

**SWP 33/90 JUST IN TIME (JIT) MANUFACTURING -
BUT AT WHAT COST?**

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JIT MANUFACTURING - BUT AT WHAT COST?

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Abstract

The aim of this paper is to present the findings of a study of the costs of changing to the use of the just-in-time method of production. These findings result from collaborative work with three UK manufacturing organisations, none of which is a Japanese subsidiary. A conceptual model of the process of change to just-in-time manufacturing is presented and examples of the costs that are likely to be incurred at each stage of the change process are described. The purpose of the conceptual model and detailed study of the costs is to assist the planning and the financial management of changing to JIT manufacturing in a batch production environment.

INTRODUCTION

The last decade has been a most exciting period for those directly responsible for the management of production. This is because this has been a period of transition for some of them and change is usually accompanied by some form of resistance to it.

The transition has originated from the discarding of some long established concepts and practices used for the design and control of production systems. In their place some organisations have adopted the concepts of just-in-time manufacturing, an approach that has been developed and, some would say, almost perfected by the Japanese.

The impact of applying the just-in-time manufacturing philosophy transcends the boundaries of the production function. It requires a review of the assumptions and practices of management accounting. The development of the throughput accounting concepts¹ is the result of a need for a method of accounting which is designed to provide financial data that is more in accordance with the strategic objectives of the just-in-time production system than that possible using standard costing data. Similarly, organisational structure designs for production operations, based upon traditional procedures for the management of the human resource, have been challenged because the JIT method of production often requires changes to the established demarcations of skills, job responsibilities and remuneration packages.

The most significant change is the realisation that the manufacturing function can become an effective competitive weapon and that it is not just the corporate villain, i.e. a creator of costs and the absorber of capital. This transition is the major breakthrough goal for manufacturing management, adopting these new concepts requires unlearning the old ones. The acceptance of this new perspective on the role of manufacturing is also a corporate mind-set problem in many organisations.

The aim of this paper is to present the findings of an examination of the costs of changing to the use of the just-in-time method of production. These findings result from collaborative work with three UK manufacturing organisations, none of which is a Japanese subsidiary. A conceptual model of the process of a change to just-in-time manufacturing is presented and examples of the costs that are likely to be incurred at each stage of the change process are described.

THE STRATEGIC SIGNIFICANCE OF JIT

The last decade has also been a period when there has been an acceleration in the rate of decline of the UK manufacturing sector. The balance of trade in manufactured goods has for some time been in deficit and recently the scale of this deficit has reached record levels. The survival of those businesses that remain will depend upon their ability to become world class manufacturers. What constitutes world class manufacturing is shown in Figure 1. During the 1990s the dimensions of customer service expected of the producers of manufactured goods are forecast to be quality, cost, variety and speed of delivery to the customer.² Figure 1 also shows how the manufacturing strategy has had to be adapted over time to fit with the drive for a competitive advantage as international competition increased in numbers and therefore in intensity.

World class manufacturing therefore constitutes a further move to use manufacturing to gain competitive edge through improved customer service. Product excellence can be achieved by design but manufacturing excellence can enhance the competitiveness of the product, i.e. it can improve the quality of the product surround.

There are a number of companies in Britain that are judged to be world class manufacturers and have gained the distinction of being considered to be among the best manufacturing companies in the UK³. What characteristics are considered, by the author of the article on these companies, to be the strategic objectives for the production function to achieve world class manufacturing status:

"People motivated by quality, rigorous organisation and a drive towards just-in-time manufacture, supported by appropriate technology: these are the constituents of Britain's or any other country's best manufacturing plants"³.

It would appear that just-in-time manufacture is a necessary step to improve the international competitiveness of most repetitive manufacturing businesses. However, a recently published survey⁴ of the implementation of JIT in the UK presents a rather disappointing and unsatisfactory rate of take-up of this philosophy for managing production. Only 8% of the responding companies stated that they were conducting a major JIT programme. A reason for this may be apprehension about the cost of implementation although it is generally recognised that installing a JIT production system is characterised by low investment, high short-term pay-off and high predictability of pay-off⁵. The approach to implementing JIT and its costs are the subject of this paper and its objective is to clarify the cost of implementation issue.

STAGES OF IMPLEMENTATION

An often overlooked historical fact concerning just-in-time manufacture is that one of the first articles published on this subject was entitled "Toyota production system and Kanban system: Materialisation of just-in-time and respect-for-human system".⁶ The "just-in-time" catch phrase and philosophy were quickly adopted by the west but the JIT catch phrase seems to have gained a pre-eminence over the "respect-for-human" aspect of the Toyota production system design.

For the purpose of this article the acronym JIT should be interpreted to include both the timely purchase and manufacture of parts to the correct quality standards and the employee involvement and teamworking aspects of the JIT production system.

The study of JIT implementations in the collaborating firms has shown that the transition process, i.e. from the traditional "push" batch production process to the JIT "pull" method, consists of four distinct stages. These are shown on Figure 2. The Figure also shows that there may be an opportunity cost incurred during the transition period, i.e. there will probably be a period when output and productivity falls as the production workforce adjusts to a new way of working and quality and throughput problems are exposed.

During each phase of the transition process some expenditure will be required but with careful planning these can be minimised. The progress to JIT manufacturing is also shown as a sequential process on Figure 2 but, in reality, many of the tasks carried out to establish a JIT production system are implemented in parallel⁶. The extent of elapsed time required for the transition to be made is partly dependent on the company's expertise in change management and the resources allocated to implementing the change.

An examination of the tasks to be carried out during each phase of the transition may provide an explanation for the working capital requirements for a change to JIT manufacturing.

Phase 1 - The preparation phase

1. To gain an understanding of JIT manufacturing in order to carry out a cost/benefit analysis of its application.
2. To determine a JIT implementation plan and an organisation structure to manage the change.
3. To provide the training needed to gain the commitment of senior management and those who will be directly or indirectly effected by the change to JIT manufacturing.

Phases 2 and 3 - The process development phases

1. To design a production system for just-in-time manufacturing operations based upon work cells and a multi-skilled workforce.
2. To design the methods to be used for production planning and the measurement of production performance for the just-in-time manufacturing system.

Phase 4 - The cost focus phase

1. To establish new methods to add value to the product without adding cost and reducing costs without reducing value.
2. To establish supplier improvement teams to complement the just-in-time operations now operating inside the company.

Figure 3 shows an organisation structure for JIT implementation. Also detailed are more complete descriptions of the tasks to be carried out by each team. Very little mention is made of the emphasis to be given to quality improvement in the preceding description of the activities for JIT implementation. However, Figure 2 and 3 also show that a by-product of JIT process development is quality improvement and this is an objective to which significant resources have been allocated. Quality management is directed to waste elimination and therefore, it is the core of the JIT philosophy.

THE COSTS OF JIT IMPLEMENTATION

The major cost to an organisation of changing to JIT manufacturing is the education of all the employees about the relevant elements of the JIT philosophy which will effect them or to which they can contribute. If insufficient investment is made on the education of people at all levels within the organisation then the opportunity to draw on their experience and abilities to resolve operating problems may never be gained. If the employees are enthused by the philosophy of JIT then there is the prospect of their commitment to the continuous improvement of company operations for years to come.

The costs of the company JIT education programme can of course be significant not only in terms of the costs of providing the seminars but also in terms of the opportunity costs of lost production. However, the level of investment in education is considered to be critical to achieving the full potential from the JIT philosophy for manufacturing.

Figure 4 shows the range of off-the-job seminars provided by one of the firms which has collaborated with this study. Figure 5 details who inside the company has

attended the various types of courses offered. Some of the courses have been run many times and now the company's managers have taken over the running of the courses from the consultants.

The details shown on Figure 5 do not include the on-the-job training of the production personnel to develop a greater range of manufacturing skills. Therefore a flexible workforce will require a substantial amount of time to broaden their range of skills if the previous manufacturing philosophy of the company was to design production systems that required a workforce with a narrow specialised expertise.

What then are the costs of implementation?

This study has identified the following:

1. Initial education on JIT philosophy
- attendance at a seminar or similar programme
2. Running of in-house seminars to introduce senior management to the JIT philosophy. External training resources were used.
3. Consultancy support on an evaluation of the cost/benefits of implementing JIT.
4. JIT system design and the use of simulation software to evaluate the production throughput efficiency and labour requirements.
5. Consultancy support on the implementation task teams in the more technical roles, i.e. resolving system design and operating problems.
6. Establishing the manufacturing system usually not a major investment. An example is £15,000 of which 50% was the labour cost to install conveyors etc. and the remainder is the cost of the production equipment.

A further £6,000 was required for environmental items, e.g. a team meeting room and eating area.

7. Consultancy support on the running of seminars to educate the company employees on a wide range of principles and control tools for JIT operations (for example those detailed on Figure 4). Total consultancy support fees for all the activities detailed are £150,000 per annum.
8. The probable loss of output and productivity during the initial phase of JIT implementation. This study, which is based upon an extremely small sample and therefore is statistically unrepresentative, has collected data to indicate that this fall in output could be as much as 25%.

The time required to recover the previous levels of productivity can be quite considerable, i.e. eight to ten weeks. and this length of time is determined by the company's ability to isolate and correct the operating problems made visible by using just-in-time methods of production. This is a very testing time for the JIT champions of change because the sceptics will be at the pinnacle of their ability to cast doubts about the wisdom of this change during this period.

9. There could be a cost for the development of a flexible workforce, i.e. not only in terms of the training costs but also a negotiated increase in pay because of the change in the job definition for the JIT system.

A STRATEGY FOR MINIMISING THESE COSTS

Certain of the costs detailed in the previous section of this paper are unavoidable, i.e. the cost of the initial introduction to the JIT philosophy and the capital costs for establishing the JIT production facility.

However, there are others that can be minimised. For example:

1. The use of videos to explain the principles of JIT manufacturing, e.g. the twenty-nine-minute JIT skit developed at Hewlett-Packard, Greeley Division.

The objective of the use of the video is to explain how JIT manufacture is better than the traditional approach. It will also be necessary for management to explain why it is necessary to change.

2. It is recommended that simulation studies of JIT system design are carried out. If this requires the investment in outside expertise then this should not be excessively expensive and could prove to be an economic investment in the medium term.
3. Develop in-house trainers. Test the aptitude of individuals in management and the production workforce who will be responsible for
 - (a) running management seminars instead of consultants
 - (b) train other production workers on the particular skills required for the goal of a flexible labour force.
4. To minimise the impact of the reduced output during the transition to JIT manufacture select a department or an activity where excess capacity already exists inside the organisation.

For a completely new production facility for an existing product, establish a buffer stock of finished product prior to implementing the change to JIT manufacture.

CONCLUSIONS

For manufacturing excellence to be achieved and for the production activity to be used as a competitive weapon requires a new perspective on the role of manufacturing. Therefore traditional attitudes and manufacturing practices will need to change.

The emergence of the just-in-time philosophy for the management of production provides a solution to this mind-set problem. The cost to implement the just-in-time method of production is not substantial, as has been shown, and insignificant when compared with the only other alternative, i.e. continuing to manufacturing in an uncompetitive way.

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EVOLUTION OF JAPANESE COMPETITIVE STRATEGIES AND REQUIRED MANUF. STRATEGIES

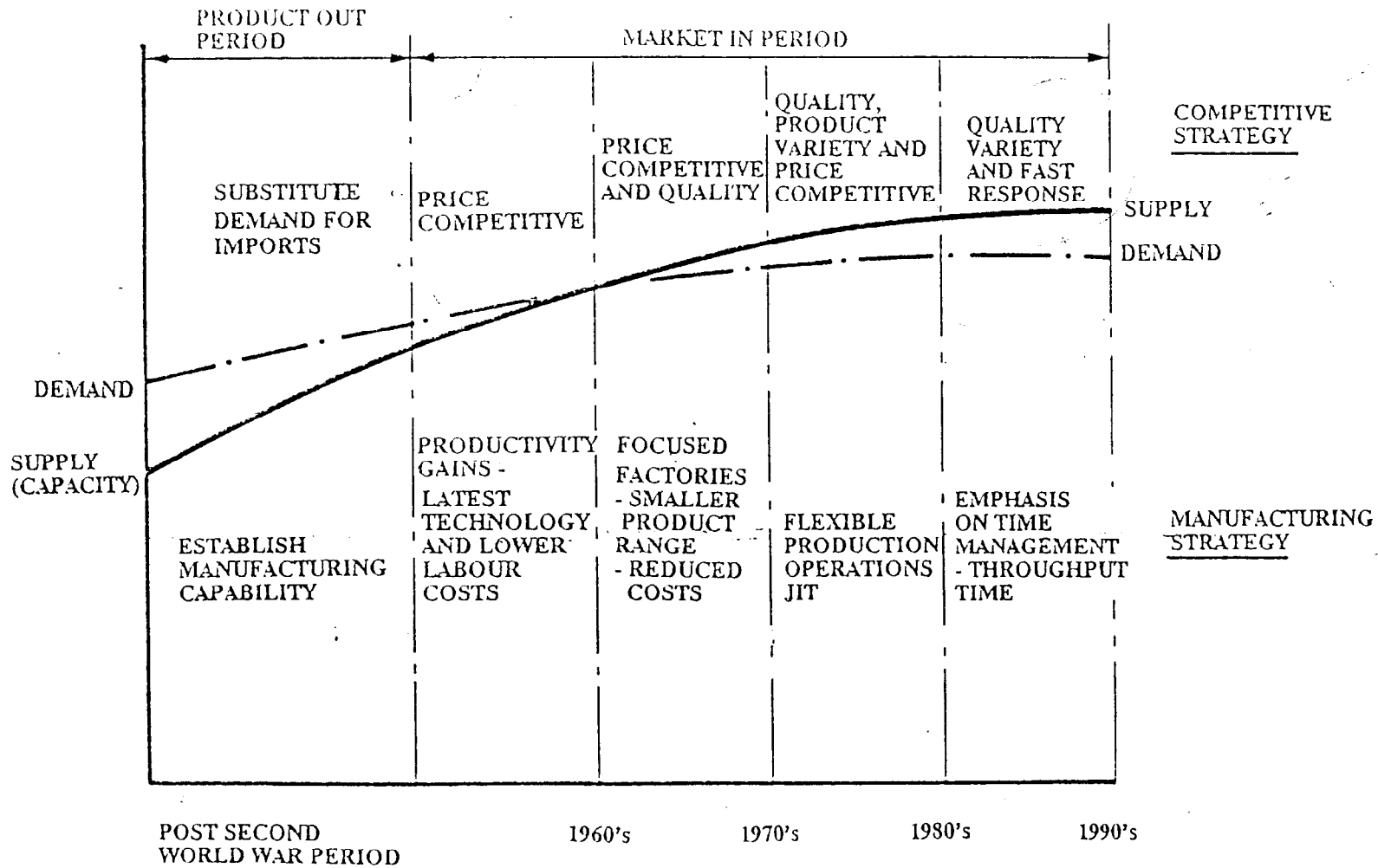


FIGURE 1

FIGURE 2

THE TRANSITION CURVE
CHANGING TO THE JIT PHILOSOPHY FOR MANUFACTURING

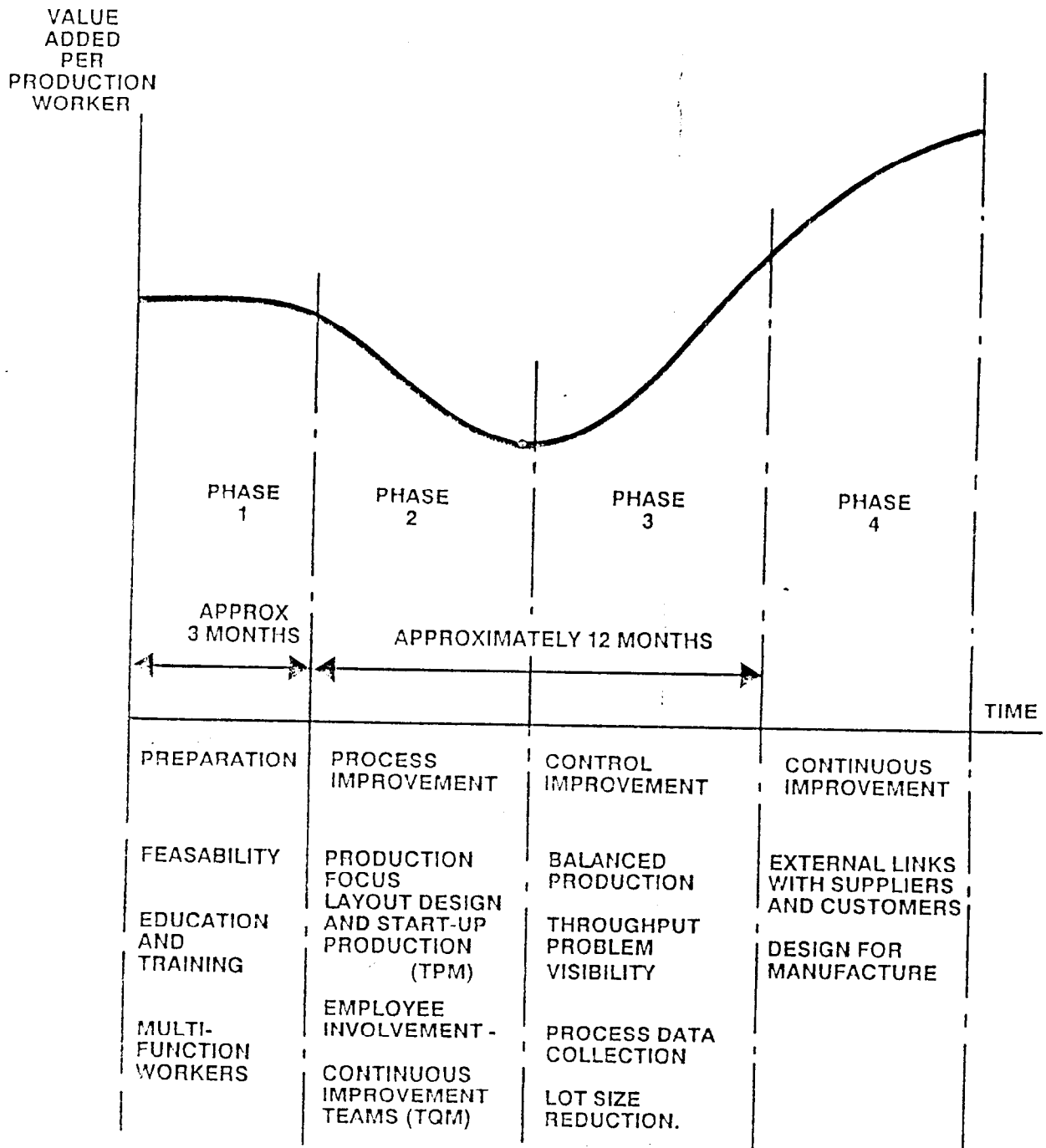
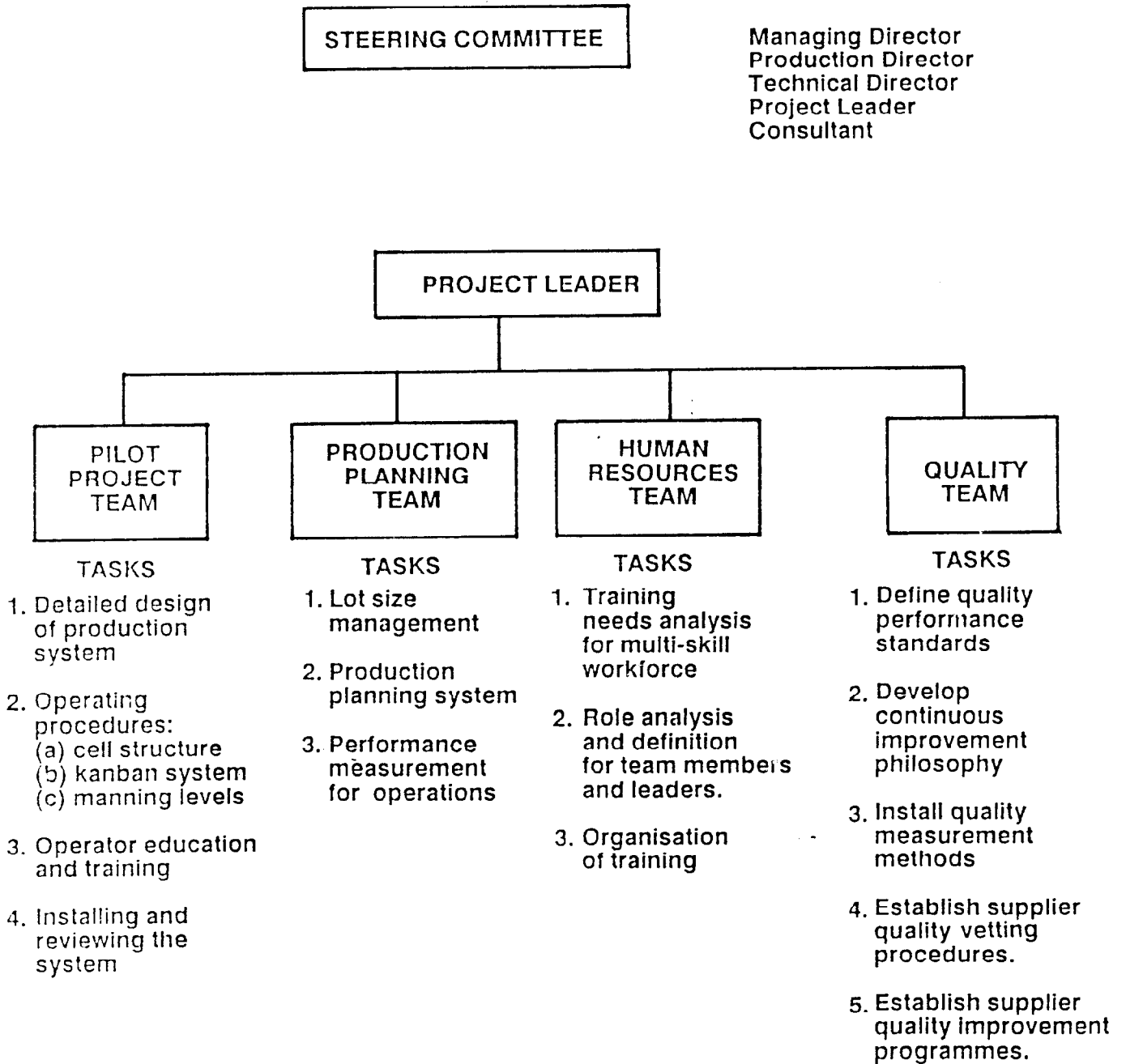


FIGURE 3

PROJECT TASK GROUP STRUCTURE FOR JIT IMPLEMENTATION



Team size: (Full-time and Part-time membership (approx 50% of time))

2F/T & 3P/T

3P/T

3P/T

5P/T

FIGURE 4

CIP TRAINING MODULES

MODULE	TITLE	CONTENTS	DAYS
A	CIP WORKSHOP	<ul style="list-style-type: none"> * CIP CONCEPTS AND PRINCIPLES. * JIT GAME, CASE STUDY AND PILOT PROJECT. * OVERVIEW OF MODULES C, D AND E. 	2
B	OPERATOR WORKSHOP	<ul style="list-style-type: none"> * CIP CONCEPTS AND PRINCIPLES. * JIT GAME AND PILOT PROJECT. * OVERVIEW OF MODULES C, D AND E. 	1
C	PLANNING APPROACH	<ul style="list-style-type: none"> * CIP PLANNING PRINCIPLES. * ORDER ENTRY TO DESPATCH PROCEDURES. * CONTROL POINTS AND PERFORMANCE MEASURES. 	1
D	PURCHASING	<ul style="list-style-type: none"> * VENDOR RELATIONSHIPS AND SELECTION. * VENDOR SCHEDULING AND PLANNING LINKS. * SQA AND VENDOR APPRAISAL. 	1
E	DESIGN APPROACH	<ul style="list-style-type: none"> * DESIGN PRINCIPLES - DESIGN FOR MANUFACTURE. * MODULAR DESIGN AND USE OF COMMONALITY. * NEW PRODUCT INTRODUCTION, MODIFICATION PROCEDURES. 	1

FIGURE 4

CIP TRAINING MODULES

MODULE	TITLE	CONTENTS	DAYS
F	ENGINEERING TECHNIQUES	<ul style="list-style-type: none"> * Material flow principles and cell design * Kan Ban principles, control and sizing * Set-up reduction/line flexibility design 	1
G	QUALITY TECHNIQUES	<ul style="list-style-type: none"> * Technique selection and application * Quality group working and operator controls * Problem solving and support requirements 	2
H	PRODUCT QUALITY	<ul style="list-style-type: none"> * Market position and customer perceptions * Support systems and definition of standards * Line test procedures and requirements 	1
I	SUPPLIER BRIEFING	<ul style="list-style-type: none"> * CIP concepts and principles * Planning principles and pilot project * Requirements of vendors and selection 	0.5
J	CUSTOMER BRIEFING	<ul style="list-style-type: none"> * CIP concepts and principles * Planning principles and achievements * Customer service policy and targets 	0.5

