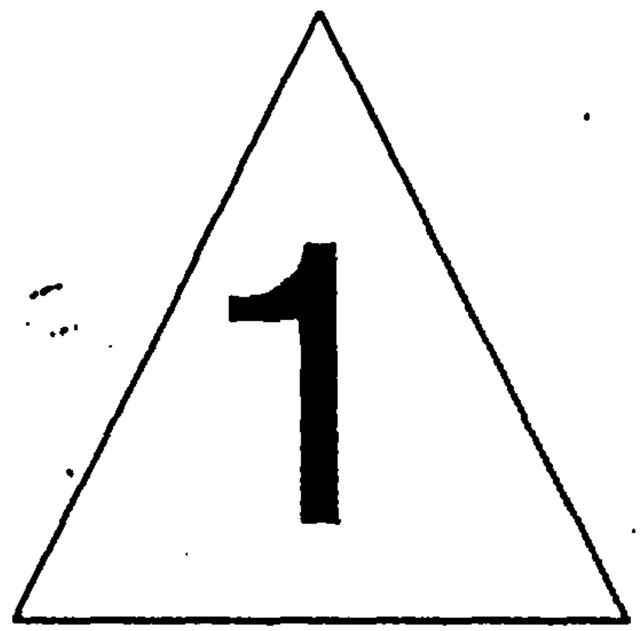
Metal Weighing and Recording

Identify all points at which metal is weighed and recorded and add the following symbol. A number should be inserted for reference to the Weighing and Recording planning form.



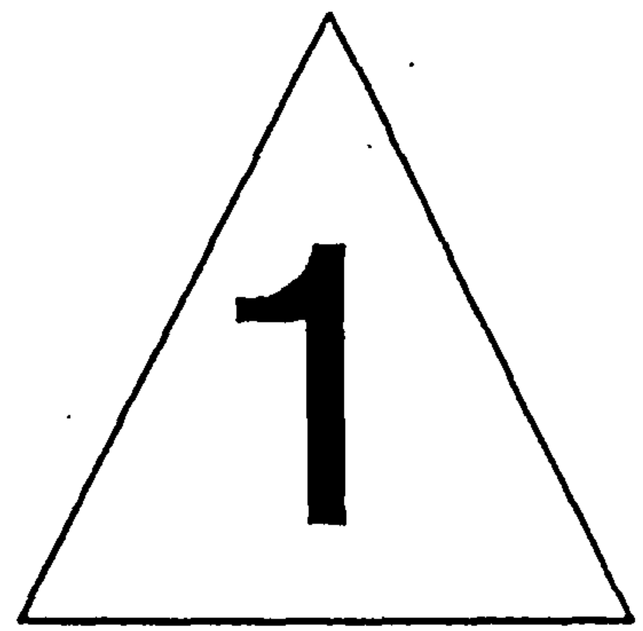
W

Weigh Only
(Blue)



R

Record Only
(Blue)



W+R

Weigh and Record
(Blue)

(Blue)

Quest: Leading Improvement

Process Flow Control

Quest: Leading Improvement

METAL CONTROL

- WHY VISUAL STOCK SYSTEMS

  - FOR EASE OF SHIFT METAL CONTROL.

  - USE KAN-BAN PRINCIPLES.

  - KEEP FLOOR LOAD AT MINIMUM.

  - TO BE SEEN BY ALL.

  - ENCOURAGE OWNERSHIP.

Process Flow Control

Using 'Pull System' principles, design a process flow control system for your department. Use the following steps:

1. List your process stages.
2. Design methods of pulling work to each stage from the previous stage, based on stock levels.

Planning Form
Process Flow

Process Stage	*Map Reference*
Stock Level Required (Hours)	

Pull System Rules	
If stock is below_____, then	*If stock level is more than required level*

METAL CONTROL

- **INVENTORY OWNERSHIP**
  - REMELT TO OWN ALL LOG AND BILLET.
  - SEPARATE EACH OPERATING AREA TO BE RESPONSIBLE FOR OWN METAL.
  - ALL TO UNDERSTAND IMPLICATIONS OF BAD RECORDING.
  - IDENTIFY TRAINING NEEDS FOR REGULAR CREWS AND FOR COVER.
  - MAKE EVERY EFFORT TO GET IT RIGHT.

METAL CONTROL

- **RECONCILIATION BY SHIFT**
  - OPENING STOCK
  - ADD MOVEMENTS IN BY CATEGORY OF MOVEMENT
  - DEDUCT MOVEMENTS OUT BY CATEGORY OF MOVEMENT
  - CLOSING STOCK
- **IT IS THE RESPONSIBILITY OF EACH SHIFT TEAM LEADER TO AGREE FOR THEIR AREA.**

Module Evaluation

Seminar Evaluation

Module 10. Cost Management

Please complete the following questionnaire which will enable us to improve the seminar for future participants. Where a graded response is requested, please circle the number which best represents your response.

1. Which session did you find most useful?

---

2. Which session did you find least useful?

---

3. Looking at the seminar as a whole, how useful was it?

1	2	3	4	5
not useful				very useful

Seminar Evaluation (continued)

4. Individual Sessions

	Not Useful				Very Useful
4.1. Introduction and Background	1	2	3	4	5
4.2. The Map System	1	2	3	4	5
4.3. Metal Flow	1	2	3	4	5
4.4. Recording Accuracy	1	2	3	4	5
4.5. Visual Stock Systems	1	2	3	4	5
4.6. Energy Costs	1	2	3	4	5
4.7. Project Planning	1	2	3	4	5

5. Ideas for improvement

Appendix D.

The Team Leader Survey

New Production Systems Programme Survey

Three years ago, the 'Leading Improvement' programme was conducted at Banbury. This questionnaire is intended to assist the evaluation of that programme.

1. What was the main aim of the programme?

2. How much did the programme satisfy this objective?

1	2	3	4	5
Not at all				Completely

a. What were the three most positive affects of the programme?

1.

2.

3.

b. What were the three worst affects of the programme?

1.

2.

3.

3. What affect did the programme have on overall manufacturing performance in the area you work in?

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

4. What affect did the programme have on the following specific areas:

Stock levels

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

_____

_____

_____

Production lead times

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

_____

Set up times

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Product quality

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Product volume

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Factory Housekeeping

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Production Workflow

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Equipment Maintenance

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

_____

_____

_____

Working Methods

a. During the programme

	1	2	3	4	5	
Deteriorated alot			No change		Improved	alot

b. Since the programme finished

	1	2	3	4	5	
Deteriorated alot			No change		Improved	alot

How did the programme affect this, as it exists now?

_____

_____

_____

Any other comments:

5. <u>How did the programme affect the people in the area in which you work?</u>

On their contribution to company performance

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

On their job satisfaction

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

6. <u>What affect did the programme have on the following specific areas?</u>

Employee involvement in improvement

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

_____

Employee responsibility

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Employee work discipline

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Employee motivation

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Employee problem solving

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Employee job security

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Employee skills

a. During the programme

1	2	3	4	5
Deteriorated alot		No change		Improved alot

b. Since the programme finished

1	2	3	4	5
Deteriorated alot		No change		Improved alot

How did the programme affect this, as it exists now?

Any other comments: